

Test report for

47 CFR Part 15 Subpart C



Product name : T DASH
Applicant : TMS Products B.V.
FCC ID : 2BLBWTDSH
IC : Not applicable

Test report No. : P000443649 001 Ver 1.0

Laboratory information

Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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The Industry Canada company number for Kiwa Nederland B.V. is: 4173A. The CABID is NL0001.

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Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Kiwa Nederland B.V.

Testing Location

Test Site	Kiwa Nederland B.V.
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.50	24-10-2024	First draft	PvW
v1.00	04-11-2024	Initial release	PvW

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Summary of Test results

FCC	Description	Section in report	Verdict
15.247 (a)	6 dB bandwidth	3.1	Pass
--	99% bandwidth	3.2	Pass
15.247 (b)	RF output power	3.3	Pass
15.247 (e)	Power spectral density	3.4	Pass
15.247 (d)	Band edge	3.5	Pass

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

1 General Description

1.1 Applicant

Client name:	TMS Products B.V.
Address:	2 ^e Havenstraat 3
Zip code:	1976 CE, IJmuiden
Telephone:	+31(0)654680808
E-mail:	info@tmsproducts.com
Contact name:	Marcel Schaap

1.2 Manufacturer

Manufacturer name:	TMS Products B.V.
Address:	2 ^e Havenstraat 3
Zip code:	1976 CE, IJmuiden
Telephone:	+31(0)654680808
E-mail:	info@tmsproducts.com
Contact name:	Marcel Schaap

1.3 Tested Equipment Under Test (EUT)

Product name:	T DASH
Brand name:	TMS Products B.V.
FCC ID:	2BLBWTD SH
IC:	Not applicable
Product description:	Motorsport Display
Variant model(s):	--
Batch and/or serial No.	84
Software version:	--
Hardware version:	--
Date of receipt:	17-10-2024
Tests started:	22-10-2024
Testing ended:	22-10-2024

1.3.1 Auxiliary items

AUX1

Product name:	Power supply for EUT
Product type:	Delta Elektronik
Remarks:	Simulates a vehicle battery

1.4 Product specifications of Equipment under test

Tx Frequency:	BLE: 2400 – 2483.5 MHz
Rx frequency:	BLE: 2400 – 2483.5 MHz
Occupied channel width:	2 MHz
Antenna type:	Ceramic chip antenna
Antenna gain:	+0.5 dBi
Type of modulation:	GFSK
Emission designator	1M07G1D

Disclaimer: The operating frequency bands are declared by the applicant

1.5 Environmental conditions

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %

1.6 Measurement standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247

1.8 Observation and remarks

The equipment is used in vehicles and is only powered by the battery of the vehicle, so AC conducted emissions testing is not applicable.

Radiated spurious emissions testing according to FCC Part 15 Subpart C §15.209 is performed at Kiwa Creiven.

1.9 Modifications to the EUT (Equipment Under Test)

None.

1.10 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Kiwa Nederland B.V. accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards"*.

All tests are performed by:

Name : ing. A. Mostert

Review of test methods and report by:

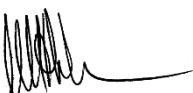
Name : ing. M.H. Khan

The above conclusions have been verified by the following signatory:

Date : 04-11-2024

Name : ing. M.H. Khan

Function : Test Engineer

Signature : 

2 Test configuration of the Equipment Under Test

2.1 Test mode

The manufacturer provided test mode firmware on the EUT with which it was possible to change the continuous transmission mode between modulated/CW and the operating frequency between lowest/middle/highest channel.

2.2 Test setups

Antenna port conducted tests

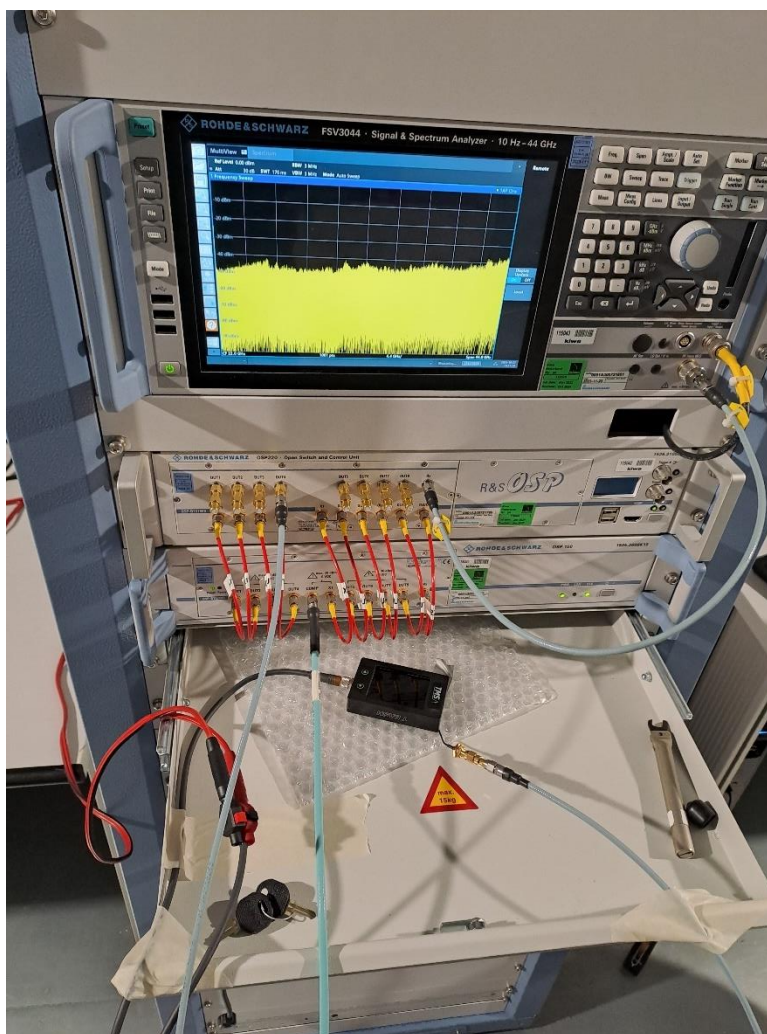


Figure 1. EUT and auxiliary setup

List of used cables					
Number	Function	From	To	Length	Remarks
1	DC Power	AUX 1	EUT	< 3m	-

2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV3044	115043	03-2022	31-10-2024	3.1 – 3.5
Test software	Rohde & Schwarz	WMS 32	--	--	--	3.1 – 3.5
Open switch and control unit	Rohde & Schwarz	OSP220	115042	01-2024	01-2027	3.1 – 3.5

2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 6dB bandwidth Measurement

3.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.1.4 Test procedure

According to ANSI C63.10, section 6.9

IRN 404 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

3.1.5 Test Results of the 6 dB bandwidth Measurement

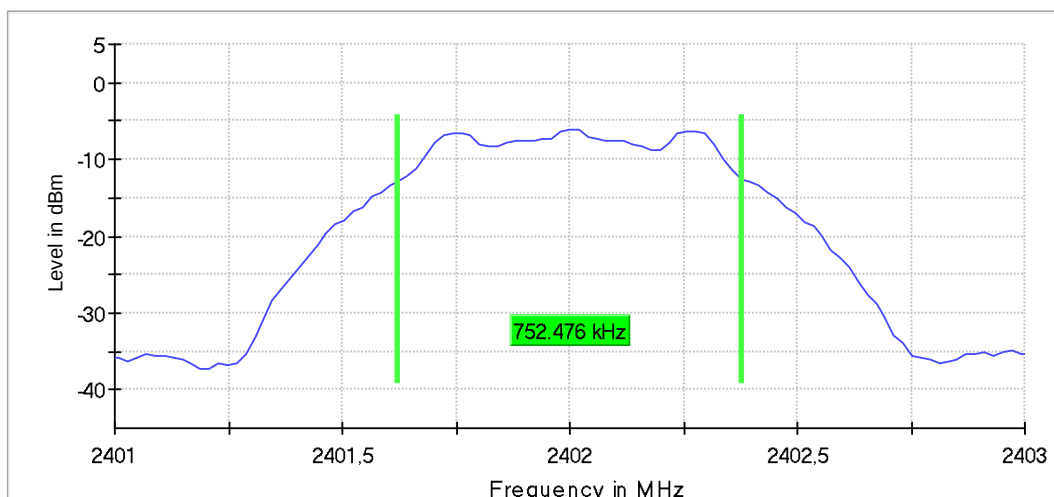
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	752.5
	18	2440	1 Mbps	752.5
	39	2480	1 Mbps	752.5
Uncertainty	± 36.2 kHz			

Note: plots are provided on the next page.

3.1.6 Plots of the 6 dB bandwidth

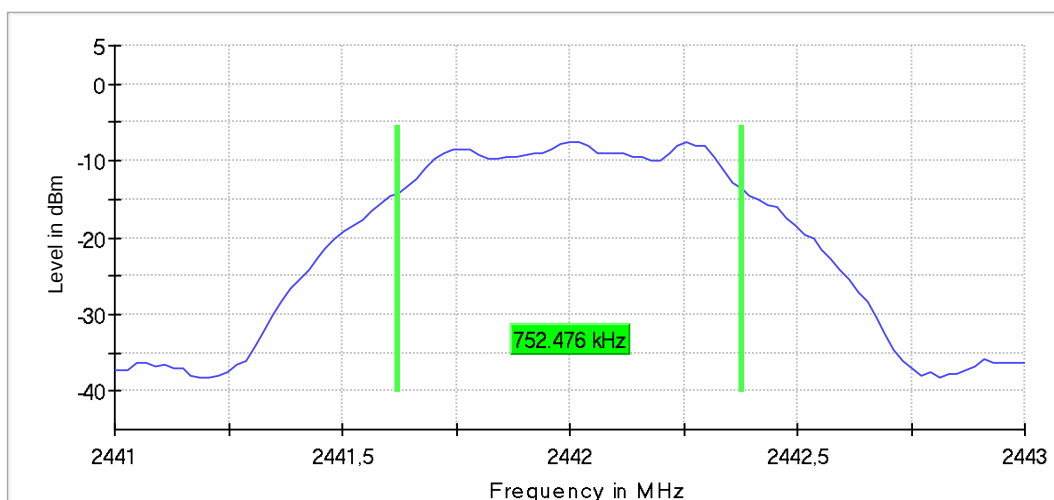
Channel 37

6 dB Bandwidth



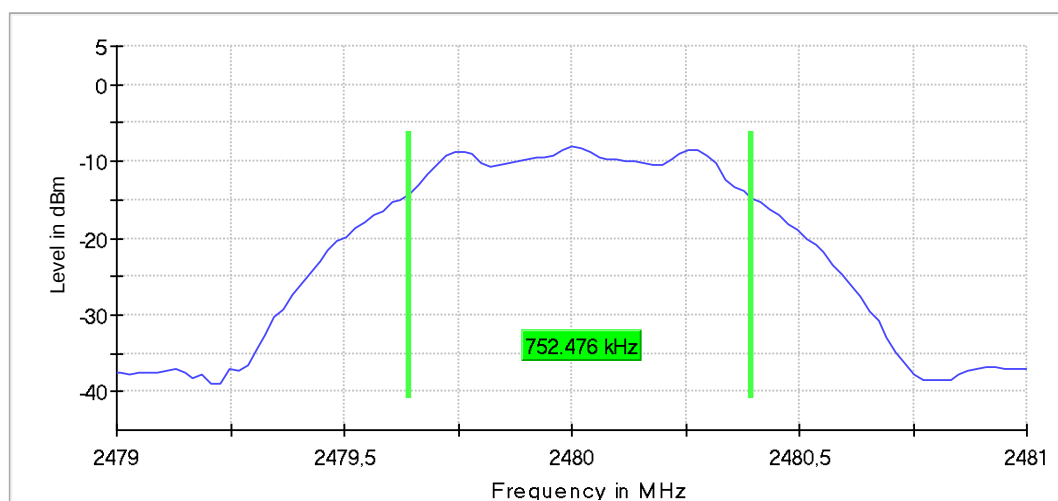
Channel 18

6 dB Bandwidth



Channel 39

6 dB Bandwidth



3.2 99% Occupied Bandwidth

3.2.1 Limit

According to RSS-Gen 6.7

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.2.4 Test procedure

According to ANSI C63.10, section 6.9

IRN 404 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

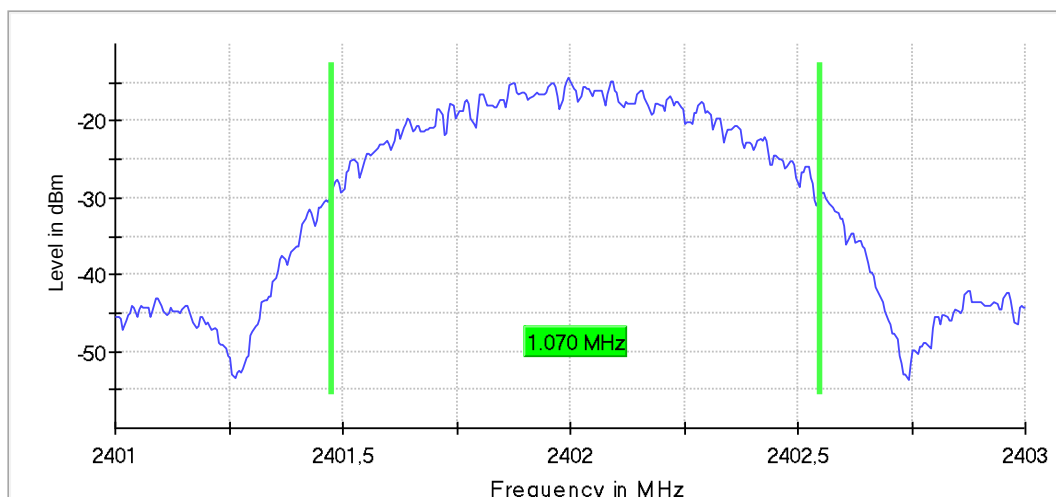
3.2.5 Test results of the 99% occupied bandwidth measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	1070
	18	2440	1 Mbps	1070
	39	2480	1 Mbps	1075
Uncertainty	± 12 kHz			

3.2.6 Plots of the 99% occupied bandwidth measurement

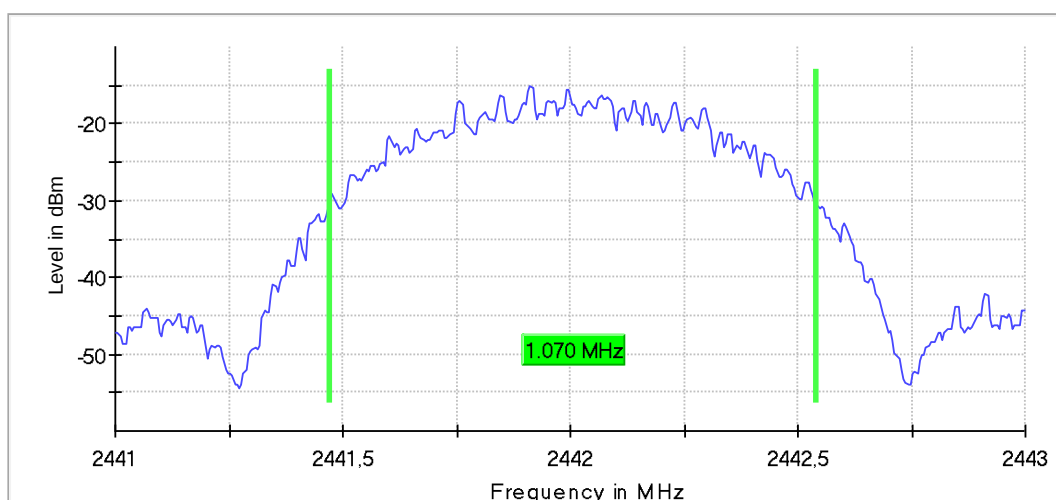
Channel 37

99 % Bandwidth



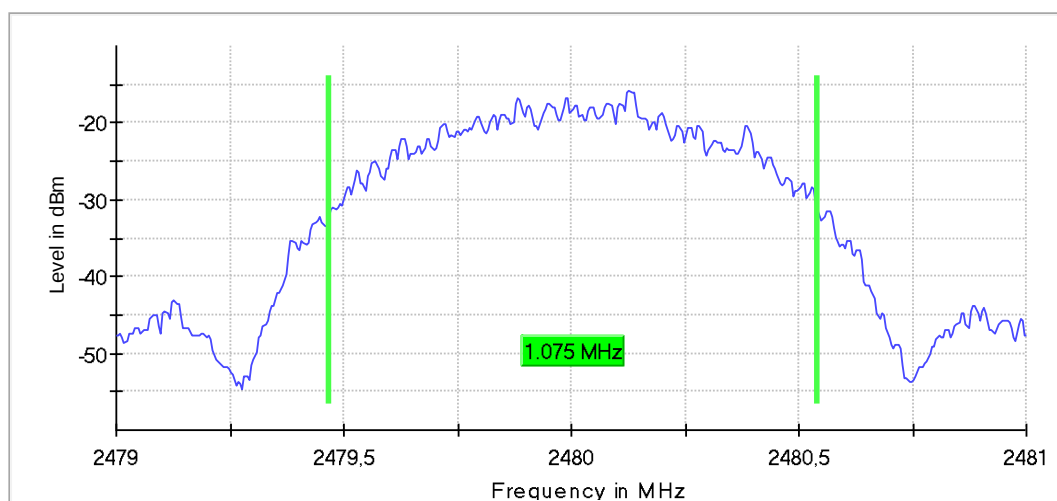
Channel 18

99 % Bandwidth



Channel 39

99 % Bandwidth



3.3 Output Power Measurement

3.3.1 Limit

FCC: For systems using digital modulation in the 2400-2483.5 MHz, the limit for the peak output power is 1W (30 dBm). If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

RSS: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4W

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.3.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.

IRN 402 - RF power (W) - Method 12 – Peak power using a spectrum analyzer.

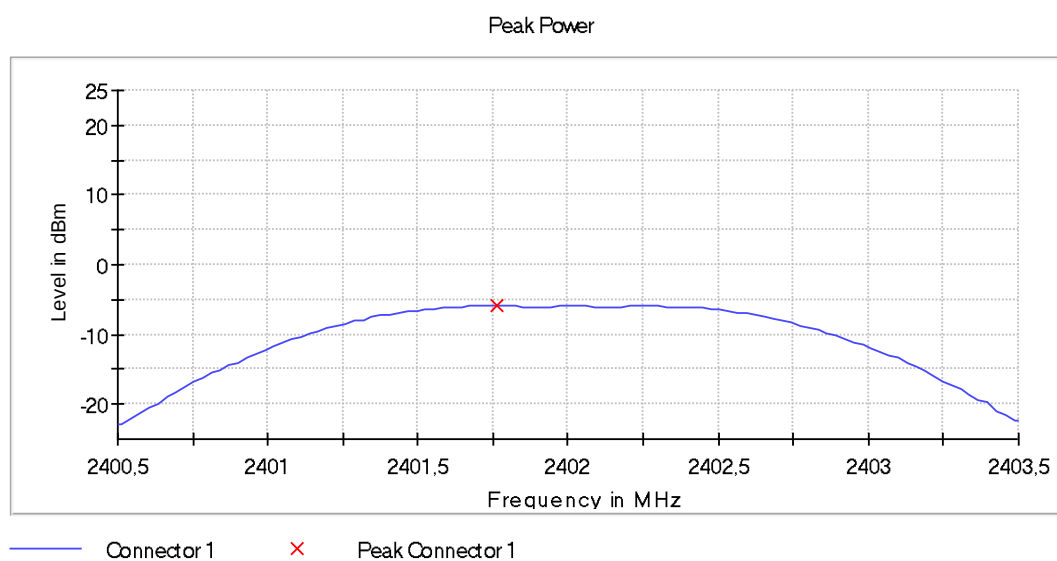
3.3.5 Test results of Output Power Measurement

Peak method						
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power conducted (dBm)	Peak output power conducted (W)	Peak output power EIRP (W)
Bluetooth Low Energy	37	2402	1 Mbps	-5.9	0.00026	0.00029
	18	2440	1 Mbps	-7.3	0.00019	0.00021
	39	2480	1 Mbps	-8.0	0.00016	0.00018
Uncertainty				±0.71 dB		

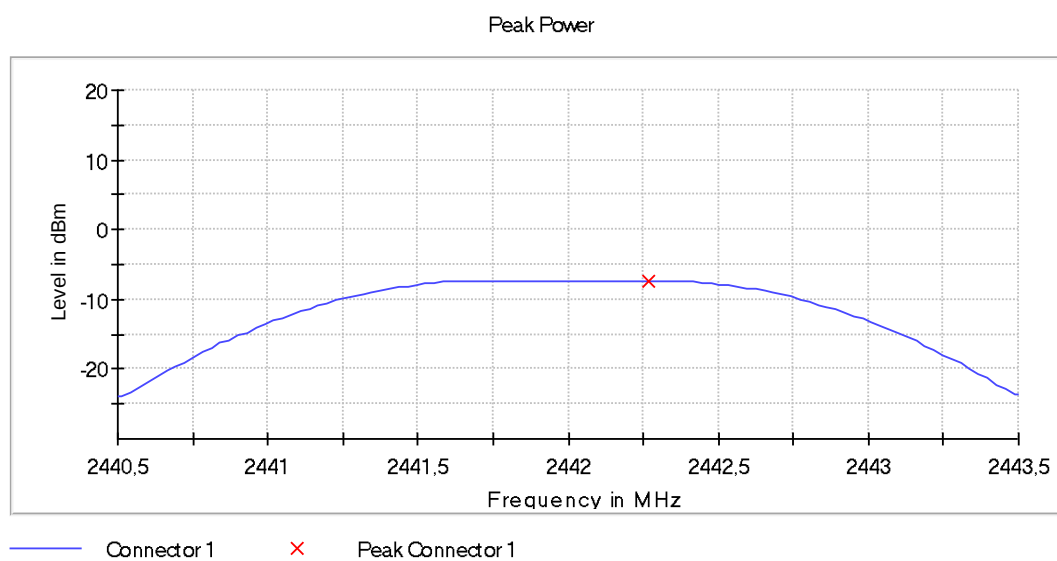
Note: plots are provided on the next page

3.3.6 Plots of the Output power

Channel 37

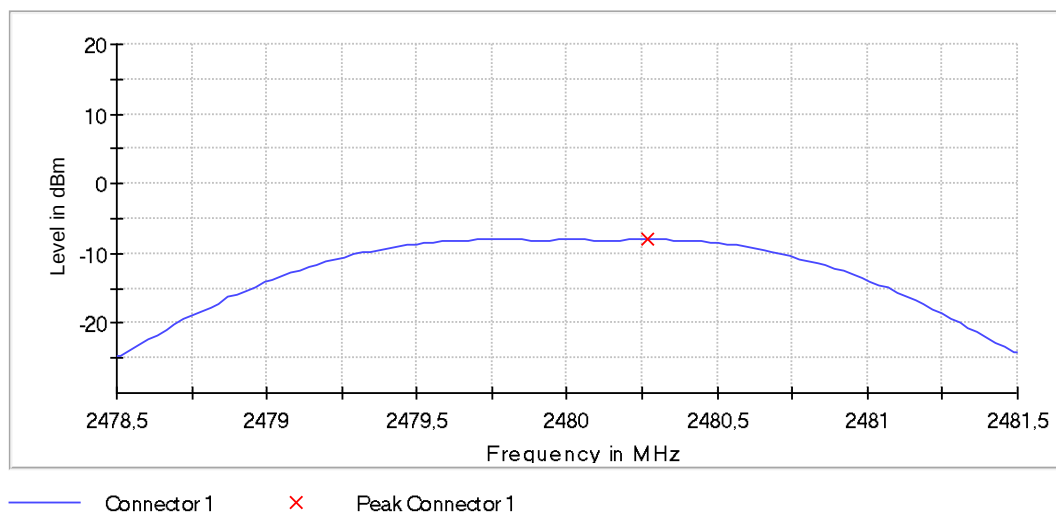


Channel 18



Channel 39

Peak Power



3.4 Power Spectral Density

3.4.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.4.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.

IRN 412 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band)

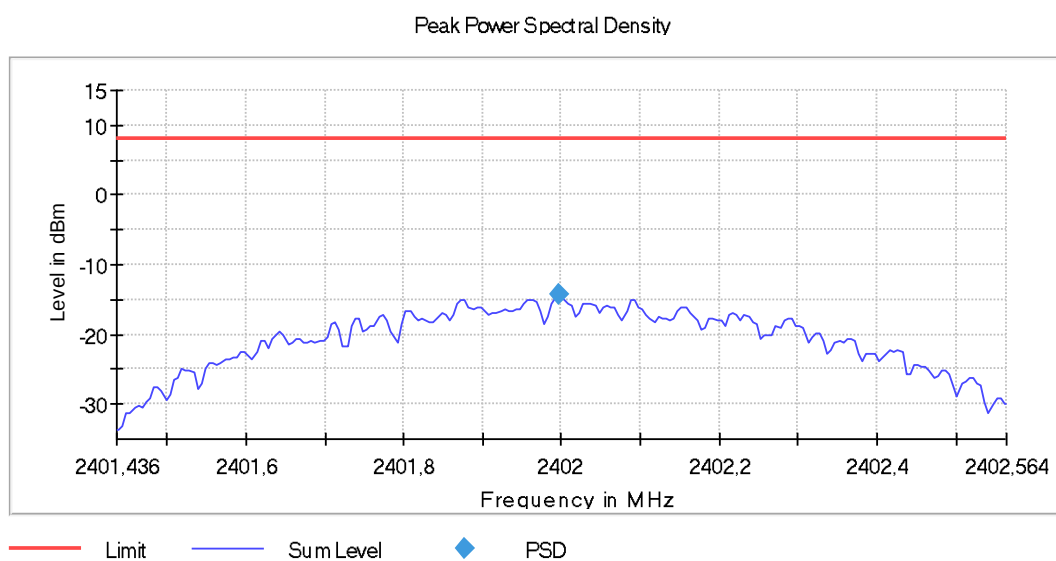
3.4.5 Test results of Power Spectral Density Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD conducted(dBm/10 kHz)	Limit (conducted) (dBm/3kHz)
Bluetooth Low Energy	37	2402	1 Mbps	-14	8
	18	2440	1 Mbps	-15	8
	39	2480	1 Mbps	-16	8
Uncertainty	±2 dB				

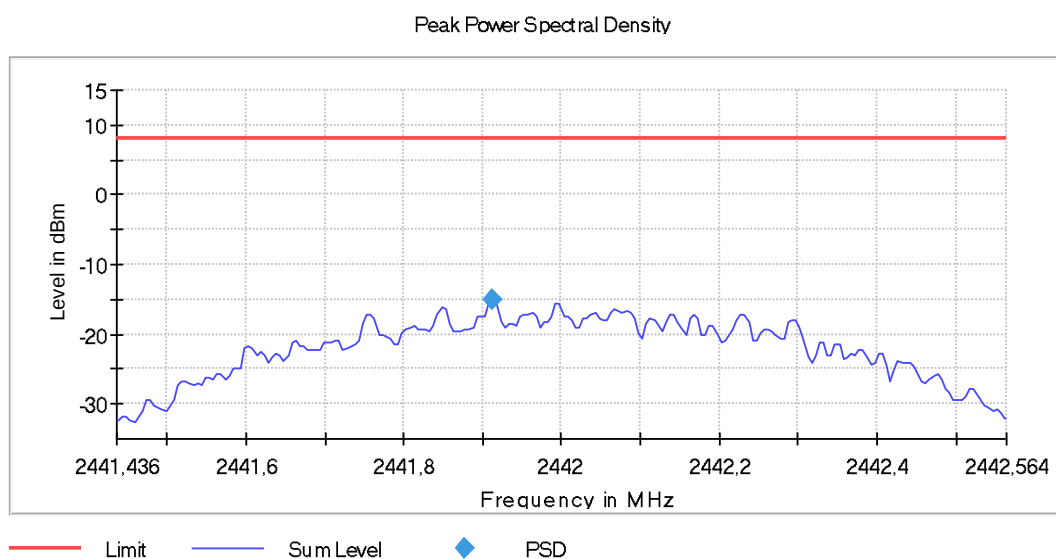
Note: plots are provided on the next page

3.4.6 Plots of the Power Spectral Density

Channel 37

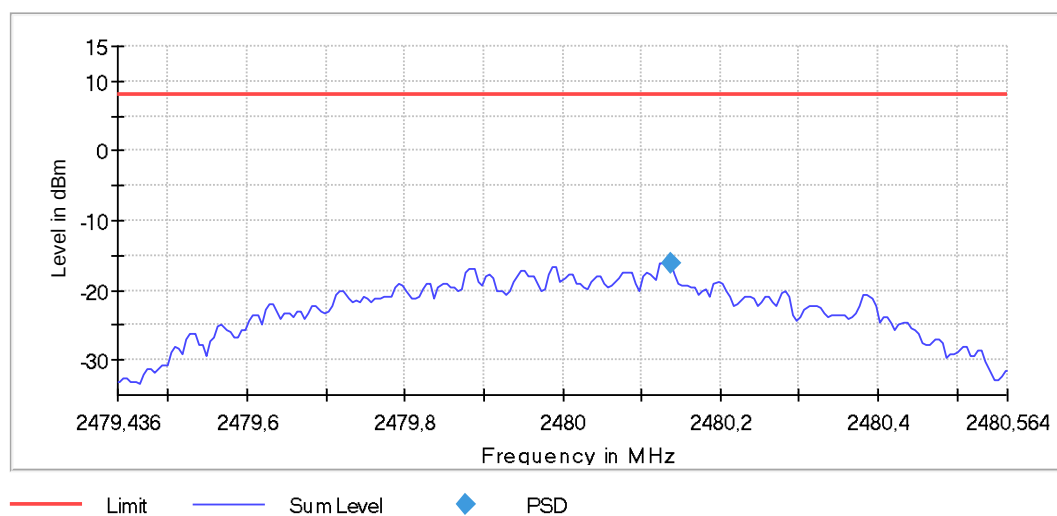


Channel 18



Channel 39

Peak Power Spectral Density



3.5 Band edge Measurement

3.5.1 Limit

Band edge:

At the edge of the authorized band the RF power shall be at least 20 dB down.

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.5.3 Test setup

The test setup is as shown in chapter 2.2 of this report. (Antenna port conducted)

3.5.4 Test procedure

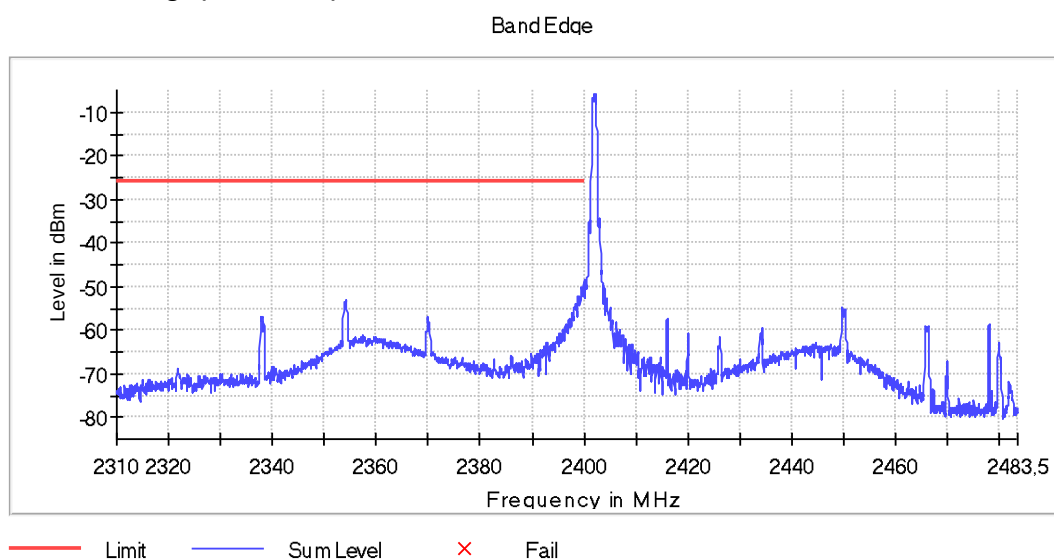
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02, section 8.7.
IRN 415 Spurious Emissions (W) – Method 12

3.5.5 Measurement Uncertainty

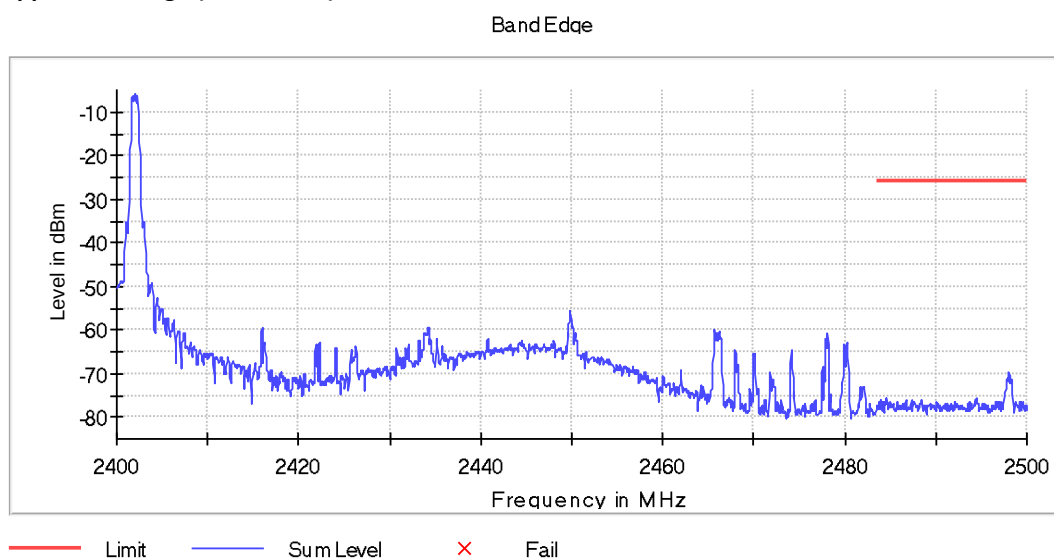
± 3 dB

3.5.6 Plots of the Band edge Measurements

BLE Lower band edge (Channel 37)

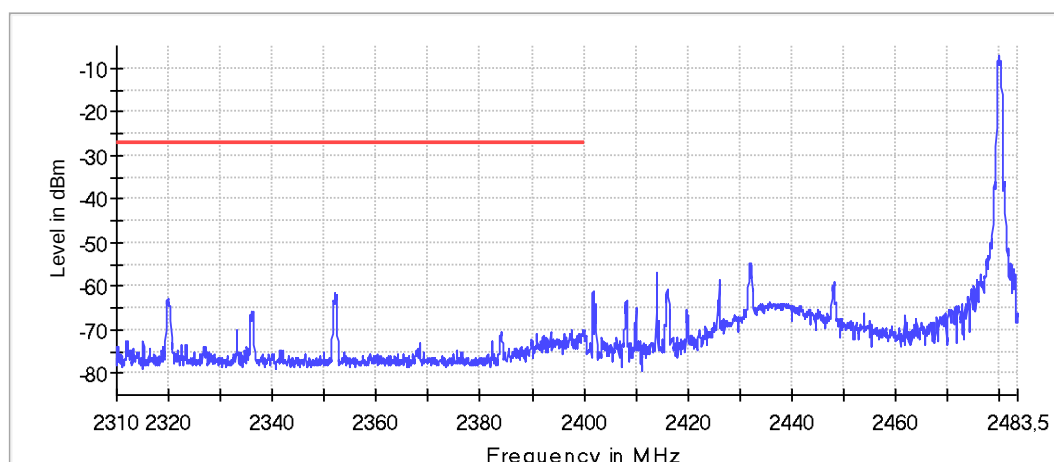


BLE upper band edge (Channel 37)



BLE Lower band edge (Channel 39)

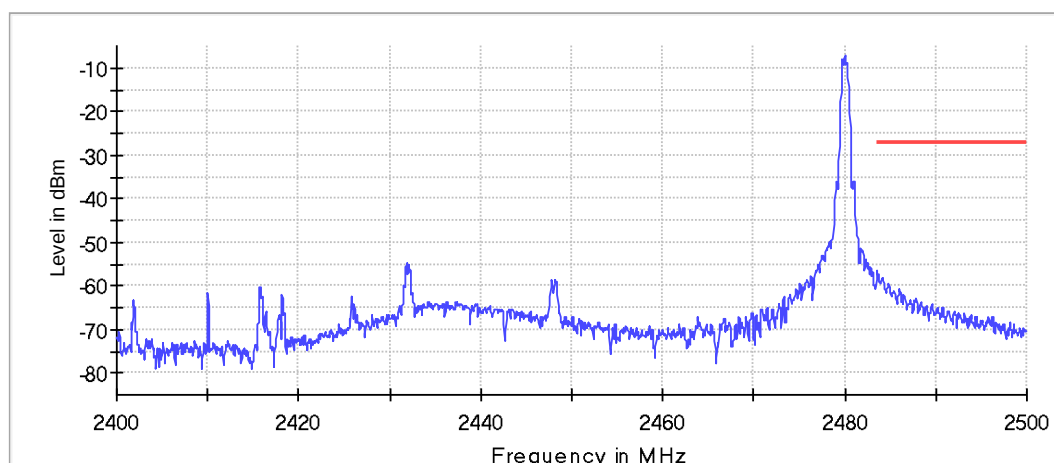
Band Edge



— Limit — Sum Level × Fail

BLE Upper band edge (Channel 39)

Band Edge



— Limit — Sum Level × Fail

4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Field Strength Measurement:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} + \text{Corr. (dB)}$$

Where:

E = Electric field strength

U = Measuring receiver voltage

AF = Antenna factor

CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).

Linear interpolation will be used for frequencies in between the values in the table.

Tables shows an extract of the values.

Frequency (MHz)	AF (dB/m) ID: 114436 VHA 9103 + BBA 9106 SN: 9856	Cable loss (dB) Id: SAR cable	Corr. (dB)
30	18.6	0.68	19.28
100	10.4	1.15	11.55
150	14.8	1.41	16.21
200	16.0	1.63	17.63
250	16.9	1.93	18.83

Frequency (MHz)	Gain (dBi) ID: 114385 EMCO LPDA SN: 9856	Cable loss (dB) Id: SAR cable	Corr. (dB)
250	11.8	1.93	13.73
300	13	2.12	15.12
350	15.6	2.2	17.8
400	17.1	2.29	19.39
450	17.3	2.53	19.83
500	17.7	2.67	20.37
550	18.4	2.9	21.3
600	19.2	3.02	22.22
650	19.7	3.09	22.79
700	20.3	3.22	23.52
750	21.4	3.56	24.96
800	22	3.69	25.69
900	22.1	3.81	25.91
950	22.6	3.91	26.51
1000	22.5	4.3	26.8

Frequency (MHz)	AF (dB/m)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	Kiwa ID: 114607 Emco 3115 SN: 9412-4377	Kiwa ID: 114693 Miteq JS4-18004000-30-8P-A1	TE 01315	
1000	23,6	40,4	2,0	66
1500	25,1	40,5	2,4	68
2000	27,1	40,5	2,7	70,3
2500	28,6	40,7	3,2	72,5
3000	30,5	40,7	3,2	74,4
3500	31,2	40,7	3,4	75,3
4000	32,7	40,9	4,9	78,5
4500	32,4	40,9	4,4	77,7
5000	33,2	40,7	4,6	78,5
5500	34,0	40,5	4,5	79
6000	34,6	40,0	5,2	79,8
6500	34,3	39,4	5,9	79,6
7000	35,2	38,6	5,7	79,5
7500	36,4	39,2	5,9	81,5
8000	37,0	38,9	6,3	82,2
8500	37,5	38,4	6,4	82,3
9000	38,1	37,4	6,5	82
9500	37,8	37,0	7,1	81,9
10000	38,2	36,5	7,3	82
10500	38,1	36,7	7,6	82,4
11000	38,3	36,9	8,3	83,5
11500	38,5	37,6	8,1	84,2
12000	39,1	38,3	8,4	85,8
12500	38,7	38,5	8,3	85,5
13000	39,2	38,9	9,2	87,3
13500	40,5	40,2	8,3	89
14000	41,1	40,0	8,2	89,3
14500	41,4	40,1	8,2	89,7
15000	40,2	41,4	8,3	89,9
15500	37,9	41,4	8,6	87,9
16000	37,5	42,8	9,2	89,5
16500	38,6	42,3	8,8	89,7
17000	41,1	43,1	9,4	93,6
17500	42,7	43,2	9,4	95,3
18000	44,0	44,2	9,8	98

Frequency (MHz)	AF (dB/m)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	Kiwa ID: 114518 Flann 20240-25 SN: 163703	Kiwa ID:114693 Miteq JS4-18004000-30-8P-A1	TE 01315	
18000	31,3	26,2	9,8	67,3
19000	31,5	26,1	9,6	67,2
20000	31,7	25,9	11	68,6
21000	31,9	24,3	10,7	66,9
22000	32,1	18,3	10,5	60,9
23000	32,2	18,9	10,8	61,9
24000	32,3	23,6	11,4	67,3
25000	32,4	24,5	11,6	68,5
26000	32,5	25,3	11,7	69,5

<< END OF REPORT>>