

# RF Test Report

**Project Number:** 4427245 / 8089

**Report Number:** 4427245EMC01

**Revision Level:** 2

**Client:** GE Lighting

**Equipment Under Test:** Daughter Board of GED80MCC/Z2P1500

**Model:** A-1002271-01 Rev 3

**FCC ID:** PUU80MCCZ2P15

**IC ID:** 10798A-80MCCZ2P15

**Applicable Standards:** ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)


RSS-247, Issue 2

RSS-GEN Issue 5


**Report issued on:** 16 April 2019

**Test Result:** Compliant

Tested by:

  
\_\_\_\_\_  
Aaron Froehlich, EMC Test 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.*

*This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.*

*Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.*

## Table of Contents

<b>1</b>	<b>SUMMARY OF TEST RESULTS</b> .....	<b>4</b>
1.1	MODIFICATIONS REQUIRED FOR COMPLIANCE .....	4
<b>2</b>	<b>GENERAL INFORMATION</b> .....	<b>5</b>
2.1	CLIENT INFORMATION .....	5
2.2	TEST LABORATORY .....	5
2.3	GENERAL INFORMATION OF EUT .....	5
2.4	OPERATING MODES AND CONDITIONS .....	5
2.5	EUT CONNECTION BLOCK DIAGRAM – CONDUCTED MEASUREMENTS.....	6
2.6	EUT CONNECTION BLOCK DIAGRAM – RADIATED MEASUREMENTS .....	6
2.7	SYSTEM CONFIGURATIONS .....	7
<b>3</b>	<b>BANDWIDTH</b> .....	<b>8</b>
3.1	TEST RESULT.....	8
3.2	TEST METHODS .....	8
3.3	TEST SITE .....	9
3.4	TEST EQUIPMENT .....	9
3.5	TEST DATA.....	10
<b>4</b>	<b>FUNDAMENTAL OUTPUT POWER</b> .....	<b>12</b>
4.1	TEST RESULT.....	12
4.2	TEST METHOD.....	12
4.3	TEST SITE .....	12
4.4	TEST EQUIPMENT .....	12
4.5	TEST DATA.....	13
<b>5</b>	<b>POWER SPECTRAL DENSITY</b> .....	<b>14</b>
5.1	TEST RESULT.....	14
5.2	TEST METHOD.....	14
5.3	TEST SITE .....	14
5.4	TEST EQUIPMENT .....	14
5.5	TEST DATA.....	15
<b>6</b>	<b>CONDUCTED SPURIOUS EMISSIONS / BAND EDGE</b> .....	<b>16</b>
6.1	TEST RESULT.....	16
6.2	TEST METHOD.....	16
6.3	TEST SITE .....	16
6.4	TEST EQUIPMENT .....	16
6.5	TEST DATA – DTS BAND EDGE.....	17
6.6	TEST DATA – CONDUCTED SPURIOUS EMISSIONS .....	19
<b>7</b>	<b>FIELD STRENGTH OF SPURIOUS RADIATION</b> .....	<b>20</b>
7.1	TEST RESULT.....	20
7.2	TEST METHOD.....	20
7.3	TEST SITE .....	21
7.4	TEST EQUIPMENT .....	21
7.5	TEST DATA.....	22
<b>8</b>	<b>EMISSIONS IN RESTRICTED FREQUENCY BANDS</b> .....	<b>26</b>
8.1	TEST RESULT.....	26
8.2	TEST METHOD.....	26
8.3	TEST SITE .....	26
8.4	TEST EQUIPMENT .....	27
8.5	TEST DATA – RESTRICTED BAND EDGE .....	28



8.6 TEST DATA – SPURIOUS EMISSIONS ..... 30

**9 CONDUCTED EMISSIONS ..... 31**

9.1 TEST RESULT..... 31

9.2 TEST METHOD..... 31

9.3 TEST SITE ..... 31

9.4 TEST EQUIPMENT ..... 31

9.6 TEST DATA..... 32

**10 MEASUREMENT UNCERTAINTY..... 34**

**11 REVISION HISTORY ..... 35**

# 1 Summary of Test Results

Test Description	Test Specification		Test Result
DTS / Occupied bandwidth	§15.247(a) (2)	RSS-247 5.2a RSS-GEN 6.7	Compliant
Fundamental output power	§15.247(b) (3)	RSS-247 5.4d	Compliant
Power spectral density	§15.247(e)	RSS-247 5.2b	Compliant
Emissions in non-restricted frequency bands	§15.247(d)	RSS-247 5.5	Compliant
Emissions in restricted frequency bands	§15.205, §15.209	RSS-GEN 8.9, 8.10	Compliant
Field strength of spurious radiation	§15.205, §15.209	RSS-GEN 8.9	Compliant
AC Mains Conducted Emission	§15.207	RSS-GEN 8.8	Compliant
Antenna Requirement	§15.203	RSS-GEN 6.8	Compliant <sup>1</sup>

Notes:

1. DUT is professionally installed.

## 1.1 Modifications Required for Compliance

The DUT must be in a fully potted host for compliance with emissions in restricted frequency bands. Channel 26 was reduced to a power setting of “25 raw”.

## 2 General Information

### 2.1 Client Information

Name: GE Lighting  
Address: 1975 Noble Road  
City, State, Zip, Country: Cleveland, OH 44112

### 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

Product Marketing Name (PMN): Daughter Board of GED80MCC/Z2P1500  
Model Number (HVIN): A-1002271-01 Rev 3  
Firmware Version ID (FVIN): Github Repository - Lighting/Ironman v0.3.1  
Serial Number: NSN

Frequency Range: 2405 – 2480 MHz  
Data Modes: 802.15.4 - 250 kbps (Zigbee)  
Antenna: Walsin - RFPCA430618IMAB301 [2.2 dBi<sub>pk</sub>]  
PulseLarsen - W3357 [0.4 dBi<sub>pk</sub>]

Rated Voltage: 4.2 V<sub>dc</sub>  
Test Voltage: 4.2 V<sub>dc</sub>

Sample Received Date: 2/12/2019  
Dates of testing: 2/12/2019-2/21/2019

### 2.4 Operating Modes and Conditions

The EUT was programmed by the manufacturer to transmit on low, mid and high channels in all necessary modulation and modes of operation.

Ch 26 (2480 MHz) has reduced power setting of “25 raw.” All other channels had a power setting of “45 raw.” Both Ch 25 and Ch 26 were tested as the “near top” frequency as defined in ANSI C63.10:2013 Clause 5.6.1.

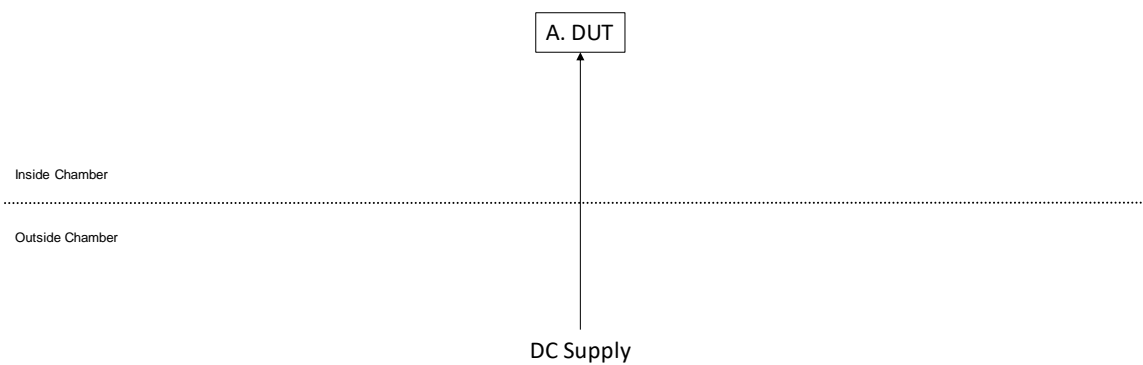
The device can operate with both the Walsin manufactured Antenna and the PulseLarsen Antenna. For all relevant tests each antenna was evaluated.

For radiated measurements the DUT without a host was tested. For conducted measurements the DUT was placed in a potted host.

## 2.5 EUT Connection Block Diagram – Conducted Measurements



## 2.6 EUT Connection Block Diagram – Radiated Measurements



## 2.7 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Current, powered by GE	DUT	A-1002271-01 Rev 3	NSN
B	Current, powered by GE	LED Driver	GED80MCC/Z2P1500	190119

### 3 Bandwidth

#### 3.1 Test Result

Test Description	Test Specification		Test Result
DTS bandwidth	15.247(a)(2)	RSS-247 5.2a RSS-GEN 6.7	Compliant
Occupied Bandwidth	RSS-GEN 6.7	ANSI C63.10 Clause 6.9.2	Reported

#### 3.2 Test Methods

For measuring the DTS 6dB bandwidth:

- a) RBW = 100 kHz
- b) VBW  $\geq$  [3  $\times$  RBW]
- c) Detector = peak
- d) Trace mode = max hold
- e) Sweep = auto couple
- f) Allow the trace to stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

For measuring the 20dB bandwidth:

- The transmitter was operated at its maximum carrier power
- RBW = 1% to 5% of the 20dB bandwidth
- VBW =  $\geq$  [3  $\times$  RBW]
- The span of the spectrum analyzer was set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- Detector = Peak
- Trace mode = max hold
- The 20 dB down function of the spectrum analyzer was used

All data rates were investigated, and the worst-case configuration results are reported in this section.



### 3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 24.0 °C  
 Relative Humidity: 29.8 %  
 Atmospheric Pressure: 99.0 kPa

### 3.4 Test Equipment

Test End Date: 19-Feb-2019

Tester: ASF

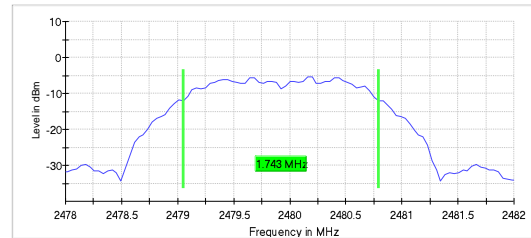
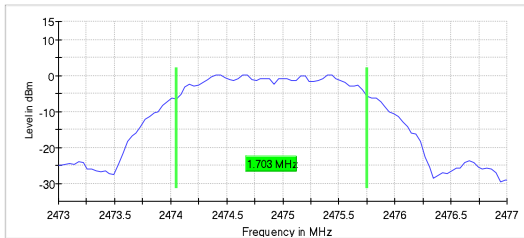
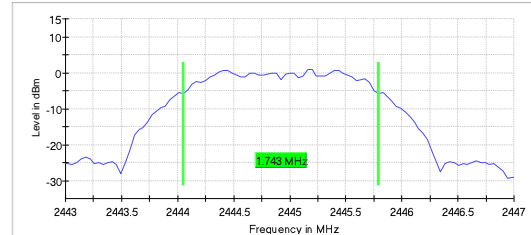
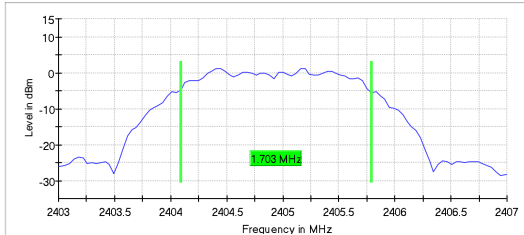
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

### 3.5 Test Data

#### 3.5.1 6 dB Bandwidth

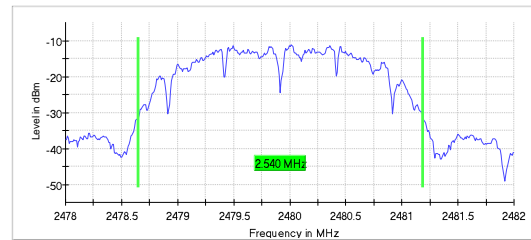
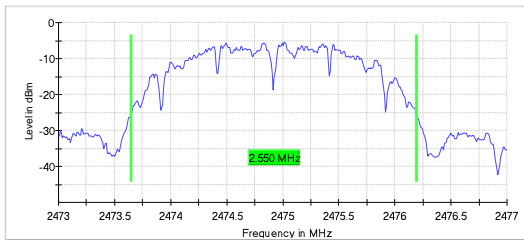
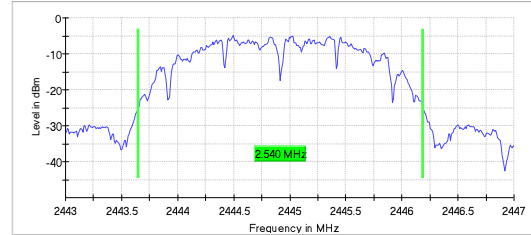
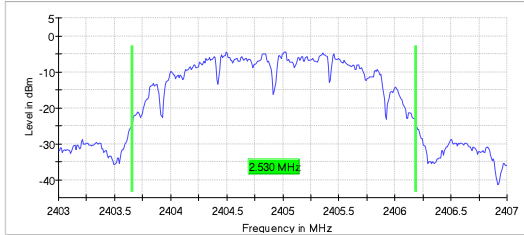
DUT Frequency(MHz)	Bandwidth(MHz)	Limit Min(MHz)	Limit Max(MHz)	Band Edge Left(MHz)	Band Edge Right(MHz)
2405	1.70297	0.5	---	2404.089109	2405.792079
2445	1.742574	0.5	---	2444.049505	2445.792079
2475	1.70297	0.5	---	2474.049505	2475.752475
2480	1.742574	0.5	---	2479.049505	2480.792079



Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 $\mu$ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 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	8 / max. 150	max. 150
Stable	5/5	5
Max Stable Difference	0.23 dB	0.50 dB

### 3.5.2 Occupied Bandwidth

DUT Frequency(MHz)	Bandwidth(MHz)	Limit Min(MHz)	Limit Max(MHz)	Band Edge Left(MHz)	Band Edge Right(MHz)
2405	2.53	---	---	2403.655	2406.185
2445	2.54	---	---	2443.645	2446.185
2475	2.55	---	---	2473.645	2476.195
2480	2.54	---	---	2478.645	2481.185



Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	>= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	400	~ 400
Sweptime	189.648 $\mu$ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 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	7 / max. 150	max. 150
Stable	5-May	5
Max Stable Difference	0.07 dB	0.50 dB

## 4 Fundamental Output Power

### 4.1 Test Result

Test Description	Regulatory Reference	Test Method	Test Result
Fundamental emission output power	15.247(b) (3) RSS-247 5.4	ANSI C63.10 Clause 11.9.2.3.2	Compliant

### 4.2 Test Method

Measurements were performed using a wideband gated RF power meter with gate parameters adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

#### Limit

The conducted power shall not exceed 1 Watt.

The e.i.r.p. shall not exceed 4 Watts

### 4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 24.0 °C

Relative Humidity: 29.8 %

Atmospheric Pressure: 99.0 kPa

### 4.4 Test Equipment

Test End Date: 19-Feb-2019

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019

Note: The equipment calibration period is 1 year.

#### 4.5 Test Data

DUT Frequency(MHz)	Gated RMS(dBm)	Limit Max(dBm)	Walsin Gated EIRP(dBm)	PulseLarsen Gated EIRP(dBm)	DutyCycle(%)	Result
2405	4.9	30	5.2	5.3	100	PASS
2445	4.4	30	6.0	4.8	100	PASS
2475	3.9	30	6.1	4.3	100	PASS
2480	-1.9	30	0.3	-1.5	100	PASS

## 5 Power Spectral Density

### 5.1 Test Result

Test Description	Regulatory Reference	Test Method	Test Result
Power Spectral Density	15.247(e) RSS-247 5.2b	ANSI C63.10 Clause 11.10	Compliant

### 5.2 Test Method

Since the fundamental emission output power was measured using an average technique, the average power spectral density method of ANSI C63.10 Clause 11.10.

The limit is 8 dBm in any 3 kHz band.

### 5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0 °C  
 Relative Humidity: 29.8 %  
 Atmospheric Pressure: 99.0 kPa

### 5.4 Test Equipment

Test End Date: 19-Feb-2019

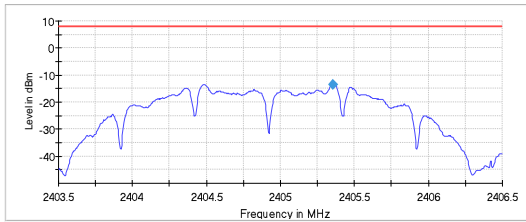
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

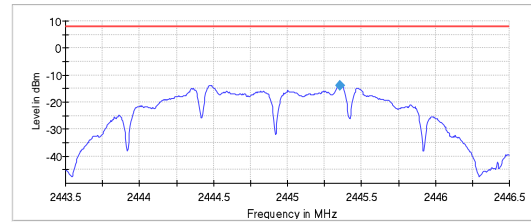
Note: The equipment calibration period is 1 year.

### 5.5 Test Data

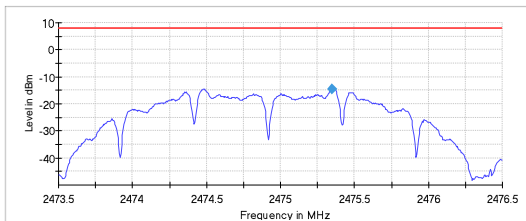
DUT Frequency(MHz)	Frequency(MHz)	PSD(dBm)	Limit Max(dBm)	Result
2405	2405.3525	-13.536	8	PASS
2445	2445.3525	-13.695	8	PASS
2475	2475.3475	-14.404	8	PASS
2480	2479.4875	-20.073	8	PASS



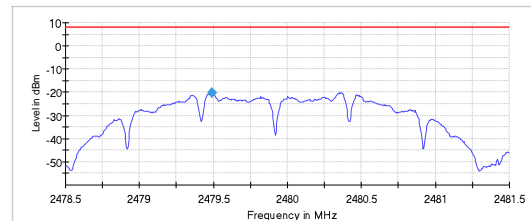
— Limit — Sum Level ◆ PSD



— Limit — Sum Level ◆ PSD



— Limit — Sum Level ◆ PSD



— Limit — Sum Level ◆ PSD

Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.40125 GHz	2.40125 GHz
Stop Frequency	2.40275 GHz	2.40275 GHz
Span	1.500 MHz	1.500 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	300	~ 300
SweepTime	1.500 s	1.500 s
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 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	4 / max. 150	max. 150
Stable	3/3	3
Max Stable Difference	0.20 dB	0.50 dB

## 6 Conducted Spurious Emissions / Band Edge

### 6.1 Test Result

Test Description	Regulatory Reference	Test Method	Test Result
Conducted Spurious Emissions	15.247(d) RSS-247 5.5	ANSI C63.10 Clause 11.11	Compliant

### 6.2 Test Method

The antenna port of the EUT was connected to a spectrum analyzer with

- Peak detector, max hold
- Resolution bandwidth of at least 100 kHz
  - o A larger RBW may be used to reduce test duration
- Video bandwidth at least 3x RBW
- Frequency range: 30 MHz to 25 GHz

Since the power is measured based on the use of the RMS averaging, the limit is 30 dB below that measured in the 100 kHz bandwidth within the band that contains the highest level of the desired power. All modes and data rates were investigated. Only the worst-case for each modulation was reported.

### 6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0 °C  
 Relative Humidity: 29.8 %  
 Atmospheric Pressure: 99.0 kPa

### 6.4 Test Equipment

Test End Date: 19-Feb-2019

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079824	25-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019

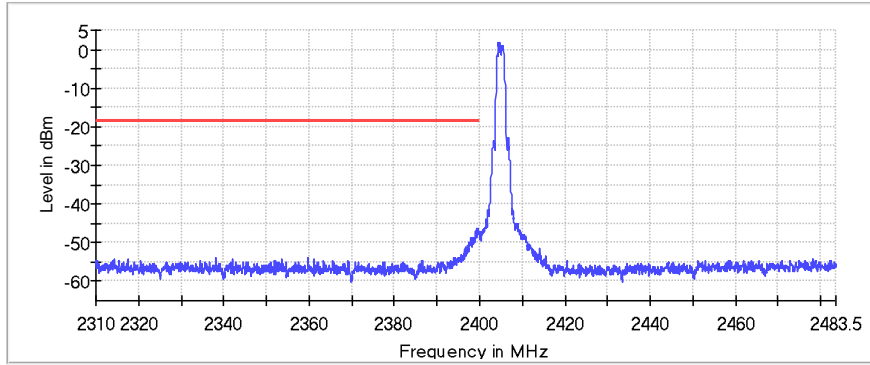
Note: The equipment calibration period is 1 year.



## 6.5 Test Data – DTS Band Edge

The red line on the plots below represents the 20 dB down peak limit. The 30 dB down Average limit, matching the Fundamental output power method of Section 4 has been applied to the Tabular data.

### 6.5.1 802.15.4 - Lower band edge:



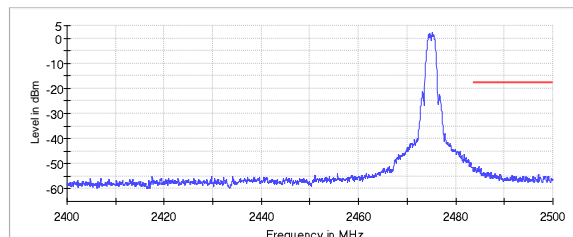
— Limit    — Sum Level    × Fail

Frequency(MHz)	Level(dBm)	Margin(dB)	Limit(dBm)	Result
2399.725	-46.3	18	-28.3	PASS
2399.175	-46.5	18.2	-28.3	PASS
2399.675	-46.6	18.2	-28.3	PASS
2399.775	-46.8	18.5	-28.3	PASS
2399.125	-46.8	18.5	-28.3	PASS
2399.975	-47	18.7	-28.3	PASS
2399.925	-47.1	18.7	-28.3	PASS
2399.075	-47.2	18.9	-28.3	PASS
2399.625	-47.3	18.9	-28.3	PASS
2399.575	-47.6	19.2	-28.3	PASS
2399.875	-47.6	19.3	-28.3	PASS
2399.225	-47.7	19.4	-28.3	PASS
2399.475	-47.8	19.5	-28.3	PASS
2399.525	-47.8	19.5	-28.3	PASS
2399.825	-48	19.7	-28.3	PASS

Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.31000 GHz	2.31000 GHz
Stop Frequency	2.40000 GHz	2.40000 GHz
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
Sweeptime	113.672 $\mu$ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 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	0.00 dB	0.50 dB

### 6.5.2 802.15.4 - Upper band edge:

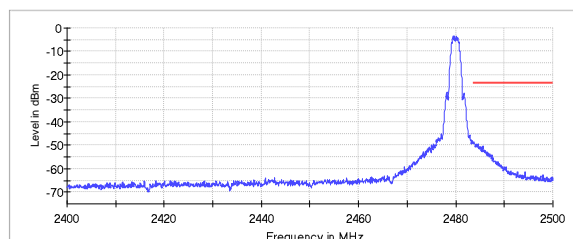
#### Channel 25



— Limit — Sum Level × Fail

Frequency(MHz)	Level(dBm)	Margin(dB)	Limit(dBm)	Result
2484.725	-51.3	23.5	-27.8	PASS
2484.025	-51.5	23.7	-27.8	PASS
2483.725	-51.6	23.8	-27.8	PASS
2483.975	-51.7	23.9	-27.8	PASS
2483.675	-51.7	24	-27.8	PASS
2484.675	-51.9	24.1	-27.8	PASS
2484.425	-52	24.2	-27.8	PASS
2485.175	-52	24.2	-27.8	PASS
2484.975	-52.1	24.4	-27.8	PASS
2485.025	-52.1	24.4	-27.8	PASS
2484.775	-52.2	24.4	-27.8	PASS
2485.125	-52.2	24.5	-27.8	PASS
2483.625	-52.3	24.5	-27.8	PASS
2484.475	-52.3	24.5	-27.8	PASS
2484.825	-52.3	24.5	-27.8	PASS
2483.525	-48.5	15.2	-33.2	PASS

#### Channel 26

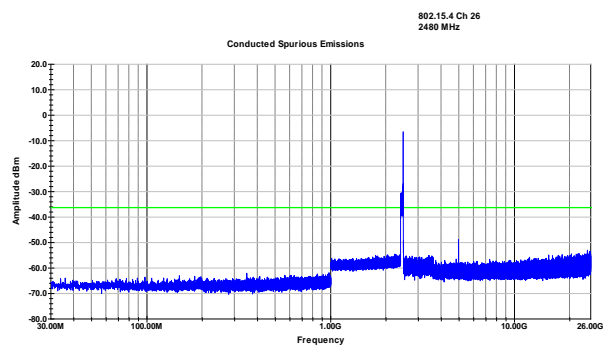
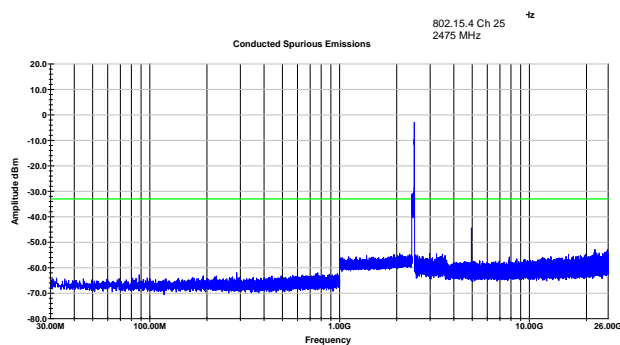
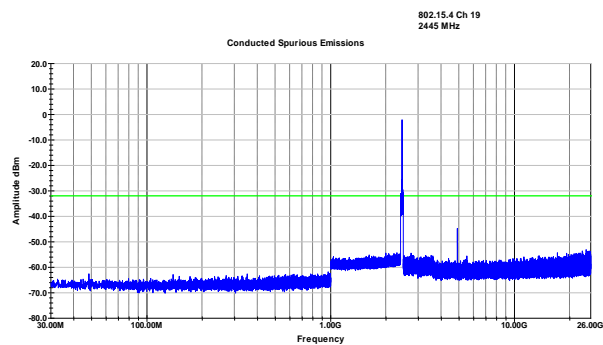
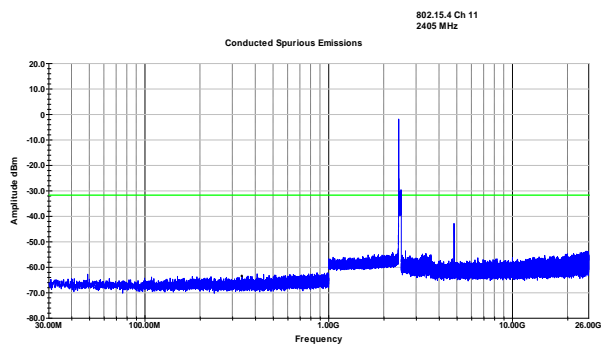


— Limit — Sum Level × Fail

Frequency(MHz)	Level(dBm)	Margin(dB)	Limit(dBm)	Result
2483.525	-48.5	15.2	-33.2	PASS
2483.625	-48.6	15.4	-33.2	PASS
2483.725	-48.7	15.5	-33.2	PASS
2483.675	-48.7	15.5	-33.2	PASS
2483.575	-48.8	15.5	-33.2	PASS
2483.875	-48.9	15.6	-33.2	PASS
2483.775	-48.9	15.6	-33.2	PASS
2483.825	-48.9	15.7	-33.2	PASS
2484.275	-49.4	16.2	-33.2	PASS
2484.575	-49.5	16.3	-33.2	PASS
2484.325	-49.7	16.4	-33.2	PASS
2483.925	-49.7	16.5	-33.2	PASS
2484.175	-49.9	16.7	-33.2	PASS
2484.625	-50.1	16.8	-33.2	PASS
2484.025	-50.1	16.8	-33.2	PASS

Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 μs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 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	8 / max. 150	max. 150
Stable	3/3	3
Max Stable Difference	0.21 dB	0.50 dB

## 6.6 Test Data – Conducted Spurious Emissions



## 7 Field Strength of Spurious Radiation

### 7.1 Test Result

Test Description	Regulatory Reference	Test Method	Test Result
Radiated Emissions Cabinet Radiation	15.209 / 15.205 RSS-GEN 8.9	ANSI C63.10 Clauses 11.12.2.7, 6.3 and 6.5, 6.6	Compliant

### 7.2 Test Method

The measurement methods defined in ANSI C63.10: 2013 were used. This test demonstrates compliance through cabinet/case emissions with the antenna port terminated in 50 Ω [Clause 11.12.2.1]. The associated antenna port conducted test may be found in Section 8 of this report.

Lowest, middle, and highest channels were investigated – the device was commanded to continuously transmit on channels low, middle, and high channels. Three orthogonal axis were investigated. There was no significant difference in cabinet radiation with variation of channel or DUT orientation.

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 3 meters

Limits within restricted bands of operation:

Frequency	Limits <sup>(1)</sup> Microvolts/m	Measured distance Meters
9 to 490 kHz	2400/F(kHz)	300 <sup>(2)(4)</sup>
490 kHz to 1.705 MHz	24000/F(kHz)	30 <sup>(2)</sup>
1.705 to 30 MHz	30	30 <sup>(2)</sup>
30 to 88 MHz	100	3 <sup>(2)</sup>
88 to 216 MHz	150	3 <sup>(2)</sup>
216 to 960 MHz	200	3 <sup>(2)</sup>
960 to 1000 MHz	500	3 <sup>(2)</sup>
1 to 40 GHz	500	3 <sup>(3)</sup>

- (1) These limits are applicable to emissions outside of the intentional transmit frequency band.
- (2) Quasi-peak limit
- (3) Average limit. Peak limit is 20 dB above average
- (4) Peak detector from 9-90 kHz and 110-490 kHz

### 7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 22.9 °C  
 Relative Humidity: 39.5 %  
 Atmospheric Pressure: 98.1 kPa

### 7.4 Test Equipment

Test End Date: 20-Feb-2019

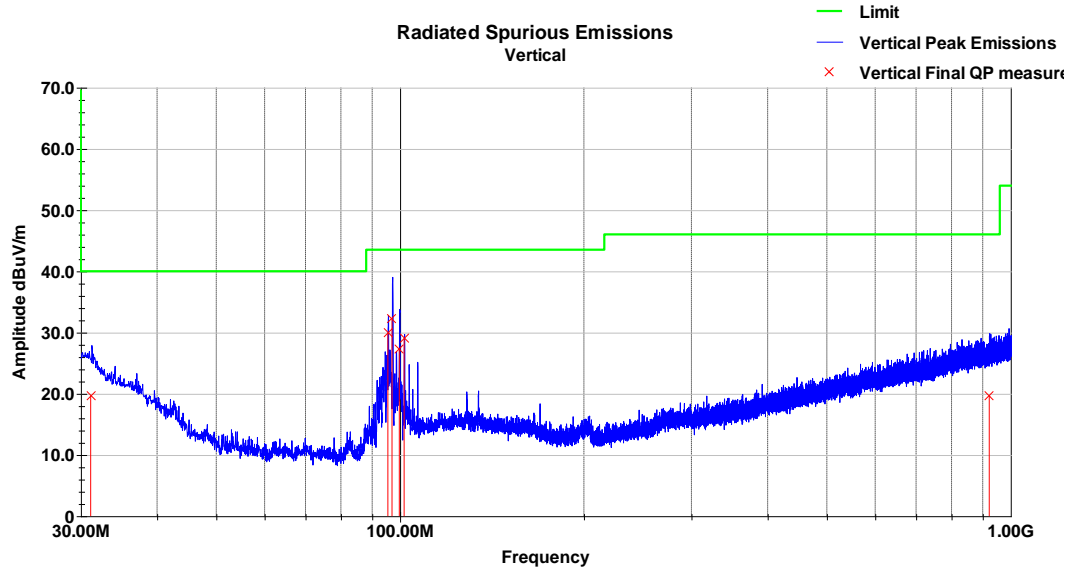
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	10-Aug-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	25-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019
ANTENNA, HORN (SMALL)	LB-180400-20-C-KF	A-INFO	15007	30-Mar-2019
RF CABLE	SF102	HUBER & SUHNER	B079823	25-Jul-2019
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	27-Jul-2019
ANTENNA, BILOG	JB6	SUNOL	B079689	30-Oct-2019
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	23-Jul-2019
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	24-Jul-2019
RF CABLE	UC-N-MM-275	MAURY MICROWAVE	17015	23-Jul-2019

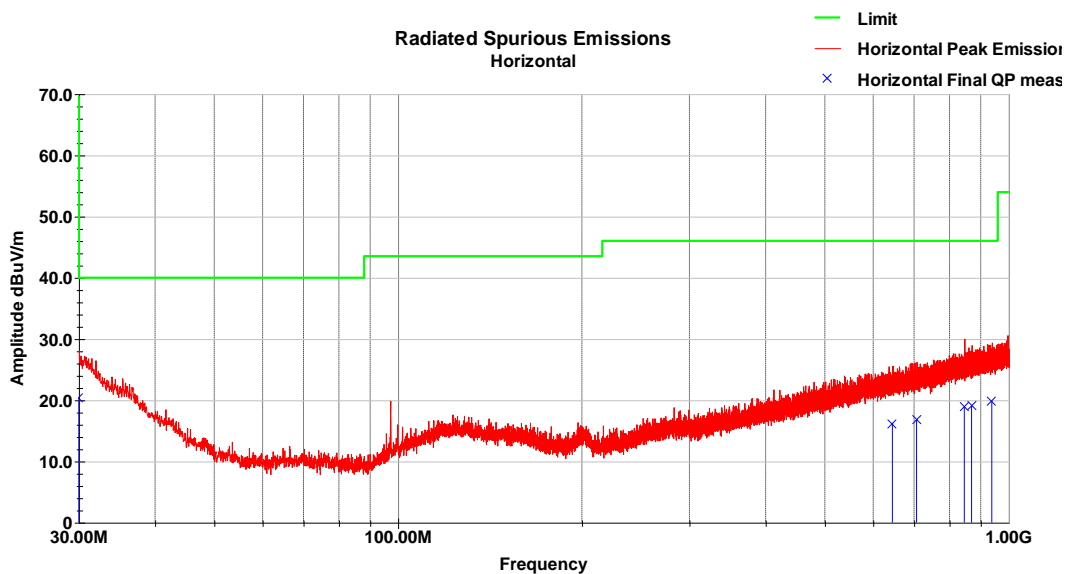
Note: The equipment calibration period is 1 year.

## 7.5 Test Data

### 7.5.1 30-1000 MHz

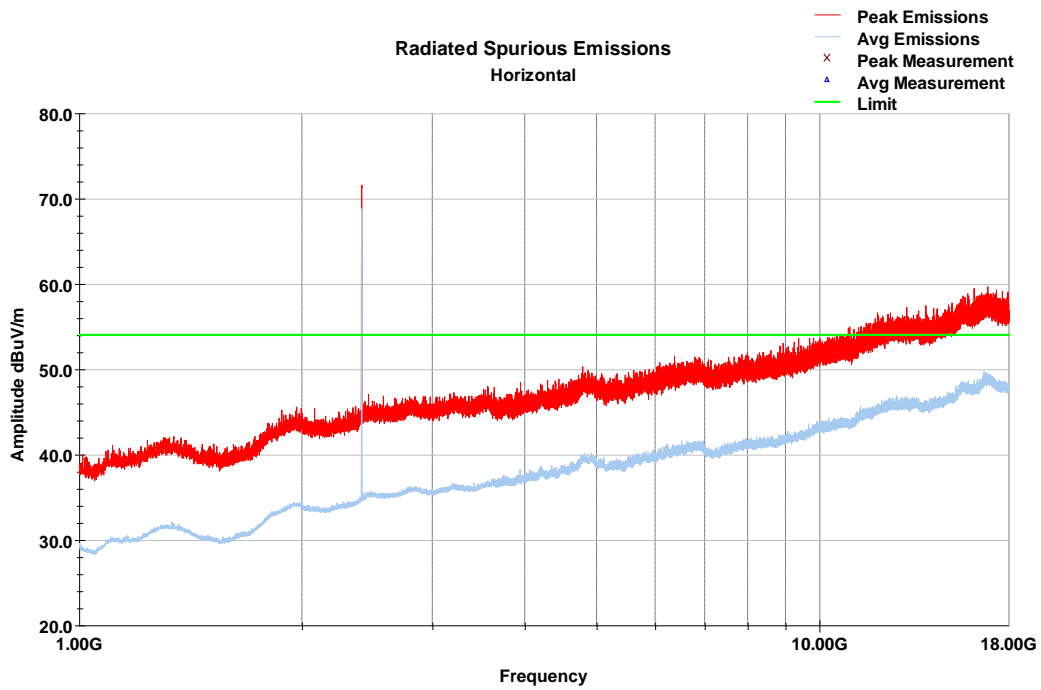
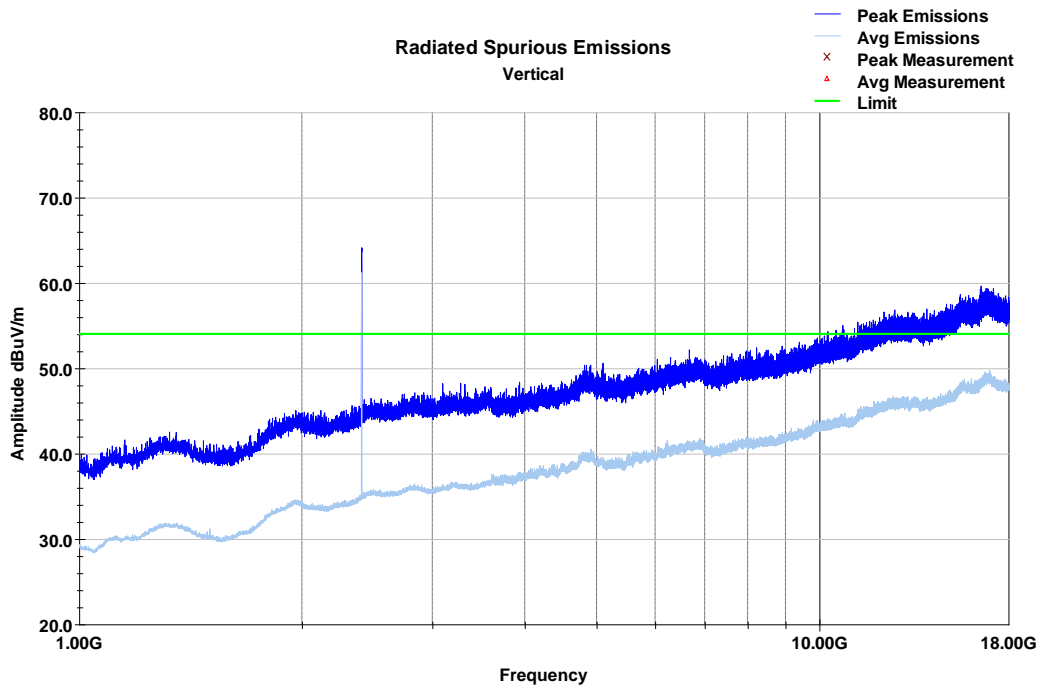


Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.14	29.3	V	215.0	227.0	21.4	0.7	31.7	19.7	40.0	-20.3
95.50	53.0	V	197.0	120.0	9.3	1.3	33.6	29.9	43.5	-13.6
97.01	55.0	V	213.0	137.0	9.7	1.3	33.7	32.3	43.5	-11.2
99.73	49.3	V	282.0	175.0	10.4	1.3	33.7	27.4	43.5	-16.2
101.52	50.5	V	198.0	106.0	10.9	1.3	33.7	29.0	43.5	-14.5
922.38	25.6	V	274.0	113.0	23.1	4.2	33.3	19.7	46.0	-26.4
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										



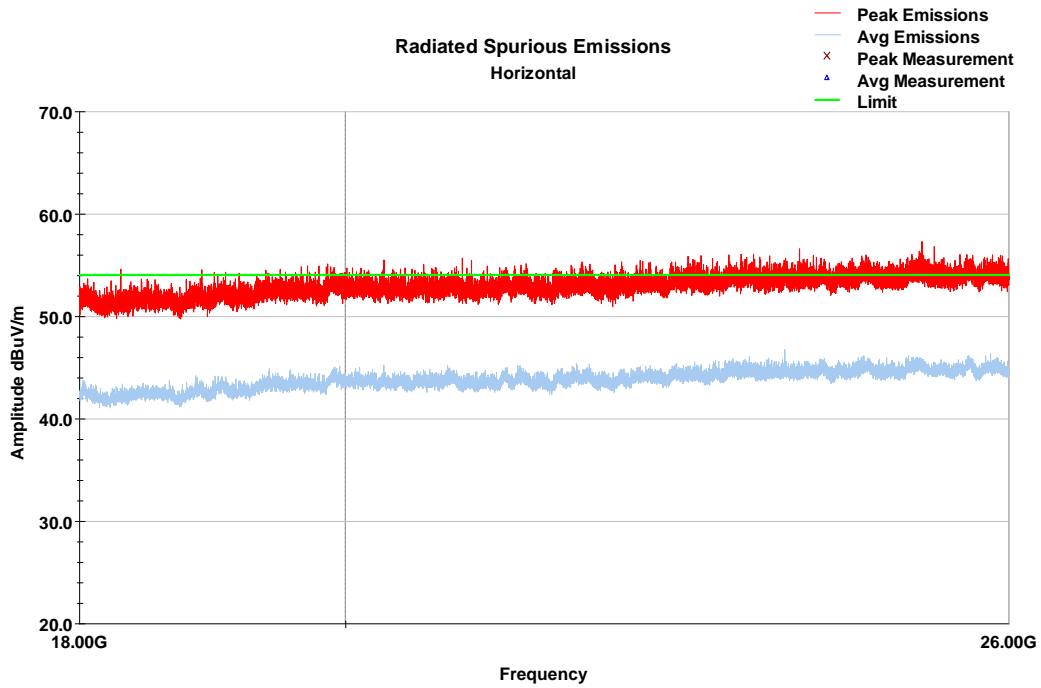
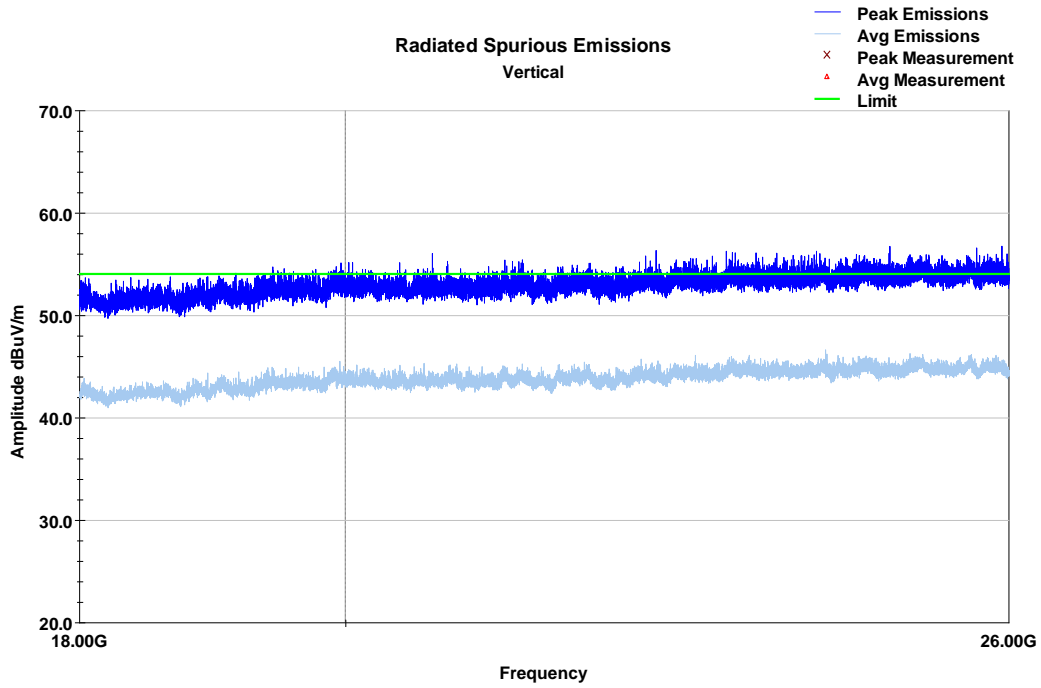
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.00	29.1	H	13.0	224.0	22.2	0.7	31.6	20.4	40.0	-19.6
645.10	25.7	H	15.0	201.0	20.3	3.5	33.3	16.2	46.0	-29.8
706.56	25.6	H	286.0	201.0	20.9	3.6	33.3	16.9	46.0	-29.2
846.09	25.5	H	144.0	219.0	22.6	4.0	33.3	18.9	46.0	-27.2
869.51	25.6	H	63.0	150.0	22.7	4.0	33.3	19.0	46.0	-27.0
938.34	25.6	H	64.0	183.0	23.2	4.2	33.2	19.8	46.0	-26.2
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

7.5.2 1-18 GHz





7.5.3 18-25 GHz



## 8 Emissions in Restricted Frequency Bands

### 8.1 Test Result

Test Description	Test Specification		Test Result
Restricted Band Emissions	15.205 / 15.209	RSS-GEN S8.9 / 8.10	Compliant

### 8.2 Test Method

Measurements were made using the conducted methods defined in ANSI C63.10, Clause 11.12.2. The measurements were converted to a radiated field strength equivalent using the equations defined in that section. Both peak and average measurements were performed at the antenna port.

A reference level offset was applied to the spectrum analyzer so that conducted measurements in dB $\mu$ V represent field strength measurements in dB $\mu$ V/m.

Example calculations:

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

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

Where,

D = Distance, 3m

CL = Cable Loss

DC = Duty Cycle Correction Factor, which is  $10 \cdot \log(1/D)$  for rms mode

D = % Duty Cycle

AG = The actual antenna gain or 2 dBi, whichever is lower

All data rates and modes were investigated. Only the plots from the configuration which produced the worst-case emissions are included in this report.

802.15.4	D	CL	DC	AG	Offset
Low	-11.7	11	0	2	1.3
High	-11.7	11	0	2.2	1.5

### 8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0 °C

Relative Humidity: 29.8 %

Atmospheric Pressure: 99.0 kPa

## 8.4 Test Equipment

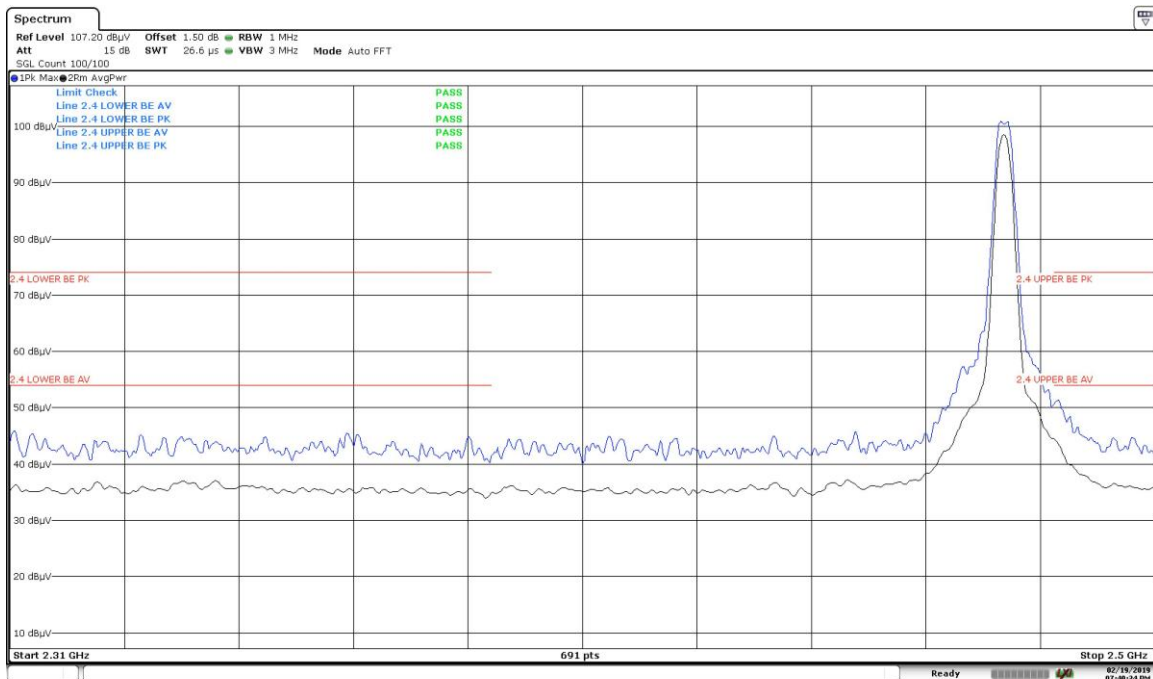
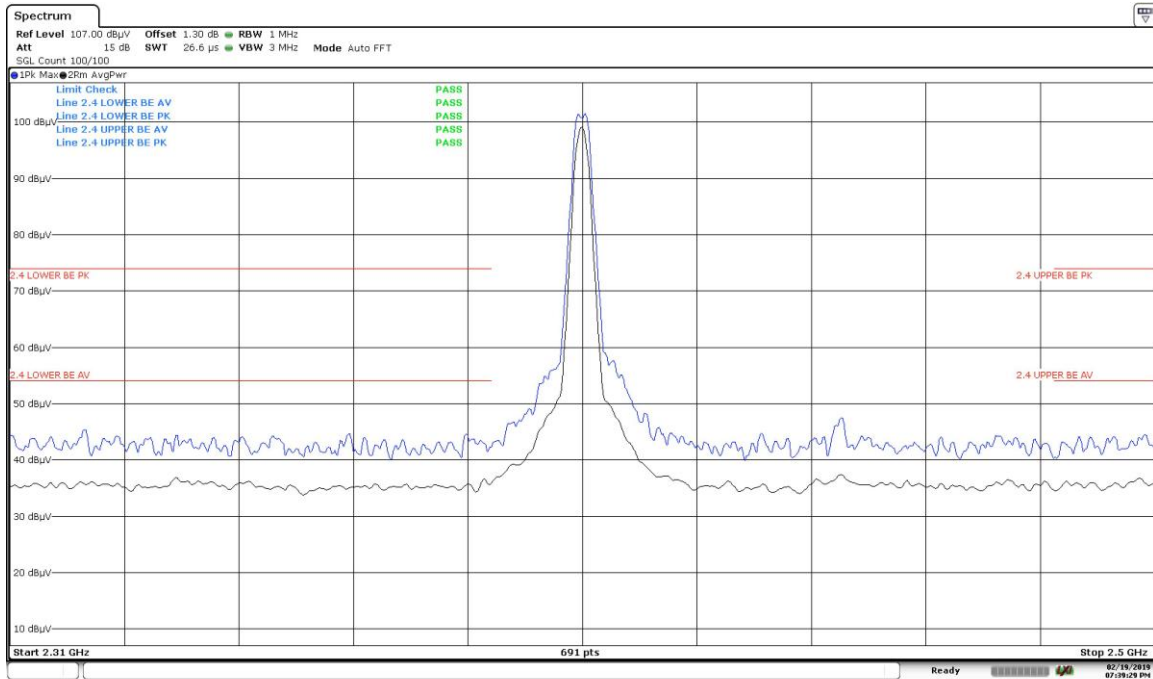
Test End Date: 19-Feb-2019

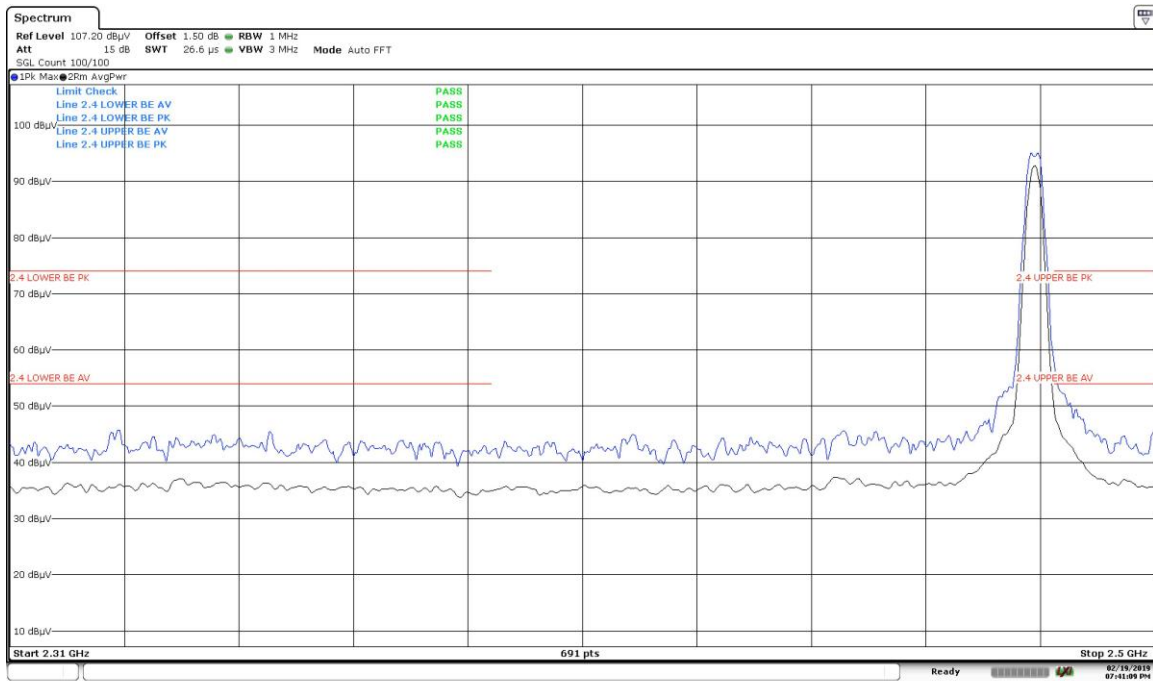
Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

### 8.5 Test Data – Restricted Band Edge

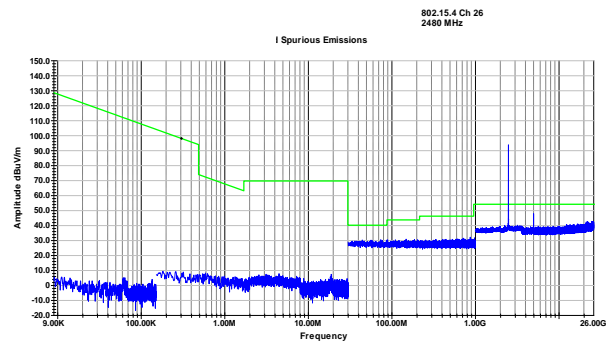
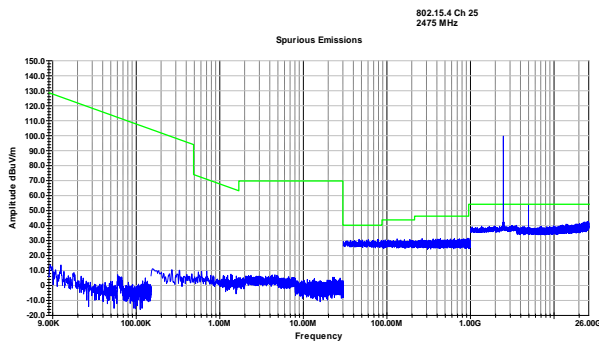
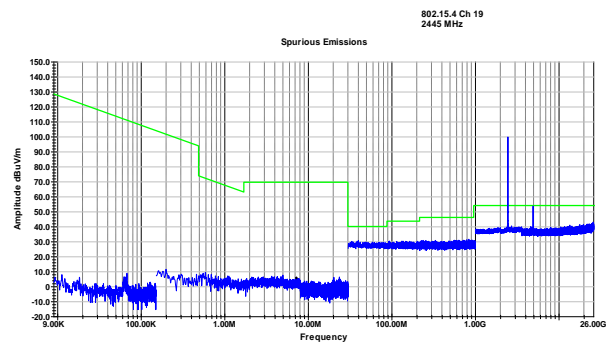
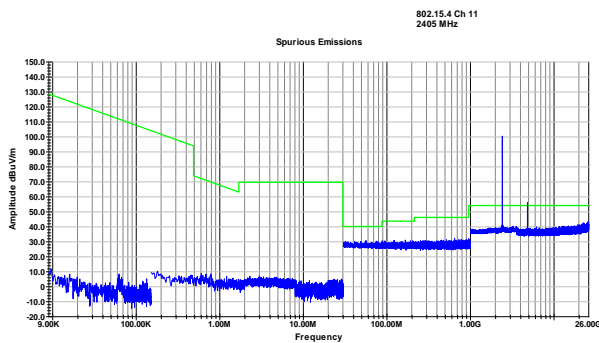




### 8.6 Test Data – Spurious Emissions

Antenna	DUT Ch	DUT Freq MHz	Freq GHz	Avg Value dBuV/m	Ant Gain dBi	Final Value dBuV/m	Avg Limit dBuV/m	Margin dB
Walsin	11	2405	4.809	50.97	0.33	51.30	54	-2.70
Walsin	19	2445	4.891	48.37	1.59	49.96	54	-4.04
Walsin	25	2475	4.949	48.91	2.2	51.11	54	-2.89
Walsin	26	2480	4.961	42.83	2.2	45.03	54	-8.97
Pulse	11	2405	4.809	50.97	0.4	51.37	54	-2.63
Pulse	19	2445	4.891	48.37	0.4	48.77	54	-5.23
Pulse	25	2475	4.949	48.91	0.4	49.31	54	-4.69
Pulse	26	2480	4.961	42.83	0.4	43.23	54	-10.77

DUT Data Rate	DUT Ch	DUT Freq MHz	Freq GHz	Pk Value dBuV/m	Ant Gain dBi	Final Value dBuV/m	Pk Lim it dBuV/m	Margin dB
Walsin	11	2405	4.809	55.43	0.33	55.76	74	-18.24
Walsin	19	2445	4.891	53.12	1.59	54.71	74	-19.29
Walsin	25	2475	4.949	53.01	2.2	55.21	74	-18.79
Walsin	26	2480	4.959	47.22	2.2	49.42	74	-24.58
Pulse	11	2405	4.809	55.43	0.4	55.83	74	-18.17
Pulse	19	2445	4.891	53.12	0.4	53.52	74	-20.48
Pulse	25	2475	4.949	53.01	0.4	53.41	74	-20.59
Pulse	26	2480	4.959	47.22	0.4	47.62	74	-26.38



## 9 Conducted Emissions

### 9.1 Test Result

Test Description	Basic Standards	Test Result
Conducted Emissions	ANSI C63.4	Compliant

### 9.2 Test Method

With the receiver's resolution bandwidth was set to 9 kHz, exploratory scans were performed over the measuring frequency range (0.15 MHz to 30 MHz) 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	Limits (dBuV)
0.15 to 0.5 MHz	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 46 Pk 56
5 to 30 MHz	Avg 50 Pk 60

### 9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions:

Temperature: 23.4 °C  
 Relative Humidity: 38.0 %  
 Atmospheric Pressure 98.0 kpa

### 9.4 Test Equipment

Test End Date: 21-Feb-2019

Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	3-Dec-2019
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	24-Jul-2019
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	17-Aug-2019
CONDUCTED COMB GENERATOR	CGC-255	COM-POWER	B079696	CNR

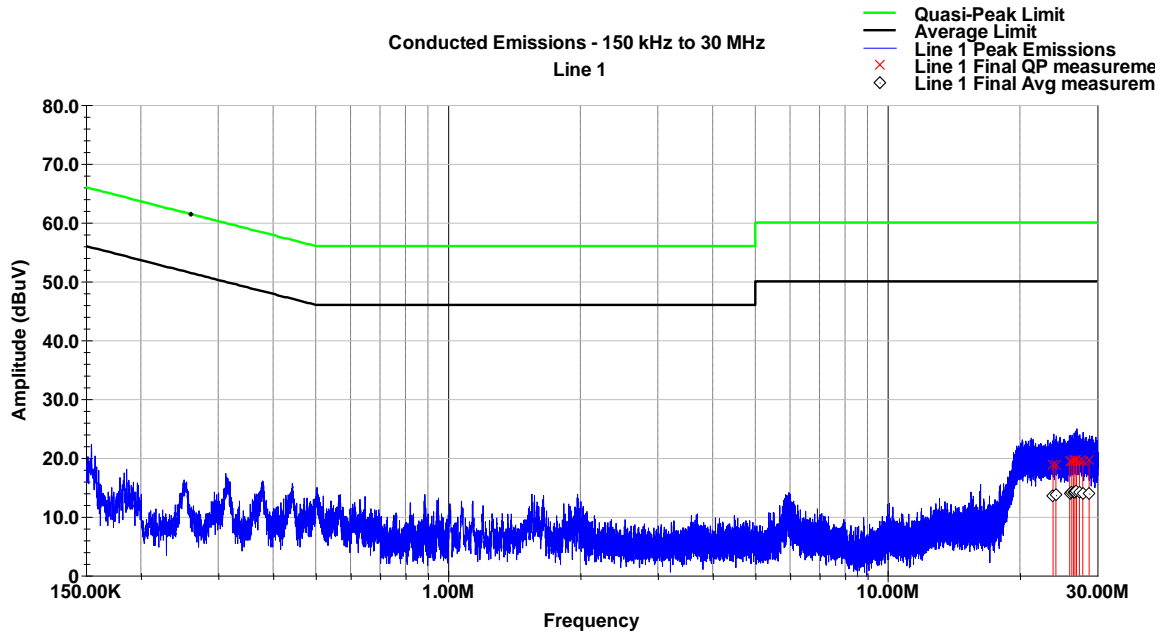
Notes:

The calibration period equipment is 1 year.

CNR – Calibration Not Required

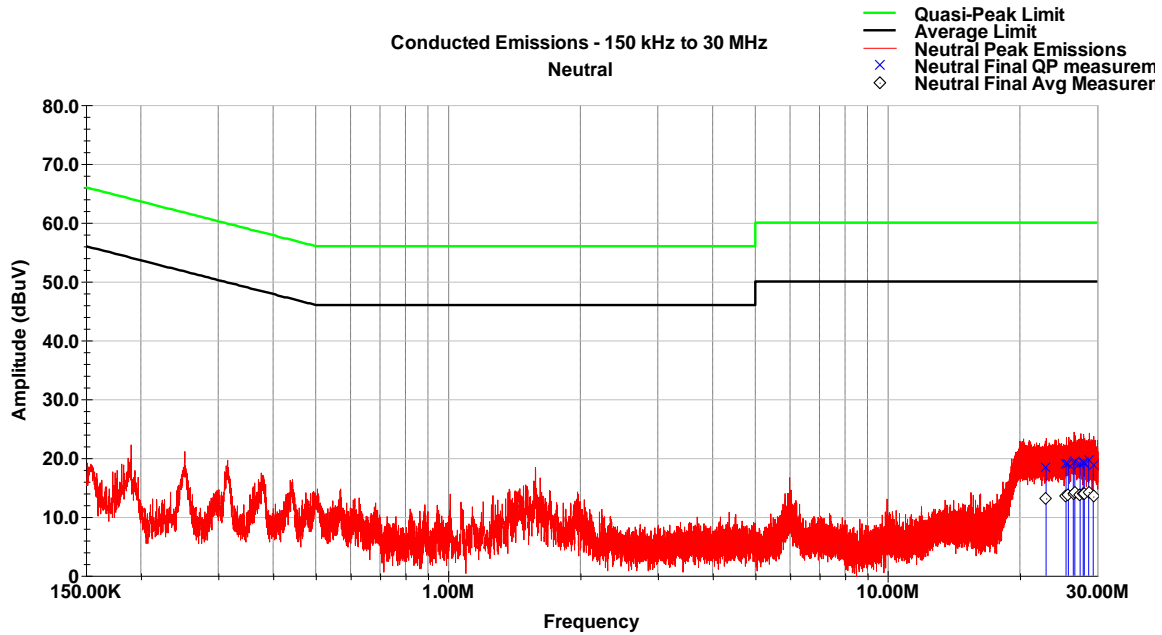
Software: "Conducted Emissions" TILE! profile dated 10 Nov 2011

### 9.6 Test Data



Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
23.790	18.8	60.0	-41.2	13.5	50.0	-36.5
24.150	18.9	60.0	-41.1	13.7	50.0	-36.3
25.954	19.5	60.0	-40.5	14.0	50.0	-36.0
26.244	19.5	60.0	-40.5	14.2	50.0	-35.8
26.494	19.5	60.0	-40.5	14.2	50.0	-35.8
26.682	19.3	60.0	-40.7	14.1	50.0	-35.9
26.900	19.6	60.0	-40.4	14.4	50.0	-35.6
27.314	19.4	60.0	-40.6	14.1	50.0	-35.9
27.805	19.5	60.0	-40.5	14.1	50.0	-35.9
28.738	19.6	60.0	-40.4	13.9	50.0	-36.1





Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
22.936	18.4	60.0	-41.6	13.1	50.0	-36.9
25.474	19.0	60.0	-41.0	13.6	50.0	-36.4
25.784	18.9	60.0	-41.1	13.7	50.0	-36.3
26.453	19.2	60.0	-40.8	13.9	50.0	-36.1
26.664	19.5	60.0	-40.5	14.1	50.0	-35.9
27.422	19.1	60.0	-40.9	13.8	50.0	-36.2
27.861	19.1	60.0	-40.9	13.9	50.0	-36.1
28.017	19.2	60.0	-40.8	14.0	50.0	-36.0
28.682	19.6	60.0	-40.4	14.2	50.0	-35.8
29.363	18.8	60.0	-41.2	13.4	50.0	-36.6

## 10 Measurement Uncertainty

The measurement uncertainty figures are be calculated in accordance with TR 100 028-1 [2] and correspond to an expansion factor (coverage factor)  $k = 2$  (which provide confidence levels of 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Parameter	Expanded Uncertainty for Normal k factor equal to 2	
	Required	Laboratory Actual
Radio Frequency	$\pm 1 \times 10^{-5}$	$\pm 9.8 \times 10^{-8}$
total RF power, conducted	$\pm 1.5$ dB	$\pm 1.2$ dB
RF power density, conducted	$\pm 3$ dB	$\pm 0.7$ dB
spurious emissions, conducted	$\pm 3$ dB	$\pm 2.1$ dB
all emissions, radiated	$\pm 6$ dB	$\pm 4.8$ dB
temperature	$\pm 1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
humidity	$\pm 5$ %	$\pm 3.5\%$
DC and low frequency voltages	$\pm 3$ %	$\pm 0.4\%$
Conducted disturbance at mains port using AMN	$\pm 3.4$ dB	$\pm 2.5$ dB

## 11 Revision History

Revision Level	Description of changes	Revision Date
DRAFT	--	25 February 2019
0	Initial release	5 March 2019
1	Section 4.5 – Combined Power tables. Section 7.5 – Fixed limit reference at band edge (30 MHz) Section 9 – Updated limit references	1 April 2019
2	Section 7.5 – Fixed limit reference at band edge (30 MHz) Section 4.5 – Power Table corrected.	16 April 2019