**Amber Helm Development L.C.**
92723 Michigan Hwy-152
Sister Lakes, Michigan 49047 USA
Tel: 888-847-8027

# EMC Test Report

**PBS9-WR2008TX**
Issued: **April 17, 2020**

regarding

**USA: CFR Title 47, Part 15.247** (Emissions)
**Canada: ISED RSS-247v2** (Emissions)

for

# GNMOD090004

**Category: BLE Lock Module**

Judgments:
**15.247/RSS-247v2 Compliant Transmitter**
Testing Completed: April 14, 2020

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

## PassiveBolt, Inc.

330 E. Liberty St., Suite 3D, Ann Arbor Michigan 48104 USA
Phone: +1 (734) 972-0306, Fax: none
Contact: Kabir Maiga, kabir@passivebolt.com

Data Recorded by: Dr. Joseph Brunett, EMC-002790-NE

Reviewed by: Gordon Helm, EMC-002401-NE

Prepared by: Dr. Joseph Brunett, EMC-002790-NE

Date of Issue: April 17, 2020

## Revision History

| Rev. No. | Date | Details | Revised By |
|---|---|---|---|
| r0 | April 17, 2020 | Initial Draft. | J. Brunett |
| r1 | June 2, 2020 | Include AC Mains cond. | J. Brunett |

## Contents

## List of Tables



## List of Figures

# 1 Test Report Scope and Limitations

## 1.1 Laboratory Authorization

Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: US5348 and US5356) and with ISED Canada, Ottawa, ON (File Ref. No: 3161A and 24249). Amber Helm Development L.C. holds accreditation under NVLAP Lab Code 200129-0.

## 1.2 Report Retention

For equipment verified to comply with the regulations herein, the manufacturer is obliged to retain this report with the product records for the life of the product, and no less than ten years. A copy of this Report will remain on file with this laboratory until May 2030.

## 1.3 Subcontracted Testing

This report does not contain data produced under subcontract.

## 1.4 Test Data

This test report contains data included within the laboratories scope of accreditation.

## 1.5 Limitation of Results

The test results contained in this report relate only to the item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require reevaluation.

## 1.6 Copyright



## 1.7 Endorsements

This report shall not be used to claim product endorsement by any accrediting, regulatory, or governmental agency.

### 1.8 Test Location

The EUT was fully tested by **Amber Helm Development L.C.**, headquartered at 92723 Michigan Hwy-152, Sister Lakes, Michigan 49047 USA. Table 1 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1: Test Site List.

| Description | Location | Quality Num. |
|---|---|---|
| OATS (3 meter) | 3615 E Grand River Rd., Williamston, Michigan 48895 | OATSC |

### 1.9 Traceability and Equipment Used

Pertinent test equipment used for measurements at this facility is listed in Table 2. The quality system employed at Amber Helm Development L.C. has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 2: Equipment List.

| Description | Manufacturer/Model | SN | Quality Num. | Cal/Ver By / Date Due |
|---|---|---|---|---|
| Biconical | EMCO / 93110B | 9802-3039 | BICEMCO01 | Keysight / Aug-2020 |
| Log Periodic Antenna | EMCO / 3146 | 9305-3614 | LOGEMCO01 | Keysight / Aug-2020 |
| BNC-BNC Coax | WRTL / RG58/U | 001 | CAB001-BLACK | AHD / Jul-2020 |
| 3.5-3.5MM Coax | PhaseFlex / PhaseFlex | 001 | CAB015-PURP | AHD / Jul-2020 |
| Spectrum Analyzer | R & S / FSV30 | 101660 | RSFSV30001 | RS / Apr-2021 |
| Quad Ridge Horn | Singer / A6100 | C35200 | HQR1TO18S01 | Keysight / Aug-2020 |
| K-Band Horn | JEF / NRL Std. | 001 | HRNK01 | AHD / Jul-2020 |
| LISN | Solar / 8012-50-R-24-BNC | 970917 | LISNB | AHD / March-2021 |

# 2 Test Specifications and Procedures

## 2.1 Test Specification and General Procedures

The goal of PassiveBolt, Inc. is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the PassiveBolt, Inc. GNMOD090004 for compliance to:

| **Country/Region** | **Rules or Directive** | **Referenced Section(s)** |
|---|---|---|
| United States | Code of Federal Regulations | CFR Title 47, Part 15.247 |
| Canada | ISED Canada | ISED RSS-247v2 |

It has been determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

| | |
|---|---|
| ANSI C63.4:2014 | "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" |
| ANSI C63.10:2013 | "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices" |
| TP0102RA | "AHD Internal Document TP0102 - Radiated Emissions Test Procedure" |
| TP0106RC | "AHD Internal Document TP0106 - Emissions Measurement Procedures (above 40 GHz)" |
| ISED Canada | "The Measurement of Occupied Bandwidth" |
| ICES-003; Issue 6 (2016) | "Information Technology Equipment (ITE) - Limits and methods of measurement" |

# 3 Configuration and Identification of the Equipment Under Test

## 3.1 Description and Declarations

The EUT is BLE radio module for use in electronic door locks. The EUT is approximately 5.6 x 13.5 x 1.5 cm in dimension, and is depicted in Figure 1. It is powered by 6 VDC host chassis alkaline batteries. This device is intended to be installed by the manufacturer in their own electronic door locks. Table 3 outlines provider declared EUT specifications.

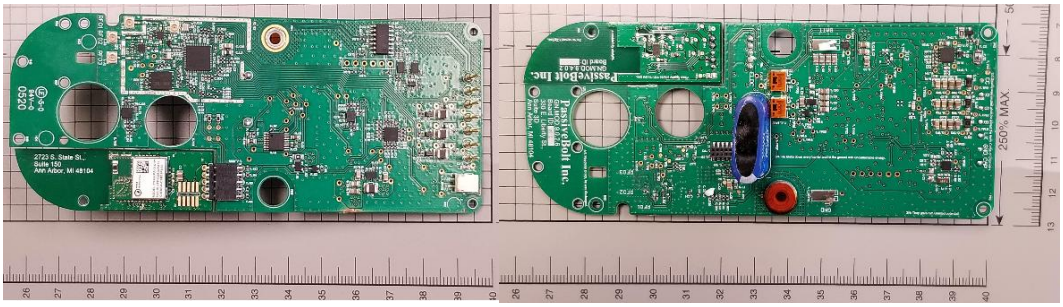


Figure 1: Photos of EUT.

Table 3: EUT Declarations.

| **General Declarations** | |
|---|---|
| **Equipment Type:** | BLE Lock Module |
| **Country of Origin:** | USA |
| **Nominal Supply:** | 6 VDC |
| **Oper. Temp Range:** | Not Declared |
| **Frequency Range:** | 2402 – 2480 MHz |
| **Antenna Dimension:** | Not Declared |
| **Antenna Type:** | Dipole, Patch |
| **Antenna Gain:** | 3 dBi (patch, dipole) |
| **Number of Channels:** | 40 |
| **Channel Spacing:** | 2 MHz |
| **Alignment Range:** | Not Declared |
| **Type of Modulation:** | GFSK (1, 2MBps) |
| | |
| **United States** | |
| **FCC ID Number:** | 2AV6C-GNMOD090004 |
| **Classification:** | DTS |
| | |
| **Canada** | |
| **IC Number:** | 26054-GNMOD090004 |
| **Classification:** | Spread Spectrum Device (2400-2483.5MHz) |

### 3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

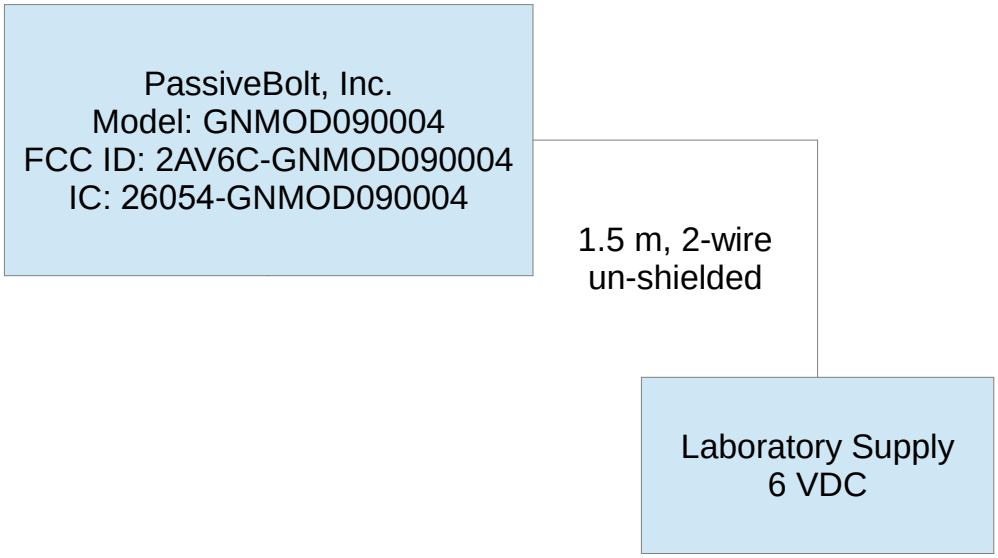



Figure 2: EUT Test Configuration Diagram.

### 3.1.2 Modes of Operation

The EUT is capable of operating as a BLE control module for use in host door lock devices manufactured only by PassiveBolt, Inc. The EUT includes 3 BLE ports, each individually switched from the single onboard BLE radio. Host devices must be evaluated by the manufacturer following FCC KDB 996369 guidelines. In addition to its BLE radio functionality, the EUT is also tested herein when co-located with a pre-certified ZigBee transceiver (FCC ID: XFF-CSB04PA1X, IC: 8365A-CSB04PA1X). Only a single BLE port can operate at one time. Full digital spurious emissions, including worst case spurious from the pre-certified Zigbee radio, are reported herein. Both the integral BLE and the Zigbee module are capable of simultaneous transmission, and were both set to actively transmit while the EUT was fully tested.

### 3.1.3 Variants

There is only a single electrical version of the EUT, as tested.

### 3.1.4 Test Samples

Two samples of the EUT were provided for testing, both capable of CW and modulated transmission of the BLE radio via a mobile application using the BLE link. Mobile application also allowed for activation of the co-located precertified ZigBee transceiver.

### 3.1.5 Functional Exerciser

Normal operating EUT functionality was verified by observation of transmitted signal. Access keycards were provided to place the EUT into CW transmitting modes as well as for normal access testing.

### 3.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory. Pretesting on the samples provided indicated that the worst case configuration for emissions was with the dipole antenna populated on the BLE ports and at the 1 MBps modulation rate, for both harmonic and digital spurious emissions.

### 3.1.7 Production Intent

The EUT appears to be a production ready sample.

### 3.1.8 Declared Exemptions and Additional Product Notes

This testing is performed on the EUT as a module, intended for installation into other host products manufactured by PassiveBolt, Inc.. It is the manufacturer's responsibility to verify that all end (host) products into which this module is installed are fully compliant. EUT was tested with two distinct antennas, a 3 dBi Patch antenna (PassiveBolt PN: GN.MOD.9.1.1.4) and a 3 dBi Dipole antenna (PassiveBolt PN: W177970AS14).

# 4 Emissions

## 4.1 General Test Procedures

### 4.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our screen room. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.8 are employed. After pre-scan, emission measurements are made on the test site of record. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded. If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied.

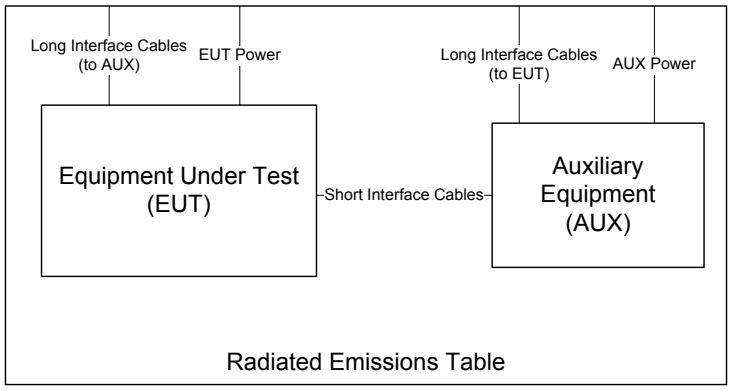



Figure 3: Radiated Emissions Diagram of the EUT.

For devices with intentional emissions below 30 MHz, a shielded loop antenna and/or E-field and H-Field broadband probes are used depending on the regulations. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, the broadband probes employed are 10cm diameter single-axis shielded transducers and measurements are repeated and summed over three axes.

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through $360^o$ in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain or broadband ridge-horn antennas on our OATS with a $4 \times 5$ m rectangle of ECCOSORB absorber covering the OATS ground screen and a 1.5m table height. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dB$\mu$V/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where $P_R$ is the power recorded on spectrum analyzer, in dBm, $K_A$ is the test antenna factor in dB/m, $K_G$ is the combined pre-amplifier gain and cable loss in dB, $K_E$ is duty correction factor (when applicable) in dB, and $C_F$ is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

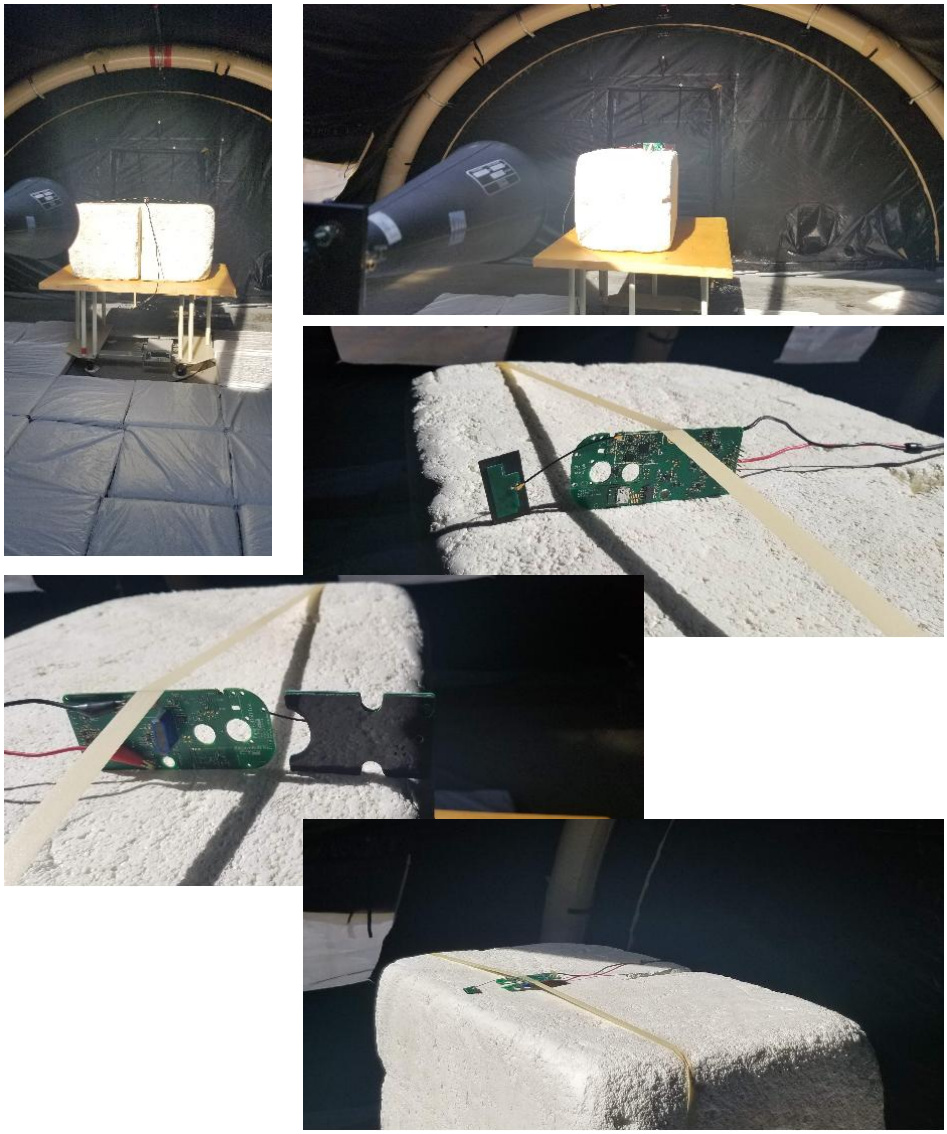


Figure 4: Radiated Emissions Test Setup Photograph(s).

### 4.1.2 Conducted Emissions Test Setup and Procedures

**Transmit Antenna Port Conducted Emissions** At least one sample EUT supplied for testing was provided with a 50Ω antenna port. Conducted transmit chain emissions measurements (where applicable) are made by connecting the EUT antenna port directly to the test receiver port. Photographs of the test setup employed are depicted in Figure 5.

Figure 5: Conducted RF Test Setup Photograph(s).

**AC Port Conducted Spurious** For this device, AC power line conducted emissions are measured in our screen room. If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.4 / CISPR 22 are employed. Alternatively, an on-table layout more representative of actual use may be employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 6.

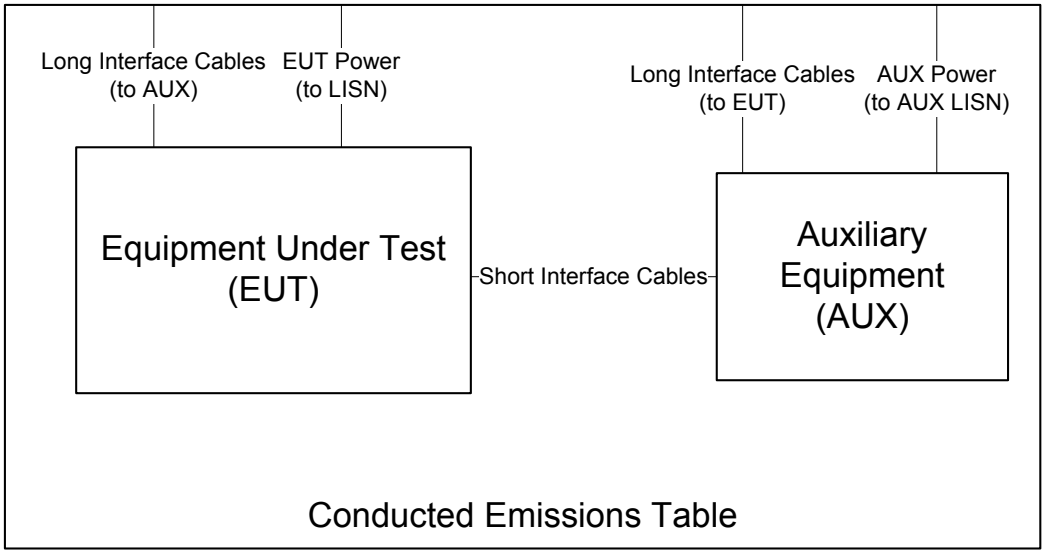



Figure 6: Conducted Emissions Setup Diagram of the EUT.

Conducted emissions are measured and recorded for each AC mains power source over the spectrum 0.15 MHz to 30 MHz for both the ungrounded (HI/PHASE) and grounded (LO/GND) conductors with the EUT placed in its highest current draw operating mode(s). The test receiver is set to peak-hold mode in order to record the peak emissions throughout the course of functional operation. Only if an emission exceeds or is near the limit are quasi-peak and average detection applied. Photographs of the test setup employed are depicted in Figure 7.

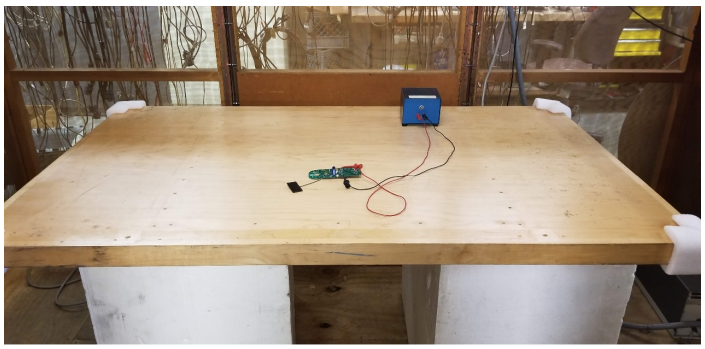


Figure 7: Conducted Emissions Test Setup Photograph(s).

The EUT is not subject to measurement of power line conducted emissions as it is powered solely by its internal battery.

### 4.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report.

In the case the EUT is designed for operation from a battery power source, the extreme test voltages are evaluated over the range specified in the test standard; no less than ±10% of the nominal battery voltage declared by the manufacturer. For all battery operated equipment, worst case intentional and spurious emissions are re-checked employing a new (fully charged) battery.

## 4.2 Intentional Emissions

### 4.2.1 Duty and Transmission Cycle, Pulsed Operation

The details and results of testing the EUT for pulsed operation are summarized in Table 4. Plots showing the measurements made to obtain these values are provided in Figure 8.

Table 4: Pulsed Emission Characteristics (Duty Cycle).

| **Frequency Range** | **Det** | **IFBW** | **VBW** | **Test Date:** | 11-Apr-20 |
|---|---|---|---|---|---|
| f > 1 000 MHz | Pk | 3 MHz | 10 MHz | **Test Engineer:** | Joseph Brunett |
| | | | | **EUT** | PassiveBolt S9 |
| | | | | **Meas. Distance:** | Conducted |

| **Pulsed Operation / Duty Cycle** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Transmit Mode | Symbol Rate (Msym/s) | Data Rate (Mbps) | Voltage (V) | Oper. Freq (MHz) | Tx Cycle Time* (ms) | On-Time* (ms) | Duty Cycle (%) | Power Duty Correction (dB) |
| CM | - | - | 3.0 | 2440.0 | - | - | - | 0.0 |

* Duty cycle is not applied for demonstrating compliance for this device. Only peak data is used to demonstrate compliance.

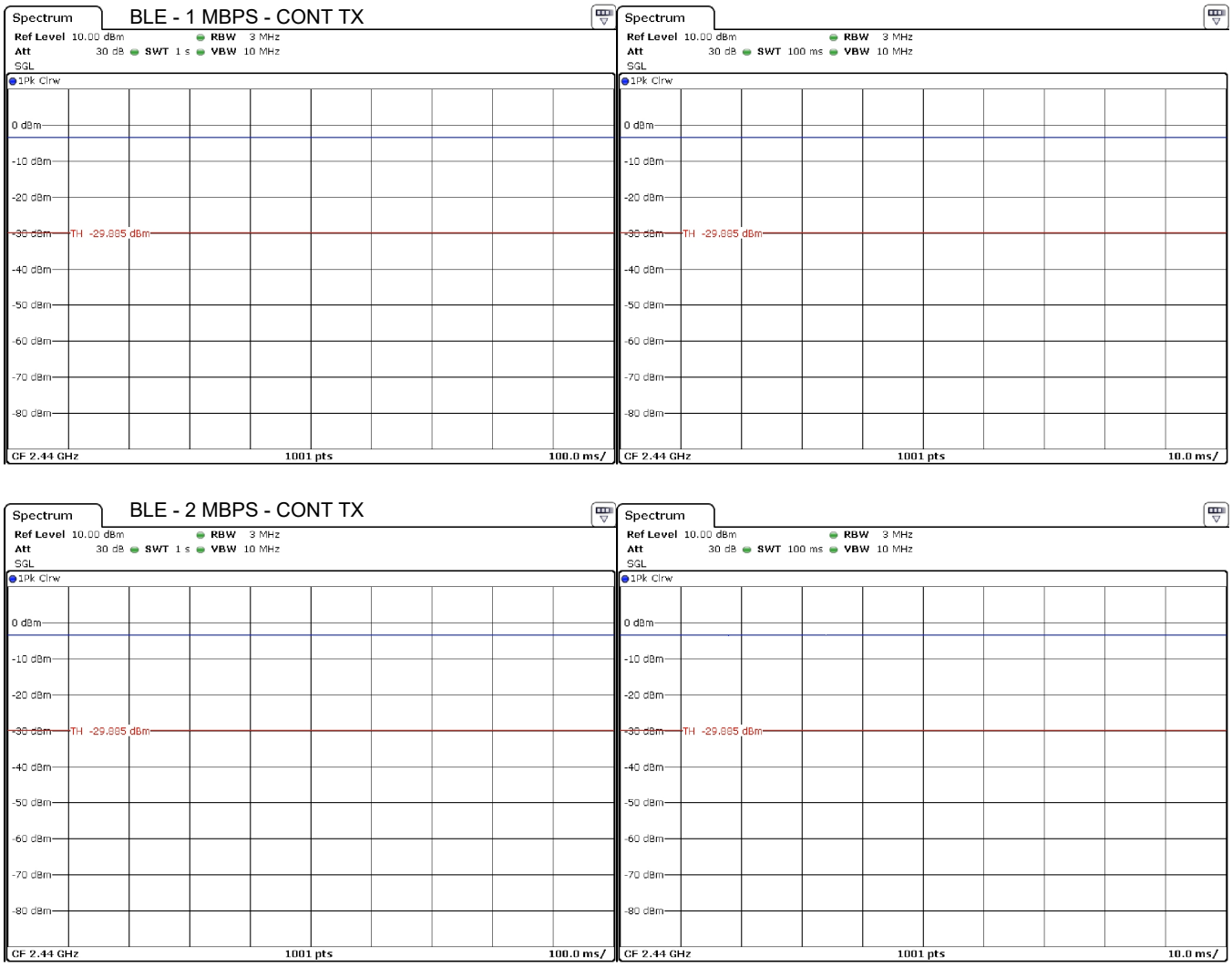



Figure 8: Pulsed Emission Characteristics (Duty Cycle).

### 4.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available packet length and minimum packet spacing. Radiated emissions are recorded following the test procedures listed in Section 2.1. The 6 dB bandwidth is measured for the lowest, middle, and highest channels available. The 99% emission bandwidth per IC test procedures is also reported. The results of this testing are summarized in Table 5. Plots showing measurements employed obtain the emission bandwidths reported are provided in Figure 9.

Table 5: Intentional Emission Bandwidth.

| **Frequency Range** | **Det** | **IFBW** | **VBW** | | |
|---|---|---|---|---|---|
| f > 1 000 MHz | Pk | 30 kHz | 1 MHz | **Test Date:** | 04/05/20 |
| | | | | **Test Engineer:** | Joseph Brunett |
| | | | | **EUT** | PassiveBolt S9 |
| | | | | **Meas. Distance:** | Contucted |

| **Occupied Bandwidth** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Transmit Mode | Port* | Data Rate (Mbps) | Voltage (V) | Oper. Freq (MHz) | 6 dB BW (MHz) | 6 dB BW Limit (MHz) | 99% OBW (MHz) | 20 dB BW (MHz) | Pass/Fail |
| CM 1 Mbps | A | 1.0 | 3.0 | 2402.0 | 0.602 | 0.500 | 1.046 | 1.208 | Pass |
| | | | | 2440.0 | 0.646 | 0.500 | 1.052 | 1.208 | Pass |
| | | | | 2480.0 | 0.621 | 0.500 | 1.058 | 1.211 | Pass |
| CM 2 Mbps | A | 2.0 | 3.0 | 2402.0 | 1.165 | 0.500 | 2.116 | 1.208 | Pass |
| | | | | 2440.0 | 1.268 | 0.500 | 2.079 | 1.208 | Pass |
| | | | | 2480.0 | 1.202 | 0.500 | 2.131 | 1.211 | Pass |

* OBW was observed to be the same for all three BLE tx ports.

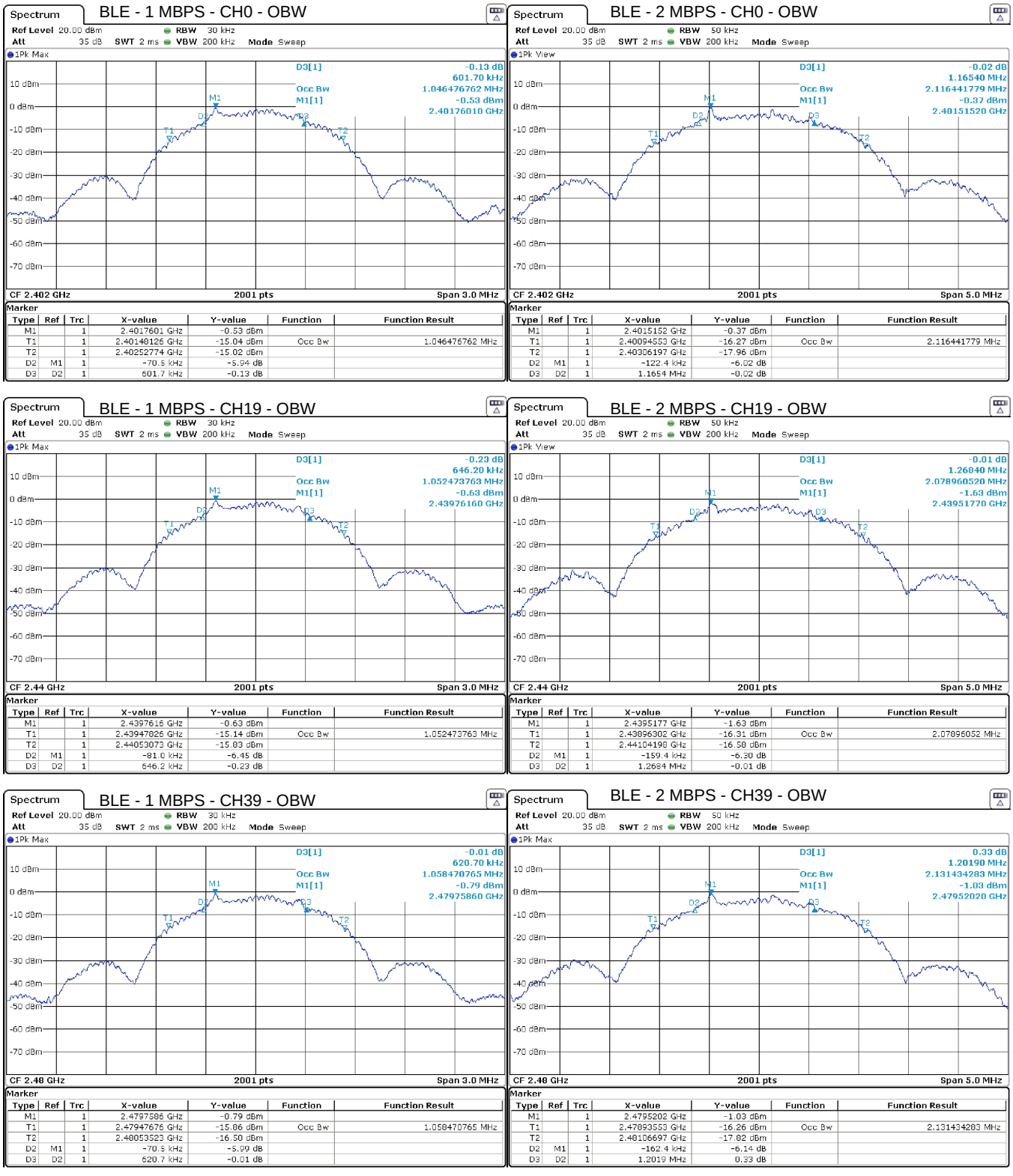



Figure 9: Intentional Emission Bandwidth.

### 4.2.3 Effective Isotropic Radiated Power

The EUT's radiated power is computed from antenna port conducted power measurements and the gain of the EUT antenna(s). Where the EUT is not sold with an antenna connector, a modified product has been provided including such. Peak conducted output power was measured directly from the EUT at the port where the antenna attaches. The test receiver bandwidth was set to be greater than the measured emission bandwidth of the EUT to capture the true peak. Antenna gain is either provided directly by the antenna manufacturer or measured by comparison between calculated EIRP and conducted output power. Table 6 details the results of these measurements. Plots showing conducted measurements made are depicted in Figure 10.

Table 6: Radiated Power Results.

| **Frequency Range** | **Det** | **IF Bandwidth** | **Video Bandwidth** | **Test Date:** | 5-Apr-20 |
|---|---|---|---|---|---|
| f > 1 000 MHz | Pk/Avg | 3 MHz | 10 MHz | **Test Engineer:** | J. Brunett |
| | | | | **EUT:** | PassiveBolt S9 |
| | | | | **Meas. Distance:** | conducted |

FCC/IC

| # | Mode | Channel | Freq. MHz | Ant. Used | Ant. Pol. | Table Azim. deg | Ant Height m | Ka dB/m | Kg dB | E3(Pk) dBµV/m | EIRP (Pk) dBm | Pout* (Pk) dBm | Ant Gain** dBi | EIRP (Avg) Limit dBm | Pass dB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CW Port 01 | L | 2402.0 | conducted | - | - | - | | | | -.4 | -3.4 | 3.0 | 30.0 | 30.4 |
| 2 | | M | 2440.0 | conducted | - | - | - | | | | -.4 | -3.4 | 3.0 | 30.0 | 30.4 |
| 3 | | H | 2480.0 | conducted | - | - | - | | | | -3.7 | -6.7 | 3.0 | 30.0 | 33.7 |
| 4 | CW Port 02 | L | 2402.0 | conducted | - | - | - | | | | -.9 | -3.9 | 3.0 | 30.0 | 30.9 |
| 5 | | M | 2440.0 | conducted | - | - | - | | | | -.6 | -3.6 | 3.0 | 30.0 | 30.6 |
| 6 | | H | 2480.0 | conducted | - | - | - | | | | -4.1 | -7.1 | 3.0 | 30.0 | 34.1 |
| 7 | CW Port 03 | L | 2402.0 | conducted | - | - | - | | | | -.8 | -3.8 | 3.0 | 30.0 | 30.8 |
| 8 | | M | 2440.0 | conducted | - | - | - | | | | -.5 | -3.5 | 3.0 | 30.0 | 30.5 |
| 9 | | H | 2480.0 | conducted | - | - | - | | | | -4.1 | -7.1 | 3.0 | 30.0 | 34.1 |
| # | Mode | Channel | Freq. MHz | Supply Voltage | Ant. Pol. | Table Azim. deg | Ant Height m | Ka dB/m | Kg dB | E3(Pk) dBµV/m | EIRP (Pk) dBm | Pout* (Pk) dBm | | | |
| 10 | CW Port 01 | L | 2402.0 | 6.6 | H/V | - | - | | | | | -3.4 | | | |
| 11 | | | 2402.0 | 6.0 | H/V | - | - | | | | | -3.4 | | | |
| 12 | | | 2402.0 | 5.4 | H/V | - | - | | | | | -3.4 | | | |
| 13 | | | | | | | | | | | | | | | |

* Measured conducted from the radio using conducted test sample.

** EUT was provided with two antennas, a PCB dipole antenna (3 dBi) and and a PCB patch antenna (3 dBi). Highest gain included here for computation of EIRP.

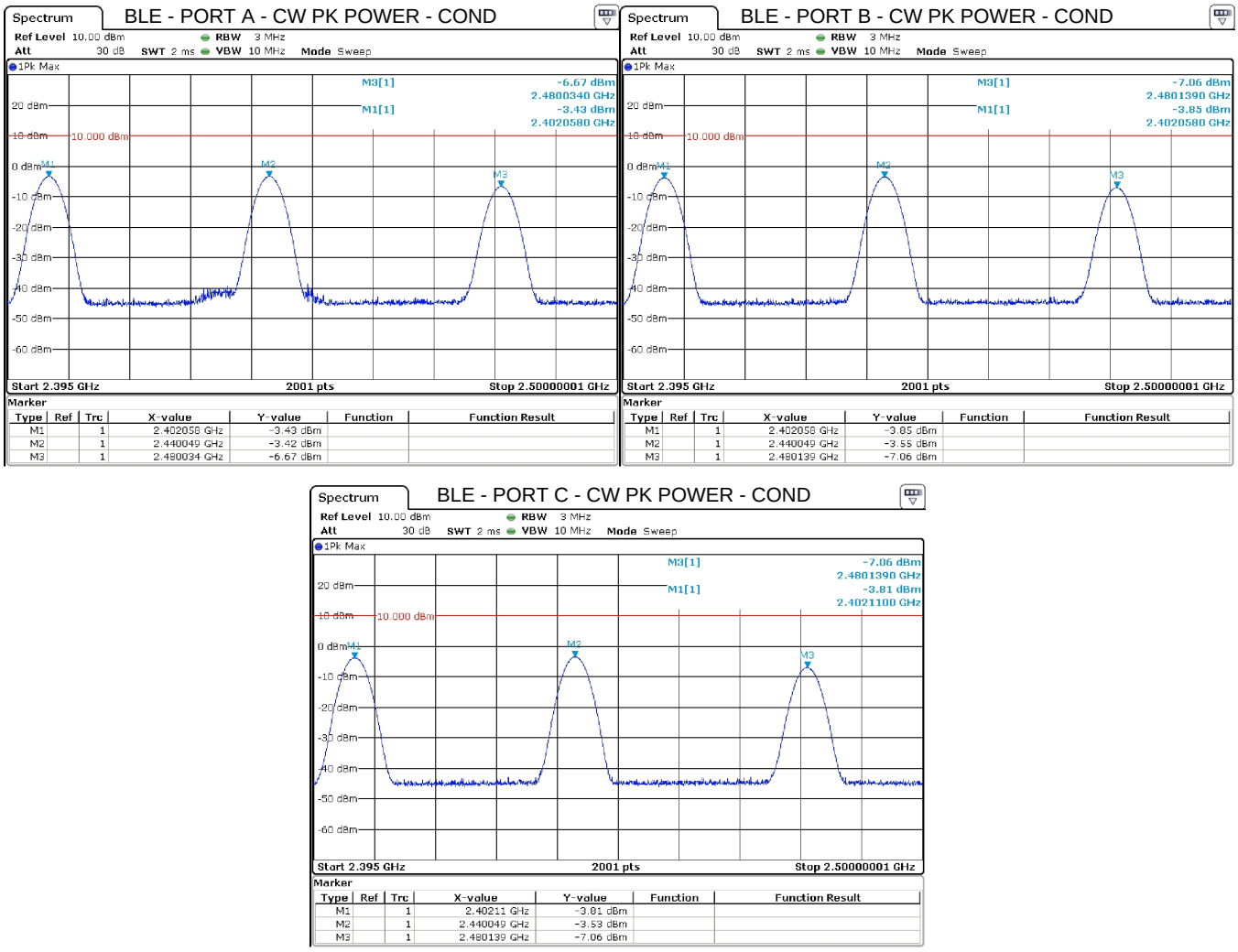



Figure 10: Conducted RF Power Plots

### 4.2.4 Power Spectral Density

For this test, the EUT was attached directly to the test receiver. Following FCC DTS measurement procedures, the emission spectrum is first scanned for maximum spectral peaks, the span and receiver bandwidth are then reduced until the power spectral density is measured in the prescribed receiver bandwidth. The results of this testing are summarized in Table 7. Plots showing how these measurements were made are depicted in Figure 11.

Table 7: Power Spectral Density Results.

| **Frequency Range** | **Detector** | **IF Bandwidth** | **Video Bandwidth** | **Test Date:** | 04/05/20 |
|---|---|---|---|---|---|
| 2400-2483.5 | Pk | 3 kHz | 10 kHz | **Test Engineer:** | Joseph Brunett |
| | | | | **EUT:** | PassiveBolt S9 |
| | | | | **Meas. Distance:** | Conducted |

| | | | | | | FCC/IC |
|---|---|---|---|---|---|---|
| Mode | Channel | Frequency (MHz) | Ant. Used | PSDcond (meas)* (dBm/3kHz) | PSD Limit (dBm/3kHz) | Pass By (dB) |
| CM 1 Mbps, Port 01 | L | 2402.0 | Cond. | -13.7 | 8.00 | 21.7 |
| | M | 2440.0 | Cond. | -13.6 | 8.00 | 21.6 |
| | H | 2480.0 | Cond. | -16.9 | 8.00 | 24.9 |
| CM 1 Mbps, Port 02 | L | 2402.0 | Cond. | -14.2 | 8.00 | 22.2 |
| | M | 2440.0 | Cond. | -14.1 | 8.00 | 22.1 |
| | H | 2480.0 | Cond. | -17.4 | 8.00 | 25.4 |
| CM 1 Mbps, Port 03 | L | 2402.0 | Cond. | -14.1 | 8.00 | 22.1 |
| | M | 2440.0 | Cond. | -14.3 | 8.00 | 22.3 |
| | H | 2480.0 | Cond. | -17.3 | 8.00 | 25.3 |

* PSD measured conducted out the the EUT antenna port following FCC DTS PKPSD procedure.

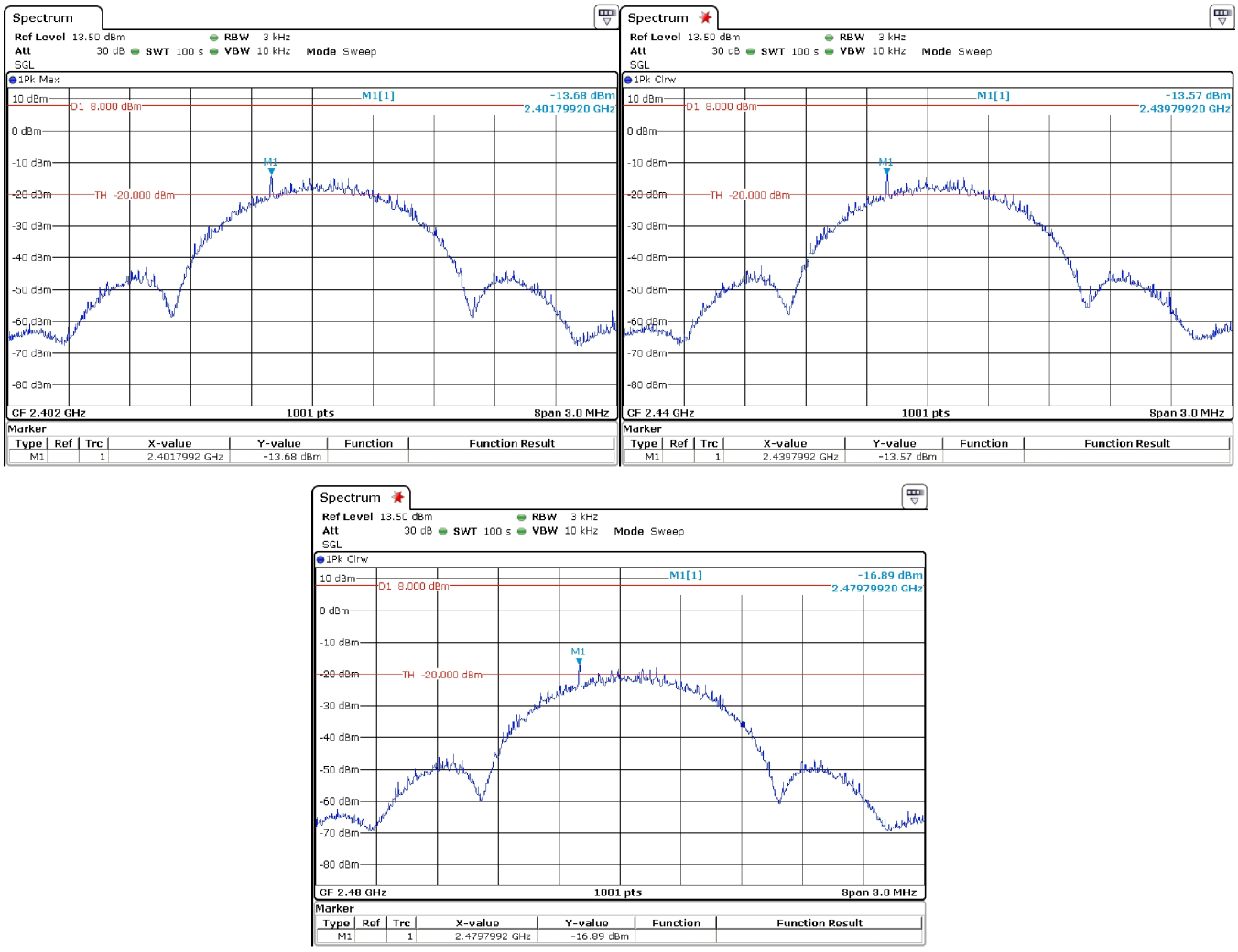



Figure 11: Power Spectral Density Plots.

## 4.3 Unintentional Emissions

### 4.3.1 Transmit Chain Radiated Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 8. Measurements are performed to 10 times the highest fundamental operating frequency.

Table 8(a): Transmit Chain Spurious Emissions.

| Frequency Range | Det | IF Bandwidth | Video Bandwidth | | |
|---|---|---|---|---|---|
| 25 MHz ≤ f ≤ 1 000 MHz | Pk/QPk | 120 kHz | 300 kHz | **Test Date:** | 15-Mar-20 |
| f > 1 000 MHz | Pk/Avg | 1 MHz | 3 MHz | **Test Engineer:** | J. Brunett |
| | | | | **EUT:** | PassiveBolt S9 |
| | | | | **Mode:** | Cont. Modulated, PORT 01, dipole ant |
| | | | | **Meas. Distance:** | 3m |

| | | | | | | | | | | | | | | FCC/IC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Freq. Start MHz | Freq. Stop MHz | Ant. Used | Ant. Pol. | Table Azim. deg | Ant Height m | Ka dB/m | Kg dB | E3(Pk) dBµV/m | E3 Pk Lim dBµV/m | E3(Avg) dBµV/m | E3 Avg Lim dBµV/m | Pass dB | Comments |
| 1 | Fundamental Restricted Band Edge (Low Side) | | | | | | | | | | | | | |
| 2 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 48.9 | 74.0 | | 54.0 | 5.1 | all channels; 1MBps, BLE Only |
| 3 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 47.7 | 74.0 | | 54.0 | 6.3 | all channels; 2MBps, BLE Only |
| 4 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 57.2 | 74.0 | 51.1 | 54.0 | 2.9 | all channels; 2MBps + ZigBee Active |
| 5 | Fundamental Restricted Band Edge (High Side) | | | | | | | | | | | | | |
| 6 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 49.2 | 74.0 | | 54.0 | 4.8 | all channels; 1MBps, BLE Only |
| 7 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 46.9 | 74.0 | | 54.0 | 7.1 | all channels; 2MBps, BLE Only |
| 8 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 58.3 | 74.0 | 52.3 | 54.0 | 1.7 | all channels; 2MBps + ZigBee Active |
| 9 | Harmonic / Spurious Emissions** | | | | | | | | | | | | | |
| 10 | 4804.0 | 4804.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.9 | 74.0 | | 54.0 | 8.1 | Wosrt case - CM 1MBps + ZigBee Active |
| 11 | 4880.0 | 4805.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 12 | 4960.0 | 4806.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.6 | 74.0 | | 54.0 | 8.4 | Wosrt case - CM 1MBps + ZigBee Active |
| 13 | 4000.0 | 6000.0 | HQR1TO18S01 | H/V | all | all | 32.6 | -0.6 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 14 | 6000.0 | 8400.0 | HQR1TO18S01 | H/V | all | all | 34.3 | -0.8 | 41.1 | 74.0 | | 54.0 | 12.9 | max all, CM, noise |
| 15 | 8400.0 | 12500.0 | HQR1TO18S01 | H/V | all | all | 35.6 | -1.1 | 42.4 | 74.0 | | 54.0 | 11.6 | max all, CM, noise |
| 16 | 12500.0 | 18000.0 | HQR1TO18S01 | H/V | all | all | 34.2 | -1.6 | 43.6 | 74.0 | | 54.0 | 10.4 | max all, CM, noise |
| 17 | 18000.0 | 26500.0 | HRNK01 | H/V | all | all | 32.0 | 0.0 | 41.4 | 74.0 | | 54.0 | 12.6 | max all, CM, noise |
| 18 | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | |

EUT measured in each of Flat, Side, End orientations. Worst case emission from all three orientations reported here.

** No other spurious emissions from the EUT were observed within 20 dB of the regulatory limit.

## Table 8(b): Transmit Chain Spurious Emissions.

| Frequency Range | Det | IF Bandwidth | Video Bandwidth |
|---|---|---|---|
| 25 MHz ≤ f ≤ 1 000 MHz | Pk/QPk | 120 kHz | 300 kHz |
| f > 1 000 MHz | Pk/Avg | 1 MHz | 3 MHz |

**Test Date:** 15-Mar-20
**Test Engineer:** J. Brunett
**EUT:** PassiveBolt S9
**Mode:** Cont. Modulated, PORT 02, dipole ant
**Meas. Distance:** 3m

| | | | | | | | | | | | | | | FCC/IC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Freq. Start MHz | Freq. Stop MHz | Ant. Used | Ant. Pol. | Table Azim. deg | Ant Height m | Ka dB/m | Kg dB | E3(Pk) dBµV/m | E3 Pk Lim dBµV/m | E3(Avg) dBµV/m | E3 Avg Lim dBµV/m | Pass dB | Comments |
| 1 | Fundamental Restricted Band Edge (Low Side) | | | | | | | | | | | | | |
| 2 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 47.4 | 74.0 | | 54.0 | 6.6 | all channels; 1MBps, BLE Only |
| 3 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 46.3 | 74.0 | | 54.0 | 7.7 | all channels; 2MBps, BLE Only |
| 4 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 55.9 | 74.0 | 50.2 | 54.0 | 3.8 | all channels; 2MBps + ZigBee Active |
| 5 | Fundamental Restricted Band Edge (High Side) | | | | | | | | | | | | | |
| 6 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 48.6 | 74.0 | | 54.0 | 5.4 | all channels; 1MBps, BLE Only |
| 7 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 47.1 | 74.0 | | 54.0 | 6.9 | all channels; 2MBps, BLE Only |
| 8 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 57.9 | 74.0 | 52.0 | 54.0 | 2.0 | all channels; 2MBps + ZigBee Active |
| 9 | Harmonic / Spurious Emissions** | | | | | | | | | | | | | |
| 10 | 4804.0 | 4804.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.9 | 74.0 | | 54.0 | 8.1 | Wosrt case - CM 1MBps + ZigBee Active |
| 11 | 4880.0 | 4805.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 12 | 4960.0 | 4806.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.6 | 74.0 | | 54.0 | 8.4 | Wosrt case - CM 1MBps + ZigBee Active |
| 13 | 4000.0 | 6000.0 | HQR1TO18S01 | H/V | all | all | 32.6 | -0.6 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 14 | 6000.0 | 8400.0 | HQR1TO18S01 | H/V | all | all | 34.3 | -0.8 | 40.9 | 74.0 | | 54.0 | 13.1 | max all, CM, noise |
| 15 | 8400.0 | 12500.0 | HQR1TO18S01 | H/V | all | all | 35.6 | -1.1 | 42.4 | 74.0 | | 54.0 | 11.6 | max all, CM, noise |
| 16 | 12500.0 | 18000.0 | HQR1TO18S01 | H/V | all | all | 34.2 | -1.6 | 44.2 | 74.0 | | 54.0 | 9.8 | max all, CM, noise |
| 17 | 18000.0 | 26500.0 | HRNK01 | H/V | all | all | 32.0 | 0.0 | 42.1 | 74.0 | | 54.0 | 11.9 | max all, CM, noise |
| 18 | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | |

EUT measured in each of Flat, Side, End orientations. Worst case emission from all three orientations reported here.
** No other spurious emissions from the EUT were observed within 20 dB of the regulatory limit.

## Table 8(c): Transmit Chain Spurious Emissions.

| Frequency Range | Det | IF Bandwidth | Video Bandwidth |
|---|---|---|---|
| 25 MHz ≤ f ≤ 1 000 MHz | Pk/QPk | 120 kHz | 300 kHz |
| f > 1 000 MHz | Pk/Avg | 1 MHz | 3 MHz |

**Test Date:** 15-Mar-20
**Test Engineer:** J. Brunett
**EUT:** PassiveBolt S9
**Mode:** Cont. Modulated, PORT 03, dipole ant
**Meas. Distance:** 3m

| | | | | | | | | | | | | | | FCC/IC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | Freq. Start MHz | Freq. Stop MHz | Ant. Used | Ant. Pol. | Table Azim. deg | Ant Height m | Ka dB/m | Kg dB | E3(Pk) dBµV/m | E3 Pk Lim dBµV/m | E3(Avg) dBµV/m | E3 Avg Lim dBµV/m | Pass dB | Comments |
| 1 | Fundamental Restricted Band Edge (Low Side) | | | | | | | | | | | | | |
| 2 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 47.2 | 74.0 | | 54.0 | 6.8 | all channels; 1MBps, BLE Only |
| 3 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 46.8 | 74.0 | | 54.0 | 7.2 | all channels; 2MBps, BLE Only |
| 4 | 2390.0 | 2390.0 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.5 | -0.3 | 54.9 | 74.0 | 50.2 | 54.0 | 3.8 | all channels; 2MBps + ZigBee Active |
| 5 | Fundamental Restricted Band Edge (High Side) | | | | | | | | | | | | | |
| 6 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 48.9 | 74.0 | | 54.0 | 5.1 | all channels; 1MBps, BLE Only |
| 7 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 48.1 | 74.0 | | 54.0 | 5.9 | all channels; 2MBps, BLE Only |
| 8 | 2483.5 | 2483.5 | HQR1TO18S01 | H/V | 0 | 1.5 | 30.8 | -0.3 | 58.2 | 74.0 | 52.1 | 54.0 | 1.9 | all channels; 2MBps + ZigBee Active |
| 9 | Harmonic / Spurious Emissions** | | | | | | | | | | | | | |
| 10 | 4804.0 | 4804.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.6 | 74.0 | | 54.0 | 8.4 | Wosrt case - CM 1MBps + ZigBee Active |
| 11 | 4880.0 | 4805.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 45.9 | 74.0 | | 54.0 | 8.1 | Wosrt case - CM 1MBps + ZigBee Active |
| 12 | 4960.0 | 4806.0 | HQR1TO18S01 | H/V | all | 1.5 | 32.3 | -0.5 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 13 | 4000.0 | 6000.0 | HQR1TO18S01 | H/V | all | all | 32.6 | -0.6 | 46.3 | 74.0 | | 54.0 | 7.7 | Wosrt case - CM 1MBps + ZigBee Active |
| 14 | 6000.0 | 8400.0 | HQR1TO18S01 | H/V | all | all | 34.3 | -0.8 | 42.9 | 74.0 | | 54.0 | 11.1 | max all, CM, noise |
| 15 | 8400.0 | 12500.0 | HQR1TO18S01 | H/V | all | all | 35.6 | -1.1 | 43.7 | 74.0 | | 54.0 | 10.3 | max all, CM, noise |
| 16 | 12500.0 | 18000.0 | HQR1TO18S01 | H/V | all | all | 34.2 | -1.6 | 44.3 | 74.0 | | 54.0 | 9.7 | max all, CM, noise |
| 17 | 18000.0 | 26500.0 | HRNK01 | H/V | all | all | 32.0 | 0.0 | 42.9 | 74.0 | | 54.0 | 11.1 | max all, CM, noise |
| 18 | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | |

EUT measured in each of Flat, Side, End orientations. Worst case emission from all three orientations reported here.
** No other spurious emissions from the EUT were observed within 20 dB of the regulatory limit.

### 4.3.2 Relative Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions relative to the fundamental in a 100 kHz receiver bandwidth (at the nominal voltage and temperature) are provided in Figure 12 below.

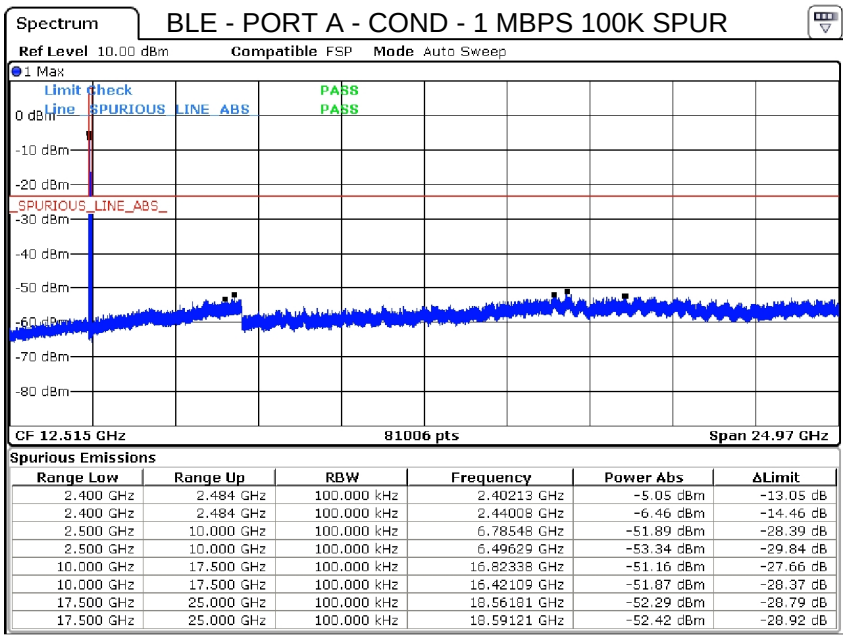
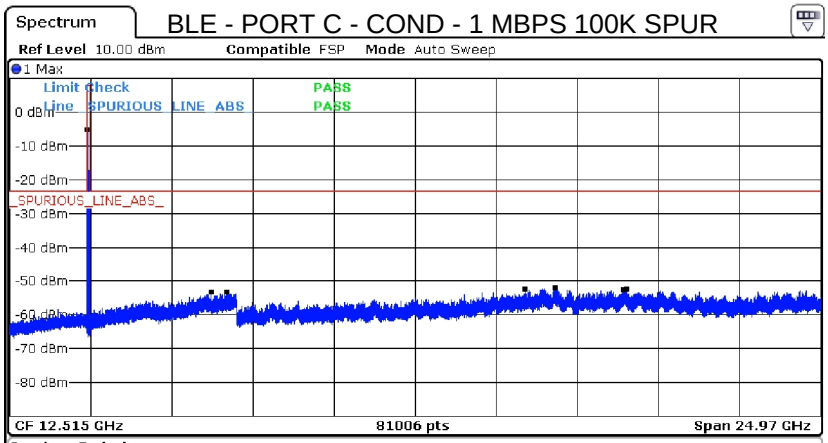



Figure 12(a): Conducted Transmitter Emissions Measured.




Spurious Emissions

| Range Low | Range Up | RBW | Frequency | Power Abs | ΔLimit |
|---|---|---|---|---|---|
| 2.400 GHz | 2.484 GHz | 100.000 kHz | 2.43983 GHz | -5.24 dBm | -13.24 dB |
| 2.400 GHz | 2.484 GHz | 100.000 kHz | 2.40179 GHz | -5.25 dBm | -13.25 dB |
| 2.500 GHz | 10.000 GHz | 100.000 kHz | 6.23080 GHz | -53.10 dBm | -29.60 dB |
| 2.500 GHz | 10.000 GHz | 100.000 kHz | 6.68648 GHz | -53.33 dBm | -29.83 dB |
| 10.000 GHz | 17.500 GHz | 100.000 kHz | 16.80088 GHz | -51.95 dBm | -28.45 dB |
| 10.000 GHz | 17.500 GHz | 100.000 kHz | 15.90781 GHz | -52.28 dBm | -28.78 dB |
| 17.500 GHz | 25.000 GHz | 100.000 kHz | 19.02199 GHz | -52.19 dBm | -28.69 dB |
| 17.500 GHz | 25.000 GHz | 100.000 kHz | 18.91549 GHz | -52.49 dBm | -28.99 dB |

Figure 12(b): Conducted Transmitter Emissions Measured.

### 4.3.3 General Radiated Spurious

The results for the measurement of general spurious emissions (emissions arising from digital circuitry) at the nominal voltage and temperature are provided in Table 9. Radiation from digital components are measured up to 1000 MHz or to the highest frequency required by the applied standards, whichever is greater.

Table 9: Radiated Digital Spurious Emissions.

| Frequency Range | Det | IF Bandwidth | Video Bandwidth | | |
|---|---|---|---|---|---|
| 25 MHz ≤ f ≤ 1 000 MHz | Pk/QPk | 120 kHz | 300 kHz | **Test Date:** | 15-Mar-20 |
| f > 1 000 MHz | Pk | 1 MHz | 3 MHz | **Test Engineer:** | J. Brunett |
| f > 1 000 MHz | Avg | 1 MHz | 10kHz | **EUT:** | PassiveBolt S9 |
| | | | | **EUT Mode:** | Active, Port 01 Worst Case, Dipole Ant |
| | | | | **Meas. Distance:** | 3 meters |

**Digital Spurious Emissions** FCC/IC + CE(CISPR)

| | Test | Antenna | | Ant | Table | | | E-Field @ 3m** | | FCC/IC Class B | | CE Class B | | FCC/IC Class A | | CE Class A | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Freq. | QN | Test | Ht. | Angle | Ka | Kg | Pk | QPk/Avg | E3lim | Pass | E3lim | Pass | E3lim | Pass | E3lim | Pass | |
| # | MHz | Used | Pol. | m | deg | dB/m | dB | dBµV/m | dBµV/m | dBµV/m | dB | dBµV/m | dB | dBµV/m | dB | dBµV/m | dB | Comments |
| 1 | 82.1 | BICEMCO01 | H | 1.2 | 90.0 | 9.5 | -.5 | 32.8 | | 40.0 | 7.2 | 40.5 | 7.7 | 49.5 | 16.7 | 50.5 | 17.7 | |
| 2 | 82.1 | BICEMCO01 | V | 1.0 | 90.0 | 9.5 | -.5 | 27.1 | | 40.0 | 12.9 | 40.5 | 13.4 | 49.5 | 22.4 | 50.5 | 23.4 | |
| 3 | 125.4 | BICEMCO01 | H | max all | max all | 11.9 | -.6 | 33.8 | | 43.5 | 9.7 | 40.5 | 6.7 | 54.0 | 20.2 | 50.5 | 16.7 | background |
| 4 | 125.4 | BICEMCO01 | H | max all | max all | 11.9 | -.6 | 30.9 | | 43.5 | 12.6 | 40.5 | 9.6 | 54.0 | 23.1 | 50.5 | 19.6 | background |
| 5 | 186.1 | BICEMCO01 | H | max all | max all | 14.6 | -.8 | 38.9 | | 43.5 | 4.6 | 40.5 | 1.6 | 54.0 | 15.1 | 50.5 | 11.6 | background |
| 6 | 186.1 | BICEMCO01 | V | max all | max all | 14.6 | -.8 | 36.2 | | 43.5 | 7.3 | 40.5 | 4.3 | 54.0 | 17.8 | 50.5 | 14.3 | background |
| 7 | 190.1 | BICEMCO01 | H | max all | max all | 14.9 | -.8 | 37.2 | | 43.5 | 6.3 | 40.5 | 3.3 | 54.0 | 16.8 | 50.5 | 13.3 | background |
| 8 | 190.1 | BICEMCO01 | V | max all | max all | 14.9 | -.8 | 36.7 | | 43.5 | 6.8 | 40.5 | 3.8 | 54.0 | 17.3 | 50.5 | 13.8 | background |
| 9 | 231.9 | LOGEMCO01 | H | max all | max all | 11.9 | -3.1 | 38.9 | | 46.0 | 7.1 | 47.5 | 8.6 | 56.9 | 18.0 | 57.5 | 18.6 | background |
| 10 | 231.9 | LOGEMCO01 | V | max all | max all | 11.9 | -3.1 | 39.9 | | 46.0 | 6.1 | 47.5 | 7.6 | 56.9 | 17.0 | 57.5 | 17.6 | background |
| 11 | 293.4 | LOGEMCO01 | H | max all | max all | 13.6 | -3.6 | 40.6 | | 46.0 | 5.4 | 47.5 | 6.9 | 56.9 | 16.3 | 57.5 | 16.9 | background |
| 12 | 293.4 | LOGEMCO01 | V | max all | max all | 13.6 | -3.6 | 41.7 | | 46.0 | 4.3 | 47.5 | 5.8 | 56.9 | 15.2 | 57.5 | 15.8 | background |
| 13 | 361.2 | LOGEMCO01 | H | max all | max all | 15.0 | -4.1 | 41.2 | | 46.0 | 4.8 | 47.5 | 6.3 | 56.9 | 15.7 | 57.5 | 16.3 | background |
| 14 | 361.2 | LOGEMCO01 | V | max all | max all | 15.0 | -4.1 | 38.2 | | 46.0 | 7.8 | 47.5 | 9.3 | 56.9 | 18.7 | 57.5 | 19.3 | background |
| 15 | 440.0 | LOGEMCO01 | H | max all | max all | 16.4 | -4.6 | 39.8 | | 46.0 | 6.2 | 47.5 | 7.7 | 56.9 | 17.1 | 57.5 | 17.7 | background |
| 16 | 440.0 | LOGEMCO01 | V | max all | max all | 16.4 | -4.6 | 38.2 | | 46.0 | 7.8 | 47.5 | 9.3 | 56.9 | 18.7 | 57.5 | 19.3 | background |
| 17 | 551.0 | LOGEMCO01 | H | max all | max all | 18.3 | -5.3 | 41.9 | | 46.0 | **4.1** | 47.5 | 5.6 | 56.9 | 15.0 | 57.5 | 15.6 | background |
| 18 | 763.0 | LOGEMCO01 | H | max all | max all | 21.1 | -6.4 | 38.7 | | 46.0 | 7.3 | 47.5 | 8.8 | 56.9 | 18.2 | 57.5 | 18.8 | background |
| 19 | 763.0 | LOGEMCO01 | V | max all | max all | 21.1 | -6.4 | 33.9 | | 46.0 | 12.1 | 47.5 | 13.6 | 56.9 | 23.0 | 57.5 | 23.6 | background |
| 20 | 993.0 | LOGEMCO01 | H | max all | max all | 24.0 | -7.4 | 34.7 | | 54.0 | 19.3 | 47.5 | 12.8 | 60.0 | 25.3 | 57.5 | 22.8 | background |
| 21 | 993.0 | LOGEMCO01 | V | max all | max all | 24.0 | -7.4 | 35.8 | | 54.0 | 18.2 | 47.5 | 11.7 | 60.0 | 24.2 | 57.5 | 21.7 | background |
| 22 | | | | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | | | | | | | |

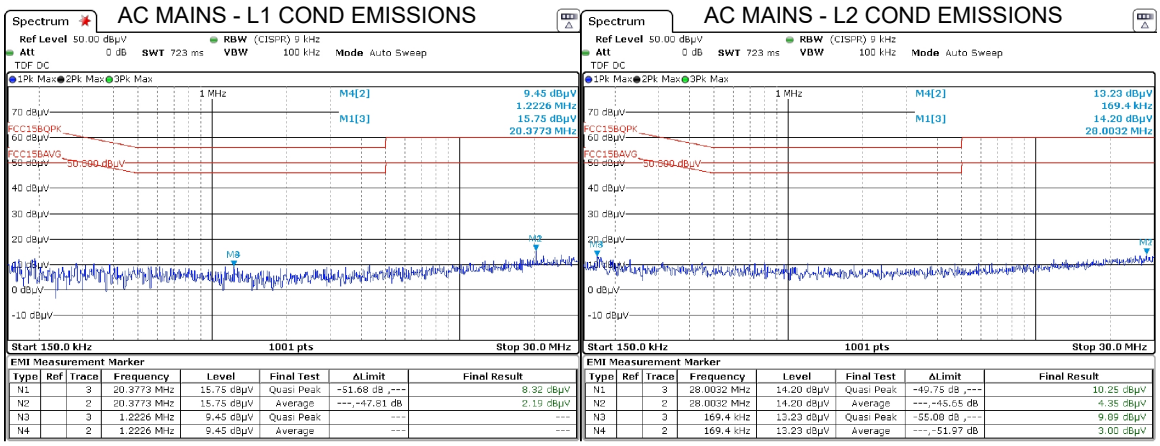
*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.

** When E-field is reported directly from Spectrum Analyzer, Antenna Factors and Cable losses are included directly in SA settings.

### 4.3.4 Conducted Emissions Test Results - AC Power Port(s)

The results of emissions from the EUT's AC mains power port(s) are reported in Table 10.

Table 10: AC Mains Power Conducted Emissions Results.



## 5 Measurement Uncertainty and Accreditation Documents

The maximum values of measurement uncertainty for the laboratory test equipment and facilities associated with each test are given in the table below. This uncertainty is computed for a 95.45% confidence level based on a coverage factor of $k = 2$.

Table 11: Measurement Uncertainty.

| Measured Parameter | Measurement Uncertainty† |
|---|---|
| Radio Frequency | $\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS-1))/2 + 1\,\text{Hz})$ |
| Conducted Emm. Amplitude | $\pm 1.9\,\text{dB}$ |
| Radiated Emm. Amplitude $(30 - 200\,\text{MHz})$ | $\pm 4.0\,\text{dB}$ |
| Radiated Emm. Amplitude $(200 - 1000\,\text{MHz})$ | $\pm 5.2\,\text{dB}$ |
| Radiated Emm. Amplitude $(f > 1000\,\text{MHz})$ | $\pm 3.7\,\text{dB}$ |

†Ref: CISPR 16-4-2:2011+A1:2014


United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200129-0

AHD (Amber Helm Development, L.C.)
Sister Lakes, MI

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:*

**Electromagnetic Compatibility & Telecommunications**

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2019-06-28 through 2020-06-30
*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*



Figure 13: Accreditation Documents