

EMC Test Report

regarding

USA: CFR Title 47, Part 15.247 (Emissions)
Canada: IC RSS-247v3/GENv5 (Emissions)

for



DUAL BRFM

Category: DTS Transceiver

Judgments:

Aligns with FCC Part 15.247, ISSED RSS-247v3

Testing Completed: May 22, 2024



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Revision History

Rev. No.	Date	Details	Revised By
r0	May 23, 2024	Initial Release.	J. Nantz
r1	June 18, 2024	Updated Declarations section 3.1.8	J. Nantz
r2	June 18, 2024	Signatures added	J. Nantz
r3	June 20, 2024	Composite power added	J. Nantz

Contents

Revision History	2
Table of Contents	2
1 Test Report Scope and Limitations	4
1.1 Laboratory Authorization	4
1.2 Report Retention	4
1.3 Subcontracted Testing	4
1.4 Test Data	4
1.5 Limitation of Results	4
1.6 Copyright	4
1.7 Endorsements	4
1.8 Test Location	5
1.9 Traceability and Equipment Used	5
2 Test Specifications and Procedures	6
2.1 Test Specification and General Procedures	6
3 Configuration and Identification of the Equipment Under Test	7
3.1 Description and Declarations	7
3.1.1 EUT Configuration	8
3.1.2 Modes of Operation	8
3.1.3 Variants	8
3.1.4 Test Samples	8
3.1.5 Functional Exerciser	8
3.1.6 Modifications Made	8
3.1.7 Production Intent	8
3.1.8 Declared Exemptions and Additional Product Notes	8
4 Emissions	9
4.1 General Test Procedures	9
4.1.1 Radiated Test Setup and Procedures	9
4.1.2 Power Supply Variation	11
4.2 Intentional Emissions	12
4.2.1 Duty and Transmission Cycle, Pulsed Operation	12
4.2.2 Fundamental Emission Bandwidth	15
4.2.3 Effective Isotropic Radiated Power	18
4.2.4 Power Spectral Density	19
4.3 Unintentional Emissions	22
4.3.1 Restricted Band Transmit Chain Spurious Emissions	22
4.3.2 OOB Transmit Chain Spurious Emissions	24

5 Measurement Uncertainty and Accreditation Documents

25

List of Tables

1.8.0 Test Site List.	5
1.9.0 Equipment List.	5
3.1.0 EUT Declarations.	7
4.2.1 Pulsed Emission Characteristics (Duty Cycle).	12
4.2.2 Intentional Emission Bandwidth.	15
4.2.3 Radiated Power Results.	18
4.2.4 Power Spectral Density Results.	19
4.3.1 (i) Transmit Chain Spurious Emissions.	22
4.3.1 (ii) Transmit Chain Spurious Emissions.	23
4.3.1 (iii) Transmit Chain Spurious Emissions.	23
5.0.0 Measurement Uncertainty.	25

List of Figures

3.1.0 Photos of EUT.	7
3.1.1 EUT Test Configuration Diagram.	8
4.1.1 Radiated Emissions Diagram of the EUT.	9
4.1.1 Radiated Emissions Test Setup Photograph(s).	10
4.2.1 (i) Example Pulsed Emission Characteristics (Duty Cycle).	13
4.2.1 (ii) Example Pulsed Emission Characteristics (Duty Cycle).	14
4.2.2 (i) Example Intentional Emission Bandwidth Plots.	16
4.2.2 (ii) Example Intentional Emission Bandwidth Plots.	17
4.2.4 (i) Power Spectral Density Plots.	20
4.2.4 (ii) Power Spectral Density Plots.	21
4.3.2 Worst Case Transmitter OOB Emissions Measured.	24
5.0.0 Accreditation Documents	25

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 June 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
Spectrum Analyzer	R & S / FSV30	101660	RSFSV3001	RS / Apr-2025
EMI Receiver	R & S / ESW26	101313	RSESW2601	RS / November-2024
Quad Ridge Horn	Singer / A6100	C35200	HQR1TO18S01	Keysight / Aug-2024
Biconical	EMCO / 93110B	9802-3039	BICEMCO01	Keysight / Aug-2025
Log Periodic Antenna	EMCO / 3146	9305-3614	LOGEMCO01	Keysight / Aug-2025
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 Vitesco Technologies GmbH 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 Vitesco Technologies GmbH DUAL BRFM 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-247v3/GENv5
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 proprietary 802.15.4 transceiver. The EUT is approximately 16 x 7 x 2 cm in dimension, and is depicted in Figure 3.1.0 . It is powered by 5.5 VDC vehicular power source. This product is used as a wireless battery health network manager to monitor the state of multiple battery cells 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:	DTS Transceiver
Country of Origin:	USA
Nominal Supply:	5.5 VDC
Oper. Temp Range:	Not Declared
Frequency Range:	2405 - 2480 MHz
Antenna Dimension:	2.5 x 0.75 cm
Antenna Type:	Chip Antenna
Antenna Gain:	2.6 dBi max.
Number of Channels:	16
Channel Spacing:	5 MHz
Alignment Range:	Not Declared
Type of Modulation:	GFSK
United States	
FCC ID Number:	2A6TC-DBRFM
Classification:	DTS
Canada	
IC Number:	28616-DBRFM
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 employs 2 radio's, both capable of operating at 1Mbps and 2Mbps data rates over 16 operating channels. The manufacturer provided PC software for radio configuration and for monitoring the device performance during testing.

3.1.3 Variants

There is only a single variant of the EUT.

3.1.4 Test Samples

Three samples of the EUT were provided for testing. Two programmed with a radio test firmware configurable by laptop and UART for radio testing (SN: 3057, 3058) and one normal operating sample (SN:3068), all of which were tested herein.

3.1.5 Functional Exerciser

The manufacturer provided a laptop with a special GUI to monitor each port during testing.

3.1.6 Modifications Made

Pretesting indicated the radio power level had to be reduced to a setting of 8. Final testing was performed on samples with this power level implemented by the manufacturer.

3.1.7 Production Intent

The EUT appears to be a production ready sample.

3.1.8 Declared Exemptions and Additional Product Notes

The manufacturer declares that the EUT is used as a network manager and as such will never have both radios transmitting on the same channel at the same time. 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.

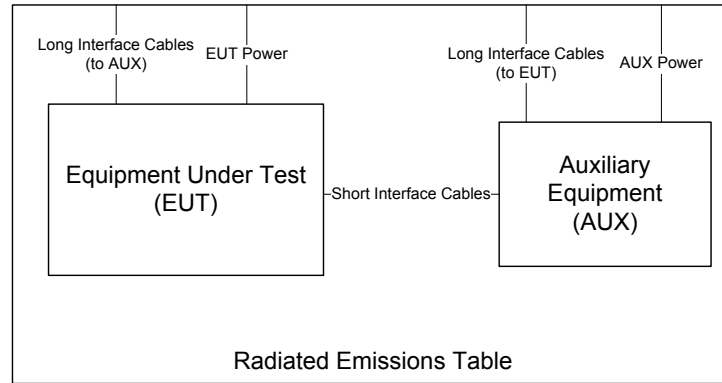


Figure 4.1.1 Radiated Emissions Diagram of the EUT.

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.

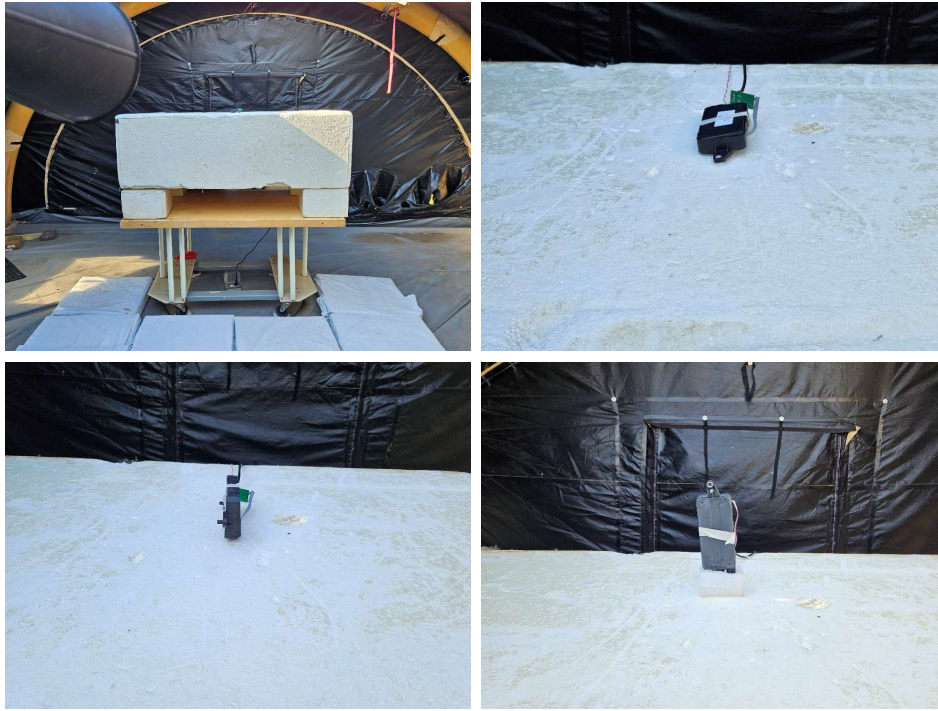


Figure 4.1.1 Radiated Emissions Test Setup Photograph(s).

4.1.2 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: 21-May-24
Test Engineer: John Nantz
EUT Vitesco Dual BRFM
Meas. Distance: Conducted

R0	Duty Factor							
	Mode	Data Rate Mbps	Voltage V	Oper. Freq MHz	Pulse Length	Pulse Period	Duty Cycle %	Power Duty Correction dB
R1	RAD 1 - CM	1.0	5.5	2440.0	1.0	1.0	100.0	0.0
R2		2.0	5.5	2440.0	1.0	1.0	100.0	0.0
R3	RAD 2 - CM	1.0	5.5	2440.0	1.0	1.0	100.0	0.0
R4		2.0	5.5	2440.0	1.0	1.0	100.0	0.0
#	C1	C3	C4	C5	C6	C7	C8	C9

ROW COLUMN NOTE

All C8 Duty Cycle measured in line with DTS guidance 558074 D01 v5 r02 sec 6(b) for averaging only over full-power transmission pulses.

RADIO 1

1 MBPS

2 MBPS



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

RADIO 2

1 MBPS

2 MBPS



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: 21-May-24
Test Engineer: John Nantz
EUT: Vitesco Dual BRFM
Meas. Distance: Conducted

R0	Occupied Bandwidth								
	MODE		Voltage (V)	Oper. Freq (MHz)	6 dB BW (MHz)	6 dB BW Limit (MHz)	99% OBW (MHz)	20 dB BW (MHz)	Pass/Fail
R1	RAD 1	1 Mbps	5.5	2405.0	1.379	0.50	2.042	2.373	Pass
R2				2440.0	1.364	0.50	2.039	2.378	Pass
R3				2480.0	1.374	0.50	2.041	2.363	Pass
R4		2 Mbps	5.5	2405.0	1.374	0.50	2.044	2.368	Pass
R5				2440.0	1.349	0.50	2.038	2.368	Pass
R6				2480.0	1.354	0.50	2.043	2.368	Pass
R7	RAD 2	1 Mbps	5.5	2405.0	1.369	0.50	2.042	2.368	Pass
R8				2440.0	1.359	0.50	2.044	2.383	Pass
R9				2480.0	1.374	0.50	2.040	2.383	Pass
R10		2 Mbps	5.5	2405.0	1.374	0.50	2.042	2.373	Pass
R11				2440.0	1.399	0.50	2.046	2.388	Pass
R12				2480.0	1.404	0.50	2.036	2.383	Pass
#	C1	C2	C3	C4	C5	C6	C7	C8	C9

ROW COLUMN NOTE

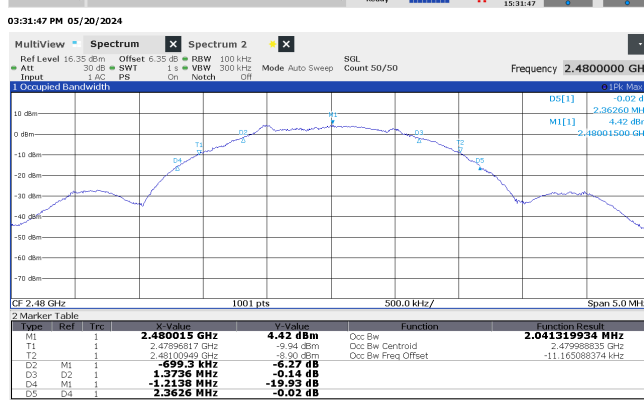
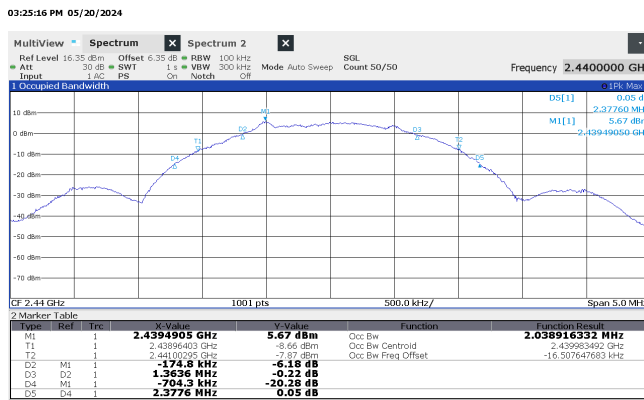
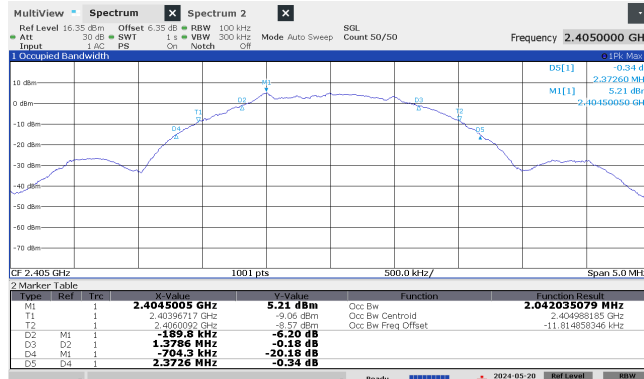
R0

C5

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

RADIO 1

1 MBPS



2 MBPS

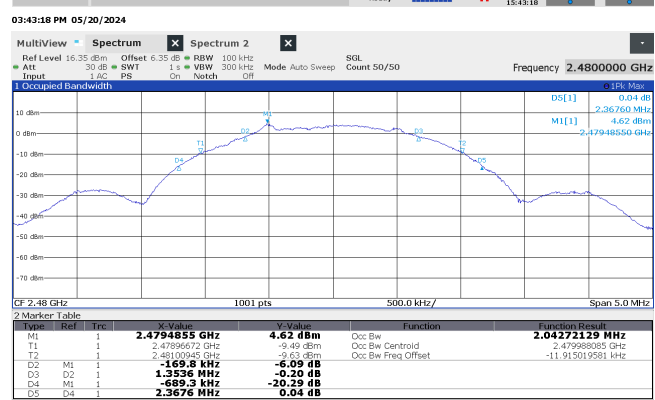
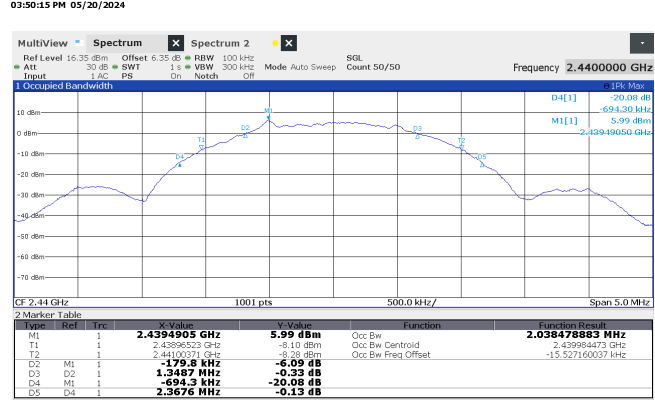
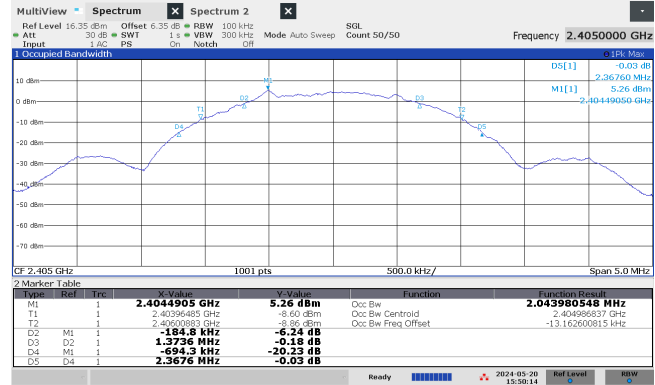
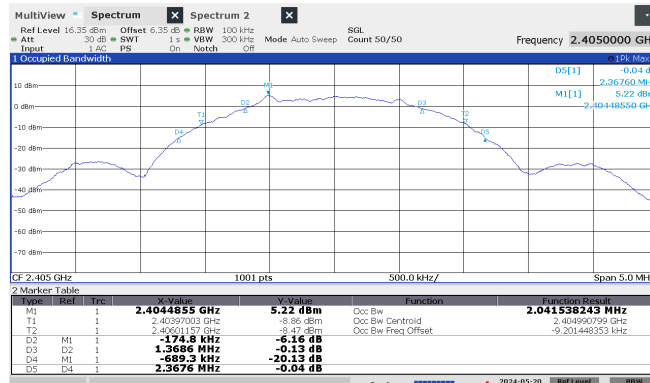


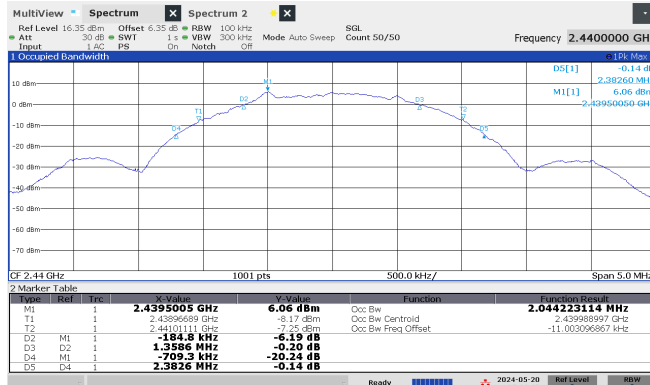
Figure 4.2.2 (i) Example Intentional Emission Bandwidth Plots.

RADIO 2

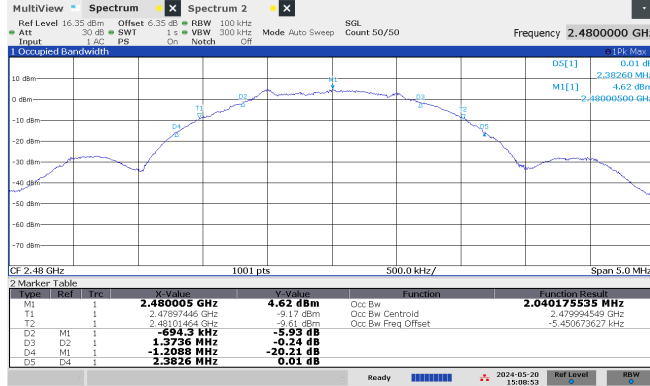
1 MBPS



03:19:31 PM 05/20/2024

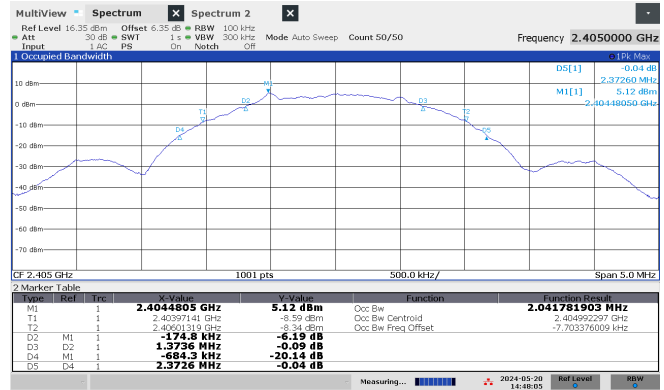


03:11:41 PM 05/20/2024

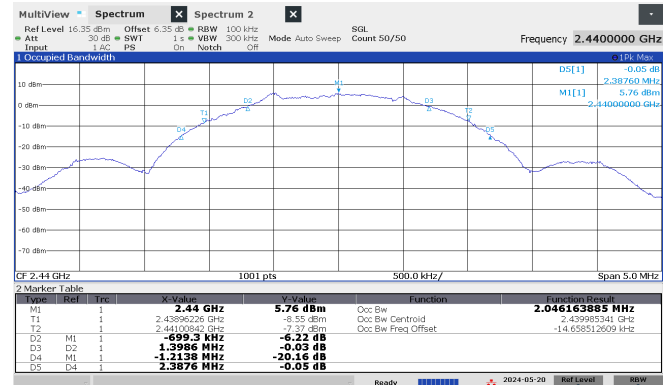


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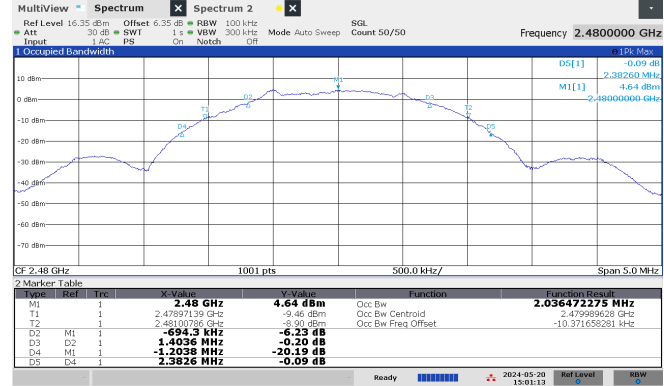
2 MBPS



02:48:05 PM 05/20/2024



02:58:07 PM 05/20/2024



03:01:14 PM 05/20/2024

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 .

Table 4.2.3 Radiated Power Results.

SN: Homologation 26

Test Date: 21-May-24
 Test Engineer: John Nantz
 EUT: Vitesco Dual BRFM
 Meas. Distance: Conducted

R0	Fundamental Power											
	Mode	Channel	Freq. MHz	Pout (Pk) dBm	Duty dB	Pout + Duty dBm	Ant Gain dBi	EIRP (Avg) dBm	EIRP (Avg) Limit dBm	Pass dB	Comments	
R1	RAD 1	1 Mbps	L	2405.0	6.3	0.0	6.3	2.6	8.88	36.0	27.1	
R2			M	2440.0	6.9	0.0	6.9	2.6	9.53	36.0	26.5	
R3			H	2480.0	5.7	0.0	5.7	2.6	8.30	36.0	27.7	
R4		2 Mbps	L	2405.0	6.3	0.0	6.3	2.6	8.85	36.0	27.2	
R5			M	2440.0	6.9	0.0	6.9	2.6	9.50	36.0	26.5	
R6			H	2480.0	5.7	0.0	5.7	2.6	8.27	36.0	27.7	
R7	RAD 2	1 Mbps	L	2405.0	6.0	0.0	6.0	2.6	8.57	36.0	27.4	
R8			M	2440.0	6.6	0.0	6.6	2.6	9.20	36.0	26.8	
R9			H	2480.0	5.5	0.0	5.5	2.6	8.10	36.0	27.9	
R10		2 Mbps	L	2405.0	6.0	0.0	6.0	2.6	8.57	36.0	27.4	
R11			M	2440.0	6.6	0.0	6.6	2.6	9.21	36.0	26.8	
R12			H	2480.0	5.5	0.0	5.5	2.6	8.12	36.0	27.9	
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12

(ROW) (COLUMN) NOTE:
 R0 C5 Measured maximum peak conducted power from the radio using conducted test sample following DTS Guidance 558074 D01 v5 r02 Section 8.3.1.1
 R0 C8 Worst Case Antenna Gain from Antenna Datasheet: 2.6 dBi.

R0	Composite Power										
	Mode				Pout Max (Pk)		Total Composite Pout (Pk)		Band Limit (Pk)	Pass	Comments
					dBm	Watts		dBm	dBm		
	RAD 1				6.93	0.0049	0.0095	9.78	30	20.22	
	RAD 2				6.61	0.0046					
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	

(ROW) (COLUMN) NOTE:
 R0 C5 Max all channels/baud rates
 R0 C7 Sum of peak powers delivered to all antennas in band according to §15.247, section b(3)
 R0 C9 Maximum power limit according to §15.247, section b(3)

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 2400-2483.5
Detector Pk

IF Bandwidth 3 kHz

Video Bandwidth 10 kHz

Test Date: 21-May-24

Test Engineer: John Nantz

EUT: Vitesco Dual BRFM

Meas. Distance: Conducted

Power Spectral Density								
R0	Mode		Channel	Frequency (MHz)	Ant. Used	PSDcond (meas) (dBm/3kHz)	PSD Limit (dBm/3kHz)	Pass By (dB)
R1	RAD 1	1 Mbps	L	2405.0	Cond.	-9.0	8.00	17.0
R2			M	2440.0	Cond.	-8.8	8.00	16.8
R3			H	2480.0	Cond.	-9.3	8.00	17.3
R4		2 Mbps	L	2405.0	Cond.	-9.0	8.00	17.0
R5			M	2440.0	Cond.	-8.6	8.00	16.6
R6			H	2480.0	Cond.	-9.3	8.00	17.3
R1	RAD 2	1 Mbps	L	2405.0	Cond.	-8.4	8.00	16.4
R2			M	2440.0	Cond.	-7.8	8.00	15.8
R3			H	2480.0	Cond.	-8.4	8.00	16.4
R4		2 Mbps	L	2405.0	Cond.	-8.2	8.00	16.2
R5			M	2440.0	Cond.	-7.6	8.00	15.6
R6			H	2480.0	Cond.	-8.7	8.00	16.7
#		C1	C2	C3	C4	C5	C6	C7

(ROW)
R0

(COLUMN)
C5

NOTE:

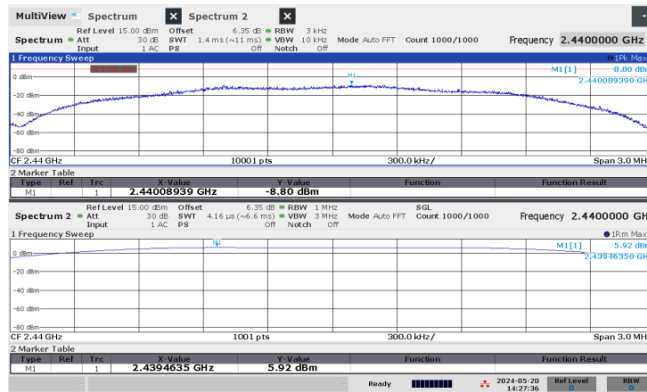
PSD measured conducted out the EUT antenna port following ANSI C63.10, section: 11.10.2

RADIO 1

1 MBPS



02:28:48 PM 05/20/2024

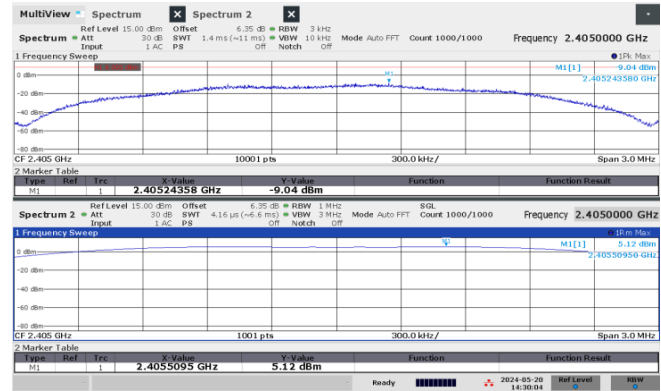


02:27:36 PM 05/20/2024



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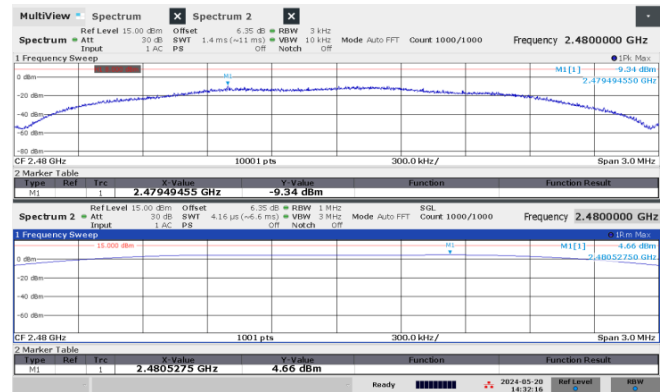
2 MBPS



02:30:05 PM 05/20/2024



02:30:59 PM 05/20/2024

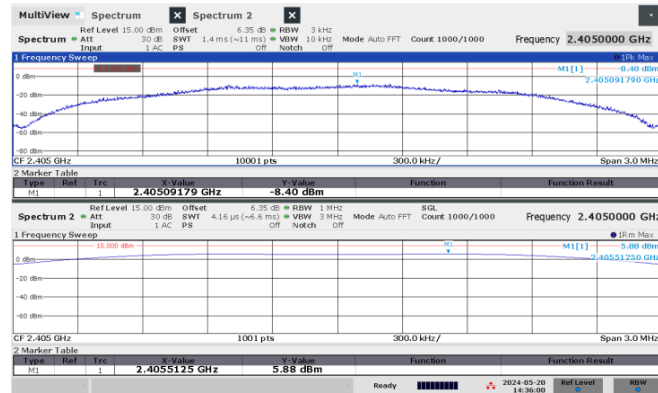


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Figure 4.2.4 (i) Power Spectral Density Plots.

RADIO 2

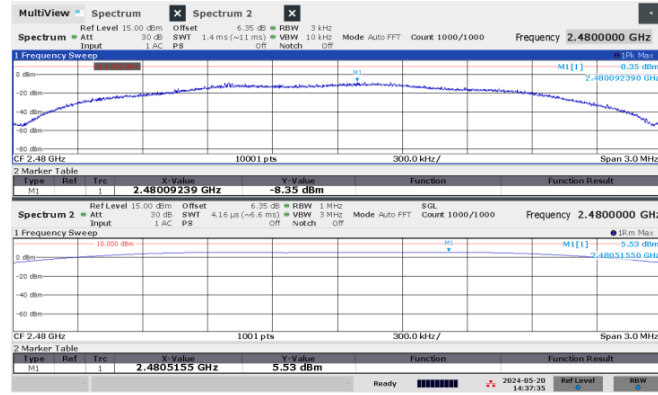
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02:36:01 PM 05/20/2024

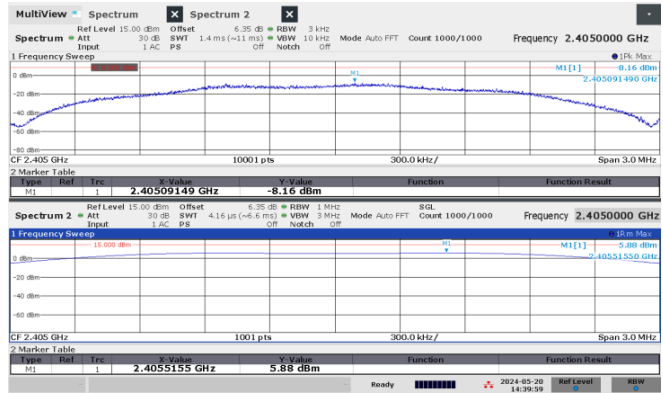


02:36:53 PM 05/20/2024

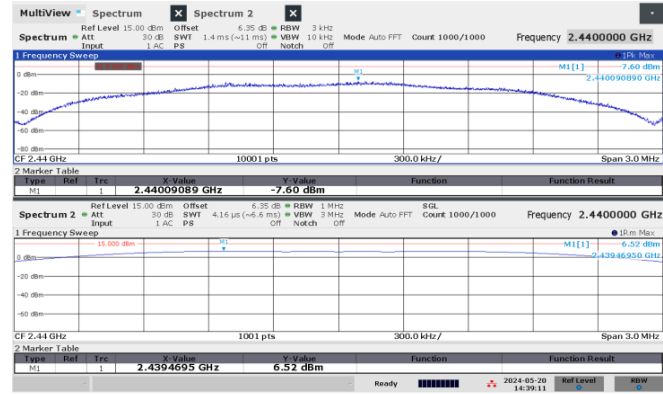


02:37:36 PM 05/20/2024

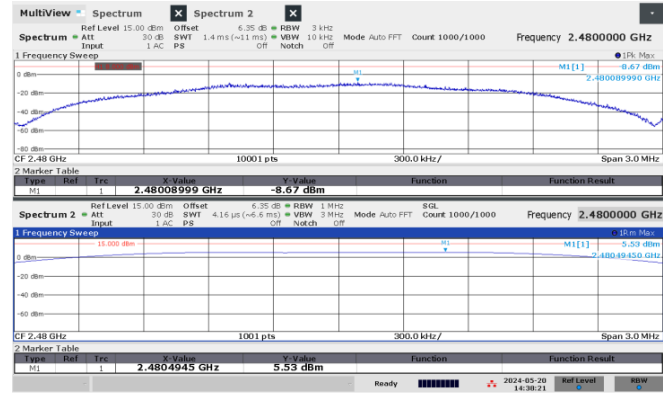
2 MBPS



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02:39:12 PM 05/20/2024



02:38:21 PM 05/20/2024

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:	21-May-24
30 MHz < f < 1 000 MHz	Pk/Qpk	100 kHz	300 kHz	Test Engineer:	John Nantz
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz	EUT:	Vitesco Dual BRFM
				Meas. Distance:	Conducted

Transmitter Spurious - RADIO 1														FCC/IC
R0	Mode	Frequency Start MHz	Stop MHz	Output Power Pk dBm	Avg dBm	Ant Gain dBi	GR Factor dB	Avg Duty Factor dB	Meas. Pk dBuV/m	Limit Pk dBuV/m	Meas. Avg dBuV/m	Limit Avg dBuV/m	Pass dB	Comments
R1	Fundamental Restricted Band Edge (Low Side)													
R2	1M/2M	2390.0	2390.0	-66.3	-69.1	2.6	0.0	0.0	31.5	74.0	28.7	54.0	25.3	max all - baud rates/L,M,H channels/noise
R3	Fundamental Restricted Band Edge (High Side)													
R4	1M/2M	2483.5	2483.5	-61.4	-62.9	2.6	0.0	0.0	36.4	74.0	34.9	54.0	19.1	max all - baud rates/L,M,H channels/noise
R5	Restricted Bands Emissions													
R6	1M/2M	30	88	-88.4		2.6	4.7	0.0	14.1			40	25.9	max all - baud rates/L,M,H channels/noise
R7	1M/2M	88	216	-88.7		2.6	4.7	0.0	13.8			43	29.2	max all - baud rates/L,M,H channels/noise
R8	1M/2M	216	1000	-88.5		2.6	4.7	0.0	14.0			46	32.0	max all - baud rates/L,M,H channels/noise
R9	1M/2M	1000.0	2400.0	-66.3	-69.1	2.6	0.0	0.0	31.5	74.0	28.7	54.0	25.3	max all - baud rates/L,M,H channels/noise
R10	1M/2M	2483.5	4000.0	-61.4	-62.9	2.6	0.0	0.0	36.4	74.0	34.9	54.0	19.1	max all - baud rates/L,M,H channels/noise
R11	1M/2M	4810.0	4810.0	-74.5	-78.7	2.6	0.0	0.0	23.3	74.0	19.1	54.0	34.9	max all - baud rates/L,M,H channels/noise
R12	1M/2M	4870.0	4870.0	-74.0	-78.4	2.6	0.0	0.0	23.8	74.0	19.4	54.0	34.6	max all - baud rates/L,M,H channels/noise
R13	1M/2M	4950.0	4950.0	-73.7	-78.0	2.6	0.0	0.0	24.1	74.0	19.8	54.0	34.2	max all - baud rates/L,M,H channels/noise
R14	1M/2M	4000.0	6000.0	-73.7	-78.0	2.6	0.0	0.0	24.1	74.0	19.8	54.0	34.2	max all - baud rates/L,M,H channels/noise
R15	1M/2M	6000.0	8400.0	-73.1	-79.5	2.6	0.0	0.0	24.7	74.0	18.3	54.0	35.7	max all - baud rates/L,M,H channels/noise
R16	1M/2M	8400.0	12500.0	-65.8	-70.4	2.6	0.0	0.0	32.0	74.0	27.4	54.0	26.6	max all - baud rates/L,M,H channels/noise
R17	1M/2M	12500.0	25000.0	-59.0	-71.8	2.6	0.0	0.0	38.8	74.0	26.0	54.0	28.0	max all - baud rates/L,M,H channels/noise
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW) (COLUMN) NOTE:

R0 C4/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 C4/C5 Measured using the mode with widest bandwidth and max. output power/PSD according to ANSI C63-10-2013 sections 5.6.2.2 and 6.10.5.2 respectively

R0 C6 Worst Case Antenna Gain per Datasheet is 2.6 dBi > 2 dBi - used for calculation in alignment with ANSI C63.10, section 11.12.2.6

R0 C7 Ground Reflection Factor as described in ANSI C63.10-2013 section 11.12.2.2 c

R0 C9 Computed according to ANSI C63.10-2013 section 11.12.2.2 e

Table 4.3.1 (ii) Transmit Chain Spurious Emissions.

Frequency Range
30 MHz < f < 1 000 MHz
f > 1 000 MHz

Det
Pk/Qpk
Pk/Avg

IF Bandwidth
100 kHz
1 MHz

Video Bandwidth
300 kHz
3 MHz

Test Date:
Test Engineer:
EUT:
Meas. Distance:

21-May-24
John Nantz
Vitesco Dual BRFM
Conducted

Transmitter Spurious - RADIO 2														FCC/IC
R0	Mode	Frequency		Output Power		Ant Gain	GR Factor	Avg Duty Factor	Electric Field @ 3m				Pass	Comments
		Start MHz	Stop MHz	Pk dBm	Avg dBm				Meas. Pk dBuV/m	Limit Pk dBuV/m	Meas. Avg dBuV/m	Limit Avg dBuV/m		
R1	Fundamental Restricted Band Edge (Low Side)													
R2	1M/2M	2390.0	2390.0	-67.7	-69.1	2.6	0.0	0.0	30.1	74.0	28.7	54.0	25.3	max all - baud rates/L,M,H channels/noise
R3	Fundamental Restricted Band Edge (High Side)													
R4	1M/2M	2483.5	2483.5	-59.8	-61.9	2.6	0.0	0.0	38.0	74.0	35.9	54.0	18.1	max all - baud rates/L,M,H channels/noise
R5	Restricted Bands Emissions													
R6	1M/2M	30	88	-87.5		2.6	4.7	0.0	15.0			40	25.0	max all - baud rates/L,M,H channels/noise
R7	1M/2M	88	216	-85.3		2.6	4.7	0.0	17.2			43	25.8	max all - baud rates/L,M,H channels/noise
R8	1M/2M	216	1000	-83.4		2.6	4.7	0.0	19.1			46	26.9	max all - baud rates/L,M,H channels/noise
R9	1M/2M	1000.0	2400.0	-67.7	-69.1	2.6	0.0	0.0	30.1	74.0	28.7	54.0	25.3	max all - baud rates/L,M,H channels/noise
R10	1M/2M	2483.5	4000.0	-59.8	-61.9	2.6	0.0	0.0	38.0	74.0	35.9	54.0	18.1	max all - baud rates/L,M,H channels/noise
R11	1M/2M	4810.0	4810.0	-71.0	-78.2	2.6	0.0	0.0	26.8	74.0	19.7	54.0	34.4	max all - baud rates/L,M,H channels/noise
R12	1M/2M	4870.0	4870.0	-72.2	-78.5	2.6	0.0	0.0	25.6	74.0	19.3	54.0	34.7	max all - baud rates/L,M,H channels/noise
R13	1M/2M	4950.0	4950.0	-70.3	-76.9	2.6	0.0	0.0	27.5	74.0	20.9	54.0	33.1	max all - baud rates/L,M,H channels/noise
R14	1M/2M	4000.0	6000.0	-70.3	-76.9	2.6	0.0	0.0	27.5	74.0	20.9	54.0	33.1	max all - baud rates/L,M,H channels/noise
R15	1M/2M	6000.0	8400.0	-75.1	-82.0	2.6	0.0	0.0	22.7	74.0	15.8	54.0	38.2	max all - baud rates/L,M,H channels/noise
R16	1M/2M	8400.0	12500.0	-59.8	-70.9	2.6	0.0	0.0	38.0	74.0	26.9	54.0	27.1	max all - baud rates/L,M,H channels/noise
R17	1M/2M	12500.0	25000.0	-58.2	-71.8	2.6	0.0	0.0	39.6	74.0	26.0	54.0	28.0	max all - baud rates/L,M,H channels/noise
#	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

(ROW) (COLUMN) NOTE:

- R0 C4/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 C4/C5 Measured using the mode with widest bandwidth and max. output power/PSD according to ANSI C63.10-2013 sections 5.6.2.2 and 6.10.5.2 respectively
R0 C6 Worst Case Antenna Gain per Datasheet is 2.6 dBi > 2 dBi - used for calculation in alignment with ANSI C63.10, section 11.12.2.6
R0 C7 Ground Reflection Factor as described in ANSI C63.10-2013 section 11.12.2.2 c
R0 C9 Computed according to ANSI C63.10-2013 section 11.12.2.2 e

Table 4.3.1 (iii) Transmit Chain Spurious Emissions.

Frequency Range
30 MHz < f < 1 000 MHz
f > 1 000 MHz

Det
Pk/Qpk
Pk/Avg

IF Bandwidth
100 kHz
1 MHz

deo Bandwidth
300 kHz
3 MHz

Test Date:
Test Engineer:
EUT:
Meas. Distance:

21-May-24
John Nantz
Vitesco Dual BRFM
3m

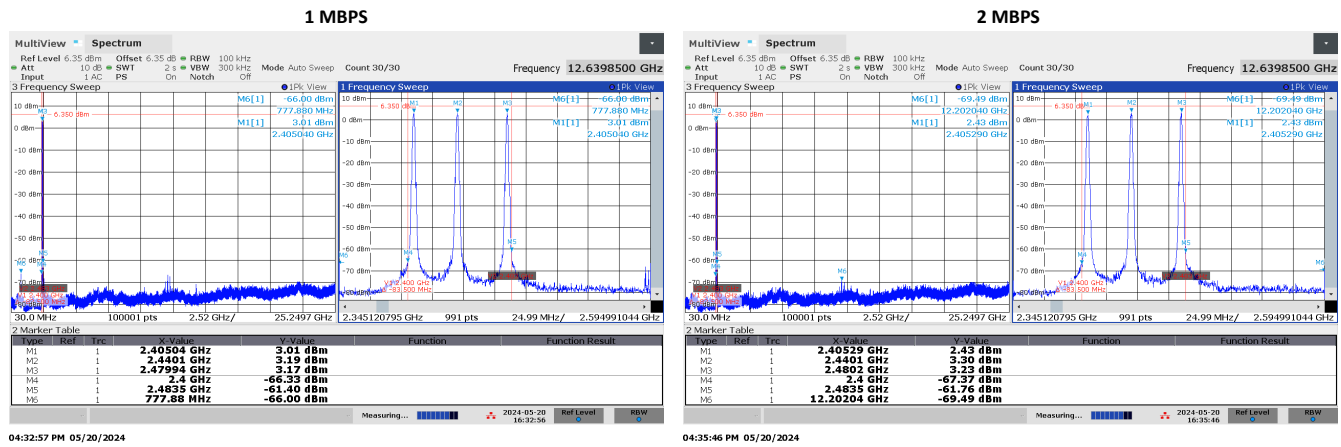
Radiated Transmitter Spurious Intermodulation Products – RADIO1 + RADIO2														FCC/IC
R0	Mode	Frequency		Antenna		Ka dB/m	Kg dB	Electric Field @ 3m				Pass	Comments	
		Start MHz	Stop MHz	QN Used	Test Pol.			Meas. Pk dBuV/m	Limit Pk dBuV/m	Meas. Avg dBuV/m	Limit Avg dBuV/m			
R1	CM, 1Mbps	2370.9	2370.9	HQR1TO18S01	H/V	32.0	-0.9	43.0	74.0	37.2	54.0	16.8	Radio 1, CH-L, Radio 2, CH-M	
R2	CM, 1Mbps	2330.8	2330.8	HQR1TO18S01	H/V	31.7	-0.9	37.2	74.0	30.3	54.0	23.7	Radio 1, CH-L, Radio 2, CH-H	
R3	CM, 1Mbps	2369.7	2369.7	HQR1TO18S01	H/V	32.0	-0.9	39.9	74.0	32.5	54.0	21.5	Radio 1, CH-M, Radio 2, CH-L	
R4	CM, 1Mbps	2519.3	2519.3	HQR1TO18S01	H/V	33.1	-0.9	30.3	74.0	24.7	54.0	29.3	Radio 1, CH-M, Radio 2, CH-H	
R5	CM, 1Mbps	2330.3	2330.3	HQR1TO18S01	H/V	31.7	-0.9	36.1	74.0	30.5	54.0	23.5	Radio 1, CH-H, Radio 2, CH-L	
R6	CM, 1Mbps	2519.4	2519.4	HQR1TO18S01	H/V	33.1	-0.9	35.5	74.0	28.9	54.0	25.1	Radio 1, CH-H, Radio 2, CH-M	
R7														
R8														
R9														
R10														
R11														
#	C1	C2	C3	C4	C5	C6	C7	C9	C10	C11	C12	C13	C14	

(ROW) (COLUMN) NOTE:

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.

RADIO 1



RADIO 2

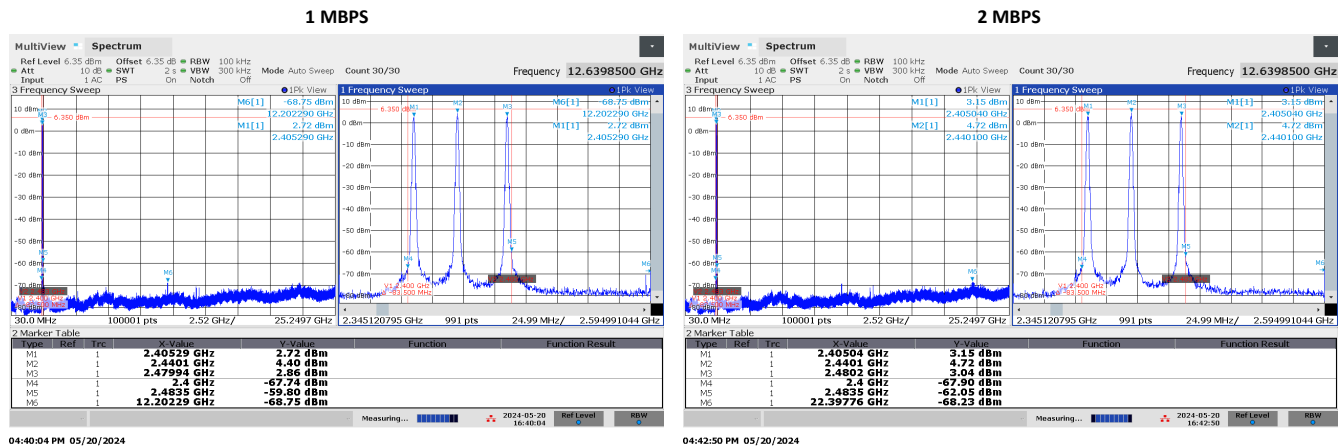


Figure 4.3.2 Worst Case Transmitter OOB Emissions Measured.

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 [†]
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

[†]Ref: CISPR 16-4-2:2011+A1:2014



Figure 5.0.0 Accreditation Documents