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FCC PART 15.247 & IC RSS-247

CLASS II PERMISSIVE CHANGE

2.4 GHz FHSS

TEST REPORT

| | | | |
|----------------------|--|--|--|
| Applicant | SILICON LABORATORIES FINLAND OY | | |
| Address | SINIKALLIONTE 5A ESPOO, FL-02630, FINLAND | | |
| FCC ID | QOQWT12 | | |
| IC | 5123A-BGTWT12A | | |
| Model Number | WT12 | | |
| Product Description | BLUETOOTH MODULE | | |
| Date Sample Received | 4/7/2016 | | |
| Final Test Date | 9/19/2016 | | |
| Tested By | Tim Royer | | |
| Approved By | Cory Leverett | | |

| Report Number | Version Number | Description | Issue Date |
|--------------------|----------------|----------------------|------------|
| 1849UT16TestReport | Rev1 | Initial Issue | 09/15/2016 |
| 1849UT16TestReport | Rev2 | Added Lower BE Plots | 09/21/2016 |

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.



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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:

- Fulfill the general approval requirements as identified in this test report
- Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Authorized Signatory Name:



Tested by: _____

Name and Title: Tim Royer, Project Manager/Testing Technician

Date: 9/19/2016



Reviewed and approved by: _____

Name and Title: Cory Leverett, Project Manager

Date: 09/21/2016

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GENERAL INFORMATION

EUT Specification

| | | | |
|----------------------|--|---|--|
| Regulatory Standards | FCC Title 47 CFR Part 15.247 IC RSS-247 Issue 1 & RSS-GEN Issue 4 | | |
| FCC ID | QOQWT12 | | |
| IC | 5123A-BGTWT12A | | |
| Model | WT12 | | |
| EUT Description | BLUETOOTH MODULE | | |
| BT Chipset Version | BT V2.1 + EDR with Adaptive Frequency Hopping only | | |
| Operating Frequency | TX: 2402 – 2480 MHz | RX: 2402 – 2480 MHz | |
| EUT Power Source | <input type="checkbox"/> 110–120Vac/50– 60Hz | | |
| | <input type="checkbox"/> DC Power | | |
| | <input checked="" type="checkbox"/> Battery Operated Exclusively | | |
| Test Item | <input type="checkbox"/> Prototype | <input type="checkbox"/> Pre-Production | <input checked="" type="checkbox"/> Production |
| Type of Equipment | <input type="checkbox"/> Fixed | <input type="checkbox"/> Mobile | <input checked="" type="checkbox"/> Portable |
| Antenna Connector | None | | |
| Antenna | Integral Chip Antenna | | |
| Test Conditions | Temperature: 24-26°C Relative humidity: 50-65% | | |
| Measurement Standard | ANSI C63.10-2013 (Test Procedures) ANSI C63.4-2009 (Radiated Site Validation) | | |
| Test Exercise | Engineering Software in the EUT was used to enable the modes of operation, 3DH5 Packet types were used for all tests | | |

Host Equipment

| Device | Manufacturer | Model | FCC ID/IC | Supplied By | Used For |
|----------------|--------------------------------|------------|-------------------------------|-------------|----------|
| Portable Radio | Relm Wireless Corp. – BK Radio | KNG2-P800C | K95KNGP800C 2116A-KNGP800C | RELM | Host |

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RESULTS SUMMARY

| FCC Rule Part No. | IC Standard Ref. | Requirement | Test Item | Result |
|-------------------|------------------|--------------------|-------------------|--------|
| 15.247(d) | RSS-247 § 5.5 | Unwanted Emissions | Bandedge | Pass |
| | | | Radiated Spurious | Pass |

Notes:

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BANDEDGE

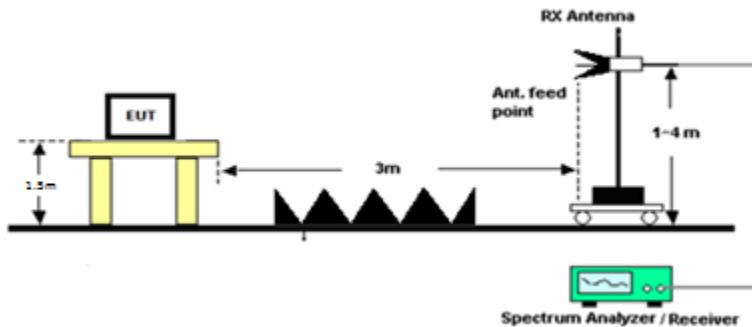
Rule Part No.: FCC 15.247(d) & 15.209, IC RSS 247 § 5.5 & RSS GEN § 8.9

Requirements: Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW, additionally adjacent restricted band edge emissions must comply with 15.209 and RSS-GEN 8.9 limits.

Test Method: ANSI C63.10 § 6.10.4 Authorized band-edge relative method

ANSI C63.10 § 6.10.6 Restricted band-edge marker delta method

Setup:



Notes:

The marker delta method of measurement technique used for adjacent restricted bandedges may be used for measuring emissions that are up to 2 MHz removed from the bandedge. Radiated emissions that are removed by more than 2 MHz from the bandedge must be measured in the conventional manner.

RESULTS: Meets Requirements

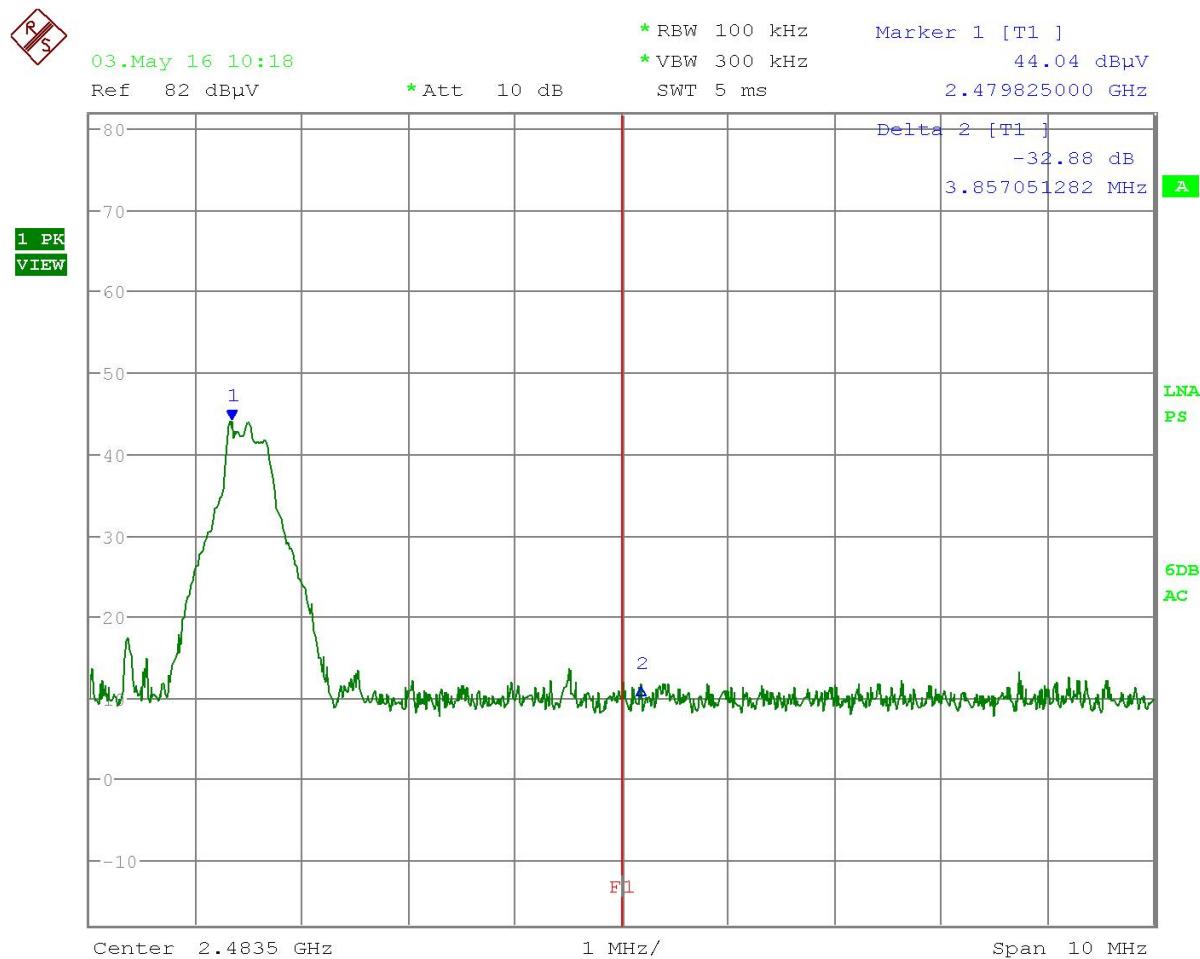
Applicant: SILICON LABORATORIES FINLAND OY
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BANDEDGE

Data: Horizontal 3DH5 Upper Restricted Band Edge Hopping Stopped

| Peak/ Average | Field Strength of Carrier (dBuV/m) | Emission Level Below Carrier (dB) | Field Strength of Emission (dBuV/m) | Emission Limit (dBuV/m) | Margin (dB) |
|------------------|---|---|--|-------------------------------|----------------|
| Peak | 80.96 | 32.88 | 48.08 | 74 | 25.92 |
| Average | 69.41 | 32.88 | 36.53 | 54 | 17.47 |



Date: 3.MAY.2016 10:18:32

RESULTS: Meets Requirements

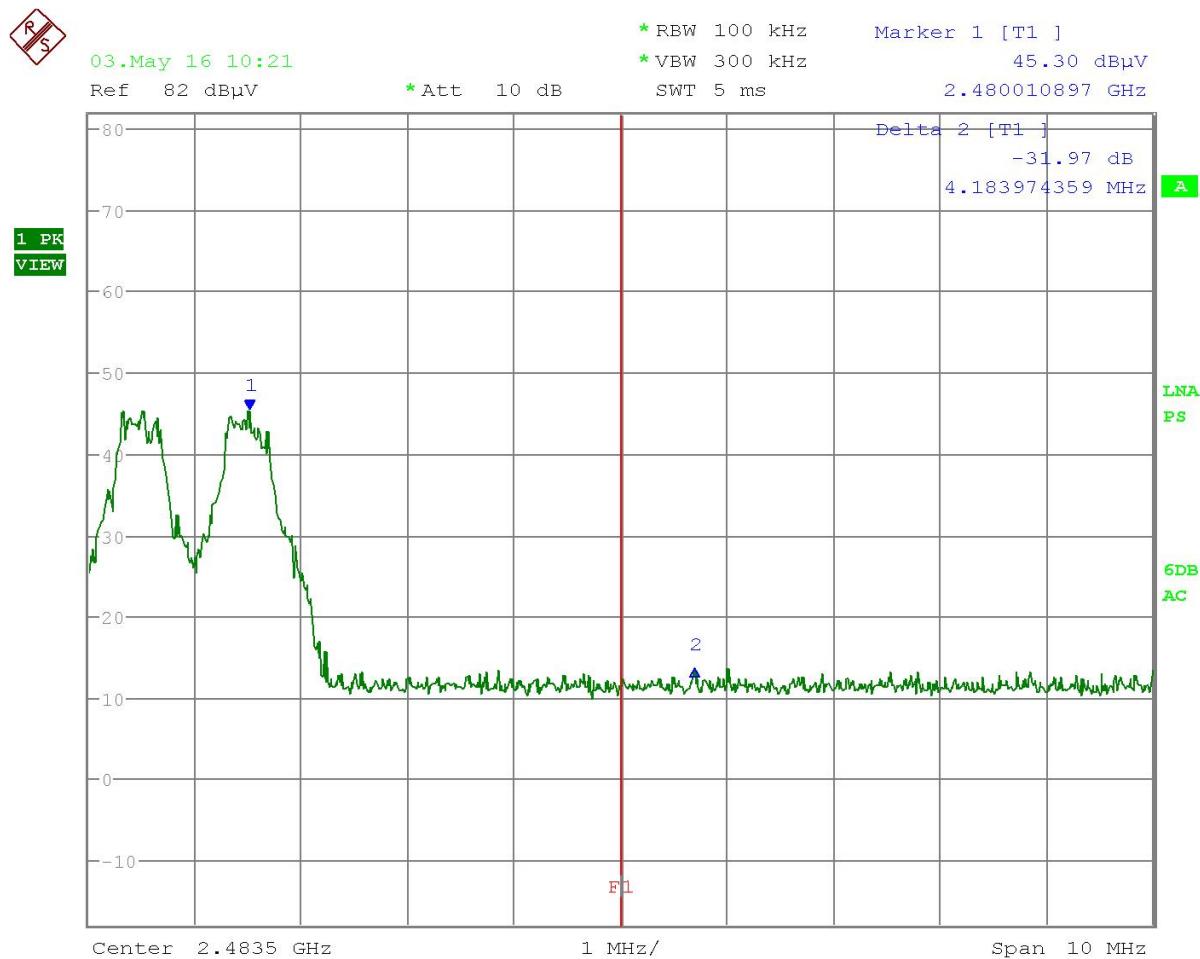
Applicant: SILICON LABORATORIES FINLAND OY
 FCC ID: QOQWT12
 IC: 5123A-BGTWT12A
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BANDEDGE

Data: Horizontal 3DH5 Upper Restricted Band Edge Hopping

| Peak/ Average | Field Strength of Carrier (dBuV/m) | Emission Level Below Carrier (dB) | Field Strength of Emission (dBuV/m) | Emission Limit (dBuV/m) | Margin (dB) |
|------------------|---|---|--|-------------------------------|----------------|
| Peak | 80.96 | 31.97 | 48.99 | 74 | 25.01 |
| Average | 69.41 | 31.97 | 37.5 | 54 | 16.5 |



Date: 3.MAY.2016 10:21:55

RESULTS: Meets Requirements

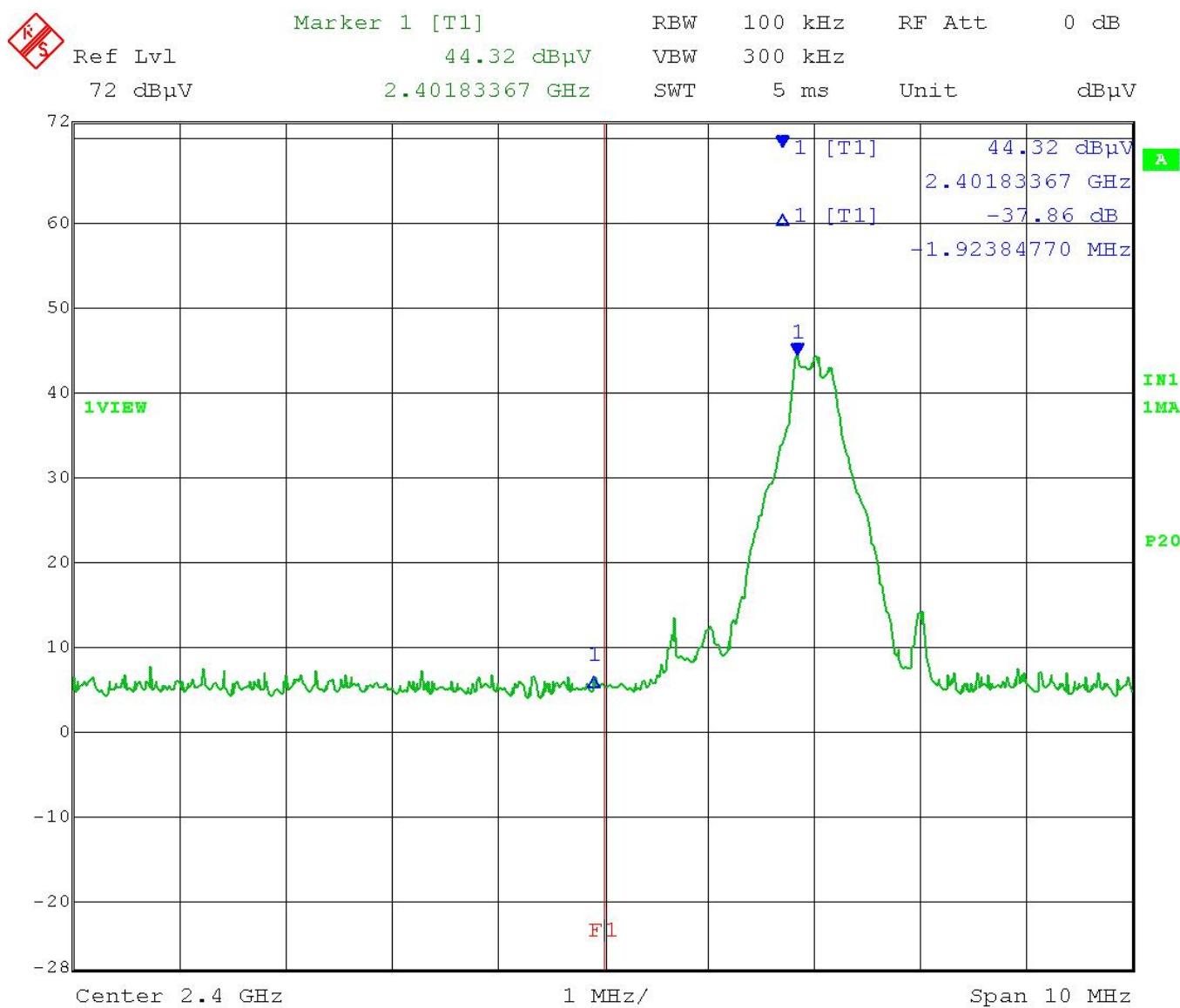
Applicant: SILICON LABORATORIES FINLAND OY
 FCC ID: QOQWT12
 IC: 5123A-BGTWT12A
 Report: 1849UT16TestReport_Rev2

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BANDEDGE

Data: Horizontal 3DH5 Lower Restricted Band Edge Hopping Stopped

| Peak/ Average | Field Strength of Carrier (dBuV/m) | Emission Level Below Carrier (dB) | Field Strength of Emission (dBuV/m) | Emission Limit (dBuV/m) | Margin (dB) |
|------------------|---|---|--|-------------------------------|----------------|
| 80.96 | 31.97 | 48.99 | 74 | 25.01 | 80.96 |
| 69.41 | 31.97 | 37.5 | 54 | 16.5 | 69.41 |



Date: 19.SEP.2016 09:33:47

Applicant: SILICON LABORATORIES FINLAND OY
 FCC ID: QOQWT12
 IC: 5123A-BGTWT12A
 Report: 1849UT16TestReport_Rev2

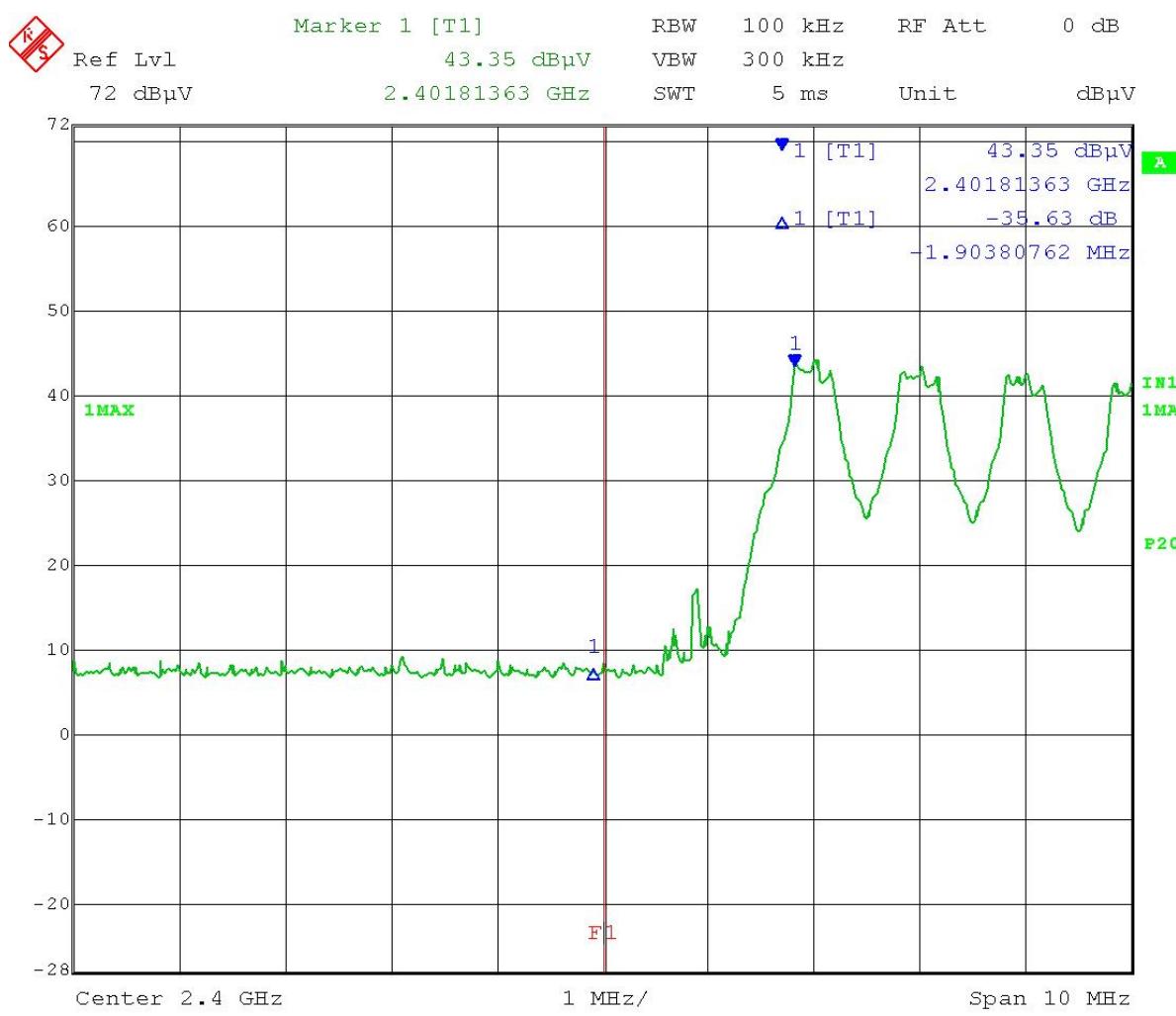
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BANDEDGE

Data: **Horizontal 3DH5 Lower Restricted Band Edge Hopping**

| Peak/ Average | Field Strength of Carrier (dBuV/m) | Emission Level Below Carrier (dB) | Field Strength of Emission (dBuV/m) | Emission Limit (dBuV/m) | Margin (dB) |
|------------------|---|---|--|-------------------------------|----------------|
| Peak | 80.96 | 31.97 | 48.99 | 74 | 25.01 |
| Average | 69.41 | 31.97 | 37.5 | 54 | 16.5 |



Date: 19.SEP.2016 10:05:27

Applicant: SILICON LABORATORIES FINLAND OY
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RADIATED SPURIOUS EMISSIONS

Rules Part No.: FCC part 15.247 (d) & 15.209, IC RSS 247 § 5.5 & RSS GEN § 8.9

Requirements: Emissions found in restricted bands the levels must comply with the general limits found in FCC part 15.209

| Frequency | Limits |
|---------------------------------|-------------------------------------|
| FCC Part 15.209, IC RSS-GEN 8.9 | |
| 9 to 490 kHz | 2400/F (kHz) μ V/m @ 300 meters |
| 490 to 1705 kHz | 24000/F (kHz) μ V/m @ 30 meters |
| 1705 kHz to 30 MHz | 29.54 dB μ V/m @ 30 meters |
| 30 – 88 | 40.0 dB μ V/m @ 3 meters |
| 80 – 216 | 43.5 dB μ V/m @ 3 meters |
| 216 – 960 | 46.0 dB μ V/m @ 3 meters |
| Above 960 | 54.0 dB μ V/m @ 3 meters |

Test Method: ANSI C63.4 § Annex D Validation of radiated emissions standard test sites
ANSI C63.10 § 6.3 Common requirements radiated emissions
ANSI C63.10 § 6.4 Emissions below 30 MHz
ANSI C63.10 § 6.5 Emissions between 30 & 1000 MHz
ANSI C63.10 § 6.6 Emissions above 1 GHz

Field Strength Calculation:

The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB μ V) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

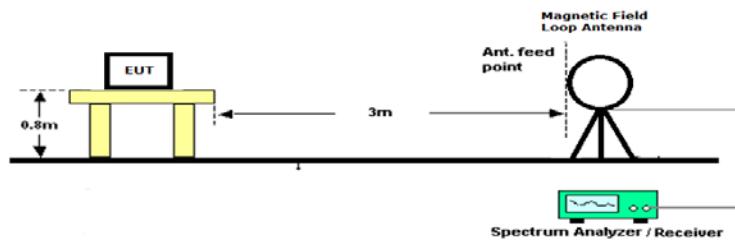
Example:

| | | | |
|------------|---------------|------------|---------------------------------|
| Freq (MHz) | Meter Reading | + ACF | + CL = FS |
| 33 | 20 dB μ V | + 10.36 dB | + 0.5 = 30.86 dB μ V/m @ 3m |

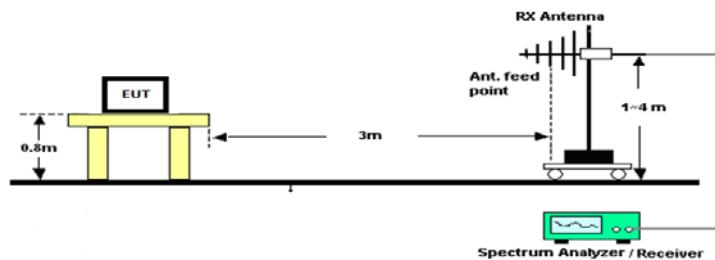
RADIATED SPURIOUS EMISSIONS

Setup:

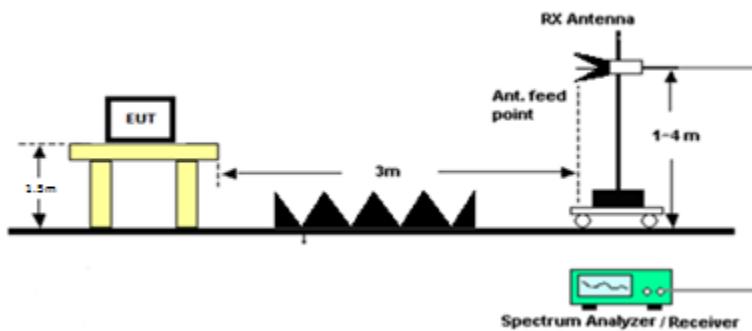
Emissions below 30 MHz



Emissions 30 – 1000 MHz



Emissions above 1 GHz



RADIATED SPURIOUS EMISSIONS

Notes: The EUT was checked in three orthogonal planes as required, a setup photo is provided to show the orientation of the worst case position.

Only the worst case data rate and Output Power which produced emissions within 20dB of the limit are reported.

The spectrum was measured from 9 KHz to 25 GHz

Test Data: **Restricted Band Emissions 3DH5 Field Strength at 3 Meters**

| Tuned Freq (MHz) | Emission Freq (MHz) | Detector Type (QP/PK/A V) | Meter Reading (dBuV) | Ant. Polarity (H/V) | Coax Loss (dB) | Correction Factor (dB/m) | Field Strength (dBuV/m) | Margin (dB) |
|------------------|---------------------|---------------------------|----------------------|---------------------|----------------|--------------------------|--------------------------|-------------|
| 2,402.00 | 4,804.00 | AV | 5.5 | V | 8.07 | 34 | 47.57 | 6.43 |
| 2,402.00 | 4,804.00 | PK | 8.13 | V | 8.07 | 34 | 50.2 | 23.8 |
| 2,402.00 | 12,010.00 | AV | -5 | V | 13.05 | 39.3 | 47.35 | 6.65 |
| 2,402.00 | 12,010.00 | PK | 5.3 | V | 13.05 | 39.3 | 57.65 | 16.35 |
| 2,441.00 | 4,882.00 | AV | 2.2 | V | 8.14 | 33.92 | 44.26 | 9.74 |
| 2,441.00 | 4,882.00 | PK | 3.9 | V | 8.14 | 33.92 | 45.96 | 28.04 |
| 2,441.00 | 7,323.00 | AV | 1.3 | V | 10 | 35.6 | 46.9 | 7.1 |
| 2,441.00 | 7,323.00 | PK | 2.55 | V | 10 | 35.6 | 48.15 | 25.85 |
| 2,441.00 | 12,205.00 | AV | -1.1 | V | 13.14 | 39.3 | 51.34 | 2.66 |
| 2,441.00 | 12,205.00 | PK | 4.58 | V | 13.14 | 39.3 | 57.02 | 16.98 |
| 2,480.00 | 4,960.00 | AV | 1.5 | H | 8.2 | 33.96 | 43.66 | 10.34 |
| 2,480.00 | 4,960.00 | PK | 2.25 | H | 8.2 | 33.96 | 44.41 | 29.59 |
| 2,480.00 | 7,440.00 | AV | 5 | H | 10.08 | 35.6 | 50.68 | 3.32 |
| 2,480.00 | 7,440.00 | PK | 6.65 | H | 10.08 | 35.6 | 52.33 | 21.67 |
| 2,480.00 | 12,400.00 | AV | -1.2 | V | 13.24 | 39.2 | 51.24 | 2.76 |
| 2,480.00 | 12,400.00 | PK | 0.04 | V | 13.24 | 39.20 | 52.48 | 21.52 |

Results Meet Requirements



EMC EQUIPMENT LIST

| Device | Manufacturer | Model | Serial Number | Cal/Char Date | Due Date |
|---|----------------------|-------------------------------|--|---------------|----------|
| Antenna: Biconical 1096 Chamber | Eaton | 94455-1 | 1096 | 07/14/15 | 07/14/17 |
| Antenna: Log-Periodic 1122 | Electro-Metrics | LPA-25 | 1122 | 07/14/15 | 07/14/17 |
| CHAMBER | Panashield | 3M | N/A | 04/25/16 | 12/31/17 |
| Antenna: Double-Ridged Horn/ETS Horn 2 | ETS-Lindgren Chamber | 3117 | 00041534 | 02/25/15 | 02/25/17 |
| Antenna: Double-Ridged Horn 18-40 GH | EMCO | 3116 | 9011-2145 | 11/18/15 | 11/18/17 |
| Software: Field Strength Program | Timco | N/A | Version 4.0 | NA | NA |
| Antenna: Active Loop | ETS-Lindgren | 6502 | 00062529 | 11/18/15 | 11/18/17 |
| EMI Test Receiver R & S ESU 40 Chamber | Rohde & Schwarz | ESU 40 | 100320 | 04/01/16 | 04/01/18 |
| Coaxial Cable - Chamber 3 cable set (Primary) | Micro-Coax | Chamber 3 cable set (Primary) | KMMK-0244-01; KMMK-0670-00; KFKF-0198-01 | 08/08/16 | 08/08/18 |
| Bore-sight Antenna Positioning Tower | Sunol Sciences | TLT2 | NA | NA | NA |
| High Pass Filter 18GHz | Micro-Tronics | HPS18771 | -002 | 05/13/16 | 05/13/18 |
| Band Reject Filter - 2.4 GHz | Micro-Tronics | BRM50702-02 | -G042 | 05/13/16 | 15/13/18 |
| Pre-amp | RF-LAMBDA | RLNA00M45GA | NA | 01/04/16 | 01/04/18 |

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

END OF TEST REPORT