RF Test Report

Project Number: 4427245 / 8089
Report Number: 4427245EMC02 **Revision Level:** 1

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: 1 April 2019
Test Result: Compliant

Tested by: Aaron Froehlich, EMC Test Engineer

Reviewed by: David Schramm, Operations Manager

Table of Contents

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[1]

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.

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:	2402 – 2480 MHz
Data Modes:	Bluetooth Low Energy – GFSK
Antenna:	Walsin - RFPCA430618IMAB301 [2.2 dBi_{pk}]
	PulseLarsen Larson - W3357 [0.4 dBi_{pk}]
Rated Voltage:	4.2 V_{dc}
Test Voltage:	4.2 V_{dc}
Sample Received Date:	2/12/2019
Dates of testing:	2/12/2019-2/20/2019

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.

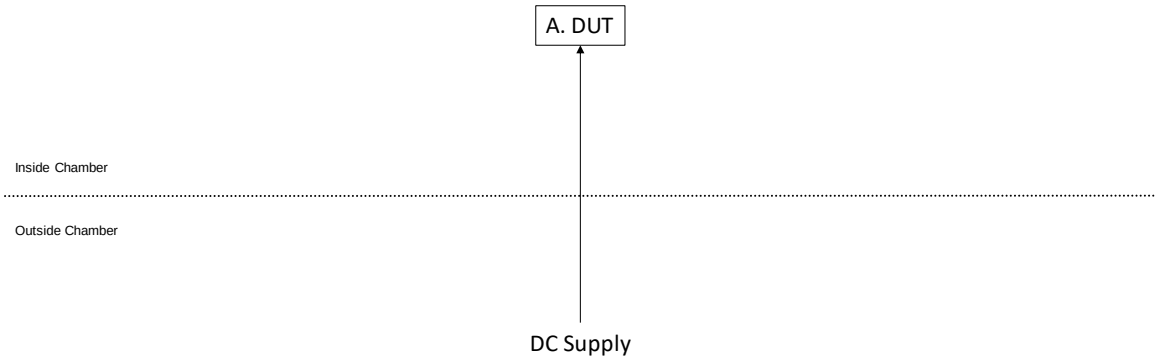
All channels has a power setting of “35 raw”.

The device can operate with both the Walsin manufactured Antenna and the PulseLarsen Larson 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 the host filled with pitch (potted).

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 ≥ [3 × 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 = ≥ [3 × 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

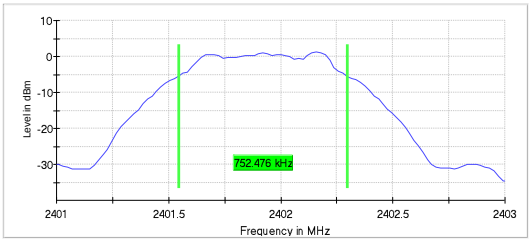
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

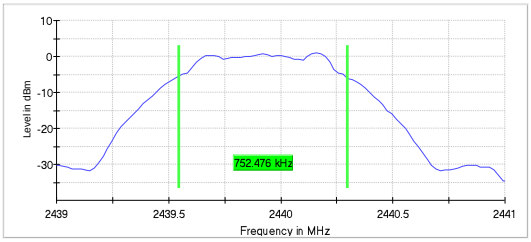
Note: The equipment calibration period is 1 year.

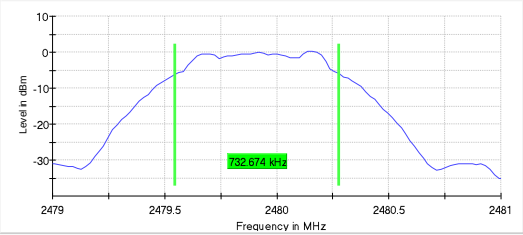
3.5 *Test Data*

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)
2402	0.752476	0.5	---	2401.544554	2402.29703
2440	0.752476	0.5	---	2439.544554	2440.29703
2480	0.732674	0.5	---	2479.544554	2480.277228



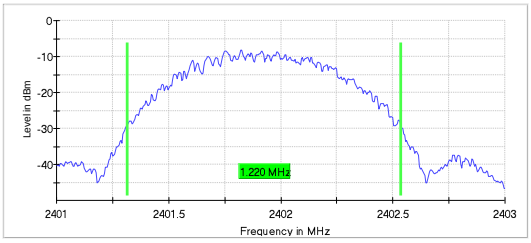


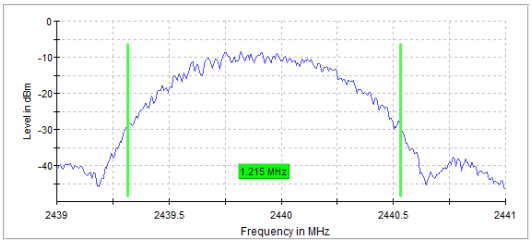


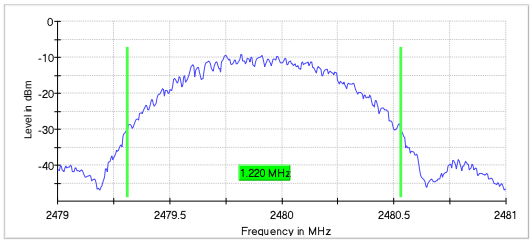
Settings		
Setting	**Instrument Value**	**Target Value**
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
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	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)
2402	1.22	---	---	2401.3175	2402.5375
2440	1.215	---	---	2439.3175	2440.5325
2480	1.22	---	---	2479.3125	2480.5325







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
Sweeptime	189.648 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	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
2402	2	30	2.3	2.4	100	PASS
2440	1.5	30	3.1	1.9	100	PASS
2480	1	30	3.2	1.4	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*

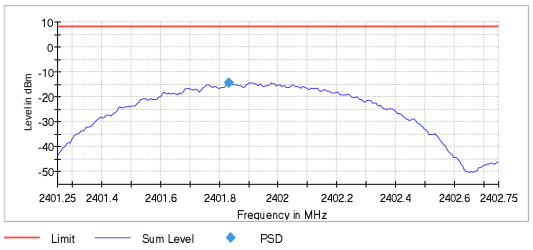
Test End Date: 19-Feb-2019 Tester: ASF

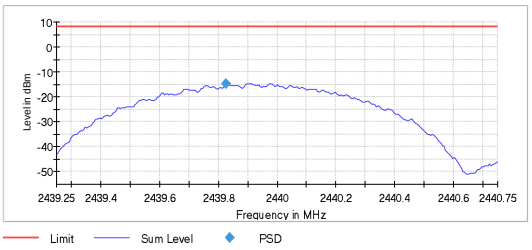
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

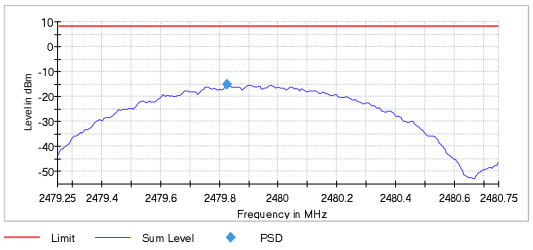
Note: The equipment calibration period is 1 year.

5.5 *Test Data*

DUT Frequency(MHz)	Frequency(MHz)	PSD(dBm)	Limit Max(dBm)	Result
2402	2401.8325	-14.346	8	PASS
2440	2439.8275	-14.636	8	PASS
2480	2479.8275	-15.267	8	PASS







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
  - 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*

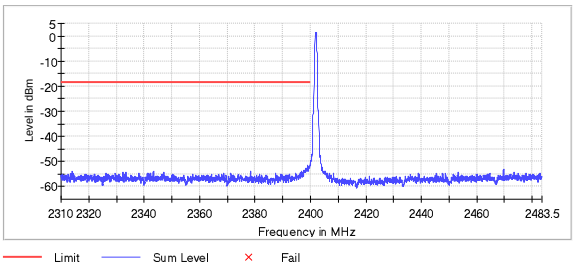
Test End Date: 19-Feb-2019 Tester: ASF

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.

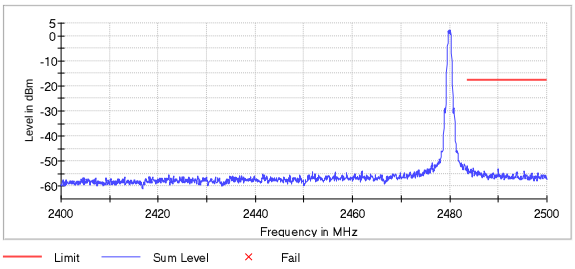
6.5 *Test Data – DTS Band Edge*

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.



Frequency(MHz)	Level(dBm)	Margin(dB)	Limit(dBm)	Result
2399.875	-49.6	21.2	-28.4	PASS
2399.825	-50.3	21.9	-28.4	PASS
2399.925	-50.6	22.2	-28.4	PASS
2399.975	-51.1	22.7	-28.4	PASS
2398.875	-51.7	23.3	-28.4	PASS
2399.625	-51.7	23.3	-28.4	PASS
2399.475	-52	23.6	-28.4	PASS
2399.425	-52	23.6	-28.4	PASS
2399.025	-52	23.7	-28.4	PASS
2398.825	-52.1	23.7	-28.4	PASS
2399.075	-52.1	23.8	-28.4	PASS
2399.575	-52.2	23.8	-28.4	PASS
2398.925	-52.2	23.8	-28.4	PASS
2399.225	-52.3	23.9	-28.4	PASS
2399.275	-52.3	23.9	-28.4	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 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	4 / max. 150	max. 150
Stable	3-Mar	3
Max Stable Difference	0.00 dB	0.50 dB

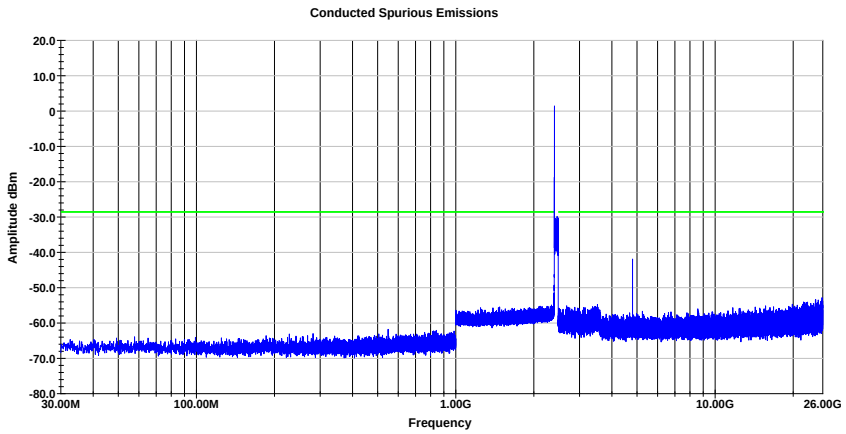


Frequency(MHz)	Level(dBm)	Margin(dB)	Limit(dBm)	Result
2483.575	-51.9	24.3	-27.6	PASS
2483.525	-52.4	24.7	-27.6	PASS
2483.625	-52.4	24.8	-27.6	PASS
2484.825	-52.8	25.2	-27.6	PASS
2484.875	-52.9	25.2	-27.6	PASS
2484.325	-52.9	25.3	-27.6	PASS
2484.375	-52.9	25.3	-27.6	PASS
2483.825	-53.1	25.5	-27.6	PASS
2489.975	-53.2	25.6	-27.6	PASS
2483.775	-53.3	25.7	-27.6	PASS
2490.025	-53.4	25.8	-27.6	PASS
2484.725	-53.6	26	-27.6	PASS
2495.325	-53.7	26.1	-27.6	PASS
2495.375	-53.7	26.1	-27.6	PASS
2487.075	-53.8	26.2	-27.6	PASS

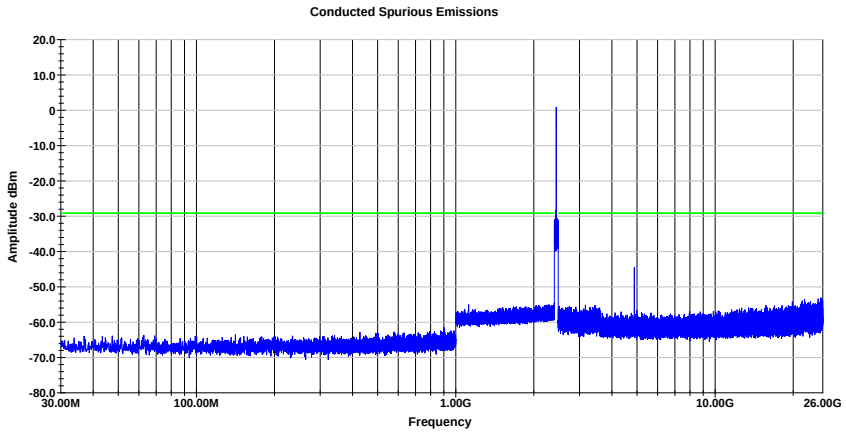
Settings		
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
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	5 / max. 150	max. 150
Stable	3-Mar	3
Max Stable Difference	0.24 dB	0.50 dB

6.6 *Test Data – Conducted Spurious Emissions*

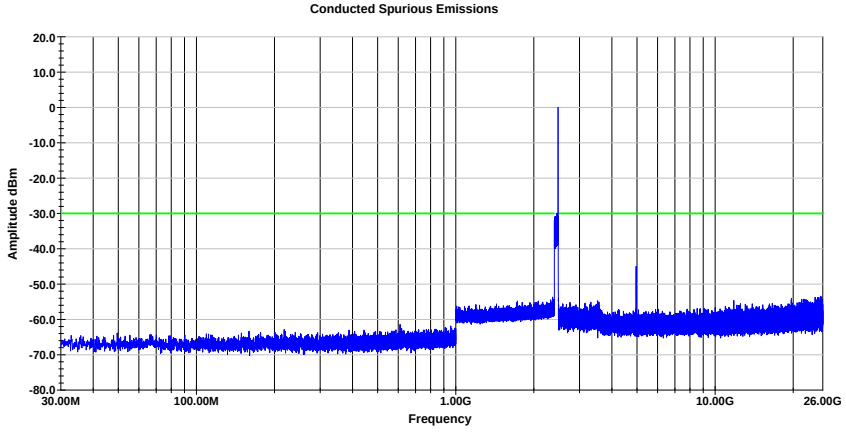
BLE Ch 02402 MHz



BLE Ch 192440 MHz



BLE Ch 392480 MHz



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

(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*

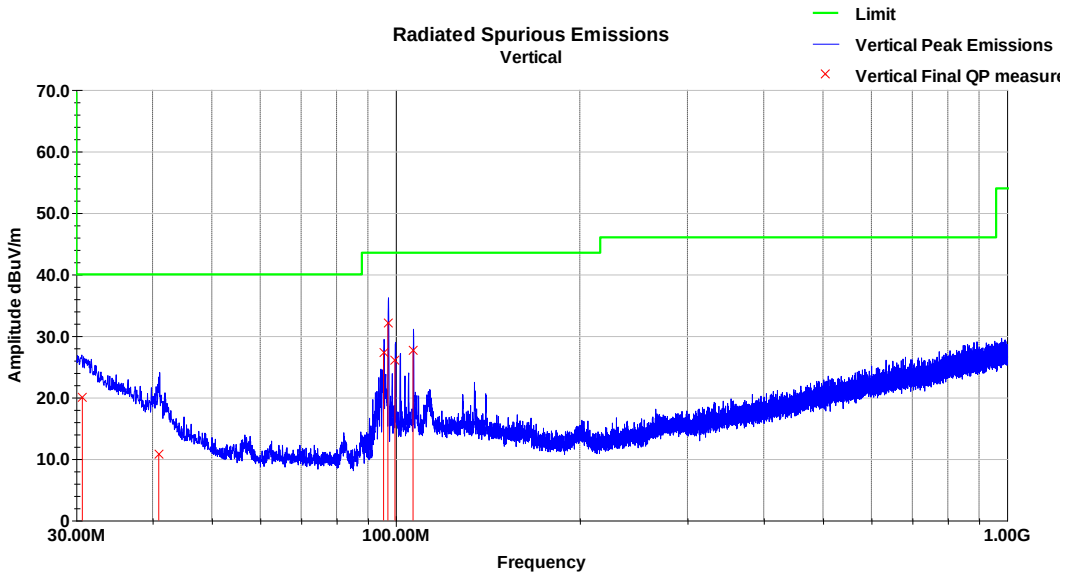
Test End Date: 20-Feb-2019 Tester: ASF

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

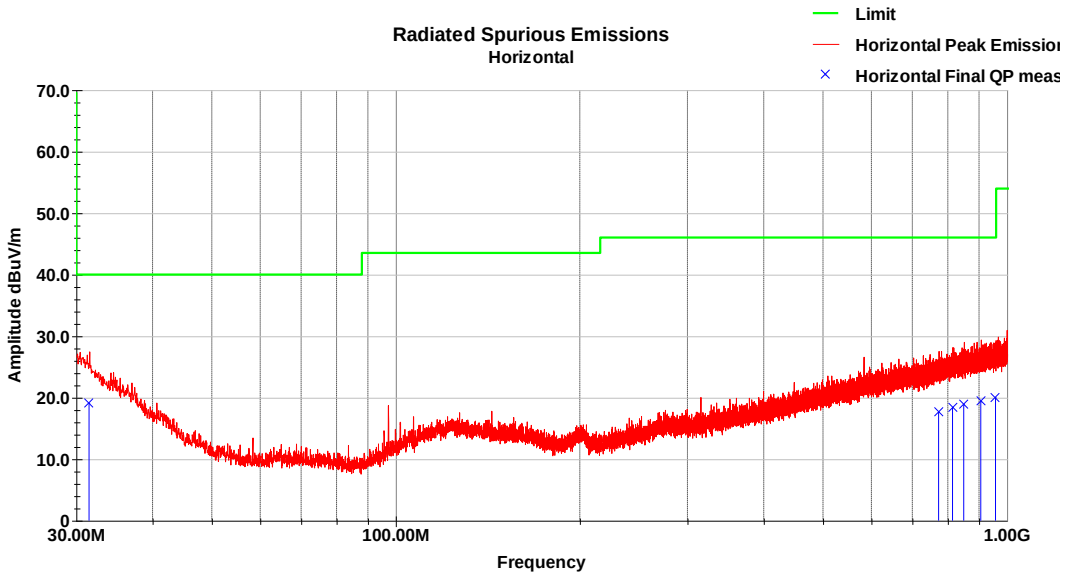
Note: The equipment calibration period is 1 year.

7.5 *Test Data*

7.5.1 30-1000 MHz

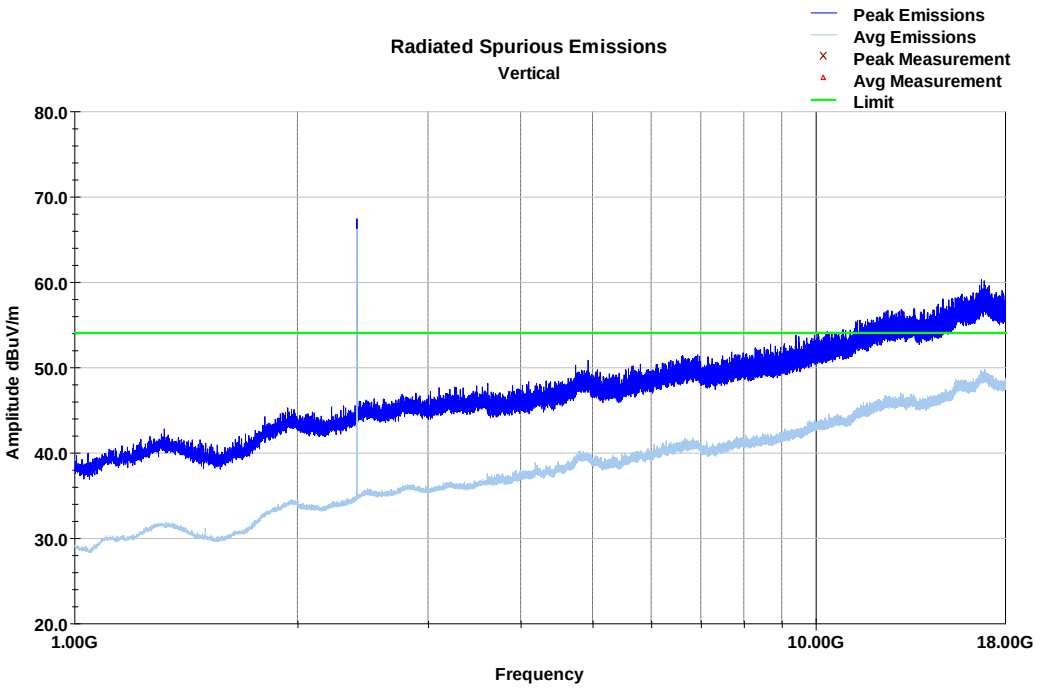


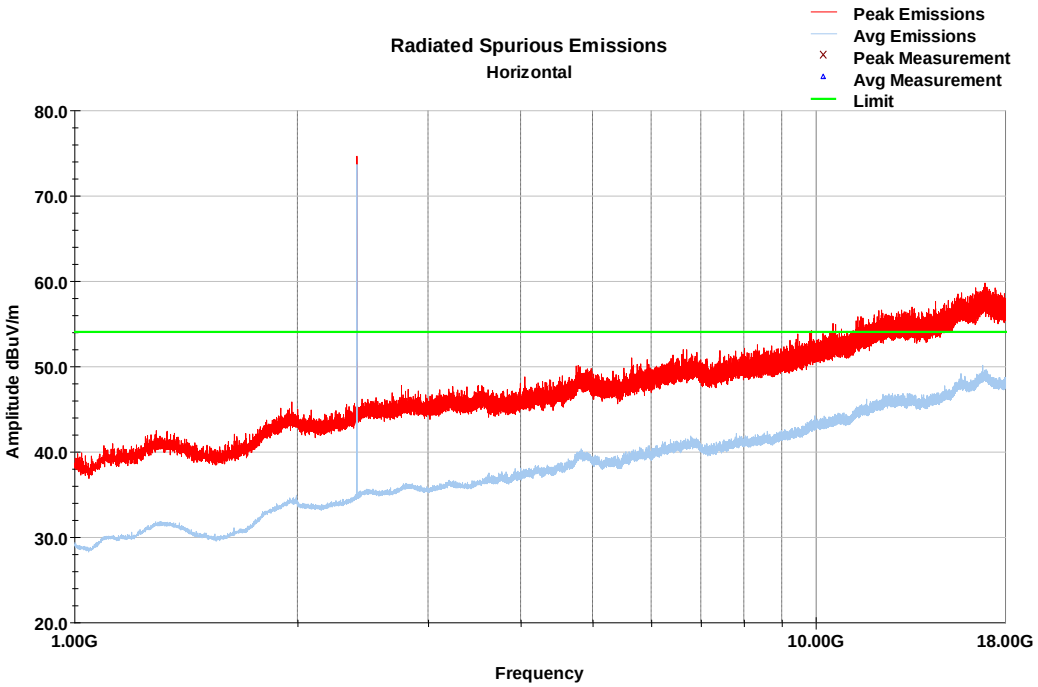
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.70	29.2	V	25.0	235.0	21.7	0.7	31.7	19.9	40.0	-20.1
40.94	28.6	V	229.0	113.0	13.7	0.8	32.4	10.8	40.0	-29.2
95.50	50.4	V	51.0	165.0	9.3	1.3	33.6	27.4	43.5	-16.1
97.06	54.8	V	325.0	144.0	9.7	1.3	33.7	32.2	43.5	-11.3
99.67	47.9	V	329.0	105.0	10.4	1.3	33.7	26.0	43.5	-17.5
106.71	47.9	V	312.0	122.0	12.0	1.4	33.8	27.6	43.5	-15.9
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										



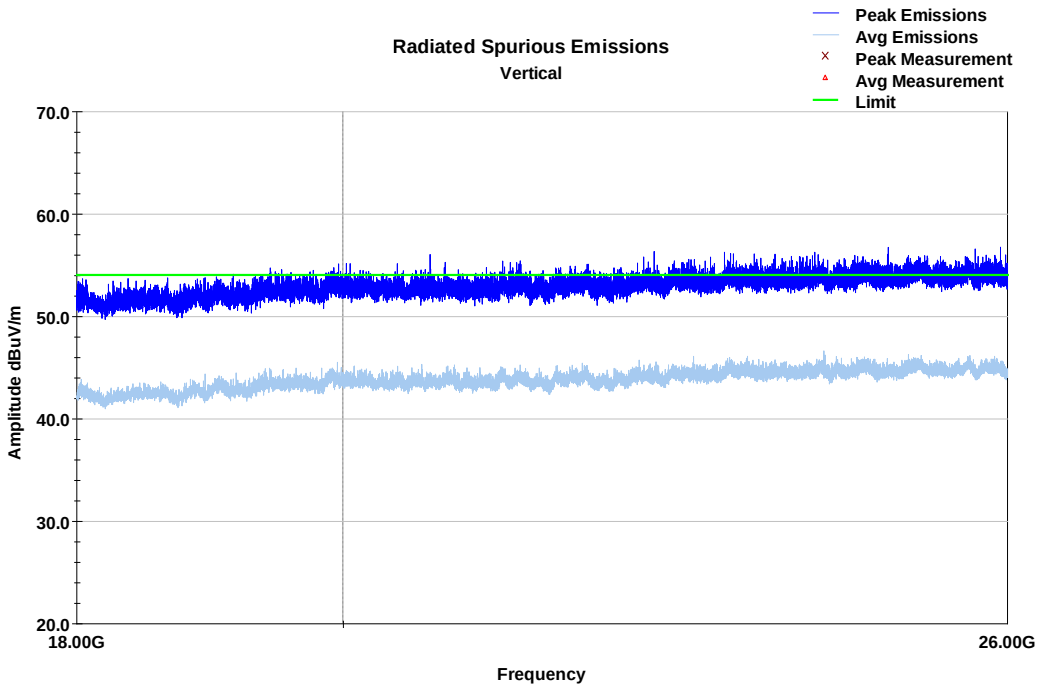
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.48	29.1	H	291.0	191.0	21.1	0.7	31.8	19.2	40.0	-20.8
772.81	25.5	H	157.0	200.0	21.6	3.8	33.3	17.7	46.0	-28.3
814.37	25.6	H	249.0	133.0	22.2	3.9	33.3	18.5	46.0	-27.6
849.73	25.5	H	317.0	175.0	22.6	4.0	33.3	18.9	46.0	-27.1
905.84	25.5	H	310.0	107.0	23.0	4.1	33.3	19.4	46.0	-26.6
957.68	25.6	H	102.0	111.0	23.4	4.3	33.3	20.1	46.0	-26.0
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

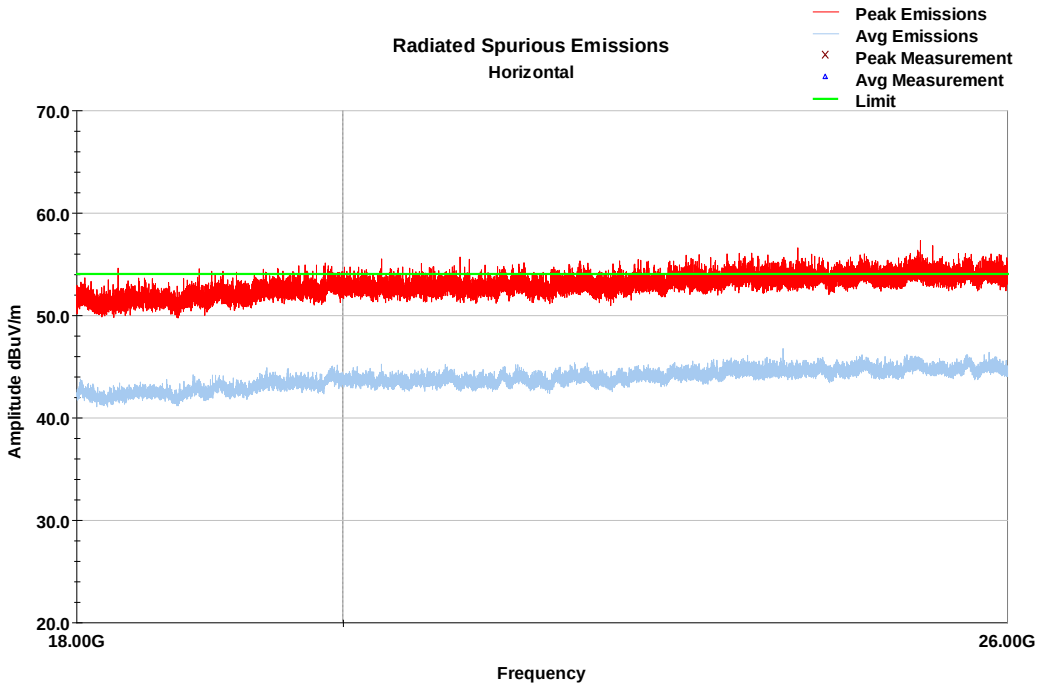
7.5.2 **1-18 GHz**


Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
10.00G
18.00G
Frequency


Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
10.00G
18.00G
Frequency

7.5.3 **18-25 GHz**


Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
18.00G
26.00G
Frequency


Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
18.00G
26.00G
Frequency

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 dBµV represent field strength measurements in dBµV/m.

Example calculations:
Offset = -20Log(D) + 104.8 - 107 + CL + DC + AG
Offset at 3m = -11.7 + CL + DC + AG

Where,

D = Distance, 3m
CL = Cable Loss
DC = Duty Cycle Correction Factor, which is 10*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.

BLE	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

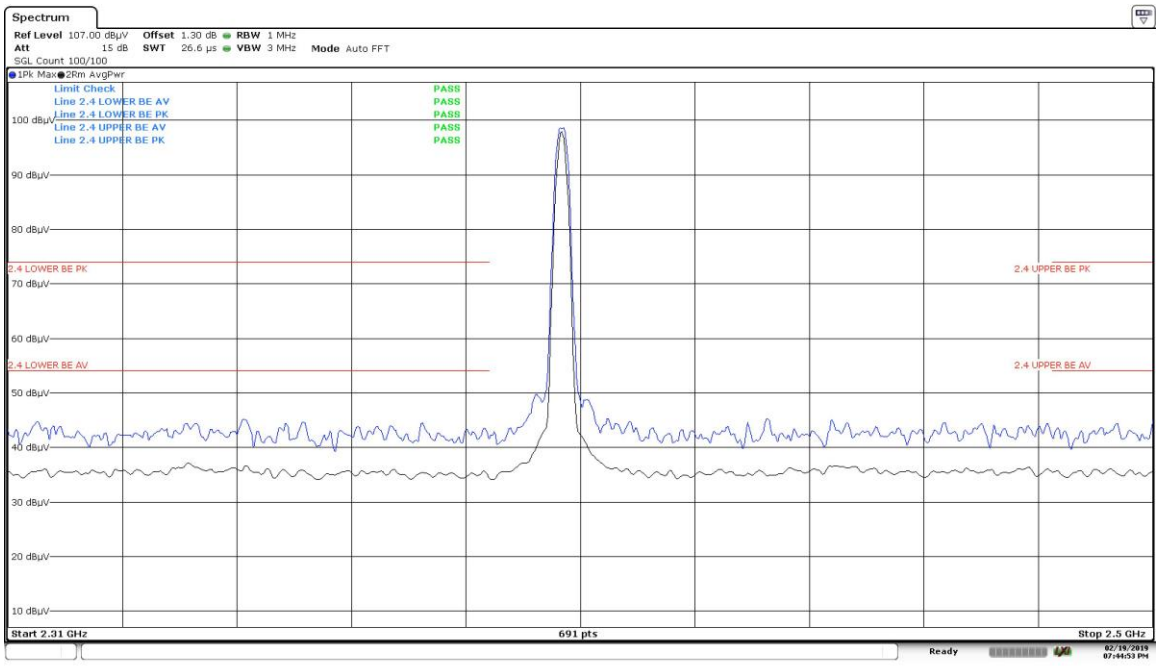
8.4 *Test Equipment*

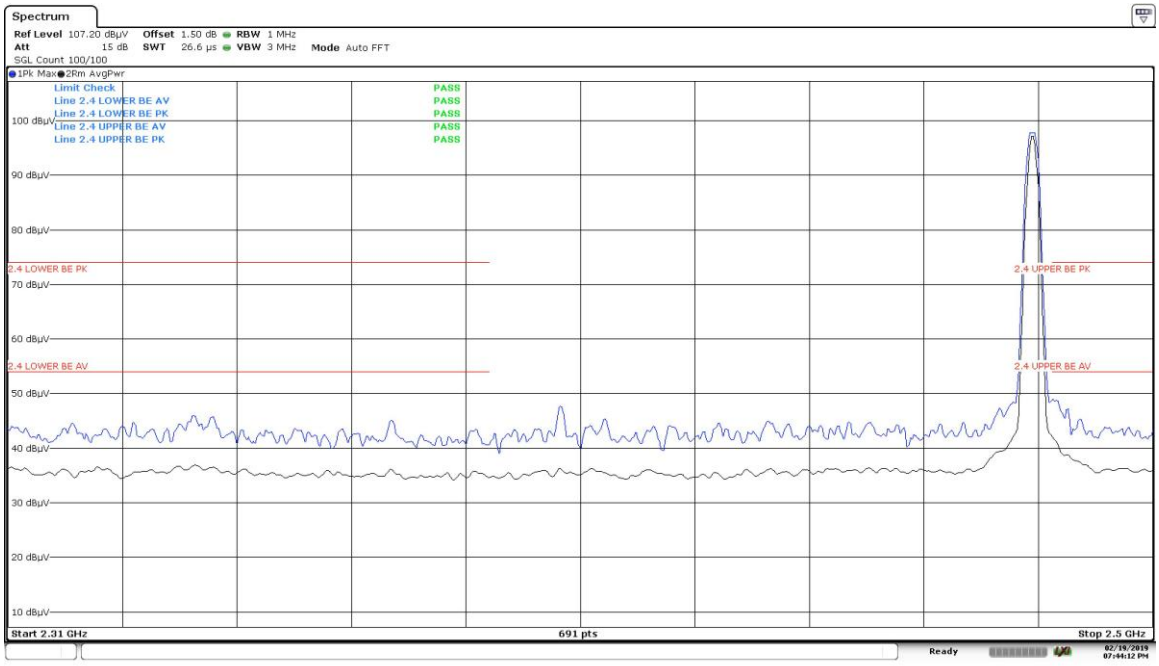
Test End Date: 19-Feb-2019 Tester: ASF

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*

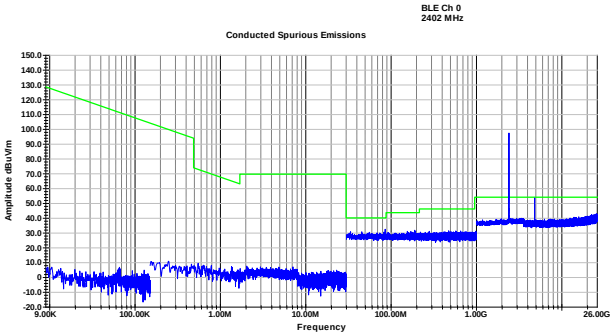


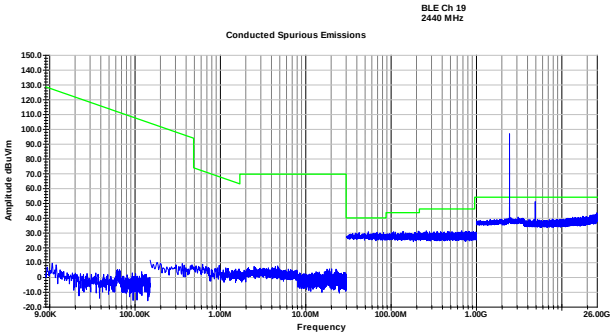


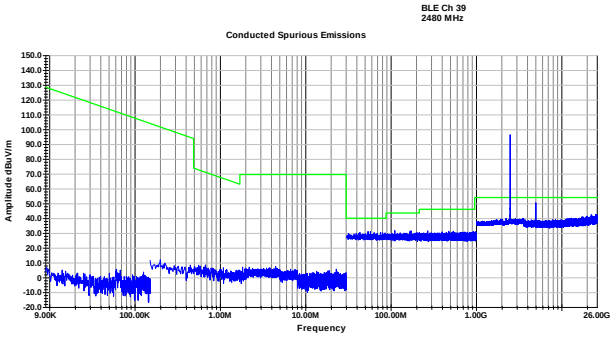
8.6 *Test Data – Conducted Spurious Emissions*

DUT Ch	DUT Freq MHz	Freq GHz	Avg Value dBuV/m	Ant Gain dBi	Final Value dBuV/m	Avg Limit dBuV/m	Margin dB
0	2402	4.804	50.89	0.33	51.22	54	-2.78
19	2440	4.880	47.91	1.59	49.50	54	-4.50
39	2480	4.960	47.43	2.2	49.63	54	-4.37

DUT Ch	DUT Freq MHz	Freq GHz	Pk Value dBuV/m	Ant Gain dBi	Final Value dBuV/m	Pk Limit dBuV/m	Margin dB
0	2402	4.804	53.45	0.33	53.78	74	-20.22
19	2440	4.880	50.13	1.59	51.72	74	-22.28
39	2480	4.959	49.65	2.2	51.85	74	-22.15







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

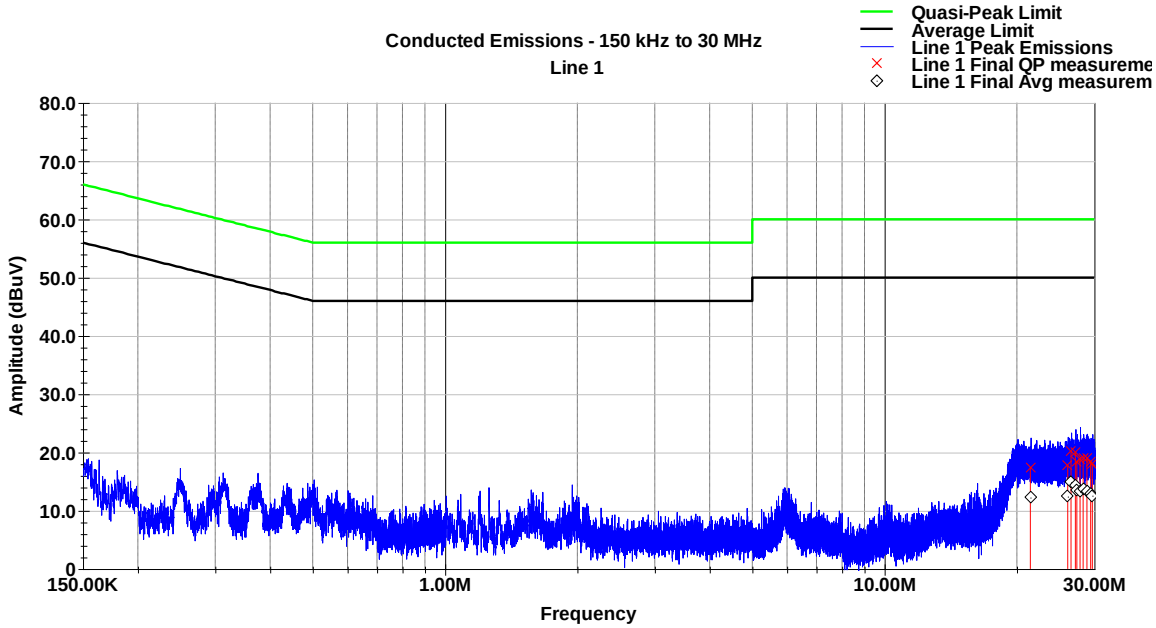
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	3-Dec-2019
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	24-Jul-2019
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	17-Aug-2019
CONDUCTED COMB GENERATOR	CGC-255	COM-POWER	B079696	CNR

Notes:

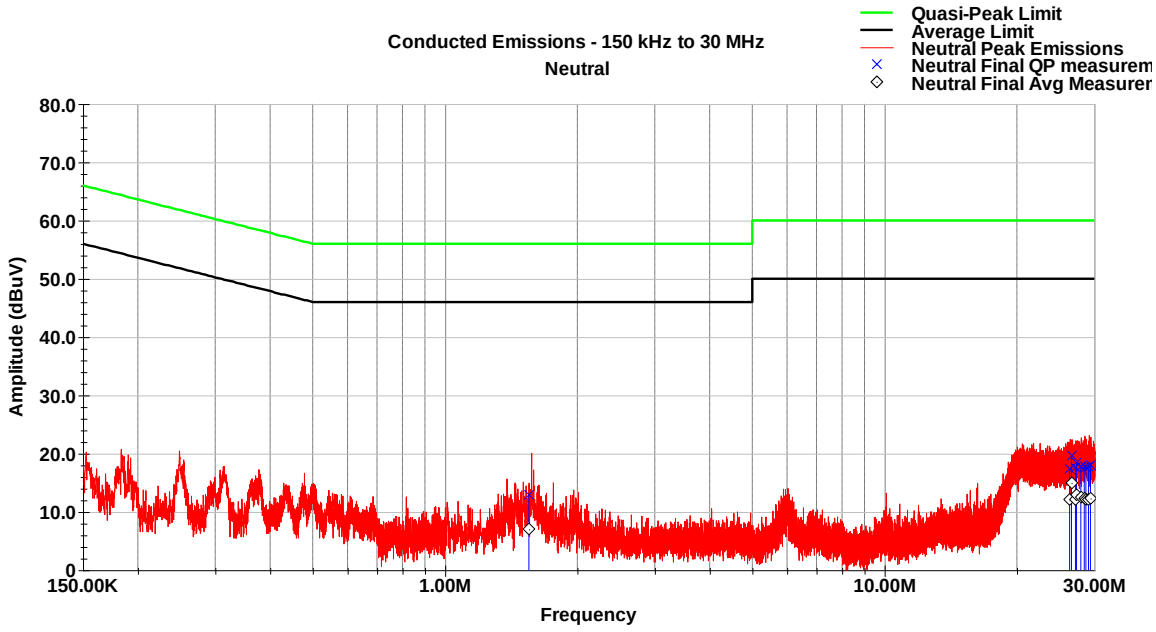
The calibration period equipment is 1 year.
CNR – Calibration Not Required

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
21.454	17.5	60.0	-42.5	12.3	50.0	-37.7
26.105	17.7	60.0	-42.3	12.4	50.0	-37.6
26.550	20.2	60.0	-39.8	14.9	50.0	-35.1
27.157	20.0	60.0	-40.0	14.3	50.0	-35.7
27.376	18.5	60.0	-41.5	13.6	50.0	-36.4
27.843	18.9	60.0	-41.1	13.3	50.0	-36.7
28.288	19.0	60.0	-41.0	13.7	50.0	-36.3
28.867	19.0	60.0	-41.0	13.4	50.0	-36.6
29.433	18.4	60.0	-41.6	12.9	50.0	-37.1
29.691	18.0	60.0	-42.0	12.6	50.0	-37.4



Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
1.551	13.0	56.0	-43.0	7.0	46.0	-39.0
26.360	17.5	60.0	-42.5	12.1	50.0	-37.9
26.613	19.6	60.0	-40.4	15.0	50.0	-35.0
27.180	17.7	60.0	-42.3	12.2	50.0	-37.8
27.339	18.4	60.0	-41.6	13.0	50.0	-37.0
27.948	17.8	60.0	-42.2	12.5	50.0	-37.5
28.463	17.9	60.0	-42.1	12.4	50.0	-37.6
28.701	17.6	60.0	-42.4	12.1	50.0	-37.9
29.102	17.7	60.0	-42.3	12.2	50.0	-37.8
29.405	17.9	60.0	-42.1	12.3	50.0	-37.7

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)).

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

11 Revision History

Revision Level	Description of changes	Revision Date
DRAFT	--	25 February 2019
0	Initial release	
1	Cover Page – Corrected RSS Gen ref to v5 Section 4.5 – Combined Power Tables. Section 7.2 – Corrected section cross reference error not saving in PDF version. Section 6.5 – Corrected section cross reference error. Section 9 – Removed Class B limit references.	1 April 2019