FCC Test Report

Report No.:	2405U45453EB
Applicant:	M5Stack Technology Co., Ltd
Address:	5F, Tangwei Stock Commercial BuildingYouli Road, Bao'an District, Shenzhen,Guangdong,China
Product Name:	M5AtomS3R
Product Model:	AtomS3R
Multiple Models:	AtomS3R Lite, AtomS3R Cam, AtomS3R Ext
Trade Mark:	M5STACK
FCC ID:	2AN3WM5ATOMS3R
Standards:	FCC CFR Title 47 Part 15C (§15.247)
Test Date:	2024-06-21to 2024-07-11
Test Result:	Complied
Report Date:	2024-07-12

Reviewed by: Abel chen

Abel Chen
Project Engineer

Approved by: Jacob Gong

Jacob Kong
Manager

Prepared by:

World Alliance Testing & Certification (Shenzhen) Co., Ltd

No. 1002, East Block, Laobing Building, Xingye Road 3012, Xixiang street, Bao'an District, Shenzhen, Guangdong, People's Republic of China

NVLAP TESTING NVLAP LAB CODE 600335-0

ilac-MRA

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Announcement

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2. The results in this report apply only to the sample tested.

3. This sample tested is in compliance with the limits of the above regulation.

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5. The information marked "#" is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

Revision History

Version No.	Issued Date	Description
00	*2024-07-12*	*Original*

Contents

1 General Information

1.1 Client Information

Applicant:	M5Stack Technology Co., Ltd
Address:	5F, Tangwei Stock Commercial Building Youli Road, Bao'an District, Shenzhen, Guangdong, China
Manufacturer:	M5Stack Technology Co., Ltd
Address:	5F, Tangwei Stock Commercial Building Youli Road, Bao'an District, Shenzhen, Guangdong, China

1.2 Product Description of EUT

The EUT is M5AtomS3R that contains BLE and 2.4G WLAN radios, this report covers the full testing of the BLE radio.

Sample Serial Number	2N9F-1, 2N9F-3, 2N9F-4, 2N9F-5 for CE & RE test, 2N9F-2 for RF test (assigned by WATC)
Sample Received Date	2024-06-20
Sample Status	Good Condition
Frequency Range	2402MHz - 2480MHz(BLE1M/2M)
Maximum Conducted Peak Output Power	8.71dBm
Modulation Technology	GFSK
Spatial Streams	SISO (1TX, 1RX)
Antenna Gain#	4.23dBi
Power Supply	DC 4.5~5.5V from type C port
Adapter Information	N/A
Modification	Sample No Modification by the test lab

1.3 Antenna information

15.203 requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Device Antenna information:	

The BLE antenna is an internal antenna which cannot replace by end-user, please see product internal photos for details.

1.4 Related Submittal(s)/Grant(s)

No related submittal(s)/Grant(s)

1.5 Measurement Uncertainty

Parameter		Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
AC Power Lines Conducted Emissions		±3.14dB
Emissions, Radiated	Below 30MHz	±2.78dB
	Below 1GHz	±4.84dB
	Above 1GHz	±5.44dB
Emissions, Conducted		1.75dB
Conducted Power		0.74dB
Frequency Error		150Hz
Bandwidth		0.34%
Power Spectral Density		0.74dB

Note: *The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

1.6 Laboratory Location

World Alliance Testing & Certification (Shenzhen) Co., Ltd

No. 1002, East Block, Laobing Building, Xingye Road 3012, Xixiang street, Bao'an District, Shenzhen, Guangdong, People's Republic of China

Tel: +86-755-29691511, Email: qa@watc.com.cn

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 463912, the FCC Designation No. : CN5040.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0160.

1.7 Test Methodology

FCC CFR 47 Part 2

FCC CFR 47 Part 15

KDB 558074 D01 DTS Meas Guidance v05r02

ANSI C63.10-2020

2 Description of Measurement

2.1 Test Configuration

Operating channels:					
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	19	2440	38	2478
1	2404	20	2442	39	2480
…	…	…	…	/	/
18	2438	…	…	/	/

According to ANSI C63.10-2020 chapter 5.6.1 Table 11 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

Lowest channel		Middle channel		Highest channel	
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	19	2440	39	2480

Test Mode:				
Transmitting mode:	Keep the EUT in continuous transmitting with modulation			
Exercise software#:	ESP_RF_Test_CN			
Mode	**Data rate**	**Power Level Setting#**		
		Low Channel	**Middle Channel**	**High Channel**
BLE 1M	1Mbps	11	11	11
BLE 2M	2Mbps	11	11	11
The exercise software and the maximum power setting that provided by manufacturer.				

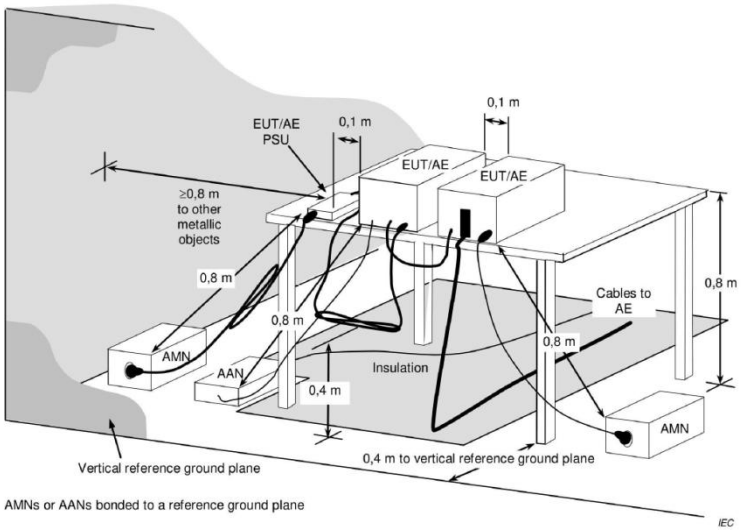
Worst-Case Configuration:
For radiated emissions, EUT was investigated in three orthogonal orientation, the worst-case orientation was recorded in report For AC power line conducted emission and radiated emission 9kHz-1GHz and above 18GHz were performed with the EUT transmits at the channel with highest output power as worst-case scenario. All the multiple models with same RF circuit, there are some difference for non-transmitter portions circuit between them, so the model AtomS3R was selected for full test, other models was checked the AC power line conducted emission and radiated emission of below 1GHz range.

2.2 Test Auxiliary Equipment

Manufacturer	Description	Model	Serial Number
MEIZU	adapter	unknown	unknown
unknown	USB cable	unknown	unknown
DELL	laptop	unknown	unknown

2.3 Test Setup

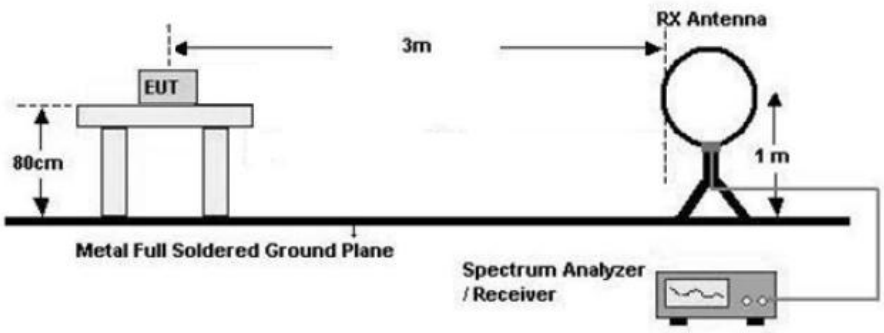
1) Conducted emission measurement:



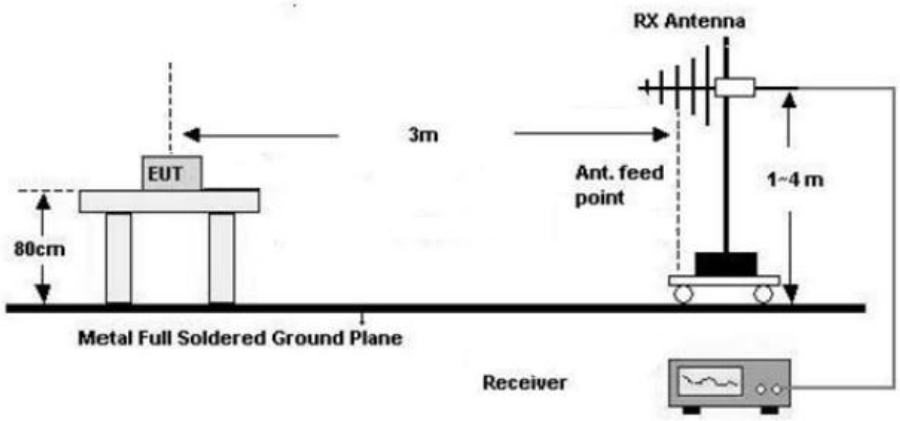
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

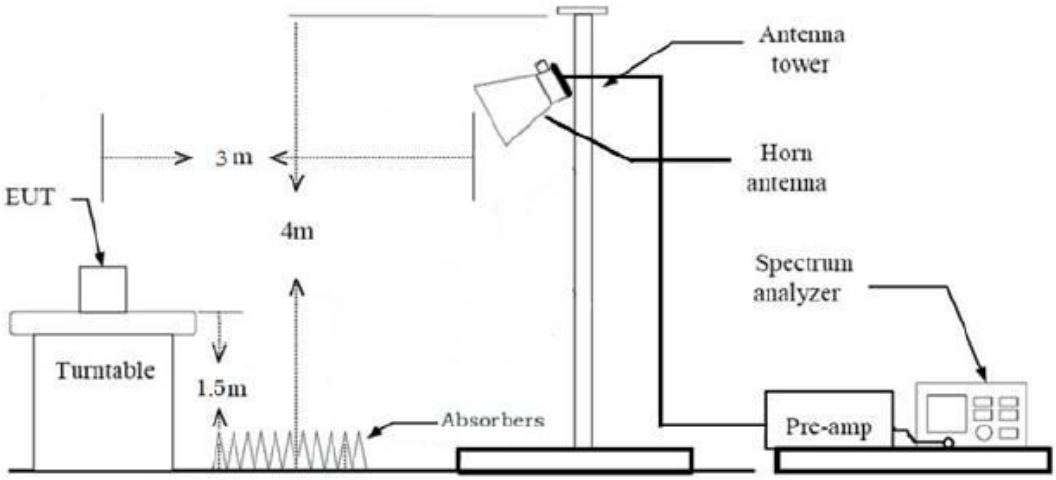
Below 30MHz (3m SAC)



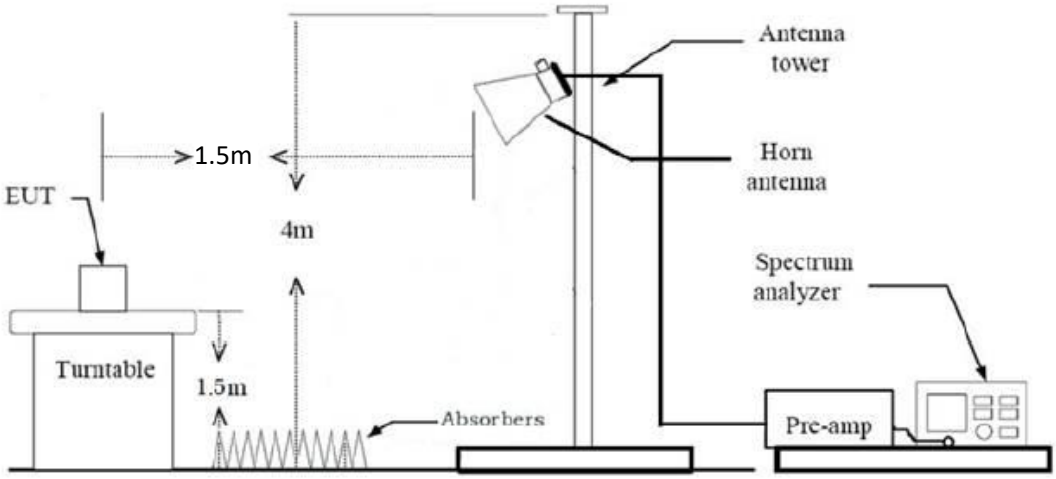
30MHz-1GHz (3m SAC)



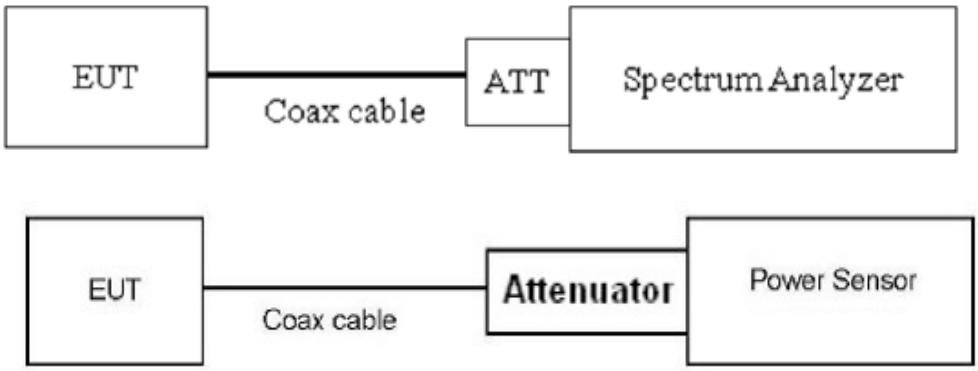
1GHz-18GHz(3m FAC)



Above 18GHz (3m FAC)



3) RF Conducted Test



or

2.4 Test Procedure

Conducted emission:

1. The E.U.T is placed on a non-conducting table 40cm from the vertical ground plane and 80cm above the horizontal ground plane (Please refer to the block diagram of the test setup and photographs).
2. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.
3. Line conducted data is recorded for both Line and Neutral

Radiated Emission Procedure:

a) For below 30MHz

1. All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz- 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).
2. Loop antenna use, investigation was done on the three antenna orientations (parallel, perpendicular, gound-parallel)

b) For 30MHz-1GHz:

1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m.
2. EUT works in each mode of operation that needs to be tested. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

c) For above 1GHz:

1. The EUT was placed on the tabletop of a rotating table 1.5 m the ground at a 3 m fully anechoic room. The measurement distance from the EUT to the receiving antenna is 3 m (1-18GHz) and 1.5 m (above 18GHz).
2. EUT works in each mode of operation that needs to be tested，and having the EUT continuously working. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.
3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.
4. Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

RF Conducted Test:

1. The antenna port of EUT was connected to the RF port of the test equipment (Power Meter or

Spectrum analyzer) through Attenuator and RF cable.

2. The cable assembly insertion loss of 6.5dB (including 6.0dB Attenuator and 0.5dB cable) was entered as an offset in the power meter. Note: Actual cable loss was unavailable at the time of testing, therefore a loss of 0.5dB was assumed as worst case. This was later verified to be true by laboratory. (if the RF cable provided by client, the cable loss declared by client)
3. The EUT is keeping in continuous transmission mode and tested in all modulation modes.

2.5 Measurement Method

Description of Test	Measurement Method
AC Line Conducted Emissions	ANSI C63.10-2020 Section 6.2
Maximum Conducted Output Power	ANSI C63.10-2020 Section 11.9.1.1
Power Spectral Density	ANSI C63.10-2020 Section 11.10.2
6 dB Emission Bandwidth	ANSI C63.10-2020 Section 11.8.1
99% Occupied Bandwidth	ANSI C63.10-2020 Section 6.9.3
100kHz Bandwidth of Frequency Band Edge	ANSI C63.10-2020 Section 6.10
Radiated emission	ANSI C63.10-2020 Section 11.11&11.12.1
Duty Cycle	ANSI C63.10-2020 Section 11.6

2.6 Measurement Equipment

Manufacturer	Description	Model	Management No.	Calibration Date	Calibration Due Date
AC Line Conducted Emission Test					
ROHDE& SCHWARZ	EMI TEST RECEIVER	ESR	101817	2024/6/4	2025/6/3
R&S	LISN	ENV216	101748	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.12	N/A	2024/6/4	2025/6/3
Farad	Test Software	EZ-EMC	Ver. EMEC-3A1	/	/
Radiated Emission Test					
R&S	EMI test receiver	ESR3	102758	2024/6/4	2025/6/3
ROHDE& SCHWARZ	SPECTRUM ANALYZER	FSV40-N	101608	2024/6/4	2025/6/3

SONOMA INSTRUMENT	Low frequency amplifier	310	186014	2024/6/4	2025/6/3
COM-POWER	preamplifier	PAM-118A	18040152	2024/6/4	2025/6/3
COM-POWER	Amplifier	PAM-840A	461306	2023/8/8	2024/8/7
BACL	Loop Antenna	1313-1A	4010611	2024/2/7	2027/2/6
SCHWARZBECK	Log - periodic wideband antenna	VULB 9163	9163-872	2023/7/7	2026/7/6
Astro Antenna Ltd	Horn antenna	AHA-118S	3015	2023/7/6	2026/7/5
Ducommun technologies	Horn Antenna	ARH-4223-02	1007726-03	2023/7/10	2026/7/9
Oulitong	Band Reject Filter	OBSF-2400-248 3.5-50N	OE02103119	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.9	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.14	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.15	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.16	N/A	2024/6/4	2025/6/3
N/A	Coaxial Cable	NO.17	N/A	2024/6/4	2025/6/3
Audix	Test Software	E3	191218 V9	/	/
RF Conducted Test					
ROHDE& SCHWARZ	SPECTRUM ANALYZER	FSU-26	200680/026	2024/6/4	2025/6/3
narda	6dB attenuator	603-06-1	N/A	2024/6/4	2025/6/3

Note: All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or International standards.

3 Test Results

3.1 Test Summary

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(e)	Power Spectral Density	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
-	99% Occupied Bandwidth	Report only
§15.247(d)	100kHz Bandwidth of Frequency Band Edge	Compliance
§15.205, §15.209, §15.247(d)	Radiated emission	Compliance
-	Duty Cycle	Report only

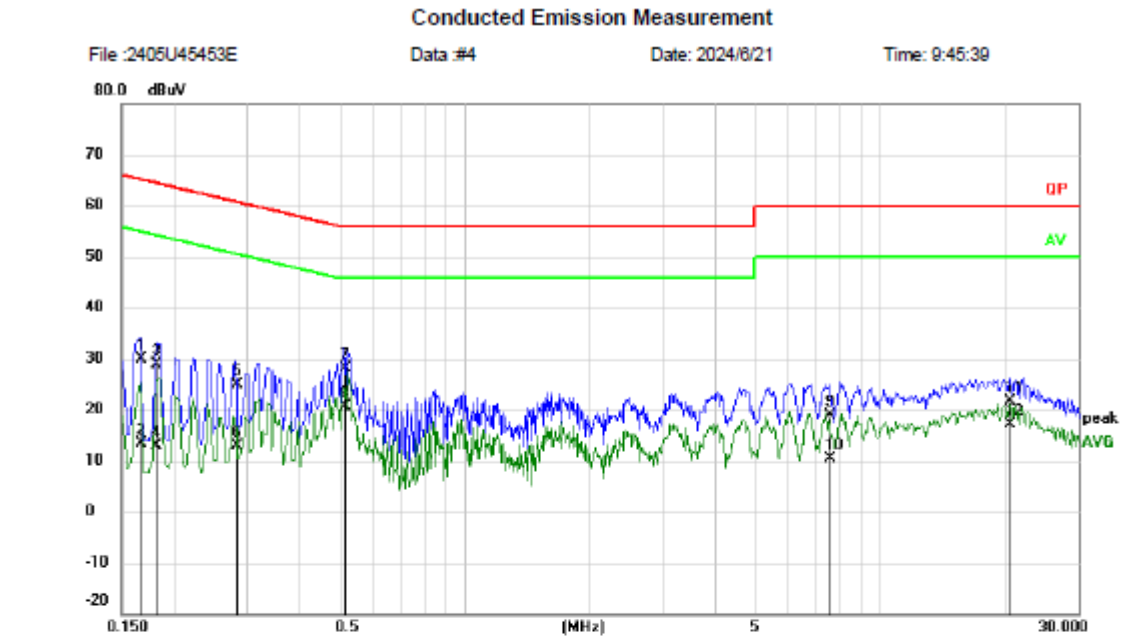
3.2 Limit

Test items	Limit
AC Line Conducted Emissions	See details §15.207 (a)
Conducted Output Power	For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.
6dB Emission Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz.
Power Spectral Density	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.
Spurious Emissions, 100kHz Bandwidth of Frequency Band Edge	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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

3.3 AC Line Conducted Emissions Test Data

Test Date:	2024-06-21	Test By:	Lirou Li
Environment condition:	Temperature: 22.8°C; Relative Humidity:59%; ATM Pressure: 100.9kPa		

Model: AtomS3R



Limit: QP
Mode:transmitting
Note: BLE

Phase: L1
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

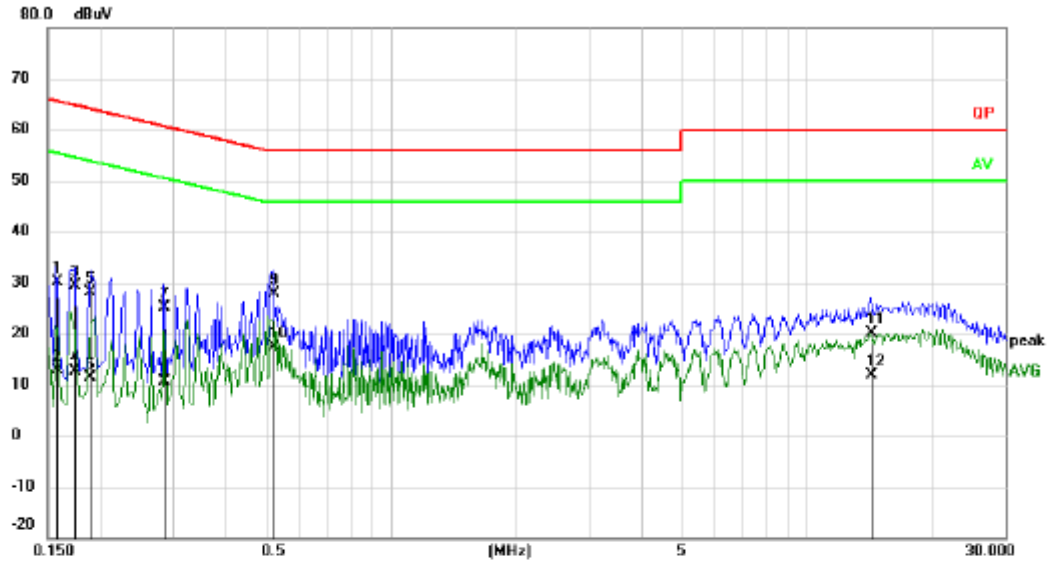
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	19.19	10.75	29.94	65.16	-35.22	QP	
2		0.1660	2.66	10.75	13.41	55.16	-41.75	AVG	
3		0.1819	18.09	10.68	28.77	64.40	-35.63	QP	
4		0.1819	2.27	10.68	12.95	54.40	-41.45	AVG	
5		0.2819	14.20	10.68	24.88	60.76	-35.88	QP	
6		0.2819	2.23	10.68	12.91	50.76	-37.85	AVG	
7		0.5180	17.34	10.82	28.16	56.00	-27.84	QP	
8	*	0.5180	9.86	10.82	20.68	46.00	-25.32	AVG	
9		7.5260	7.93	11.01	18.94	60.00	-41.06	QP	
10		7.5260	-0.59	11.01	10.42	50.00	-39.58	AVG	
11		20.5620	11.14	10.53	21.67	60.00	-38.33	QP	
12		20.5620	6.71	10.53	17.24	50.00	-32.76	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Conducted Emission Measurement

File :2405U45453E Data :#3 Date: 2024/6/21 Time: 9:37:05



Limit: QP
Mode:transmitting
Note: BLE

Phase: N
Power: DC 5V

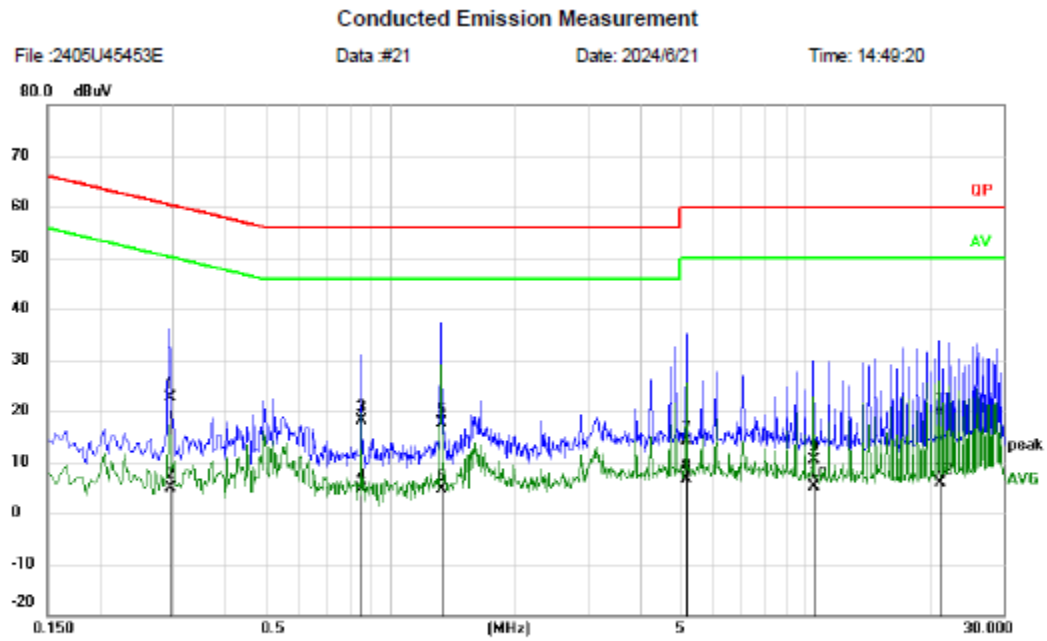
Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1580	19.59	10.58	30.17	65.57	-35.40	QP	
2		0.1580	2.23	10.58	12.81	55.57	-42.76	AVG	
3		0.1740	18.87	10.51	29.38	64.77	-35.39	QP	
4		0.1740	2.10	10.51	12.61	54.77	-42.16	AVG	
5		0.1900	17.73	10.45	28.18	64.04	-35.86	QP	
6		0.1900	0.97	10.45	11.42	54.04	-42.62	AVG	
7		0.2860	14.50	10.53	25.03	60.64	-35.61	QP	
8		0.2860	0.05	10.53	10.58	50.64	-40.06	AVG	
9	*	0.5220	17.27	10.70	27.97	56.00	-28.03	QP	
10		0.5220	6.56	10.70	17.26	46.00	-28.74	AVG	
11		14.2419	9.28	10.86	20.14	60.00	-39.86	QP	
12		14.2419	0.95	10.86	11.81	50.00	-38.19	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Model: AtomS3R Lite



Limit: QP
Mode:transmitting
Note: BLE

Phase: L1
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

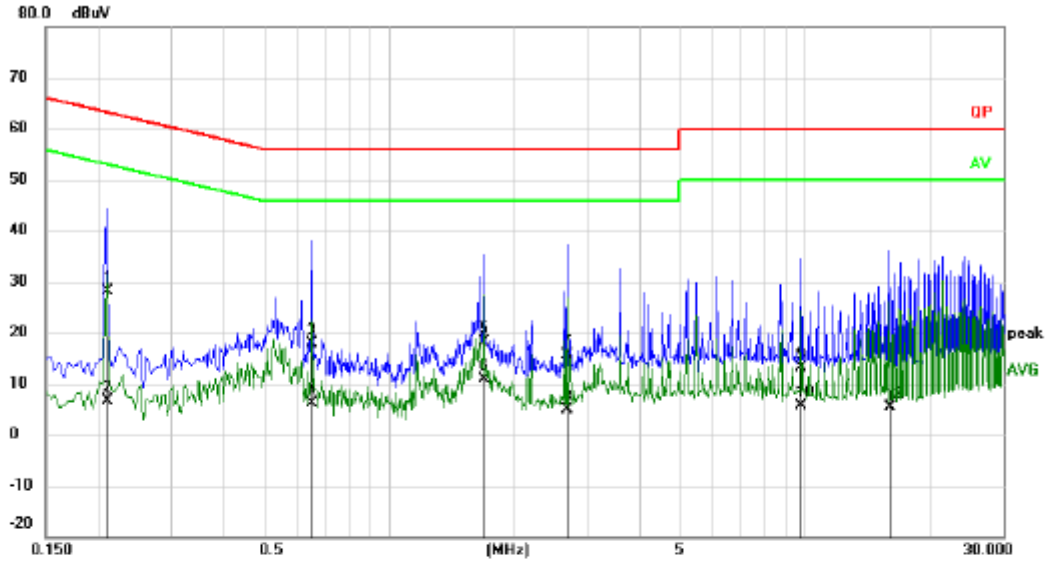
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2940	11.91	10.70	22.61	60.41	-37.80	QP	
2		0.2940	-5.90	10.70	4.80	50.41	-45.61	AVG	
3	*	0.8540	7.27	10.97	18.24	56.00	-37.76	QP	
4		0.8540	-6.37	10.97	4.60	46.00	-41.40	AVG	
5		1.3300	6.68	10.87	17.55	56.00	-38.45	QP	
6		1.3300	-6.34	10.87	4.53	46.00	-41.47	AVG	
7		5.1779	2.95	11.14	14.09	60.00	-45.91	QP	
8		5.1779	-4.62	11.14	6.52	50.00	-43.48	AVG	
9		10.4660	-0.04	10.43	10.39	60.00	-49.61	QP	
10		10.4660	-5.23	10.43	5.20	50.00	-44.80	AVG	
11		21.0980	9.15	10.52	19.67	60.00	-40.33	QP	
12		21.0980	-4.53	10.52	5.99	50.00	-44.01	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Conducted Emission Measurement

File :2405U45453E Data :#22 Date: 2024/6/21 Time: 13:56:08



Limit: QP
Mode:transmitting
Note: BLE

Phase: N
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.2100	17.68	10.42	28.10	63.21	-35.11	QP	
2		0.2100	-3.85	10.42	6.57	53.21	-46.64	AVG	
3		0.6540	7.37	10.60	17.97	56.00	-38.03	QP	
4		0.6540	-4.42	10.60	6.18	46.00	-39.82	AVG	
5		1.6900	7.47	10.68	18.15	56.00	-37.85	QP	
6		1.6900	0.13	10.68	10.81	46.00	-35.19	AVG	
7		2.6860	5.07	10.60	15.67	56.00	-40.33	QP	
8		2.6860	-5.83	10.60	4.77	46.00	-41.23	AVG	
9		9.7700	2.35	10.71	13.06	60.00	-46.94	QP	
10		9.7700	-5.07	10.71	5.64	50.00	-44.36	AVG	
11		16.0500	6.31	10.83	17.14	60.00	-42.86	QP	
12		16.0500	-5.40	10.83	5.43	50.00	-44.57	AVG	

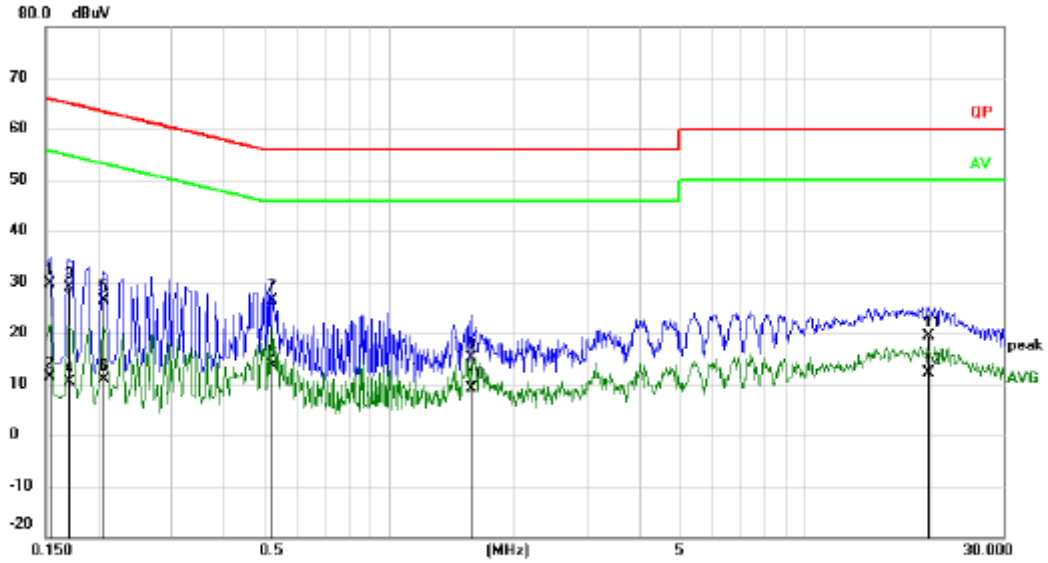
*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Model: AtomS3R Cam

Conducted Emission Measurement

File :2405U45453E Data :#9 Date: 2024/6/21 Time: 10:33:59



Limit: QP
Mode:transmitting
Note: BLE

Phase: L1
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

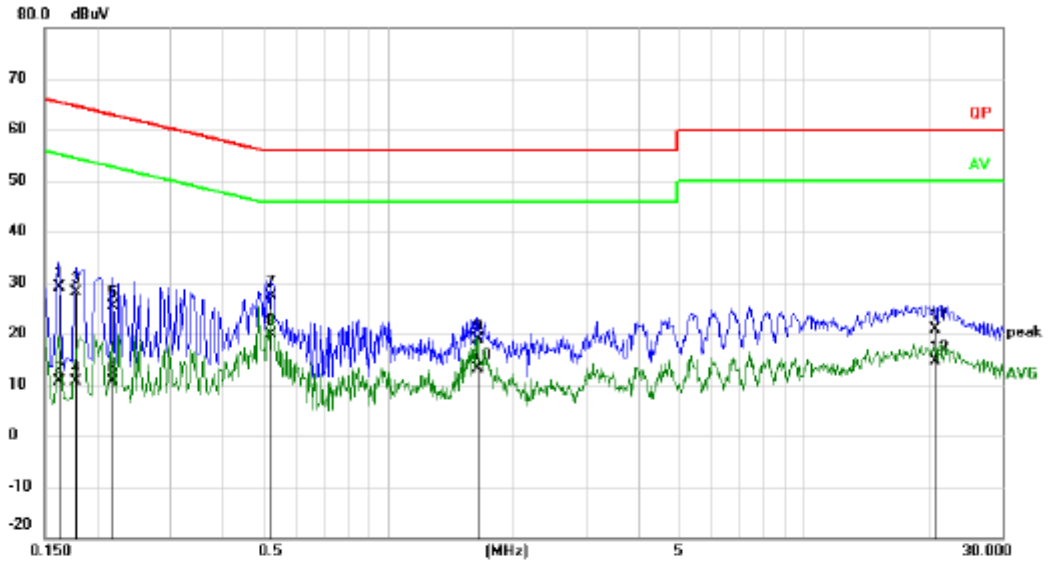
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1539	18.76	10.79	29.55	65.79	-36.24	QP	
2		0.1539	0.52	10.79	11.31	55.79	-44.48	AVG	
3		0.1700	18.11	10.73	28.84	64.96	-36.12	QP	
4		0.1700	-0.23	10.73	10.50	54.96	-44.46	AVG	
5		0.2060	15.69	10.61	26.30	63.37	-37.07	QP	
6		0.2060	0.34	10.61	10.95	53.37	-42.42	AVG	
7	*	0.5220	15.65	10.82	26.47	56.00	-29.53	QP	
8		0.5220	2.74	10.82	13.56	46.00	-32.44	AVG	
9		1.5780	4.29	10.73	15.02	56.00	-40.98	QP	
10		1.5780	-1.66	10.73	9.07	46.00	-36.93	AVG	
11		19.7658	8.76	10.55	19.31	60.00	-40.69	QP	
12		19.7658	1.47	10.55	12.02	50.00	-37.98	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Conducted Emission Measurement

File :2405U45453E Data :#10 Date: 2024/6/21 Time: 10:40:47



Limit: QP
Mode:transmitting
Note: BLE

Phase: N
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1620	18.50	10.56	29.06	65.36	-36.30	QP	
2		0.1620	0.19	10.56	10.75	55.36	-44.61	AVG	
3		0.1780	17.52	10.50	28.02	64.58	-36.56	QP	
4		0.1780	0.16	10.50	10.66	54.58	-43.92	AVG	
5		0.2180	14.84	10.44	25.28	62.89	-37.61	QP	
6		0.2180	0.18	10.44	10.62	52.89	-42.27	AVG	
7		0.5260	16.62	10.69	27.31	56.00	-28.69	QP	
8	*	0.5260	9.28	10.69	19.97	46.00	-26.03	AVG	
9		1.6380	8.26	10.68	18.94	56.00	-37.06	QP	
10		1.6380	2.48	10.68	13.16	46.00	-32.84	AVG	
11		20.6340	10.29	10.65	20.94	60.00	-39.06	QP	
12		20.6340	3.92	10.65	14.57	50.00	-35.43	AVG	

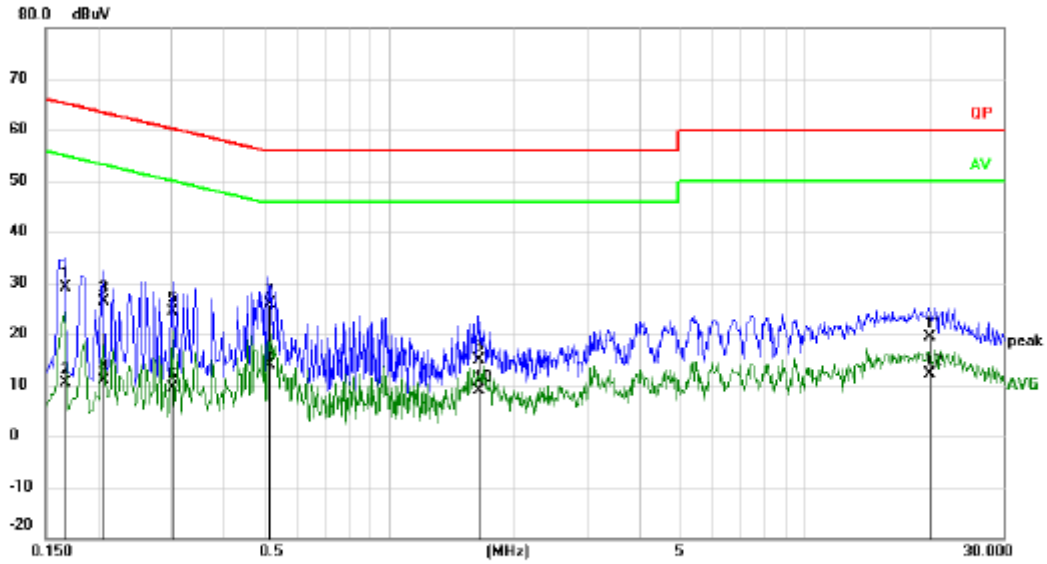
*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Model: AtomS3R Ext

Conducted Emission Measurement

File :2405U45453E Data :#16 Date: 2024/6/21 Time: 11:33:05



Limit: QP
Mode:transmitting
Note: BLE

Phase: L1
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

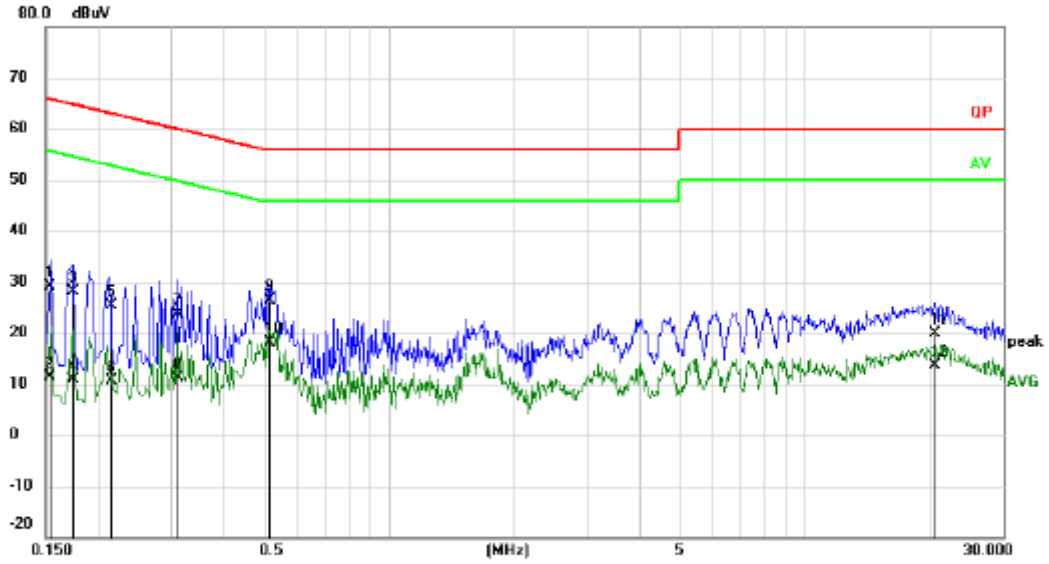
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1660	18.39	10.75	29.14	65.16	-36.02	QP	
2		0.1660	-0.28	10.75	10.47	55.16	-44.69	AVG	
3		0.2060	15.66	10.61	26.27	63.37	-37.10	QP	
4		0.2060	0.22	10.61	10.83	53.37	-42.54	AVG	
5		0.3020	13.60	10.71	24.31	60.19	-35.88	QP	
6		0.3020	-1.31	10.71	9.40	50.19	-40.79	AVG	
7	*	0.5180	14.94	10.82	25.76	56.00	-30.24	QP	
8		0.5180	3.13	10.82	13.95	46.00	-32.05	AVG	
9		1.6420	4.15	10.69	14.84	56.00	-41.16	QP	
10		1.6420	-1.73	10.69	8.96	46.00	-37.04	AVG	
11		19.8740	8.83	10.55	19.38	60.00	-40.62	QP	
12		19.8740	1.57	10.55	12.12	50.00	-37.88	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Conducted Emission Measurement

File :2405U45453E Data :#15 Date: 2024/6/21 Time: 11:24:25



Limit: QP
Mode:transmitting
Note: BLE

Phase: N
Power: DC 5V

Temperature: 22.8 ℃
Humidity: 59 %
Air Pressure: 1009 hpa

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over Limit		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1539	18.60	10.59	29.19	65.79	-36.60	QP	
2		0.1539	0.80	10.59	11.39	55.79	-44.40	AVG	
3		0.1740	17.73	10.51	28.24	64.77	-36.53	QP	
4		0.1740	0.46	10.51	10.97	54.77	-43.80	AVG	
5		0.2140	15.06	10.42	25.48	63.05	-37.57	QP	
6		0.2140	0.15	10.42	10.57	53.05	-42.48	AVG	
7		0.3100	13.17	10.55	23.72	59.97	-36.25	QP	
8		0.3100	0.57	10.55	11.12	49.97	-38.85	AVG	
9		0.5180	15.58	10.70	26.28	56.00	-29.72	QP	
10	*	0.5180	7.40	10.70	18.10	46.00	-27.90	AVG	
11		20.4619	9.18	10.65	19.83	60.00	-40.17	QP	
12		20.4619	2.92	10.65	13.57	50.00	-36.43	AVG	

*:Maximum data x:Over limit !:over margin

Engineer Signature: Lirou

Remark:

Measurement (dBuV)= Reading Level (dBuV) + Correct Factor(dB)

Correct Factor(dB)= LISN Voltage Division Factor (dB)+ Cable loss(dB)

Over Limit = Measurement – Limit

3.4 Radiated emission Test Data

9 kHz-30MHz:

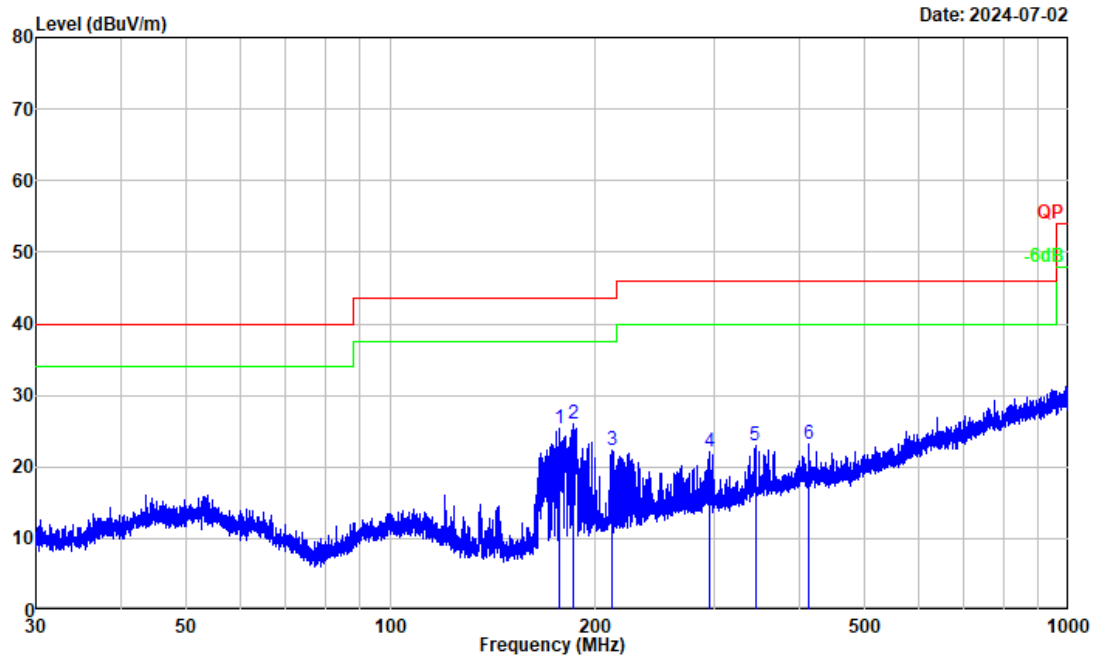
Test Date:	2024-07-02	**Test By:**	Luke Li
Environment condition:	Temperature: 23.4°C; Relative Humidity:65%; ATM Pressure: 99.9kPa		

For radiated emissions below 30MHz, there were no emissions found within 20dB of limit.

30MHz-1GHz:

Test Date:	2024-07-02	**Test By:**	Luke Li
Environment condition:	Temperature: 23.4°C; Relative Humidity:65%; ATM Pressure: 99.9kPa		

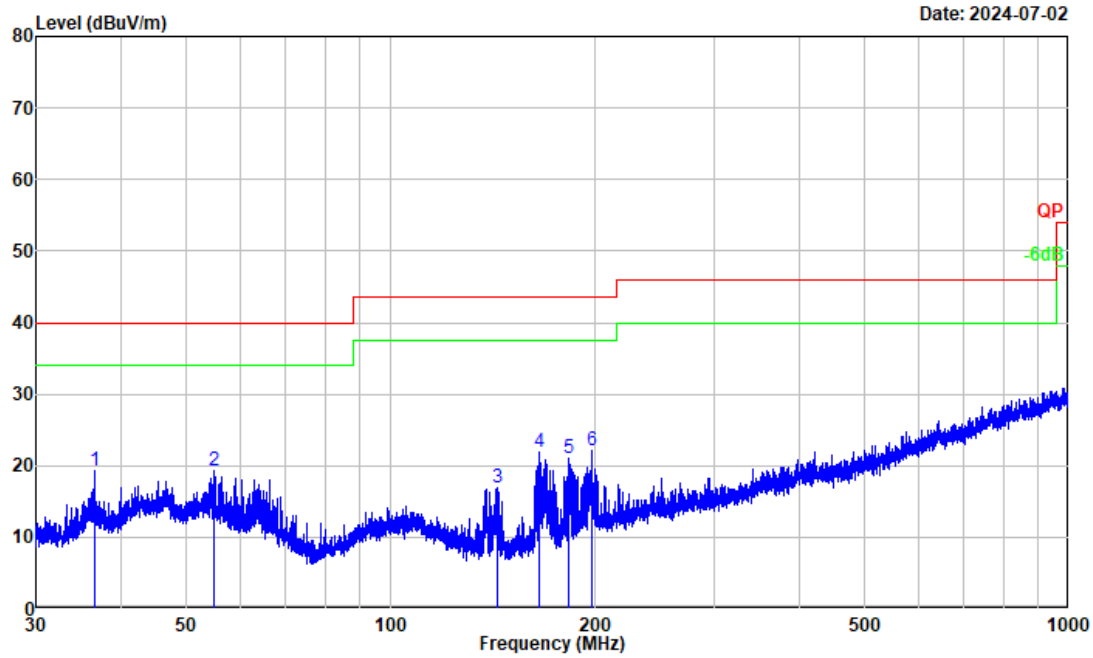
Model: AtomS3R



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 23.4℃/65%R.H./99.9kPa
Tested by : Luke Li
Polarization : horizontal
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	177.238	40.80	-15.36	25.44	43.50	-18.06	Peak
2	186.238	40.55	-14.45	26.10	43.50	-17.40	Peak
3	212.042	35.48	-13.14	22.34	43.50	-21.16	Peak
4	295.361	32.58	-10.53	22.05	46.00	-23.95	Peak
5	344.944	31.77	-8.71	23.06	46.00	-22.94	Peak
6	414.132	30.45	-7.18	23.27	46.00	-22.73	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain



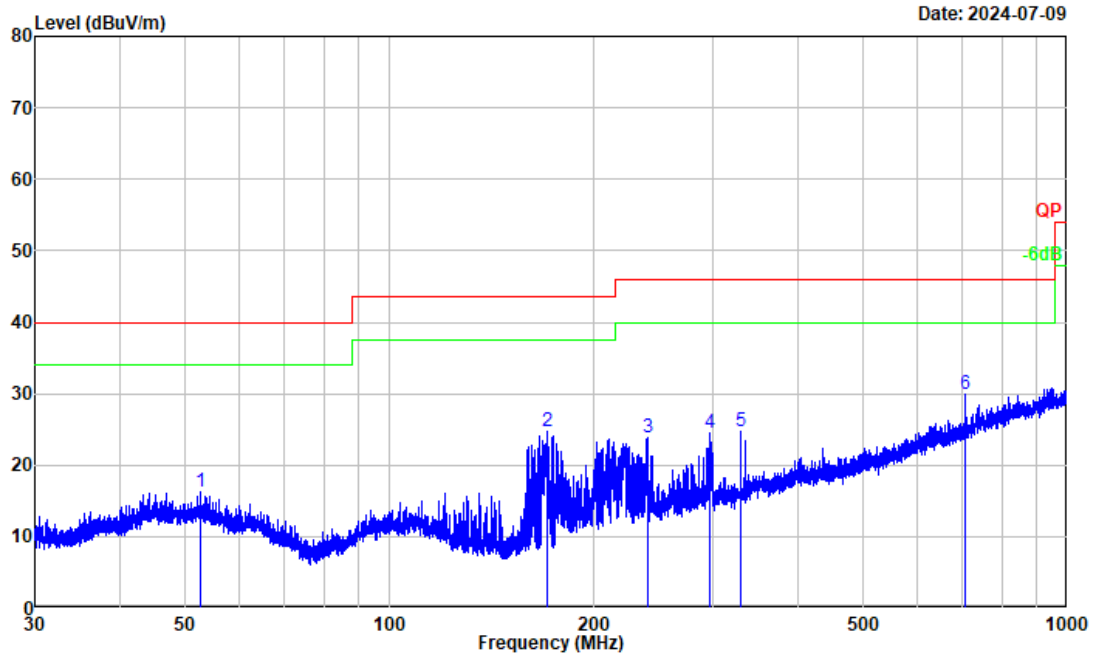
Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 23.4℃/65%R.H./99.9kPa
Tested by : Luke Li
Polarization : vertical
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	36.671	33.76	-14.49	19.27	40.00	-20.73	Peak
2	55.007	31.96	-12.62	19.34	40.00	-20.66	Peak
3	143.858	34.05	-17.13	16.92	43.50	-26.58	Peak
4	165.813	38.10	-16.12	21.98	43.50	-21.52	Peak
5	183.001	35.89	-14.82	21.07	43.50	-22.43	Peak
6	197.940	35.39	-13.27	22.12	43.50	-21.38	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

Test Date:	2024-07-09	Test By:	Luke Li
Environment condition:	Temperature: 22.8°C; Relative Humidity:64%; ATM Pressure: 100.1kPa		

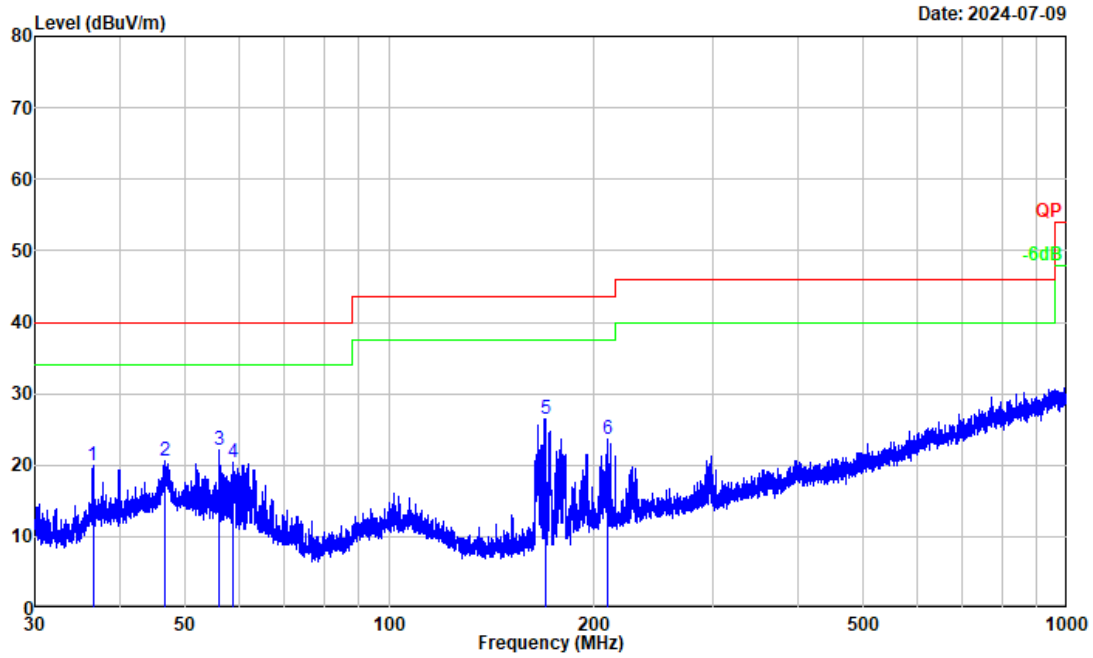
Model: AtomS3R Lite



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : horizontal
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	52.671	28.46	-12.17	16.29	40.00	-23.71	Peak
2	171.280	40.59	-15.82	24.77	43.50	-18.73	Peak
3	241.210	35.66	-11.92	23.74	46.00	-22.26	Peak
4	297.570	34.91	-10.48	24.43	46.00	-21.57	Peak
5	329.571	34.21	-9.40	24.81	46.00	-21.19	Peak
6	706.669	31.75	-1.88	29.87	46.00	-16.13	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

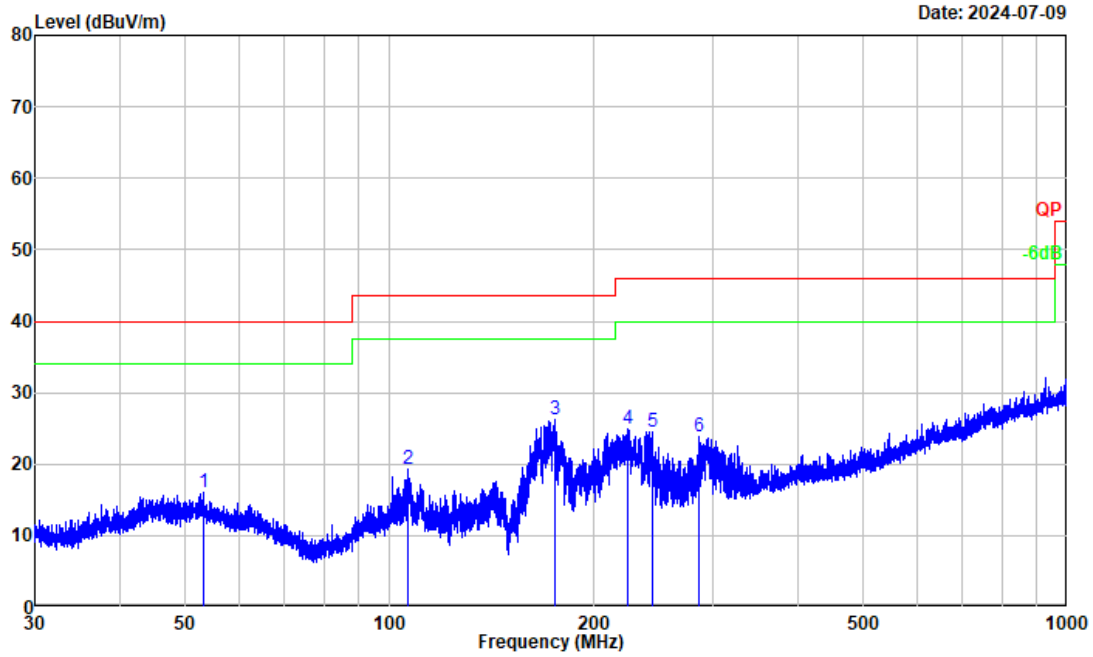


Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : vertical
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	36.542	34.48	-14.54	19.94	40.00	-20.06	Peak
2	46.669	32.85	-12.22	20.63	40.00	-19.37	Peak
3	56.103	35.05	-12.84	22.21	40.00	-17.79	Peak
4	58.849	33.82	-13.47	20.35	40.00	-19.65	Peak
5	170.083	42.40	-15.86	26.54	43.50	-16.96	Peak
6	209.547	36.73	-13.17	23.56	43.50	-19.94	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

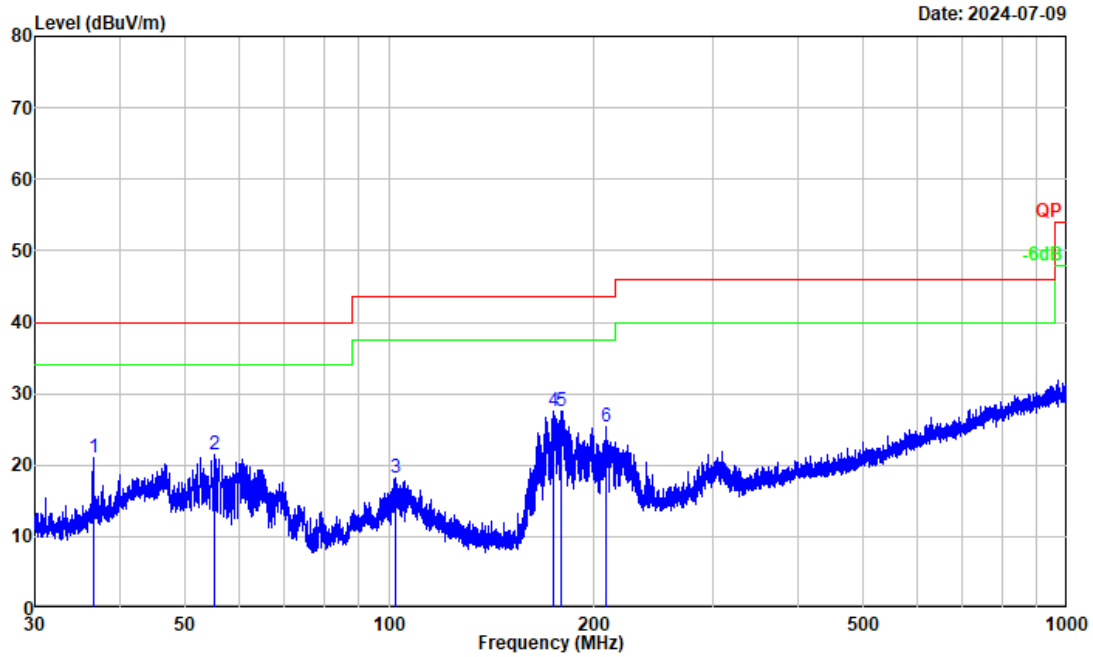
Model: AtomS3R Cam



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : horizontal
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	53.158	28.35	-12.21	16.14	40.00	-23.86	Peak
2	106.542	32.72	-13.51	19.21	43.50	-24.29	Peak
3	175.537	41.65	-15.51	26.14	43.50	-17.36	Peak
4	225.069	37.55	-12.60	24.95	46.00	-21.05	Peak
5	244.082	36.37	-11.82	24.55	46.00	-21.45	Peak
6	285.557	34.64	-10.79	23.85	46.00	-22.15	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

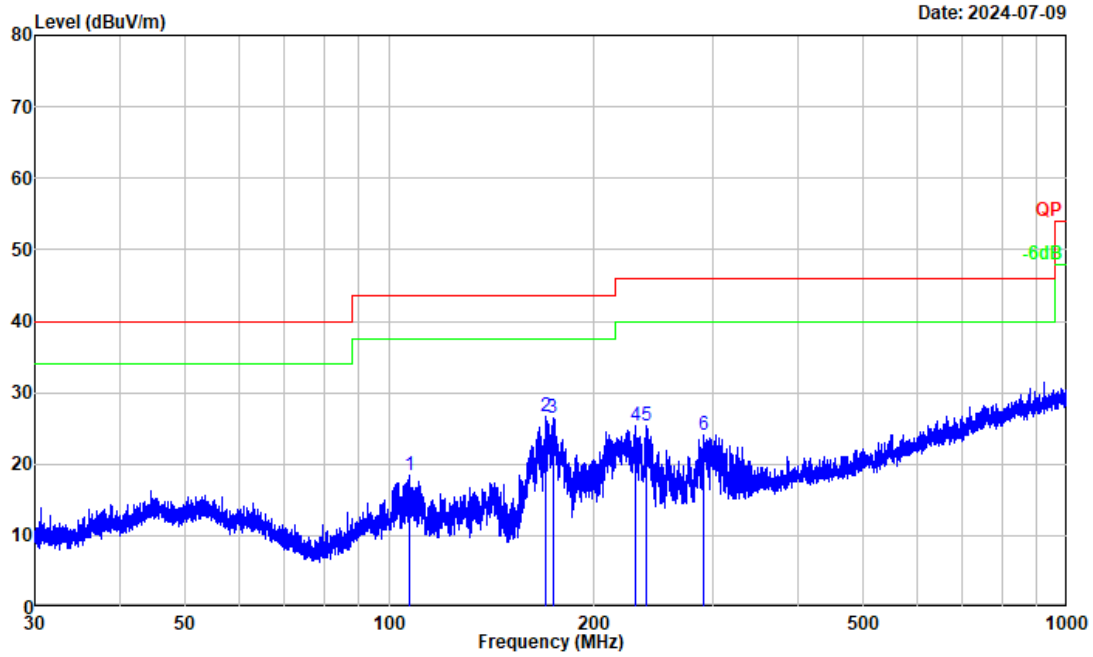


Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : vertical
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	36.574	35.50	-14.53	20.97	40.00	-19.03	Peak
2	55.249	34.06	-12.67	21.39	40.00	-18.61	Peak
3	102.241	31.83	-13.67	18.16	43.50	-25.34	Peak
4	174.922	43.00	-15.52	27.48	43.50	-16.02	Peak
5	178.877	42.77	-15.18	27.59	43.50	-15.91	Peak
6	208.631	38.41	-13.15	25.26	43.50	-18.24	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

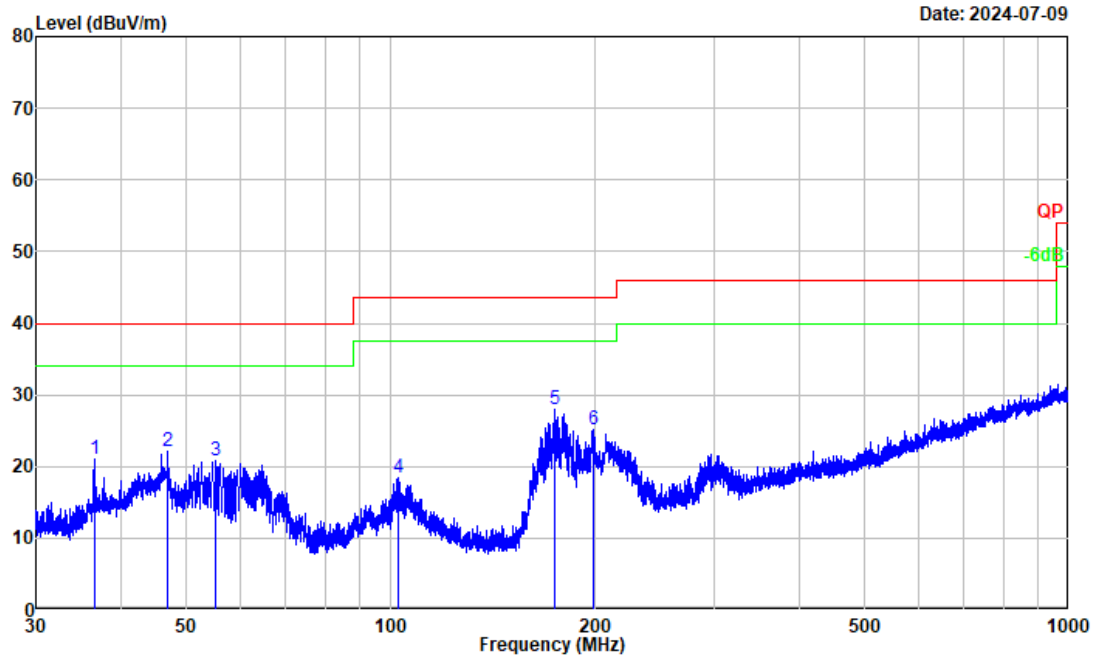
Model: AtomS3R Ext



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : horizontal
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	107.057	31.99	-13.54	18.45	43.50	-25.05	Peak
2	170.157	42.51	-15.86	26.65	43.50	-16.85	Peak
3	174.157	42.13	-15.60	26.53	43.50	-16.97	Peak
4	230.258	37.72	-12.30	25.42	46.00	-20.58	Peak
5	239.945	37.28	-11.98	25.30	46.00	-20.70	Peak
6	290.864	34.62	-10.64	23.98	46.00	-22.02	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/64%R.H./100.1kPa
Tested by : Luke Li
Polarization : vertical
Remark : BLE

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	36.558	35.58	-14.54	21.04	40.00	-18.96	Peak
2	46.853	34.29	-12.21	22.08	40.00	-17.92	Peak
3	55.346	33.55	-12.69	20.86	40.00	-19.14	Peak
4	102.600	32.14	-13.67	18.47	43.50	-25.03	Peak
5	174.922	43.41	-15.52	27.89	43.50	-15.61	Peak
6	198.635	38.44	-13.21	25.23	43.50	-18.27	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

Remark:

Result = Reading + Factor

Factor = Antenna factor + Cable loss – Amplifier gain

Over Limit = Result – Limit

Above 1GHz:

Test Date:	2024-07-04	Test By:	Bard Huang
Environment condition:	Temperature: 22.8°C; Relative Humidity:63%; ATM Pressure: 100.5kPa		

Frequency (MHz)	Reading level (dBμV)	Polar	Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark
BLE 1M							
Low Channel							
2390.000	38.76	horizontal	7.18	45.94	54.00	-8.06	Average
2390.000	47.79	horizontal	7.18	54.97	74.00	-19.03	Peak
2390.000	38.87	vertical	7.18	46.05	54.00	-7.95	Average
2390.000	47.48	vertical	7.18	54.66	74.00	-19.34	Peak
4804.000	50.05	horizontal	-0.21	49.84	74.00	-24.16	Peak
4804.000	47.96	vertical	-0.21	47.75	74.00	-26.25	Peak
Middle Channel							
4880.000	49.84	horizontal	0.08	49.92	74.00	-24.08	Peak
4880.000	50.01	vertical	0.08	50.09	74.00	-23.91	Peak
High Channel							
2483.500	38.15	horizontal	7.25	45.40	54.00	-8.60	Average
2483.500	49.06	horizontal	7.25	56.31	74.00	-17.69	Peak
2483.500	38.45	vertical	7.25	45.70	54.00	-8.30	Average
2483.500	48.59	vertical	7.25	55.84	74.00	-18.16	Peak
4960.000	50.76	horizontal	0.28	51.04	74.00	-22.96	Peak
4960.000	49.41	vertical	0.28	49.69	74.00	-24.31	Peak
BLE 2M							
Low Channel							
2390.000	38.97	horizontal	7.18	46.15	54.00	-7.85	Average
2390.000	47.99	horizontal	7.18	55.17	74.00	-18.83	Peak
2390.000	38.91	vertical	7.18	46.09	54.00	-7.91	Average
2390.000	48.38	vertical	7.18	55.56	74.00	-18.44	Peak
4804.000	49.57	horizontal	-0.21	49.36	74.00	-24.64	Peak
4804.000	49.16	vertical	-0.21	48.95	74.00	-25.05	Peak
Middle Channel							
4880.000	49.69	horizontal	0.08	49.77	74.00	-24.23	Peak
4880.000	48.55	vertical	0.08	48.63	74.00	-25.37	Peak
High Channel							
2483.500	39.77	horizontal	7.25	47.02	54.00	-6.98	Average

2483.500	49.01	horizontal	7.25	56.26	74.00	-17.74	Peak
2483.500	38.85	vertical	7.25	46.10	54.00	-7.90	Average
2483.500	48.61	vertical	7.25	55.86	74.00	-18.14	Peak
4960.000	50.97	horizontal	0.28	51.25	74.00	-22.75	Peak
4960.000	49.48	vertical	0.28	49.76	74.00	-24.24	Peak

Remark:

Corrected Amplitude= Reading level + corrected Factor

Corrected Factor = Antenna factor + Cable loss – Amplifier gain

Margin = Corrected Amplitude – Limit

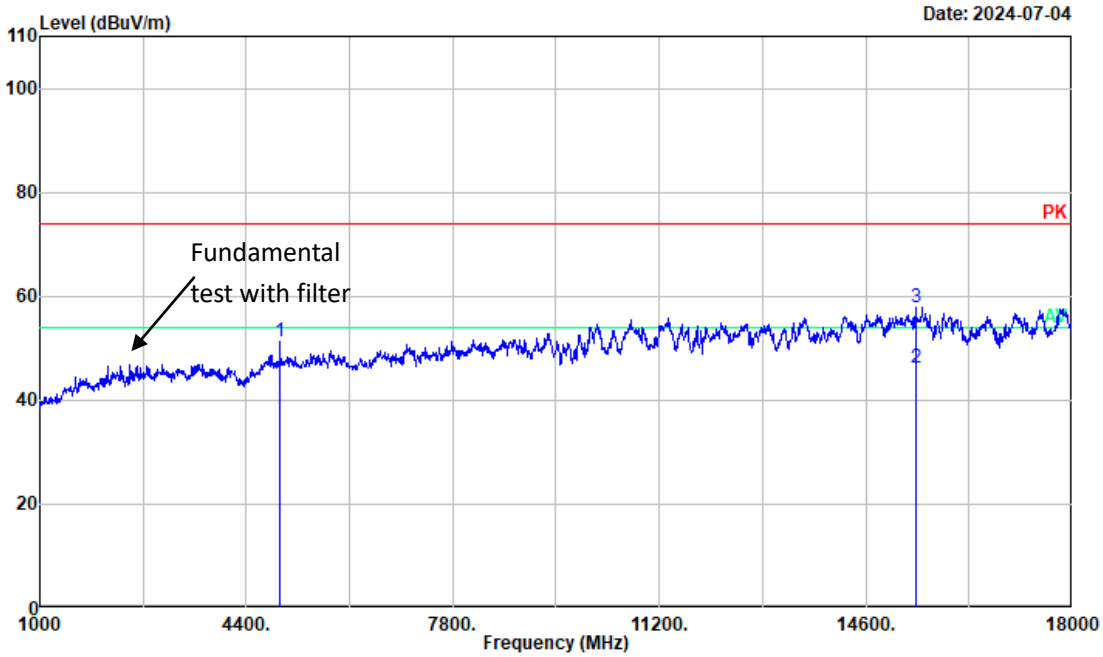
For the test result of Peak below the Peak limit more than 20dB, which can compliance with the average limit, just the Peak level was recorded.

The emission levels of other frequencies that were lower than the limit 20dB, not show in test report.

For emissions in 18GHz-25GHz range, all emissions were investigated and in the noise floor level.

Test plot for example as below:

Mode:	BLE 2M	Channel:	2480MHz

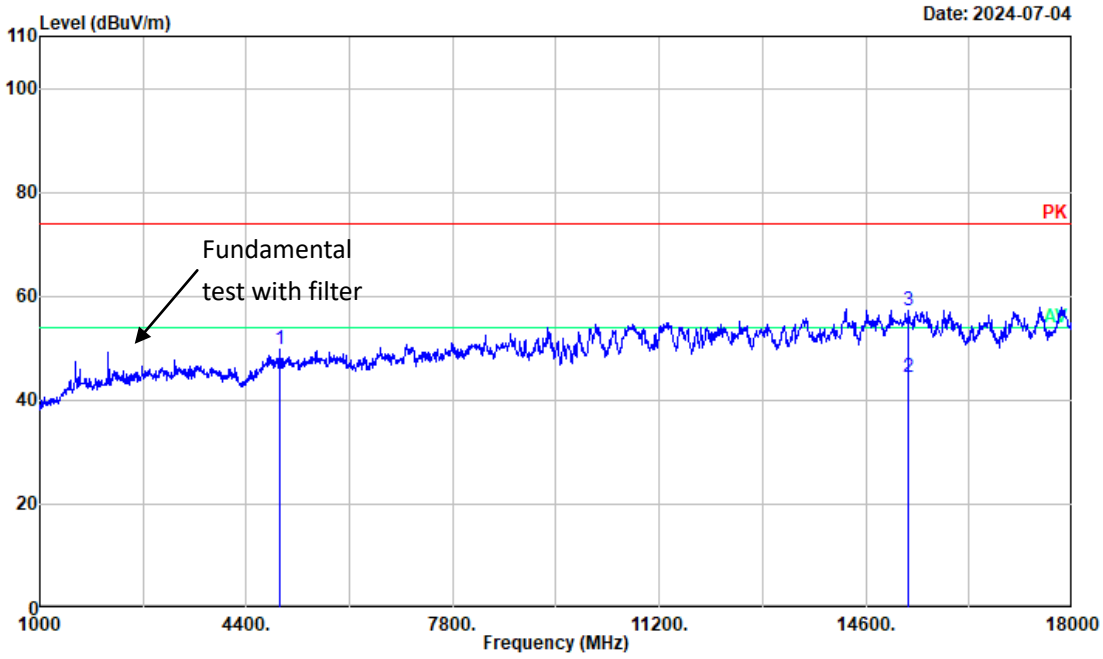


Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/63%R.H./100.5kPa
Tested by : Bard Huang
Polarization : horizontal
Remark : BLE 2M high channel

--No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Over Limit (dB)	Detector
1	4960.000	50.97	0.28	51.25	74.00	-22.75	Peak
2	15423.210	36.79	9.37	46.16	54.00	-7.84	Average
3	15423.210	48.35	9.37	57.72	74.00	-16.28	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

Mode:	BLE 2M	Channel:	2480MHz



Project No. : 2405U45453E
Test Mode : Transmitting
Test Voltage : DC 5V
Environment : 22.8℃/63%R.H./100.5kPa
Tested by : Bard Huang
Polarization : vertical
Remark : BLE 2M high channel

--No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)	Detector
1	4960.000	49.48	0.28	49.76	74.00	-24.24	Peak
2	15304.150	35.63	8.79	44.42	54.00	-9.58	Average
3	15304.150	48.54	8.79	57.33	74.00	-16.67	Peak

Remarks: Factor = Antenna factor + Cable loss - Preamp gain

3.5 RF Conducted Test Data

Test Date:	2024-07-11	Test By:	Ryan Zhang
Environment condition:	Temperature: 23.4°C; Relative Humidity:66%; ATM Pressure: 100.8kPa		

3.5.1 6dB Emission Bandwidth

BLE 1M

Mode	Value (MHz)	Limit (MHz)	Result
Low	0.689	0.5	Pass
Middle	0.689	0.5	Pass
High	0.689	0.5	Pass

BLE 2M

Mode	Value (MHz)	Limit (MHz)	Result
Low	1.349	0.5	Pass
Middle	1.349	0.5	Pass
High	1.349	0.5	Pass

3.5.2 99% Occupied Bandwidth

BLE 1M

Mode	99% OBW (MHz)
Low	1.032
Middle	1.032
High	1.026

BLE 2M

Mode	99% OBW (MHz)
Low	2.034
Middle	2.028
High	2.028

3.5.3 Maximum Conducted Output Power

BLE 1M

Mode	Value (dBm)	Limit (dBm)	Result
Low	8.36	30.00	Pass
Middle	8.71	30.00	Pass
High	8.60	30.00	Pass

BLE 2M

Mode	Value (dBm)	Limit (dBm)	Result
Low	8.27	30.00	Pass
Middle	8.61	30.00	Pass
High	8.47	30.00	Pass

3.5.4 100 kHz Bandwidth of Frequency Band Edge

BLE 1M

Mode	Value (dB)	Limit (dB)	Result
Low	55.41	20.00	Pass
High	57.22	20.00	Pass

BLE 2M

Mode	Value (dB)	Limit (dB)	Result
Low	44.21	20.00	Pass
High	55.03	20.00	Pass

3.5.5 Power Spectral Density

BLE 1M

Mode	Value (dBm/3kHz)	Limit (dBm/3kHz)	Result
Low	-9.08	8.00	Pass
Middle	-8.69	8.00	Pass
High	-7.30	8.00	Pass

BLE 2M

Mode	Value (dBm/3kHz)	Limit (dBm/3kHz)	Result
Low	-14.33	8.00	Pass
Middle	-13.83	8.00	Pass
High	-14.07	8.00	Pass

3.5.6 Duty Cycle

BLE 1M

Mode	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T (Hz)	VBW Setting (kHz)
Low	100.000	100.000	100.00	NA	NA	0.010
Middle	100.000	100.000	100.00	NA	NA	0.010
High	100.000	100.000	100.00	NA	NA	0.010

BLE 2M

Mode	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T (Hz)	VBW Setting (kHz)
Low	100.000	100.000	100.00	NA	NA	0.010
Middle	100.000	100.000	100.00	NA	NA	0.010
High	100.000	100.000	100.00	NA	NA	0.010

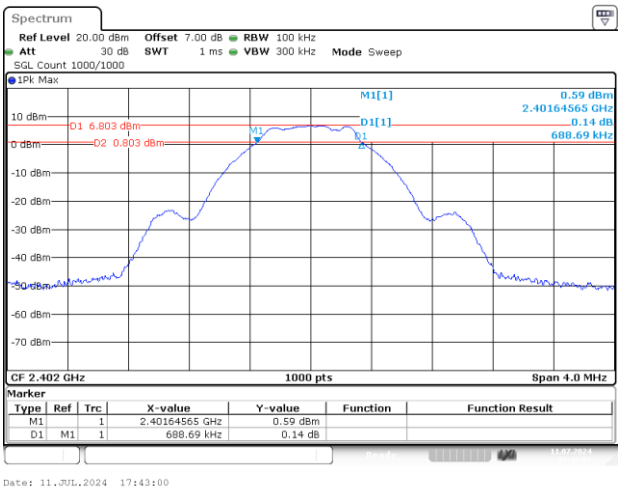
Duty Cycle = Ton/(Ton+Toff)*100%

Test Plots:

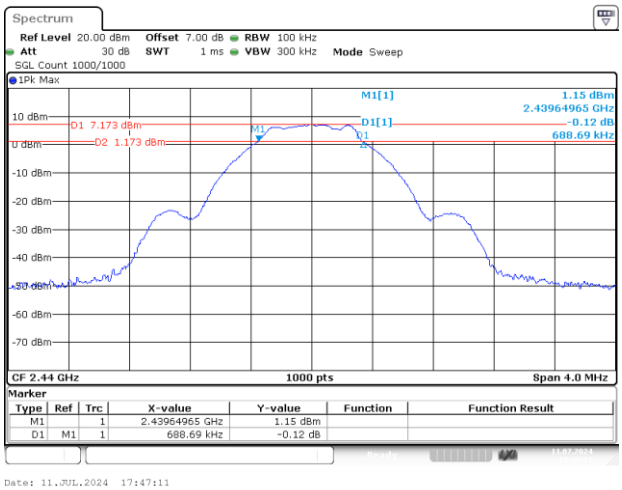
6dB Emission Bandwidth

BLE 1M

Low 0.689MHz

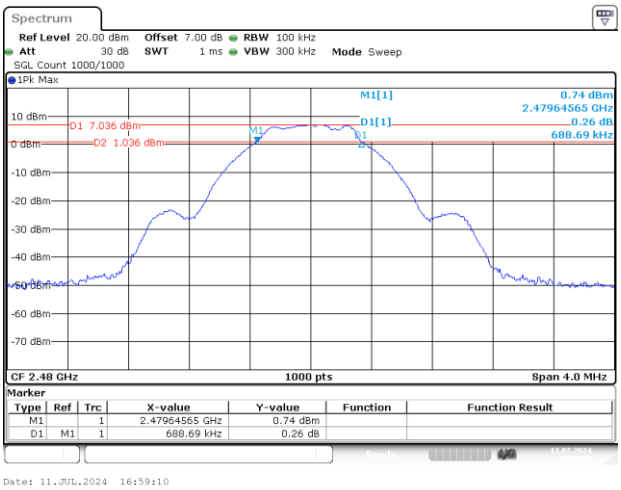


Middle 0.689MHz

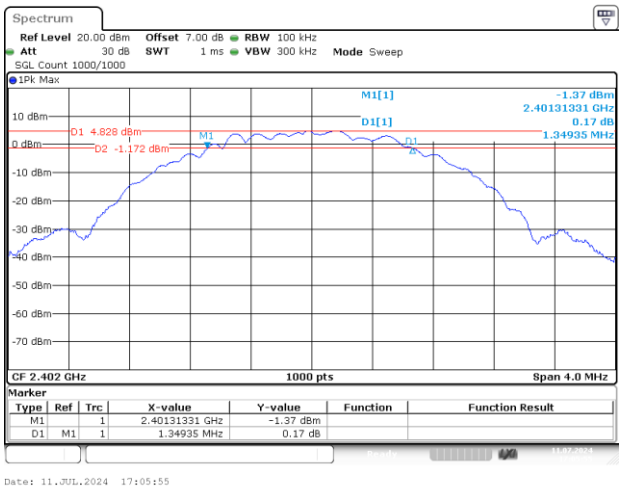


BLE 2M

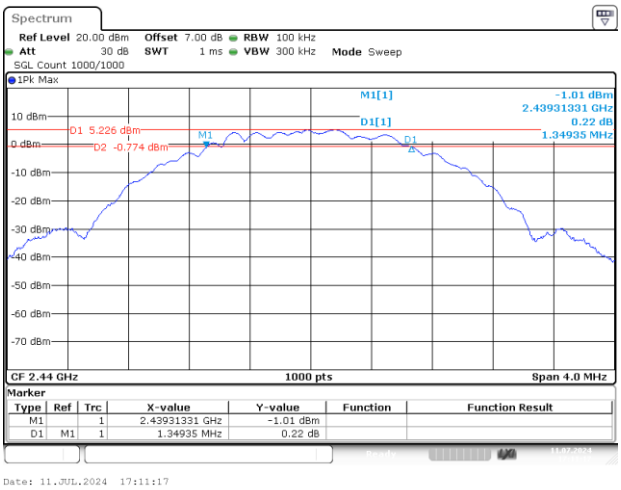
High 0.689MHz



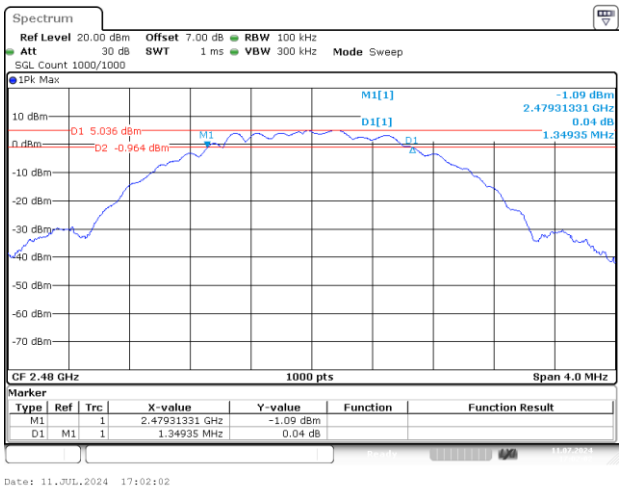
Low 1.349MHz



Middle 1.349MHz



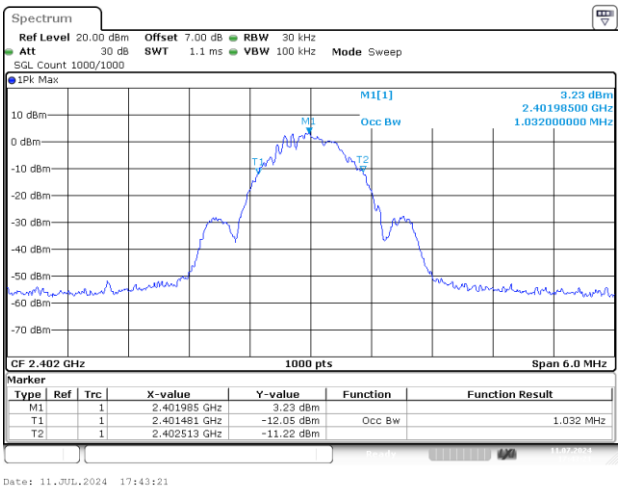
High 1.349MHz



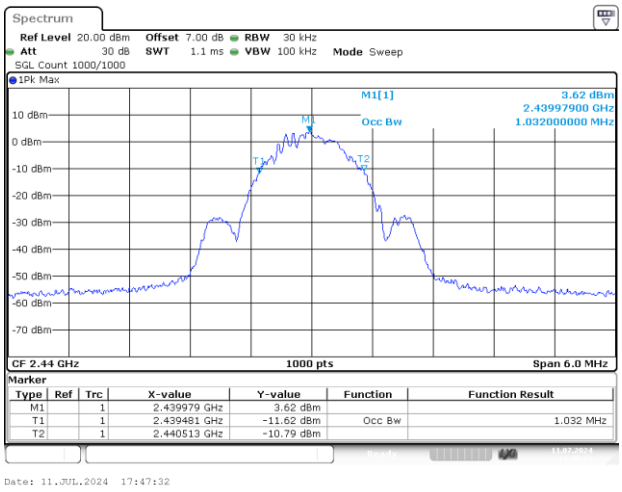
99% Occupied Bandwidth

BLE 1M

Low 1.032MHz

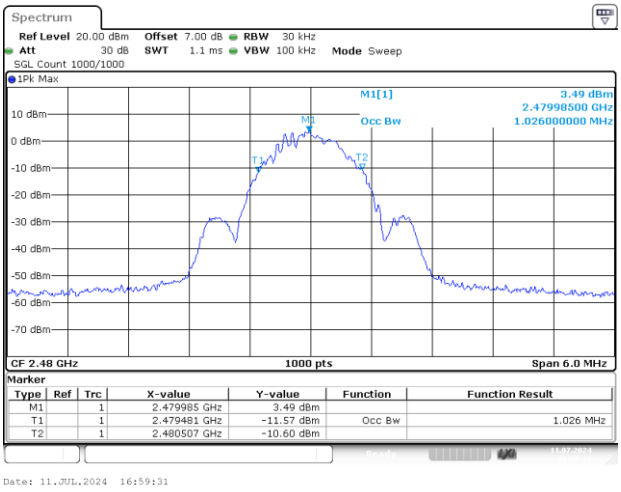


Middle 1.032MHz

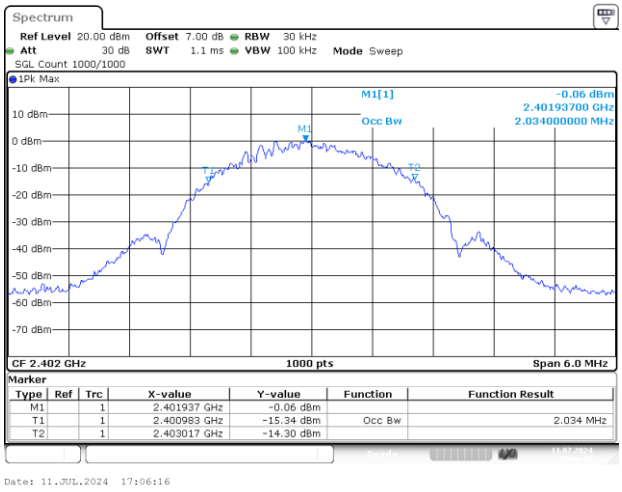


BLE 2M

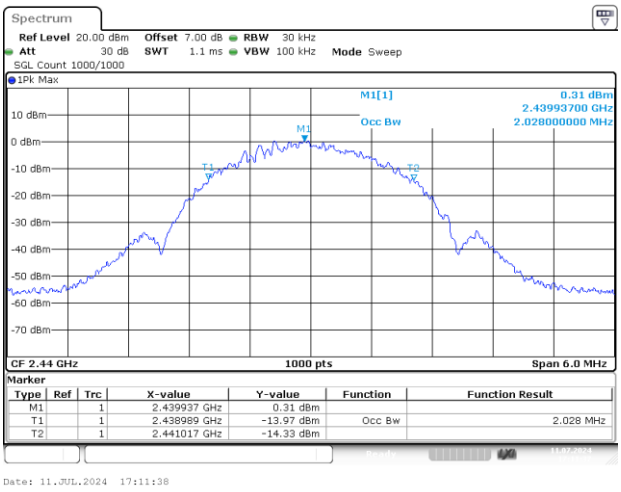
High 1.026MHz



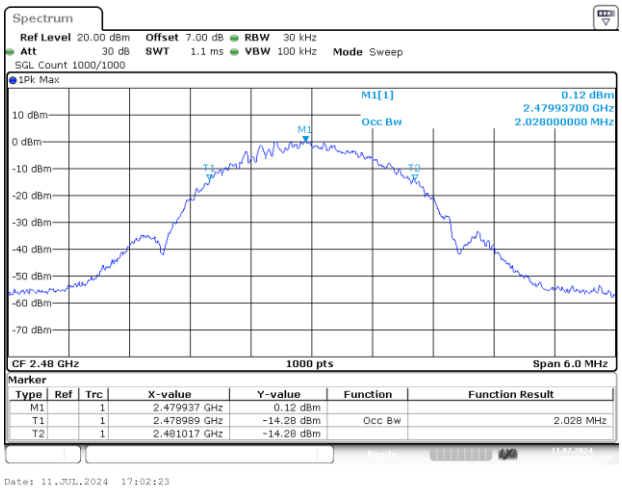
Low 2.034MHz



Middle 2.028MHz



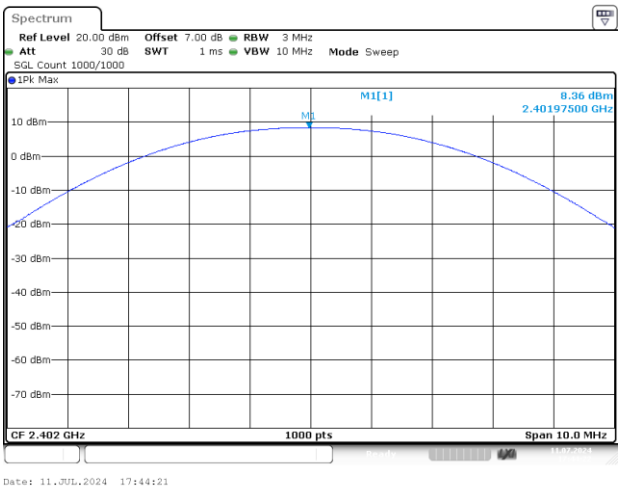
High 2.028MHz



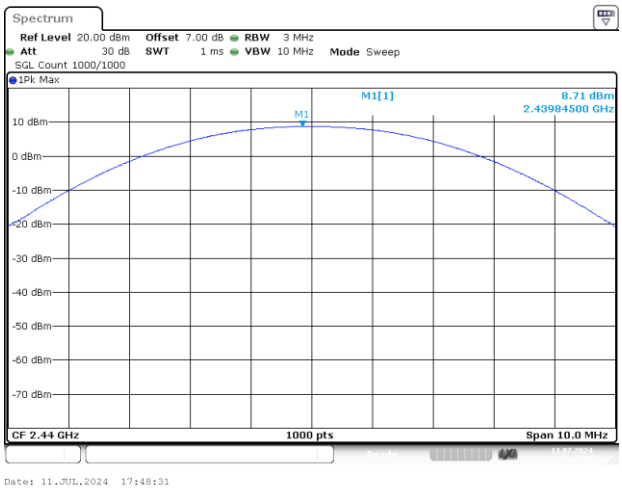
Maximum Conducted Output Power

BLE 1M

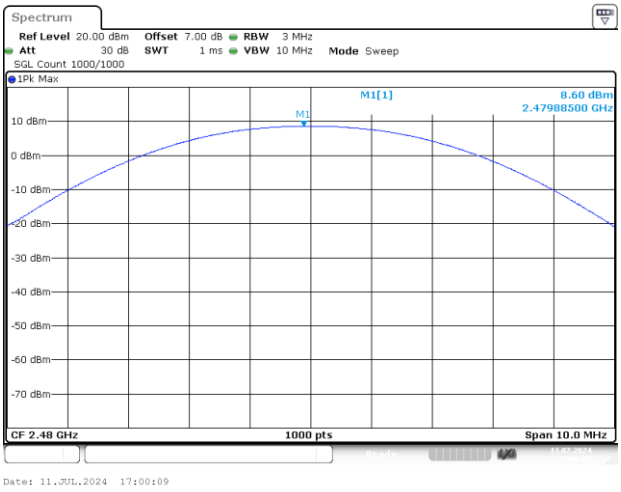
Low 8.36dBm



Middle 8.71dBm

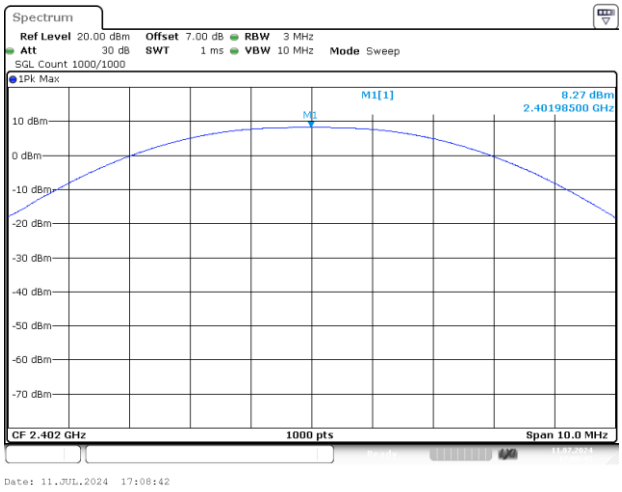


High 8.60dBm

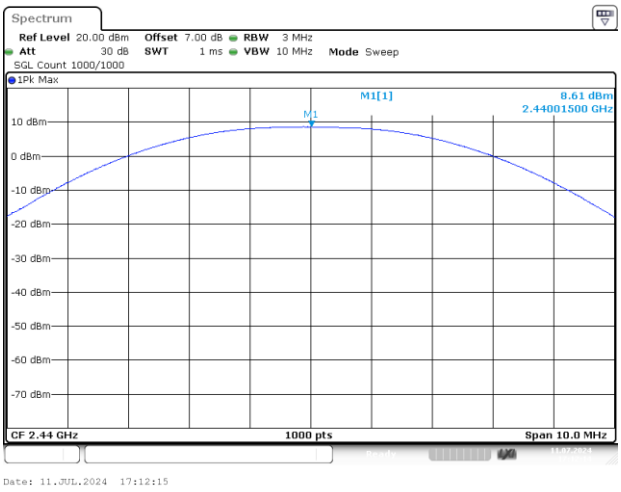


BLE 2M

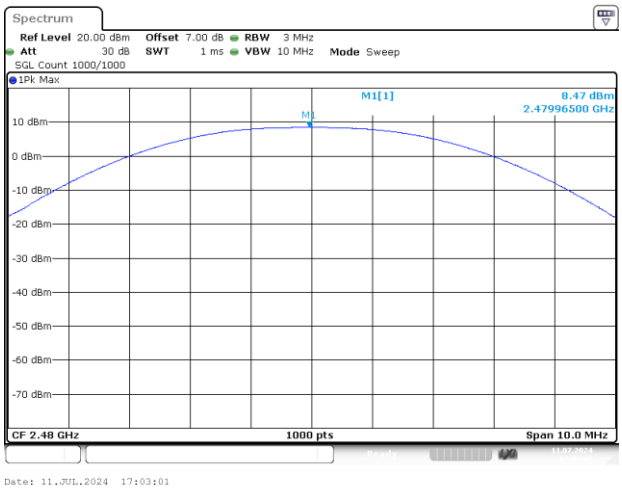
Low 8.27dBm



Middle 8.61dBm



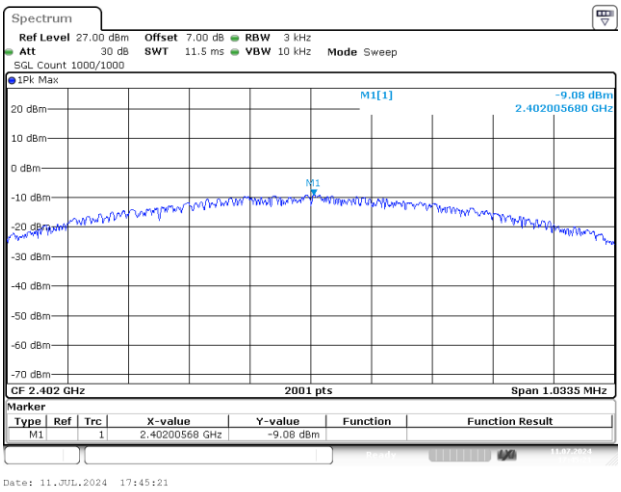
High 8.47dBm



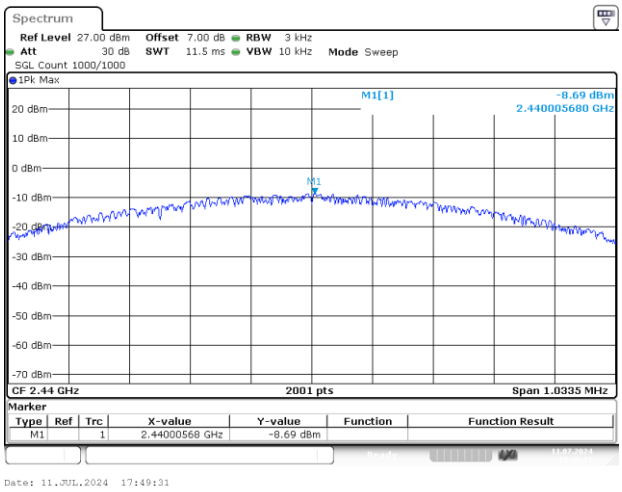
Power Spectral Density

BLE 1M

Low -9.08dBm/3kHz

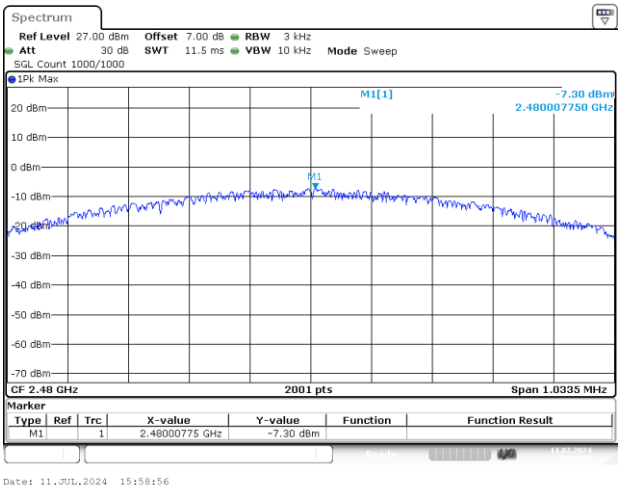


Middle -8.69dBm/3kHz

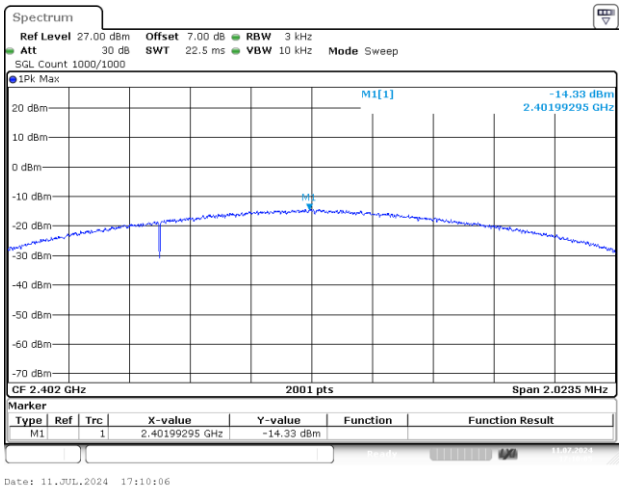


BLE 2M

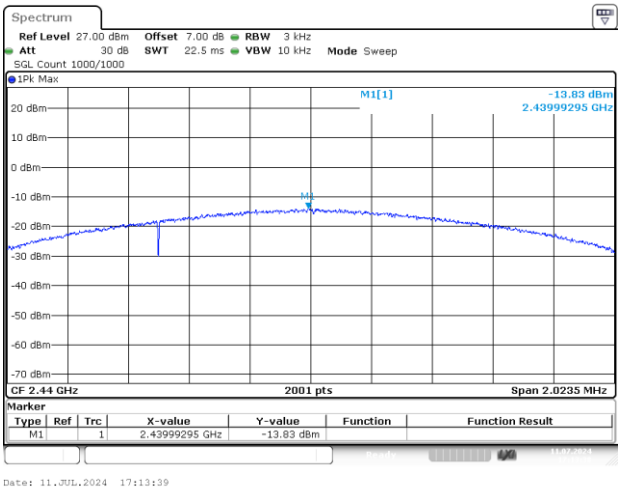
High -7.30dBm/3kHz



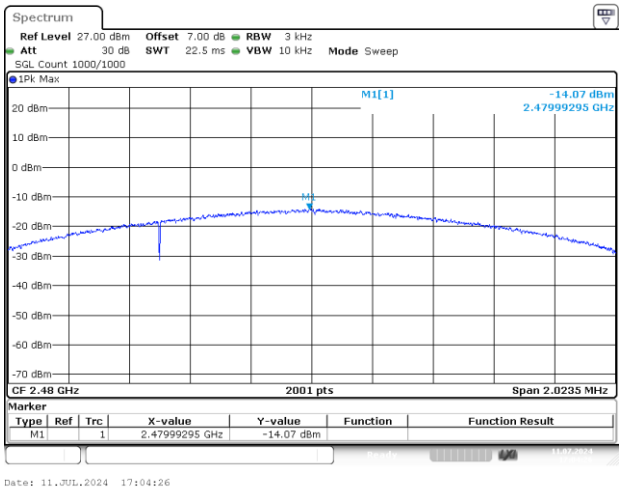
Low -14.33dBm/3kHz



Middle -13.83dBm/3kHz



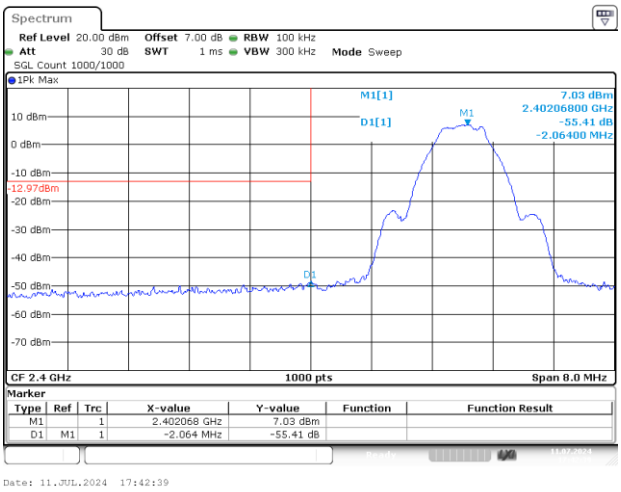
High -14.07dBm/3kHz



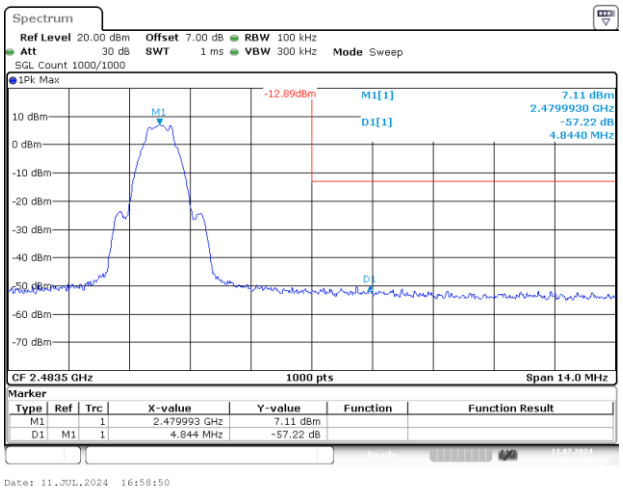
100 kHz Bandwidth of Frequency Band Edge

BLE 1M

Low 55.41dB

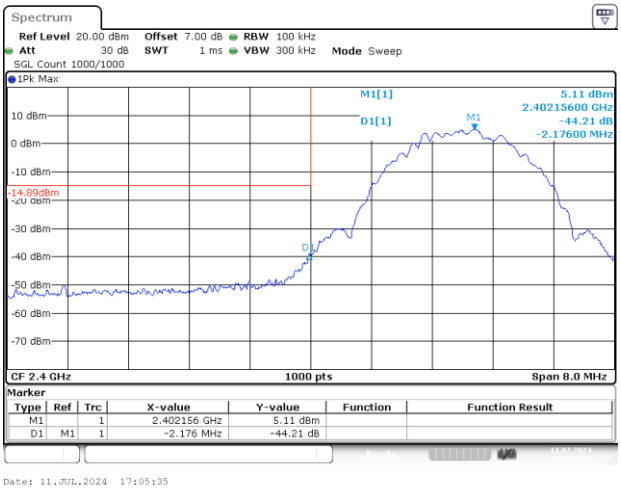


High 57.22dB

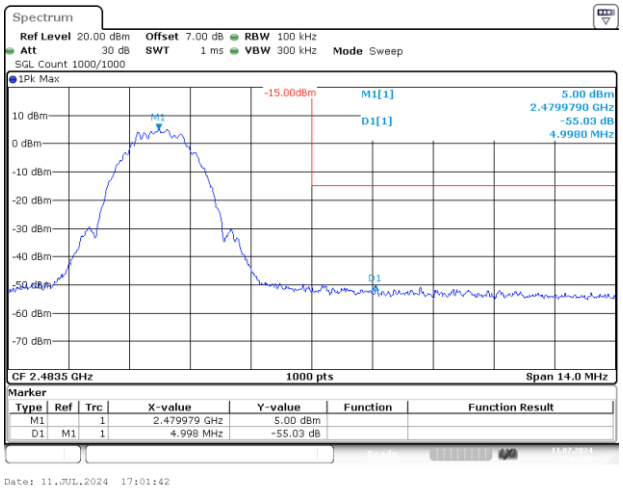


BLE 2M

Low 44.21dB



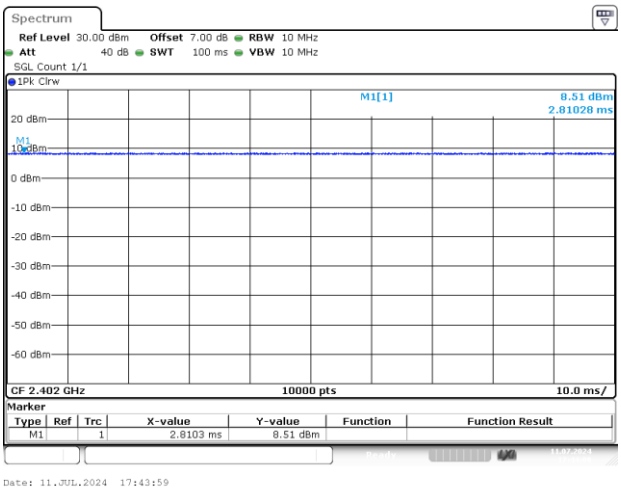
High 55.03dB



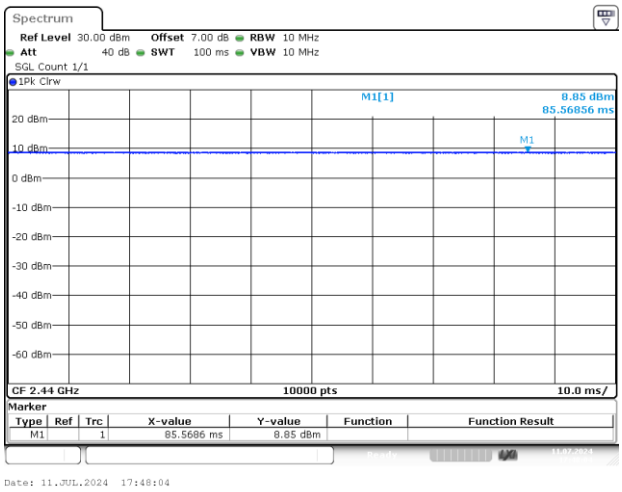
Duty Cycle

BLE 1M

Low

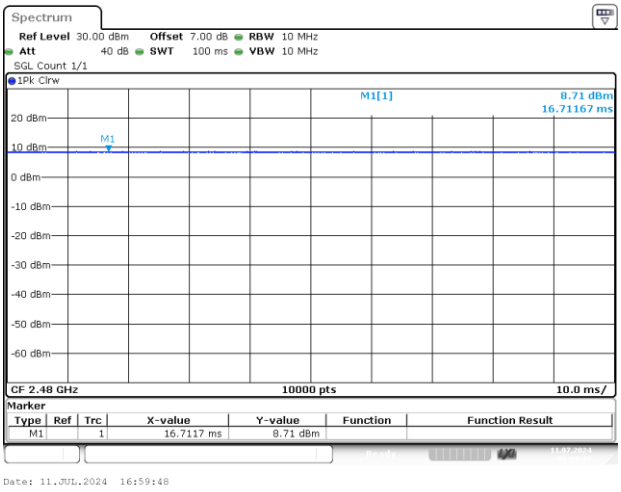


Middle

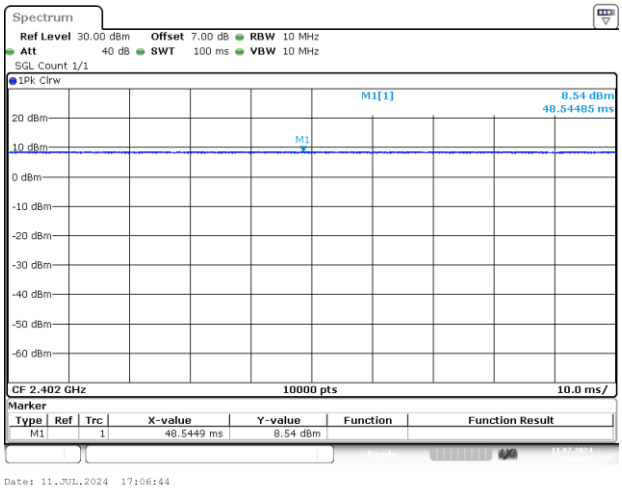


BLE 2M

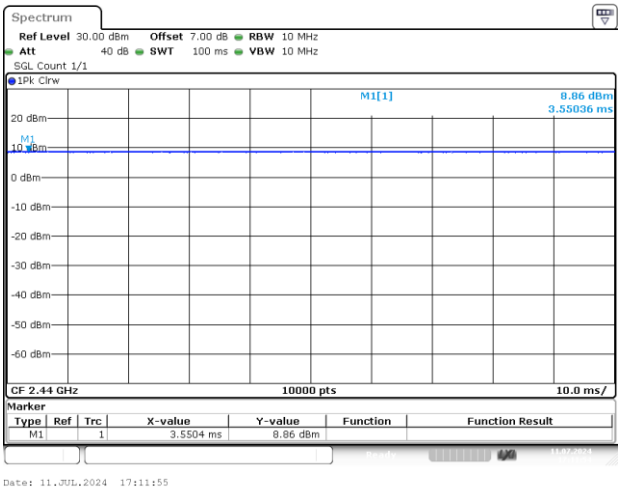
High



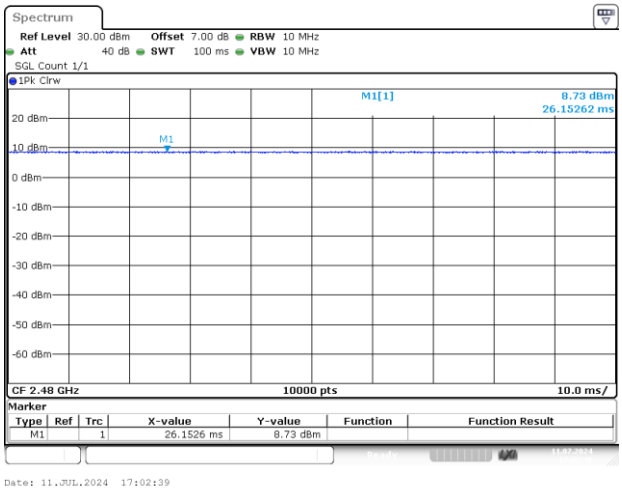
Low



Middle



High



4 Test Setup Photo

Please refer to the attachment 2405U45453E Test Setup photo.

5 E.U.T Photo

Please refer to the attachment 2405U45453E External photo and 2405U45453E Internal photo.

---End of Report---