**Amber Helm Development L.C.**
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**TSLBTV-WR2433NA**
Issued: **October 31, 2024**

# Radio Test Report

regarding

**USA: CFR Title 47, Part 15.247/15.109** (Emissions)
**Canada: IC RSS-247v3/GENe** (Emissions)

for

# BTVMS01

**Category: TPMS Sensor**

Judgments:
**Aligns with FCC 15.247, ISED RSS-247v3**
Testing Completed: October 31, 2024

TESTING
NVLAP LAB CODE 200129-0

Prepared for:

## Tesla, Inc.

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Rpt. Prep./Rev. by: John Nantz

Date of Issue: October 31, 2024

## Revision History

| Rev. No. | Date | Details | Revised By |
|---|---|---|---|
| r0 | October 31, 2024 | Initial Release. | J. Brunett |
| r1 | November 5, 2024 | Correct Cert. No. | J. Brunett |
| r2 | November 13, 2024 | Add equip. + FW | J. Brunett |

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# 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 November 2034.

## 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 laboratory's scope of accreditation. Any data in this report that is not covered under the laboratory's scope is clearly identified.

## 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 1.8.0 lists all sites employed herein. Specific test sites utilized are also listed in the test results sections of this report where needed.

Table 1.8.0 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 1.9.0 . 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. All equipment is evaluated on a cycle no greater than 12 months following laboratory validation procedures and is calibrated following manufacturer recommended intervals.

Table 1.9.0 Equipment List.

| Description | Manufacturer/Model | SN | Quality Num. | Cal/Ver By / Date Due |
|---|---|---|---|---|
| EMI Receiver | R & S / ESW26 | 101313 | RSESW2601 | RS / Dec-2025 |
| Spectrum Analyzer | R & S / FSV30 | 101660 | RSFSV3001 | RS / Apr-2025 |
| BNC-BNC Coax | WRTL / RG58/U | 001 | CAB001-BLACK | AHD / March-2025 |
| 3.5-3.5MM Coax | PhaseFlex / PhaseFlex | 001 | CAB015-PURP | AHD / Jul-2025 |
| Biconical | EMCO / 93110B | 9802-3039 | BICEMCO01 | Keysight / Aug-2025 |
| Log Periodic Antenna | EMCO / 3146 | 9305-3614 | LOGEMCO01 | Keysight / Aug-2025 |
| Quad Ridge Horn | Singer / A6100 | C35200 | HQR1TO18S01 | Keysight / Aug-2025 |
| K-Band Horn | JEF / NRL Std. | 001 | HRNK01 | AHD / On Use |

# 2 Test Specifications and Procedures

## 2.1 Test Specification and General Procedures

The goal of Tesla, 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 Tesla, Inc. BTVMS01 for compliance to:

| **Country/Region/Manu.** | **Rules or Directive** | **Referenced Section(s)** |
|---|---|---|
| United States | Code of Federal Regulations | CFR Title 47, Part 15.247/15.109 |
| Canada | ISED Canada | IC RSS-247v3/GENe |

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" |
| KDB 558074 D01 v05r02 | "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES " |
| KDB 662911 D01v02r01 | "Emissions Testing of Transmitters with Multiple Outputs in the Same Band" |
| KDB 662911 D02 v01 | "MIMO with Cross-Polarized Antenna" |
| WR-ITP0102RA | "AHD Internal Document - Radiated Emissions Test Method" |
| WR-ITP0101LC | "AHD Internal Document - Conducted Emissions Test Method" |
| ICES-003; Issue 7 (2020) | "Information Technology Equipment (ITE) - Limits and methods of measurement" |

# 3 Configuration and Identification of the Equipment Under Test

## 3.1 Description and Declarations

The equipment under test is a 1Mbps BLE tire pressure sensor. The EUT is approximately 4 x 4 x 2 cm in dimension, and is depicted in Figure 3.1.0 . It is powered by 3.3 VDC nominal lithium coin cell. The EUT is used in a motor vehicle to transmit TPM data to a receiver in the vehicle. Table 3.1.0 outlines provider declared EUT specifications.

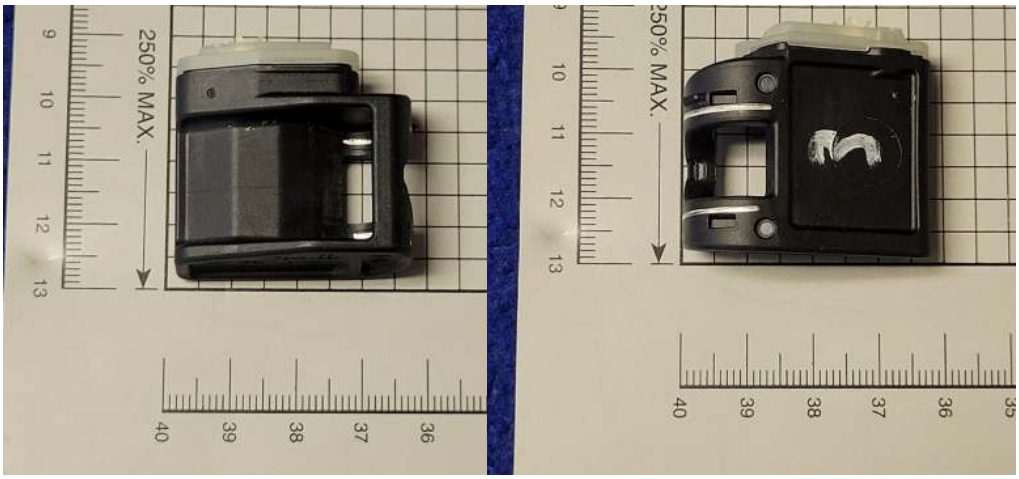


Figure 3.1.0 Photos of EUT.

Table 3.1.0 EUT Declarations.

| **General Declarations** | |
|---|---|
| **Equipment Type:** | TPMS Sensor |
| **Country of Origin:** | Not Declared |
| **Nominal Supply:** | 3.3 VDC nominal |
| **Oper. Temp Range:** | $-40^{o}$C to $+120^{o}$C |
| **Frequency Range:** | $2400 - 2483.5$ MHz |
| **Antenna Dimension:** | Integral |
| **Antenna Type:** | PCB Trace |
| **Antenna Gain:** | -3.8 dBi max. |
| **Number of Channels:** | 40 |
| **Channel Spacing:** | 2 MHz |
| **Alignment Range:** | Not Declared |
| **Type of Modulation:** | GFSK |
| | |
| **United States** | |
| **FCC ID Number:** | 2AEIM-BTVMS01 |
| **Classification:** | DTS |
| | |
| **Canada** | |
| **IC Number:** | 20098-BTVMS01 |
| **Classification:** | Other |

### 3.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 3.1.1 .

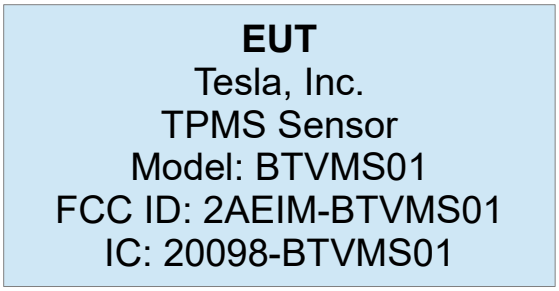


Figure 3.1.1 EUT Test Configuration Diagram.

### 3.1.2 Modes of Operation

The EUT is a BLE DTS transceiver which can operate only in a standard BLE core specification 1Mbps data rate. The EUT is fully tested in this mode, as reported herein.

### 3.1.3 Variants

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

### 3.1.4 Test Samples

Two samples of the EUT were provided in total, one normal (production ready) sample (SN: 3) with integral antenna and one special RF test sample with cover removed and a coaxial cable attached to where the integral antenna is normally attached (SN:X). Both test samples are provided with Wireless DTM test software dtm_tesla_im40-v4.1 for product testing control from a paired BLE application.

### 3.1.5 Functional Exerciser

Normal functionality was confirmed by measurement of transmitted signals.

### 3.1.6 Modifications Made

No modifications were made to the EUT by this lab.

### 3.1.7 Production Intent

The EUT appears to be a production ready sample.

### 3.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003).

# 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 4.1.1 . 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.

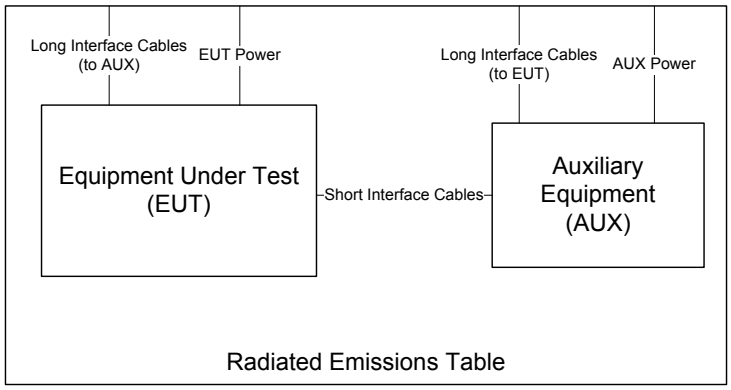


Figure 4.1.1 Radiated Emissions Diagram of the EUT.

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 regulation. Shielded loops are placed at a 1 meter receive height at the desired measurement distance. For exposure in this band, 10cm diameter single-axis broadband probes meeting the requirements of ISED SPR-002 section 5.2 are employed. Measurements are repeated and summed over three axes, and the entire frequency range is measured with and without the EUT transmitting.

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 4.1.1 .

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 4.1.1 Radiated Emissions Test Setup Photograph(s).

### 4.1.2 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 4.2.1 . Plots showing the measurements made to obtain these values are provided in Figure 4.2.1 .

Table 4.2.1 Pulsed Emission Characteristics (Duty Cycle).

**Test Date:** 27-Oct-24
**Test Engineer:** J. Brunett
**EUT** Tesla BTVMS01
**Meas. Distance:** Conducted

| | Test Mode Pulsed Operation / Average Measurement Duty Cycle | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R0 | Mode | Data Rate Mbps | Voltage V | Oper. Freq MHz | Pulse Length ms | Pulse Period ms | Duty Cycle % | Avg Power Duty Correction dB |
| R1 | | 1.000 | 3.3 | 2440.0 | 2.2 | 2.5 | 86.4 | 0.6 |
| # | C1 | C3 | C4 | C5 | C6 | C7 | C8 | C9 |

| (ROW) | (COLUMN) | NOTE |
|---|---|---|
| R0 | C8 | Duty Cycle is measured in line with DTS guidance 558074 D01 v5 r02 section 6(b) for averaging only over full-power transmission pulses. |

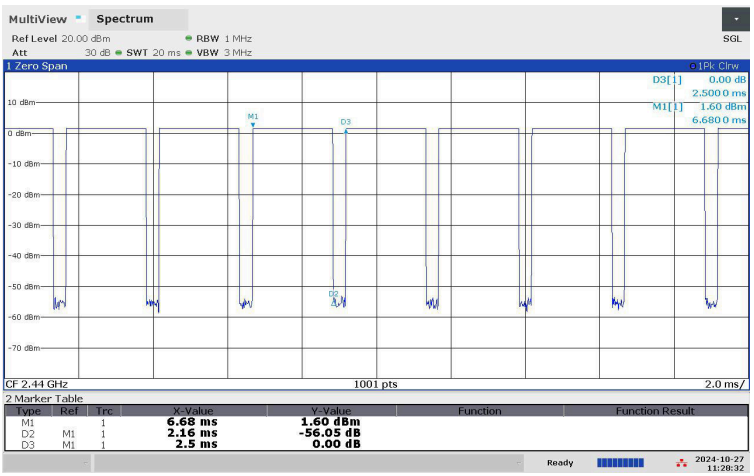


Figure 4.2.1 Example Pulsed Emission Characteristics (Duty Cycle).

### 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 4.2.2 . Plots showing measurements employed obtain the emission bandwidths reported are provided in Figure 4.2.2 .

Table 4.2.2 Intentional Emission Bandwidth.

**Test Date:** 27-Oct-24
**Test Engineer:** J. Brunett
**EUT:** Tesla BTVMS01
**Meas. Distance:** Conducted

| | Occupied Bandwidth | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R0 | Transmit Mode | Data Rate (Mbps) | Voltage (V) | Oper. Freq (MHz) | 6 dB BW (MHz) | 6 dB BW Limit (MHz) | 99% OBW (MHz) | Pass/Fail |
| R1 | BLE | 1.000 | 3.3 | 2402.0 | 0.650 | 0.500 | 1.012 | Pass |
| R2 | | | | 2440.0 | 0.653 | 0.500 | 1.014 | Pass |
| R3 | | | | 2480.0 | 0.650 | 0.500 | 1.016 | Pass |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C9 |

| ROW | COLUMN | NOTE |
|---|---|---|
| R1-R9 | C5 | DTS Bandwidth measured with RBW = 100 kHz per ANSI C63.10, section 11.8.1 |

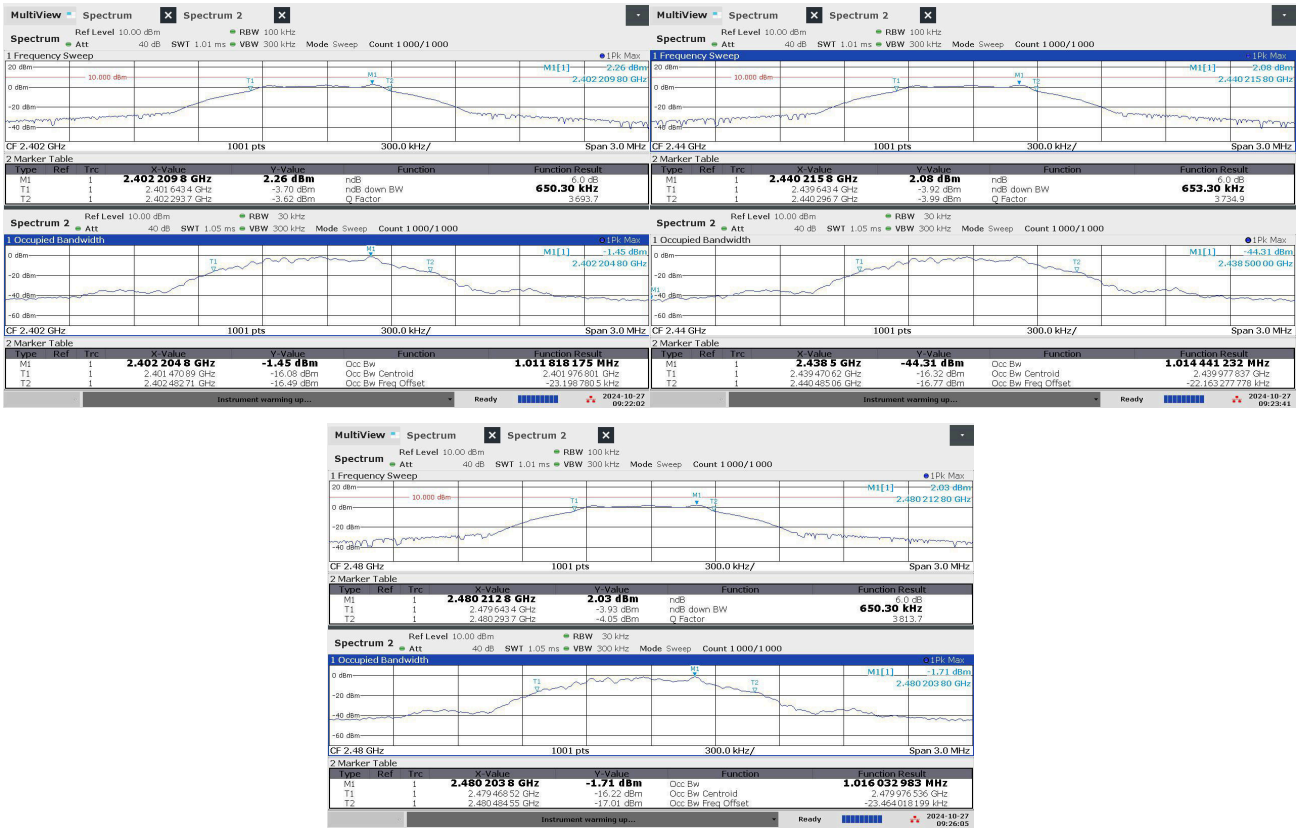


Figure 4.2.2 Example Intentional Emission Bandwidth Plots.

### 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. The results of this testing are summarized in Table 4.2.3 .

Table 4.2.3 Radiated Power Results.

**Test Date:** 27-Oct-24
**Test Engineer:** J. Brunett
**EUT:** Tesla BTVMS01
**Meas. Distance:** Conducted

| | Fundamental Power | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R0 | Mode | Channel | Freq. MHz | Pout (Pk) dBm | Duty dB | Pout + Duty (Pk) dBm | Ant Gain (declared) dBi | EIRP (Pk) dBm | EIRP (Avg) Limit dBm | Pass dB | Comments |
| R1 | BLE/HPA (1Mbps) | 0 | 2402.0 | 0.9 | 0.0 | 0.9 | -3.8 | -2.9 | 36.0 | 38.9 | |
| R2 | | 19 | 2440.0 | 0.7 | 0.0 | 0.7 | -3.8 | -3.1 | 36.0 | **39.1** | |
| R3 | | 39 | 2480.0 | 0.7 | 0.0 | 0.7 | -3.8 | -3.2 | 36.0 | 39.2 | |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 |

| (ROW) | (COLUMN) | NOTE |
|---|---|---|
| R0 | C4 | Maximum peak conducted output power measured following DTS Guidance 558074 D01 v5 r02 Section 8.3.1.1 |
| R0 | C7 | Worst case antenna gain from antenna specification / measurement. |
| R0 | C8 | Peak power is used to demonstrate compliance. |

### 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 4.2.4 . Plots showing how these measurements were made are depicted in Figure 4.2.4 .

Table 4.2.4 Power Spectral Density Results.

| **Frequency Range** | **Detector** | **IF Bandwidth** | **Video Bandwidth** | **Test Date:** | 27-Oct-24 |
|---|---|---|---|---|---|
| 2400-2483.5 | Pk | 3 kHz | 10 kHz | **Test Engineer:** | J. Brunett |
| | | | | **EUT:** | Tesla BTVMS01 |
| | | | | **Meas. Distance:** | Conducted |

| **3kHz Power Spectral Density** | | | | | | | |
|---|---|---|---|---|---|---|---|
| R0 | Mode | Channel | Frequency (MHz) | Ant. Used | PSDcond (meas) (dBm/3kHz) | PSD Limit (dBm/3kHz) | Pass By (dB) |
| R1 | BLE/HPA (1Mbps) | 0 | 2402.0 | Cond. | -14.1 | 8.00 | 22.1 |
| R2 | | 19 | 2440.0 | Cond. | -14.2 | 8.00 | 22.2 |
| R3 | | 39 | 2480.0 | Cond. | -14.2 | 8.00 | 22.2 |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 |

| (ROW) | (COLUMN) | NOTES |
|---|---|---|
| R0 | C5 | PSD measured conducted out the EUT antenna port following ANSI C63.10, 11.10.2 |


Figure 4.2.4 Power Spectral Density Plots.

## 4.3 Unintentional Emissions

### 4.3.1 Restricted Band Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 4.3.1 . Measurements are performed to 10 times the highest fundamental operating frequency.

Table 4.3.1 Transmit Chain Spurious Emissions.

| | Frequency Range | Det | IF Bandwidth | Video Bandwidth | | |
|---|---|---|---|---|---|---|
| | | | | | **Test Date:** | 27-Oct-24 |
| Restricted Band Emissions | 30 MHz< f < 1 000 MHz | Pk/Qpk | 100 KHz | 300 KHz | **Test Engineer:** | J. Brunett |
| Restricted Band Emissions | f > 1 000 MHz | Pk/Avg | 1 MHz | 3 MHz | **EUT:** | Tesla BTVMS01 |
| Restricted Band Edge | f > 1 000 MHz | Pk/Avg | 100 KHz | 300 KHz | **Meas. Distance:** | 3 m |

| **Transmitter Spurious** | | | | | | | | | | | | | | FCC/IC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | | Test Antenna | | | Cable | Duty | Electric Field @ 3m | | | | Pass | |
| | Mode | Start | Stop | QN | Ant. | Ka | Kg | Factor | Meas. Pk | Limit Pk | Meas. Avg | Limit Qpk/Avg | | |
| R0 | | MHz | MHz | | Pol. | dB | dB | dB | dBuV/m | dBuV/m | dBuV/m | dBuV/m | dB | Comments |
| R1 | Fundamental Restricted Band Edge (Low Side) | | | | | | | | | | | | | |
| R2 | BLE (1Mbps) | 2390.0 | 2390.0 | HQR1TO18S01 | H | 2.6 | 0.0 | 0.6 | 48.9 | 74.0 | 47.8 | 54.0 | 6.2 | max all, L,M,H CH |
| R3 | BLE (1Mbps) | 2390.0 | 2390.0 | HQR1TO18S01 | V | 2.6 | 0.0 | 0.6 | 48.9 | 74.0 | 46.8 | 54.0 | 7.2 | max all, L,M,H CH |
| R4 | Fundamental Restricted Band Edge (High Side) | | | | | | | | | | | | | |
| R5 | BLE (1Mbps) | 2483.5 | 2483.5 | HQR1TO18S01 | H | 2.6 | 0.0 | 0.6 | 56.4 | 74.0 | 48.5 | 54.0 | 5.5 | max all, L,M,H CH |
| R6 | BLE (1Mbps) | 2483.5 | 2483.5 | HQR1TO18S01 | V | 2.6 | 0.0 | 0.6 | 56.4 | 74.0 | 46.8 | 54.0 | 7.2 | max all, L,M,H CH |
| R7 | Restricted Bands Emissions | | | | | | | | | | | | | |
| R8 | BLE (1Mbps) | 30.0 | 88.0 | BICEMCO01 | H/V | 13.3 | -0.3 | 0.6 | 19.8 | | | 40.0 | 20.2 | max all, L,M,H CH |
| R9 | BLE (1Mbps) | 88.0 | 216.0 | BICEMCO01 | H/V | 7.8 | -0.5 | 0.6 | 23.5 | | | 43.5 | 20.0 | max all, L,M,H CH |
| R10 | BLE (1Mbps) | 216.0 | 960.0 | LOGEMCO01 | H/V | 23.4 | -0.9 | 0.6 | 24.7 | | | 46.0 | 21.3 | max all, L,M,H CH |
| R11 | BLE (1Mbps) | 960.0 | 4000.0 | HQR1TO18S01 | H/V | 21.5 | -0.2 | 0.6 | 56.4 | 74.0 | 48.5 | 54.0 | 5.5 | max all, L,M,H CH |
| R12 | BLE (1Mbps) | 4804.0 | 4804.0 | HQR1TO18S01 | H/V | 24.6 | -0.5 | 0.6 | 56.2 | 74.0 | 53.0 | 54.0 | **1.0** | max all, L CH |
| R13 | BLE (1Mbps) | 4880.0 | 4880.0 | HQR1TO18S01 | H/V | 24.6 | -0.5 | 0.6 | 55.1 | 74.0 | 51.9 | 54.0 | 2.1 | max all, M CH |
| R14 | BLE (1Mbps) | 4960.0 | 4960.0 | HQR1TO18S01 | H/V | 24.6 | -0.5 | 0.6 | 53.2 | 74.0 | 50.0 | 54.0 | 4.0 | max all, H CH |
| R15 | BLE (1Mbps) | 4000.0 | 6000.0 | HQR1TO18S01 | H/V | 24.9 | -0.4 | 0.6 | 56.2 | 74.0 | 53.0 | 54.0 | 1.0 | max all, L,M,H CH |
| R17 | BLE (1Mbps) | 7320.0 | 7320.0 | HQR1TO18S01 | H/V | 25.2 | -0.7 | 0.6 | 59.1 | 74.0 | 52.5 | 54.0 | 1.5 | max all, M CH |
| R18 | BLE (1Mbps) | 7440.0 | 7440.0 | HQR1TO18S01 | H/V | 25.3 | -0.7 | 0.6 | 53.2 | 74.0 | 46.6 | 54.0 | 7.4 | max all, H CH |
| R16 | BLE (1Mbps) | 6000.0 | 8400.0 | HQR1TO18S01 | H/V | 27.1 | -0.6 | 0.6 | 59.1 | 74.0 | 52.5 | 54.0 | 1.5 | max all, L,M,H CH |
| R21 | BLE (1Mbps) | 8400.0 | 12500.0 | HQR1TO18S01 | H/V | 32.0 | -0.8 | 0.6 | 43.4 | 74.0 | 32.3 | 54.0 | 21.7 | noise floor, max all |
| R25 | BLE (1Mbps) | 12500.0 | 18000.0 | HQR1TO18S01 | H/V | 35.4 | -1.1 | 0.6 | 48.9 | 74.0 | 39.5 | 54.0 | 14.5 | noise floor, max all |
| R26 | BLE (1Mbps) | 18000.0 | 26500.0 | HRNK01 | H/V | 33.7 | 0.0 | 0.6 | 45.9 | 74.0 | 37.0 | 54.0 | 17.0 | noise floor, max all |
| R27 | | | | | | | dB | | | | | | | |
| R28 | | | | | | | | | | | | | | |
| # | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 |

| (ROW) | (COLUMN) | NOTES |
|---|---|---|
| R0 | C9/C11 | Computed according to ANSI C63.10-2013 section 11.12.2.2e |
| R2/R4 | C9/C11 | Computed according to ANSI C63.10-2013 section 11.12.2.2e |
| R7-R20 | C9/C11 | Radiated measurements were made in line with ANSI C63-10-2013 section 11.12.1. Antenna and cable factors are included in reported SA data. |
| R7-R9 | C11 | Average measured following ANSI C63.10 11.12.2.5.2.1 with Power Duty Cycle added to Average Measured Field Strength. |

### 4.3.2 OOB 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) in the worst cases are provided in Figure 4.3.2 below.

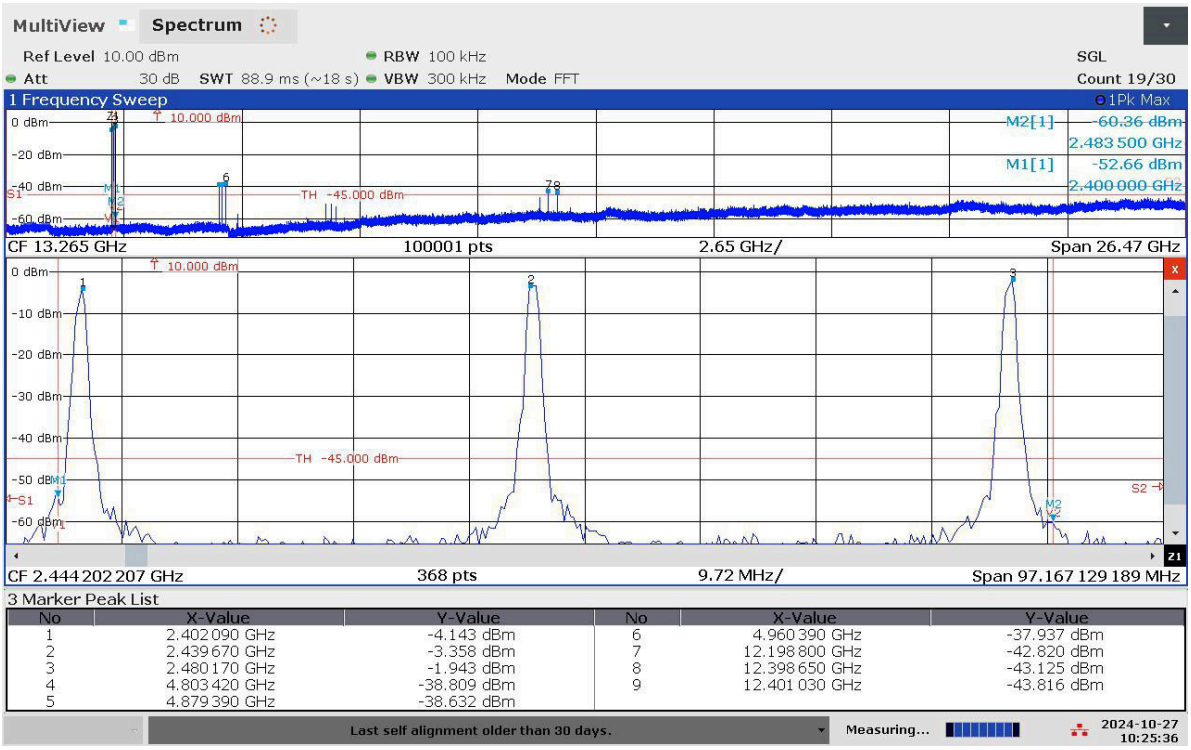


Figure 4.3.2 Worst Case Transmitter OOB Emissions Measured.

### 4.3.3 Radiated Digital and Cabinet Spurious

The results for the measurement of digital and cabinet spurious emissions are not reported herein as all emissions were greater than 20 dB below the regulatory limit. Emissions from digital components are measured to 1 GHz, or to five times the maximum crystal or oscillator operating frequency, whichever is greater. Cabinet emissions are measured up to the highest frequency tested during conducted measurements.

# 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 5.0.0 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 ($f < 30\,\text{MHz}$) | $\pm 3.1\,\text{dB}$ |
| 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® ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

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 17025:2017. 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).*

2023-06-20 through 2024-06-30
*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*



Figure 5.0.0 Accreditation Documents