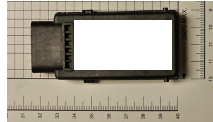


# EMC Test Report

regarding

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

for



## PKA2.2

**Category: Vehicular BLE Transceiver**

Judgments:

**FCC 15.247, ISSED RSS-247v2 Compliant**

Testing Completed: March 26, 2024



Prepared for:

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r0	April 1, 2024	Initial Release.	J. Nantz
r1	April 17, 2024	Clarified use of peak detector.	J. Nantz

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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 April 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**

This report shall not be reproduced, except in full, without the written approval of Amber Helm Development L.C.

### **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 / November-2024
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-2024
K-Band Horn	JEF / NRL Std.	001	HRNK01	AHD / Jul-2024
BNC-BNC Coax	WRTL / RG58/U	001	CAB001-BLACK	AHD / July-2024
3.5-3.5MM Coax	PhaseFlex / PhaseFlex	001	CAB015-PURP	AHD / July-2024

## 2 Test Specifications and Procedures

### 2.1 Test Specification and General Procedures

The goal of Robert Bosch LLC 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 Robert Bosch LLC PKA2.2 for compliance to:

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

3 Configuration and Identification of the Equipment Under Test

3.1 Description and Declarations

The EUT is a BLE transceiver. The EUT is approximately 8.4 x 4.3 x 1.7 cm in dimension, and is depicted in Figure 3.1.0 . It is powered by 13.4 VDC vehicular power system. This device is used in a motor vehicle. Table 3.1.0 outlines provider declared EUT specifications.

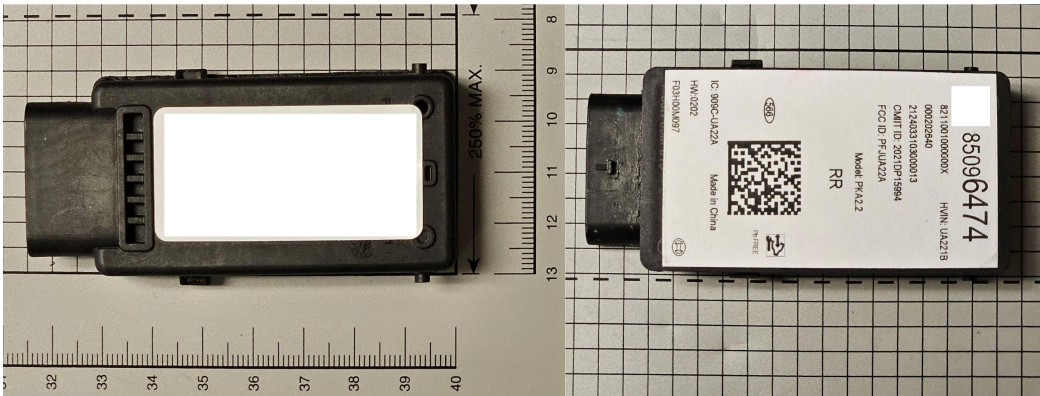


Figure 3.1.0 Photos of EUT.

Table 3.1.0 EUT Declarations.

General Declarations	
Equipment Type:	Vehicular BLE Transceiver
Country of Origin:	not declared
Nominal Supply:	13.4 VDC
Oper. Temp Range:	not declared
Frequency Range:	2402 – 2480 MHz
Antenna Dimension:	Integral
Antenna Type:	PCB trace
Antenna Gain:	3.2 dBi
Number of Channels:	40
Channel Spacing:	2 MHz
Alignment Range:	Not Declared
Type of Modulation:	GFSK
United States	
FCC ID Number:	PFJUA22A
Classification:	DTS
Canada	
IC Number:	909C-UA22A
Classification:	Other

### 3.1.1 EUT Configuration

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

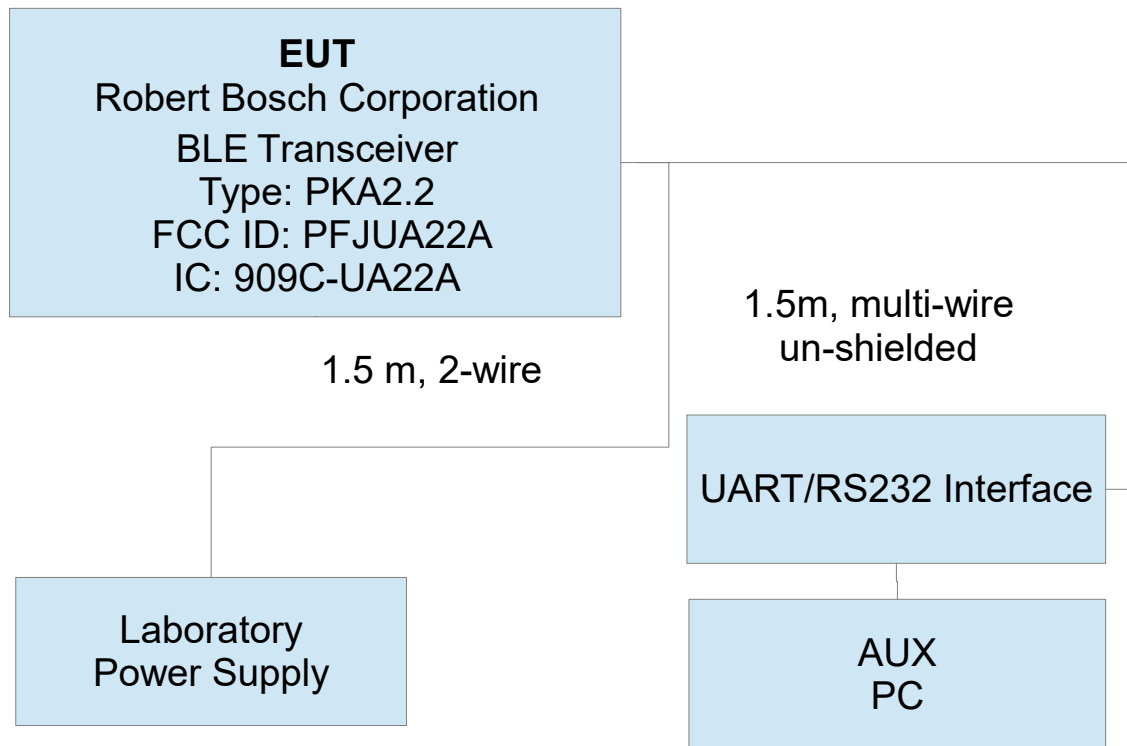


Figure 3.1.1 EUT Test Configuration Diagram.

### 3.1.2 Modes of Operation

The PKA2.2 BLE transceiver operates on a fixed internal power setting of 5 dBm, and is capable of 500kbps (LR), 1MBps and 2MBps data rates, all of which are tested herein.

### 3.1.3 Variants

There are two variants of the EUT, HVIN PK-PKA-2.2.0, which has CAN bus resistors populated, and HVIN PK-PKA-2.2.1 without CAN bus resistors populated. The RF sections of both variants are identical.

### 3.1.4 Test Samples

Five samples in total were provided. One normal operating sample (SN: 4409), one sample with the antenna replaced by an RF connector for conducted RF emissions testing (SN: 4412) and 3 samples for photos (SN's: 4413, 4414, 4415).

### 3.1.5 Functional Exerciser

Normal functionality was confirmed by measurement of transmitted signals.

### 3.1.6 Modifications Made

No modification were made by the laboratory.



### **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.

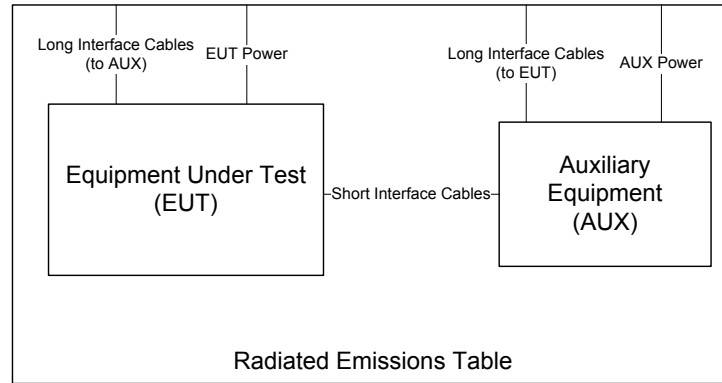


Figure 4.1.1 Radiated Emissions Diagram of the EUT.

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 ISSED 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° 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 × 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 dBμV/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.

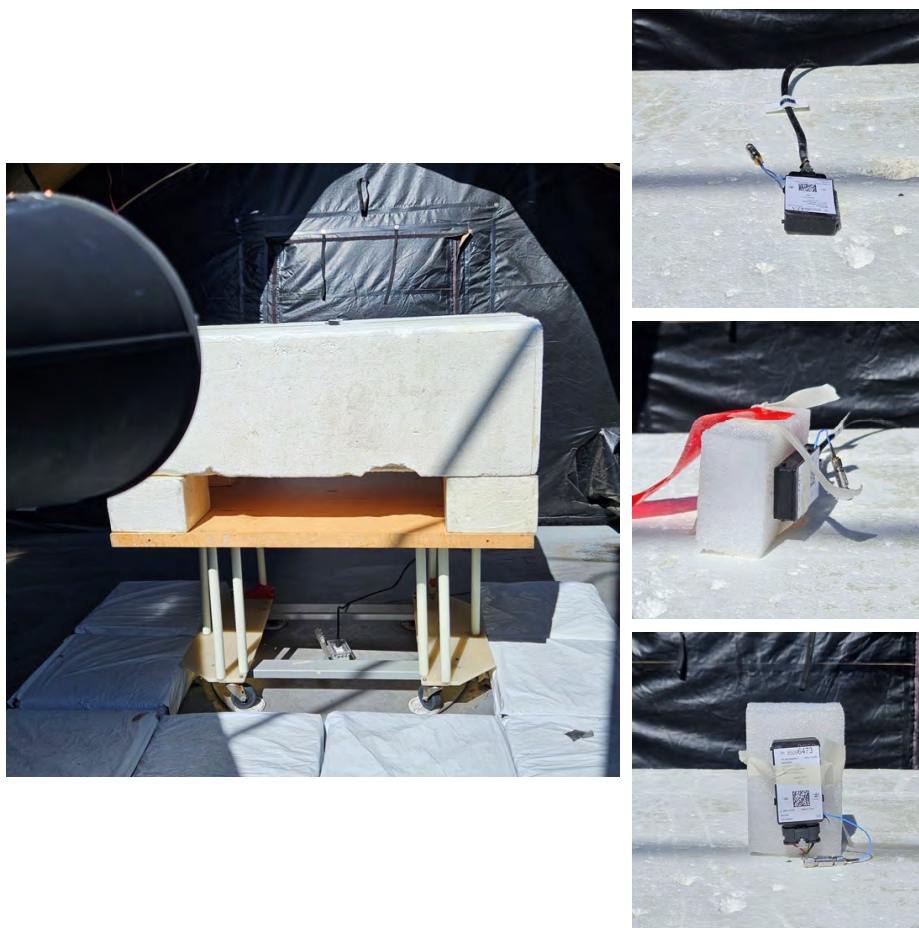


Figure 4.1.1 Radiated Emissions Test Setup Photograph(s).

#### 4.1.2 Conducted Emissions Test Setup and Procedures

**Transmit Antenna Port Conducted Emissions** At least one sample EUT supplied for testing was provided with a  $50\Omega$  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 4.1.2 .



Figure 4.1.2 Conducted RF Test Setup Photograph(s).

**Vehicle Power Conducted Spurious** The EUT is not subject to power line conducted emissions regulations as it is powered solely by the vehicle power system for use in said motor vehicle.

#### 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.

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:26-Mar-24

Test Engineer:John Nantz

EUTBOSCH PKA2.2

Meas. Distance:Conducted

ROW	Test Mode Pulsed Operation / Average Measurement Duty Cycle							
	Mode	Data Rate Mbps	Voltage V	Oper. Freq MHz	Pulse Length ms	Pulse Period ms	Duty Cycle %	Power Duty Correction dB
R1	BLE	0.500	13.5	2440.0	1.1	1.9	57.3	2.4
R2		1.000	13.5	2440.0	0.4	0.6	63.6	2.0
R3		2.000	13.5	2440.0	0.2	0.6	33.9	4.7
#	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.					
R0		C9	Duty cycle correction is not employed to demonstrate compliance.					

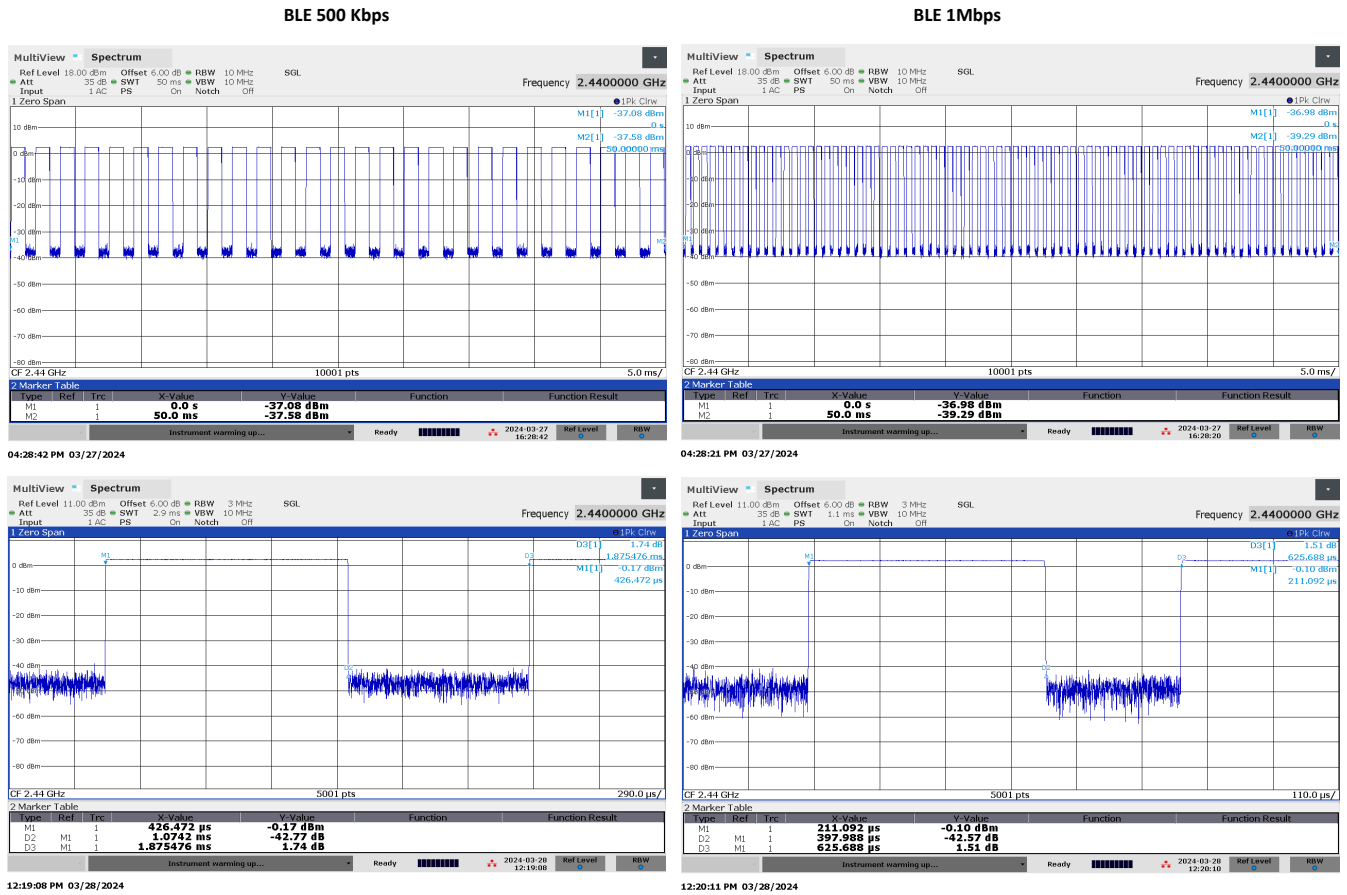


Figure 4.2.1 (i) Example Pulsed Emission Characteristics (Duty Cycle).

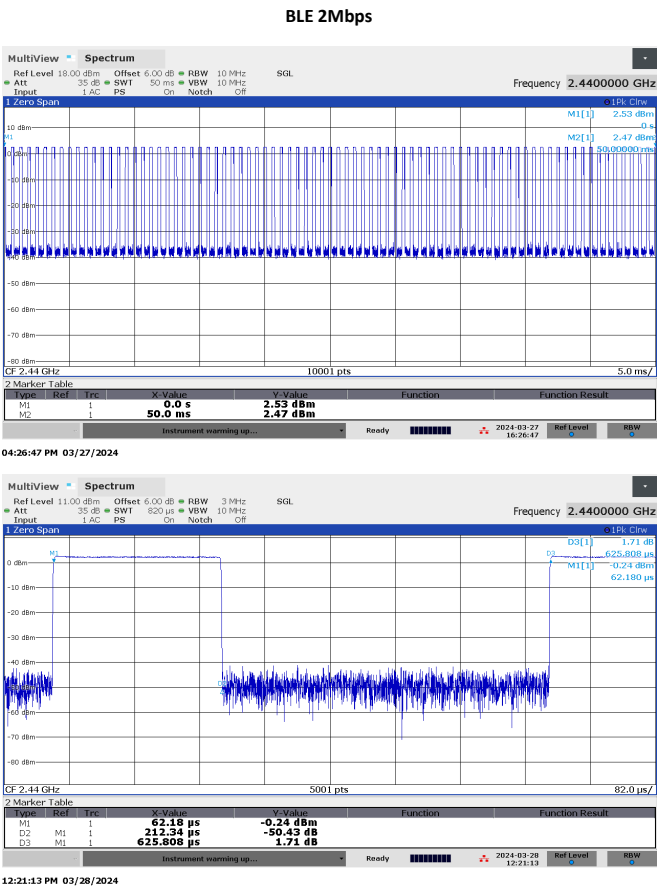


Figure 4.2.1 (ii) Example Pulsed Emission Characteristics (Duty Cycle).

#### 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:** 26-Mar-24  
**Test Engineer:** John Nantz  
**EUT:** BOSCH PKA2.2  
**Meas. Distance:** Conducted

R0	Occupied Bandwidth								
	Transmit Mode	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
R1	BLE-LR	0.500	13.5	2402.0	0.709	0.500	1.106	1.269	Pass
R2				2440.0	0.714	0.500	1.103	1.269	Pass
R3				2480.0	0.689	0.500	1.103	1.274	Pass
R4	BLE	1.000	13.5	2402.0	0.699	0.500	1.104	1.259	Pass
R5				2440.0	0.704	0.500	1.103	1.254	Pass
R6				2480.0	0.694	0.500	1.105	1.264	Pass
R7	BLE	2.000	13.5	2402.0	1.179	0.500	2.068	2.253	Pass
R8				2440.0	1.169	0.500	2.059	2.248	Pass
R9				2480.0	1.184	0.500	2.075	2.258	Pass
#	C1	C2	C3	C4	C5	C6	C7	C8	C9

ROW

COLUMN

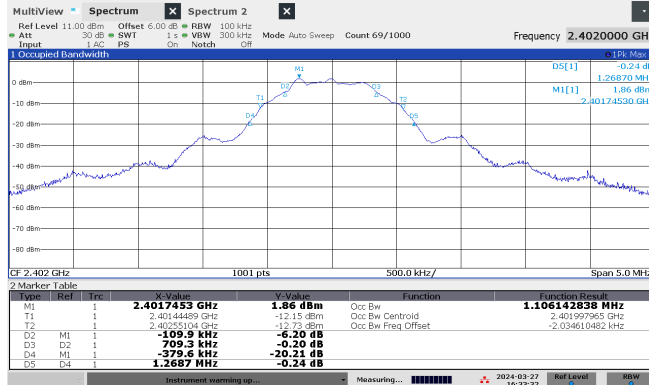
NOTE

R1-R9

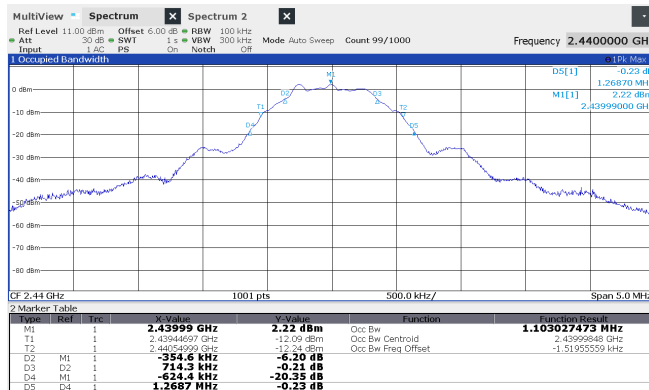
C5

DTS Bandwidth measured with RBW = 100 kHz per ANSI C63.10, section 11.8.1

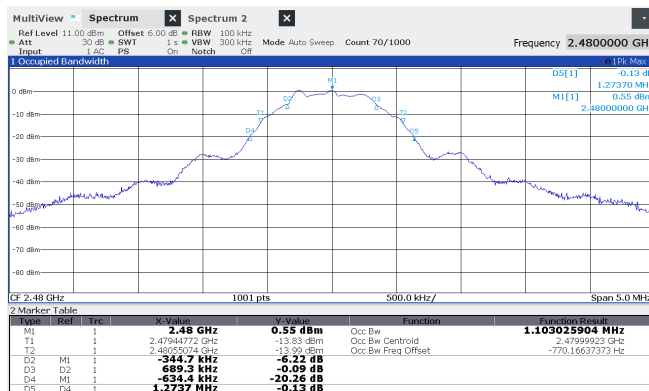
## BLE 500 Kbps



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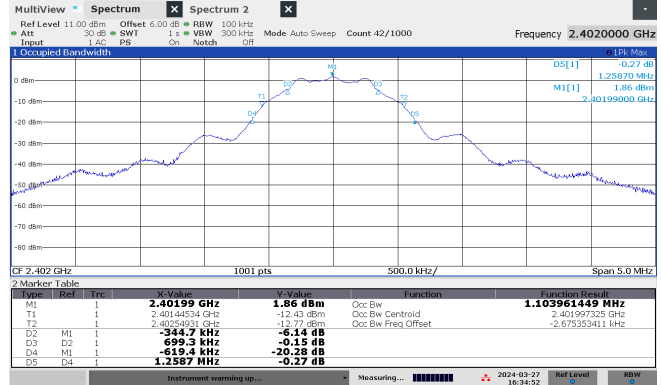


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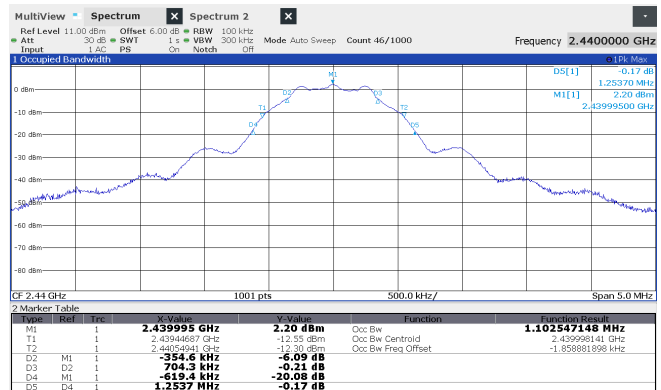


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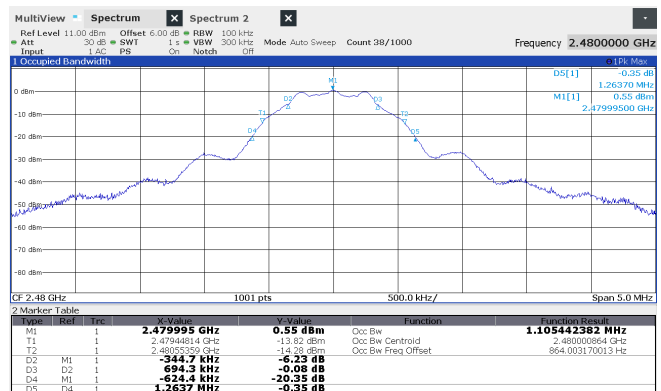
## BLE 1Mbps



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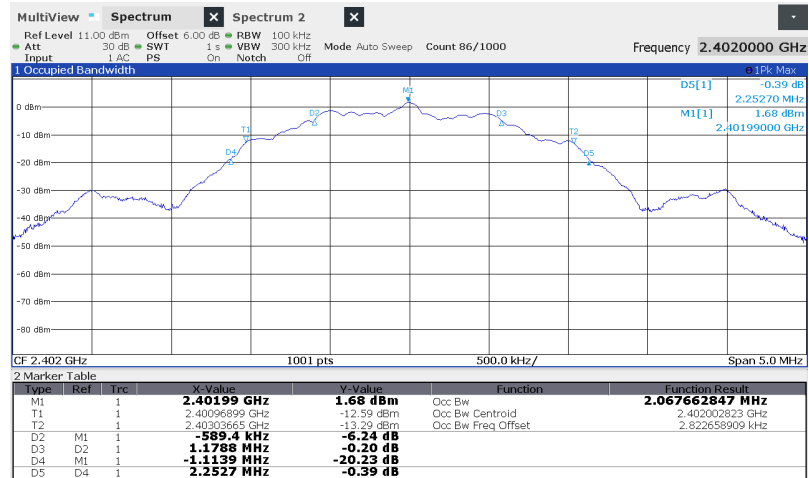


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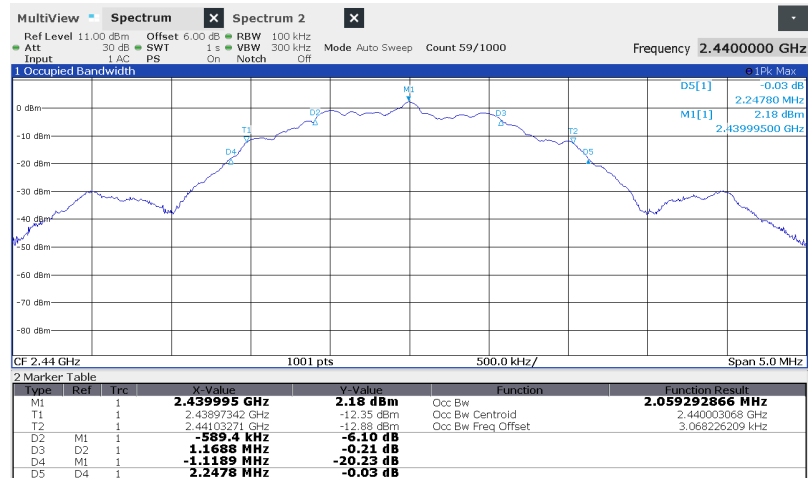
Figure 4.2.2 (i) Example Intentional Emission Bandwidth Plots.



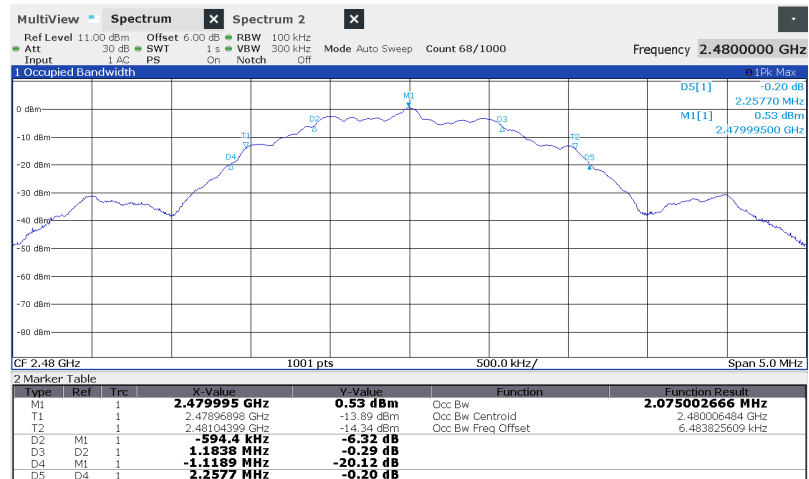
## BLE 2Mbps



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04:42:24 PM 03/27/2024



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Figure 4.2.2 (ii) 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 . Peak conducted output power was

Table 4.2.3 Radiated Power Results.

**Test Date:** 26-Mar-24  
**Test Engineer:** John Nantz  
**EUT:** BOSCH PKA2.2  
**Meas. Distance:** Conducted

R0	Fundamental Power										
	Mode	Channel	Freq. MHz	Pout (Pk/Avg) dBm	Duty dB	Pout + Duty (Pk) dBm	Ant Gain (declared) dBi	EIRP (Avg) dBm	EIRP (Avg) Limit dBm	Pass dB	Comments
R1	BLE (500KBPS)	37	2402.0	1.9	0.0	1.9	3.2	5.1	36.0	30.9	
R2		17	2440.0	2.3	0.0	2.3	3.2	5.5	36.0	30.5	
R3		39	2480.0	0.8	0.0	0.8	3.2	4.0	36.0	32.0	
R4	BLE (1MBPS)	37	2402.0	1.9	0.0	1.9	3.2	5.1	36.0	30.9	
R5		17	2440.0	2.4	0.0	2.4	3.2	5.6	36.0	<b>30.4</b>	
R6		39	2480.0	0.8	0.0	0.8	3.2	4.0	36.0	32.0	
R7	BLE (2MBPS)	37	2402.0	1.8	0.0	1.8	3.2	5.0	36.0	31.0	
R8		17	2440.0	2.3	0.0	2.3	3.2	5.5	36.0	30.5	
R9		39	2480.0	0.7	0.0	0.7	3.2	3.9	36.0	32.1	
#	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 datasheet.								
	R0	C8	Peak power is used to demonstrate compliance.								

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 manufacturer or measured by comparison between calculated EIRP and conducted output power. Plots showing conducted measurements made are depicted in Figure 4.2.3 .

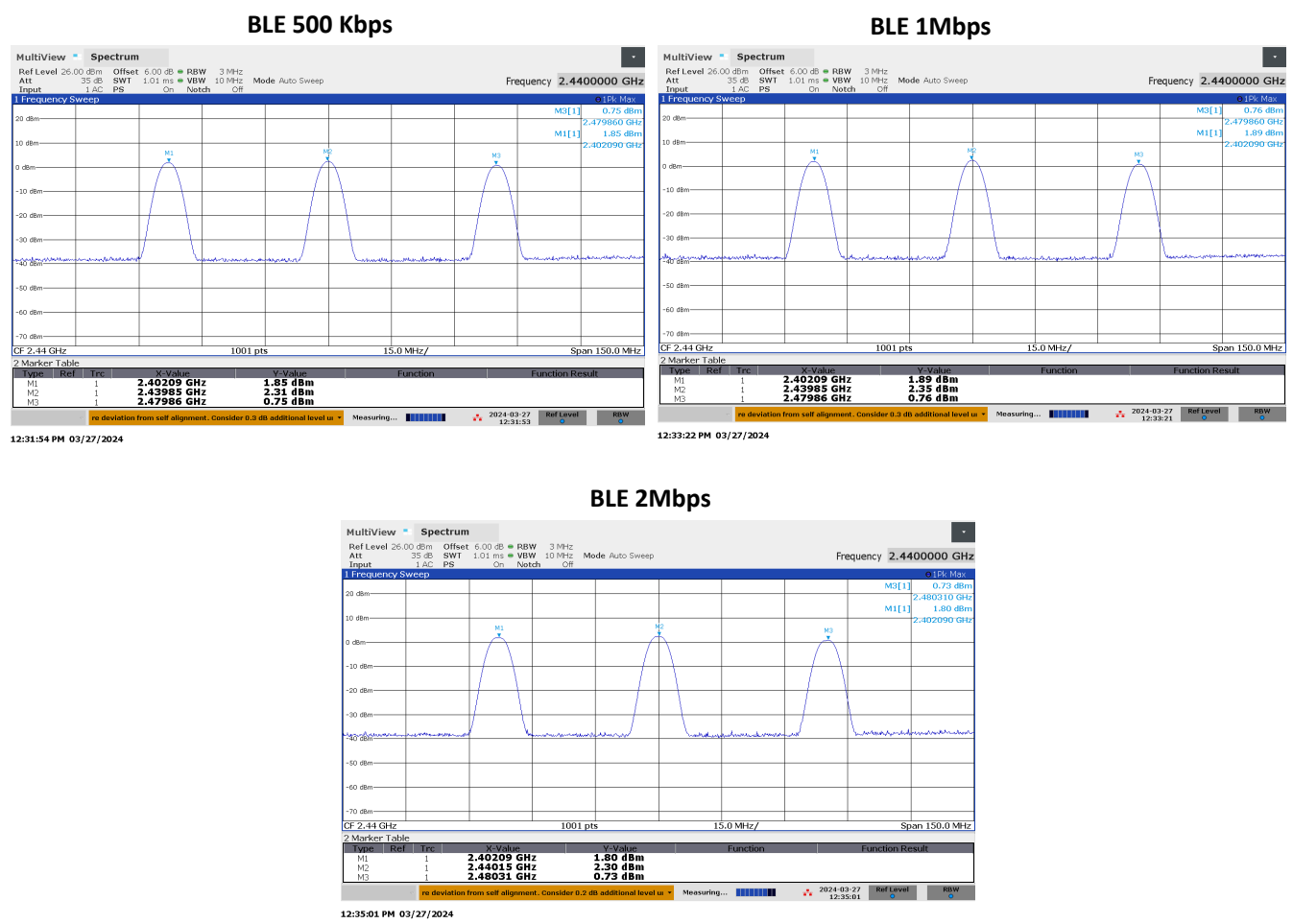


Figure 4.2.3 Conducted RF Power Plots

#### 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 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.

<b>Frequency Range</b>	<b>Detector</b>	<b>IF Bandwidth</b>	<b>Video Bandwidth</b>	<b>Test Date:</b>	26-Mar-24
2400-2483.5	Pk	3 kHz	10 kHz	<b>Test Engineer:</b>	John Nantz
				<b>EUT:</b>	BOSCH PKA2.2
				<b>Meas. Distance:</b>	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 (500KBPS)	37	2402.0	Cond.	-4.7	8.00	12.7
R2		17	2440.0	Cond.	-4.2	8.00	<b>12.2</b>
R3		39	2480.0	Cond.	-5.9	8.00	13.9
R4	BLE (1MBPS)	37	2402.0	Cond.	-13.3	8.00	21.3
R5		17	2440.0	Cond.	-13.0	8.00	21.0
R6		39	2480.0	Cond.	-14.8	8.00	22.8
R7	BLE (2MBPS)	37	2402.0	Cond.	-15.4	8.00	23.4
R8		17	2440.0	Cond.	-14.9	8.00	22.9
R9		39	2480.0	Cond.	-15.9	8.00	23.9
#	C1	C2	C3	C4	C5	C6	C7

(ROW)

(COLUMN)

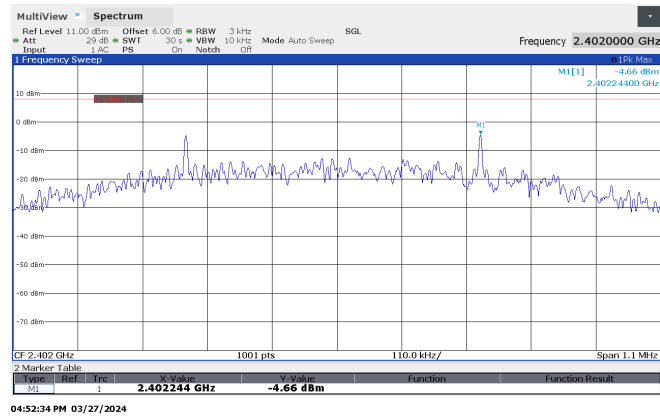
NOTES

R0

C5

PSD measured conducted out the EUT antenna port following ANSI C63.10, 11.10.2

BLE 500 Kbps



BLE 1Mbps

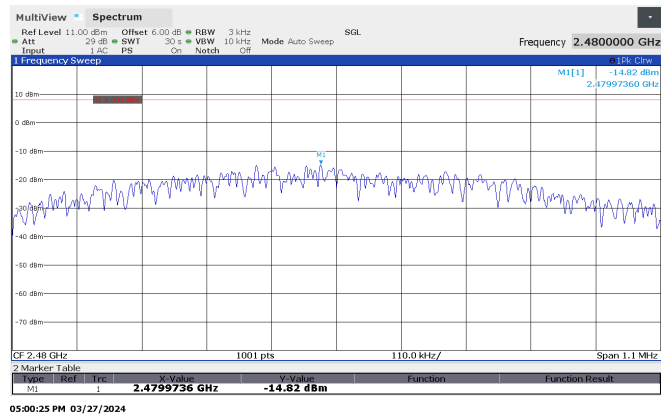
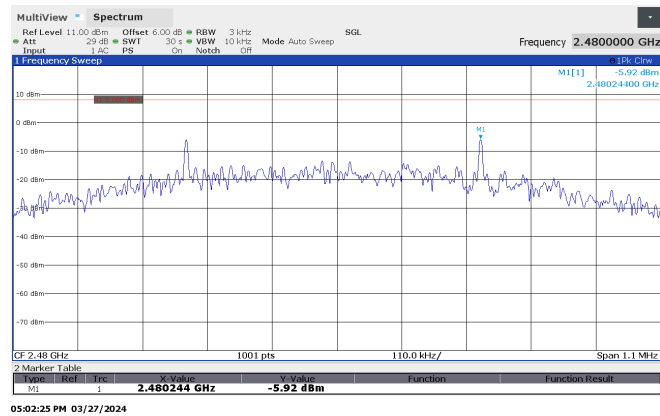
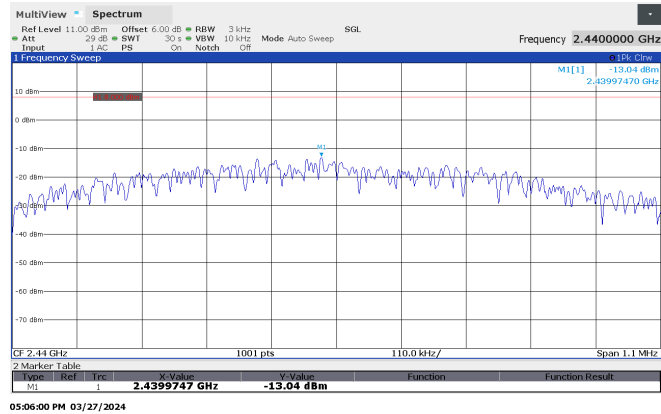
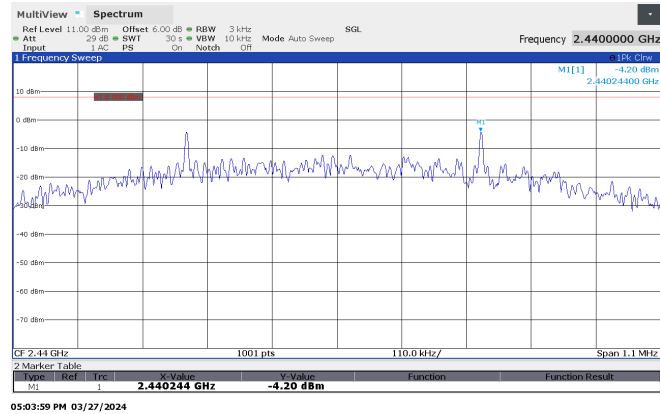
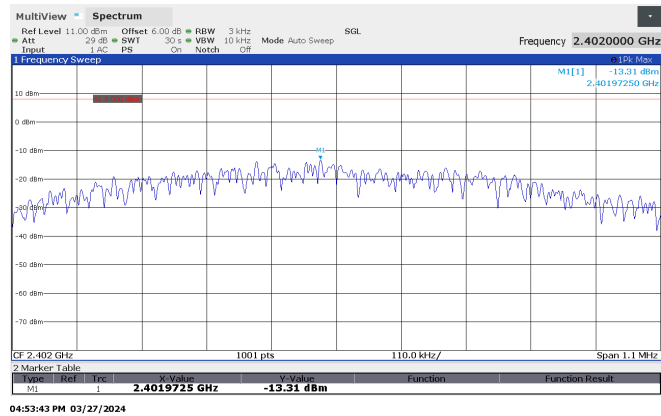


Figure 4.2.4 (i) Power Spectral Density Plots.

BLE 2Mbps

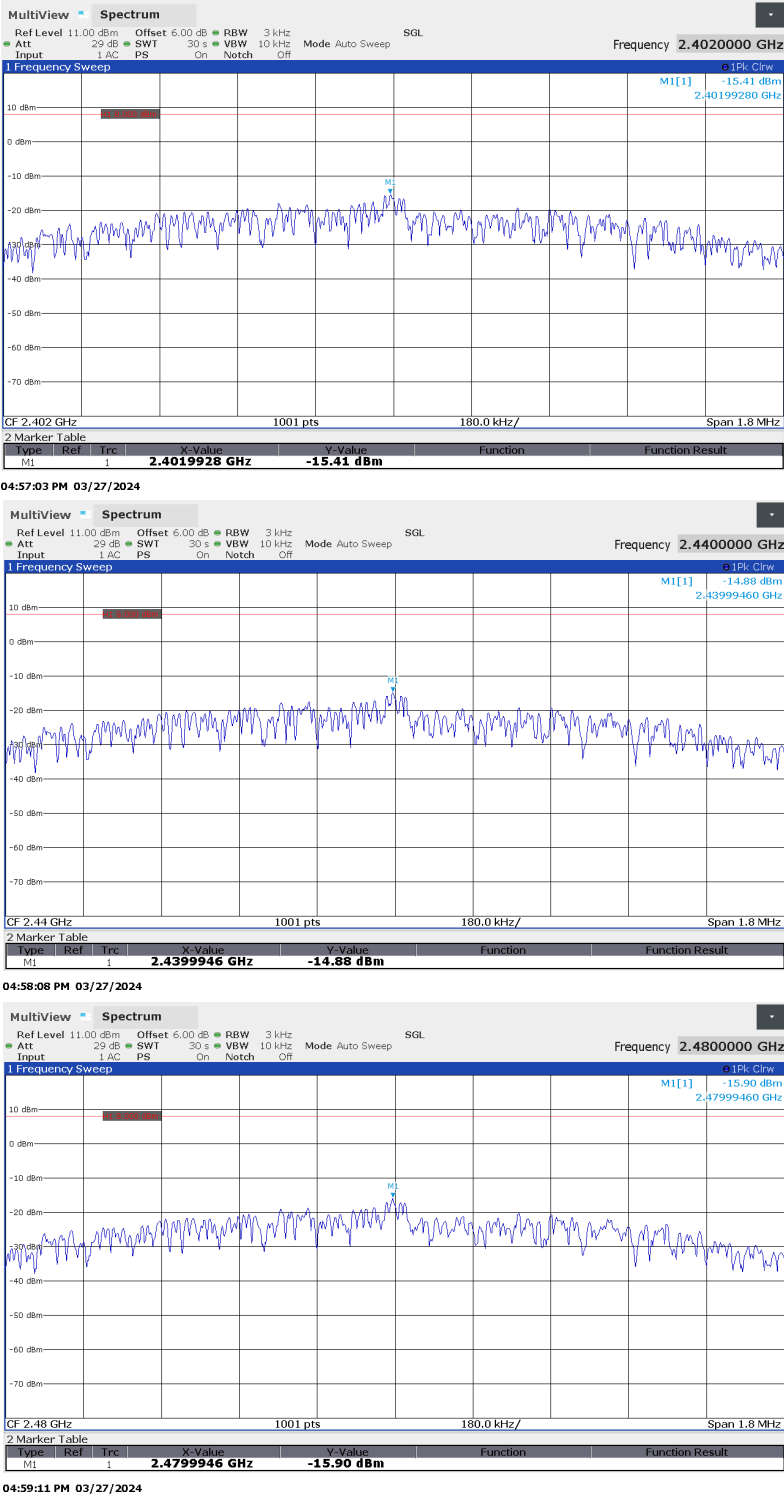


Figure 4.2.4 (ii) Power Spectral Density Plots.

### 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 (i) Transmit Chain Spurious Emissions.

Frequency Range				Det		IF Bandwidth		Video Bandwidth		Test Date:				26-Mar-24	
Restricted Band Emissions		30 MHz< f < 1 000 MHz		Pk/Qpk		100 KHz		300 KHz		Test Engineer:				John Nantz	
Restricted Band Emissions		f > 1 000 MHz		Pk/Avg		1 MHz		3 MHz		EUT:				BOSCH PKA2.2	
Restricted Band Edge		f > 1 000 MHz		Pk/Avg		100 KHz		300 KHz		Meas. Distance:				Conducted	

Transmitter Spurious															FCC/IC
R0	Mode	Frequency		Output Power Meas.		Ant	GR Factor	Avg Duty	Electric Field @ 3m				Pass	Comments	
		Start MHz	Stop MHz	Pk dBm	Qpk/Avg dBm	Gain dBi	dB	Factor dB	Calc. Pk dBuV/m	Limit Pk dBuV/m	Calc. Avg dBuV/m	Limit Avg dBuV/m	dB		
R1	Fundamental Restricted Band Edge (Low Side)														
R2	BLE (500Kbps)	2390.0	2390.0	-44.8	-63.3	3.2	0.0	0.0	53.6	74.0	35.2	54.0	18.8	max L,M,H channels or noise	
R3	Fundamental Restricted Band Edge (High Side)														
R4	BLE (500Kbps)	2483.5	2483.5	-50.2	-65.7	3.2	0.0	0.0	48.2	74.0	32.8	54.0	21.2	max L,M,H channels or noise	
R5	Restricted Bands Emissions														
R6	BLE (500Kbps)	30.0	88.0	-77.5		3.2	4.7	0.0	25.6			40	14.4	max L,M,H channels or noise	
R7	BLE (500Kbps)	88.0	216.0	-79.2		3.2	4.7	0.0	23.9			43.5	19.6	max L,M,H channels or noise	
R8	BLE (500Kbps)	216.0	960.0	-72.3		3.2	4.7	0.0	30.8			46	15.2	max L,M,H channels or noise	
R9	BLE (500Kbps)	960.0	4000.0	-42.9	-58.3	3.2	0.0	0.0	55.5	74.0	40.2	54.0	13.8	max L,M,H channels or noise	
R10	BLE (500Kbps)	4804.0	4804.0	-55.2	-65.4	3.2	0.0	0.0	43.2	74.0	33.1	54.0	20.9	CH Low	
R11	BLE (500Kbps)	4880.0	4880.0	-55.6	-65.3	3.2	0.0	0.0	42.8	74.0	33.2	54.0	20.8	CH Mid	
R12	BLE (500Kbps)	4960.0	4960.0	-51.5	-60.8	3.2	0.0	0.0	46.9	74.0	37.7	54.0	16.3	CH High	
R13	BLE (500Kbps)	4000.0	6000.0	-51.5	-60.8	3.2	0.0	0.0	46.9	74.0	37.7	54.0	16.3	max L,M,H channels or noise	
R14	BLE (500Kbps)	6000.0	8400.0	-52.4	-64.4	3.2	0.0	0.0	46.0	74.0	34.1	54.0	19.9	max L,M,H channels or noise	
R15	BLE (500Kbps)	7206.0	7206.0	-52.4	-64.4	3.2	0.0	0.0	46.0	74.0	34.1	54.0	19.9	CH Low	
R16	BLE (500Kbps)	7320.0	7320.0	-53.2	-64.9	3.2	0.0	0.0	45.2	74.0	33.6	54.0	20.4	CH Mid	
R17	BLE (500Kbps)	7440.0	7440.0	-53.1	-64.6	3.2	0.0	0.0	45.3	74.0	33.9	54.0	20.1	CH High	
R18	BLE (500Kbps)	8400.0	12500.0	-56.3	-68.4	3.2	0.0	0.0	42.1	74.0	30.1	54.0	23.9	max L,M,H channels or noise	
R19	BLE (500Kbps)	12500.0	26000.0	-59.0	-71.9	3.2	0.0	0.0	39.4	74.0	26.6	54.0	27.4	max L,M,H channels or noise	
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	

(ROW)	(COLUMN) NOTES													
R0	C5	Conducted measurements were made in line with DTS guidance 558074 D01 v5 r02 sections 8.5, 8.6 and 8.7 respectively.												
R2/R4	C5	Measured according to ANSI C63-10-2013 section 11.13.3.3												
R6-R8	C4	Measured according to ANSI C63-10-2013 section 11.12.2.4												
R9-R19	C5	Measured according to ANSI C63-10-2013 section 11.12.2.5.1												
R0	C7	Ground Reflection Factor as described in ANSI C63.10-2013 section 11.12.2.2c												
R0	C9/C11	Computed according to ANSI C63.10-2013 section 11.12.2.2e												

Table 4.3.1 (ii) Transmit Chain Spurious Emissions.

Restricted Band Emissions	Frequency Range	Det	IF Bandwidth	Video Bandwidth	Test Date:	26-Mar-24
Restricted Band Emissions	30 MHz < f < 1 000 MHz	Pk/Qpk	100 KHz	300 KHz	Test Engineer:	John Nantz
Restricted Band Emissions	f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz	EUT:	BOSCH PKA2.2
Restricted Band Edge	f > 1 000 MHz	Pk/Avg	100 KHz	300 KHz	Meas. Distance:	Conducted

Transmitter Spurious														FCC/IC
R0	Mode	Frequency		Output Power Meas.		Ant Gain	GR Factor	Avg Duty	Electric Field @ 3m				Pass	
		Start MHz	Stop MHz	Pk dBm	Qpk/Avg dBm				dB	Factor dB	Calc. Pk dBuV/m	Limit Pk dBuV/m		
R0														
R1	Fundamental Restricted Band Edge (Low Side)													
R2	BLE (1Mbps)	2390.0	2390.0	-58.5	-68.2	3.2	0.0	0.0	39.9	74.0	30.3	54.0	23.7	max L,M,H channels or noise
R3	Fundamental Restricted Band Edge (High Side)													
R4	BLE (1Mbps)	2483.5	2483.5	-50.9	-65.9	3.2	0.0	0.0	47.5	74.0	32.6	54.0	21.4	max L,M,H channels or noise
R5	Restricted Bands Emissions													
R6	BLE (1Mbps)	30.0	88.0	-77.2		3.2	4.7	0.0	25.9			40	14.1	max L,M,H channels or noise
R7	BLE (1Mbps)	88.0	216.0	-79.7		3.2	4.7	0.0	23.4			43.5	20.1	max L,M,H channels or noise
R8	BLE (1Mbps)	216.0	960.0	-72.4		3.2	4.7	0.0	30.7			46	15.3	max L,M,H channels or noise
R9	BLE (1Mbps)	960.0	4000.0	-43.1	-59.3	3.2	0.0	0.0	55.3	74.0	39.2	54.0	14.8	max L,M,H channels or noise
R10	BLE (1Mbps)	4804.0	4804.0	-55.5	-64.4	3.2	0.0	0.0	42.9	74.0	34.1	54.0	19.9	CH Low
R11	BLE (1Mbps)	4880.0	4880.0	-56.0	-64.4	3.2	0.0	0.0	42.4	74.0	34.1	54.0	19.9	CH Mid
R12	BLE (1Mbps)	4960.0	4960.0	-51.4	-59.8	3.2	0.0	0.0	47.0	74.0	38.7	54.0	15.3	CH High
R13	BLE (1Mbps)	4000.0	6000.0	-51.4	-59.8	3.2	0.0	0.0	47.0	74.0	38.7	54.0	15.3	max L,M,H channels or noise
R14	BLE (1Mbps)	6000.0	8400.0	-52.7	-63.4	3.2	0.0	0.0	45.7	74.0	35.1	54.0	18.9	max L,M,H channels or noise
R15	BLE (1Mbps)	7206.0	7206.0	-52.7	-63.4	3.2	0.0	0.0	45.7	74.0	35.1	54.0	18.9	CH Low
R16	BLE (1Mbps)	7320.0	7320.0	-53.5	-63.9	3.2	0.0	0.0	44.9	74.0	34.6	54.0	19.4	CH Mid
R17	BLE (1Mbps)	7440.0	7440.0	-53.1	-63.5	3.2	0.0	0.0	45.3	74.0	35.0	54.0	19.0	CH High
R18	BLE (1Mbps)	8400.0	12500.0	-56.4	-67.5	3.2	0.0	0.0	42.0	74.0	31.0	54.0	23.0	max L,M,H channels or noise
R19	BLE (1Mbps)	12500.0	26000.0	-58.9	-71.9	3.2	0.0	0.0	39.5	74.0	26.6	54.0	27.4	max L,M,H channels or noise
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW) (COLUMN) NOTES

- R0 C5 Conducted measurements were made in line with DTS guidance 558074 D01 v5 r02 sections 8.5, 8.6 and 8.7 respectively.  
R2/R4 C5 Measured according to ANSI C63-10-2013 section 11.13.3.3  
R6-R8 C4 Measured according to ANSI C63-10-2013 section 11.12.2.4  
R9-R19 C5 Measured according to ANSI C63-10-2013 section 11.12.2.5.1  
R0 C7 Ground Reflection Factor as described in ANSI C63.10-2013 section 11.12.2.2c  
R0 C9/C11 Computed according to ANSI C63.10-2013 section 11.12.2.2e

Table 4.3.1 (iii) Transmit Chain Spurious Emissions.

Restricted Band Emissions	Frequency Range	Det	IF Bandwidth	Video Bandwidth	Test Date:	26-Mar-24
Restricted Band Emissions	30 MHz < f < 1 000 MHz	Pk/Qpk	100 KHz	300 KHz	Test Engineer:	John Nantz
Restricted Band Emissions	f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz	EUT:	BOSCH PKA2.2
Restricted Band Edge	f > 1 000 MHz	Pk/Avg	100 KHz	300 KHz	Meas. Distance:	Conducted

Transmitter Spurious														FCC/IC
R0	Mode	Frequency		Output Power Meas.		Ant Gain	GR Factor	Avg Duty Factor	Electric Field @ 3m				Pass	Comments
		Start MHz	Stop MHz	Pk dBm	Qpk/Avg dBm				Calc. Pk dBuV/m	Limit Pk dBuV/m	Calc. Avg dBuV/m	Limit Avg dBuV/m		
R1	Fundamental Restricted Band Edge (Low Side)													
R2	BLE (2Mbps)	2390.0	2390.0	-56.9	-70.5	3.2	0.0	0.0	41.5	74.0	28.0	54.0	26.0	max L,M,H channels or noise
R3	Fundamental Restricted Band Edge (High Side)													
R4	BLE (2Mbps)	2483.5	2483.5	-43.5	-59.9	3.2	0.0	0.0	54.9	74.0	38.6	54.0	15.4	max L,M,H channels or noise
R5	Restricted Bands Emissions													
R6	BLE (2Mbps)	30.0	88.0	-76.7		3.2	4.7	0.0	26.4			40	13.6	max L,M,H channels or noise
R7	BLE (2Mbps)	88.0	216.0	-80.6		3.2	4.7	0.0	22.5			43.5	21.0	max L,M,H channels or noise
R8	BLE (2Mbps)	216.0	960.0	-71.03		3.2	4.7	0.0	32.1			46	13.9	max L,M,H channels or noise
R9	BLE (2Mbps)	960.0	4000.0	-51.8	-68.4	3.2	0.0	0.0	46.6	74.0	30.1	54.0	23.9	max L,M,H channels or noise
R10	BLE (2Mbps)	4804.0	4804.0	-55.6	-71.8	3.2	0.0	0.0	42.8	74.0	26.7	54.0	27.3	CH Low
R11	BLE (2Mbps)	4880.0	4880.0	-56.2	-72.3	3.2	0.0	0.0	42.2	74.0	26.2	54.0	27.8	CH Mid
R12	BLE (2Mbps)	4960.0	4960.0	-51.8	-67.8	3.2	0.0	0.0	46.6	74.0	30.7	54.0	23.3	CH High
R13	BLE (2Mbps)	4000.0	6000.0	-51.8	-67.8	3.2	0.0	0.0	46.6	74.0	30.7	54.0	23.3	max L,M,H channels or noise
R14	BLE (2Mbps)	6000.0	8400.0	-52.9	-68.7	3.2	0.0	0.0	45.5	74.0	29.8	54.0	24.2	max L,M,H channels or noise
R15	BLE (2Mbps)	7206.0	7206.0	-52.9	-68.7	3.2	0.0	0.0	45.5	74.0	29.8	54.0	24.2	CH Low
R16	BLE (2Mbps)	7320.0	7320.0	-54.0	-69.8	3.2	0.0	0.0	44.4	74.0	28.7	54.0	25.3	CH Mid
R17	BLE (2Mbps)	7440.0	7440.0	-53.5	-69.4	3.2	0.0	0.0	44.9	74.0	29.1	54.0	24.9	CH High
R18	BLE (2Mbps)	8400.0	12500.0	-56.6	-72.0	3.2	0.0	0.0	41.8	74.0	26.5	54.0	27.5	max L,M,H channels or noise
R19	BLE (2Mbps)	12500.0	26000.0	-53.6	-67.0	3.2	0.0	0.0	44.8	74.0	31.5	54.0	22.5	max L,M,H channels or noise
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW) (COLUMN) NOTES

- R0 C5 Conducted measurements were made in line with DTS guidance 558074 D01 v5 r02 sections 8.5, 8.6 and 8.7 respectively.  
R2/R4 C5 Measured according to ANSI C63-10-2013 section 11.13.3.3  
R6-R8 C4 Measured according to ANSI C63-10-2013 section 11.12.2.4  
R9-R19 C5 Measured according to ANSI C63-10-2013 section 11.12.2.5.1  
R0 C7 Ground Reflection Factor as described in ANSI C63.10-2013 section 11.12.2.2c  
R0 C9/C11 Computed according to ANSI C63.10-2013 section 11.12.2.2e



Table 4.3.1 (iv) Transmit Chain Spurious Emissions.

<b>Frequency Range</b>	<b>Det</b>	<b>IF Bandwidth</b>	<b>Video Bandwidth</b>	<b>Test Date:</b>	27-Mar-24
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	<b>Test Engineer:</b>	J. Nantz
f > 1 000 MHz	Avg/RMS	1 MHz	3 MHz	<b>EUT:</b>	Bosch PKA2.2
				<b>EUT Mode:</b>	BLE Active (All Modes) w/ 50Ohm Term on BLE Prt
				<b>Meas. Distance:</b>	3 m
				<b>Temperature:</b>	14C
				<b>Rel. Humidity:</b>	42%

Transmitter Unwanted Spurious Emissions															FCC/IC + EU(CISPR)	
#	Test Freq. MHz	Antenna		Ka dB/m	Kg dB	E-Field @ 3m**		FCC/IC Class B		EU 55032 Class B		FCC/IC Class A		EU 55032 Class A		Comments
		QN Used	Test Pol.			Pk dBμV/m	QPk/Avg dBμV/m	E3lim dBμV/m	Pass dB	E3lim dBμV/m	Pass dB	E3lim dBμV/m	Pass dB	E3lim dBμV/m	Pass dB	
1	33.7	BICEMCO01	H	12.2	-3	36.4	34.2	40.0	5.8	40.5	6.3	49.5	15.3	50.5	16.3	background
2	33.7	BICEMCO01	V	12.2	-3	32.4	27.3	40.0	12.7	40.5	13.2	49.5	22.2	50.5	23.2	background
3	71.6	BICEMCO01	H	7.6	-4	25.7	20.8	40.0	19.2	40.5	19.7	49.5	28.7	50.5	29.7	
4	71.6	BICEMCO01	V	7.6	-4	26.2	20.7	40.0	19.3	40.5	19.8	49.5	28.8	50.5	29.8	
5	112.3	BICEMCO01	H	9.3	-6	27.1	21.0	43.5	22.5	40.5	19.5	54.0	33.0	50.5	29.5	
6	112.3	BICEMCO01	V	9.3	-6	30.3	24.4	43.5	19.1	40.5	16.1	54.0	29.6	50.5	26.1	
7	470.0	LOGEMCO01	H	16.9	-1.6	33.5	31.3	46.0	14.7	47.5	16.2	56.9	25.6	57.5	26.2	
8	470.0	LOGEMCO01	V	16.9	-1.6	29.8	26.1	46.0	19.9	47.5	21.4	56.9	30.8	57.5	31.4	
9	868.0	LOGEMCO01	H	22.2	-2.8	39.5	35.0	46.0	11.0	47.5	12.5	56.9	21.9	57.5	22.5	background
10	868.0	LOGEMCO01	V	22.2	-2.8	31.0	26.1	46.0	19.9	47.5	21.4	56.9	30.8	57.5	31.4	
11	945.0	LOGEMCO01	H	23.2	-3.0	37.9	33.3	46.0	12.7	47.5	14.2	56.9	23.6	57.5	24.2	background
12	945.0	LOGEMCO01	V	23.2	-3.0	38.1	33.3	46.0	12.7	47.5	14.2	56.9	23.6	57.5	24.2	background
13																
14	No other spurious emissions observed within 20 dB of the regulatory limit up to 26.5 GHz.															
15																

\*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.

4.3.2 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.

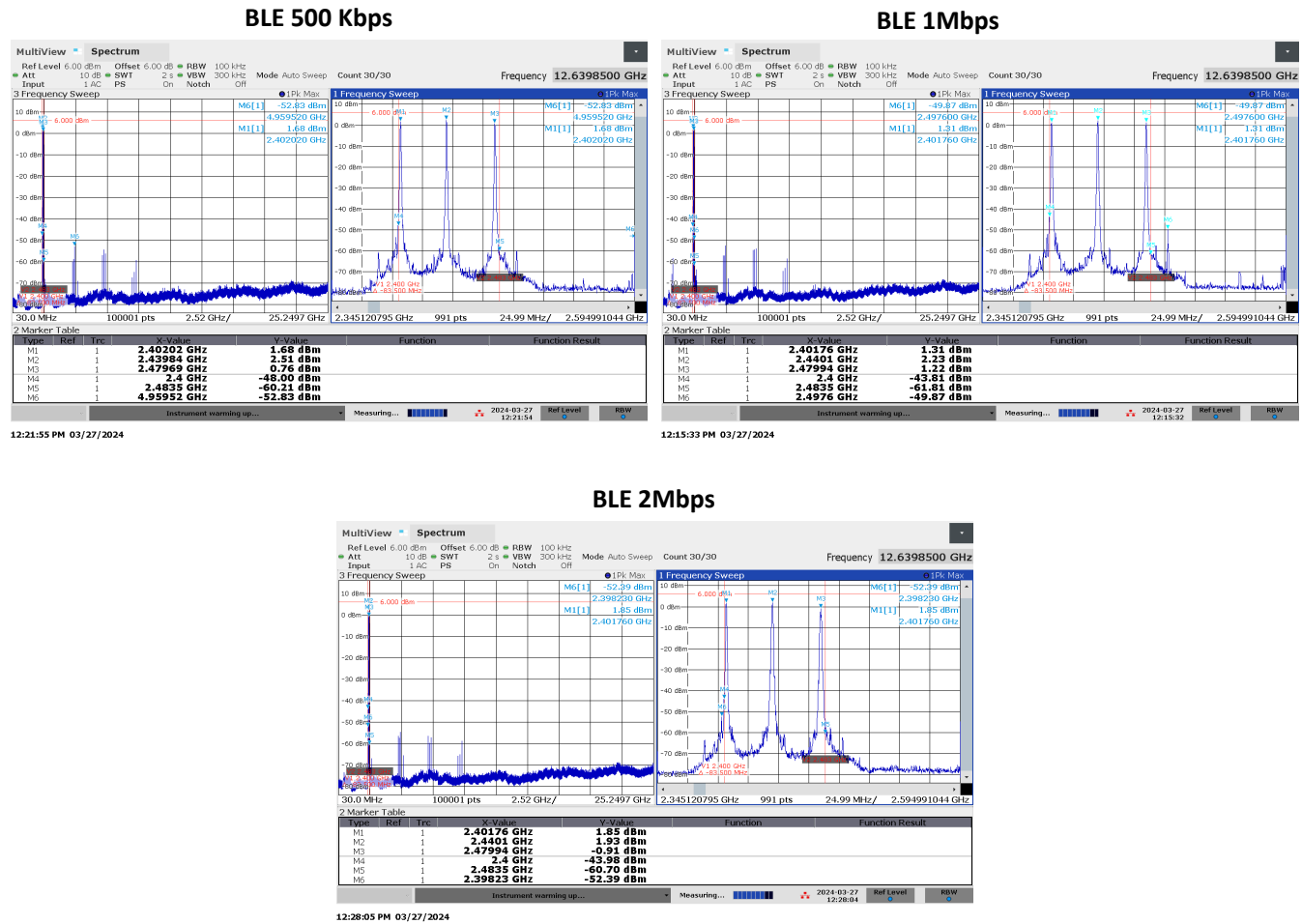


Figure 4.3.2 Worst Case Transmitter OOB Emissions Measured.

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 <sup>†</sup>
Radio Frequency	$\pm(f_{Mkr}/10^7 + RBW/10 + (SPN/(PTS - 1))/2 + 1 \text{ Hz})$
Conducted Emm. Amplitude	±1.9 dB
Radiated Emm. Amplitude ( $f < 30 \text{ MHz}$ )	±3.1 dB
Radiated Emm. Amplitude (30 – 200 MHz)	±4.0 dB
Radiated Emm. Amplitude (200 – 1000 MHz)	±5.2 dB
Radiated Emm. Amplitude ( $f > 1000 \text{ MHz}$ )	±3.7 dB

<sup>†</sup>Ref: CISPR 16-4-2:2011+A1:2014



Figure 5.0.0 Accreditation Documents