FCC RADIO TEST REPORT

FCC ID	:	**2AGOZ-V6P**
Equipment	:	**Handheld controller**
Brand Name	:	**META PLATFORMS TECHNOLOGIES, LLC**
Model Name	:	**V6P**
Applicant	:	**Meta Platforms Technologies, LLC. 1 Hacker Way, Menlo Park, CA 94025, USA**
Manufacturer	:	**Meta Platforms Technologies, LLC 1 Hacker Way, Menlo Park, CA 94025, USA**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on May 15, 2023 and testing was performed from May 17, 2023 to May 25, 2023. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory
No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issue Date
FR230417-02	01	Initial issue of report	Jun. 15, 2023
FR230417-02	02	Revise Conducted Band Edges and Spurious Emission Measurement This report is an updated version, replacing the report issued on Jun. 15, 2023.	Jun. 30, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3) 15.247(b)(4)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	4.38 dB under the limit at 2375.940 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.6	15.203	Antenna Requirement	Pass	-

Note: Not required means after assessing, test items are not necessary to carry out.

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Yun Huang

Report Producer: Lea Yu

1 General Description

1.1 Product Feature of Equipment Under Test

Product Specification is subject to this standard	
General Specs	SRD-nRF
Sample 1	config A
Sample 2	config B
Tx/Rx Frequency Range	2402 MHz ~ 2478 MHz
Type of Modulation	nRF: GFSK

Antenna information		
2402 MHz ~ 2478 MHz	Peak Gain (dBi)	1.9

Remark: The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

1.2 Modification of EUT

No modifications made to the EUT during the testing.

1.3 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	TH05-HY, 03CH16-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

1.4 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
nRF	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	-	-
	19	2440	-	-
	20	2442	-	-

2.2 Test Mode

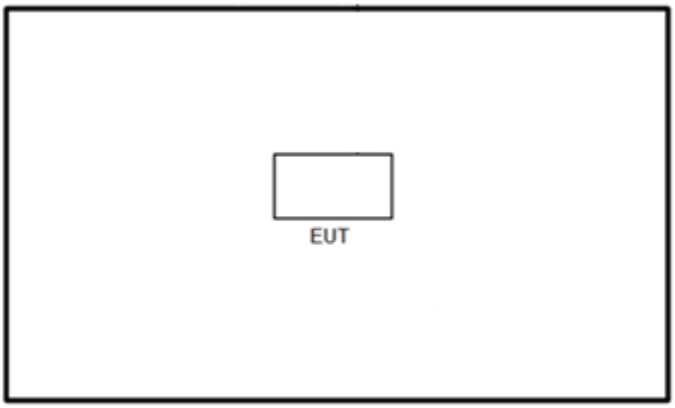
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	**Data Rate / Modulation**
Conducted Test Cases	Mode 1: nRF Tx CH00_2402 MHz_2Mbps Mode 2: nRF Tx CH19_2440 MHz_2Mbps Mode 3: nRF Tx CH38_2478 MHz_2Mbps
Radiated Test Cases	Mode 1: nRF Tx CH00_2402 MHz_2Mbps Mode 2: nRF Tx CH19_2440 MHz_2Mbps Mode 3: nRF Tx CH38_2478 MHz_2Mbps
Remark: 1. For Radiated Test Cases, the tests were performed with Sample 2. 2. For radiation spurious emission, the modulation and the data rate picked for testing are determined by the Max. RF conducted power.	

2.3 Connection Diagram of Test System

< SRD-nRF Tx Mode>



2.4 EUT Operation Test Setup

The RF test items, utility “python 3.7” was installed in EUT which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

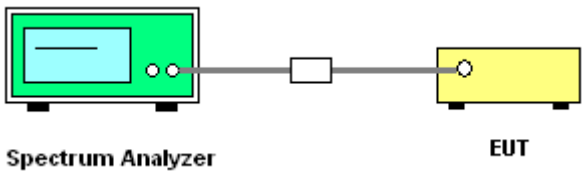
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 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.

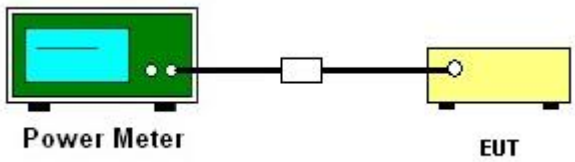
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator.
3. The path loss is compensated to the results for each measurement.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

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

3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth (VBW) = 10 kHz. In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6 dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100 kHz is a reference level and is used as 20 dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup

3.3.5 Test Result of Power Spectral Density Plots (100kHz)

Please refer to Appendix A.

3.3.6 Test Result of Power Spectral Density Plots (3kHz)

Please refer to Appendix A.

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

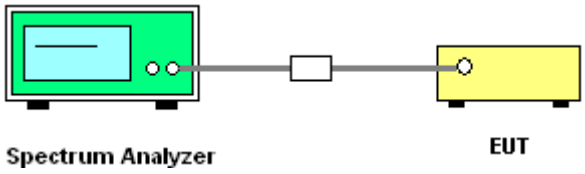
3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



3.4.5 Test Result of Conducted Band Edges Plots

Please refer to Appendix A.

3.4.6 Test Result of Conducted Spurious Emission Plots

Please refer to Appendix A.

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/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

3.5.2 Measuring Instruments

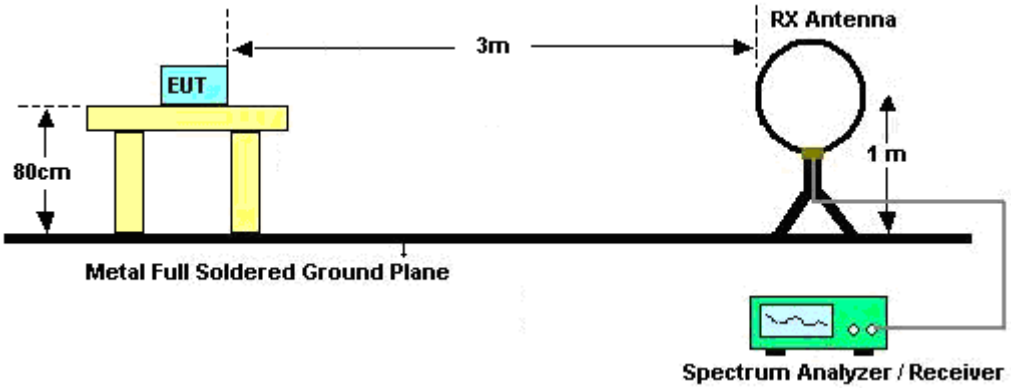
Please refer to the measuring equipment list in this test report.

3.5.3 Test Procedures

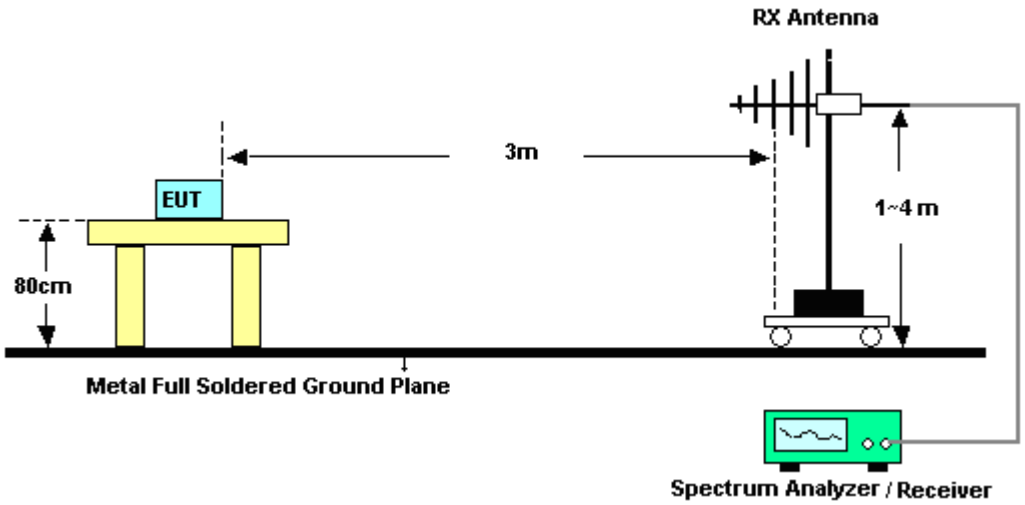
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW = 100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW = 3 MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

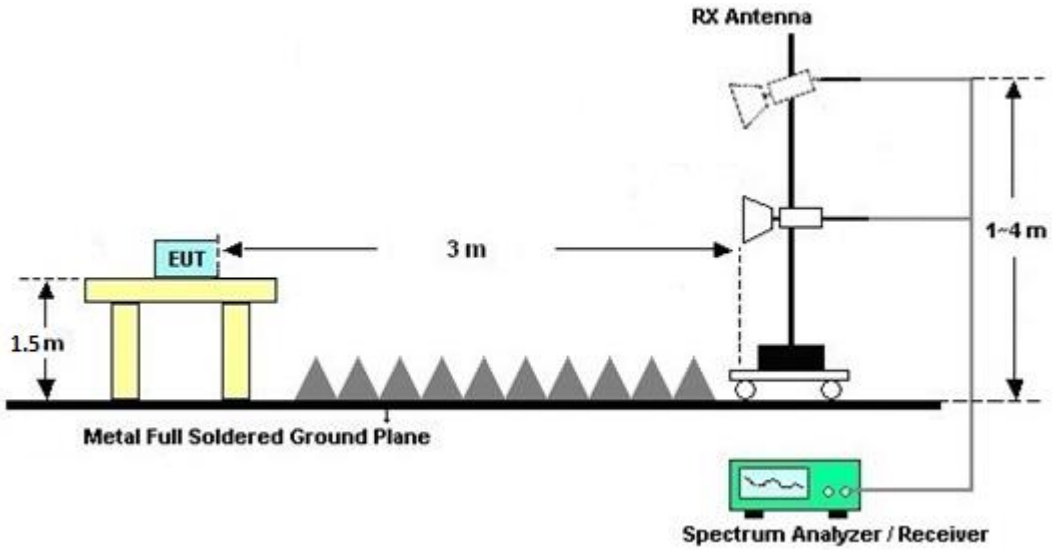
For radiated test below 30MHz



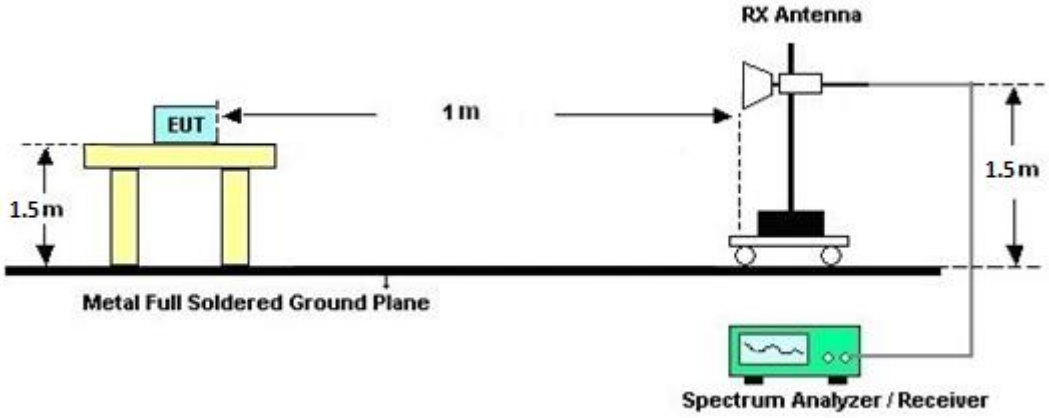
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix B and C.

3.6 Antenna Requirements

3.6.1 Standard Applicable

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 rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1GHz~18GHz	Mar. 23, 2023	May 20, 2023~ May 21, 2023	Mar. 22, 2024	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	1223	18GHz-40GHz	Jul. 05, 2022	May 20, 2023~ May 21, 2023	Jul. 04, 2023	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz~1GHz	Oct. 08, 2022	May 20, 2023~ May 21, 2023	Oct. 07, 2023	Radiation (03CH16-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	May 20, 2023~ May 21, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 28, 2022	May 20, 2023~ May 21, 2023	Jun. 27, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1GHz~18GHz	Dec. 26, 2022	May 20, 2023~ May 21, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	May 20, 2023~ May 21, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1GHz	Jul. 04, 2022	May 20, 2023~ May 21, 2023	Jul. 03, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	May 20, 2023~ May 21, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	805935/4	N/A	Aug. 09, 2022	May 20, 2023~ May 21, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	802434/4	N/A	Aug. 09, 2022	May 20, 2023~ May 21, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	N/A	Aug. 09, 2022	May 20, 2023~ May 21, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	May 20, 2023~ May 21, 2023	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	May 20, 2023~ May 21, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	May 20, 2023~ May 21, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	May 20, 2023~ May 21, 2023	N/A	Radiation (03CH16-HY)
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 17, 2022	May 17, 2023~ May 25, 2023	Nov. 16, 2023	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 12 (NO:113)	10MHz~6GHz	Dec. 13, 2022	May 17, 2023~ May 25, 2023	Dec. 12, 2023	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100057	9kHz-40GHz	Dec. 30, 2022	May 17, 2023~ May 25, 2023	Dec. 29, 2023	Conducted (TH05-HY)

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.5 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6 dB**

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.6 dB**

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Ray Wang	Temperature:	21~25	°C
Test Date:	2023/5/17~2023/5/25	Relative Humidity:	51~54	%

<Config A (#4)>

TEST RESULTS DATA
Average Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail	Setting
nRF	2Mbps	1	0	2402	7.30	30.00	1.90	9.20	36.00	Pass	8
nRF	2Mbps	1	19	2440	7.50	30.00	1.90	9.40	36.00	Pass	8
nRF	2Mbps	1	38	2478	7.50	30.00	1.90	9.40	36.00	Pass	8

<Config B (#6)>

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
nRF	2Mbps	1	00	2402	1.994	0.568	0.50	Pass
nRF	2Mbps	1	19	2440	1.998	0.564	0.50	Pass
nRF	2Mbps	1	38	2478	1.998	0.564	0.50	Pass

TEST RESULTS DATA
Average Power Table

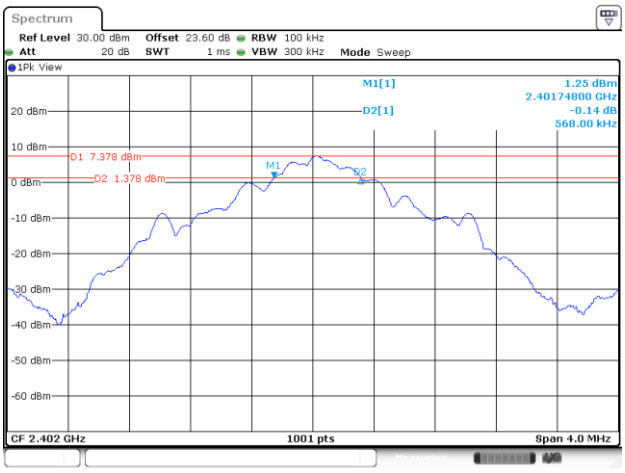
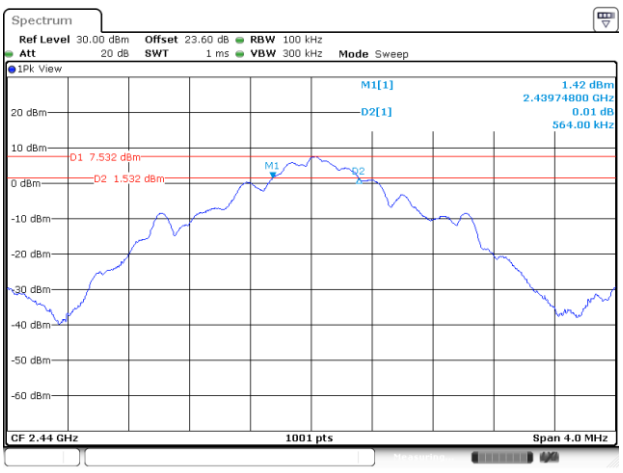
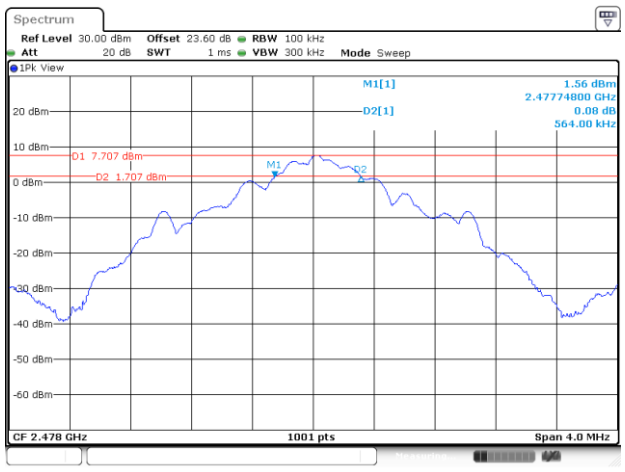
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
nRF	2Mbps	1	00	2402	7.30	30.00	1.90	9.20	36.00	Pass
nRF	2Mbps	1	19	2440	7.50	30.00	1.90	9.40	36.00	Pass
nRF	2Mbps	1	38	2478	7.60	30.00	1.90	9.50	36.00	Pass

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
nRF	2Mbps	1	00	2402	7.42	-7.44	1.90	8.00	Pass
nRF	2Mbps	1	19	2440	7.55	-7.40	1.90	8.00	Pass
nRF	2Mbps	1	38	2478	7.71	-7.37	1.90	8.00	Pass

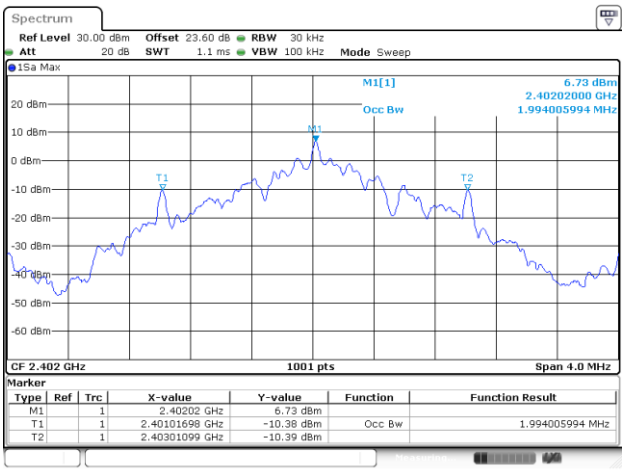
Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

6dB Bandwidth

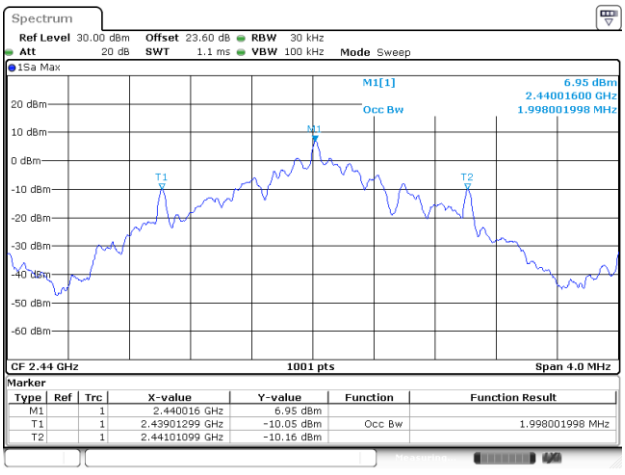
6 dB Bandwidth Plot on Channel 00	6 dB Bandwidth Plot on Channel 19
	
6 dB Bandwidth Plot on Channel 38	
	

99% Occupied Bandwidth

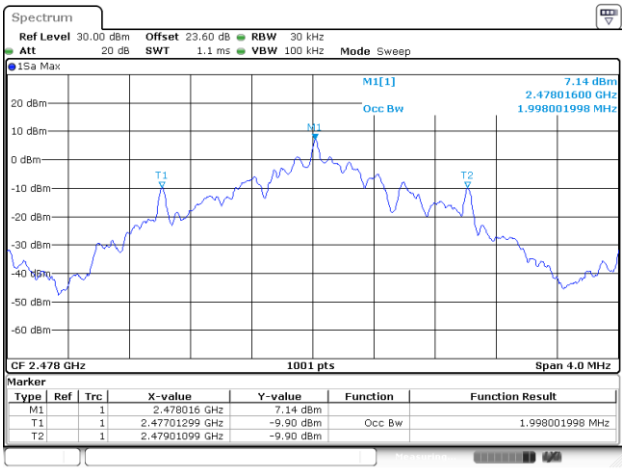
99% Occupied Bandwidth Plot on Channel 00



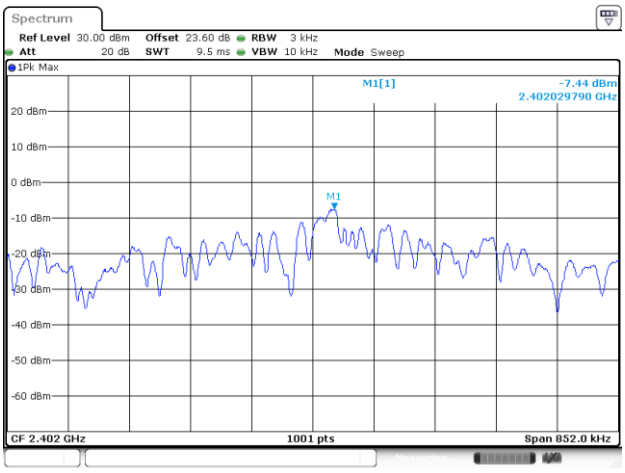
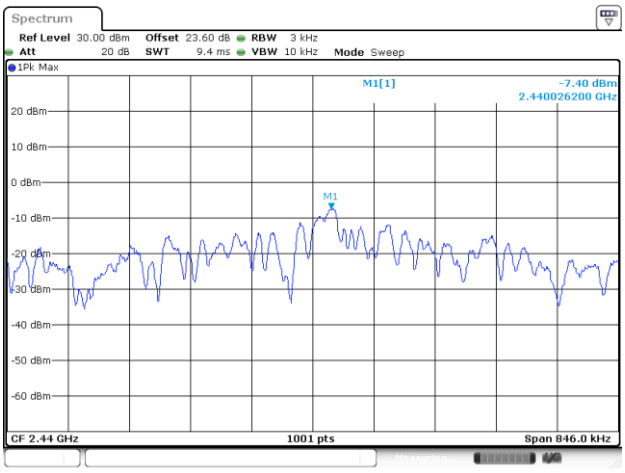
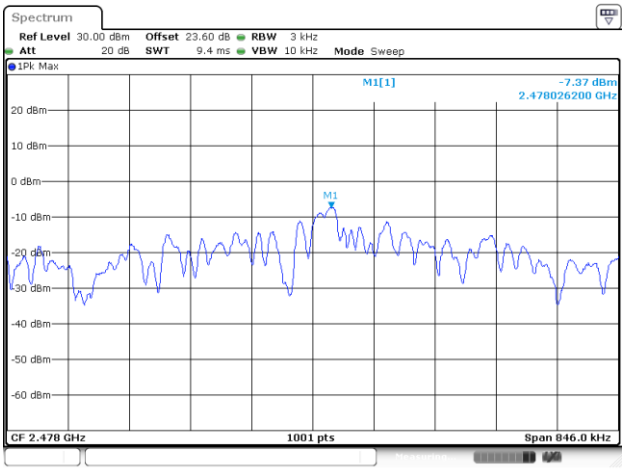
99% Occupied Plot Bandwidth on Channel 19



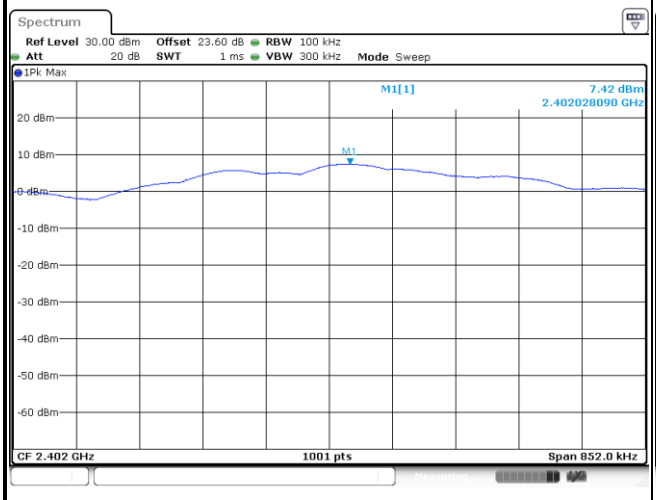
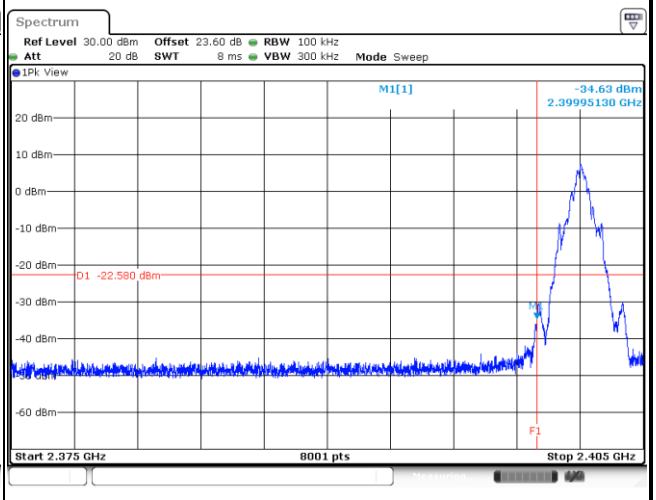
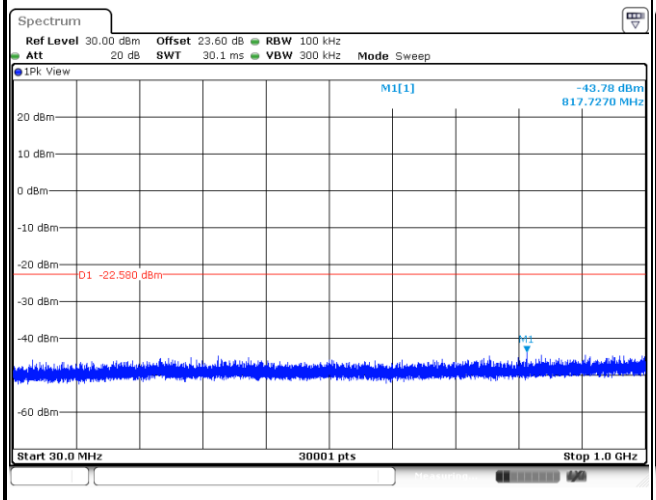
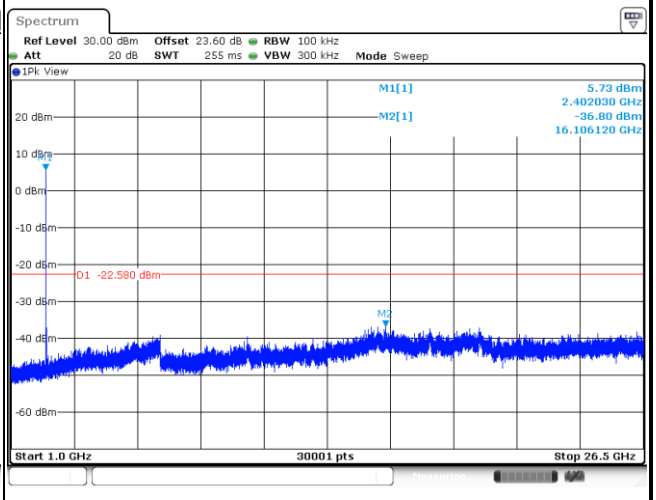
99% Occupied Bandwidth Plot on Channel 38

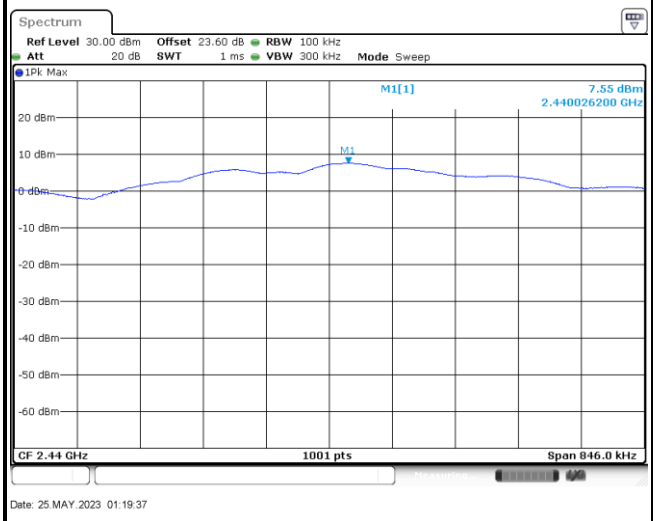
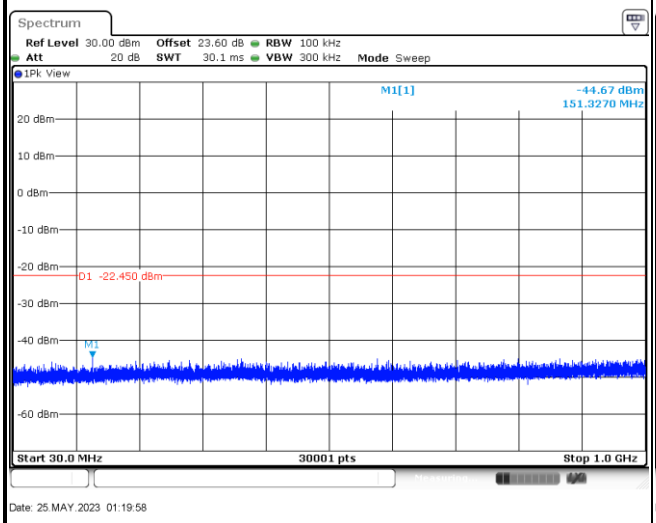
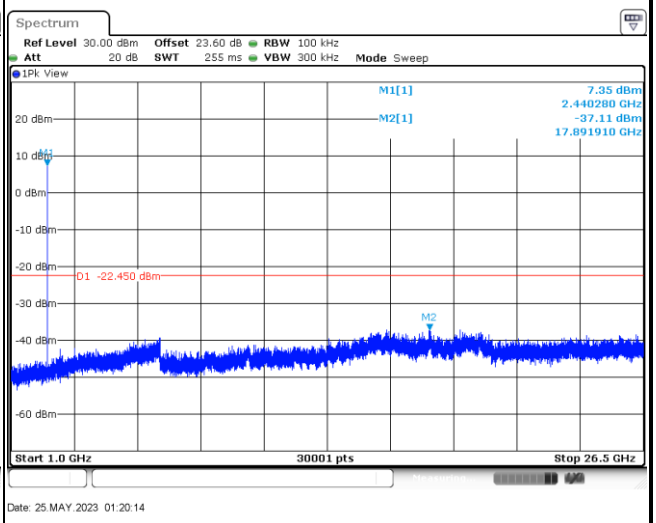


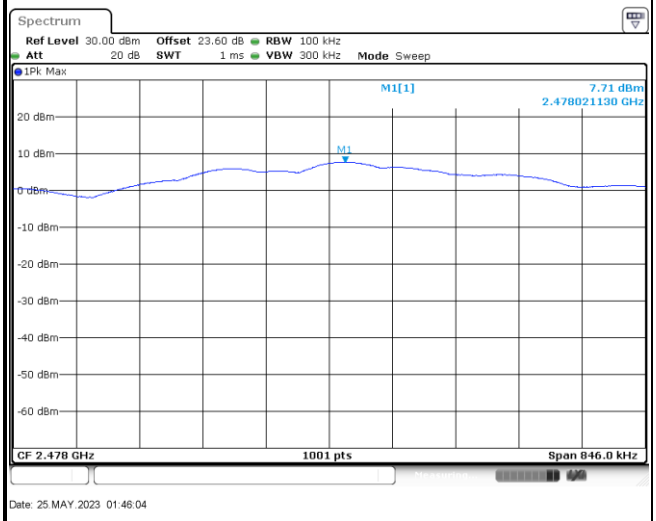
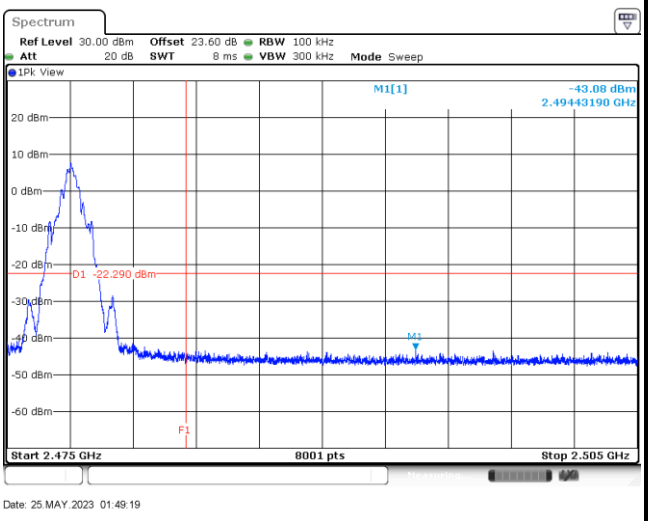
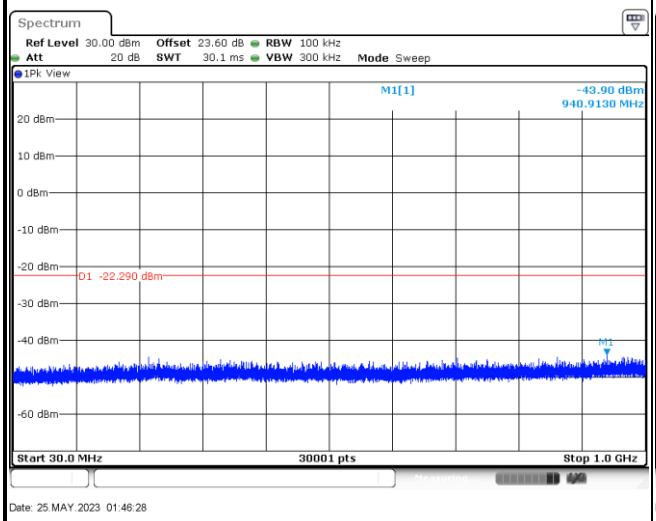
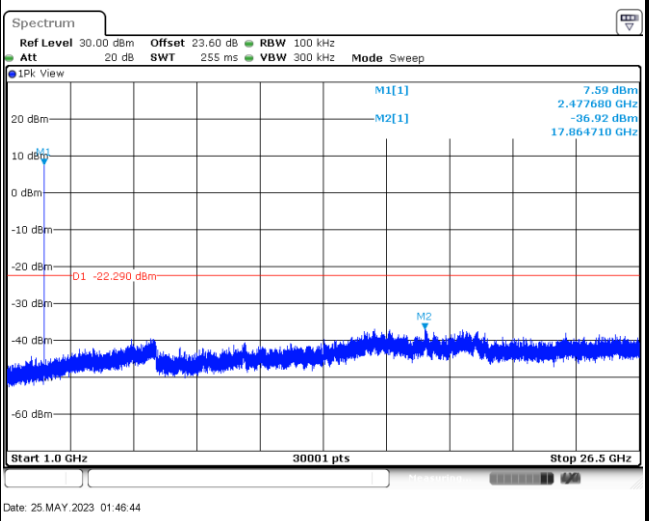
Power Spectral Density (dBm/3kHz)

Power Density (dBm/3kHz) Plot Channel 00	Power Density (dBm/3kHz) Plot Channel 19
	
Power Density (dBm/3kHz Plot Channel 38	
	

Band Edges and Spurious Emission

Channel 00	
100kHz PSD reference Level Plot	**Low Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Channel 19	
100kHz PSD reference Level Plot	**Low Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Channel 38	
100kHz PSD reference Level Plot	**Low Channel Plot**
	
Spurious Emission 30MHz~1GHz Plot	**Spurious Emission 1GHz~26.5GHz Plot**
	

Appendix B. Radiated Spurious Emission

Test Engineer :	Gary Guo and Bill Chang	**Temperature :**	20~25°C
		Relative Humidity :	50~65%

2.4GHz 2400~2483.5MHz

nRF (Band Edge @ 3m)

nRF	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	TanRF	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
nRF CH 00 2402MHz		2373.63	55.76	-18.24	74	41.67	27.24	17.32	30.47	112	130	P	H
		2338.14	48.12	-5.88	54	34.17	27.18	17.25	30.48	112	130	A	H
	*	2402	103.28	-	-	88.96	27.4	17.38	30.46	112	130	P	H
	*	2402	102.72	-	-	88.4	27.4	17.38	30.46	112	130	A	H
													H
													H
		2371.11	53.77	-20.23	74	39.71	27.21	17.32	30.47	303	356	P	V
		2337.72	47.09	-6.91	54	33.14	27.18	17.25	30.48	303	356	A	V
	*	2402	102.68	-	-	88.36	27.4	17.38	30.46	303	356	P	V
	*	2402	102.05	-	-	87.73	27.4	17.38	30.46	303	356	A	V
													V
													V
nRF CH 19 2440MHz		2342.48	54.52	-19.48	74	40.54	27.2	17.26	30.48	111	127	P	H
		2375.94	49.62	-4.38	54	35.5	27.26	17.33	30.47	111	127	A	H
	*	2440	102.8	-	-	88.21	27.6	17.44	30.45	111	127	P	H
	*	2440	102.25	-	-	87.66	27.6	17.44	30.45	111	127	A	H
		2484.39	54.27	-19.73	74	39.45	27.74	17.51	30.43	111	127	P	H
		2491.88	47.09	-6.91	54	32.2	27.8	17.52	30.43	111	127	A	H
		2378.6	53.89	-20.11	74	39.73	27.29	17.34	30.47	102	304	P	V
		2375.94	48.76	-5.24	54	34.64	27.26	17.33	30.47	102	304	A	V
	*	2440	101.68	-	-	87.09	27.6	17.44	30.45	102	304	P	V
	*	2440	101.16	-	-	86.57	27.6	17.44	30.45	102	304	A	V
		2493.98	54.72	-19.28	74	39.83	27.8	17.52	30.43	102	304	P	V
		2486.28	47.14	-6.86	54	32.3	27.76	17.51	30.43	102	304	A	V

nRF	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	TanRF Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
nRF CH 38 2478MHz	*	2478	101.96	-	-	87.2	27.7	17.5	30.44	-	-	P	H
	*	2478	101.42	-	-	86.66	27.7	17.5	30.44	-	-	A	H
		2486.88	55.4	-18.6	74	40.55	27.77	17.51	30.43	-	-	P	H
		2483.56	47.82	-6.18	54	33.01	27.74	17.51	30.44	-	-	A	H
													H
													H
	*	2478	102.03	-	-	87.27	27.7	17.5	30.44	-	-	P	V
	*	2478	101.46	-	-	86.7	27.7	17.5	30.44	-	-	A	V
		2483.8	54.67	-19.33	74	39.86	27.74	17.51	30.44	-	-	P	V
		2483.52	47.92	-6.08	54	33.11	27.74	17.51	30.44	-	-	A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

2.4GHz 2400~2483.5MHz

nRF (Harmonic @ 3m)

nRF	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	TanRF Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
nRF CH 00 2402MHz		4804	39.93	-34.07	74	62.96	32.32	11.3	66.65	-	-	P	H
		7206	48.3	-25.7	74	63.9	37.01	13.67	66.28	100	65	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		4804	40.81	-33.19	74	63.84	32.32	11.3	66.65	-	-	P	V
		7206	49.94	-24.06	74	65.54	37.01	13.67	66.28	100	125	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V

nRF	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	TanRF Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
nRF CH 19 2440MHz		4880	47.28	-26.72	74	69.85	32.66	11.35	66.58	100	298	P	H
		4880	44.34	-9.66	54	66.91	32.66	11.35	66.58	100	298	A	H
		7320	46.97	-27.03	74	62.95	36.86	13.49	66.33	100	73	P	H
		7320	41.85	-12.15	54	57.83	36.86	13.49	66.33	100	73	A	H
		12200	52.01	-21.99	74	61.2	39.1	17.8	66.09	101	115	P	H
		12200	45.95	-8.05	54	55.14	39.1	17.8	66.09	101	115	A	H
													H
													H
													H
													H
													H
													H
		4880	48.73	-25.27	74	71.3	32.66	11.35	66.58	312	335	P	V
		4880	42.17	-11.83	54	64.74	32.66	11.35	66.58	312	335	A	V
		7320	48.96	-25.04	74	64.94	36.86	13.49	66.33	100	125	P	V
		7320	44.37	-9.63	54	60.35	36.86	13.49	66.33	100	125	A	V
		12200	51	-23	74	60.19	39.1	17.8	66.09	100	62	P	V
		12200	45.33	-8.67	54	54.52	39.1	17.8	66.09	100	62	A	V
													V
													V
													V
													V
													V
													V

nRF	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	TanRF Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
nRF CH 38 2478MHz		4956	49.28	-24.72	74	71.54	32.85	11.4	66.51	100	306	P	H
		4956	46.78	-7.22	54	69.04	32.85	11.4	66.51	100	306	A	H
		7434	47.64	-26.36	74	64.09	36.46	13.47	66.38	100	65	P	H
		7434	42.68	-11.32	54	59.13	36.46	13.47	66.38	100	65	A	H
		12390	51.89	-22.11	74	61.11	38.9	17.93	66.05	100	114	P	H
		12390	46.48	-7.52	54	55.7	38.9	17.93	66.05	100	114	A	H
													H
													H
													H
													H
													H
													H
		4956	51.83	-22.17	74	74.09	32.85	11.4	66.51	383	334	P	V
		4956	49.25	-4.75	54	71.51	32.85	11.4	66.51	383	334	A	V
		7434	47.88	-26.12	74	64.33	36.46	13.47	66.38	100	125	P	V
		7434	43.07	-10.93	54	59.52	36.46	13.47	66.38	100	125	A	V
		12390	51.46	-22.54	74	60.68	38.9	17.93	66.05	100	63	P	V
		12390	47.15	-6.85	54	56.37	38.9	17.93	66.05	100	63	A	V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

Emission above 18GHz

2.4GHz nRF (SHF)

nRF	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	TanRF	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz nRF SHF		23192	40.05	-33.95	74	58.2	38.92	-2.82	54.25	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		23920	39.34	-34.66	74	56.59	39.17	-2.59	53.83	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

Emission below 1GHz

2.4GHz nRF (LF)

nRF	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	TanRF	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz nRF LF		30.27	26.86	-13.14	40	34.23	24.34	0.47	32.18	-	-	P	H
		179.85	22.92	-20.58	43.5	38.1	15.07	2.07	32.32	-	-	P	H
		261.12	20.57	-25.43	46	30.45	19.98	2.48	32.34	-	-	P	H
		459.6	24.81	-21.19	46	30.74	23.25	3.31	32.49	-	-	P	H
		566.7	26.29	-19.71	46	29.71	25.51	3.68	32.61	-	-	P	H
		741.7	29.89	-16.11	46	30.51	27.58	4.23	32.43	-	-	P	H
													H
													H
													H
													H
													H
													H
		30	30.22	-9.78	40	37.44	24.5	0.46	32.18	-	-	P	V
		182.01	22.79	-20.71	43.5	38.06	14.97	2.08	32.32	-	-	P	V
		288.39	20.12	-25.88	46	30.76	19.11	2.58	32.33	-	-	P	V
		500.2	25.1	-20.9	46	30.34	23.87	3.44	32.55	-	-	P	V
		720.7	28.98	-17.02	46	30.53	26.79	4.16	32.5	-	-	P	V
		955.9	32.89	-13.11	46	29.04	30.29	4.84	31.28	-	-	P	V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or emission is noise floor only.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

nRF	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	TanRF	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
nRF CH 00 2402MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = CanRF loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

3. Margin(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Margin (dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Margin (dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix C. Radiated Spurious Emission Plots

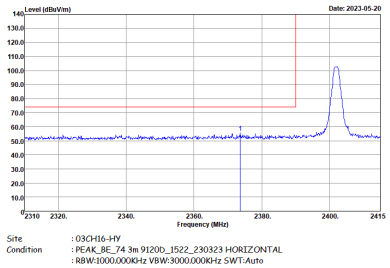
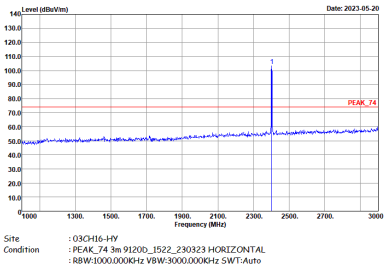
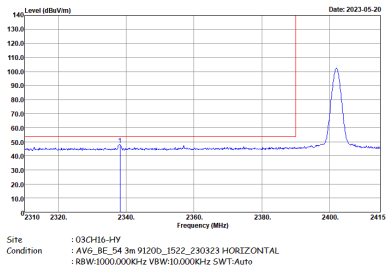
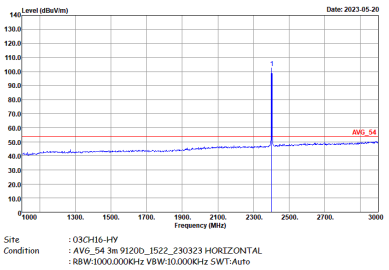
Test Engineer :	Gary Guo and Bill Chang	**Temperature :**	20~25°C
		Relative Humidity :	50~65%

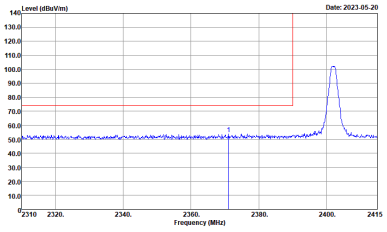
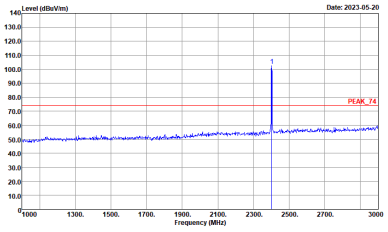
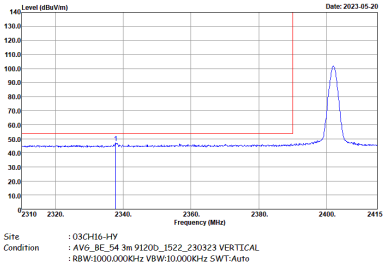
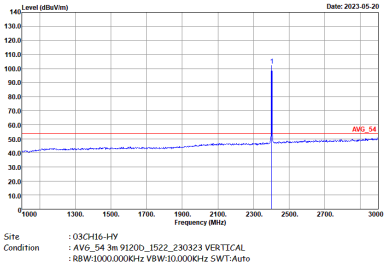
Note symbol

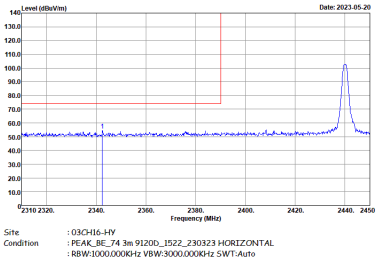
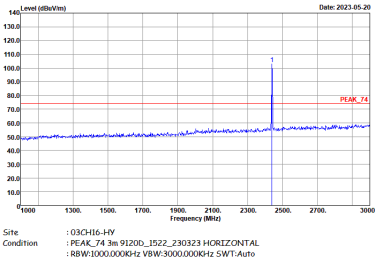
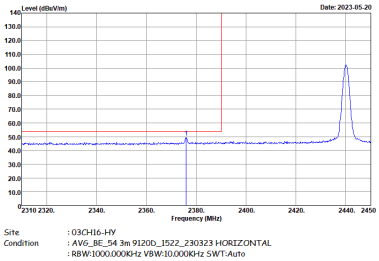
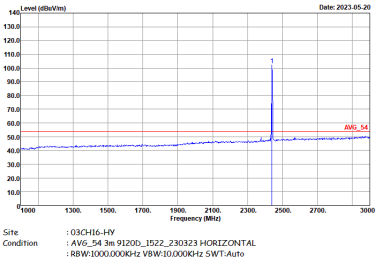
-L	**Low channel location**
-R	**High channel location**

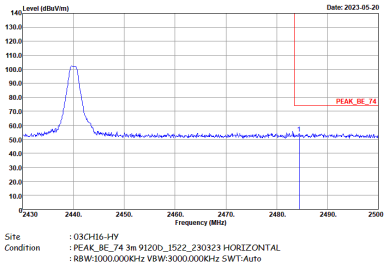
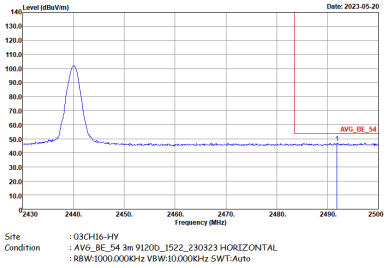
2.4GHz 2400~2483.5MHz

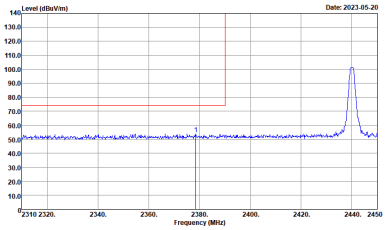
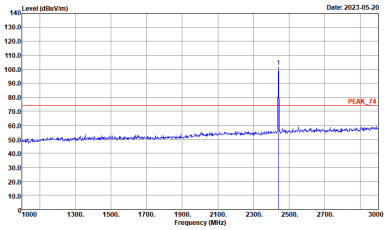
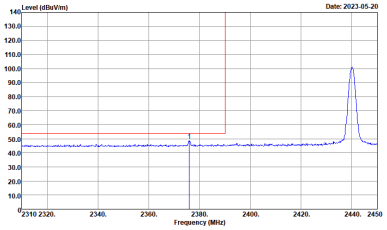
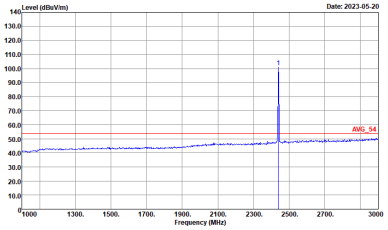
nRF (Band Edge @ 3m)

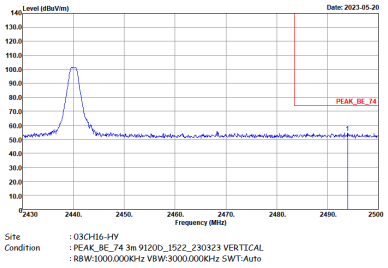
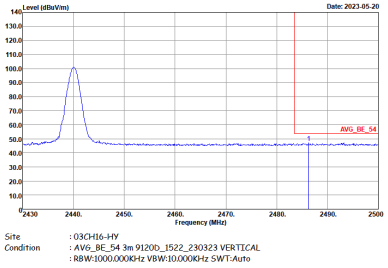
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH00 2402MHz	
	Horizontal	Fundamental
Peak		
Avg.		

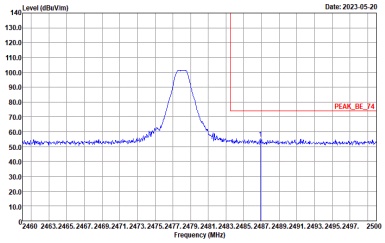
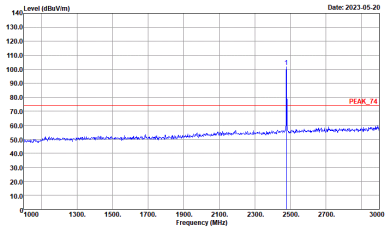
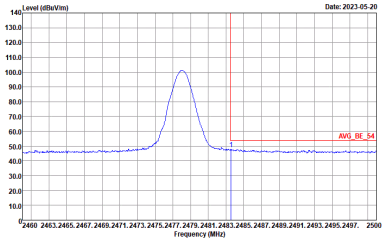
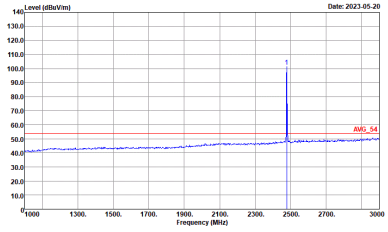
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH00 2402MHz	
	Vertical	Fundamental
Peak		
Avg		

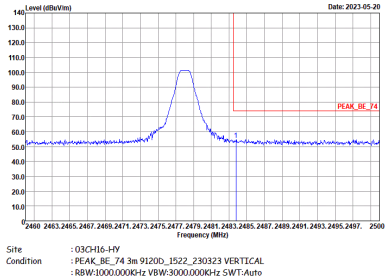
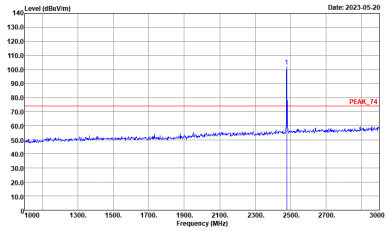
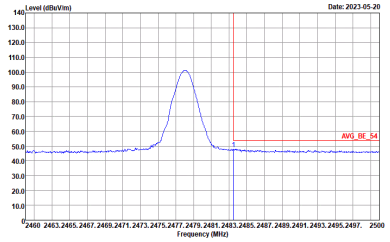
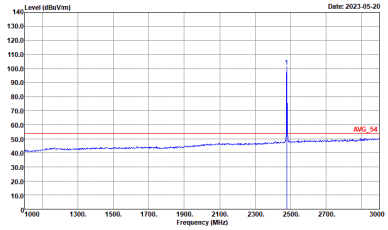
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH19 2440MHz - L	
	Horizontal	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto

nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH19 2440MHz - R	
	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH19 2440MHz - L	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_8E_74 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH16-HY Condition : AV6_8E_54 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH16-HY Condition : AV6_54 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto

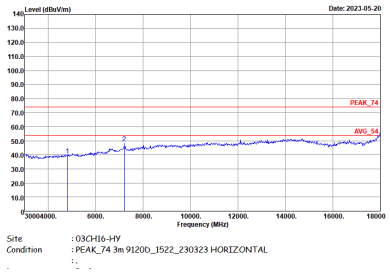
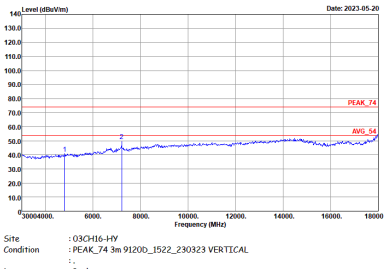
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH19 2440MHz - R	
	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

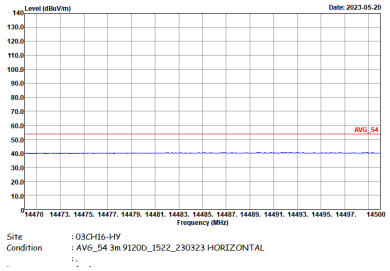
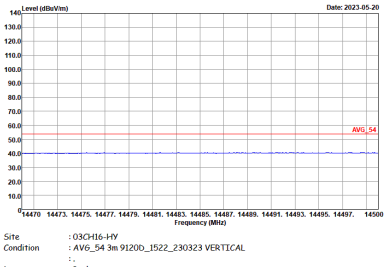
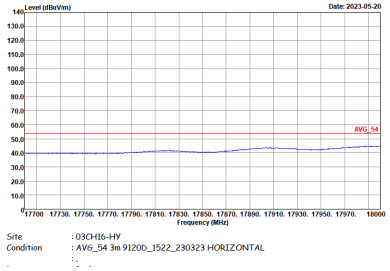
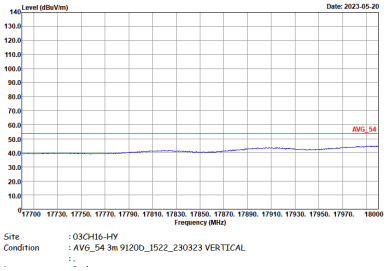
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH38 2478MHz	
	Horizontal	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522_230323 HORIZONTAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto

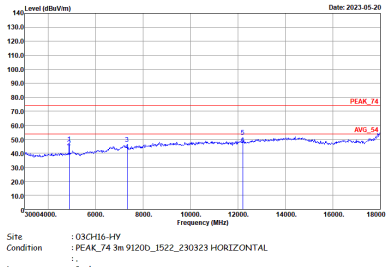
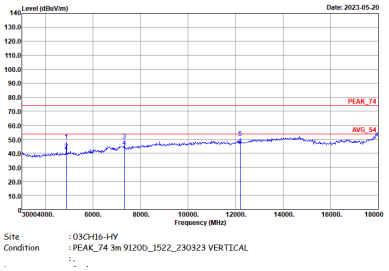
nRF	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	nRF CH38 2478MHz	
	Vertical	Fundamental
Peak	 Site : 03CH16-HY Condition : PEAK_BE_74 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH16-HY Condition : PEAK_74 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH16-HY Condition : AVG_BE_54 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH16-HY Condition : AVG_54 3m 9120D_1522_230323 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto

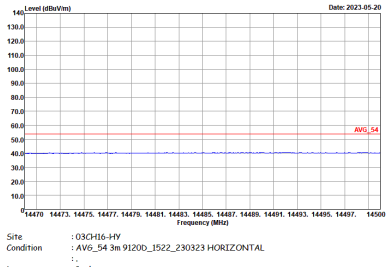
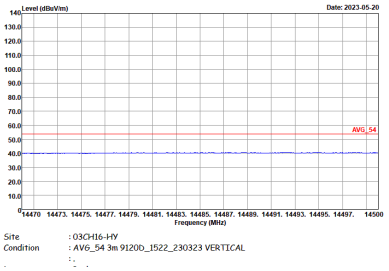
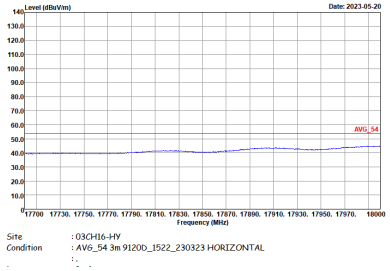
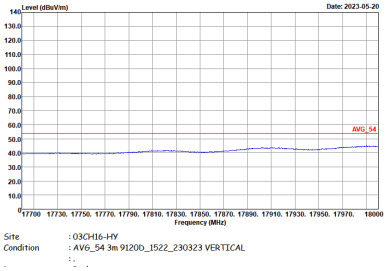
2.4GHz 2400~2483.5MHz

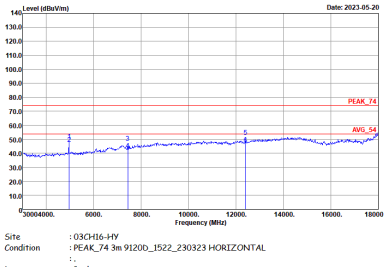
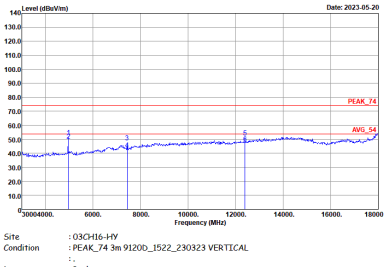
nRF (Harmonic @ 3m)

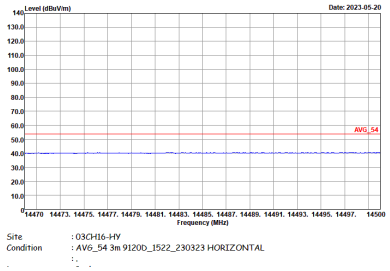
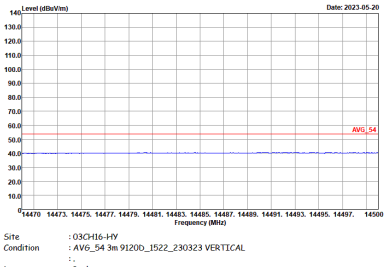
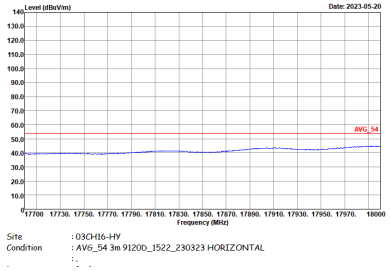
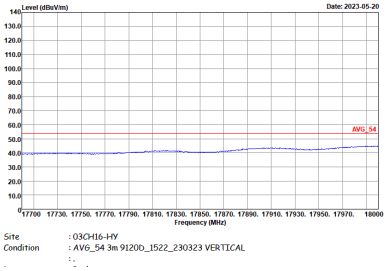
nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH00 2402MHz	
	Horizontal	Vertical
Peak Avg.		

nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH00 2402MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg		

nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH19 2440MHz	
	Horizontal	Vertical
Peak Avg.		

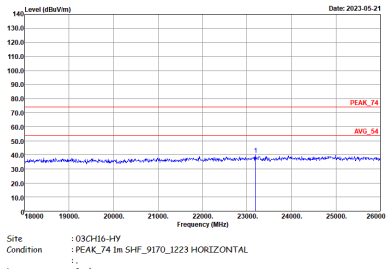
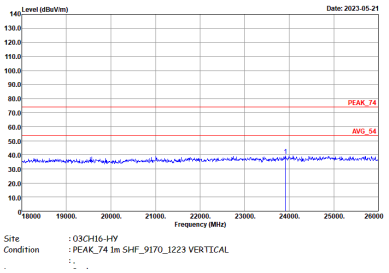
nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH19 2440MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg		

nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH38 2478MHz	
	Horizontal	Vertical
Peak		

nRF	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	nRF CH38 2478MHz	
	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg		

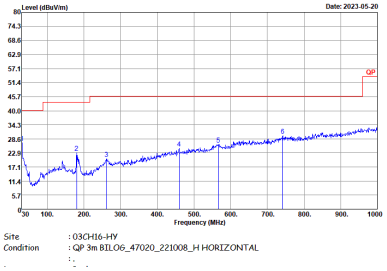
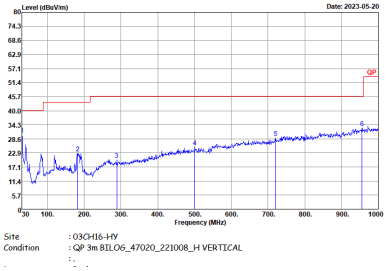
Emission above 18GHz

2.4GHz nRF (SHF @ 1m)

nRF	2.4GHz 2400~2483.5MHz	
	nRF SHF	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

2.4GHz nRF (LF)

nRF	2.4GHz 2400~2483.5MHz	
	nRF LF	
	Horizontal	Vertical
QP / Peak		

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Left_nRF	46.46	105	9.52	10kHz

Left_nRF