

TEST REPORT

of

FCC Part 15 Subpart E §15.407

FCC ID: RMN-CTSHPIO25

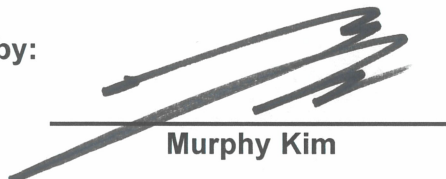
Equipment Under Test : Hybrid PIO
Model Name : CTS-HPIO-25
Variant Model Name(s) : -
Applicant : CanTops Co., Ltd.
Manufacturer : CanTops Co., Ltd.
Date of Receipt : 2023.12.14
Date of Test(s) : 2023.12.14 ~ 2024.04.23
Date of Issue : 2024.04.24

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

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- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
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- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by:



Murphy Kim

Technical
Manager:



Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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1.2. Details of Applicant

Applicant : CanTops Co., Ltd.

Address : A 1002 - 1008, Digital Empire BLDG, 16, Deongyeong-daero 1556beon-gil,
Yeongtong-gu, Suwon-si, Gyeonggi-do, South Korea, 16690

Contact Person : Han, Sang-gyu

Phone No. : +82 10 4607 6910

1.3. Details of Manufacturer

Company : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product		Hybrid PIO	
Model Name		CTS-HPIO-25	
Variant Model Name		-	
Serial Number		Conducted sample: 0292FE Radiated sample: 0297AG	
Power Supply		DC 24 V	
Frequency Range		5 727 MHz ~ 5 847 MHz	
Modulation Technique		GFSK	
Number of Channels		5 727 MHz ~ 5 847 MHz:121 channels	
Antenna Type	Port 1	Internal antenna	Multilayer monopole antenna
		Internal antenna	Multilayer monopole antenna
	Port 2	External antenna	Dipole antenna
Antenna Gain**		Port 1	Internal antenna
	Internal antenna		2.40 dB i
	Port 2	External antenna	2.90 dB i
H/W Version		1.0	
S/W Version		1.0	

1.5. Declaration by the Manufacturer

- The EUT has two ports connected to antennas.
- Port 1 is connected to Internal antenna and Port 2 can be connected to Internal antenna or External antenna.

Port 1	Port 2	
Internal antenna	Internal antenna	External antenna

- Both ports can not operate simultaneously.

1.6. Automatically Discontinue Transmission

1.6.1. Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operating failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

1.6.2. Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

1.7. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMA100B	106887	Oct. 06, 2023	Annual	Oct. 06, 2024
Spectrum Analyzer	R&S	FSV30	103453	Oct. 31, 2023	Annual	Oct. 31, 2024
Spectrum Analyzer	R&S	FSW43	100637	Apr. 08, 2024	Annual	Apr. 08, 2025
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 01, 2023	Annual	Sep. 01, 2024
Power Sensor	R&S	NRP-Z81	100669	May 16, 2023	Annual	May 16, 2024
Attenuator	AEROFLEX / INMET	40AH2W-10	40G-1	Jun. 14, 2023	Annual	Jun. 14, 2024
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 07, 2024	Annual	Feb. 07, 2025
High Pass Filter	Wainwright Instrument GmbH	WHKX6.0/18G-10SS	51	Jun. 14, 2023	Annual	Jun. 14, 2024
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	11	Oct. 17, 2023	Annual	Oct. 17, 2024
DC Power Supply	R&S	HMP2020	019922876	Apr. 27, 2023	Annual	Apr. 27, 2024
Preamplifier	H.P.	8447F	2944A03909	Aug. 04, 2023	Annual	Aug. 04, 2024
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Oct. 06, 2023	Annual	Oct. 06, 2024
Signal Conditioning Unit	R&S	SCU-18F	101058	Dec. 07, 2023	Annual	Dec. 07, 2024
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 21, 2023	Biennial	Aug. 21, 2025
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	9163-437	May 31, 2023	Biennial	May 31, 2025
Horn Antenna	R&S	HF906	100326	Feb. 19, 2024	Annual	Feb. 19, 2025
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170223	Oct. 10, 2023	Annual	Oct. 10, 2024
EMI Test Receiver	R&S	ESU26	100109	Jan. 16, 2024	Annual	Jan. 16, 2025
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/3 8330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/3 8330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-5 m	TPC24021900 04	Apr. 03, 2024	Semi-Annual	Oct. 03, 2024
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-10 m	TPC24021900 01	Apr. 03, 2024	Semi-Annual	Oct. 03, 2024
Coaxial Cable	RFONE	PL360P-292M292M-1.5M-A	20200324002	Apr. 12, 2024	Semi-Annual	Oct. 12, 2024

Note;

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date

1.8. Summary of Test Result

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart E		
Section	Test Item(s)	Result
15.205(a) 15.209(a) 15.407(b)(4)	Transmitter Radiated Spurious Emissions	Complied
15.407(a)	26 dB Bandwidth	Complied
15.407(e)	6 dB Bandwidth	Complied
15.407(a)(3)	Maximum Conducted Output Power	Complied
15.407(a)(3)	Maximum Power Spectral Density	Complied
15.207	AC Power Line Conducted Emission	N/A ¹⁾

Note;

1) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

1.9. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 General UNII Test Procedures New Rules v02r01 were used in the measurement of the DUT.

1.10. Sample Calculation

Where relevant, the following sample calculation is provided:

1.10.1. Conducted Test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

1.10.2. Radiation Test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB/m) + Cable loss (dB) - Amplifier gain (dB) + Duty factor (dB)

1.11. Information of Software for test

- Using the software of CTS_SERIAL_PROGRAM_1.0.6.0 to testing of EUT.

1.12. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
Maximum Conducted Output Power	0.34 dB	
Maximum Power Spectral Density	0.65 dB	
26 dB Bandwidth	0.03 MHz	
6 dB Bandwidth	0.06 MHz	
Radiated Emission, 9 kHz to 30 MHz	H	3.60 dB
	V	3.60 dB
Radiated Emission, below 1 GHz	H	4.60 dB
	V	4.90 dB
Radiated Emission, above 1 GHz	H	3.90 dB
	V	3.80 dB

All measurement uncertainty values are shown with a coverage factor $k = 2$ to indicate a 95 % level of confidence

1.13. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL004985	2024.04.24	Initial

1.14. Duty Cycle of EUT

Regarding to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, II.B, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.
 Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value, Set VBW ≥ RBW.
 Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

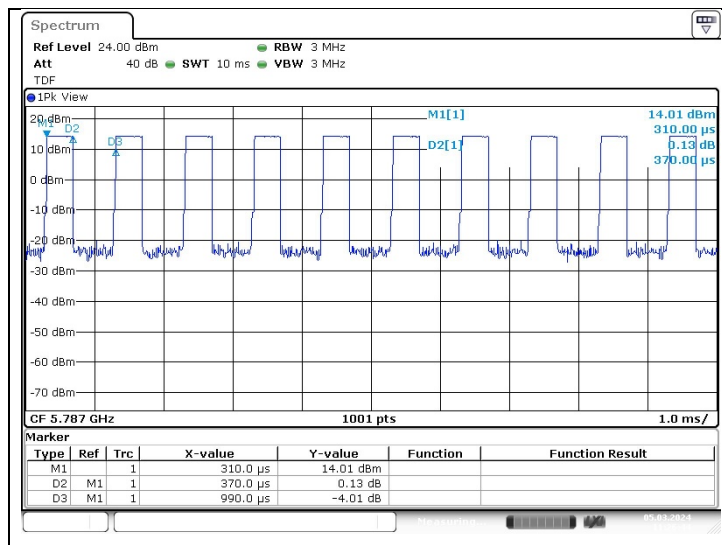
Antenna port	Frequency (MHz)	Duty Cycle (%)	Correction factor (dB)
Port 1	5 787	37.37	4.27
Port 2	5 787	38.38	4.16

Remark;

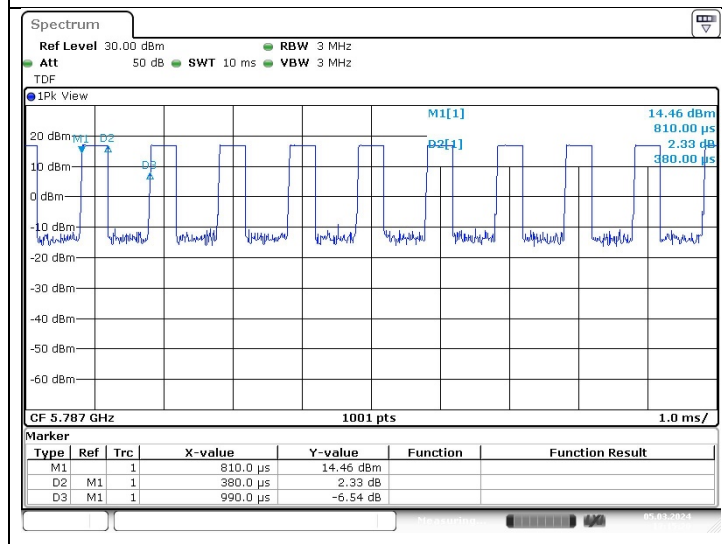
- Duty Cycle (%) = (Tx on time / Tx on + off time) x 100
- Correction Factor (dB) = 10 log (1 / Duty Cycle)

- Test plots

Port 1
5 787 MHz



Port 2
5 787 MHz

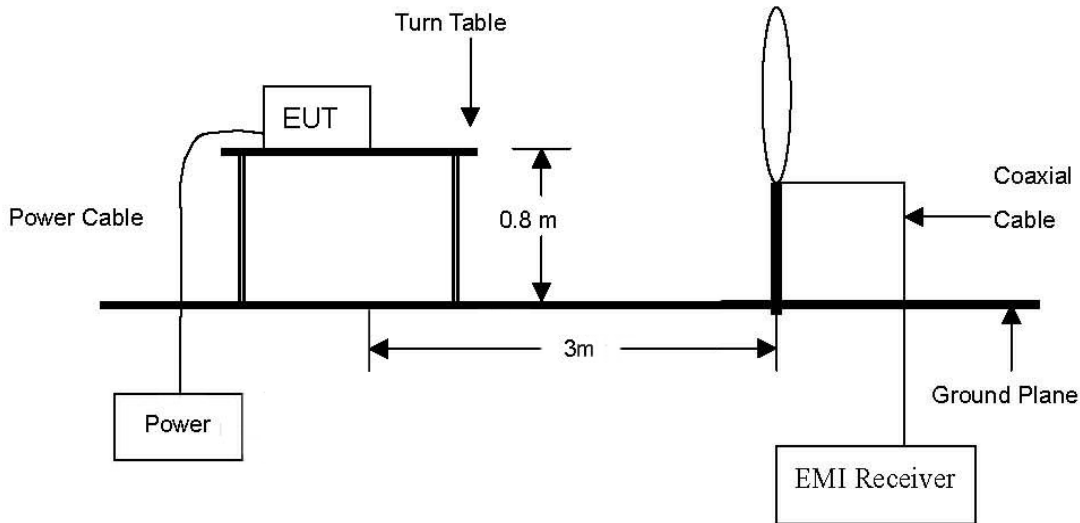


2. Transmitter Radiated Spurious Emissions

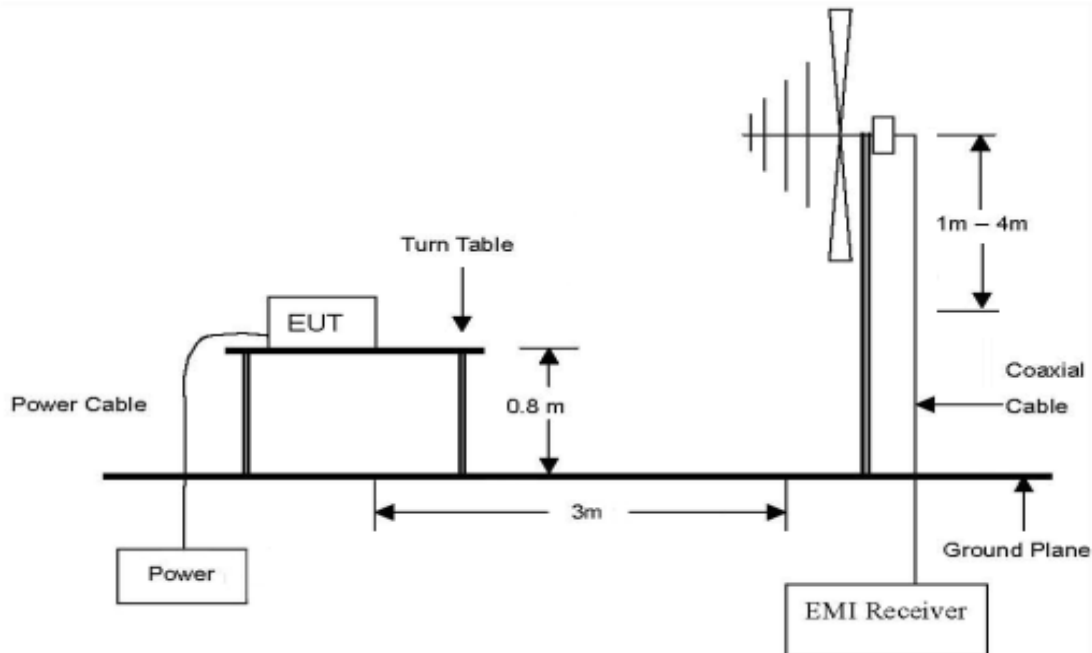
2.1. Test Setup

2.1.1. Transmitter radiated spurious emissions

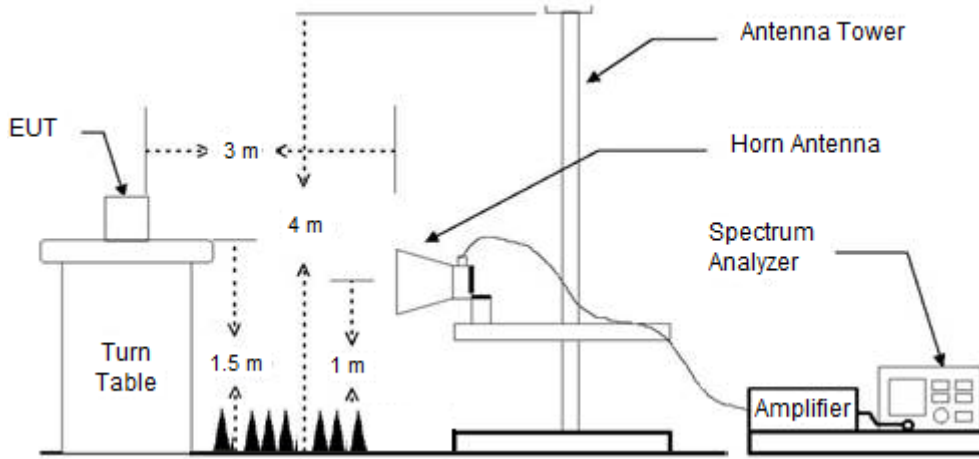
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



2.2. Limit

According to § 15.407(b)

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of -27 dB m/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dB m/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dB m/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dB m/MHz at the band edge.

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.3. Test Procedures

Radiated spurious emissions from the EUT were measured according to the dictates in section G of KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. For measurements below 1 GHz resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.
6. For measurements Above 1 GHz resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

- II.G.4. Unwanted emissions measurements below 1 GHz.

Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- II.G.5. Unwanted maximum emissions measurements above 1 GHz.

Peak emission levels are measured by setting the analyzer as follows:

Set to RBW = 1 MHz, VBW ≥ 3 MHz, Detector = Peak, Sweep time = auto, Trace mode = Max hold.

- II.G.6. Average unwanted emissions measurements above 1 GHz.

Set to RBW = 1 MHz, VBW ≥ 3 MHz, Detector = power averaging (rms), Averaging type = power averaging (rms), Sweep time = auto, Perform a trace average of at least 100 traces. If the transmission is continuous, If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 % duty cycle, at least 200 traces shall be averaged.

If tests are performed with the EUT transmitting at a duty cycle less than 98 %, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle. The correction factor is computed as follows:

- If power averaging (rms) mode was used in II.G.6.c)(iv), the correction factor is $10 \log(1/x)$, where x is the duty cycle. For example, if the transmit duty cycle was 50 %, then 3 dB must be added to the measured emission levels.

- The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z described in the test setup photo. All radiated testing of EUT was performed with worst case axis.

2.4. Test Result

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 MHz

The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are peak values.

- Port 1_Internal antenna, 5 727 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
31.01	38.90	Peak	V	15.80	-28.05	26.65	40.00	13.35
54.82	39.50	Peak	V	19.64	-27.81	31.33	40.00	8.67
151.09	38.10	Peak	H	13.71	-27.06	24.75	43.50	18.75
251.77	40.40	Peak	H	18.40	-26.41	32.39	46.00	13.61
276.87	40.50	Peak	H	18.50	-26.24	32.76	46.00	13.24
Above 300.00	Not detected	-	-	-	-	-	-	-

- Port 2_Internal antenna, 5 727 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.81	36.80	Peak	V	15.84	-28.06	24.58	40.00	15.42
54.13	40.80	Peak	V	19.77	-27.81	32.76	40.00	7.24
176.19	39.40	Peak	H	14.92	-26.87	27.45	43.50	16.05
251.69	39.00	Peak	H	18.40	-26.41	30.99	46.00	15.01
276.99	38.60	Peak	H	18.50	-26.24	30.86	46.00	15.14
368.17	36.30	Peak	H	20.31	-25.72	30.89	46.00	15.11
Above 400.00	Not detected	-	-	-	-	-	-	-

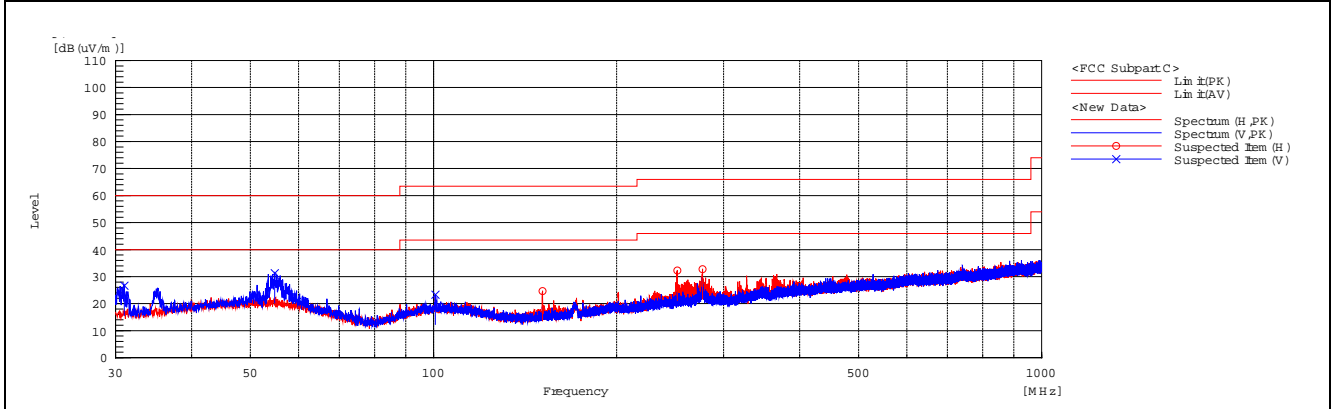
- Port 2_External antenna, 5 727 MHz

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
30.53	40.40	Peak	V	15.89	-28.06	28.23	40.00	11.77
35.05	39.00	Peak	V	16.62	-28.01	27.61	40.00	12.39
53.48	37.40	Peak	V	19.80	-27.82	29.38	40.00	10.62
276.87	41.00	Peak	H	18.50	-26.24	33.26	46.00	12.74
367.96	37.70	Peak	H	20.30	-25.72	32.28	46.00	13.72
Above 400.00	Not detected	-	-	-	-	-	-	-

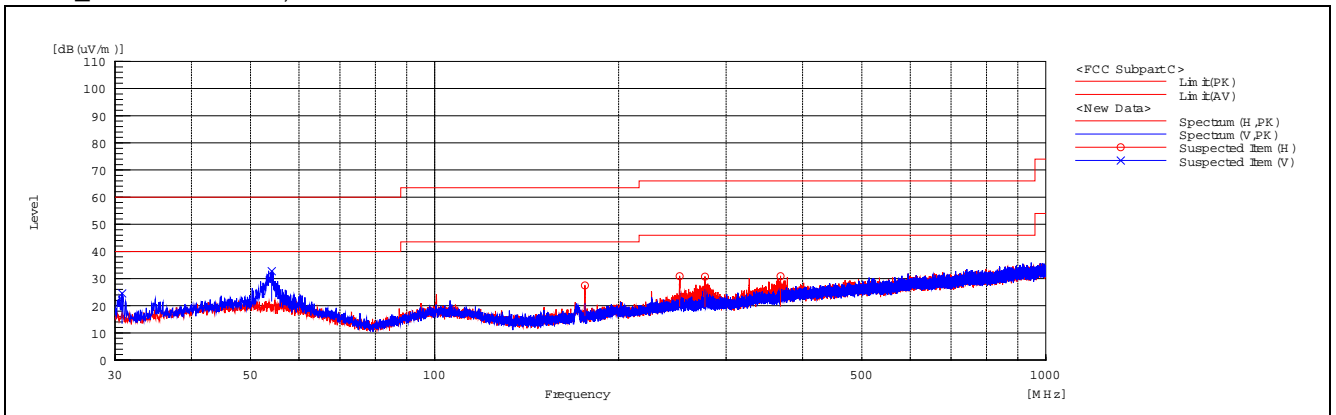
Remark;

1. Spurious emissions for all channels were investigated and almost the same below 1 GHz.
2. Test from 30 MHz to 1 000 MHz was performed using the software of EP5RE(V5.3.70) from TOYO.
3. Reported spurious emissions are measured in the channel with the highest maximum peak conducted output power.
4. Radiated spurious emission measurement as below.
(Actual = Reading + AF + AMP + CL)
5. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

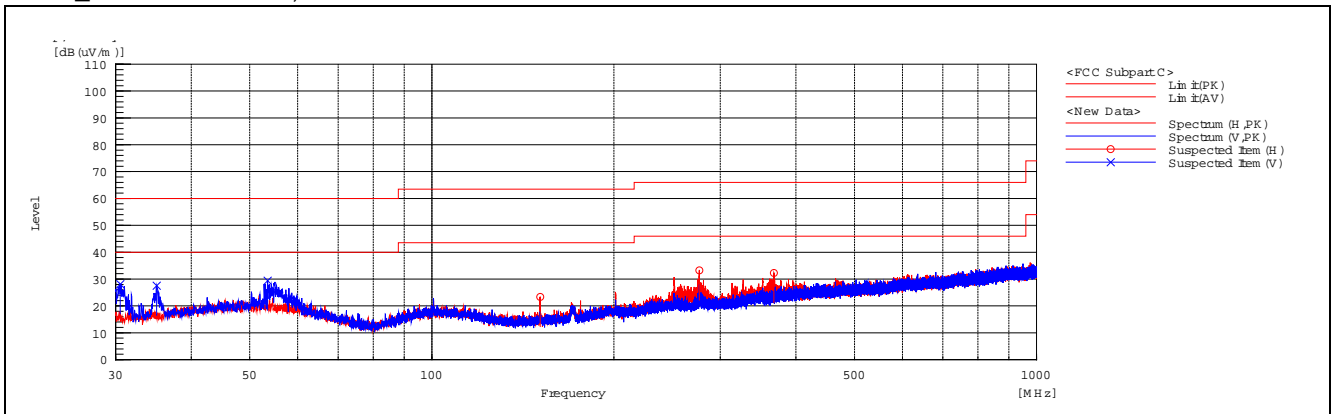
- Test plots



Port 2_ Internal antenna, 5 727 MHz



Port 2_ External antenna, 5 727 MHz



2.4.2. Radiated Spurious Emission above 1 000 MHz

- Port 1_Internal antenna: 5 727 MHz ~ 5 847 MHz

A. Low Channel (5 727 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)		Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 639.50	12.81	Peak	V	34.10	9.70		56.61	68.23	11.62
5 695.05	20.03	Peak	V	34.10	9.72		63.85	101.56	37.71
5 719.10	24.90	Peak	V	34.14	9.77		68.81	110.58	41.77
5 725.00	28.97	Peak	V	34.15	9.79		72.91	122.23	49.32

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 454.74	39.71	Peak	H	38.51	-22.97	-	55.25	74.00	18.75
*11 453.79	29.26	Average	H	38.51	-22.97	4.27	49.07	54.00	4.93
Above 11 500.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 787 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 574.36	37.06	Peak	H	38.75	-22.66	-	53.15	74.00	20.85
Above 11 600.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 847 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.00	26.12	Peak	V	34.40	9.93	70.45	122.23	51.78
5 855.00	19.93	Peak	V	34.41	9.91	64.25	110.83	46.58
5 879.19	20.19	Peak	V	34.46	9.85	64.50	102.13	37.63
5 938.77	12.98	Peak	V	34.58	9.94	57.50	68.23	10.73

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 693.57	38.99	Peak	H	38.70	-21.49	-	56.20	74.00	17.80
*11 694.63	28.17	Average	H	38.70	-21.44	4.27	49.70	54.00	4.30
Above 11 700.00	Not detected	-	-	-	-	-	-	-	-

- Port 2_Internal antenna: 5 727 MHz ~ 5 847 MHz

A. Low Channel (5 727 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 620.15	12.38	Peak	V	34.10	9.68	56.16	68.23	12.07
5 695.05	21.10	Peak	V	34.10	9.72	64.92	101.56	36.64
5 719.10	24.91	Peak	V	34.14	9.77	68.82	110.58	41.76
5 725.00	29.28	Peak	V	34.15	9.79	73.22	122.23	49.01

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 455.02	39.64	Peak	H	38.51	-22.97	-	55.18	74.00	18.82
*11 453.74	29.90	Average	H	38.51	-22.97	4.16	49.60	54.00	4.40
Above 11 500.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 787 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 573.57	39.58	Peak	H	38.75	-22.66	-	55.67	74.00	18.33
*11 573.82	30.17	Average	H	38.75	-22.66	4.16	50.42	54.00	3.58
Above 11 600.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 847 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.00	27.98	Peak	H	34.40	9.93	72.31	122.23	49.92
5 855.41	21.83	Peak	H	34.41	9.91	66.15	110.71	44.56
5 878.92	19.63	Peak	H	34.46	9.85	63.94	102.33	38.39
5 937.02	13.00	Peak	H	34.57	9.94	57.51	68.23	10.72

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 694.78	41.14	Peak	H	38.70	-21.43	-	58.41	74.00	15.59
*11 695.09	30.33	Average	H	38.70	-21.42	4.16	51.77	54.00	2.23
Above 11 700.00	Not detected	-	-	-	-	-	-	-	-

- Port 2_External antenna: 5 727 MHz ~ 5 847 MHz

A. Low Channel (5 727 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 626.00	13.47	Peak	V	34.10	9.69	57.26	68.23	10.97
5 695.05	19.52	Peak	V	34.10	9.72	63.34	101.56	38.22
5 719.25	26.42	Peak	V	34.14	9.77	70.33	110.62	40.29
5 725.00	31.16	Peak	V	34.15	9.79	75.10	122.23	47.13

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 454.81	39.29	Peak	V	38.51	-22.97	-	54.83	74.00	19.17
*11 453.74	29.75	Average	V	38.51	-22.97	4.16	49.45	54.00	4.55
Above 11 500.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 787 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 574.88	40.80	Peak	V	38.75	-22.66	-	56.89	74.00	17.11
*11 573.76	31.95	Average	V	38.75	-22.66	4.16	52.20	54.00	1.80
Above 11 600.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 847 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.14	27.42	Peak	V	34.40	9.93	71.75	121.91	50.16
5 855.68	21.51	Peak	V	34.41	9.91	65.83	110.64	44.81
5 879.19	21.64	Peak	V	34.46	9.85	65.95	102.13	36.18
5 938.37	11.89	Peak	V	34.58	9.94	56.41	68.23	11.82

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*11 693.44	40.51	Peak	V	38.70	-21.49	-	57.72	74.00	16.28
*11 693.75	30.68	Average	V	38.70	-21.48	4.16	52.06	54.00	1.94
Above 11 700.00	Not detected	-	-	-	-	-	-	-	-

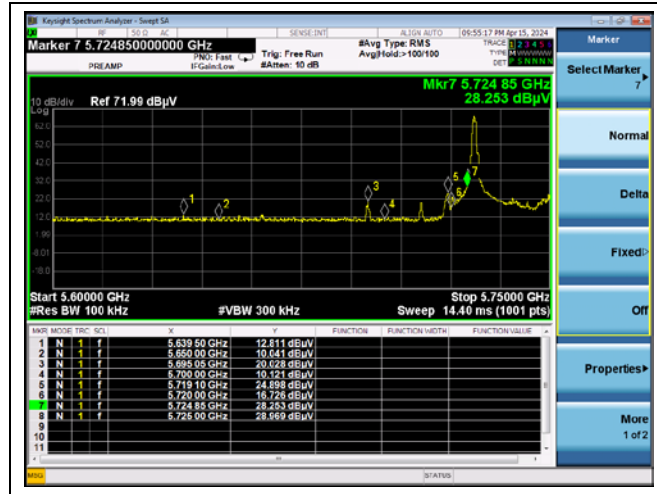
Remark;

1. "*" means the restricted band.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using Peak / average detector mode if frequency was in restricted band. Otherwise the frequency was out of restricted band, only peak detector should be used.
3. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
4. If frequency was out of restricted band, the calculation method for peak limit is same as below.
 $68.23 \text{ dB}\mu\text{V/m} = \text{EIRP} - 20 \log(d) + 104.77 = -27 - 20 \log(3) + 104.77$
5. In case of the emissions within ± 75 MHz from band edge of band 3, limit should be adjusted to emission mask of 15.407(4)(i).
6. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
7. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

- Test plots

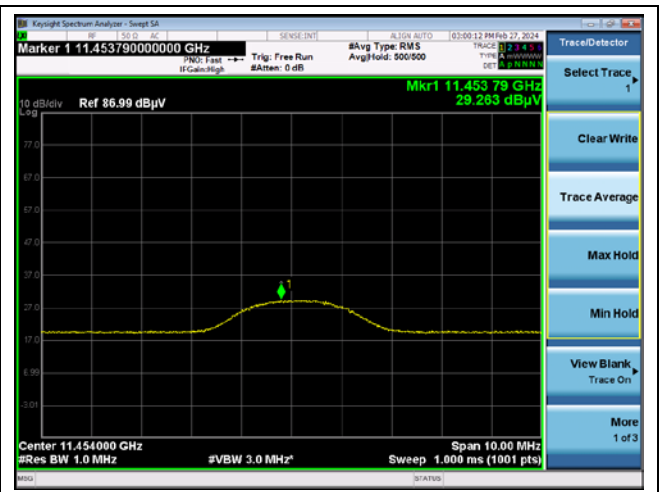
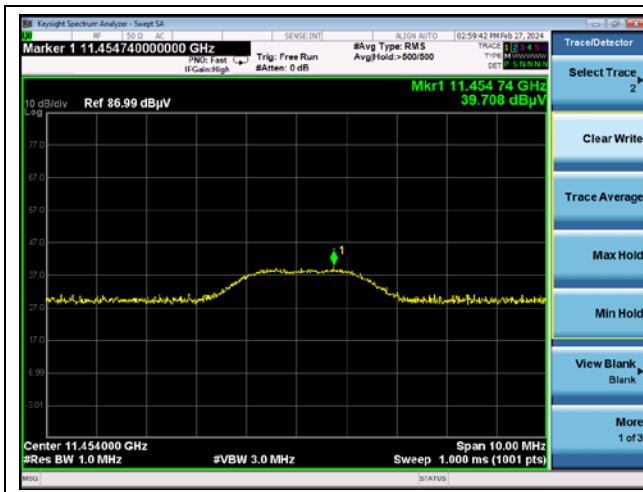
Port 1_Internal antenna: 5 727 MHz ~ 5 847 MHz

Low channel Band edge (Peak) - Band 3

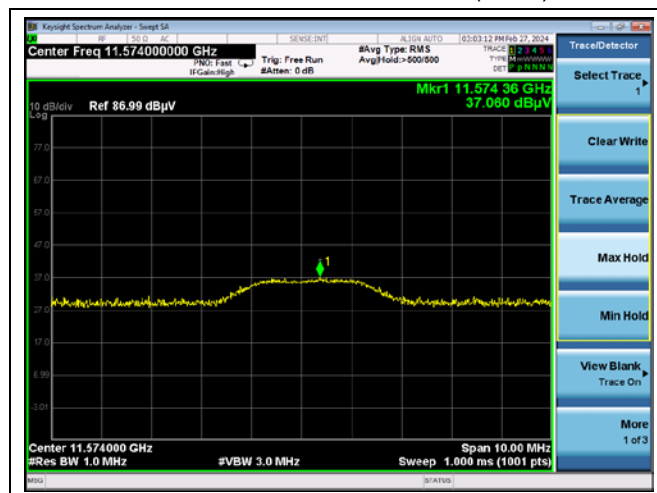


Low channel 2nd harmonic (Peak)

Low channel 2nd harmonic (Average)



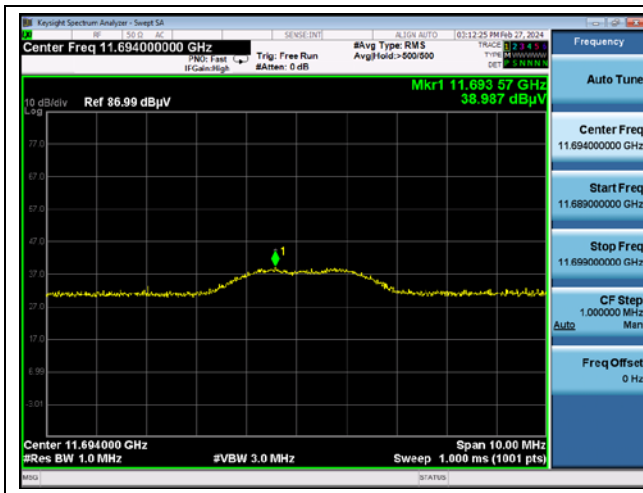
Middle channel 2nd harmonic (Peak)



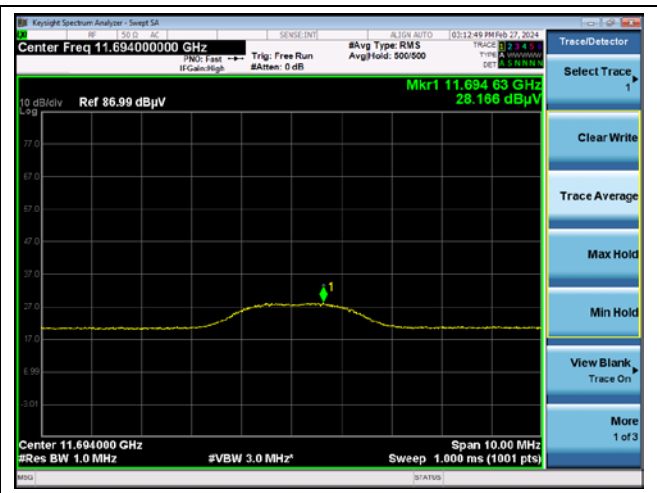
High channel Band edge (Peak) - Band 3



High channel 2nd harmonic (Peak)

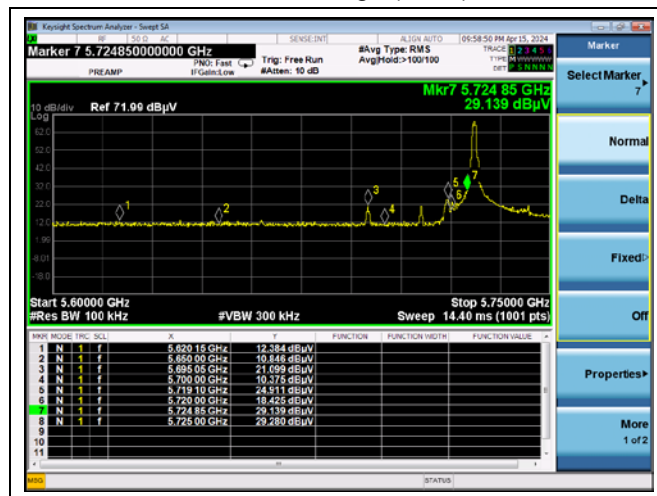


High channel 2nd harmonic (Average)



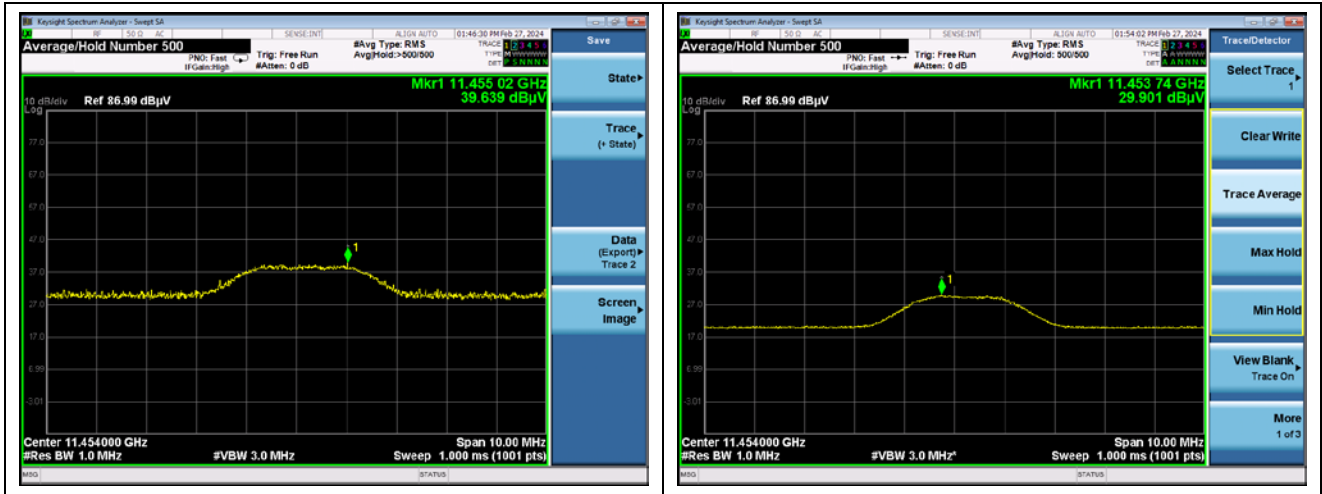
Port 2_Internal antenna: 5 727 MHz ~ 5 847 MHz

Low channel Band edge (Peak) - Band 3



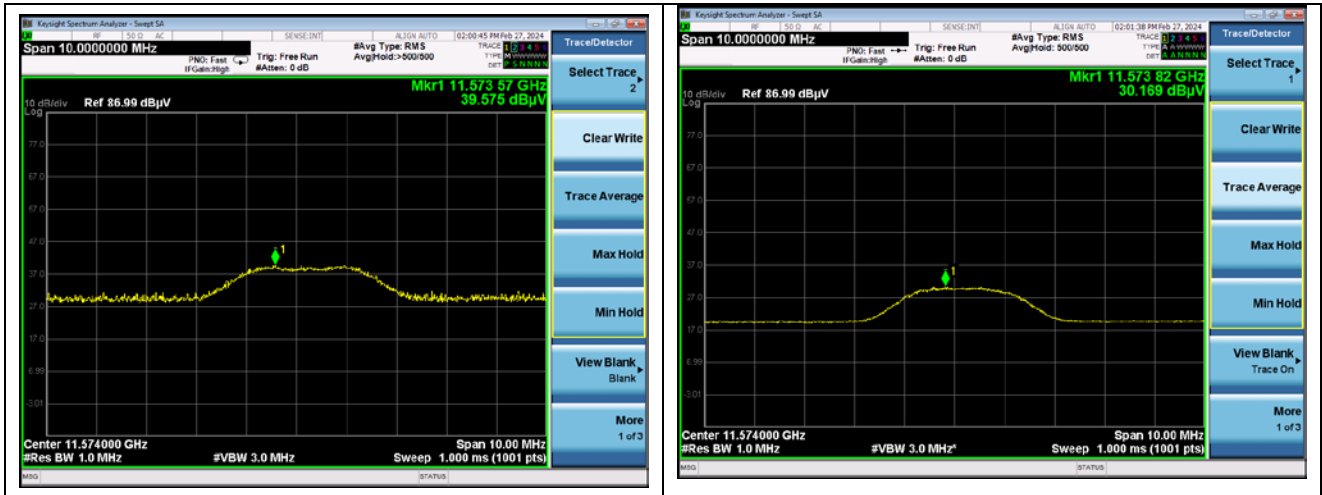
Low channel 2nd harmonic (Peak)

Low channel 2nd harmonic (Average)



Middle channel 2nd harmonic (Peak)

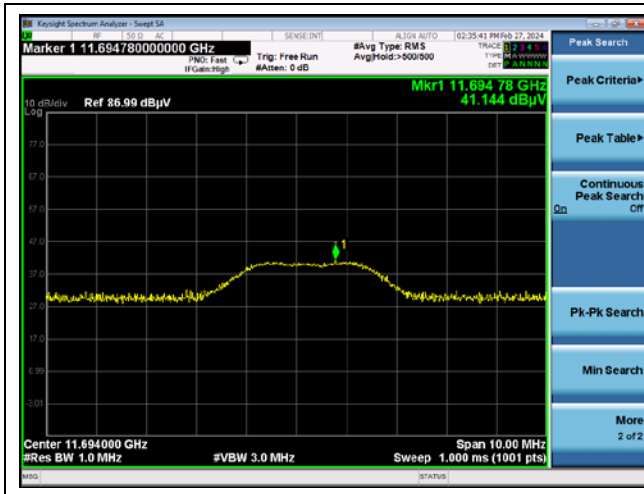
Middle channel 2nd harmonic (Average)



High channel Band edge (Peak) - Band 3



High channel 2nd harmonic (Peak)

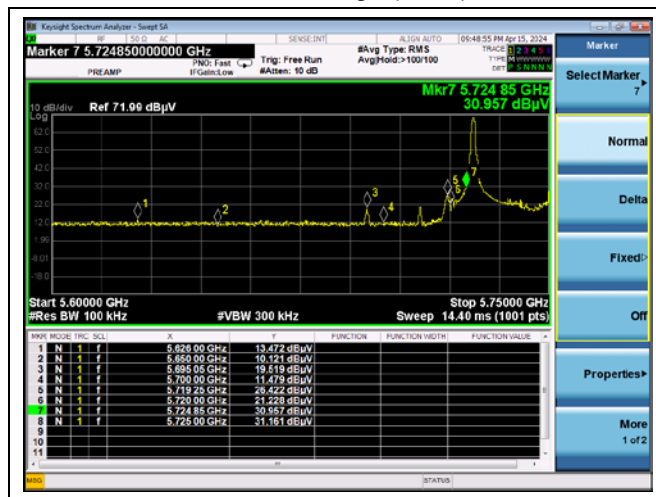


High channel 2nd harmonic (Average)

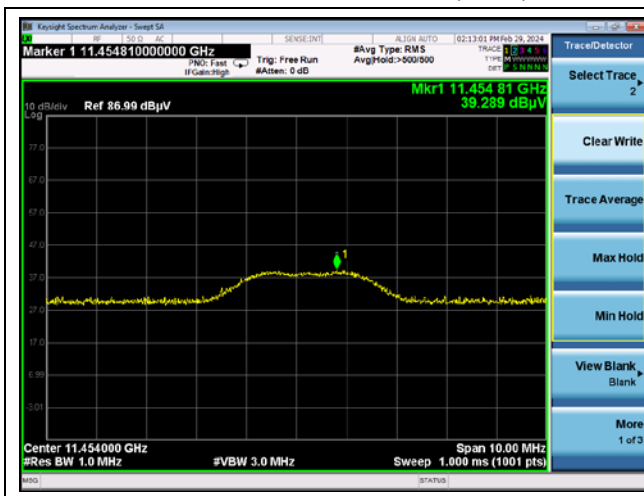


Port 2_External antenna: 5 727 MHz ~ 5 847 MHz

Low channel Band edge (Peak) - Band 3



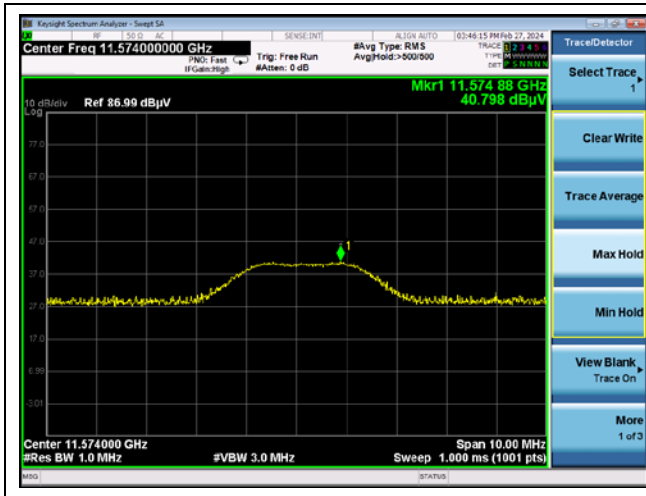
Low channel 2nd harmonic (Peak)



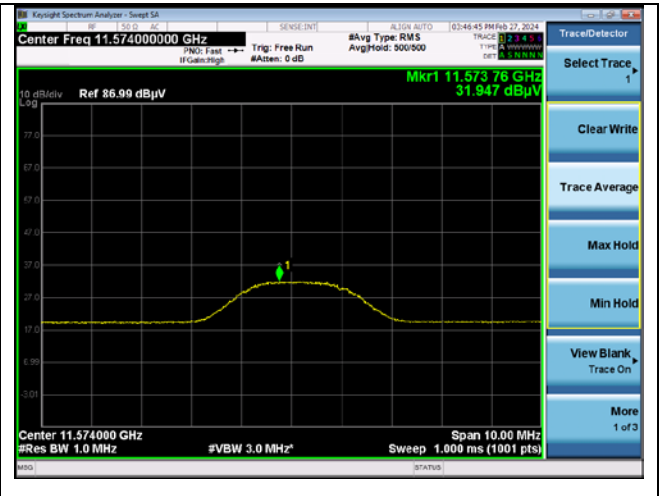
Low channel 2nd harmonic (Average)



Middle channel 2nd harmonic (Peak)



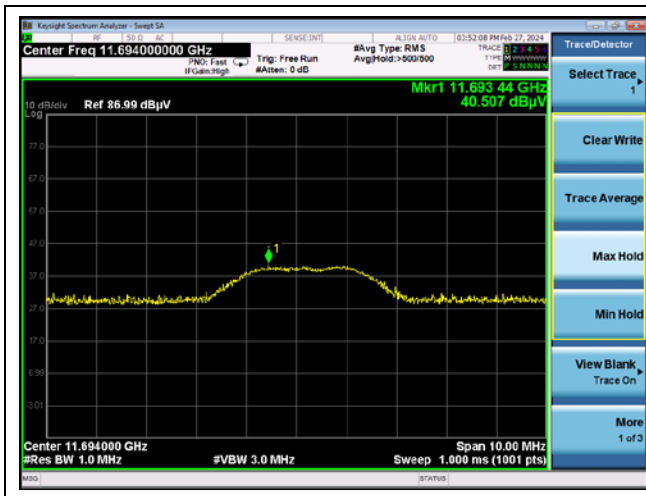
Middle channel 2nd harmonic (Average)



High channel Band edge (Peak) - Band 3



High channel 2nd harmonic (Peak)



High channel 2nd harmonic (Average)



3. 26 dB Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purpose only.

3.3. Test Procedure

1. This measurement settings are specified in section II.C.1 of KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
2. Set RBW = approximately 1 % of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

3.4. Test Result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

Mode	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	
			Port 1	Port 2
GFSK	Low	5 727	2.148	2.138
	Middle	5 787	2.178	2.128
	High	5 847	2.128	2.128