Excellence in Compliance Testing

# Certification Test Report

**FCC ID: P2SBELTCLIPT**
**IC: 4171B-BELTCLIPT**

**FCC Rule Part: 15.249**
**IC Radio Standards Specification: RSS-210**

**ACS Report Number: 14-0066.W06.1A**

Manufacturer: Neptune Technology Group, Inc.
Model: BCT

Test Begin Date: August 9, 2013
Test End Date: September 29, 2013

Report Issue Date: June 10, 2014

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

**Reviewed by:**
**Kirby Munroe**
**Director, Wireless Certifications**
**ACS, Inc.**



**This report contains 20 pages**

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# 1 GENERAL

## 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210.

## 1.2 Product description

The BCT R900 Belt Clip Transceiver is a body-worn, battery powered, 910-920MHz transceiver that is used in walk-by mode to read RF-communicating water meters manufactured by Neptune Technology Group. It stores readings on an SD card, and, upon command via Bluetooth from the handheld computer, transmits the readings to another computing device via Bluetooth.

The BCT is electrically identical to the Neptune model 13253-000 R900 Belt Clip Receiver (FCC ID: P2SBELTCLIP, IC: 4171B-BELTCLIP) with the exception of the additional firmware to active the previously populated 900 MHz transmitter. The data provided in this report is the data submitted under FCC ID: P2SBELTCLIP, IC: 4171B-BELTCLIP, ACS project number 13-0249, with respect to the Bluetooth radio characteristics.

Technical Details:

**Table1.2-1: Bluetooth Radio Properties**

| Modulation | Frequency Range (MHz) | Number of Channels | Channel Separation (kHz) | Data Rate (Mbps) |
|---|---|---|---|---|
| GFSK | 2402 - 2480 | 79 | 1000 | 1 |
| π/4-DQPSK | 2402 - 2480 | 79 | 1000 | 2 |
| 8DPSK | 2402 - 2480 | 79 | 1000 | 3 |

Antenna Type/Gain: Chip Antenna, 1.3 dBi Gain
Operating Voltage: 4.2Vdc Battery

Manufacturer Information:
Neptune Technology Group, Inc.
1600 Alabama Highway 229
Tallassee, AL 36078

EUT Serial Numbers: BC000127

Test Sample Condition: The test samples were provided in good working order with no visible defects.

### 1.3 Test Methodology and Considerations

The EUT was tested for the Bluetooth radio for all available modulations. Where applicable, data is provided for the modulation / data rate corresponding to the worst case.

The radiated emissions evaluations were conducted up to the 10th harmonic for all available modulations. Preliminary measurements were collected for the EUT set in three orthogonal orientations. The measurements reported herein correspond to the orientation and modulation / data rate leading to the highest emissions relative to the limits.

The EUT operates from internal batteries but can be connected to an external charger or computer via a USB port. The Bluetooth radio is not operable when an external device is connected via the USB port. The EUT was evaluated for radiated emissions in the stand-alone configuration only.

The Bluetooth radio is capable of transmitting simultaneously with the collocated 900 MHz transmitter therefore radiated intermodulation products where evaluated and found to be in compliance.

**Table 1.3-1: Bluetooth Radio Test configuration**

| Frequency (MHz) | Channel Number | Modulation | Data Rate (Mbps) |
|---|---|---|---|
| 2402 | 0 | GFSK | 1 |
| 2441 | 39 | | |
| 2480 | 78 | | |
| 2402 | 0 | π/4 DQPSK | 2 |
| 2441 | 39 | | |
| 2480 | 78 | | |
| 2402 | 0 | 8 DPSK | 3 |
| 2441 | 39 | | |
| 2480 | 78 | | |

# 2 TEST FACILITIES

## 2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

## 2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: 4175A
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

## 2.3 Radiated Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

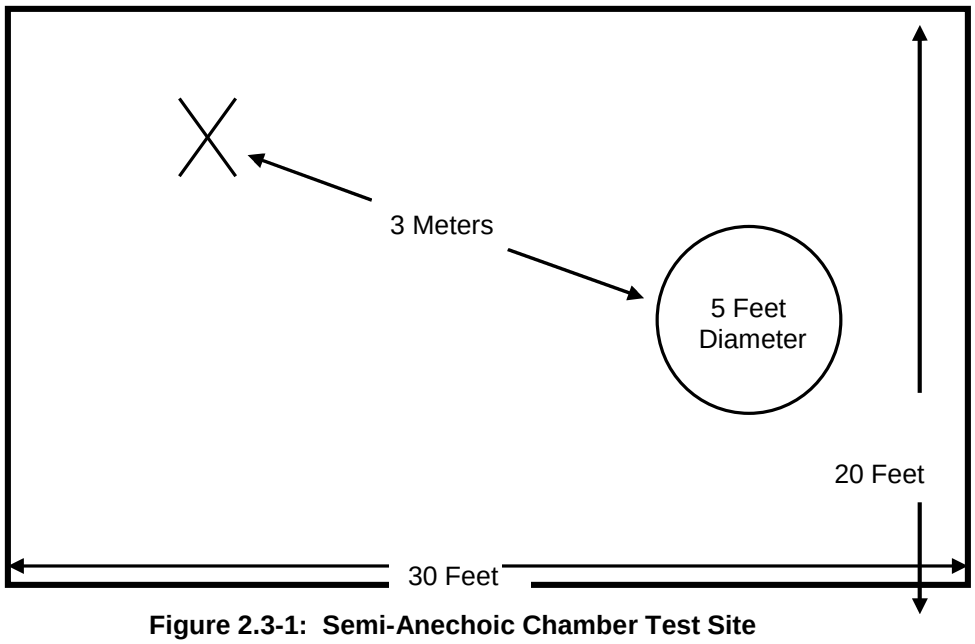


**Figure 2.3-1: Semi-Anechoic Chamber Test Site**

### 2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

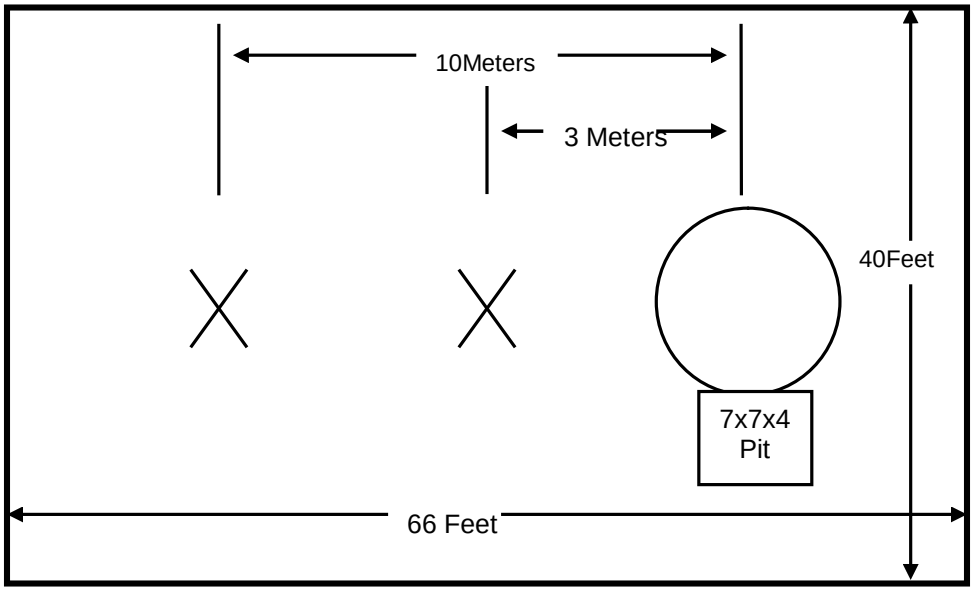


**Figure 2.3-2: Open Area Test Site**

## 2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

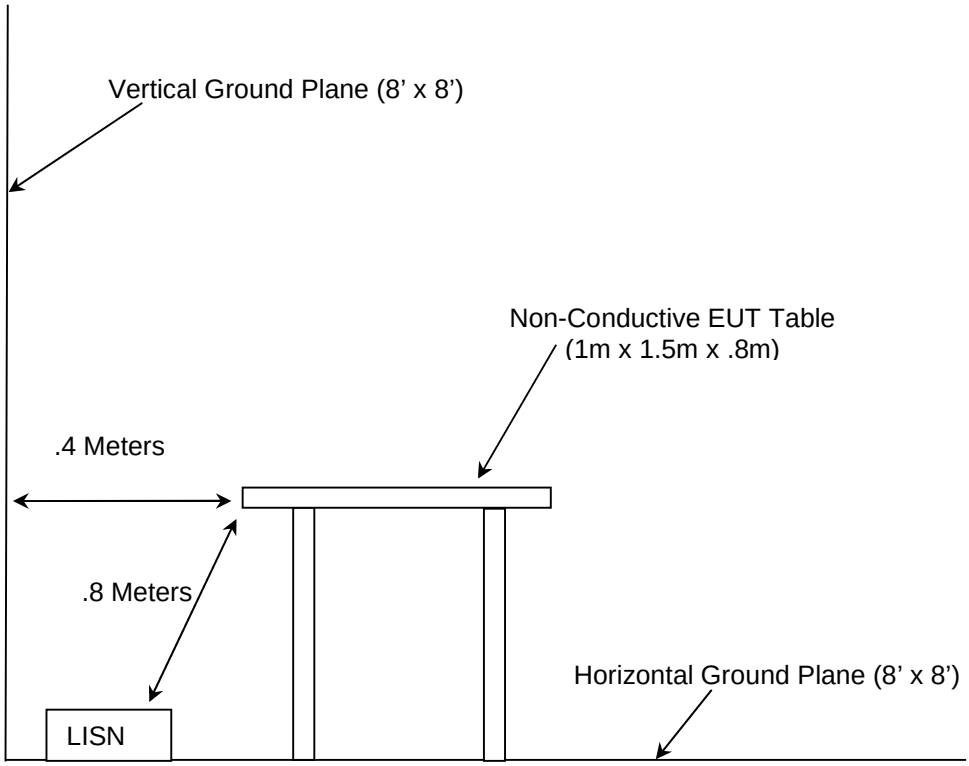


**Figure 2.4-1: AC Mains Conducted EMI Site**

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2014
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2014
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, December 2010
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

## 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment**

| AssetID | Manufacturer | Model # | Equipment Type | Serial # | Last Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| 1 | Rohde & Schwarz | ESMI - Display | Spectrum Analyzers | 833771/007 | 8/2/2012 | 8/2/2014 |
| 2 | Rohde & Schwarz | ESMI-Receiver | Spectrum Analyzers | 839587/003 | 8/2/2012 | 8/2/2014 |
| 30 | Spectrum Technologies | DRH-0118 | Antennas | 970102 | 4/23/2013 | 4/23/2015 |
| 40 | EMCO | 3104 | Antennas | 3211 | 2/14/2013 | 2/14/2015 |
| 73 | Agilent | 8447D | Amplifiers | 2727A05624 | 7/16/2013 | 7/16/2014 |
| 153 | EMCO | 3825/2 | LISN | 9411-2268 | 7/31/2012 | 7/31/2014 |
| 167 | ACS | Chamber EMI Cable Set | Cable Set | 167 | 12/17/2012 | 12/17/2013 |
| 168 | Hewlett Packard | 11947A | Attenuators | 44829 | 2/1/2013 | 2/1/2014 |
| 267 | Agilent | N1911A | Meters | MY45100129 | 1/23/2012 | 1/23/2014 |
| 268 | Agilent | N1921A | Sensors | MY45240184 | 1/17/2012 | 1/17/2014 |
| 283 | Rohde & Schwarz | FSP40 | Spectrum Analyzers | 1000033 | 7/30/2013 | 7/30/2015 |
| 291 | Florida RF Cables | SMRE-200W-12.0-SMRE | Cables | None | 11/20/2012 | 11/20/2013 |
| 292 | Florida RF Cables | SMR-290AW-480.0-SMR | Cables | None | 3/26/2013 | 3/26/2014 |
| 324 | ACS | Belden | Cables | 8214 | 6/17/2013 | 6/17/2014 |
| 334 | Rohde&Schwarz | 3160-09 | Antennas | 49404 | 11/4/2010 | NCR |
| 335 | Suhner | SF-102A | Cables | 882/2A | 7/29/2013 | 7/29/2014 |
| 338 | Hewlett Packard | 8449B | Amplifiers | 3008A01111 | 7/30/2013 | 7/30/2015 |
| 340 | Aeroflex/Weinschel | AS-20 | Attenuators | 7136 | 7/30/2013 | 7/30/2014 |
| 345 | Suhner Sucoflex | 102A | Cables | 1077/2A | 7/29/2013 | 7/29/2014 |
| 412 | Electro Metrics | LPA-25 | Antennas | 1241 | 7/27/2012 | 7/27/2014 |
| 422 | Florida RF | SMS-200AW-72.0-SMR | Cables | 805 | 11/20/2012 | 11/20/2013 |
| 432 | Microwave Circuits | H3G020G4 | Filters | 264066 | 6/19/2013 | 6/19/2014 |
| RE90 | Agilent | E7404A | Analyzers | US40240143 | 11/28/2012 | 11/28/2013 |

## 5 SUPPORT EQUIPMENT

**Table 5-1: Support Equipment**

| Item | Equipment Type | Manufacturer | Model Number | Serial Number |
|---|---|---|---|---|
| 1 | Laptop Computer | Dell | D410 | N/A |
| 2 | Laptop Power Supply | Dell | PA-1900-02D | CN-09T215-71615-417-05A0 |
| 3 | Ethernet Hub | Netgear | GS105 v3 | 27310A3406D01 |
| 4 | DC Power Supply | Bestec | EA0121WAA | 10G030813 |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

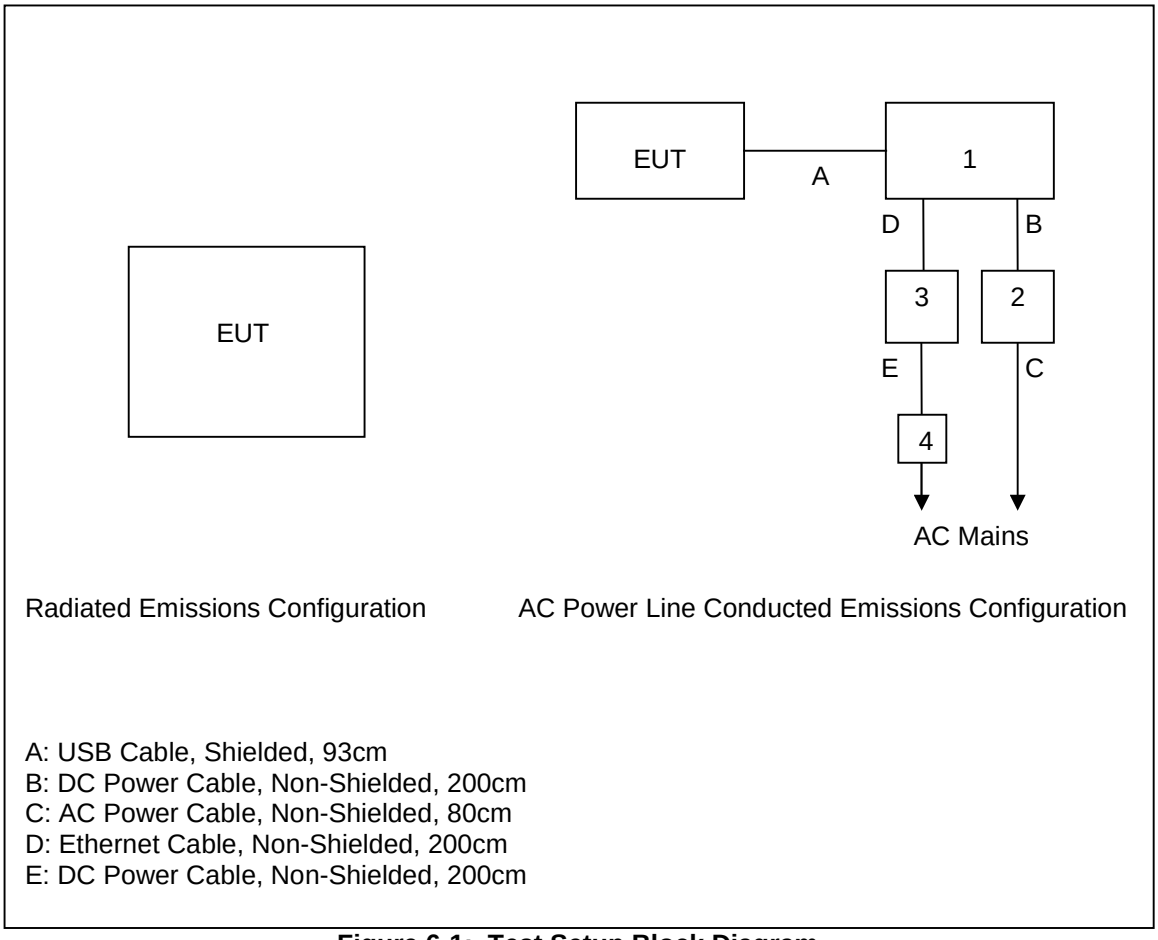


**Figure 6-1: Test Setup Block Diagram**

# 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

## 7.1 Antenna Requirement – FCC 15.203

The antenna used is an integral chip antenna with 1.3 dBi gain, which meets the requirements of Section 15.203.

## 7.2 Power Line Conducted Emissions – FCC 15.207; IC RSS-Gen 7.2.4

### 7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Applicable Limit - Corrected Reading**

### 7.2.2 Measurement Results

Results of the test are shown below in Tables 7.2.2-1 and 7.2.2-2.

**Table 7.2.2-1: Conducted EMI Results Line 1**

| Frequency (MHz) | Uncorrected Reading | | Total Correction Factor (dB) | Corrected Level | | Limit | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average |
| 0.637356 | 26.984 | 16.942 | 10.026 | 37.01 | 26.968 | 56 | 46 | 18.99 | 19.032 |
| 0.621074 | 29.627 | 20.205 | 10.011 | 39.637 | 30.216 | 56 | 46 | 16.363 | 15.784 |
| 0.48415 | 29.805 | 15.764 | 9.989 | 39.794 | 25.753 | 56.453 | 46.453 | 16.659 | 20.699 |
| 0.311024 | 29.57 | 27.412 | 9.994 | 39.563 | 37.406 | 61.399 | 51.399 | 21.836 | 13.993 |
| 0.206444 | 33.002 | 23.587 | 10.101 | 43.103 | 33.688 | 64.387 | 54.387 | 21.285 | 20.7 |
| 0.150016 | 37.1 | 23.144 | 10.182 | 47.282 | 33.326 | 66 | 56 | 18.718 | 22.674 |

**Table 7.2.2-2: Conducted EMI Results Line 2**

| Frequency (MHz) | Uncorrected Reading | | Total Correction Factor (dB) | Corrected Level | | Limit | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average |
| 0.617825 | 32.209 | 21.101 | 10.008 | 42.216 | 31.109 | 56 | 46 | 13.784 | 14.891 |
| 0.480499 | 32.481 | 17.841 | 9.989 | 42.47 | 27.83 | 56.557 | 46.557 | 14.087 | 18.727 |
| 0.459605 | 33.162 | 19.906 | 9.989 | 43.151 | 29.896 | 57.154 | 47.154 | 14.003 | 17.258 |
| 0.423431 | 32.684 | 22.608 | 9.989 | 42.673 | 32.597 | 58.188 | 48.188 | 15.515 | 15.591 |
| 0.270631 | 34.017 | 28.363 | 10.026 | 44.043 | 38.389 | 62.553 | 52.553 | 18.51 | 14.164 |
| 0.212481 | 36.892 | 26.54 | 10.094 | 46.985 | 36.634 | 64.215 | 54.215 | 17.229 | 17.581 |

## 7.3 20dB / 99% Bandwidth – FCC 15.215; IC RSS-Gen 4.6

### 7.3.1 Measurement Procedure

The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. A sampling detector was used.

### 7.3.2 Measurement Results

Results are shown below in Table 7.3.2-1 and Figures 7.3.2-1 to 7.3.2-18.

**Table 7.3.2-1: 20dB / 99% Bandwidth**

| Frequency (MHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) | Modulation | Data Rate (Mbps) |
|---|---|---|---|---|
| 2402 | 867.0 | 849.0 | GFSK | 1 |
| 2441 | 873.0 | 841.5 | | |
| 2480 | 867.0 | 853.5 | | |
| 2402 | 1260.0 | 1195.5 | π/4-DQPSK | 2 |
| 2441 | 1183.5 | 1177.5 | | |
| 2480 | 1198.5 | 1174.5 | | |
| 2402 | 1212.0 | 1146.0 | 8DPSK | 3 |
| 2441 | 1194.0 | 1149.0 | | |
| 2480 | 1188.0 | 1140.0 | | |

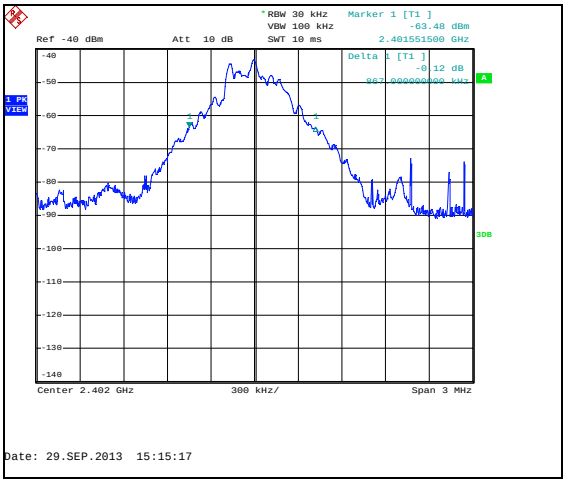


**Figure 7.3.2-1: 20dB BW Low CH (GFSK - 1Mbps)**

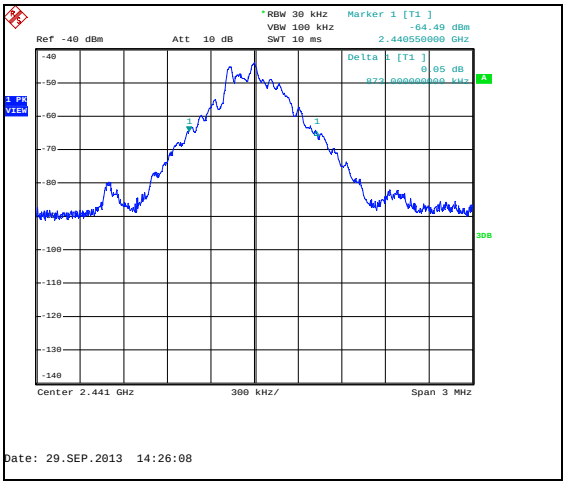


**Figure 7.3.2-2: 20dB BW Mid CH (GFSK - 1Mbps)**

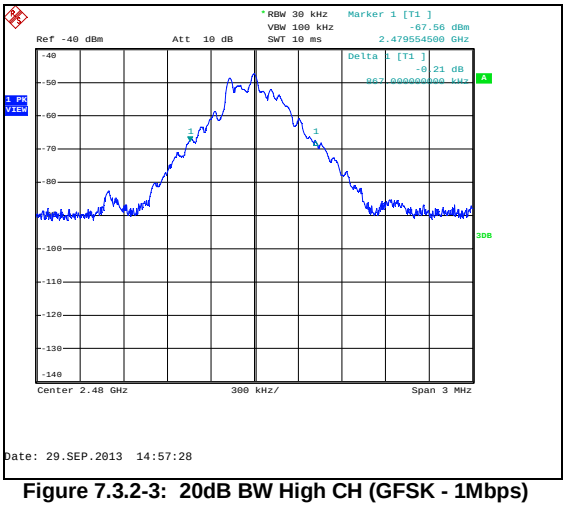


**Figure 7.3.2-3: 20dB BW High CH (GFSK - 1Mbps)**

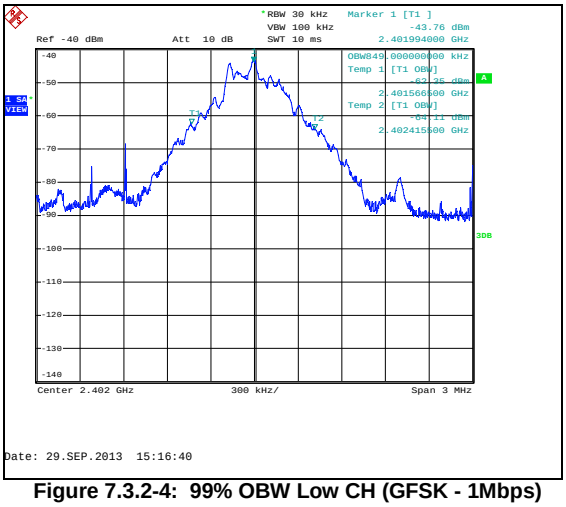


**Figure 7.3.2-4: 99% OBW Low CH (GFSK - 1Mbps)**

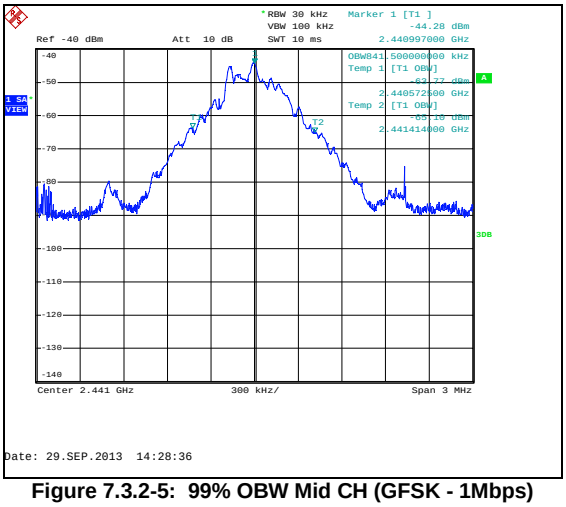


**Figure 7.3.2-5: 99% OBW Mid CH (GFSK - 1Mbps)**

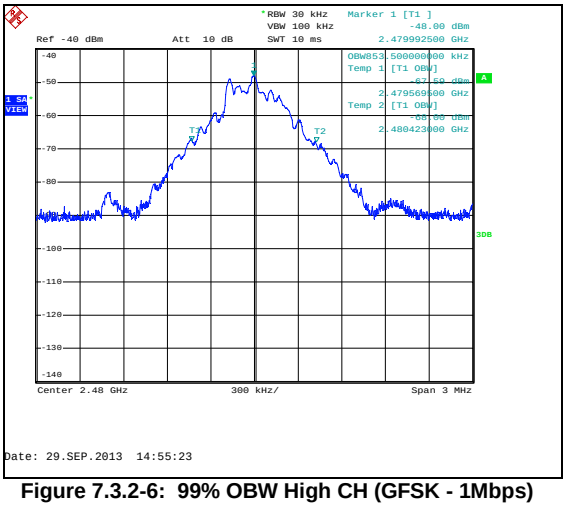


**Figure 7.3.2-6: 99% OBW High CH (GFSK - 1Mbps)**

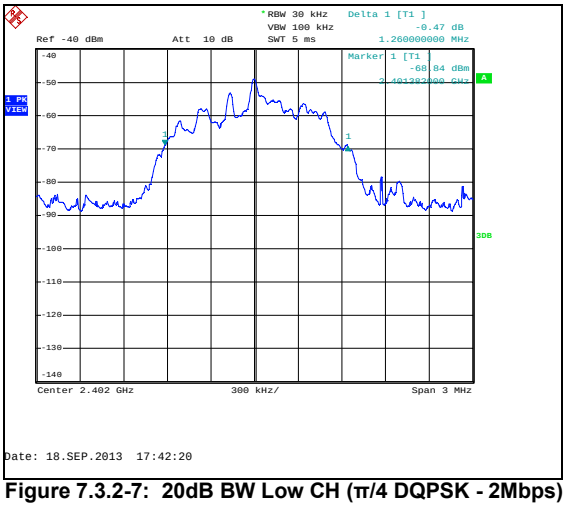


Figure 7.3.2-7: 20dB BW Low CH (π/4 DQPSK - 2Mbps)

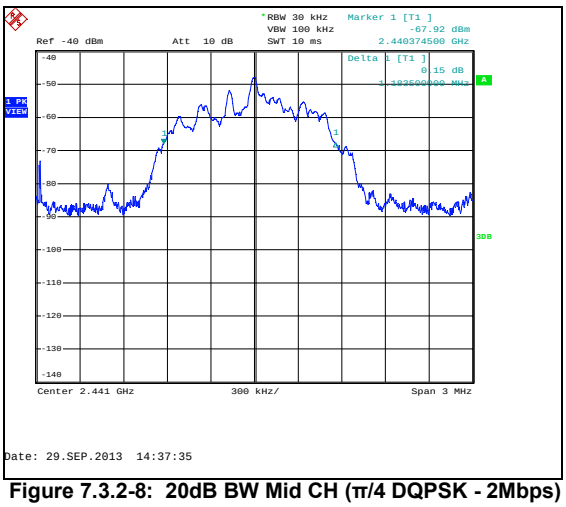


Figure 7.3.2-8: 20dB BW Mid CH (π/4 DQPSK - 2Mbps)

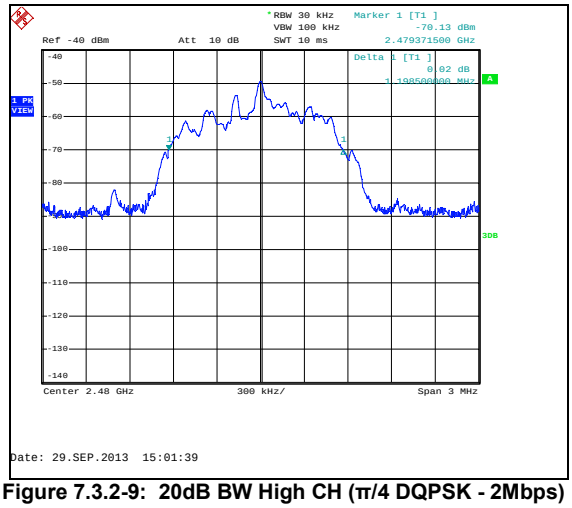


Figure 7.3.2-9: 20dB BW High CH (π/4 DQPSK - 2Mbps)

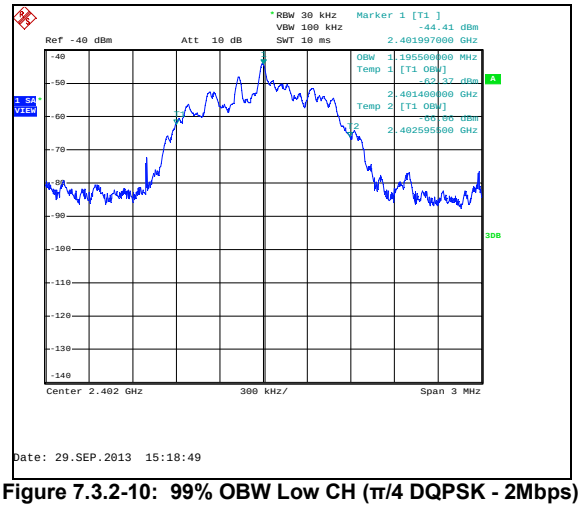


Figure 7.3.2-10: 99% OBW Low CH (π/4 DQPSK - 2Mbps)

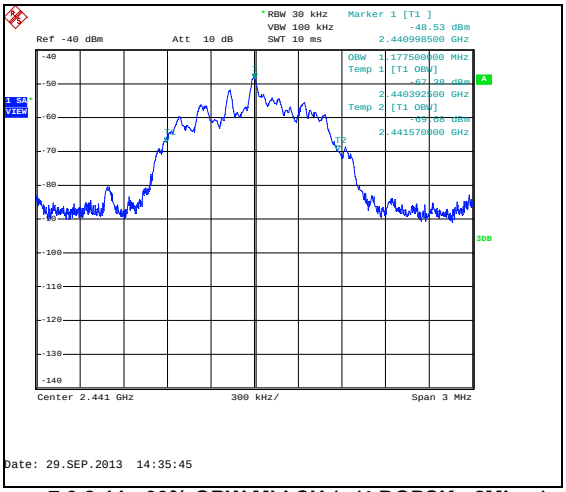


Figure 7.3.2-11: 99% OBW Mid CH (π/4 DQPSK - 2Mbps)

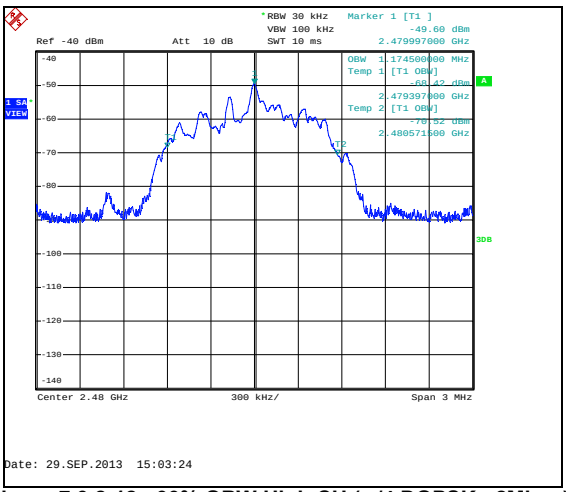


Figure 7.3.2-12: 99% OBW High CH (π/4 DQPSK - 2Mbps)

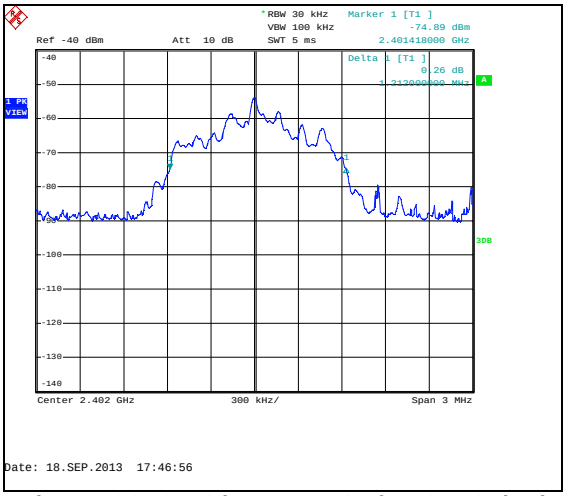


**Figure 7.3.2-13: 20dB BW Low CH (8DPSK - 3Mbps)**

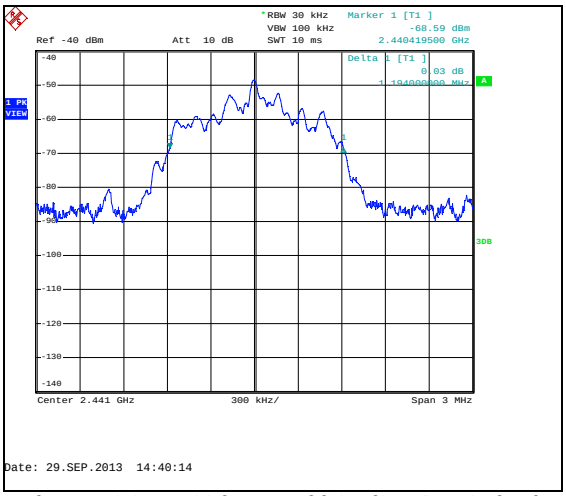


**Figure 7.3.2-14: 20dB BW Mid CH (8DPSK - 3Mbps)**

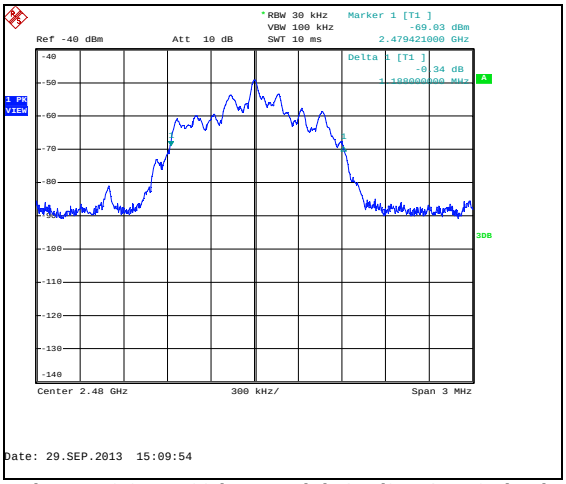


**Figure 7.3.2-15: 20dB BW High CH (8DPSK - 3Mbps)**

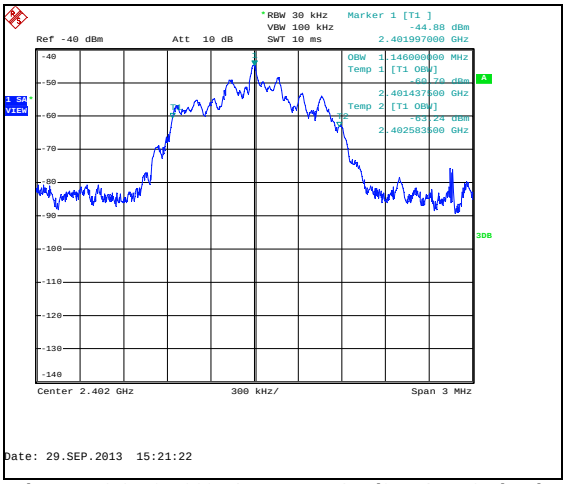


**Figure 7.3.2-16: 99% OBW Low CH (8DPSK - 3Mbps)**

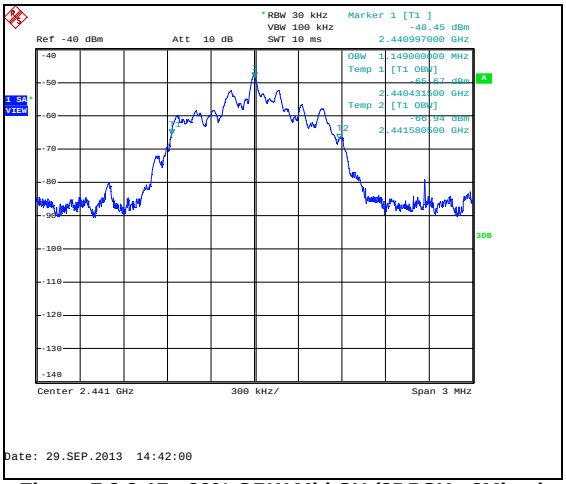


**Figure 7.3.2-17: 99% OBW Mid CH (8DPSK - 3Mbps)**

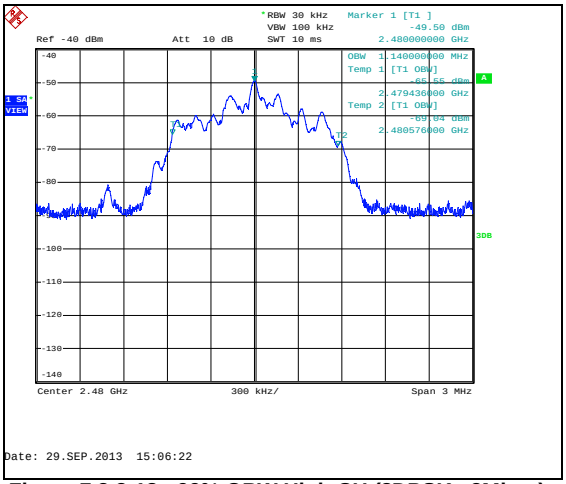


**Figure 7.3.2-18: 99% OBW High CH (8DPSK - 3Mbps)**

## 7.4 Fundamental Field Strength – FCC 15.249(a); IC RSS-210 A2.9(a)

### 7.4.1 Measurement Procedure

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Peak and average measurements were made with RBW and VBW of 3 MHz and 10 MHz respectively.

### 7.4.2 Measurement Results

Results are shown below in Tables 7.4.2-1 to 7.4.2-3.

**Table 7.4.2-1: Fundamental Field Strength (GFSK - 1Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402** | 91.95 | 87.08 | H | -6.38 | 85.57 | 80.70 | 114.0 | 94.0 | 28.4 | 13.3 |
| **2402** | 86.17 | 81.02 | V | -6.38 | 79.79 | 74.64 | 114.0 | 94.0 | 34.2 | 19.3 |
| **2441** | 90.43 | 85.78 | H | -6.17 | 84.26 | 79.61 | 114.0 | 94.0 | 29.7 | 14.4 |
| **2441** | 84.19 | 79.34 | V | -6.17 | 78.02 | 73.17 | 114.0 | 94.0 | 36.0 | 20.8 |
| **2480** | 87.07 | 82.43 | H | -5.96 | 81.11 | 76.47 | 114.0 | 94.0 | 32.9 | 17.5 |
| **2480** | 79.79 | 74.41 | V | -5.96 | 73.83 | 68.45 | 114.0 | 94.0 | 40.2 | 25.5 |

**Table 7.4.2-2: Fundamental Field Strength (π/4 DQPSK - 2Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402** | 90.21 | 81.49 | H | -6.38 | 83.83 | 75.11 | 114.0 | 94.0 | 30.2 | 18.9 |
| **2402** | 84.82 | 76.24 | V | -6.38 | 78.44 | 69.86 | 114.0 | 94.0 | 35.6 | 24.1 |
| **2441** | 89.59 | 81.49 | H | -6.17 | 83.42 | 75.32 | 114.0 | 94.0 | 30.6 | 18.7 |
| **2441** | 82.56 | 74.21 | V | -6.17 | 76.39 | 68.04 | 114.0 | 94.0 | 37.6 | 25.9 |
| **2480** | 85.35 | 77.38 | H | -5.96 | 79.39 | 71.42 | 114.0 | 94.0 | 34.6 | 22.6 |
| **2480** | 78.73 | 70.15 | V | -5.96 | 72.77 | 64.19 | 114.0 | 94.0 | 41.2 | 29.8 |

**Table 7.4.2-3: Fundamental Field Strength (8DPSK - 3Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402** | 91.57 | 82.30 | H | -6.38 | 85.19 | 75.92 | 114.0 | 94.0 | 28.8 | 18.1 |
| **2402** | 85.31 | 75.76 | V | -6.38 | 78.93 | 69.38 | 114.0 | 94.0 | 35.1 | 24.6 |
| **2441** | 89.74 | 80.52 | H | -6.17 | 83.57 | 74.35 | 114.0 | 94.0 | 30.4 | 19.6 |
| **2441** | 82.79 | 73.40 | V | -6.17 | 76.62 | 67.23 | 114.0 | 94.0 | 37.4 | 26.8 |
| **2480** | 85.57 | 76.23 | H | -5.96 | 79.61 | 70.27 | 114.0 | 94.0 | 34.4 | 23.7 |
| **2480** | 78.37 | 69.13 | V | -5.96 | 72.41 | 63.17 | 114.0 | 94.0 | 41.6 | 30.8 |

## 7.5 Radiated Spurious Emissions – FCC 15.249(a)(d)(e); IC RSS-210 A2.9(a)(b)

### 7.5.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3MHz respectively. The average emissions were further corrected by applying the duty cycle correction of the EUT for comparison to the average limit.

Radiated emissions were evaluated for all modulations and data rates.

All out of band emissions were evaluated, including any emissions at or near the band-edge.

### 7.5.2 Duty Cycle Correction

For average radiated measurements, using a 6.25% duty cycle, the measured level was reduced by a factor 24.08dB. The duty cycle correction factor is determined using the formula: 20log (6.25/100).

A detail explanation of the duty cycle is provided in the theory of operation accompanying this report.

### 7.5.3 Measurement Results

Radiated spurious emissions are reported in the table 7.5.3-1 to 7.5.3-3 below.

**Table 7.5.3-1: Radiated Spurious Emissions Tabulated Data (GFSK - 1Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402 MHz (Low Channel)** | | | | | | | | | | |
| **4804** | 58.17 | 47.85 | H | 1.41 | 59.58 | 25.18 | 74.0 | 54.0 | 14.4 | 28.8 |
| **4804** | 57.23 | 46.46 | V | 1.41 | 58.64 | 23.79 | 74.0 | 54.0 | 15.4 | 30.2 |
| **2400** | 58.42 | 43.38 | H | -6.40 | 52.02 | 12.90 | 74.0 | 54.0 | 22.0 | 41.1 |
| **2400** | 55.18 | 39.07 | V | -6.40 | 48.78 | 8.59 | 74.0 | 54.0 | 25.2 | 45.4 |
| **1601.9** | 53.44 | 43.56 | H | -10.68 | 42.76 | 8.80 | 74.0 | 54.0 | 31.2 | 45.2 |
| **1601.9** | 55.09 | 44.75 | V | -10.68 | 44.41 | 9.99 | 74.0 | 54.0 | 29.6 | 44.0 |
| **2441 MHz (Middle Channel)** | | | | | | | | | | |
| **4882** | 57.10 | 44.53 | H | 1.54 | 58.64 | 21.99 | 74.0 | 54.0 | 15.4 | 32.0 |
| **4882** | 54.52 | 41.81 | V | 1.54 | 56.06 | 19.27 | 74.0 | 54.0 | 17.9 | 34.7 |
| **1626.6** | 52.34 | 41.20 | V | -10.55 | 41.79 | 6.57 | 74.0 | 54.0 | 32.2 | 47.4 |
| **2480 MHz (High Channel)** | | | | | | | | | | |
| **4960** | 60.47 | 50.47 | H | 1.67 | 62.14 | 28.06 | 74.0 | 54.0 | 11.9 | 25.9 |
| **4960** | 54.41 | 44.96 | V | 1.67 | 56.08 | 22.55 | 74.0 | 54.0 | 17.9 | 31.4 |
| **2483.5** | 46.57 | 34.73 | H | -5.94 | 40.63 | 4.71 | 74.0 | 54.0 | 33.4 | 49.3 |
| **2483.5** | 46.27 | 34.52 | V | -5.94 | 40.33 | 4.50 | 74.0 | 54.0 | 33.7 | 49.5 |
| **1652.6** | 52.34 | 43.56 | V | -10.41 | 41.93 | 9.07 | 74.0 | 54.0 | 32.1 | 44.9 |

**Table 7.5.3-2: Radiated Spurious Emissions Tabulated Data (π/4 DQPSK - 2Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402 MHz (Low Channel)** | | | | | | | | | | |
| **4804** | 55.15 | 41.56 | H | 1.41 | 56.56 | 18.89 | 74.0 | 54.0 | 17.4 | 35.1 |
| **4804** | 52.64 | 38.86 | V | 1.41 | 54.05 | 16.19 | 74.0 | 54.0 | 20.0 | 37.8 |
| **2400** | 62.13 | 41.87 | H | -6.40 | 55.73 | 11.39 | 74.0 | 54.0 | 18.3 | 42.6 |
| **2400** | 57.35 | 38.23 | V | -6.40 | 50.95 | 7.75 | 74.0 | 54.0 | 23.0 | 46.2 |
| **1601.9** | 54.20 | 45.19 | H | -10.68 | 43.52 | 10.43 | 74.0 | 54.0 | 30.5 | 43.6 |
| **1601.9** | 56.71 | 47.17 | V | -10.68 | 46.03 | 12.41 | 74.0 | 54.0 | 28.0 | 41.6 |
| **2441 MHz (Middle Channel)** | | | | | | | | | | |
| **4882** | 54.86 | 40.36 | H | 1.54 | 56.40 | 17.82 | 74.0 | 54.0 | 17.6 | 36.2 |
| **4882** | 51.62 | 37.24 | V | 1.54 | 53.16 | 14.70 | 74.0 | 54.0 | 20.8 | 39.3 |
| **1626.5** | 53.87 | 43.31 | H | -10.55 | 43.32 | 8.68 | 74.0 | 54.0 | 30.7 | 45.3 |
| **1626.5** | 55.36 | 45.14 | V | -10.55 | 44.81 | 10.51 | 74.0 | 54.0 | 29.2 | 43.5 |
| **2480 MHz (High Channel)** | | | | | | | | | | |
| **4960** | 55.61 | 41.33 | H | 1.67 | 57.28 | 18.92 | 74.0 | 54.0 | 16.7 | 35.1 |
| **4960** | 50.92 | 37.14 | V | 1.67 | 52.59 | 14.73 | 74.0 | 54.0 | 21.4 | 39.3 |
| **2483.5** | 46.32 | 34.57 | H | -5.94 | 40.38 | 4.55 | 74.0 | 54.0 | 33.6 | 49.5 |
| **2483.5** | 46.68 | 34.37 | V | -5.94 | 40.74 | 4.35 | 74.0 | 54.0 | 33.3 | 49.7 |
| **1652.6** | 51.35 | 41.77 | H | -10.41 | 40.94 | 7.28 | 74.0 | 54.0 | 33.1 | 46.7 |
| **1652.6** | 52.87 | 42.57 | V | -10.41 | 42.46 | 8.08 | 74.0 | 54.0 | 31.5 | 45.9 |

**Table 7.5.3-3: Radiated Spurious Emissions Tabulated Data (8DPSK - 3Mbps)**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **2402 MHz (Low Channel)** | | | | | | | | | | |
| **4804** | 55.33 | 41.28 | H | 1.41 | 56.74 | 18.61 | 74.0 | 54.0 | 17.3 | 35.4 |
| **4804** | 51.72 | 38.46 | V | 1.41 | 53.13 | 15.79 | 74.0 | 54.0 | 20.9 | 38.2 |
| **2400** | 63.41 | 42.34 | H | -6.40 | 57.01 | 11.86 | 74.0 | 54.0 | 17.0 | 42.1 |
| **2400** | 57.70 | 38.41 | V | -6.40 | 51.30 | 7.93 | 74.0 | 54.0 | 22.7 | 46.1 |
| **1601.9** | 54.36 | 44.20 | H | -10.68 | 43.68 | 9.44 | 74.0 | 54.0 | 30.3 | 44.6 |
| **1601.9** | 56.40 | 45.85 | V | -10.68 | 45.72 | 11.09 | 74.0 | 54.0 | 28.3 | 42.9 |
| **2441 MHz (Middle Channel)** | | | | | | | | | | |
| **4882** | 54.78 | 40.31 | H | 1.54 | 56.32 | 17.77 | 74.0 | 54.0 | 17.7 | 36.2 |
| **4882** | 50.91 | 37.37 | V | 1.54 | 52.45 | 14.83 | 74.0 | 54.0 | 21.5 | 39.2 |
| **1626.5** | 51.92 | 40.80 | H | -10.55 | 41.37 | 6.17 | 74.0 | 54.0 | 32.6 | 47.8 |
| **1626.5** | 55.30 | 43.87 | V | -10.55 | 44.75 | 9.24 | 74.0 | 54.0 | 29.3 | 44.8 |
| **2480 MHz (High Channel)** | | | | | | | | | | |
| **4960** | 55.62 | 41.05 | H | 1.67 | 57.29 | 18.64 | 74.0 | 54.0 | 16.7 | 35.4 |
| **4960** | 50.83 | 36.88 | V | 1.67 | 52.50 | 14.47 | 74.0 | 54.0 | 21.5 | 39.5 |
| **2483.5** | 46.57 | 34.57 | H | -5.94 | 40.63 | 4.55 | 74.0 | 54.0 | 33.4 | 49.5 |
| **2483.5** | 46.65 | 34.40 | V | -5.94 | 40.71 | 4.38 | 74.0 | 54.0 | 33.3 | 49.6 |
| **1652.6** | 51.21 | 41.23 | H | -10.41 | 40.80 | 6.74 | 74.0 | 54.0 | 33.2 | 47.3 |
| **1652.6** | 52.43 | 41.96 | V | -10.41 | 42.02 | 7.47 | 74.0 | 54.0 | 32.0 | 46.5 |

### 7.5.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

$CF_T$ = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
$R_U$ = Uncorrected Reading
$R_C$ = Corrected Level
AF = Antenna Factor
CA = Cable Attenuation
AG = Amplifier Gain
DC = Duty Cycle Correction Factor

**Example Calculation: Peak (GFSK - 1Mbps) ZPOS**
Corrected Level: 58.17 + 1.41 = 59.58dBuV
Margin: 74dBuV – 59.58dBuV = 14.4dB

**Example Calculation: Average (GFSK - 1Mbps) ZPOS**
Corrected Level: 47.85 + 1.41 - 24.08 = 25.18dBuV
Margin: 54dBuV – 25.18dBuV = 28.8dB

## 8 CONCLUSION

In the opinion of ACS, Inc. the BCT, manufactured by Neptune Technology Group, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210 as applicable to the Bluetooth radio characteristics.

# END REPORT