

TEST REPORT

For

DFree-U2P

In conformity with

FCC 47 CFR Part 15 Subpart C

Model Name: DU2P-BL

FCC ID: 2APWD-U5

ISED Cert No.: -

Report No.: WE240716CB1-11

Issue Date: 04 Mar. 2025

Prepared for

DFree Inc.

2-10-9, Akasaka, Minato-ku, Tokyo, 107-0052, Japan

Prepared by

SGS Japan Inc.

3-5-23, Kitayamata, Tsuzuki-ku, Yokohama, 224-0021, Japan

Telephone: +81+(0)50-1780-7880

FAX: +81+(0)45- 592-7506

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History

Report No.	Date	Revisions	Issued By
WE240716CB1-11	04 Mar. 2025	Initial Issue	N. Inokawa

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1 General information

1.1 Product description from supplier

Test item	: DFree-U2P
Manufacturer	: DFree Inc.
Address	: 2-10-9, Akasaka, Minato-ku, Tokyo, 107-0052, Japan
Model	: DU2P-BL
FCC ID	: 2APWD-U5
ISED No.	: -
Serial number	: DH0A000048 (for conducted test) : DH0A000049 (for radiated test)
Hardware version	: vC03
Software version	: v6.99.12
Operating frequency	: 2402 - 2480 MHz (Bluetooth LE)
Modulation	: GFSK
Antenna gain	: 0.5 dBi
Rated RF output power	: 0.0039 W
Nominal power source voltages	: DC 3.7V
Receipt date of EUT	: 14 Jan. 2025

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1.2 Test(s) performed/ Summary of test result

Test specification(s) : FCC 47 CFR Part 15 Subpart C (18 Dec. 2024)

Test method(s) : ANSI C63.10: 2013

Test(s) started : 15 Jan. 2025

Test(s) completed : 30 Jan. 2025

Summary of test result : Complied

Note: The above judgment is only based on the measurement data and it does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.


The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the Laboratory.

Compliance of the EUT is more probable than non-compliance is case that the margin is less than the measurement uncertainty in the Laboratory.

Test engineer

: 
N. Inokawa
C&P EMC/Wireless

Reviewer

: 
T. Takei
Manager, C&P EMC/Wireless

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1.3 Test facility

The Federal Communications Commission has reviewed the technical characteristics of the test facilities at SGS Japan Inc., located in 3-5-23, Kitayamata, Tsuzuki-ku, Yokohama, 224-0021, Japan, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948. The description of the test facilities has been filed under registration number JP5227 at the Office of the Federal Communications Commission. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The list of all public test facilities is available on the Internet at <https://www.fcc.gov>.

Registered by Innovation, Science and Economic Development Canada (ISED):
The registered CAB identifier is JP0009.

Accredited by **American Association for Laboratory Accreditation (A2LA)** for the emission tests stated in the scope of the certificate under Certificate Number 7080.01

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the U.S. Government.



1.4 Measurement uncertainty

The treatment of uncertainty is based on the general matters on the definition of uncertainty in “Guide to the expression of uncertainty in measurement (GUM)” published by ISO. The Lab’s uncertainty is determined by referring ETSI TR 100 028-1 V1.4.1.

The uncertainty of the measurement result in the level of confidence of approximately 95% (k=2) is as follows;

AC Conducted emission	: ± 3.3 dB (150 kHz - 30 MHz)
Radiated emission	: ± 5.1 dB (9 kHz - 30 MHz)
	: ± 5.0 dB (30 MHz - 1000 MHz)
	: ± 4.2 dB (1 GHz - 6 GHz)
	: ± 4.3 dB (6 GHz - 18 GHz)
	: ± 4.4 dB (18 GHz - 26 GHz)

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1.5 Summary of test results

Requirement	Section in FCC	Result	Section in this report
Occupied Bandwidth (99%)	2.1049	Complied	2.1
6 dB Bandwidth	15.247 (a)(2)	Complied	2.2
Maximum Conducted Output Power	15.247 (b)(3)	Complied	2.3
Power Spectral Density	15.247 (e)	Complied	2.4
Conducted Spurious Emissions	15.247(d)	Complied	2.5
Transmitter Radiated Emissions	15.247(d)/15.205(b) /15.209	Complied	2.6
AC power line conducted emissions	15.207	Not Applicable*	2.7
Antenna requirement	15.203	Complied	2.8

Not Applicable*: EUT operates on battery power only.

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1.6 Setup of equipment under test (EUT)

1.6.1 Test configuration of EUT

Equipment(s) under test

No.	Item	Model No.	Manufacture	Serial No.
1-1	DFree-U2P	DU2P-BL	DFree Inc.	DH0A000048
1-2	DFree-U2P	DU2P-BL	DFree Inc.	DH0A000049

Support equipment(s)

No.	Item	Model No.	Manufacture	Serial No.
-	-	-	-	-
-	-	-	-	-

Connected cable(s)

No.	Item	From	To	Length [m]	Cable Shielded	Ferrite Core
-	-	-	-	-	-	-
-	-	-	-	-	-	-

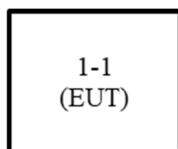
Test software

None.

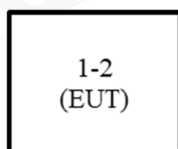
Transmit channel, power, and packet length are pre-programed and controlled by the physical button to provide the rated RF power and 39% duty cycle.

1.6.2 Setup diagram of tested system

[Configuration 1]



[Configuration 2]



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1.6.3 Operating condition

The following is the list of the test modes shown in this test report.

- Tx 2402MHz 1Mbps: The EUT is in continuous transmission mode at 2402MHz, 1Mbps
- Tx 2440MHz 1Mbps: The EUT is in continuous transmission mode at 2440MHz, 1Mbps
- Tx 2480MHz 1Mbps: The EUT is in continuous transmission mode at 2480MHz, 1Mbps

1.7 Equipment modifications

No modifications have been made to the equipment in order to achieve compliance with the applicable standards described in clause 1.2.

1.8 Deviation from the standard

No deviations from the standards described in clause 1.2.

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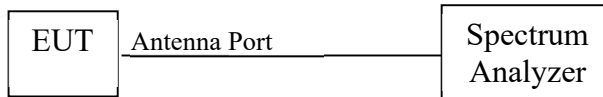
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2 Test procedure and test data

2.1 Occupied Bandwidth (99%)

Test setup

The test setup is shown below. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 6.9.3

- RBW : 1 to 5 % of OBW
- VBW > 3 x RBW
- Span : OBW x 1.5 to 5
- Trace : Max hold

Limitation

There are no limitations.

The measurement value is used for the emission designator.

Test equipment used (refer to List of utilized test equipment)

TR10	CL35	-	-
------	------	---	---

Test results

Configuration: 1

Transmission Frequency [MHz]	Data Rate	Occupied Bandwidth [kHz]
2402	1Mbps	1192.5
2440	1Mbps	1111.4
2480	1Mbps	1024.6

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[Chart]

Operating condition: Tx 2440MHz 1Mbps

Tested Date: 28 Jan. 2025
Humidity: 25 %Temperature: 20 degC
Atmos. Press: 1006 hPa

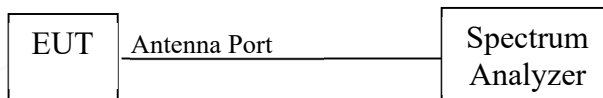
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2.2 6dB Bandwidth

Test setup

The test setup is shown below. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 11.8

- RBW : 100 kHz
- VBW: 300 kHz
- Detector : Peak
- Trace : Max hold

Applicable rule and limitation

FCC 15.247 (a)(2)

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

Test equipment used (refer to List of utilized test equipment)

TR10	CL35	-	-
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Test results - Complied with requirement

Test data

Configuration: 1

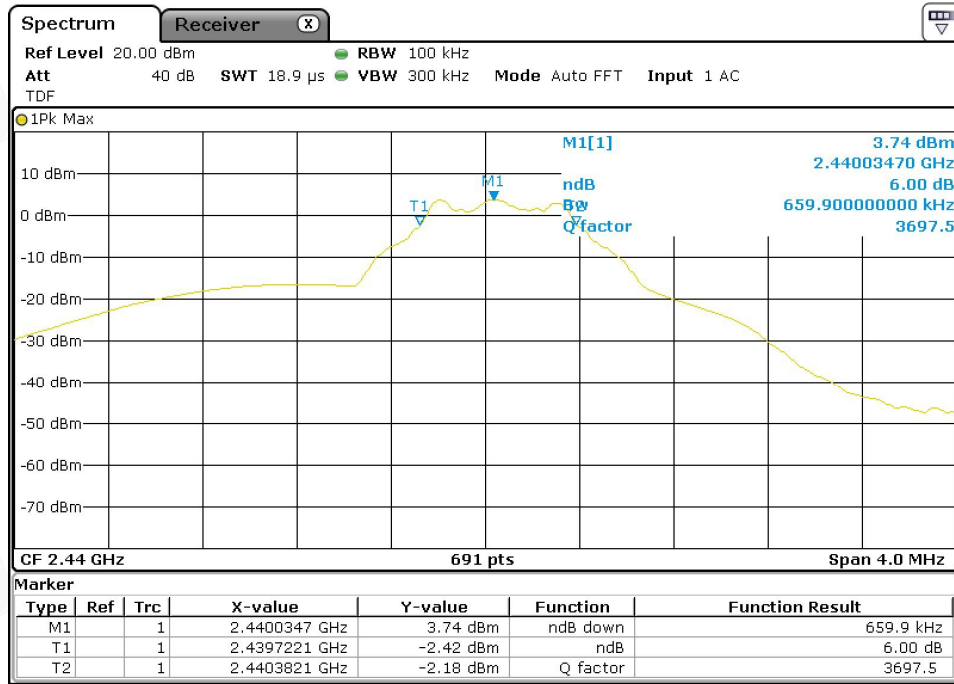
Transmission Frequency [MHz]	Data Rate	6dB Bandwidth [kHz]	Result
2402	1Mbps	659.9	Pass
2440	1Mbps	659.9	Pass
2480	1Mbps	659.9	Pass

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[Chart]

Operating condition: Tx 2440MHz 1Mbps



Tested Date: 28 Jan. 2025
Humidity: 25 %

Temperature: 20 degC
Atmos. Press: 1006 hPa

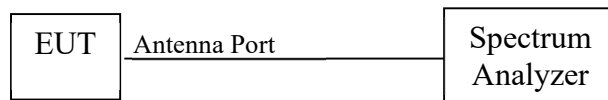
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2.3 Maximum Peak Conducted Output Power

Test setup

The test setup is shown below. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 11.9.1

- RBW > 6dB BW
- VBW > 3 x RBW
- Span > 3 x RBW
- Detector : Peak
- Trace : Max hold

Applicable rule and limitation

FCC 15.247 (b)(3)

The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt (30 dBm).

Test equipment used (refer to List of utilized test equipment)

TR10	CL35	-	-
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Test results - Complied with requirement

Test Data

Configuration: 1

Transmission Frequency [MHz]	Data Rate	Reading [dBm]	Cable Loss [dB] (*)	Output Power [dBm] (**)	Result
2402	1Mbps	3.92	1.4	5.32	Pass
2440	1Mbps	3.83	1.4	5.23	Pass
2480	1Mbps	3.69	1.4	5.09	Pass

(*) The cable loss is declared by the applicant.

(**) The test result was calculated as follows,

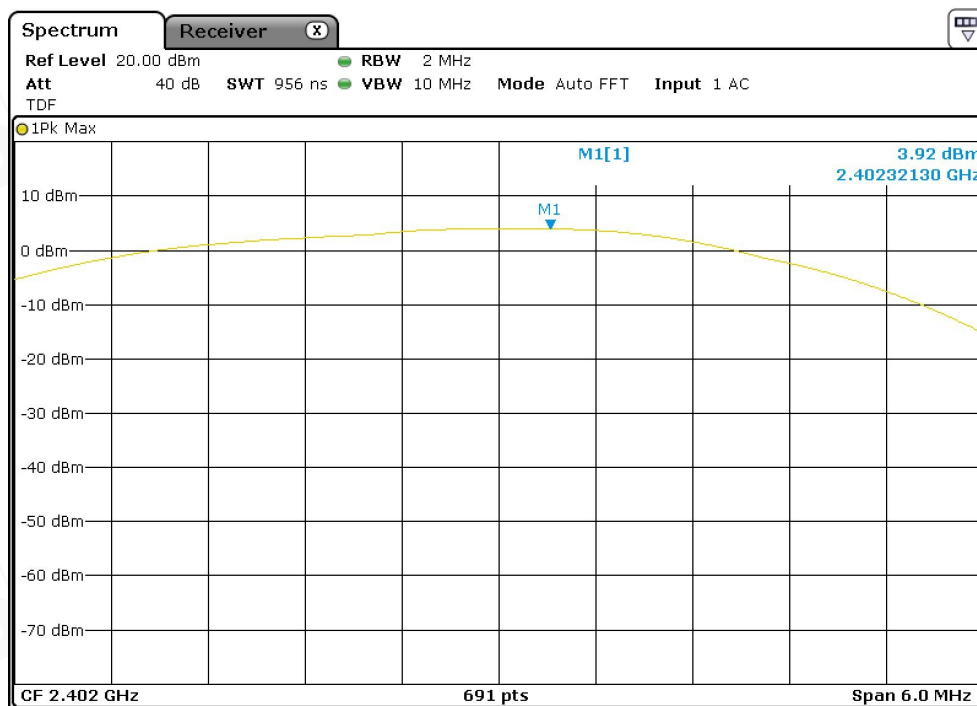
Output Power = (Reading) + (Cable Loss)

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[Chart]

Operating condition: Tx 2402MHz 1Mbps



Tested Date: 28 Jan. 2025
Humidity: 25 %

Temperature: 20 degC
Atmos. Press: 1006 hPa

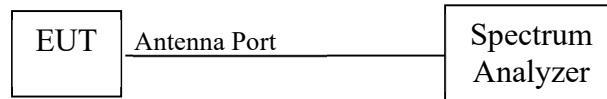
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2.4 Power Spectral Density

Test setup

The test setup is shown below. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 11.10.2

- RBW: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$
- VBW: $\text{VBW} > 3 \times \text{RBW}$
- Span: $> 1.5 \times 6\text{dB BW}$
- Detector: Peak
- Trace: Max hold

Applicable rule and limitation

FCC 15.247 (e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test equipment used (refer to List of utilized test equipment)

TR10	CL35	-	-
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Test results - Complied with requirement

Test Data

Configuration: 1

Transmission Frequency [MHz]	Data Rate	Reading [dBm/3kHz]	Cable Loss [dB] (*)	Power Spectral Density [dBm/3kHz] (**)	Result
2402	1Mbps	-9.29	1.4	-7.89	Pass
2440	1Mbps	-9.47	1.4	-8.07	Pass
2480	1Mbps	-10.22	1.4	-8.82	Pass

(*) The cable loss is declared by the applicant.

(**) The test result was calculated as follows,

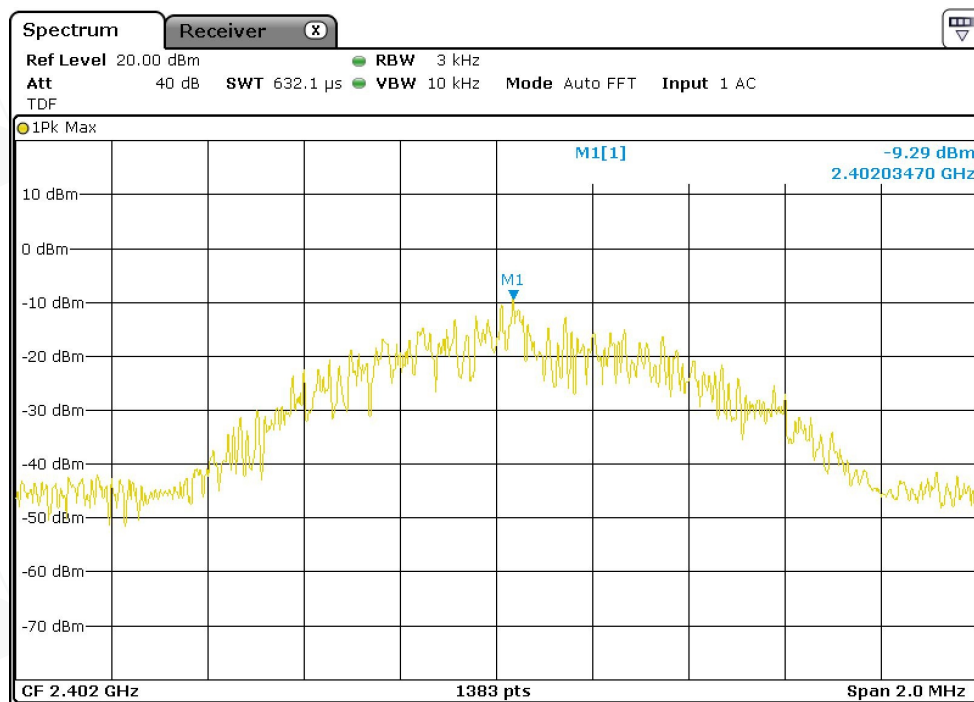
$$\text{Power Spectral Density} = (\text{Reading}) + (\text{Cable Loss})$$

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[Chart]

Operating condition: Tx 2402MHz 1Mbps



Tested Date: 28 Jan. 2025
Humidity: 25 %

Temperature: 20 degC
Atmos. Press: 1006 hPa

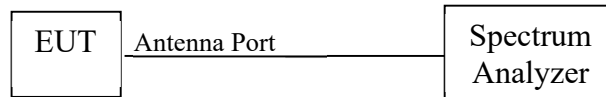
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2.5 Conducted Spurious Emissions

Test setup

The test setup is shown below. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 11.11

- RBW : 100 kHz
- VBW : 300 kHz
- Detector : Peak
- Trace : Max hold

Limitation

FCC 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test equipment used (refer to List of utilized test equipment)

TR10	CL31	-	-
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Test results - Complied with requirement

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Test Data

Configuration: 1

Operating mode: Tx 2402MHz 1Mbps

Frequency [MHz]	Spurious level [dBm]	Carrier level [dBm]	20dB below [dBm]
2400.00	-25.37	3.78	-16.22
-	-	-	-

Note: All other emissions have more than 20 dB margin.

Operating mode: Tx 2440MHz 1Mbps

Frequency [MHz]	Spurious level [dBm]	Carrier level [dBm]	20dB below [dBm]
-	-	-	-

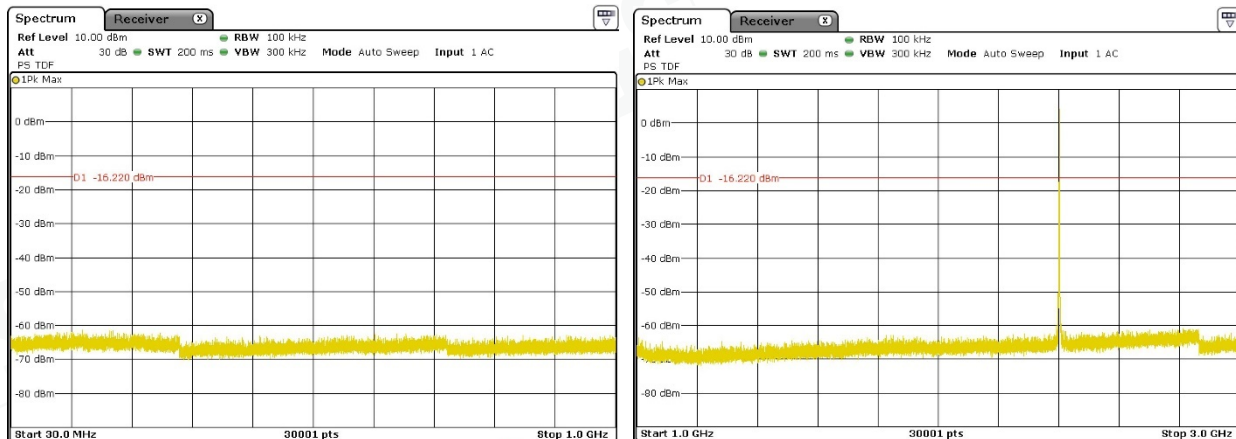
Note: All emissions have more than 20 dB margin.

Operating mode: Tx 2480MHz 1Mbps

Frequency [MHz]	Spurious level [dBm]	Carrier level [dBm]	20dB below [dBm]
2484.05	-52.91	3.79	-16.21
-	-	-	-

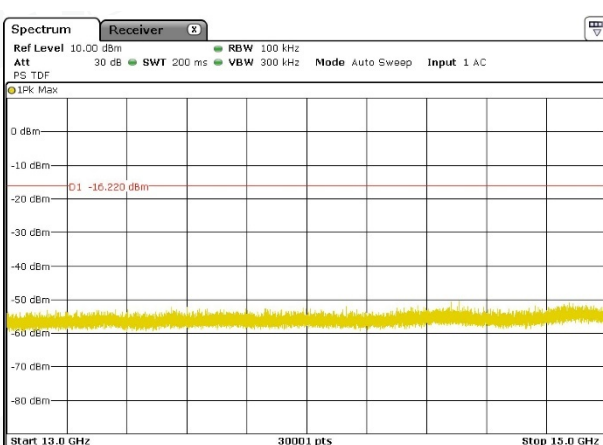
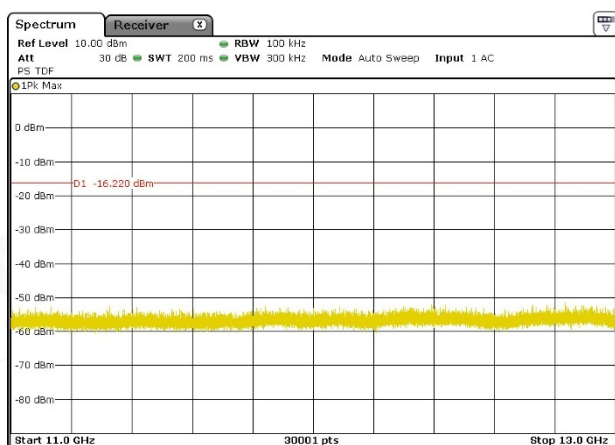
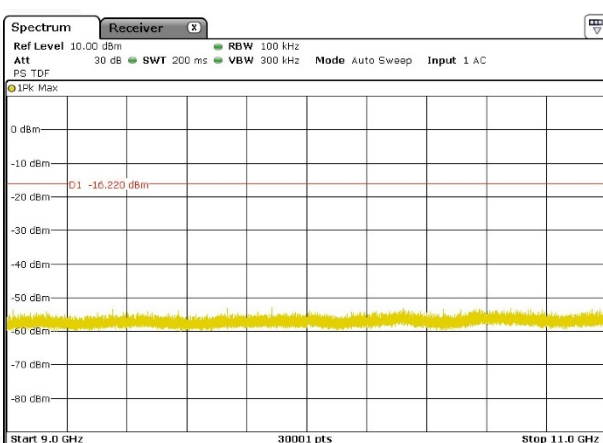
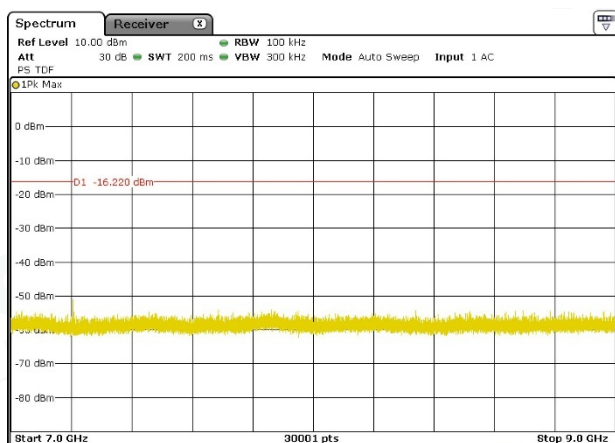
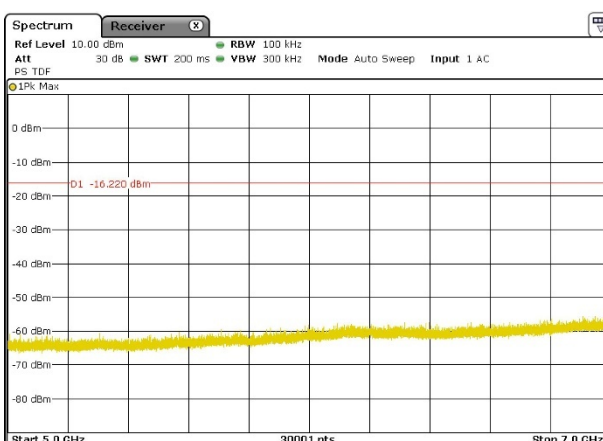
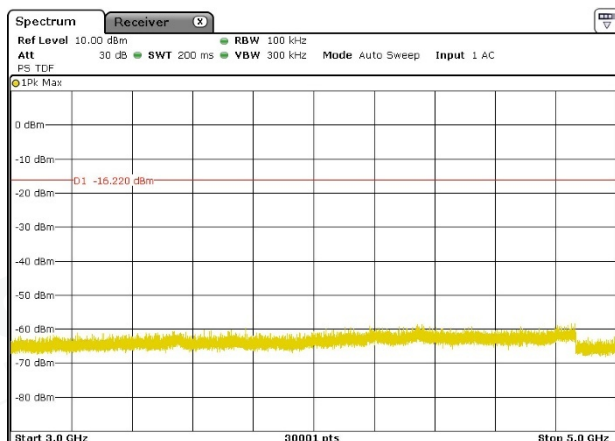
Note: All other emissions have more than 20 dB margin.

[Chart] Tx 2402MHz 1Mbps



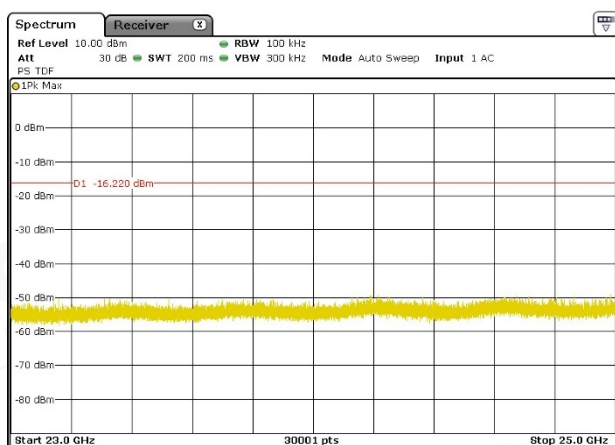
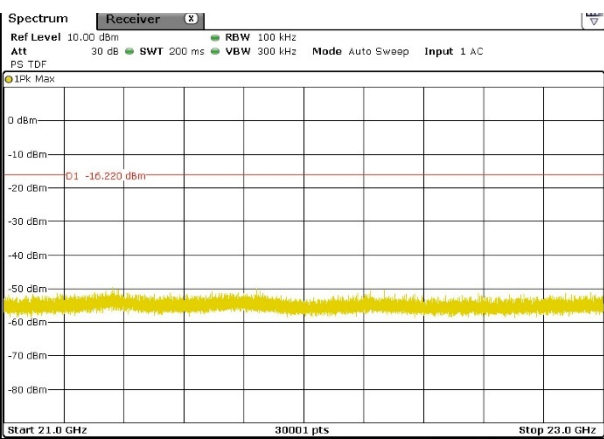
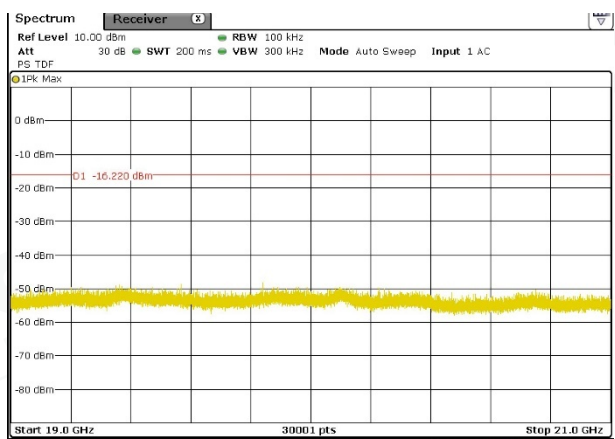
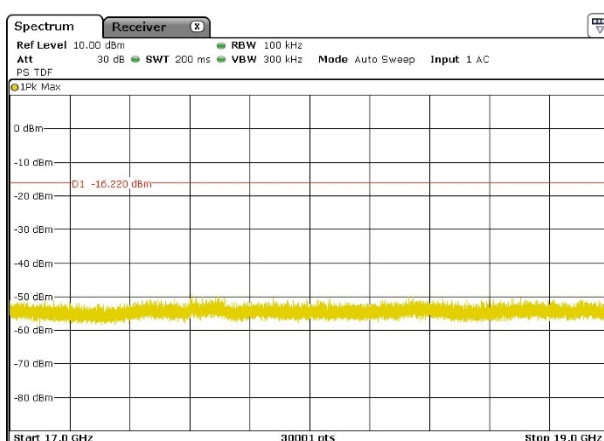
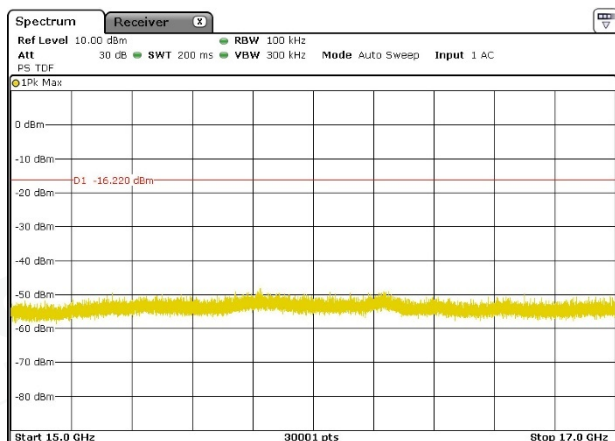
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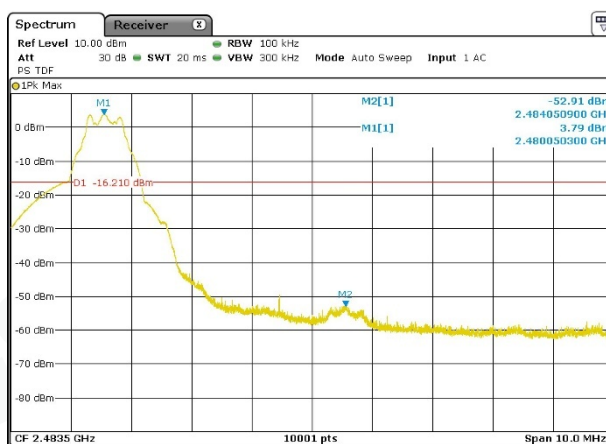
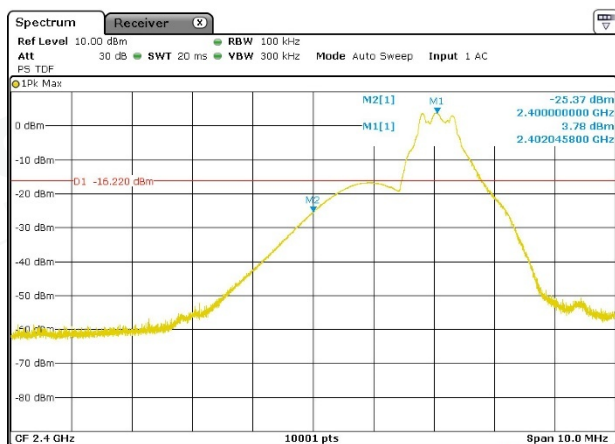
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[Band edge]

Tx 2402MHz 1Mbps

Tx 2480MHz 1Mbps



Tested Date: 16 Jan. 2025
Humidity: 25 %

Temperature: 18 degC
Atmos. Press: 1017 hPa

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2.6 Radiated emissions (for restricted frequency band)

Test setup

Test setup was implemented according to the method of ANSI C63.10 clause 6.

Test procedure

Measurement procedures were implemented according to the method of ANSI C63.10 clauses 6.
The test receiver is set as below

- [9 - 150 kHz]
RBW: 200 Hz, Detector: QP
- [150 kHz - 30 MHz]
RBW: 9 kHz, Detector: QP
- [30 - 1000 MHz]
RBW: 120 kHz, Detector: QP
- [above 1000 MHz]
RBW: 1 MHz, Detector: Ave/PK

Applicable rule and limitation

FCC 15.205 restricted bands of operation

Except as shown in paragraph 15.205 (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.490 - 0.510	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	38.6 -

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in FCC 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in FCC 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions.

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FCC 15.209 Field strength limits

Frequency [MHz]	Field Strength [μV/m]	Measurement Distance [m]	Field Strength [dBμV/m]
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
Above 960	500	3	53.9

In the emission table above, the tighter limit applies at the band edges.

The emission limits shown in the above table are based on measurements employing a quasi-peak detector.

Test results - Complied with requirement

Test equipment used (refer to List of utilized test equipment)

AC01	CL11	TR10	PR21	BA07	CL38	CL39	PR12
DH06	LP05	CL31	BRF12	HPF11	HPF5	AT17	AT33
SH01	SH05	LPF1	-	-	-	-	-

Test software used

EMI1 Ver. 7.0

Calculation method

The Correction Factor and Result are calculated as followings.

Correction Factor [dB/m] = Ant. Factor [dB/m] + Loss [dB] – Gain [dB]

Result [dBμV/m] = Reading [dBμV] + Correction Factor [dB/m]

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Test Data (below 1000MHz)

Configuration: 2

Operating mode: Tx 2402MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.264	20.8	22.3	6.9	30.4	19.6	40.0	20.4	Hori.
2	638.358	18.2	18.7	11.9	30.2	18.6	46.0	27.4	Hori.
3	735.144	18.9	19.3	12.2	30.2	20.2	46.0	25.8	Hori.
4	921.869	16.7	20.4	13.1	29.1	21.1	46.0	24.9	Hori.
5	30.079	21.1	22.4	6.9	30.4	20.0	40.0	20.0	Vert.
6	845.340	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.
7	876.614	16.8	20.6	12.9	29.5	20.8	46.0	25.2	Vert.

Operating mode: Tx 2402MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	31.642	21.6	21.6	6.9	30.4	19.7	40.0	20.3	Hori.
2	845.049	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Hori.
3	926.555	16.7	20.5	13.2	29.1	21.3	46.0	24.7	Hori.
4	30.253	20.8	22.3	6.9	30.4	19.6	40.0	20.4	Vert.
5	844.746	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.
6	924.203	16.7	20.4	13.1	29.1	21.1	46.0	24.9	Vert.

Operating mode: Tx 2402MHz 1Mbps Z-plane

[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.780	20.8	22.0	6.9	30.4	19.3	40.0	20.7	Hori.
2	843.771	17.4	20.0	12.8	29.8	20.4	46.0	25.6	Hori.
3	875.001	16.9	20.6	12.9	29.5	20.9	46.0	25.1	Hori.
4	30.936	20.8	22.0	6.9	30.4	19.3	40.0	20.7	Vert.
5	844.551	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.
6	904.219	16.5	20.4	13.0	29.3	20.6	46.0	25.4	Vert.

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Operating mode: Tx 2440MHz 1Mbps X-plane
[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.178	20.8	22.3	6.9	30.4	19.6	40.0	20.4	Hori.
2	846.101	17.4	20.1	12.8	29.7	20.6	46.0	25.4	Hori.
3	956.118	16.5	20.8	13.3	28.8	21.8	46.0	24.2	Hori.
4	30.448	20.8	22.2	6.9	30.4	19.5	40.0	20.5	Vert.
5	785.407	17.5	19.7	12.5	30.1	19.6	46.0	26.4	Vert.
6	844.666	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.
7	864.131	17.0	20.2	12.9	29.6	20.5	46.0	25.5	Vert.

Operating mode: Tx 2440MHz 1Mbps Y-plane
[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.153	20.8	22.3	6.9	30.4	19.6	40.0	20.4	Hori.
2	844.775	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Hori.
3	940.422	16.7	20.7	13.2	28.9	21.7	46.0	24.3	Hori.
4	31.870	21.6	21.5	6.9	30.4	19.6	40.0	20.4	Vert.
5	828.947	17.4	19.8	12.7	29.9	20.0	46.0	26.0	Vert.
6	844.513	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.

Operating mode: Tx 2440MHz 1Mbps Z-plane
[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.033	20.8	22.4	6.9	30.4	19.7	40.0	20.3	Hori.
2	845.998	17.3	20.1	12.8	29.7	20.5	46.0	25.5	Hori.
3	932.470	16.7	20.6	13.2	29.0	21.5	46.0	24.5	Hori.
4	30.860	20.8	22.0	6.9	30.4	19.3	40.0	20.7	Vert.
5	844.663	17.4	20.1	12.8	29.8	20.5	46.0	25.5	Vert.
6	878.326	16.7	20.5	12.9	29.5	20.6	46.0	25.4	Vert.

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Operating mode: Tx 2480MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.874	20.8	22.0	6.9	30.4	19.3	40.0	20.7	Hori.
2	842.860	17.4	20.0	12.7	29.8	20.3	46.0	25.7	Hori.
3	922.240	16.7	20.4	13.1	29.1	21.1	46.0	24.9	Hori.
4	31.031	20.8	21.9	6.9	30.4	19.2	40.0	20.8	Vert.
5	847.159	17.4	20.1	12.8	29.7	20.6	46.0	25.4	Vert.
6	918.594	16.6	20.4	13.1	29.2	20.9	46.0	25.1	Vert.

Operating mode: Tx 2480MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	31.740	21.6	21.6	6.9	30.4	19.7	40.0	20.3	Hori.
2	847.836	17.3	20.1	12.8	29.7	20.5	46.0	25.5	Hori.
3	955.459	16.4	20.7	13.3	28.8	21.6	46.0	24.4	Hori.
4	32.530	21.6	21.2	6.9	30.4	19.3	40.0	20.7	Vert.
5	767.951	17.7	19.6	12.4	30.2	19.5	46.0	26.5	Vert.
6	847.485	17.3	20.1	12.8	29.7	20.5	46.0	25.5	Vert.
7	956.008	16.4	20.8	13.3	28.8	21.7	46.0	24.3	Vert.

Operating mode: Tx 2480MHz 1Mbps Z-plane

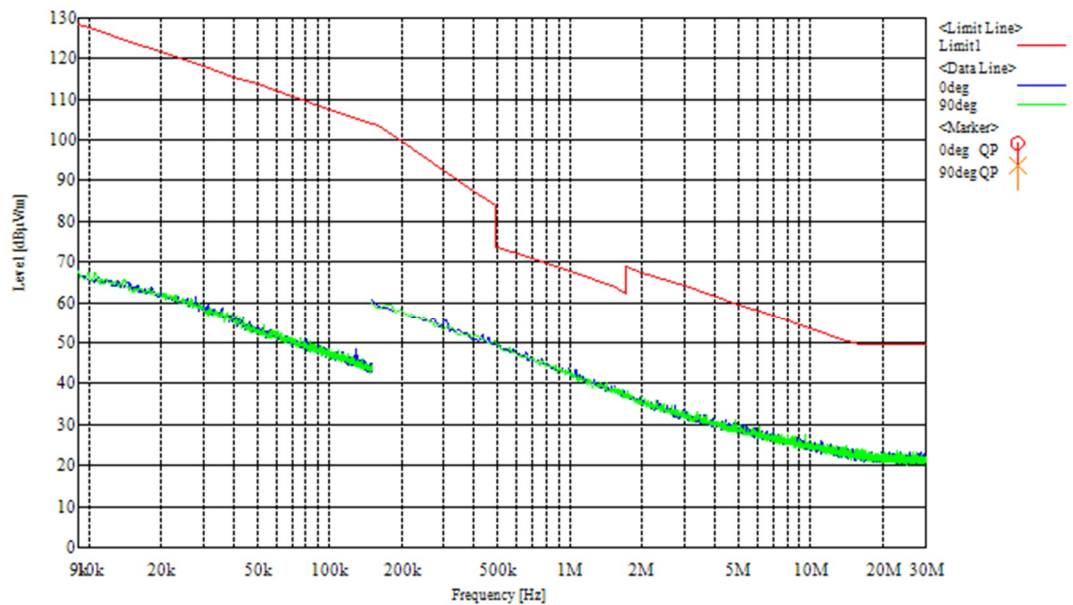
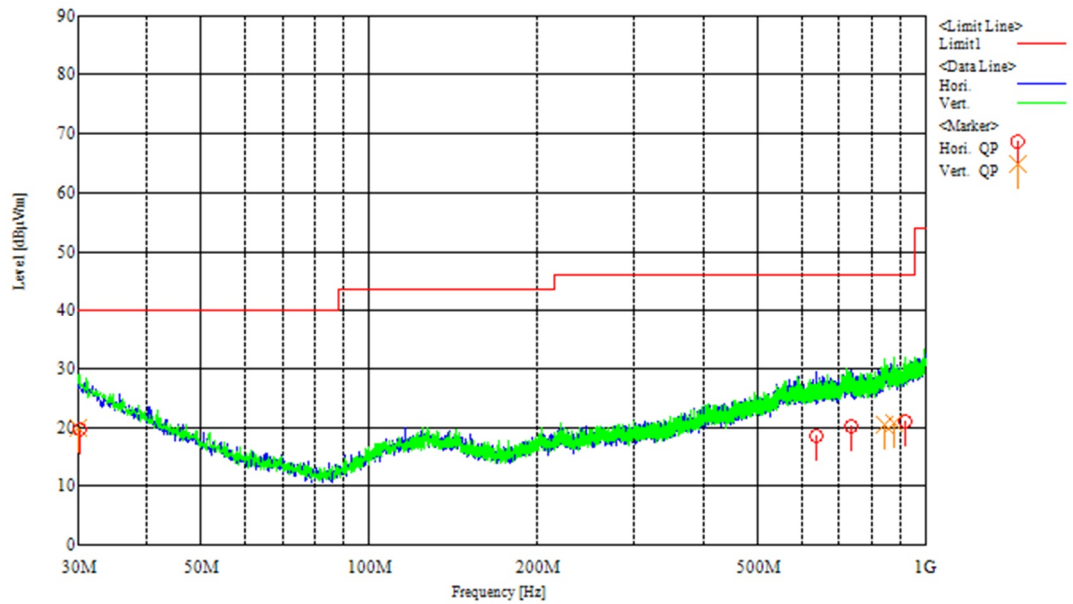
[Emission level]

No.	Frequency [MHz]	Reading [dBμV]	Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Ant.
1	30.790	20.8	22.0	6.9	30.4	19.3	40.0	20.7	Hori.
2	846.402	17.3	20.1	12.8	29.7	20.5	46.0	25.5	Hori.
3	946.366	16.5	20.7	13.3	28.9	21.6	46.0	24.4	Hori.
4	30.835	20.7	22.0	6.9	30.4	19.2	40.0	20.8	Vert.
5	844.607	17.3	20.1	12.8	29.8	20.4	46.0	25.6	Vert.
6	943.739	16.6	20.7	13.2	28.9	21.6	46.0	24.4	Vert.

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[Chart] Tx 2402MHz 1Mbps X-plane



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[Day1]

Tested Date:	29 Jan. 2025	Temperature:	20 degC
Humidity:	25 %	Atmos. Press:	1008 hPa

[Day2]

Tested Date:	30 Jan. 2025	Temperature:	22 degC
Humidity:	25 %	Atmos. Press:	1009 hPa

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Test Data (above 1000MHz)

Configuration: 2

Operating mode: Tx 2402MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4804.115	49.5	38.0	2.1	51.6	48.3	73.9	53.9	22.3	5.6	Hori.
2	4804.064	46.1	34.2	2.1	48.2	44.5	73.9	53.9	25.7	9.4	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2402MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4804.079	48.3	36.0	2.1	50.4	46.3	73.9	53.9	23.5	7.6	Hori.
2	4804.130	48.3	36.6	2.1	50.4	46.9	73.9	53.9	23.5	7.0	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2402MHz 1Mbps Z-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4804.071	48.1	36.2	2.1	50.2	46.5	73.9	53.9	23.7	7.4	Hori.
2	4804.107	47.9	36.1	2.1	50.0	46.4	73.9	53.9	23.9	7.5	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

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Operating mode: Tx 2440MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4880.081	49.5	38.1	2.6	52.1	48.9	73.9	53.9	21.8	5.0	Hori.
2	7320.120	45.6	31.5	6.9	52.5	46.6	73.9	53.9	21.4	7.3	Hori.
3	4880.071	45.9	34.0	2.6	48.5	44.8	73.9	53.9	25.4	9.1	Vert.
4	7319.955	46.2	32.7	6.9	53.1	47.8	73.9	53.9	20.8	6.1	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2440MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4880.185	47.8	36.2	2.6	50.4	47.0	73.9	53.9	23.5	6.9	Hori.
2	7320.160	46.0	31.7	6.9	52.9	46.8	73.9	53.9	21.0	7.1	Hori.
3	4880.132	48.1	36.5	2.6	50.7	47.3	73.9	53.9	23.2	6.6	Vert.
4	7320.130	48.3	33.9	6.9	55.2	49.0	73.9	53.9	18.7	4.9	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2440MHz 1Mbps Z-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4880.112	48.5	36.5	2.6	51.1	47.3	73.9	53.9	22.8	6.6	Hori.
2	7320.078	48.4	34.3	6.9	55.3	49.4	73.9	53.9	18.6	4.5	Hori.
3	4880.112	47.8	36.2	2.6	50.4	47.0	73.9	53.9	23.5	6.9	Vert.
4	7320.002	44.8	30.8	6.9	51.7	45.9	73.9	53.9	22.2	8.0	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

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Operating mode: Tx 2480MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4960.102	49.5	38.3	2.7	52.2	49.2	73.9	53.9	21.7	4.7	Hori.
2	7440.103	45.5	30.9	7.3	52.8	46.4	73.9	53.9	21.1	7.5	Hori.
3	4960.140	46.0	33.8	2.7	48.7	44.7	73.9	53.9	25.2	9.2	Vert.
4	7440.059	45.3	31.4	7.3	52.6	46.9	73.9	53.9	21.3	7.0	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2480MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4960.091	47.9	36.2	2.7	50.6	47.1	73.9	53.9	23.3	6.8	Hori.
2	7440.202	45.5	30.8	7.3	52.8	46.3	73.9	53.9	21.1	7.6	Hori.
3	4960.216	48.3	36.9	2.7	51.0	47.8	73.9	53.9	22.9	6.1	Vert.
4	7440.235	46.9	32.7	7.3	54.2	48.2	73.9	53.9	19.7	5.7	Vert.

Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2480MHz 1Mbps Z-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	4960.133	48.5	36.9	2.7	51.2	47.8	73.9	53.9	22.7	6.1	Hori.
2	7440.206	47.2	32.8	7.3	54.5	48.3	73.9	53.9	19.4	5.6	Hori.
3	4960.065	47.6	35.9	2.7	50.3	46.8	73.9	53.9	23.6	7.1	Vert.
4	7440.025	44.6	30.6	7.3	51.9	46.1	73.9	53.9	22.0	7.8	Vert.

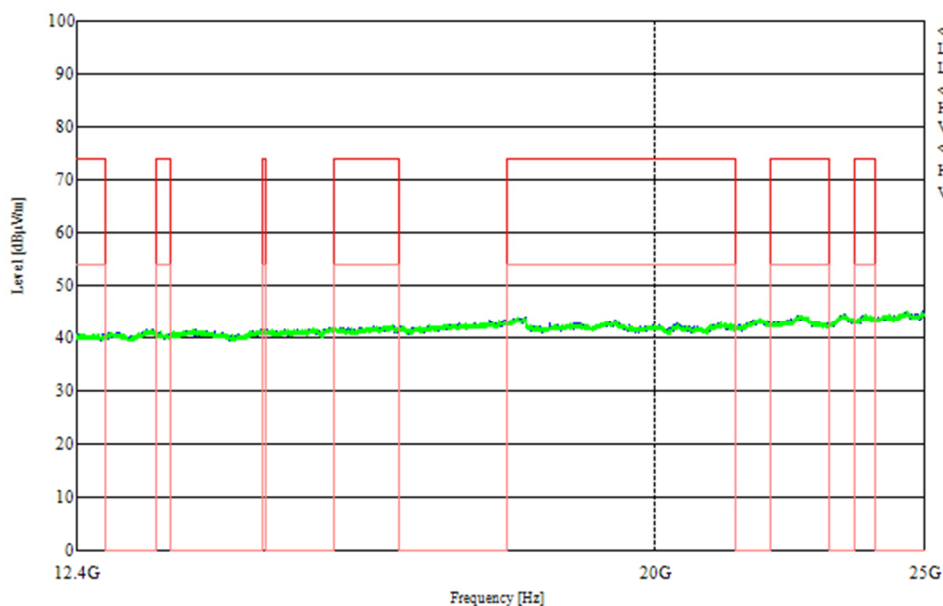
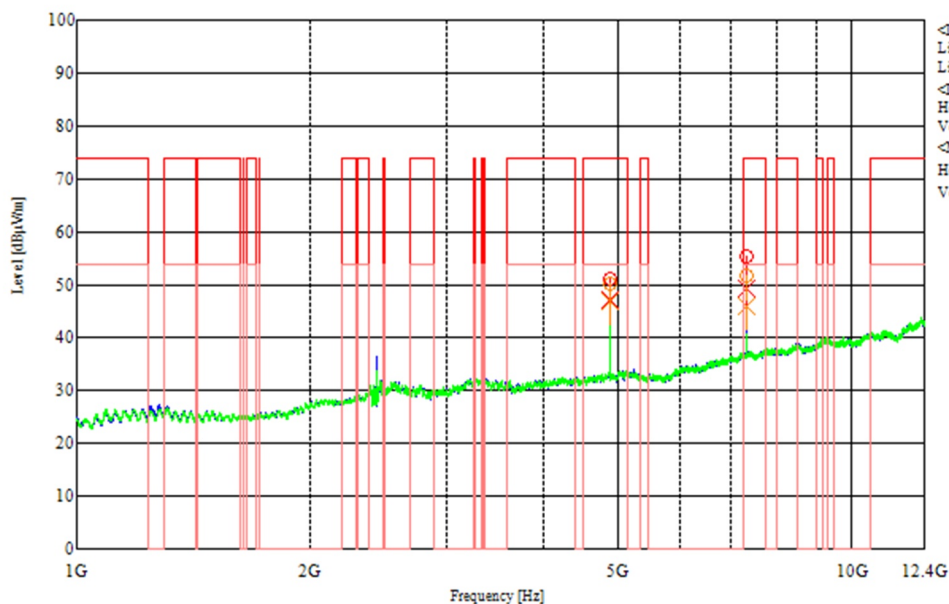
Note 1: All other emissions have more than 20 dB margin or are below the noise floor.

Note 2: 8.2dB was added to the average result as the duty cycle compensation (39%).

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[Chart] Tx 2440MHz 1Mbps Z-plane



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[Day1]

Tested Date:	15 Jan. 2025	Temperature:	18 degC
Humidity:	33 %	Atmos. Press:	1009 hPa

[Day2]

Tested Date:	16 Jan. 2025	Temperature:	18 degC
Humidity:	25 %	Atmos. Press:	1017 hPa

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Test Data (Restricted band edge)

Configuration: 2

Operating mode: Tx 2402MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	2390.000	45.1	30.7	4.8	49.9	43.7	73.9	53.9	24.0	10.2	Hori.
2	2390.000	44.3	30.6	4.8	49.1	43.6	73.9	53.9	24.8	10.3	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2402MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	2390.000	44.6	30.7	4.8	49.4	43.7	73.9	53.9	24.5	10.2	Hori.
2	2390.000	44.4	30.7	4.8	49.2	43.7	73.9	53.9	24.7	10.2	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2402MHz 1Mbps Z-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	2390.000	44.6	30.7	4.8	49.4	43.7	73.9	53.9	24.5	10.2	Hori.
2	2390.000	44.7	30.7	4.8	49.5	43.7	73.9	53.9	24.4	10.2	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

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Operating mode: Tx 2480MHz 1Mbps X-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	2483.500	46.1	31.4	5.4	51.5	45.0	73.9	53.9	22.4	8.9	Hori.
2	2483.500	44.6	30.8	5.4	50.0	44.4	73.9	53.9	23.9	9.5	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2480MHz 1Mbps Y-plane

[Emission level]

No.	Frequency [MHz]	Reading PK [dBμV]	Reading Ave [dBμV]	C.Factor [dB]	Result PK [dBμV/m]	Result Ave [dBμV/m]	Limit PK [dBμV/m]	Limit Ave [dBμV/m]	Margin PK [dB]	Margin Ave [dB]	Ant.
1	2483.500	45.1	30.9	5.4	50.5	44.5	73.9	53.9	23.4	9.4	Hori.
2	2483.500	46.2	31.4	5.4	51.6	45.0	73.9	53.9	22.3	8.9	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

Operating mode: Tx 2480MHz 1Mbps Z-plane

[Emission level]

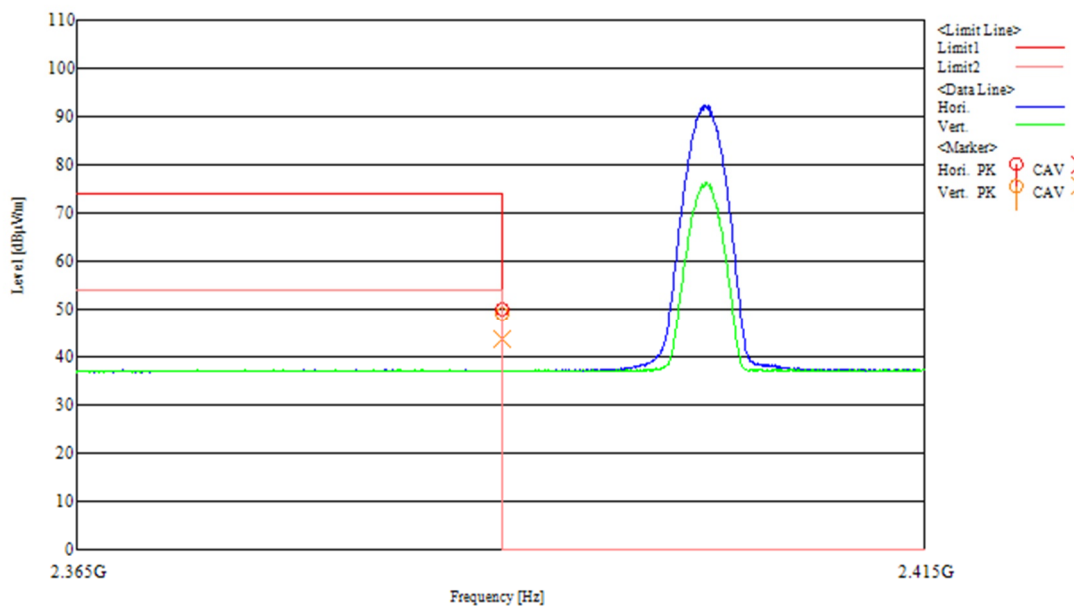
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1	2483.500	46.0	31.4	5.4	51.4	45.0	73.9	53.9	22.5	8.9	Hori.
2	2483.500	45.6	31.0	5.4	51.0	44.6	73.9	53.9	22.9	9.3	Vert.

Note: 8.2dB was added to the average result as the duty cycle compensation (39%).

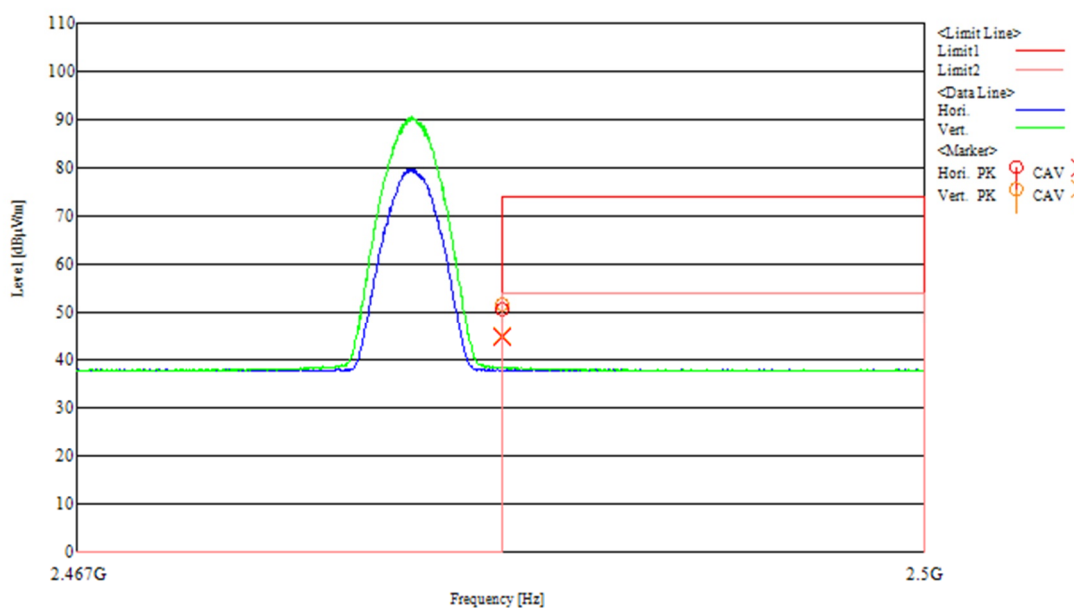
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[Chart] Tx 2402MHz 1Mbps X-plane



[Chart] Tx 2480MHz 1Mbps Y-plane



Tested Date: 15 Jan. 2025
Humidity: 33 %

Temperature: 18 degC
Atmos. Press: 1009 hPa

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2.7 AC power line conducted emissions

Test setup

Test setup was implemented according to the method of ANSI C63.10 clause 6.2 .

Test procedure

Measurement procedures were implemented according to the method of ANSI C63.10 clause 6.2.

Applicable rule and limitation

FCC 15.207

AC power line conducted emissions limits

Frequency of Emission [MHz]	Conducted emissions Limit [dBμV]	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency. The lower limit applies at the band edges.

Test equipment used (refer to List of utilized test equipment)

-	-	-
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Test software used

EMI Ver. 6.1

Calculation method

The Correction Factor and Result are calculated as followings.

$$\begin{aligned}\text{Correction Factor [dB]} &= \text{ISN Factor [dB]} + \text{Loss [dB]} \\ \text{Result [dB}\mu\text{V]} &= \text{Reading [dB}\mu\text{V]} + \text{Correction Factor [dB]}\end{aligned}$$

Test results – Not Applicable

EUT operates on battery power only.

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2.8 Antenna requirement

Applicable rule and limitation

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

Results – Complied with requirement

EUT uses no other antenna than the following antenna, which is permanently attached to the EUT.
The EUT therefore meets the requirement of this section.

No.	Antenna type	Antenna gain
1	PCB Antenna	0.5 dBi [max]

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4 List of utilized test equipment / calibration

ID No.	Kind of Equipment	Manufacturer	Model No.	Serial Number	Cal. Date	Cal. until
AC01(EM)	Anechoic Chamber (1st test room)	JSE	203397C	-	2024/03/29	2025/03/31
AC01(EG)	Anechoic Chamber (1st test room)	JSE	203397C	-	2024/03/22	2025/03/31
BA07	Biological Antenna	TESEQ	CBL6143A	26670	2024/03/11	2025/03/31
CL11	RF Cable for RE	RFT	-	-	2024/03/05	2025/03/31
CL31	RF Cable 1 m	Junkosha	MWX221	1303S118	2024/01/18	2025/01/31
CL35	RF Cable 2 m	Junkosha	MWX221	1502S020	2024/02/16	2025/02/28
CL38	RF Cable 2 m	Junkosha	MWX221	1603S626	2024/01/18	2025/01/31
CL39	RF Cable 5 m	SUHNER	SUCOFLEX126E	523222	2024/01/18	2025/01/31
DH06	DRG Horn Antenna	A.H. Systems	SAS-571	1339	2024/07/30	2026/07/31
SH01	Standard Horn Antenna (18-26G)	A.H. Systems	SAS-572	208	2024/07/16	2025/07/31
SH05	Standard Horn Antenna (12-18G)	A.H. Systems	SAS-586	214	2024/07/16	2025/07/31
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2024/01/17	2025/01/31
PR21	Pre. Amplifier	Anritsu	MH648A	6200467119	2024/03/12	2025/03/31
BRF12	Band Reject Filter (2400MHz)	M-City	BRF2440-01	RF0012-02	2024/03/19	2025/03/31
HPF11	High Pass Filter (3500MHz)	Wainwright	WHNX6-2765-3500-26500-40CC	2	2024/08/17	2025/08/31
HPF5	High Pass Filter (7000MHz)	Tokyo KEIKI	TF27MCCZGA	9001	2024/01/17	2025/01/31
LPF1	Low Pass Filter (1000MHz)	M-City	LPF1000-04	RF0012-01	2024/03/19	2025/03/31
LP05	Loop Antenna	ETS-Lindgren	6502	00143302	2024/03/08	2025/03/31
AT17	Attenuator	JFW	50HF-006N	—	2024/03/05	2025/03/31
AT33	Attenuator 10dB 26GHz	INMET	26A-10	-	2024/10/18	2025/10/31
TR10	Test Receiver (F/W : 3.66)	Rohde & Schwarz	ESR26	101313	2024/05/28	2025/05/31

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

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