



RADIO TEST REPORT

Test Report No. : 32IE0154-HO-01-E-R1

Applicant : silex technology, Inc.
Type of Equipment : SDIO Wireless Module
Model No. : SX-SDMAN
FCC ID : N6C-SDMAN
Test regulation : FCC Part 15 Subpart C: 2012
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
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5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This report is a revised version of 32IE0154-HO-01-E. 32IE0154-HO-01-E is replaced with this report.

Date of test: May 29 to June 22, 2012

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13-EM-F0429

| CONTENTS | PAGE |
|---|-------------|
| SECTION 1: Customer information..... | 3 |
| SECTION 2: Equipment under test (E.U.T.)..... | 3 |
| SECTION 3: Test specification, procedures & results..... | 5 |
| SECTION 4: Operation of E.U.T. during testing..... | 8 |
| SECTION 5: Conducted Emission..... | 10 |
| SECTION 6: Radiated Spurious Emission | 11 |
| SECTION 7: Antenna Terminal Conducted Tests..... | 12 |
| APPENDIX 1: Data of EMI test..... | 13 |
| Conducted Emission | 13 |
| 6dB Bandwidth | 15 |
| Maximum Peak Output Power | 16 |
| Radiated Spurious Emission | 17 |
| Conducted Spurious Emission | 22 |
| Conducted Emission Band Edge compliance | 28 |
| Power Density | 29 |
| 99% Occupied Bandwidth | 31 |
| APPENDIX 2: Test instruments | 32 |
| APPENDIX 3: Photographs of test setup..... | 34 |
| Conducted Emission | 34 |
| Radiated Spurious Emission | 35 |
| Worst Case Position..... | 36 |

SECTION 1: Customer information

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Contact Person : Toshiro Kometani

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : SDIO Wireless Module
Model No. : SX-SDMAN
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC3.3V
Receipt Date of Sample : April 11, 2012
Country of Mass-production : Japan
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

2.2 Product Description

Model No: SX-SDMAN (referred to as the EUT in this report) is the SDIO Wireless Module.

General Specification

Clock frequency(ies) in the system : 26MHz

Radio Specification

Radio Type : Transceiver
Method of Frequency Generation : Synthesizer
Power Supply (inner) : DC1.2V

Specification of Wireless LAN (IEEE802.11b/g/a/n-20/n-40)

| Type of radio | IEEE802.11b | IEEE802.11g | IEEE802.11a | IEEE802.11n (20 M band) | IEEE802.11n (40 M band) |
|------------------------|--|--|------------------------------------|---|--------------------------------------|
| Frequency of operation | 2412-2462MHz | 2412-2462MHz | 5180-5320MHz *1) 5745-5825MHz | 2412 - 2462MHz 5180-5320MHz *1) 5745-5825MHz | 5190 - 5310MHz *2) 5755 - 5795MHz |
| Type of modulation | DSSS (CCK, DQPSK, DBPSK) | OFDM-CCK (64QAM, 16QAM, QPSK, BPSK) | OFDM (64QAM, 16QAM, QPSK, BPSK) | | |
| Channel spacing | 5MHz | | 20MHz | <u>2.4GHz band</u> 5MHz <u>5GHz band</u> 20MHz | 40MHz |
| Antenna type | Sleeve antenna: Sansei Embedded antenna: Ethertronics | | | | |
| Antenna Gain | Sleeve antenna: 1.0dBi (2.4GHz including cableloss 0.5dB), 1.1dBi (5GHz including cableloss 1.0dB) Embedded antenna: 2.0dBi (2.4GHz including cableloss 0.5dB), 2.5dBi (5GHz including cableloss 1.0dB) | | | | |
| Antenna Connector type | U.FL connector | | | | |

*1) 5180 - 5320MHz is applied for other test report.(Test Report No.: 32IE0154-HO-01-C)

*2) 5190 - 5310MHz is applied for other test report.(Test Report No.: 32IE0154-HO-01-C)

Specification of Bluetooth (Ver.4.0 + EDR)

| Type of radio | Bluetooth |
|------------------------|---|
| Frequency of Operation | 2402-2480MHz |
| Type of Modulation | FHSS |
| Channel spacing | 1MHz |
| Antenna type | Embedded antenna: Ethertronics |
| Antenna Gain | 2.0dBi (2.4GHz including cableloss 0.5dB), 2.5dBi (5GHz including cableloss 1.0dB) |
| Antenna Connector Type | U.FL Alternative connector |

Specification of Low Energy (Ver.4.0 + EDR/LE Dual mode)

| Type of radio | Low Energy |
|------------------------|---|
| Frequency of Operation | 2402-2480MHz |
| Type of Modulation | DSSS |
| Channel spacing | 2MHz |
| Antenna type | Embedded antenna: Ethertronics |
| Antenna Gain | 2.0dBi (2.4GHz including cableloss 0.5dB), 2.5dBi (5GHz including cableloss 1.0dB) |
| Antenna Connector Type | U.FL Alternative connector |

*This test report applies for Low Energy (Ver.4.0 + EDR/LE Dual mode).

Wireless LAN and Bluetooth do not transmit simultaneously.

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2012, final revised on May 17, 2012 and effective June 18, 2012

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

*The revision on May 17, 2012 does not affect the test specification applied to the EUT.

3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|--|---|--|----------|------------------------|
| Conducted Emission | FCC: ANSI C63.4:2003 7. AC powerline Conducted Emission measurements ----- IC: RSS-Gen 7.2.4 | FCC: Section 15.207 ----- IC: RSS-Gen 7.2.4 | QP 29.6dB, 0.15000MHz, N AV 37.1dB, 1.00000MHz, N | Complied | - |
| 6dB Bandwidth | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.6.2 | FCC: Section 15.247(a)(2) ----- IC: RSS-210 A8.2(a) | See data. | Complied | Conducted |
| Maximum Peak Output Power | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.8 | FCC: Section 15.247(b)(3) ----- IC: RSS-210 A8.4(4) | | Complied | Conducted |
| Power Density | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: - | FCC: Section 15.247 (e) ----- IC: RSS-210 A8.2(b) | | Complied | Conducted |
| Spurious Emission Restricted Band Edges | FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.9 | FCC: Section15.247(d) ----- IC: RSS-210 A8.5 RSS-Gen 7.2.3 | 10.2dB 2483.500MHz, AV, Horizontal | Complied | Conducted/ Radiated |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

FCC 15.31 (e)

The RF Module has own regulator.

The RF Module is constantly provided voltage through own regulator regardless of input voltage (DC3.3V).

Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT has a unique antenna connector.

Therefore the equipment complies with the requirement of 15.203/212.

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3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|------------------------|-------------------|-------------------|--------------|---------|-----------|
| 99% Occupied Bandwidth | IC: RSS-Gen 4.6.1 | IC: RSS-Gen 4.6.1 | N/A | - | Conducted |

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

| Test room (semi-anechoic chamber) | Conducted emission (+dB) |
|--------------------------------------|-----------------------------|
| | 150kHz-30MHz |
| No.1 | 3.5dB |
| No.2 | 3.6dB |
| No.3 | 3.6dB |
| No.4 | 3.6dB |

| Test room (semi-anechoic chamber) | Radiated emission (10m*)(+dB) | | |
|--------------------------------------|----------------------------------|------------------|-----------------|
| | 9kHz -30MHz | 30MHz -300MHz | 300MHz -1GHz |
| No.1 | 4.1dB | 5.0dB | 4.8dB |
| No.2 | - | - | - |
| No.3 | - | - | - |
| No.4 | - | - | - |

*10m = Measurement distance

| Test room (semi-anechoic chamber) | Radiated emission | | | | | | |
|--------------------------------------|-------------------|------------------|-----------------|----------------|-----------------|-------------------|-------------------|
| | (3m*)(+dB) | | | | (1m*)(+dB) | | (0.5m*)(+dB) |
| | 9kHz -30MHz | 30MHz -300MHz | 300MHz -1GHz | 1GHz -10GHz | 10GHz -18GHz | 18GHz -26.5GHz | 26.5GHz -40GHz |
| No.1 | 4.2dB | 5.0dB | 5.1dB | 4.7dB | 5.7dB | 4.4dB | 4.3dB |
| No.2 | 4.1dB | 5.2dB | 5.1dB | 4.8dB | 5.6dB | 4.3dB | 4.2dB |
| No.3 | 4.5dB | 5.0dB | 5.2dB | 4.8dB | 5.6dB | 4.5dB | 4.2dB |
| No.4 | 4.7dB | 5.2dB | 5.2dB | 4.8dB | 5.6dB | 5.1dB | 4.2dB |

*3m/1m/0.5m = Measurement distance

| Power meter (+dB) | |
|-------------------|------------|
| Below 1GHz | Above 1GHz |
| 1.0dB | 1.0dB |

| Antenna terminal conducted emission and Power density (+dB) | | | Antenna terminal conducted emission (+dB) | | Channel power (+dB) |
|---|-----------|------------|---|---------------|---------------------|
| Below 1GHz | 1GHz-3GHz | 3GHz-18GHz | 18GHz-26.5GHz | 26.5GHz-40GHz | |
| 1.0dB | 1.1dB | 2.7dB | 3.2dB | 3.3dB | 1.5dB |

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test(3m and 10m)

The data listed in this test report has enough margin, more than the site margin.

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3.5 Test Location

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| | FCC Registration Number | IC Registration Number | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms |
|----------------------------|-------------------------|------------------------|----------------------------|--|------------------------|
| No.1 semi-anechoic chamber | 313583 | 2973C-1 | 19.2 x 11.2 x 7.7m | 7.0 x 6.0m | No.1 Power source room |
| No.2 semi-anechoic chamber | 655103 | 2973C-2 | 7.5 x 5.8 x 5.2m | 4.0 x 4.0m | - |
| No.3 semi-anechoic chamber | 148738 | 2973C-3 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.3 Preparation room |
| No.3 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.4 semi-anechoic chamber | 134570 | 2973C-4 | 12.0 x 8.5 x 5.9m | 6.8 x 5.75m | No.4 Preparation room |
| No.4 shielded room | - | - | 4.0 x 6.0 x 2.7m | N/A | - |
| No.5 semi-anechoic chamber | - | - | 6.0 x 6.0 x 3.9m | 6.0 x 6.0m | - |
| No.6 shielded room | - | - | 4.0 x 4.5 x 2.7m | 4.75 x 5.4 m | - |
| No.6 measurement room | - | - | 4.75 x 5.4 x 3.0m | 4.75 x 4.15 m | - |
| No.7 shielded room | - | - | 4.7 x 7.5 x 2.7m | 4.7 x 7.5m | - |
| No.8 measurement room | - | - | 3.1 x 5.0 x 2.7m | N/A | - |
| No.9 measurement room | - | - | 8.0 x 4.5 x 2.8m | 2.0 x 2.0m | - |
| No.10 measurement room | - | - | 2.6 x 2.8 x 2.5m | 2.4 x 2.4m | - |
| No.11 measurement room | - | - | 3.1 x 3.4 x 3.0m | 2.4 x 3.4m | - |

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

| Mode | Remarks* |
|---|--------------------------|
| Bluetooth(BT) LE(Low Energy) | Maximum Packet Size, PN9 |
| <p>*EUT has the power settings by the software as follows; Power settings: 10 dBm (Maximum) Software: BtUART Version 2.0 (Atheros Communications, Inc.)</p> <p>*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p> | |

*The details of Operating mode(s)

| Test Item | Operating Mode | Tested frequency |
|---------------------------|-----------------------|-------------------------|
| Conducted Emission | BT LE | 2402MHz |
| Spurious Emission | | 2440MHz |
| 6dB Bandwidth | | 2480MHz |
| Maximum Peak Output Power | | |
| Power Density | | |
| 99% Occupied Bandwidth | | |

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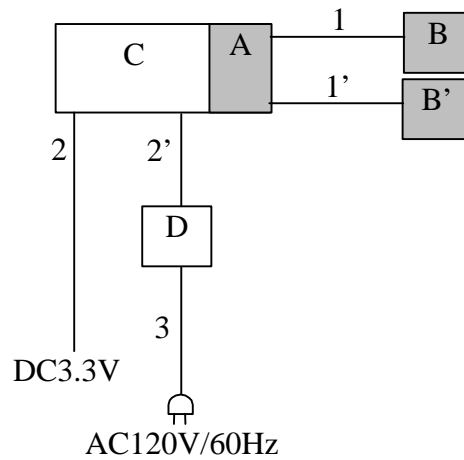
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4.2 Configuration and peripherals



- * Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
- * Output to Antenna B' is not possible. This antenna was attached to EUT as a dummy load just for testing purpose.

Description of EUT

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|----------------------|--------------|---------------|---------------------------|---------|
| A | SDIO Wireless Module | SX-SDMAN | 003C7FF0F00A | silex technology, Inc. | EUT |
| B | Embedded Antenna | 1000418 | 001 | Ethertronics | EUT |
| B' | Embedded Antenna | 1000418 | 002 | Ethertronics | EUT |
| C | Jig Board | - | - | silex technology, Inc. | - |
| D | DC Power Supply | PMC35-2A | 13090501 | KIKUSUI ELECTRONICS CORP. | *1) |

List of cables used

| No. | Name | Length (m) | Shield | | Remarks |
|-----|---------------|------------|------------|------------|---------|
| | | | Cable | Connector | |
| 1 | Antenna Cable | 0.1 | Shielded | Shielded | - |
| 1' | Antenna Cable | 0.1 | Shielded | Shielded | - |
| 2 | DC Cable | 1.5 | Unshielded | Unshielded | - |
| 2' | DC Cable | 1.5 | Unshielded | Unshielded | *1) |
| 3 | AC Cable | 1.8 | Unshielded | Unshielded | *1) |

*1) Used for Conducted Emission test only

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, raised 0.8m above the conducting ground plane.

The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. All unused 50ohm connectors of the LISN(AMN) were resistivity terminated in 50ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

| | |
|--------------------------|---------------------|
| Detector | : QP and AV |
| Measurement range | : 0.15-30MHz |
| Test data | : APPENDIX |
| Test result | : Pass |

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SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "2. Radiated emission test" of "Guidance on Measurement of Digital Transmission Systems Operating under Section 15.247".

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

The height of the measuring antenna varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

| | | | |
|--------------|-----------------|----------------|------------|
| Frequency | 30MHz to 300MHz | 300MHz to 1GHz | Above 1GHz |
| Antenna Type | Biconical | Logperiodic | Horn |

In any 100kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20dBc was applied to the frequency over the limit of FCC 15.209 / Table 5 of RSS-Gen 7.2.5(IC) and outside the restricted band of FCC15.205 / Table 3 of RSS-Gen 7.2.2 (IC).

| | | | | |
|-----------------|----------------|--|----------------------------|--|
| Frequency | Below 1GHz | Above 1GHz | | 20dBc |
| Instrument used | Test Receiver | Spectrum Analyzer | | Spectrum Analyzer |
| Detector | QP | PK | AV | PK |
| IF Bandwidth | BW 120kHz(T/R) | RBW: 1MHz VBW: 3MHz | RBW: 1MHz VBW: 3kHz *1) | RBW: 100kHz VBW: 300kHz (S/A) |
| Test Distance | 3m | 3m (below 10GHz), 1m*2) (above 10GHz) | | 3m (below 10GHz), 1m*2) (above 10GHz) |

*1) Used for the band edge of the carrier and the harmonics that can be measured.

VBW is set to 3kHz for LE due to 1/Tx on. (See Appendix)

*2) Distance Factor: $20 \times \log(3.0m/1.0m) = 9.5dB$

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of Module, Antenna to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 30M-26.5GHz
Test data : APPENDIX
Test result : Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

| Test | Span | RBW | VBW | Sweep time | Detector | Trace | Instrument used |
|---------------------------------|--|-----------------|--------------------|-------------------|-----------------|--------------|--------------------------------|
| 6dB Bandwidth | 3MHz | 100kHz | 300kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99% Occupied Bandwidth | Enough width to display 20dB Bandwidth | 1 to 3% of Span | Three times of RBW | Auto | Peak | Max Hold | Spectrum Analyzer |
| Maximum Peak Output Power | - | - | - | Auto | Peak | - | Power Meter (Sensor: 50MHz BW) |
| Peak Power Density | 1.5MHz | 3kHz | 10kHz | 500sec | Peak | Max Hold | Spectrum Analyzer *1) |
| Conducted Spurious Emission *2) | 9kHz to 150kHz | 200Hz | 620Hz | Auto | Peak | Max Hold | Spectrum Analyzer |
| | 150kHz to 30MHz | 9.1kHz | 27kHz | | | | |
| | 30MHz to 25GHz (Less or equal to 5GHz) | 100kHz | 300kHz | | | | |

*1) PSD Option 1 of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".
*2) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=9.1kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Data of EMI test

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

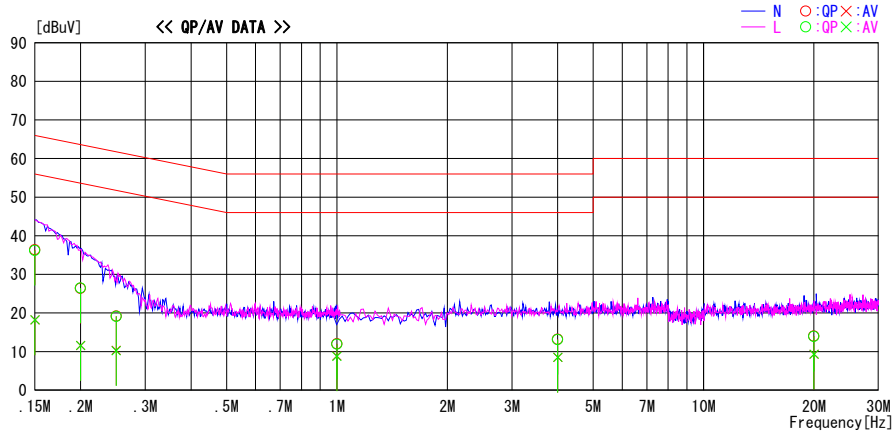
UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/06/22

Report No. : 32IE0154-HO-01

Temp./Humi. : 23 deg. C / 58% RH
Engineer : Takeshi Ghoda

Mode / Remarks : BT Tx LE 2402MHz

LIMIT : FCC15.207 QP
FCC15.207 AV



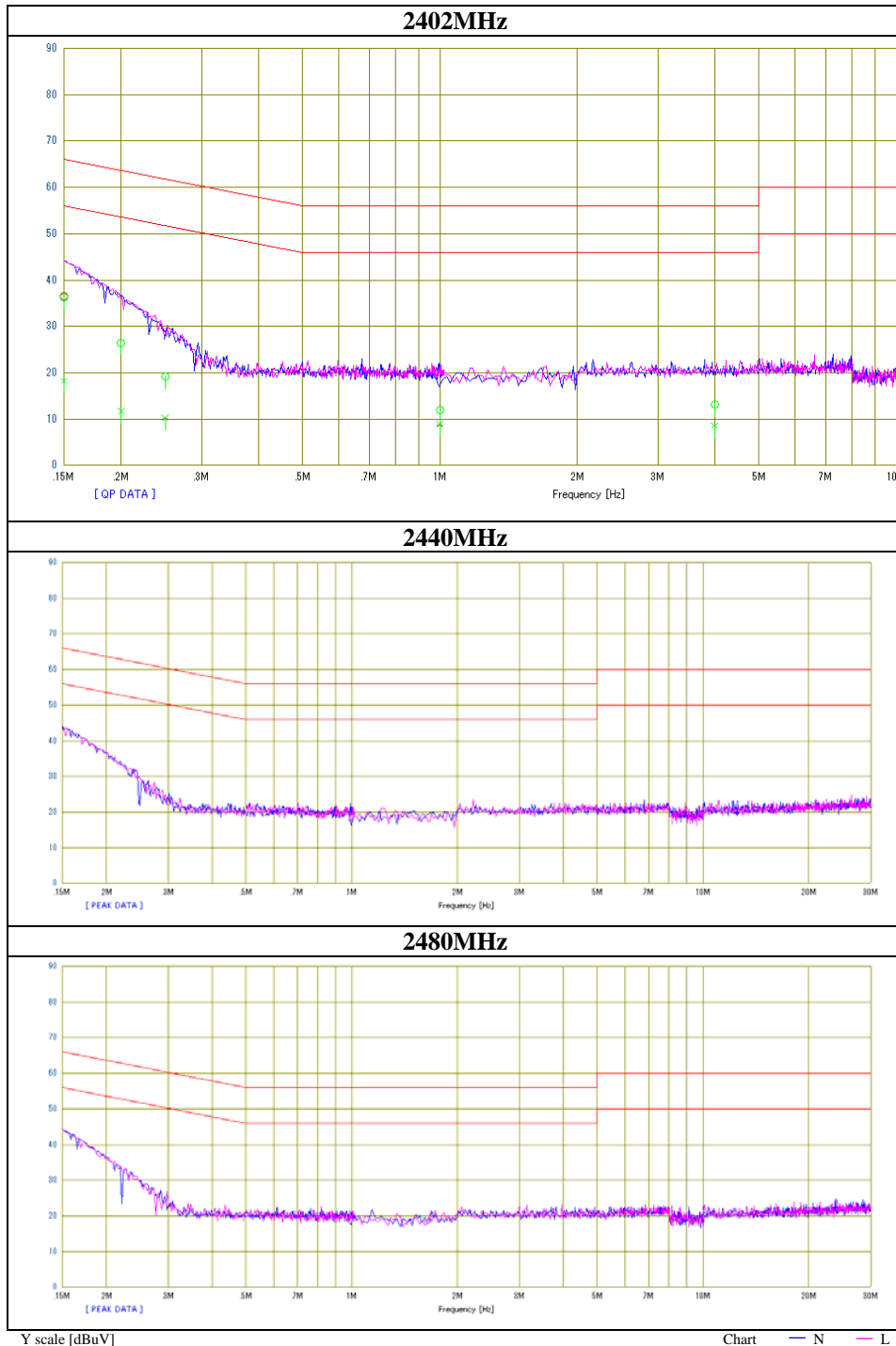
| Frequency [MHz] | Reading Level | | Corr. Factor [dB] | Results | | Limit | | Margin | | Phase | Comment |
|--------------------|---------------|--------------|-------------------------|--------------|--------------|--------------|--------------|------------|------------|-------|---------|
| | QP [dBuV] | AV [dBuV] | | QP [dBuV] | AV [dBuV] | QP [dBuV] | AV [dBuV] | QP [dB] | AV [dB] | | |
| 0.15000 | 23.1 | 4.9 | 13.3 | 36.4 | 18.2 | 66.0 | 56.0 | 29.6 | 37.8 | N | |
| 0.20000 | 13.1 | -1.7 | 13.3 | 26.4 | 11.6 | 63.6 | 53.6 | 37.2 | 42.0 | N | |
| 0.25000 | 5.9 | -3.0 | 13.3 | 19.2 | 10.3 | 61.8 | 51.8 | 42.6 | 41.5 | N | |
| 1.00000 | -1.4 | -4.5 | 13.4 | 12.0 | 8.9 | 56.0 | 46.0 | 44.0 | 37.1 | N | |
| 4.00000 | -0.4 | -5.1 | 13.6 | 13.2 | 8.5 | 56.0 | 46.0 | 42.8 | 37.5 | N | |
| 20.00000 | -0.8 | -5.5 | 14.8 | 14.0 | 9.3 | 60.0 | 50.0 | 46.0 | 40.7 | N | |
| 0.15000 | 22.9 | 4.9 | 13.3 | 36.2 | 18.2 | 66.0 | 56.0 | 29.8 | 37.8 | L | |
| 0.20000 | 13.2 | -1.7 | 13.3 | 26.5 | 11.6 | 63.6 | 53.6 | 37.1 | 42.0 | L | |
| 0.25000 | 5.8 | -3.1 | 13.3 | 19.1 | 10.2 | 61.8 | 51.8 | 42.7 | 41.6 | L | |
| 1.00000 | -1.5 | -4.6 | 13.4 | 11.9 | 8.8 | 56.0 | 46.0 | 44.1 | 37.2 | L | |
| 4.00000 | -0.5 | -5.1 | 13.6 | 13.1 | 8.5 | 56.0 | 46.0 | 42.9 | 37.5 | L | |
| 20.00000 | -0.9 | -5.5 | 14.8 | 13.9 | 9.3 | 60.0 | 50.0 | 46.1 | 40.7 | L | |

CHART: WITH FACTOR, Peak hold data. CALCULATION: RESULT=READING+C.F (LISN LOSS+ATT LOSS +CABLE LOSS)
Except for the above table : adequate margin data below the limits.

*The limit is rounded down to one decimal place.
*The test result is rounded off to one or two decimal places, so some differences might be observed.

Conducted Emission

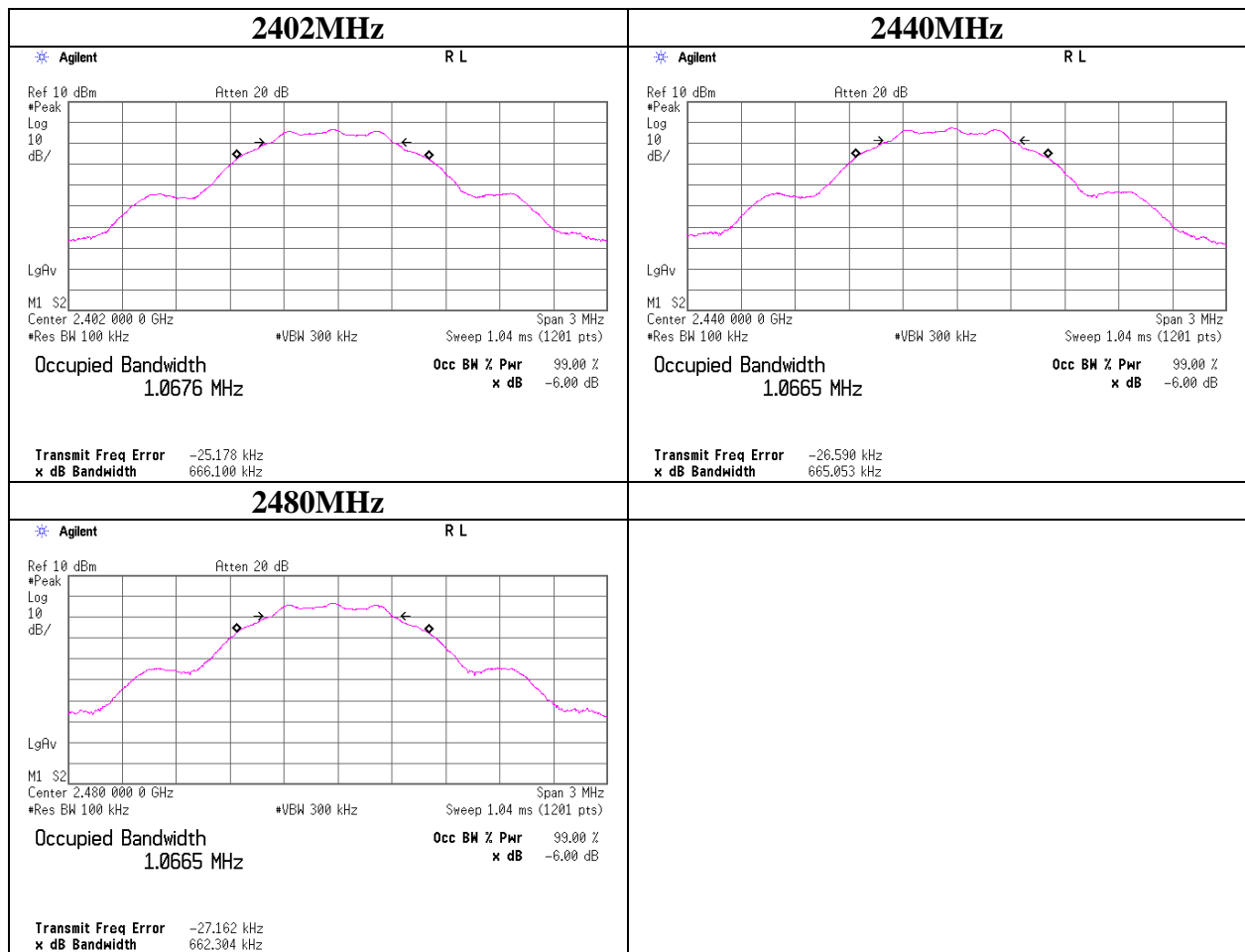
| | |
|-----------------------|---|
| Test place | Head Office EMC Lab. No.4 Semi Anechoic Chamber |
| Report No. | 32IE0154-HO-01 |
| Date | 06/22/2012 |
| Temperature/ Humidity | 23 deg. C / 58% RH |
| Engineer | Takeshi Choda |
| Mode | Tx Bluetooth Low Energy(Advertising Mode) |



6dB Bandwidth

| | |
|-----------------------|--|
| Test place | Head Office EMC Lab. No.4 Measurement Room |
| Report No. | 32IE0154-HO-01 |
| Date | 05/29/2012 |
| Temperature/ Humidity | 23deg. C / 51% RH |
| Engineer | Yutaka Yoshida |
| Mode | Tx Bluetooth Low Energy |

| Frequency [MHz] | 6dB Bandwidth [kHz] | Limit [kHz] |
|--------------------|------------------------|----------------|
| 2402 | 666.100 | >500 |
| 2440 | 665.053 | >500 |
| 2480 | 662.304 | >500 |



Maximum Peak Output Power

Test place Head Office EMC Lab. No.4 Measurement Room
Report No. 32IE0154-HO-01
Date 05/29/2012
Temperature/ Humidity 23deg. C / 51% RH
Engineer Yutaka Yoshida
Mode Tx Bluetooth Low Energy

| Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result | | Limit | | Margin [dB] |
|----------------|------------------|-----------------------|----------------|--------|------|-------|------|----------------|
| | | | | [dBm] | [mW] | [dBm] | [mW] | |
| 2402 | -3.35 | 2.03 | 9.96 | 8.64 | 7.31 | 30.00 | 1000 | 21.36 |
| 2440 | -2.65 | 2.05 | 9.96 | 9.36 | 8.63 | 30.00 | 1000 | 20.64 |
| 2480 | -3.27 | 2.06 | 9.96 | 8.75 | 7.50 | 30.00 | 1000 | 21.25 |

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

Radiated Spurious Emission

Test place : Head Office EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 32IE0154-HO-01
Date : 06/21/2012
Temperature/ Humidity : 24deg. C / 64% RH
Engineer : Tomotaka Sasagawa
Mode : Bluetooth Low Energy Tx 2402MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|----------------------|
| Hori | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Hori | 2390.000 | PK | 52.2 | 27.4 | 2.2 | 34.8 | 47.0 | 73.9 | 26.9 | See 20dBc Data Sheet |
| Hori | 2400.000 | PK | 68.4 | 27.5 | 2.2 | 34.8 | - | 73.9 | - | |
| Hori | 4804.000 | PK | 47.2 | 31.2 | 4.9 | 34.0 | 49.3 | 73.9 | 24.6 | |
| Hori | 7206.000 | PK | 44.3 | 35.9 | 6.0 | 34.2 | 52.0 | 73.9 | 21.9 | |
| Hori | 9608.000 | PK | 44.5 | 38.8 | 6.8 | 34.7 | 55.4 | 73.9 | 18.5 | |
| Hori | 24020.000 | PK | 45.2 | 40.5 | -1.7 | 31.7 | 52.3 | 73.9 | 21.6 | |
| Hori | 2390.000 | AV | 40.4 | 27.4 | 2.2 | 34.8 | 35.2 | 53.9 | 18.7 | See 20dBc Data Sheet |
| Hori | 2400.000 | AV | 52.5 | 27.5 | 2.2 | 34.8 | - | 53.9 | - | |
| Hori | 4804.000 | AV | 40.2 | 31.2 | 4.9 | 34.0 | 42.3 | 53.9 | 11.6 | |
| Hori | 7206.000 | AV | 32.4 | 35.9 | 6.0 | 34.2 | 40.1 | 53.9 | 13.8 | |
| Hori | 9608.000 | AV | 33.0 | 38.8 | 6.8 | 34.7 | 43.9 | 53.9 | 10.0 | |
| Hori | 24020.000 | AV | 32.4 | 40.5 | -1.7 | 31.7 | 39.5 | 53.9 | 14.4 | |
| Vert | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Vert | 2390.000 | PK | 46.9 | 27.4 | 2.2 | 34.8 | 41.7 | 73.9 | 32.2 | See 20dBc Data Sheet |
| Vert | 2400.000 | PK | 59.8 | 27.5 | 2.2 | 34.8 | - | 73.9 | - | |
| Vert | 4804.000 | PK | 46.5 | 31.2 | 4.9 | 34.0 | 48.6 | 73.9 | 25.3 | |
| Vert | 7206.000 | PK | 44.4 | 35.9 | 6.0 | 34.2 | 52.1 | 73.9 | 21.8 | |
| Vert | 9608.000 | PK | 44.3 | 38.8 | 6.8 | 34.7 | 55.2 | 73.9 | 18.7 | |
| Vert | 24020.000 | PK | 45.9 | 40.5 | -1.7 | 31.7 | 53.0 | 73.9 | 20.9 | |
| Vert | 2390.000 | AV | 38.5 | 27.4 | 2.2 | 34.8 | 33.3 | 53.9 | 20.6 | See 20dBc Data Sheet |
| Vert | 2400.000 | AV | 44.3 | 27.5 | 2.2 | 34.8 | - | 53.9 | - | |
| Vert | 4804.000 | AV | 34.2 | 31.2 | 4.9 | 34.0 | 36.3 | 53.9 | 17.6 | |
| Vert | 7206.000 | AV | 33.3 | 35.9 | 6.0 | 34.2 | 41.0 | 53.9 | 12.9 | |
| Vert | 9608.000 | AV | 32.9 | 38.8 | 6.8 | 34.7 | 43.8 | 53.9 | 10.1 | |
| Vert | 24020.000 | AV | 33.1 | 40.5 | -1.7 | 31.7 | 40.2 | 53.9 | 13.7 | |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
 26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Radiated Spurious Emission

Test place Head Office EMC Lab. No.2 Semi Anechoic Chamber
Report No. 32IE0154-HO-01
Date 06/21/2012
Temperature/ Humidity 24deg. C / 64% RH
Engineer Tomotaka Sasagawa
Mode Bluetooth Low Energy Tx 2402MHz

20dBc Data Sheet

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori | 2402.000 | PK | 114.0 | 27.5 | 2.2 | 34.8 | 108.9 | - | - | Carrier |
| Hori | 2400.000 | PK | 54.7 | 27.5 | 2.2 | 34.8 | 49.6 | 88.9 | 39.3 | |
| Vert | 2402.000 | PK | 105.1 | 27.5 | 2.2 | 34.8 | 100.0 | - | - | Carrier |
| Vert | 2400.000 | PK | 47.1 | 27.5 | 2.2 | 34.8 | 42.0 | 80.0 | 38.0 | |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

Radiated Spurious Emission

Test place : Head Office EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 32IE0154-HO-01
Date : 06/21/2012
Temperature/ Humidity : 24deg. C / 64% RH
Engineer : Tomotaka Sasagawa
Mode : Bluetooth Low Energy Tx 2440MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------|
| Hori | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Hori | 4880.000 | PK | 45.3 | 31.4 | 4.9 | 34.0 | 47.6 | 73.9 | 26.3 | |
| Hori | 7320.000 | PK | 44.6 | 36.0 | 6.2 | 34.2 | 52.6 | 73.9 | 21.3 | NS |
| Hori | 9760.000 | PK | 44.3 | 38.9 | 7.0 | 34.7 | 55.5 | 73.9 | 18.4 | NS |
| Hori | 24400.000 | PK | 45.6 | 40.5 | -1.7 | 32.2 | 52.2 | 73.9 | 21.7 | NS |
| Hori | 4880.000 | AV | 35.1 | 31.4 | 4.9 | 34.0 | 37.4 | 53.9 | 16.5 | |
| Hori | 7320.000 | AV | 32.8 | 36.0 | 6.2 | 34.2 | 40.8 | 53.9 | 13.1 | NS |
| Hori | 9760.000 | AV | 32.1 | 38.9 | 7.0 | 34.7 | 43.3 | 53.9 | 10.6 | NS |
| Hori | 24400.000 | AV | 33.2 | 40.5 | -1.7 | 32.2 | 39.8 | 53.9 | 14.1 | NS |
| Vert | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Vert | 4880.000 | PK | 45.6 | 31.4 | 4.9 | 34.0 | 47.9 | 73.9 | 26.0 | |
| Vert | 7320.000 | PK | 44.5 | 36.0 | 6.2 | 34.2 | 52.5 | 73.9 | 21.4 | NS |
| Vert | 9760.000 | PK | 44.6 | 38.9 | 7.0 | 34.7 | 55.8 | 73.9 | 18.1 | NS |
| Vert | 24400.000 | PK | 45.2 | 40.5 | -1.7 | 32.2 | 51.8 | 73.9 | 22.1 | NS |
| Vert | 4880.000 | AV | 35.2 | 31.4 | 4.9 | 34.0 | 37.5 | 53.9 | 16.4 | |
| Vert | 7320.000 | AV | 32.9 | 36.0 | 6.2 | 34.2 | 40.9 | 53.9 | 13.0 | NS |
| Vert | 9760.000 | AV | 32.8 | 38.9 | 7.0 | 34.7 | 44.0 | 53.9 | 9.9 | NS |
| Vert | 24400.000 | AV | 33.4 | 40.5 | -1.7 | 32.2 | 40.0 | 53.9 | 13.9 | NS |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Radiated Spurious Emission

Test place : Head Office EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 32IE0154-HO-01
Date : 06/21/2012
Temperature/ Humidity : 24deg. C / 64% RH
Engineer : Tomotaka Sasagawa
Mode : Bluetooth Low Energy Tx 2480MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|-----------------|----------------|-------------|--------|
| Hori | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Hori | 2483.500 | PK | 64.5 | 27.5 | 2.3 | 34.8 | 59.5 | 73.9 | 14.4 | |
| Hori | 4960.000 | PK | 44.9 | 31.6 | 5.0 | 34.0 | 47.5 | 73.9 | 26.4 | |
| Hori | 7440.000 | PK | 44.6 | 36.2 | 6.3 | 34.3 | 52.8 | 73.9 | 21.1 | NS |
| Hori | 9920.000 | PK | 44.8 | 39.1 | 7.1 | 34.7 | 56.3 | 73.9 | 17.6 | NS |
| Hori | 24800.000 | PK | 45.9 | 40.6 | -1.6 | 32.7 | 52.2 | 73.9 | 21.7 | NS |
| Hori | 2483.500 | AV | 48.7 | 27.5 | 2.3 | 34.8 | 43.7 | 53.9 | 10.2 | |
| Hori | 4960.000 | AV | 35.2 | 31.6 | 5.0 | 34.0 | 37.8 | 53.9 | 16.1 | |
| Hori | 7440.000 | AV | 32.1 | 36.2 | 6.3 | 34.3 | 40.3 | 53.9 | 13.6 | NS |
| Hori | 9920.000 | AV | 33.2 | 39.1 | 7.1 | 34.7 | 44.7 | 53.9 | 9.2 | NS |
| Hori | 24800.000 | AV | 34.5 | 40.6 | -1.6 | 32.7 | 40.8 | 53.9 | 13.1 | NS |
| Vert | 900.000 | QP | 21.7 | 22.2 | 11.3 | 27.9 | 27.3 | 46.0 | 18.7 | NS |
| Vert | 2483.500 | PK | 53.9 | 27.5 | 2.3 | 34.8 | 48.9 | 73.9 | 25.0 | |
| Vert | 4960.000 | PK | 44.7 | 31.6 | 5.0 | 34.0 | 47.3 | 73.9 | 26.6 | |
| Vert | 7440.000 | PK | 44.6 | 36.2 | 6.3 | 34.3 | 52.8 | 73.9 | 21.1 | NS |
| Vert | 9920.000 | PK | 44.5 | 39.1 | 7.1 | 34.7 | 56.0 | 73.9 | 17.9 | NS |
| Vert | 24800.000 | PK | 45.2 | 40.6 | -1.6 | 32.7 | 51.5 | 73.9 | 22.4 | NS |
| Vert | 2483.500 | AV | 41.4 | 27.5 | 2.3 | 34.8 | 36.4 | 53.9 | 17.5 | |
| Vert | 4960.000 | AV | 35.1 | 31.6 | 5.0 | 34.0 | 37.7 | 53.9 | 16.2 | |
| Vert | 7440.000 | AV | 32.9 | 36.2 | 6.3 | 34.3 | 41.1 | 53.9 | 12.8 | NS |
| Vert | 9920.000 | AV | 32.8 | 39.1 | 7.1 | 34.7 | 44.3 | 53.9 | 9.6 | NS |
| Vert | 24800.000 | AV | 34.2 | 40.6 | -1.6 | 32.7 | 40.5 | 53.9 | 13.4 | NS |

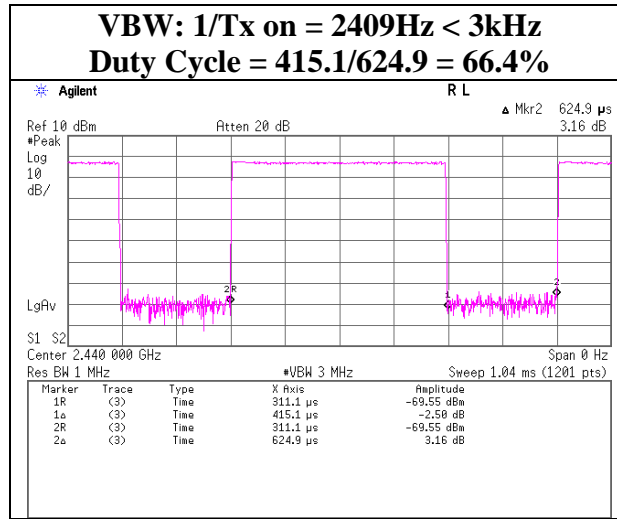
Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
 26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

VBW (AV) Calculation



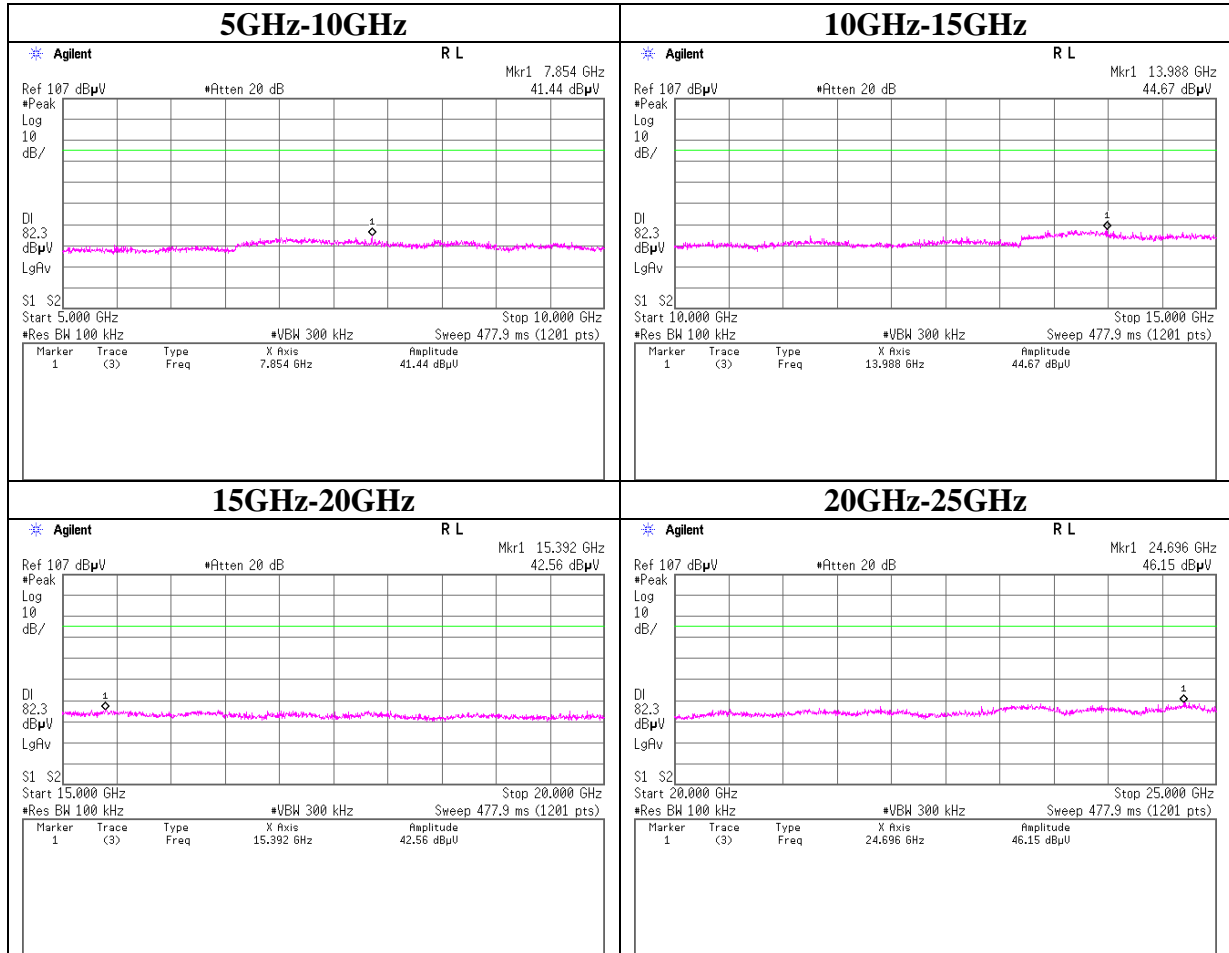
Conducted Spurious Emission

Tx 2402MHz



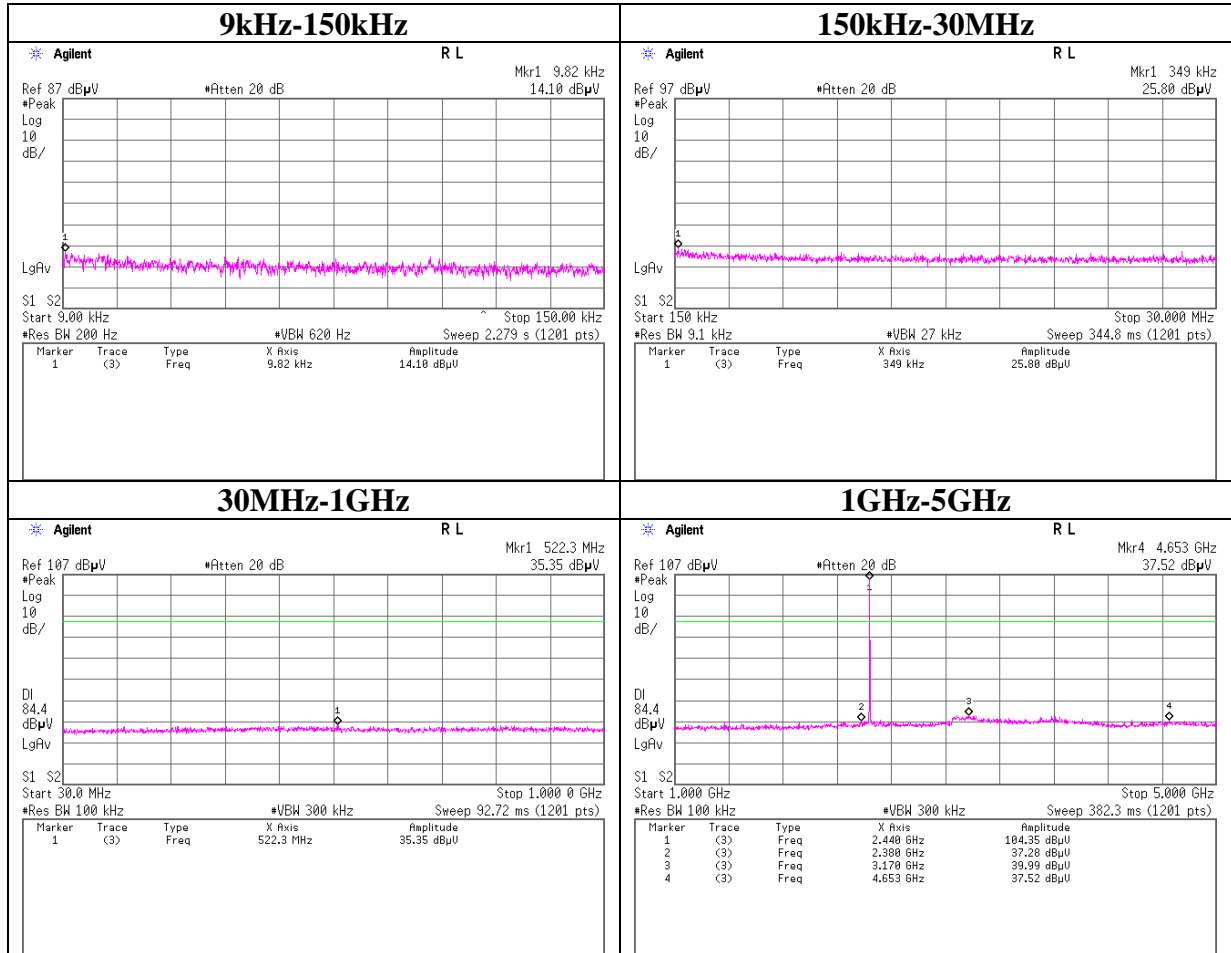
Conducted Spurious Emission

Tx 2402MHz



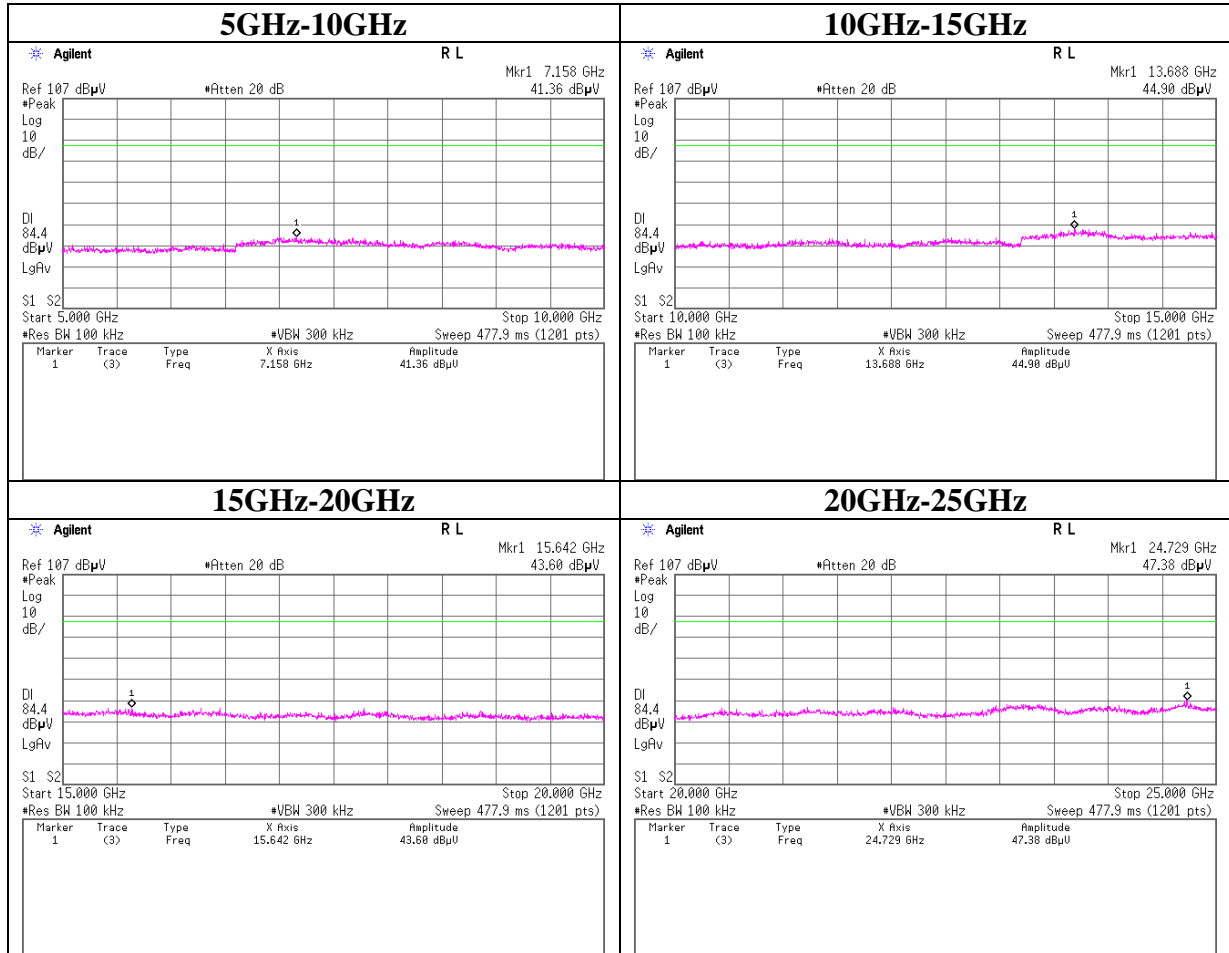
Conducted Spurious Emission

Tx 2440MHz



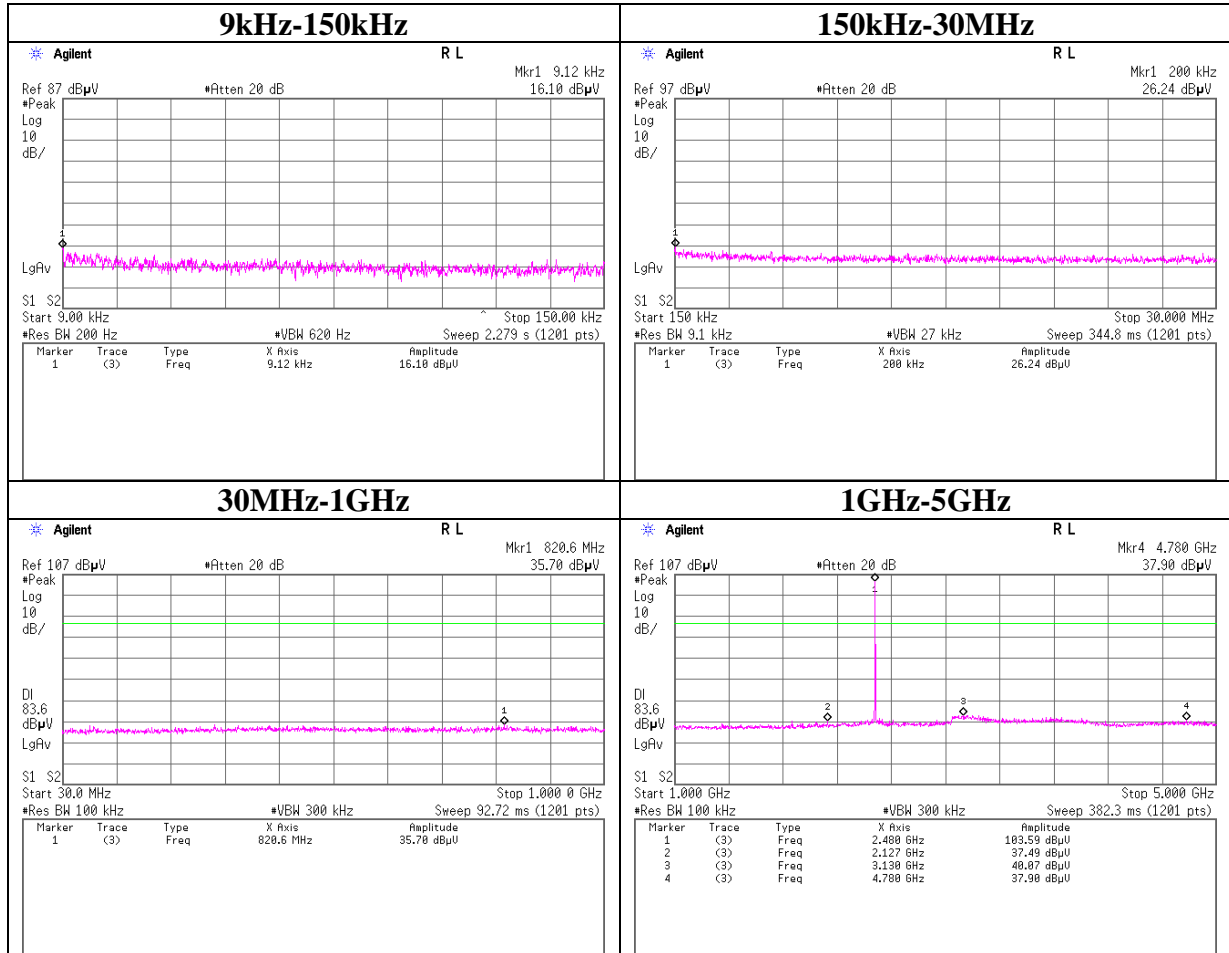
Conducted Spurious Emission

Tx 2440MHz



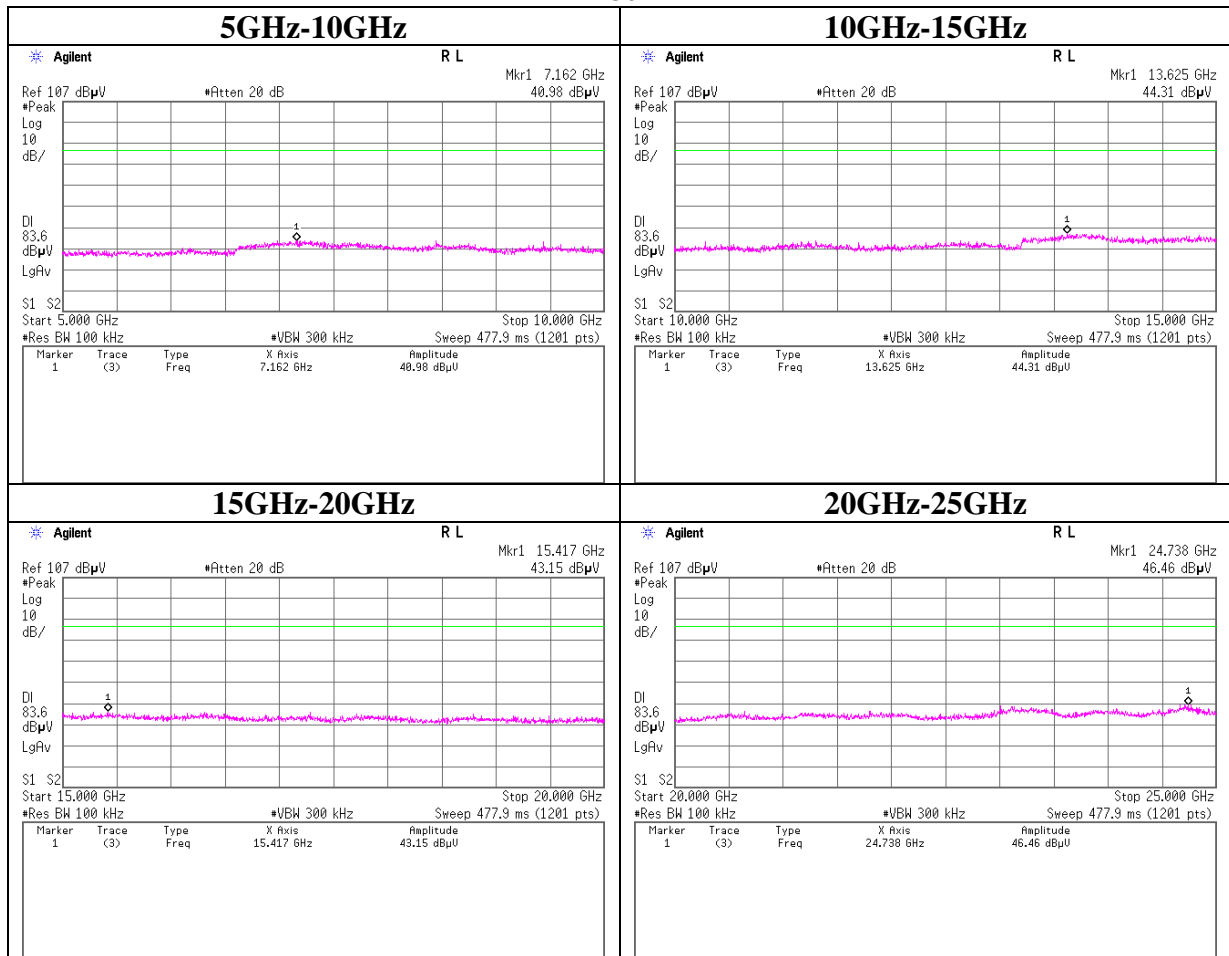
Conducted Spurious Emission

Tx 2480MHz



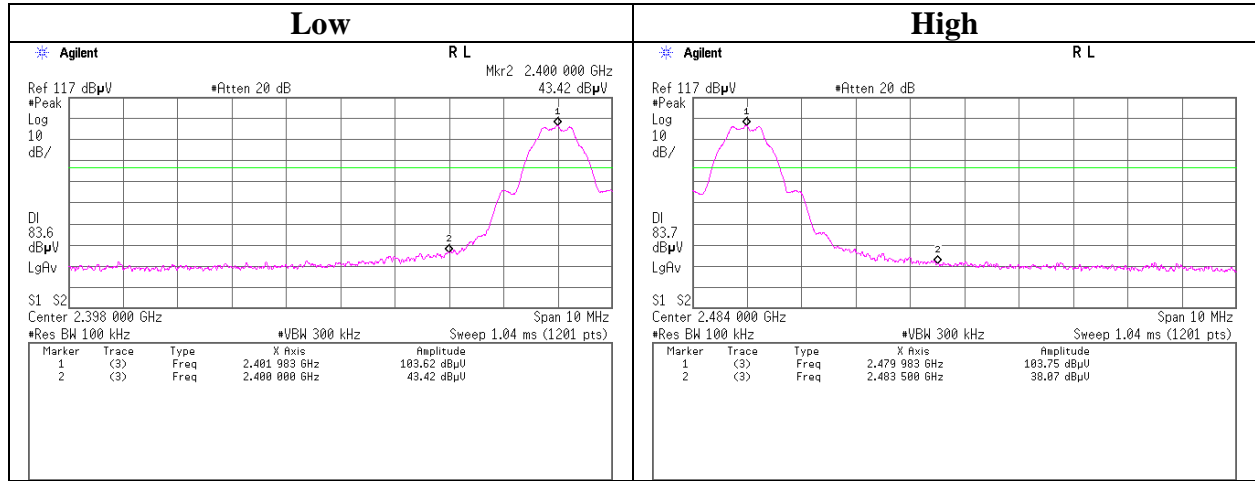
Conducted Spurious Emission

Tx 2480MHz



Conducted Emission Band Edge compliance

Tx



Power Density

Test place Head Office EMC Lab. No.4 Measurement Room
Report No. 32IE0154-HO-01
Date 05/29/2012
Temperature/ Humidity 23deg. C / 51% RH
Engineer Yutaka Yoshida
Mode Tx Bluetooth Low Energy

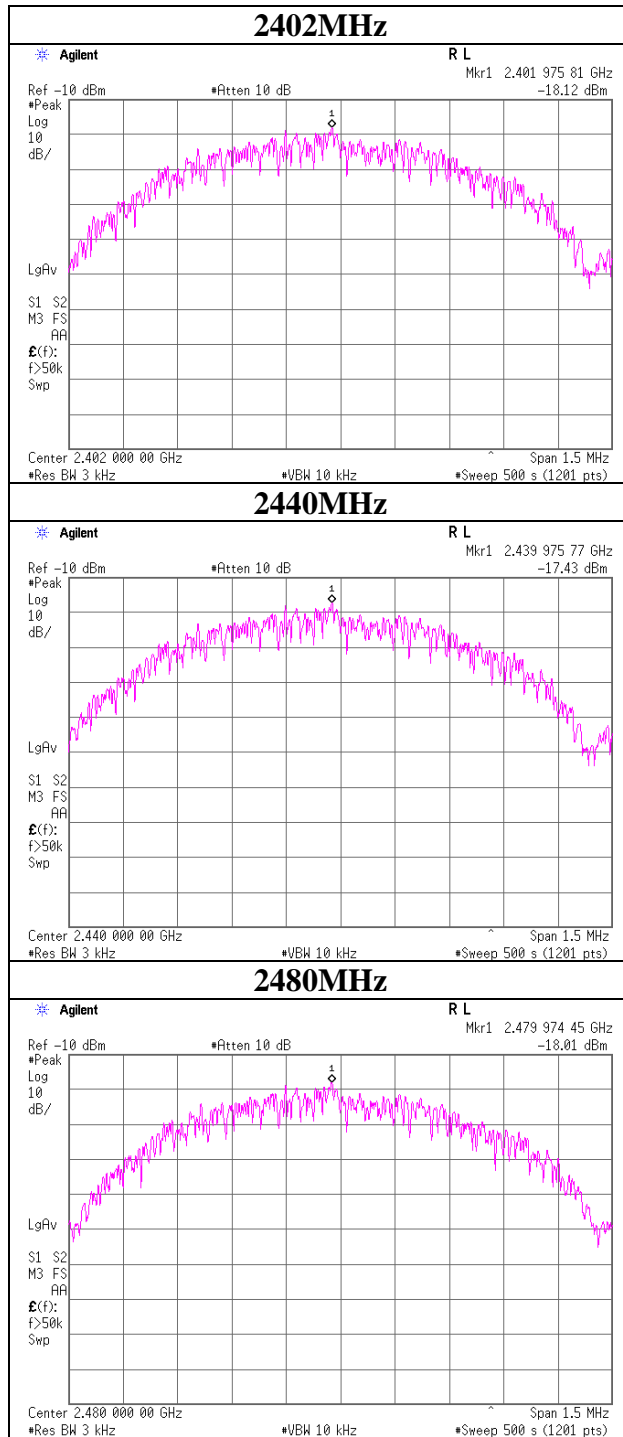
| Freq. [MHz] | Reading [dBm] | Cable Loss [dB] | Atten. [dB] | Result [dBm] | Limit [dBm] | Margin [dB] |
|----------------|------------------|-----------------------|----------------|-----------------|----------------|----------------|
| 2402.00 | -18.12 | 2.03 | 9.96 | -6.13 | 8.00 | 14.13 |
| 2440.00 | -17.43 | 2.05 | 9.96 | -5.42 | 8.00 | 13.42 |
| 2480.00 | -18.01 | 2.06 | 9.96 | -5.99 | 8.00 | 13.99 |

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

Power Density

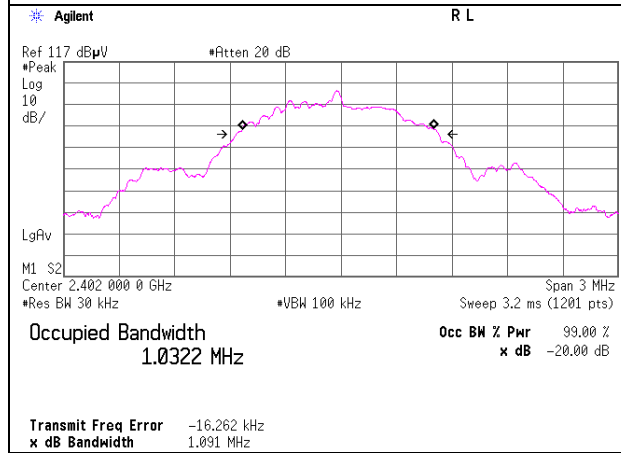
Tx



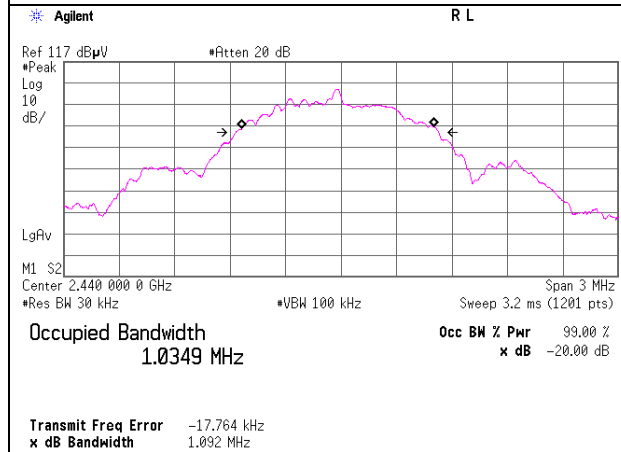
99% Occupied Bandwidth

Tx

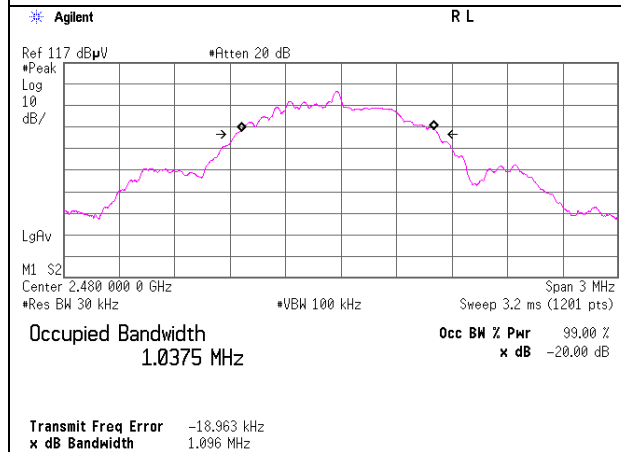
2402MHz



2440MHz



2480MHz



APPENDIX 2: Test instruments

EMI test equipment (1/2)

| Control No. | Instrument | Manufacturer | Model No | Serial No | Test Item | Calibration Date * Interval(month) |
|-------------|------------------------------|------------------|--------------------------|---------------------------|-----------|---------------------------------------|
| MSA-10 | Spectrum Analyzer | Agilent | E4448A | MY46180655 | AT/RE | 2012/02/03 * 12 |
| MCC-67 | Microwave Cable 1G-40GHz | Suhner | SUCOFLEX102 | 28635/2 | AT | 2012/04/25 * 12 |
| MCC-102 | Microwave Cable | Hirose Electric | U.FL-2LP-066J1-A(200) | - | AT | 2011/06/24 * 12 |
| MAT-24 | Attenuator(10dB)(above 1GHz) | Agilent | 8493C | 71389 | AT | 2011/06/23 * 12 |
| MPM-08 | Power Meter | Anritsu | ML2495A | 6K00003338 | AT | 2011/09/13 * 12 |
| MPSE-11 | Power sensor | Anritsu | MA2411B | 011737 | AT | 2011/09/13 * 12 |
| MOS-21 | Thermo-Hygrometer | Custom | CTH-201 | 0002 | AT | 2011/12/09 * 12 |
| MAEC-03 | Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | RE | 2012/02/24 * 12 |
| MOS-13 | Thermo-Hygrometer | Custom | CTH-180 | - | RE | 2012/02/06 * 12 |
| MJM-06 | Measure | PROMART | SEN1955 | - | RE | |
| COTS-MEMI | EMI measurement program | TSJ | TEPTO-DV | - | RE/CE | - |
| MHA-20 | Horn Antenna 1-18GHz | Schwarzbeck | BBHA9120D | 258 | RE | 2012/05/25 * 12 |
| MCC-133 | Microwave Cable | HUBER+SUHNER | SUCOFLEX104 | 336164/4(1m) / 340640(5m) | RE | 2011/09/07 * 12 |
| MPA-11 | MicroWave System Amplifier | Agilent | 83017A | MY39500779 | RE | 2012/03/29 * 12 |
| MHF-19 | High Pass Filter 3.5-18.0GHz | TOKIMEC | TF323DCA | 602 | RE | 2011/09/07 * 12 |
| MCC-76 | Microwave Cable 1G-26.5GHz | Suhner | SUCOFLEX104 | 278967/4 | RE | 2011/12/08 * 12 |
| MAEC-02 | Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-06902 | RE | 2011/06/21 * 12 |
| MOS-22 | Thermo-Hygrometer | Custom | CTH-201 | 0003 | RE | 2012/02/06 * 12 |
| MJM-14 | Measure | KOMELON | KMC-36 | - | RE | - |
| MRENT-95 | Spectrum Analyzer | Agilent | E4440A | MY46185823 | RE | 2012/06/19 * 12 |
| MTR-03 | Test Receiver | Rohde & Schwarz | ESCI | 100300 | RE | 2012/04/03 * 12 |
| MBA-02 | Biconical Antenna | Schwarzbeck | BBA9106 | VHA91032008 | RE | 2011/10/23 * 12 |
| MLA-02 | Logperiodic Antenna | Schwarzbeck | USLP9143 | 201 | RE | 2011/10/23 * 12 |
| MCC-12 | Coaxial Cable | Fujikura/Agilent | - | - | RE | 2012/02/16 * 12 |
| MAT-07 | Attenuator(6dB) | Weinschel Corp | 2 | BK7970 | RE | 2011/11/02 * 12 |
| MPA-09 | Pre Amplifier | Agilent | 8447D | 2944A10845 | RE | 2011/09/26 * 12 |
| MHA-06 | Horn Antenna 1-18GHz | Schwarzbeck | BBHA9120D | 254 | RE | 2012/02/22 * 12 |
| MPA-10 | Pre Amplifier | Agilent | 8449B | 3008A02142 | RE | 2012/01/25 * 12 |
| MHA-02 | Horn Antenna 18-26.5GHz | EMCO | 3160-09 | 1265 | RE | 2012/02/22 * 12 |
| MCC-132 | Microwave Cable | HUBER+SUHNER | SUCOFLEX104 | 336161/4(1m) / 340639(5m) | RE | 2011/09/06 * 12 |
| MCC-77 | Microwave Cable 1G-26.5GHz | Suhner | SUCOFLEX104 | 278942/4 | RE | 2011/12/08 * 12 |
| MHF-18 | High Pass Filter 3.5-18.0GHz | TOKIMEC | TF323DCA | 7002 | RE | 2011/09/08 * 12 |

EMI test equipment (2/2)

| Control No. | Instrument | Manufacturer | Model No | Serial No | Test Item | Calibration Date * Interval(month) |
|-------------|----------------------------|----------------------|---|-----------|-----------|---------------------------------------|
| MAEC-04 | Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | CE | 2012/02/29 * 12 |
| MOS-15 | Thermo-Hygrometer | Custom | CTH-180 | - | CE | 2012/02/06 * 12 |
| MJM-07 | Measure | PROMART | SEN1955 | - | CE | - |
| MTR-07 | Test Receiver | Rohde & Schwarz | ESCI | 100635 | CE | 2012/04/05 * 12 |
| MLS-06 | LISN(AMN) | Schwarzbeck | NSLK8127 | 8127363 | CE | 2012/02/06 * 12 |
| MTA-31 | Terminator | TME | CT-01 | - | CE | 2012/01/11 * 12 |
| MAT-67 | Attenuator(13dB) | JFW Industries, Inc. | 50FP-013H2 N | - | CE | 2012/01/28 * 12 |
| MCC-113 | Coaxial cable | Fujikura/Suhner/TSJ | 5D-2W(10m)/SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher) | -/04178 | CE | 2011/07/04 * 12 |

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

**Test Item: CE: Conducted Emission
RE: Radiated Emission
AT: Antenna Terminal Conducted test**