ETSI EN 300 328 V2.2.2 (FHSS)

TEST REPORT

For

Bluetooth Low Energy and 802.15.4 wireless radio module

MODEL NUMBER: HM-MT2401, HM-MT2401B

REPORT NUMBER: E04A24020079R00102

ISSUE DATE: May 8, 2024

Prepared for

Shenzhen HOPE Microelectronics Co., Ltd

30th floor of 8th Building, C Zone Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, Guangdong, China

Prepared by

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	May 8, 2024	Initial Issue	

Summary of Test Results

Test Item	Clause	Limit/Requirement	Result
RF output power	Clause 5.4.2.2.1.2	Clause 4.3.1.2	Pass
Duty Cycle, Tx-sequence, Tx-gap	Clause 5.4.2.2.1.3	Clause 4.3.1.3	N/A
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	Clause 5.4.4.2.1	Clause 4.3.1.4	Pass
Hopping Frequency Separation	Clause 5.4.5.2.1	Clause 4.3.1.5	Pass
Medium Utilization (MU) factor	Clause 5.4.2.2.1.4	Clause 4.3.1.6	N/A
Adaptivity (Adaptive FHSS)	Clause 5.4.6.2.1	Clause 4.3.1.7	Pass
Occupied Channel Bandwidth	Clause 5.4.7.2.1	Clause 4.3.1.8	Pass
Transmitter unwanted emissions in the out-of-band domain	Clause 5.4.8.2.1	Clause 4.3.1.9	Pass
Transmitter unwanted emissions in the spurious domain	Clause 5.4.9.2.1	Clause 4.3.1.10	Pass
Receiver spurious emissions	Clause 5.4.10.2.1	Clause 4.3.1.11	Pass
Receiver Blocking	Clause 5.4.11.2.1	Clause 4.3.1.12	Pass
Radiated Spurious Emission	Clause 5.4.9.2.2	Clause 4.3.1.10	Pass

Note:
1. N/A: In this whole report not applicable.

*This test report is only published to and used by the applicant, and it is not for evidence purpose in China.
*The measurement result for the sample received is <Pass> according to <ETSI EN 300 328 V2.2.2 (FHSS)> when <Accuracy Method> decision rule is applied.

CONTENTS

1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	Shenzhen HOPE Microelectronics Co., Ltd
Address:	30th floor of 8th Building, C Zone Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, Guangdong, China

Manufacturer Information

Company Name:	Shenzhen HOPE Microelectronics Co., Ltd
Address:	30th floor of 8th Building, C Zone Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, Guangdong, China

EUT Information

Product Description:	Bluetooth Low Energy and 802.15.4 wireless radio module
Model:	HM-MT2401
Series Model:	HM-MT2401B
Brand:	HOPERF
Sample Received Date:	Mar. 01, 2024
Sample Status:	Normal
Sample ID:	A24020079 001
Date of Tested:	Mar. 01, 2024 to May 8, 2024

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
ETSI EN 300 328 V2.2.2 (FHSS)	**Pass**

Prepared By:

Win Huang

Project Engineer

Checked By:

Alan He

Laboratory Leader

Approved By:

Shawn Wen

Laboratory Manager

Guangdong Global Testing Technology Co., Ltd. CERTIFICATE

2. TEST METHODOLOGY

All tests were performed in accordance with the standard ETSI EN 300 328 V2.2.2 (FHSS)

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 6947.01)** Guangdong Global Testing Technology Co., Ltd. has been assessed and proved to be in compliance with A2LA. **FCC (FCC Designation No.: CN1343)** Guangdong Global Testing Technology Co., Ltd. has been recognized to perform compliance testing on equipment subject to Supplier's Declaration of Conformity (SDoC) and Certification rules **ISED (Company No.: 30714)** Guangdong Global Testing Technology Co., Ltd. has been registered and fully described in a report filed with ISED. The Company Number is 30714 and the test lab Conformity Assessment Body Identifier (CABID) is CN0148.

Note: All tests measurement facilities use to collect the measurement data are located at Room 101-105, 203-210, Building 1, No.2, Keji 8 Road, Songshan Lake Park, Dongguan city, Guangdong, People's Republic of China, 523808

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

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

Test Item	k	Uncertainty
RF output power	1.96	± 1.2 dB
Power Spectral Density	1.96	± 1.9 dB
Duty Cycle	1.96	± 0.57%
Tx-sequence	1.96	± 0.57%
Tx-gap	1.96	± 0.57%
Medium Utilisation (MU) factor	1.96	± 0.57%
Dwell time	1.96	± 9.2 PPM
Minimum Frequency Occupation	1.96	± 9.2 PPM
Hopping Sequence	1.96	± 9.2 PPM
Hopping Frequency Separation	1.96	± 9.2 PPM
Occupied Channel Bandwidth	1.96	± 9.2 PPM
Conducted spurious emissions	1.96	30 MHz-1 GHz: ±1.5 dB 1 GHz-12.75 GHz: ± 1.8 dB
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.		

Test Item	Measurement Frequency Range	k	U(dB)
Radiated emissions	30 MHz ~ 1 GHz	2	3.79
Radiated emissions	1 GHz ~ 12.75 GHz	2	5.62
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.			

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT Name		Bluetooth Low Energy and 802.15.4 wireless radio module
Model		HM-MT2401
Series Model		HM-MT2401B
Model Difference		HM-MT2401/19.5dBm, HM-MT2401B/10dBm
Hardware Version		V1.0
Software Version		V1.0
Ratings		Input: DC 1.71V-3.8V
Power Supply	DC	3.3 V

Frequency Band:	2400 MHz to 2483.5 MHz
Frequency Range:	2402 MHz to 2480 MHz
Bluetooth Version:	Bluetooth V5.3
Bluetooth Mode:	BLE
Geo-location Capability:	Not Support
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK
Number of Channels:	1Mbps: 40 2Mbps: 37
Channel Separation:	1 MHz 2 MHz
Hopping Channel Type:	Adaptive Frequency Hopping Systems
Maximum EIRP:	1Mbps: 19.80 dBm 2Mbps: 19.69 dBm
Antenna Type:	PCB Antenna
Antenna Gain:	1 dBi
Normal Test Voltage:	3.3 Vdc
Extreme Test Temperature:	General: -40 °C to +85 °C
EUT Test software:	NcpCommander
Note: The Antenna Gain was provided by customer, and this information may affect the validity of the results, customer should be responsible for this.	

5.2. RECEIVER CATEGORY

EUT belong to	Receiver categories	Relevant receiver clauses
☒	1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p.
☐	2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or equipment (adaptive or non-adaptive) with a maximum RF output power greater than 0 dBm e.i.r.p. and less than or equal to 10 dBm e.i.r.p.
☐	3	non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % (irrespective of the

		maximum RF output power); or equipment (adaptive or non-adaptive) with a maximum RF output power of 0 dBm e.i.r.p.

5.3. CHANNEL LIST

1Mbps:
40 channels are provided to this EUT

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

2Mbps:
37 channels are provided to this EUT

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

5.4. MAXIMUM EIRP

Test Mode	Frequency (MHz)	Channel Number	Max EIRP (dBm)
GFSK(1Mbps)	2402 ~ 2480	0-39[40]	19.80
GFSK(2Mbps)	2404 ~ 2478	1-38[37]	19.69

5.5. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK(1Mbps)	CH 0(Low Channel), CH 19(MID Channel), CH 39(High Channel)	2402 MHz, 2440 MHz, 2480 MHz
GFSK(2Mbps)	CH 1(Low Channel), CH 19(MID Channel), CH 38(High Channel)	2404 MHz, 2440 MHz, 2478 MHz

Note: The hop is hopping mode.

5.6. THE WORSE CASE POWER SETTING PARAMETER

WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BLE	FHSS	GFSK	1Mbit/s
BLE	FHSS	GFSK	2Mbit/s

Note: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		NcpCommander		
Modulation Type	Transmit Antenna Number	Test Software setting value		
		CH 0	CH 19	CH 39
GFSK(1Mbps)	1	20	20	20

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		NcpCommander		
Modulation Type	Transmit Antenna Number	Test Software setting value		
		CH 1	CH 19	CH 38
GFSK(2Mbps)	1	20	20	20

5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2402-2480	PCB	1 dBi

Test Mode	Transmit and Receive Mode	Description
GFSK	☒1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.

5.8. ENVIROMENTAL CONDITIONS FOR TESTING

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage	Relative Humidity (%)
NVNT	+15 to +35	3.3 V	20 to 75
NVLT	-10	3.3 V	20 to 75
NVHT	55	3.3 V	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

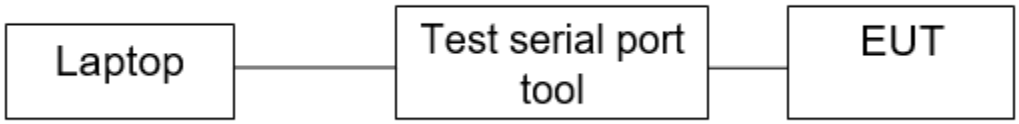
5.9. SUPPORT UNITS FOR SYSTEM TEST

The EUT has been tested as an independent unit

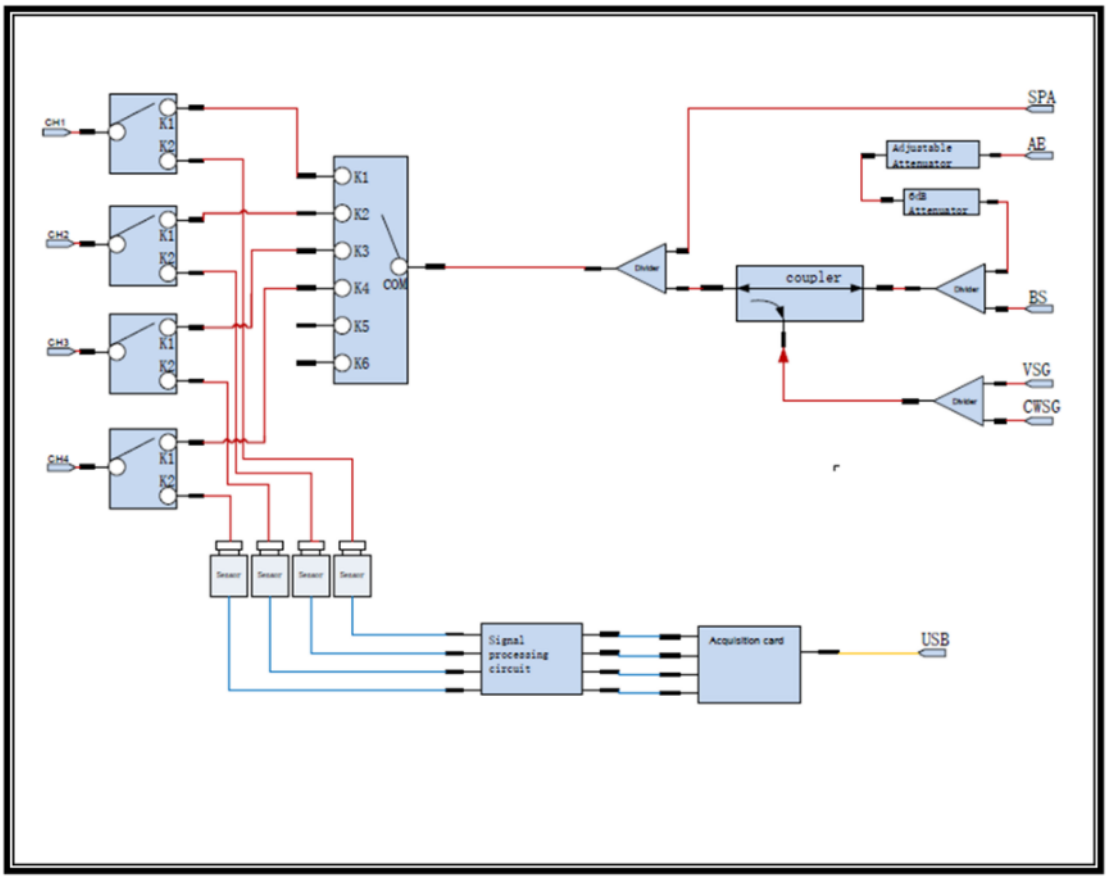
Equipment	**Manufacturer**	**Model No.**
Test serial port tool	N/A	USB TO TTL
PC	Lenovo	T430

5.10. SETUP DIAGRAM

Radiated emissions:



5.11. TEST SYSTEM CONFIGURATION



5.12. DESCRIPTION OF THE EQUIPMENT UNDER TESTED

(INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1)

a)	**Modulation Type**		
	☒ FHSS		
	☐ non-FHSS		
b)	FHSS Equipment Description		
	The Number of Hopping Frequencies	The Maximum	40
		The Minimum	15
	The (average) dwell time	9.43ms	
c)	**Adaptive / Non-adaptive Equipment**		
	☐ Non-adaptive Equipment		
	☒ Adaptive Equipment Without the Possibility to Switch to A Non-adaptive Mode		
	☐ Adaptive Equipment Which can also operate in A Non-adaptive Mode		
d)	**Adaptive Equipment Description**		
	The maximum Channel Occupancy Time implemented by the equipment		/
	☒ The equipment has implemented an LBT mechanism		
	☐ The equipment has implemented a DAA mechanism		
	☐ The equipment can operate in more than one adaptive mode		
e)	**The different transmit operating modes**		
		☒ Equipment with only one antenna	

	☒ Operating mode 1 (single antenna)	☐ Equipment with two diversity antennas but only one antenna active at any moment in time
		☐ Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one antenna is used (e.g. IEEE 802.11™ legacy mode in smart antenna systems)
	☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming	☐ Single spatial stream/Standard throughput/(e.g. IEEE 802.11™ legacy mode)
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2
	☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	☐ Single spatial stream/Standard throughput (e.g. IEEE 802.11™ legacy mode)
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1
		☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2

f)	**In case of Smart Antenna Systems**	
	The number of Receive chains	1
	The number of Transmit chains	1
	In case of beam forming, the maximum (additional) beam forming gain:	/
g)	**Operating Frequency Range(s) of the equipment**	
	Operating Frequency Range	2402 MHz to 2480 MHz
h)	**Nominal Channel Bandwidth(s)**	
	Occupied Channel Bandwidth	2.07 MHz

i)	**Type of Equipment**					
	☒Stand-Alone					
	☐ Plug-in radio Equipment					
	☐ Combined Equipment					
j)	**The extreme operating conditions that apply to the equipment**					
	Operating temperature range	-40 °C to +85 °C				
k)	**The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels**					
	Antenna Type	☒ PCB Antenna	Antenna Gain	1 dBi		
		☐ Dedicated Antennas (equipment with antenna connector)	☐Single power level with corresponding antenna(s)	Gain	ANT1	
			☐Multiple power settings and corresponding antenna(s)	Power Level 1		
				Power Level 2		
				Power Level 3		
l)	**The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:**					
	Details provided are for the	☒ Testing of stand-alone equipment				
		☐ Combined equipment				
		☐ Test jig				
	Supply Voltage	☐ AC mains	State AC voltage			

		☒ DC	State DC voltage	☐ Internal Power Supply	
				☒ External Power Supply or AC/DC adapter	DC 3.3 V
				☐ Battery	
				☐Other	
m)	**The equipment type**				
	☒ Bluetooth®				
	☐ IEEE 802.11™ [i.3]				
	☐ Proprietary				
n)	**Geo-location capability supported by the equipment**		☐ Yes ☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.		
			☒ No		

6. MEASURING EQUIPMENT AND SOFTWARE USED

Test Equipment of Conducted RF					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Due Date**
Spectrum Analyzer	Rohde & Schwarz	FSV40	102257	2023/09/18	2024/09/17
Spectrum Analyzer	KEYSIGHT	N9020A	MY51285127	2023/09/18	2024/09/17
EXG Analog Signal Generator	KEYSIGHT	N5173B	MY61253075	2023/09/18	2024/09/17
Vector Signal Generator	Rohde & Schwarz	SMM100A	101899	2023/09/18	2024/09/17
RF Control box	MWRF-test	MW100-RFCB	MW220926GTG	2023/09/18	2024/09/17
Wideband Radio Communication Tester	Rohde & Schwarz	CMW270	102792	2023/09/18	2024/09/17
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	103235	2023/09/18	2024/09/17
temperature humidity chamber	Espec	SH-241	SH-241-2014	2023/09/18	2024/09/17
RF Test Software	MWRF-test	MTS8310E (Ver. V2/0)	N/A	N/A	N/A

Test Equipment of Radiated emissions below 1GHz					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Due Date**
3m Semi-anechoic Chamber	ETS	9m*6m*6m	Q2146	2022/08/30	2025/08/29
EMI Test Receiver	Rohde & Schwarz	ESCI3	101409	2023/09/18	2024/09/17
Spectrum Analyzer	KEYSIGHT	N9020A	MY51283932	2023/09/18	2024/09/17
Pre-Amplifier	HzEMC	HPA-9K0130	HYPA21001	2023/09/18	2024/09/17
Biconilog Antenna	Schwarzbeck	VULB 9168	01315	2022/10/10	2025/10/09
Biconilog Antenna	ETS	3142E	00243646	2022/03/23	2025/03/22
Loop Antenna	ETS	6502	243668	2022/03/30	2025/03/29
Test Software	Farad	EZ-EMC (Ver.FA-03A2 RE)	N/A	N/A	N/A

Test Equipment of Radiated emissions above 1GHz					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal.**	**Due Date**
3m Semi-anechoic Chamber	ETS	9m*6m*6m	Q2149	2022/08/30	2025/08/29
Spectrum Analyzer	Rohde & Schwarz	FSV40	101413	2023/09/18	2024/09/17
Spectrum Analyzer	KEYSIGHT	N9020A	MY51283932	2023/09/18	2024/09/17
Pre-Amplifier	A-INFO	HPA-1G1850	HYPA21003	2023/09/18	2024/09/17
Horn antenna	A-INFO	3117	246069	2022/03/11	2025/03/10
Pre-Amplifier	ZKJC	HPA-184057	HYPA21004	2023/09/18	2024/09/17

Horn antenna	ZKJC	3116C	246265	2022/03/29	2025/03/28
Test Software	Farad	EZ-EMC (Ver.FA-03A2 RE+)	N/A	N/A	N/A

7. RADIATED TEST RESULTS

LIMITS

Transmitter spurious emissions:

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

Receiver spurious emissions:

The spurious emissions of the receiver shall not exceed the values given in table 13.
In case of non-FHSS equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST PROCEDURE

Transmitter spurious emissions:
Refer to Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.9

Spectrum analyser settings for pre-scan:

RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak

Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented.
Sweep Time	For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel. For FHSS equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. The above sweep time setting may result in long measuring times in case of FHSS equipment. To avoid such long measuring times, an FFT analyser may be used.

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Receiver spurious emissions:
Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Spectrum analyser settings for pre-scan:

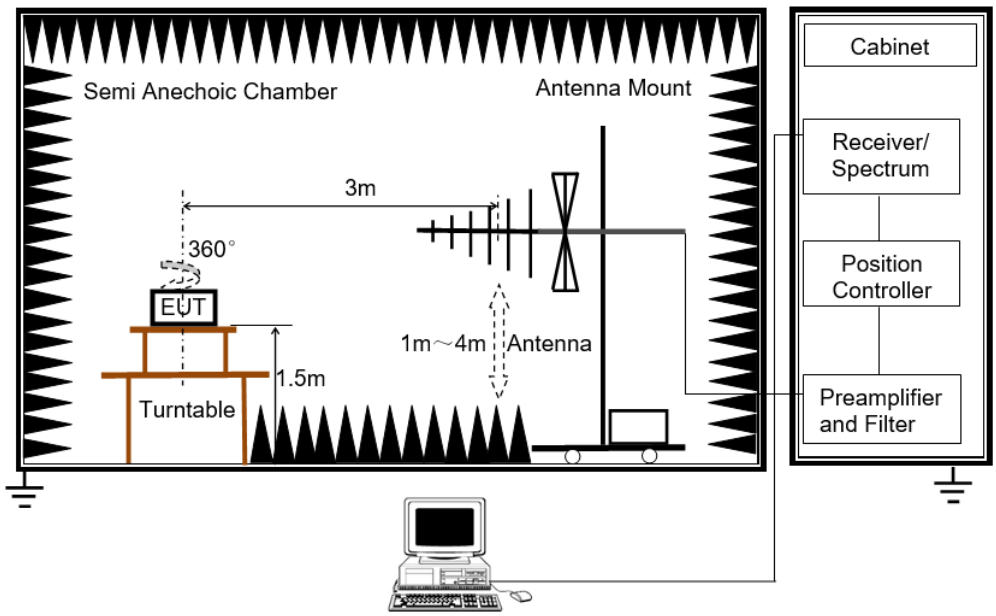
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold

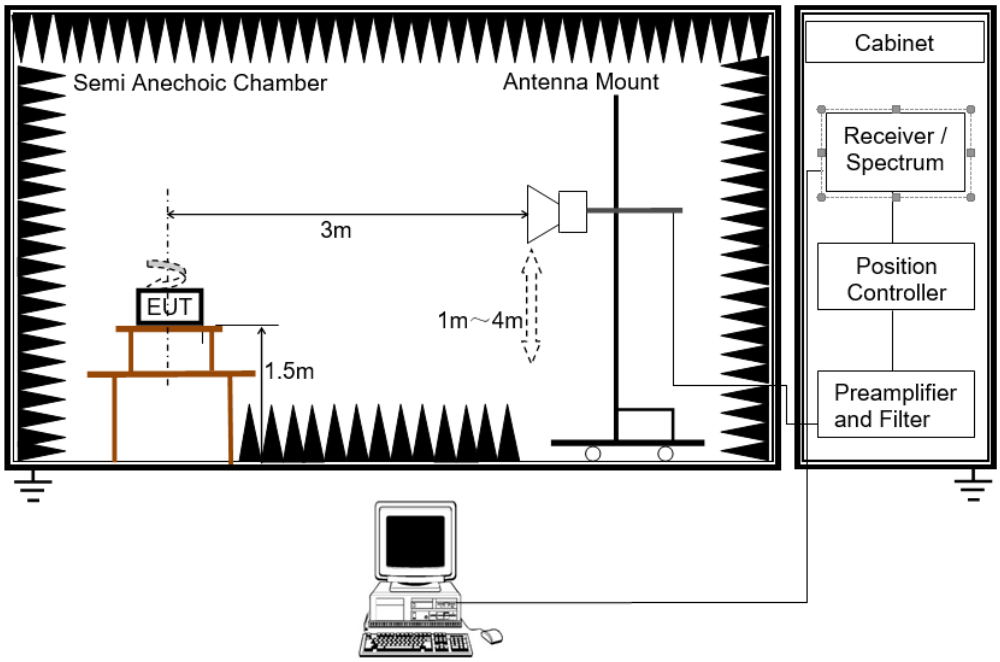
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented.
Sweep Time	Auto

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	⩾ 30 000
Sweep Time	30 ms

TEST SETUP





TEST ENVIRONMENT

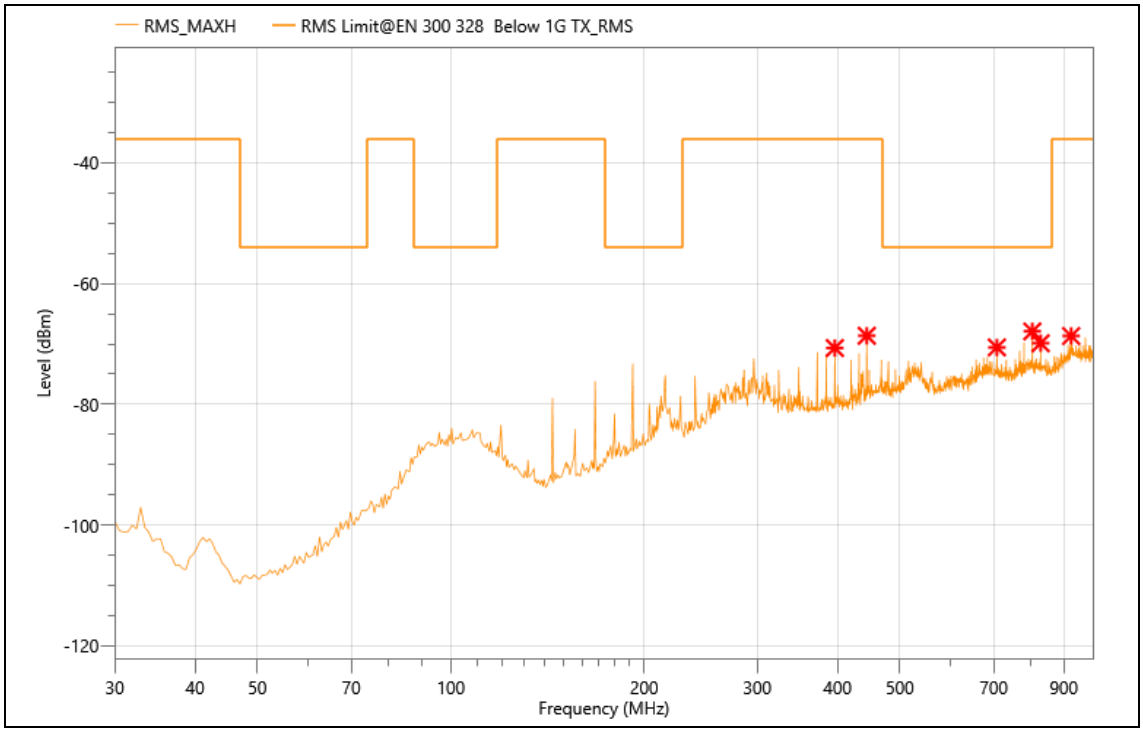
Temperature	24.3℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

- 30MHz to 1GHz

The worst result as bellow:

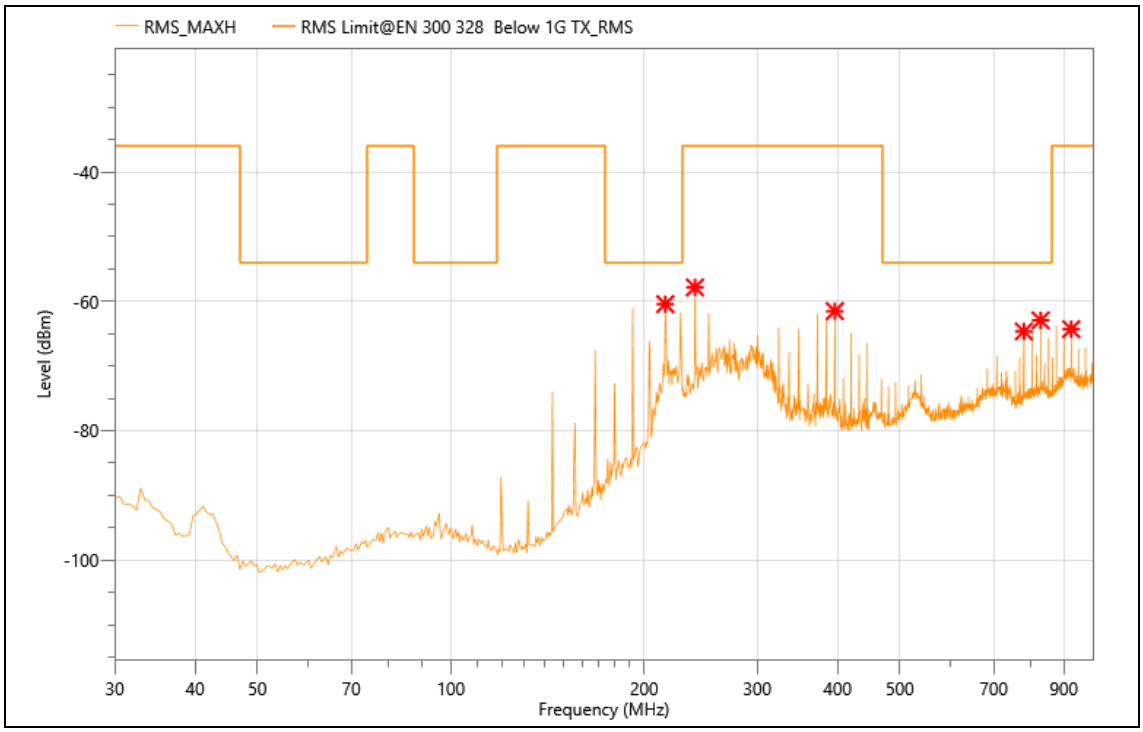
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	396.175	-72.13	1.47	-70.66	-36.00	34.66	RMS	V
2	444.190	-70.40	1.77	-68.63	-36.00	32.63	RMS	V
3	708.030	-77.50	6.94	-70.56	-54.00	16.56	RMS	V
4	804.060	-76.27	8.37	-67.90	-54.00	13.90	RMS	V
5	828.310	-78.08	8.21	-69.87	-54.00	15.87	RMS	V
6	924.340	-79.07	10.4	-68.67	-36.00	32.67	RMS	V

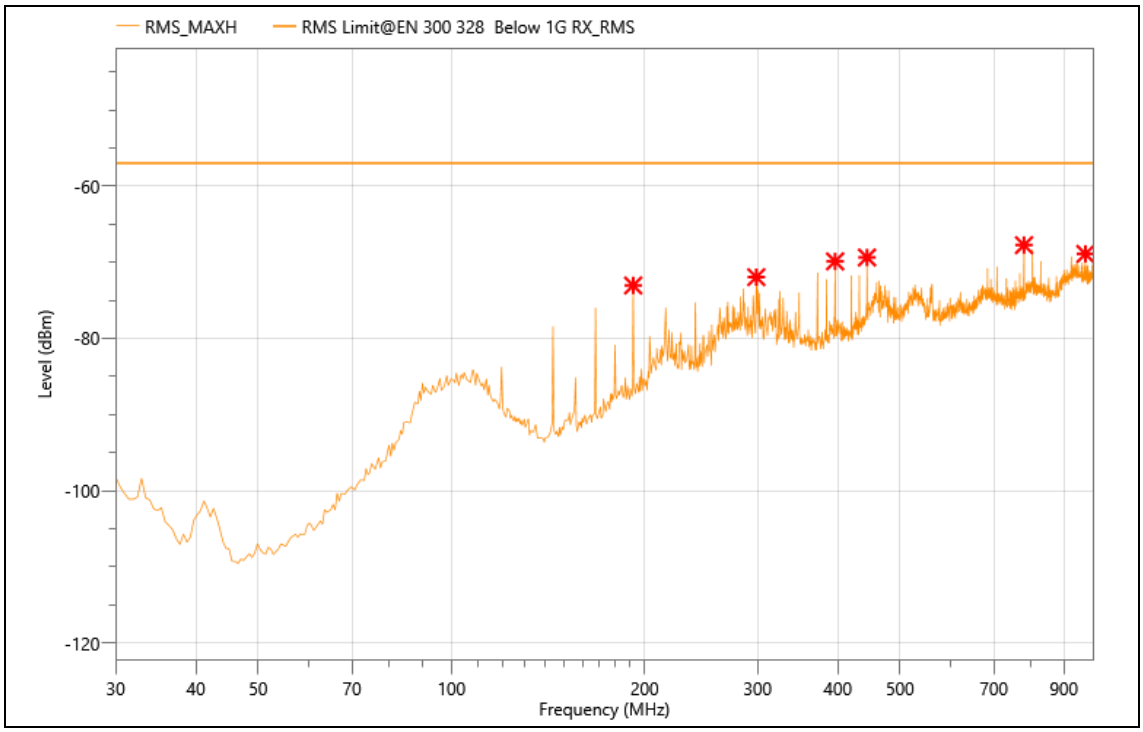
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	215.755	-59.49	-0.93	-60.42	-54.00	6.42	RMS	H
2	240.005	-58.61	0.78	-57.83	-36.00	21.83	RMS	H
3	396.175	-63.76	2.26	-61.50	-36.00	25.50	RMS	H
4	780.295	-71.40	6.76	-64.64	-54.00	10.64	RMS	H
5	828.310	-71.28	8.35	-62.93	-54.00	8.93	RMS	H
6	924.340	-74.94	10.65	-64.29	-36.00	28.29	RMS	H

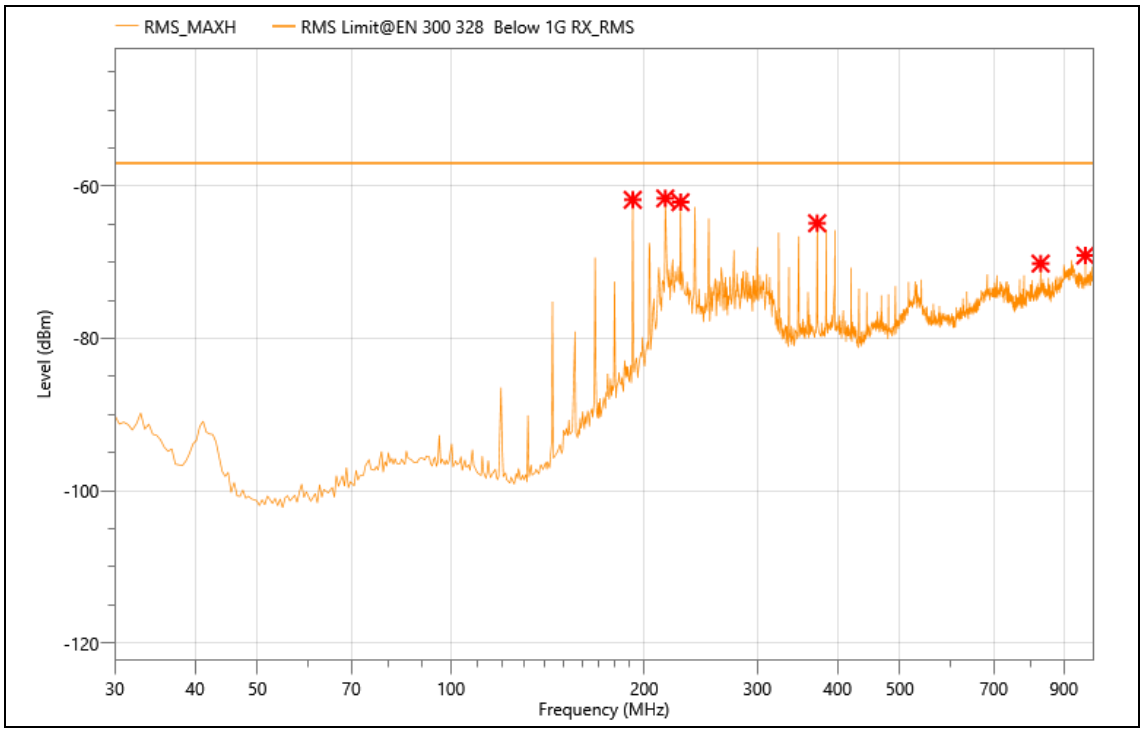
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	191.990	-67.18	-5.86	-73.04	-57.00	16.04	RMS	V
2	298.690	-71.26	-0.69	-71.95	-57.00	14.95	RMS	V
3	396.175	-71.35	1.47	-69.88	-57.00	12.88	RMS	V
4	444.190	-71.13	1.77	-69.36	-57.00	12.36	RMS	V
5	780.295	-75.28	7.54	-67.74	-57.00	10.74	RMS	V
6	972.355	-79.24	10.34	-68.90	-57.00	11.90	RMS	V

Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



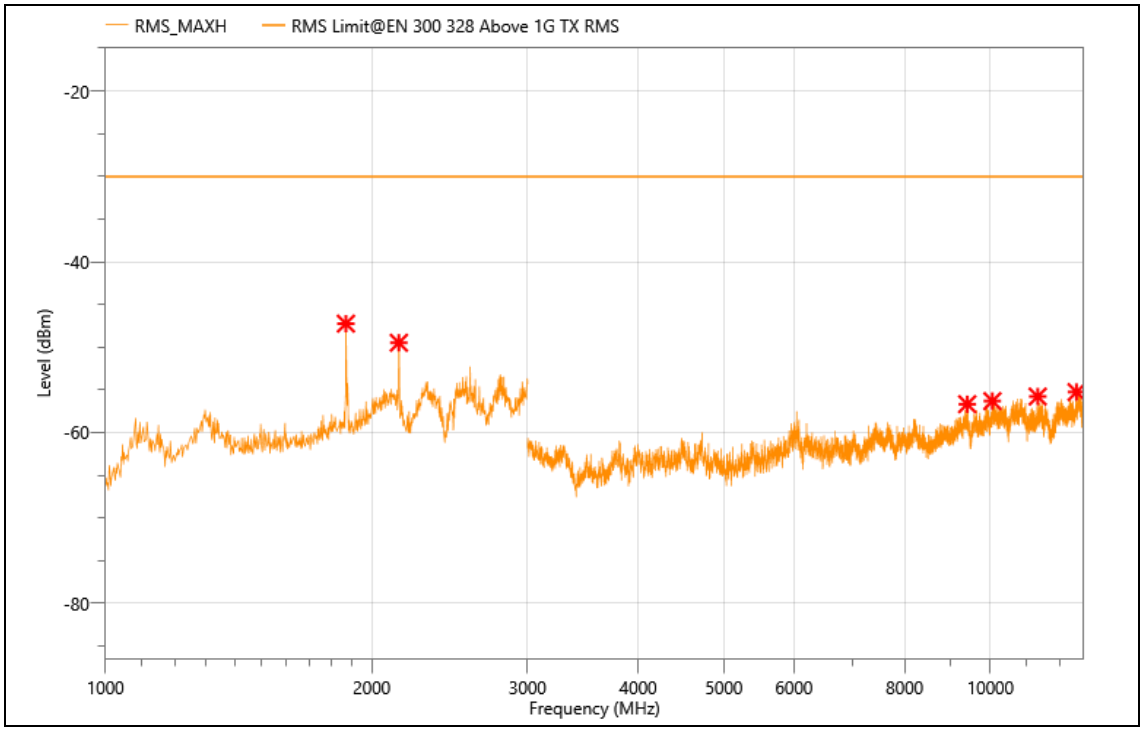
Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	191.990	-56.65	-5.14	-61.79	-57.00	4.79	RMS	H
2	215.755	-60.67	-0.93	-61.60	-57.00	4.60	RMS	H
3	227.880	-62.38	0.28	-62.10	-57.00	5.10	RMS	H
4	371.925	-66.24	1.38	-64.86	-57.00	7.86	RMS	H
5	828.310	-78.52	8.35	-70.17	-57.00	13.17	RMS	H
6	972.355	-78.71	9.61	-69.10	-57.00	12.10	RMS	H

- Above 1GHz

The worst result as bellow:

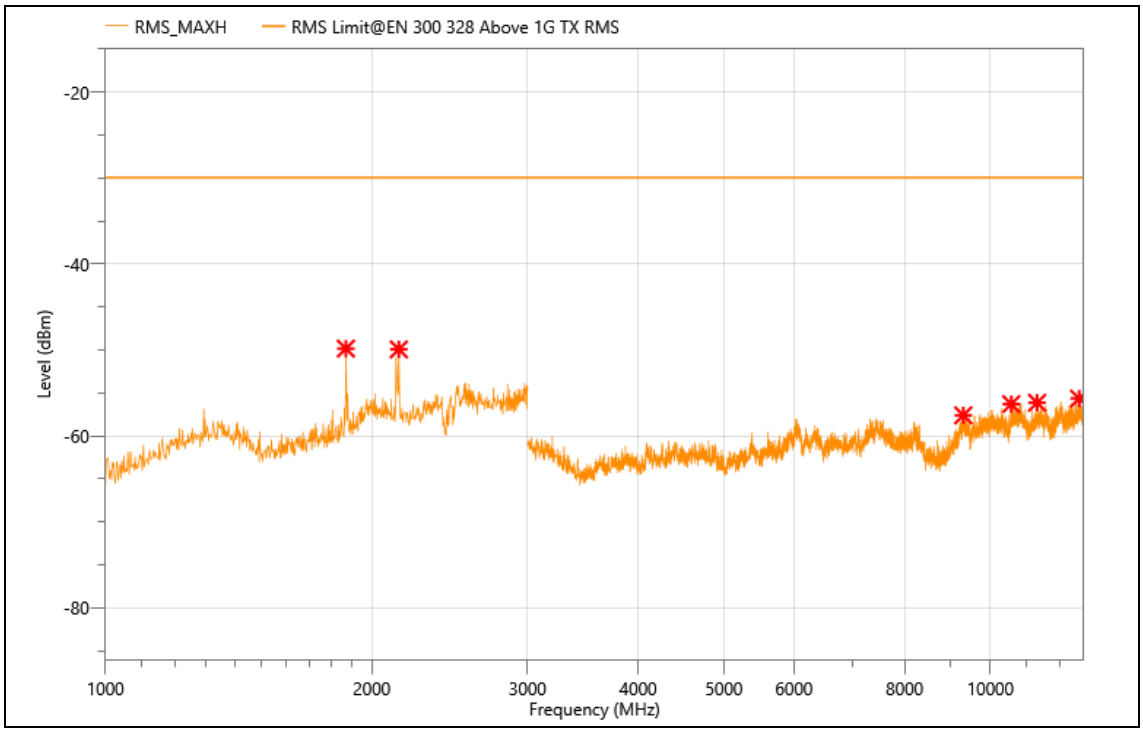
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	1870.000	-49.56	2.32	-47.24	-30.00	17.24	RMS	V
2	2146.000	-53.34	3.86	-49.48	-30.00	19.48	RMS	V
3	9416.475	-63.11	6.44	-56.67	-30.00	26.67	RMS	V
4	10053.150	-63.84	7.53	-56.31	-30.00	26.31	RMS	V
5	11310.900	-64.59	8.82	-55.77	-30.00	25.77	RMS	V
6	12513.075	-64.85	9.6	-55.25	-30.00	25.25	RMS	V

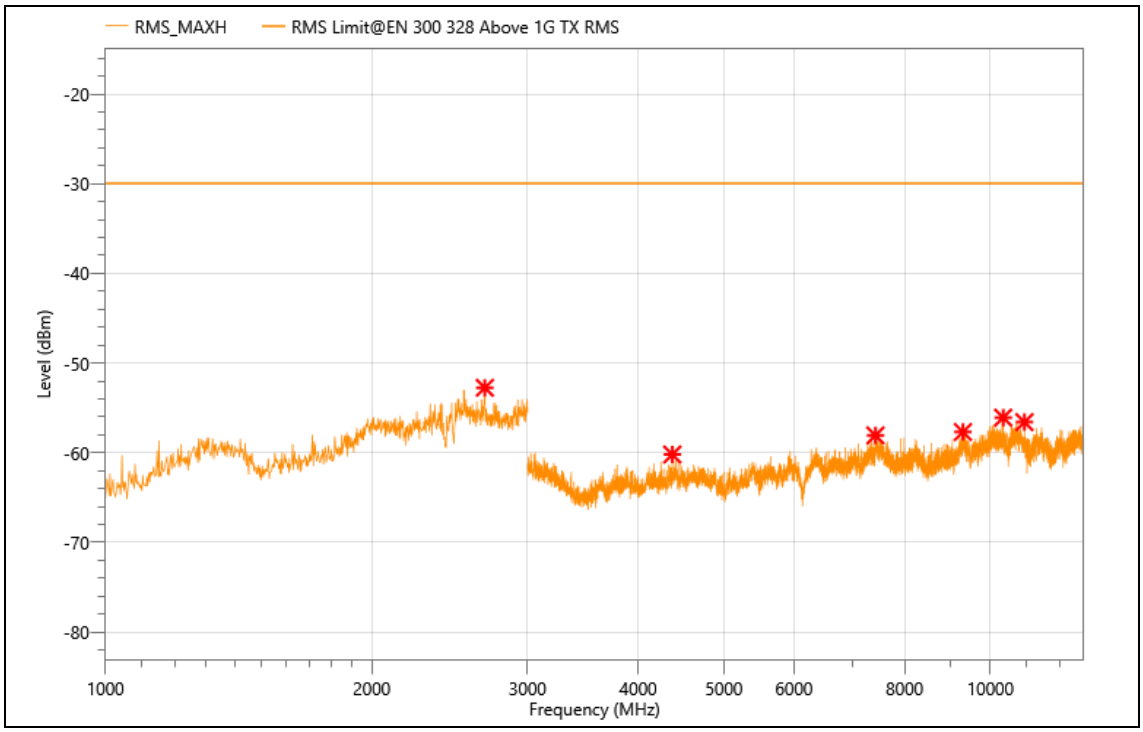
Mode:	1-DH5-2402
Power:	DC 5V
TE:	Berny
Date	2024/4/23
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	1870.000	-52.11	2.27	-49.84	-30.00	19.84	RMS	H
2	2146.000	-53.65	3.72	-49.93	-30.00	19.93	RMS	H
3	9320.925	-63.60	5.99	-57.61	-30.00	27.61	RMS	H
4	10559.175	-64.51	8.21	-56.30	-30.00	26.30	RMS	H
5	11292.375	-65.09	8.95	-56.14	-30.00	26.14	RMS	H
6	12598.875	-65.86	10.2	-55.66	-30.00	25.66	RMS	H

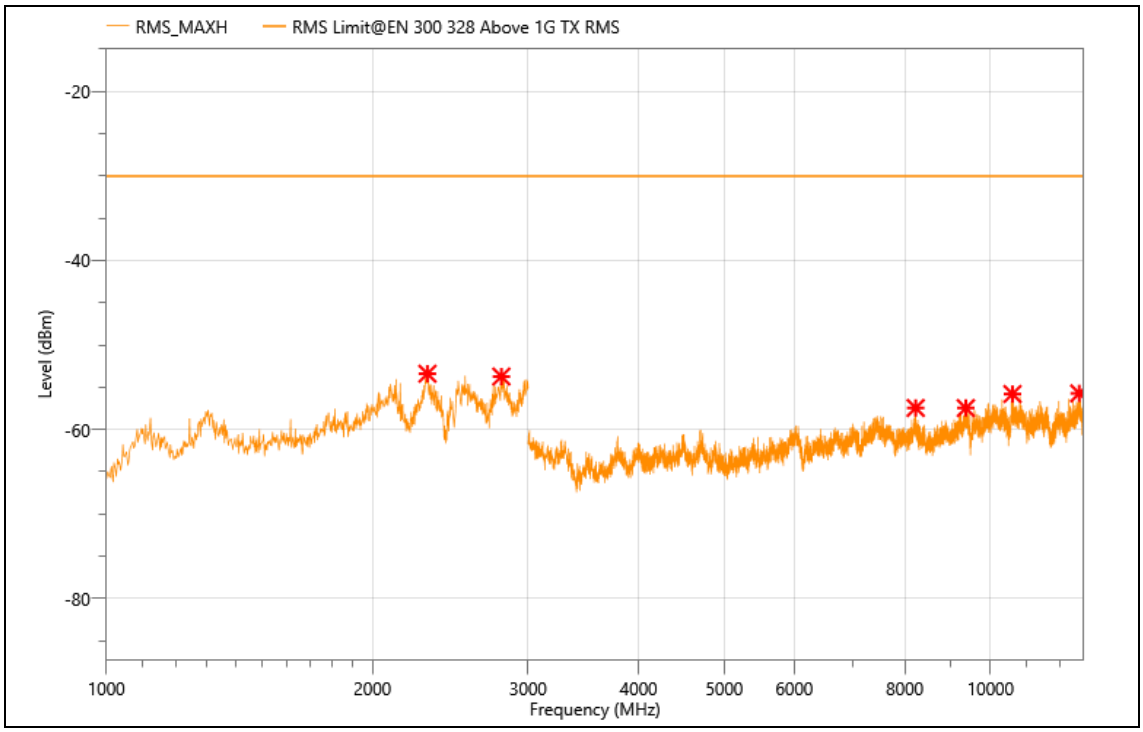
Mode:	BLE1M-2480
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	2684.000	-57.50	4.75	-52.75	-30.00	22.75	RMS	H
2	4371.825	-58.95	-1.24	-60.19	-30.00	30.19	RMS	H
3	7415.775	-63.10	5.04	-58.06	-30.00	28.06	RMS	H
4	9312.150	-63.62	5.94	-57.68	-30.00	27.68	RMS	H
5	10339.800	-64.12	8.04	-56.08	-30.00	26.08	RMS	H
6	10927.725	-64.96	8.38	-56.58	-30.00	26.58	RMS	H

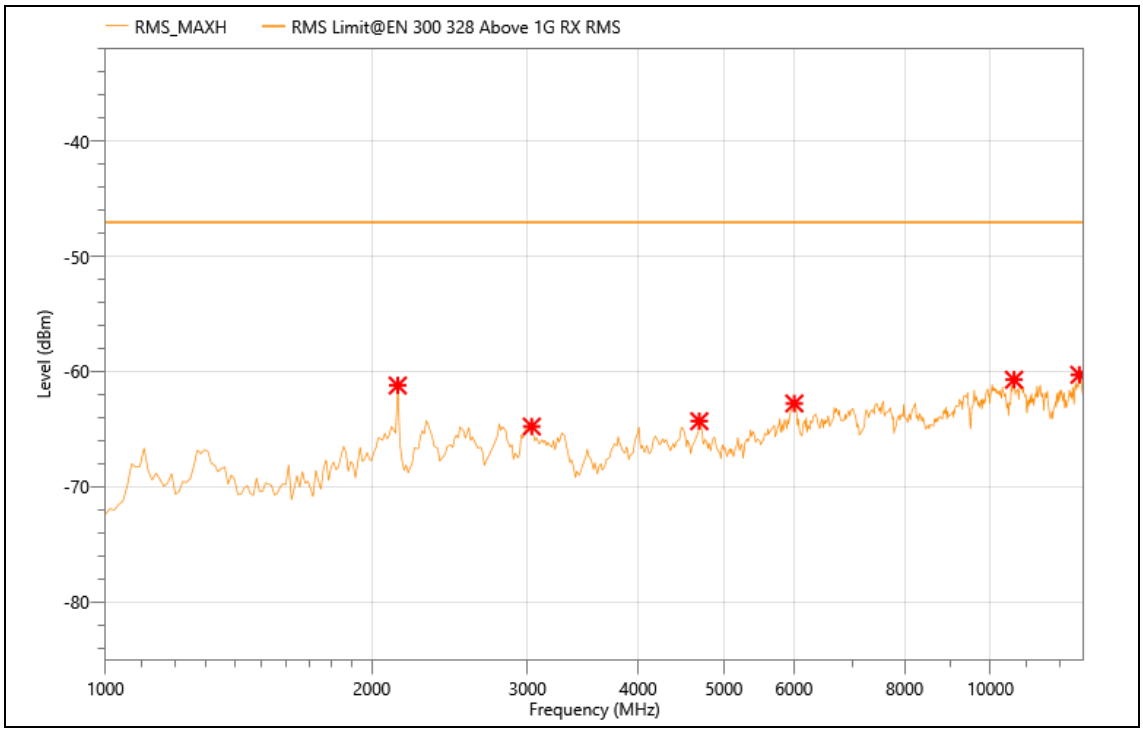
Mode:	BLE1M-2480
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	2308.000	-59.41	6	-53.41	-30.00	23.41	RMS	V
2	2798.000	-59.52	5.78	-53.74	-30.00	23.74	RMS	V
3	8229.900	-62.80	5.34	-57.46	-30.00	27.46	RMS	V
4	9378.450	-63.64	6.17	-57.47	-30.00	27.47	RMS	V
5	10589.400	-64.37	8.56	-55.81	-30.00	25.81	RMS	V
6	12599.850	-66.50	10.77	-55.73	-30.00	25.73	RMS	V

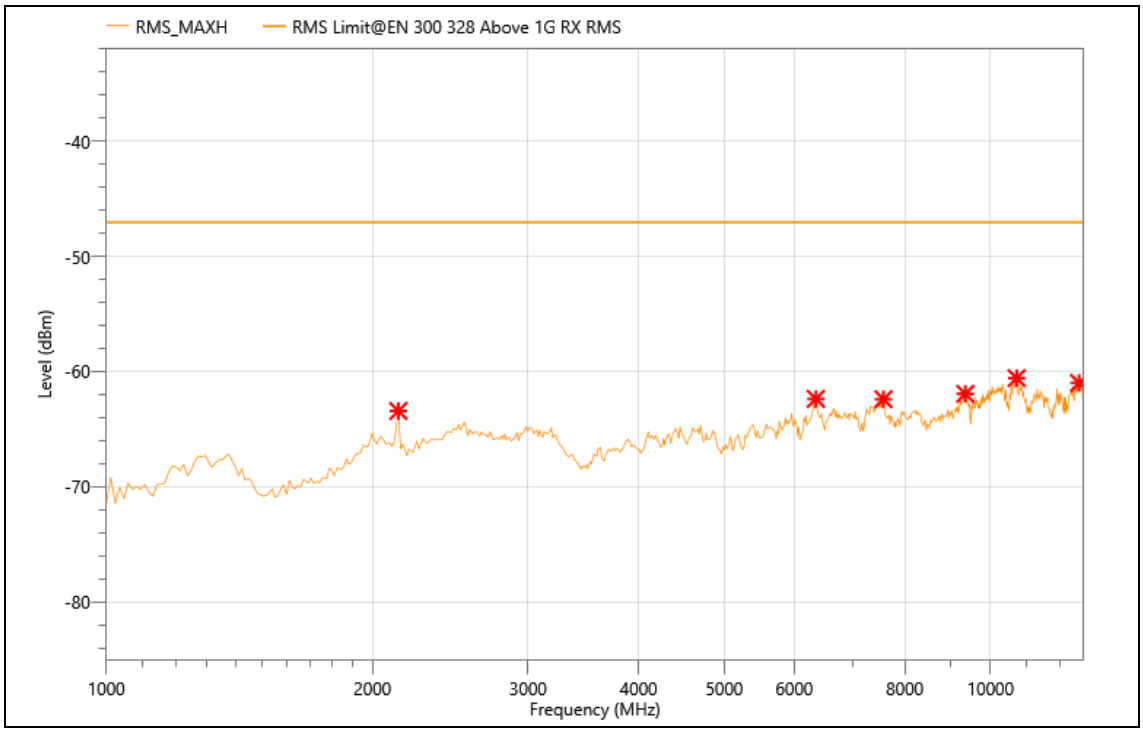
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	2139.750	-55.93	-5.28	-61.21	-47.00	14.21	RMS	V
2	3032.750	-61.54	-3.23	-64.77	-47.00	17.77	RMS	V
3	4689.500	-63.96	-0.35	-64.31	-47.00	17.31	RMS	V
4	6005.500	-66.71	3.94	-62.77	-47.00	15.77	RMS	V
5	10635.000	-69.05	8.34	-60.71	-47.00	13.71	RMS	V
6	12609.000	-70.52	10.24	-60.28	-47.00	13.28	RMS	V

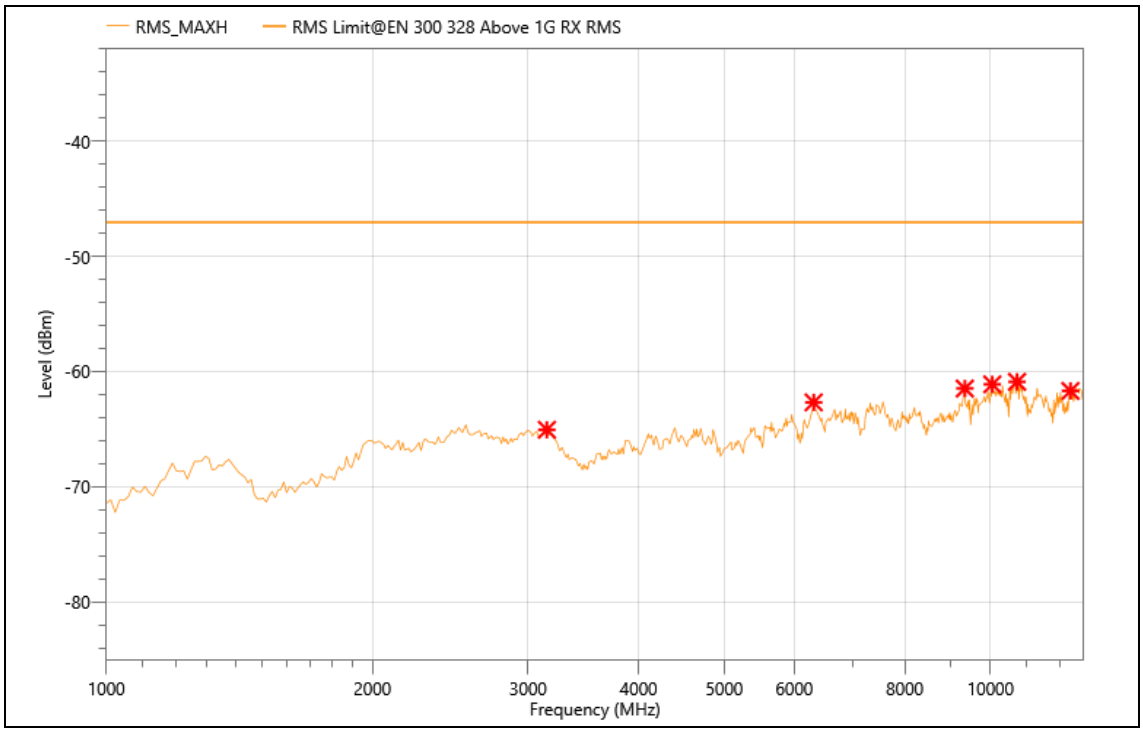
Mode:	BLE1M-2402
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	2139.750	-57.77	-5.65	-63.42	-47.00	16.42	RMS	H
2	6346.250	-65.68	3.31	-62.37	-47.00	15.37	RMS	H
3	7568.250	-67.30	4.9	-62.40	-47.00	15.40	RMS	H
4	9366.000	-67.16	5.23	-61.93	-47.00	14.93	RMS	H
5	10705.500	-68.95	8.38	-60.57	-47.00	13.57	RMS	H
6	12597.250	-70.68	9.69	-60.99	-47.00	13.99	RMS	H

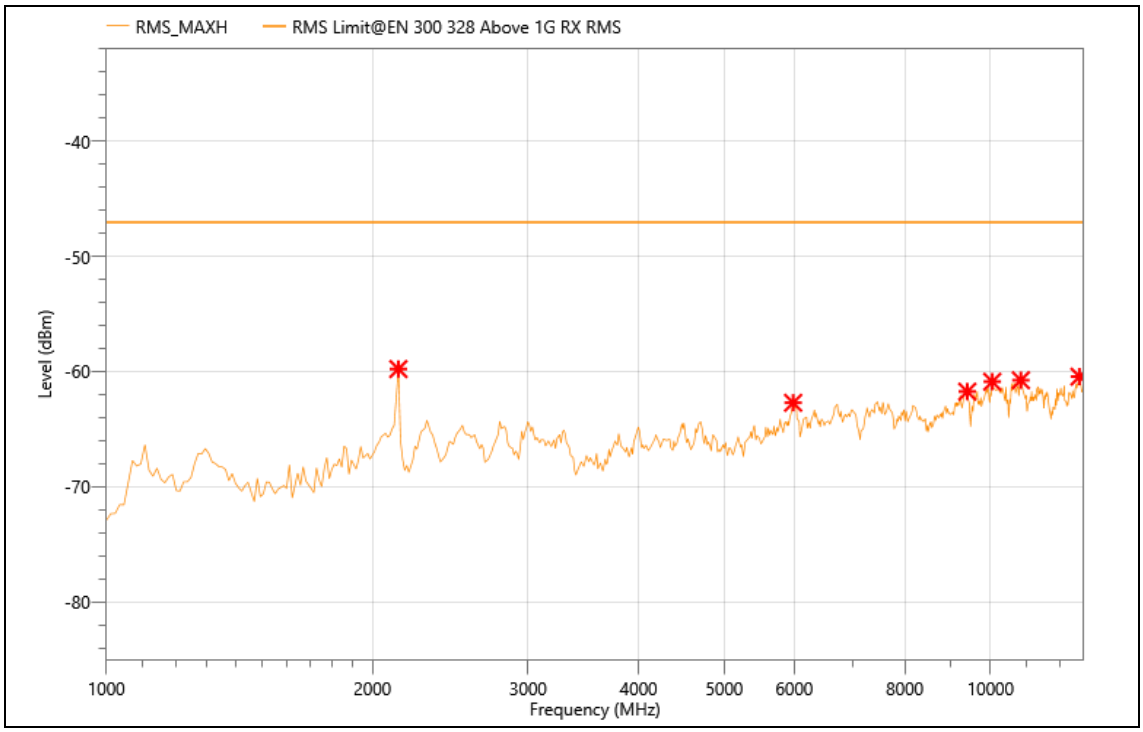
Mode:	BLE1M-2480
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	3150.250	-61.36	-3.69	-65.05	-47.00	18.05	RMS	H
2	6311.000	-66.65	3.98	-62.67	-47.00	15.67	RMS	H
3	9354.250	-66.84	5.37	-61.47	-47.00	14.47	RMS	H
4	10047.500	-68.07	6.96	-61.11	-47.00	14.11	RMS	H
5	10717.250	-69.20	8.31	-60.89	-47.00	13.89	RMS	H
6	12315.250	-71.07	9.39	-61.68	-47.00	14.68	RMS	H

Mode:	BLE1M-2480
Power:	DC 3.3V
TE:	Berny
Date	2024/4/24
T/A/P	24.3℃/54%/101Kpa



Critical_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBm)	Limit (dBm)	Margin (dB)	Det.	Pol.
1	2139.750	-54.50	-5.28	-59.78	-47.00	12.78	RMS	V
2	5982.000	-66.12	3.41	-62.71	-47.00	15.71	RMS	V
3	9413.000	-67.76	6.02	-61.74	-47.00	14.74	RMS	V
4	10047.500	-68.01	7.13	-60.88	-47.00	13.88	RMS	V
5	10823.000	-69.09	8.34	-60.75	-47.00	13.75	RMS	V
6	12609.000	-70.68	10.24	-60.44	-47.00	13.44	RMS	V

Note: 1. All the modes had been tested, but only the worst data was recorded in the report.
2.For the radiation test from 18 GHz to 26 GHz, a pre-scan was performed, and the result was 20 dB lower than the limit line, the test data was not shown in the report.

8. TEST PROCEDURES AND RESULTS

8.1. RF OUTPUT POWER

LIMITS

RF OUTPUT POWER	
Condition	Limit
☐ Non-adaptive Equipment	For Non-adaptive FHSS equipment, the manufacturer may have declared a reduced RF Output Power (see clause 5.4.1 m)) and associated Duty Cycle (see clause 5.4.1 e)) that will ensure that the equipment meets the requirement for the Medium Utilization (MU) factor further described in clause 4.3.1.6. This is verified by the conformance test referred to in clause 4.3.1.6.4. For non-adaptive FHSS equipment, where the manufacturer has declared an RF output power lower than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value.
☒ Adaptive Equipment	FHSS equipment shall be equal to or less than 20 dBm.

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.2

The power sensor was used for power measurement, and it use a fast power sensor with a minimum sensitivity of -40 dBm and capable of minimum 1 MS/s.

The test software was used to control the power detector and the sampling unit.

For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

Measurement	
☒Conducted measurement	☐Radiated measurement

CALCULATIONS

Add the (stated) antenna assembly gain G in dBi of the individual antenna.
• In case of smart antenna systems operating in mode with beamforming (see clause 5.3.2.2.4), add the additional beamforming gain Y in dB.
• If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
• The RF Output Power (Pout) shall be calculated using the formula below:

$$P_{out} = A + G + Y$$

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.2. DUTY CYCLE, TX-SEQUENCE, TX-GAP

TEST ENVIRONMENT

Temperature	℃	Relative Humidity	%
Atmosphere Pressure	kPa		

TEST RESULTS

N/A.

8.3. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

LIMITS

DWELL TIME		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.	
☒ Adaptive frequency hopping systems	Shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.	
MINIMUM FREQUENCY OCCUPATION TIME		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Option 1	Each hopping frequency of the Hopping Sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.
☒ Adaptive frequency hopping systems	Option 2	The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.
☐ Adaptive frequency hopping systems		
Condition	Limit	
☐ Non-adaptive frequency hopping systems	Shall contain at least N hopping frequencies where N is either 5 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.	
☒ Adaptive frequency hopping systems	shall be capable of operating over a minimum of 70 % of the 2.4 GHz to 2.4835 GHz band	
	Shall contain at least N hopping frequencies at all times, where N is either 15 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.	

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.4

Connect the UUT to the spectrum analyser and use the following settings:

Frequency Center	Equal to the hopping frequency being investigated
Frequency Span	0 Hz
Trance Mode	Clear / Write
Trigger Mode	Free Run
Detector	RMS
Sweep Point	30000
Sweep Time	Equal to the applicable observation period (see clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2)
RBW	~ 50 % of the Occupied Channel Bandwidth
VBW	≥ RBW

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%

Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.4. HOPPING FREQUENCY SEPARATION

LIMITS

HOPPING FREQUENCY SEPARATION	
Condition	Limit
☐ Non-adaptive frequency hopping systems	Shall be equal to or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.
☒ Adaptive frequency hopping systems	The minimum Hopping Frequency Separation shall be 100 kHz.

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.5

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	Centre of the two adjacent hopping frequencies
Frequency Span	Sufficient to see the complete power envelope of both hopping frequencies
Detector Mode	Max Peak
RBW	1 % of the span
VBW	3 × RBW
Trace	Max hold
Sweep Time	Auto

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.5. MEDIUM UTILIZATION (MU) FACTOR

TEST ENVIRONMENT

Temperature	℃	Relative Humidity	%
Atmosphere Pressure	kPa		

TEST RESULTS

N/A.

8.6. ADAPTIVITY (ADAPTIVE FHSS)

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A.

8.7. OCCUPIED CHANNEL BANDWIDTH

LIMITS

OCCUPIED CHANNEL BANDWIDTH		
Condition		Limit
All types of equipment		Each hopping frequency shall be within the 2400 to 2483.5 MHz band
Additional requirement	For non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm	Each hopping frequency shall be equal to or less than 20 MHz

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.7

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The center frequency of the channel under test
Frequency Span	2 × Nominal Channel Bandwidth
Detector	RMS
RBW	~ 1 % of the span without going below 1 %
VBW	3 × RBW
Trace	Max hold
Sweep Time	1s

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.8. TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

LIMITS

Transmitter Unwanted Emissions in The Out-Of-Band Domain	
Condition	Limit
Under Normal Test Condition	The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure 3.

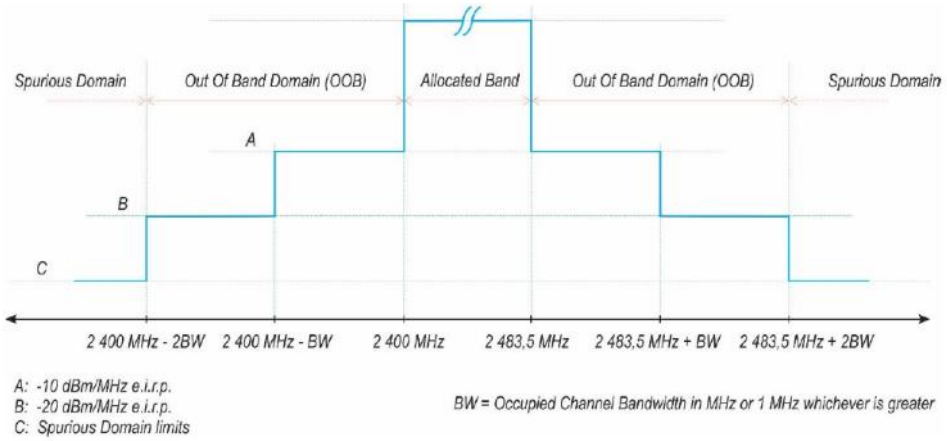


Figure 3: Transmit mask

TEST PROCEDURE

Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.8

Measurement	
☒Conducted measurement	☐Radiated measurement

Connect the UUT to the spectrum analyser and use the following settings:

Span	Zero Span
Filter Mode	Channel Filter
Trace Mode	Max Hold
Trigger Mode	Video
Detector	RMS
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
RBW / VBW	1MHz / 3MHz
Measurement Mode	Time Domain Power
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.9. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMITS

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

TEST PROCEDURE

Refer to Refer to ETSI EN 300 328 V2.2.2 (2019-07) clause 5.4.9

Measurement	
☒Conducted measurement	☐Radiated measurement

Spectrum analyser settings for pre-scan:

RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented.

Sweep Time	For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel. For FHSS equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies. The above sweep time setting may result in long measuring times in case of FHSS equipment. To avoid such long measuring times, an FFT analyser may be used.

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep
Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	Sweep time [µs] / (1 µs) with a maximum of 30 000
Sweep Time	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.10. RECEIVER SPURIOUS EMISSIONS

LIMITS

The spurious emissions of the receiver shall not exceed the values given in table 13.
In case of non-FHSS equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST PROCEDURE

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Measurement	
☒Conducted measurement	☐Radiated measurement

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.10

Spectrum analyser settings for pre-scan:

RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Detector Mode	Peak
Filter type	3 dB (Gaussian)
Trace Mode	Max hold
Sweep Points	⩾ 19 400 (< 1 GHz); ⩾ 23 500 (> 1 GHz); for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented.
Sweep Time	Auto

Spectrum analyser settings for the emissions identified during the pre-scan:

Measurement Mode	Time Domain Power
Centre Frequency	Frequency of the emission identified during the pre-scan
RBW	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
VBW	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span	Zero Span
Sweep Mode	Single Sweep

Detector Mode	RMS
Trace Mode	Max hold
Trigger Mode	Video (burst signals) or Manual (continuous signals)
Sweep Points	≥ 30 000
Sweep Time	30 ms

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

Please refer to section "Test Data" - Appendix A

8.11. RECEIVER BLOCKING

LIMITS

Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.
For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 14, table 15 or table 16.

☒ Receiver Category 1

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		

NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

☐ Receiver Category 2

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

☐ Receiver Category 3

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 30 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

TEST PROCEDURE

Please refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11

Measurement	
☒Conducted measurement	☐Radiated measurement

Step 1:
• For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 2:
• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.
Step 3:
• With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6.
• Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for the wanted signal shall be recorded in the test report.
• When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin. This signal level (Pmin) is increased by the value provided in note 2 of the applicable table corresponding to the receiver category and type of equipment.
Step 4:
• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.
Step 5:
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:
- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.

• It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.
Step 6:
• Repeat step 4 and step 5 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.
Step 7:
• For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).
Step 8:
• It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

TEST ENVIRONMENT

Temperature	20.1℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

TEST RESULTS

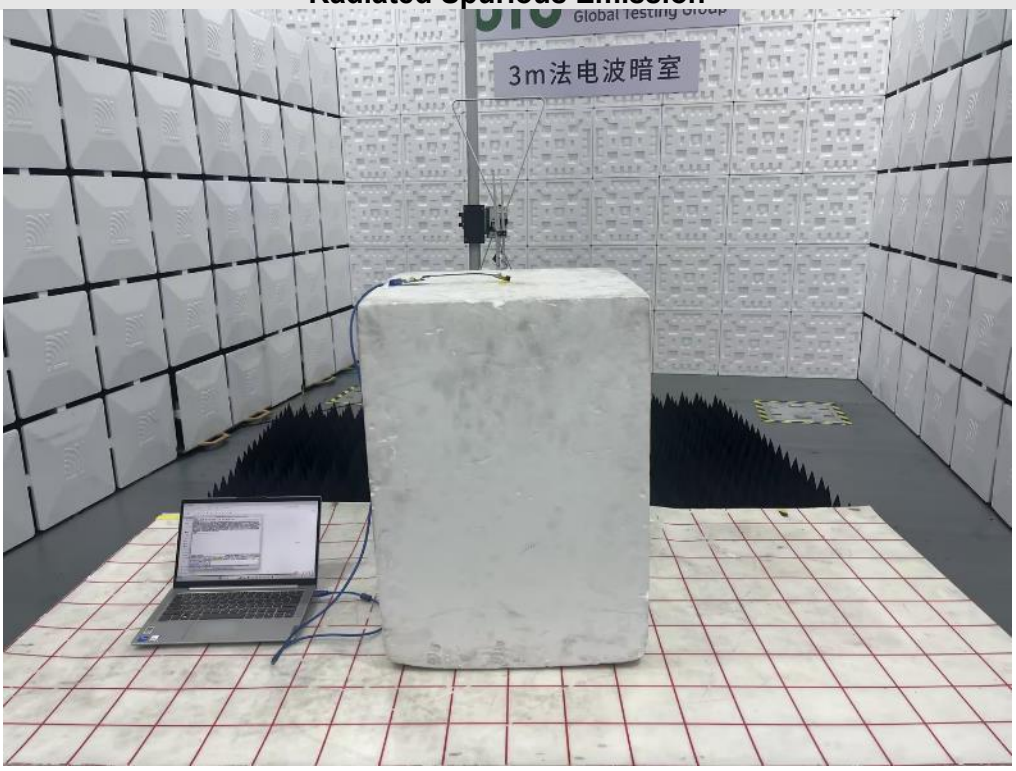
Please refer to section "Test Data" - Appendix A

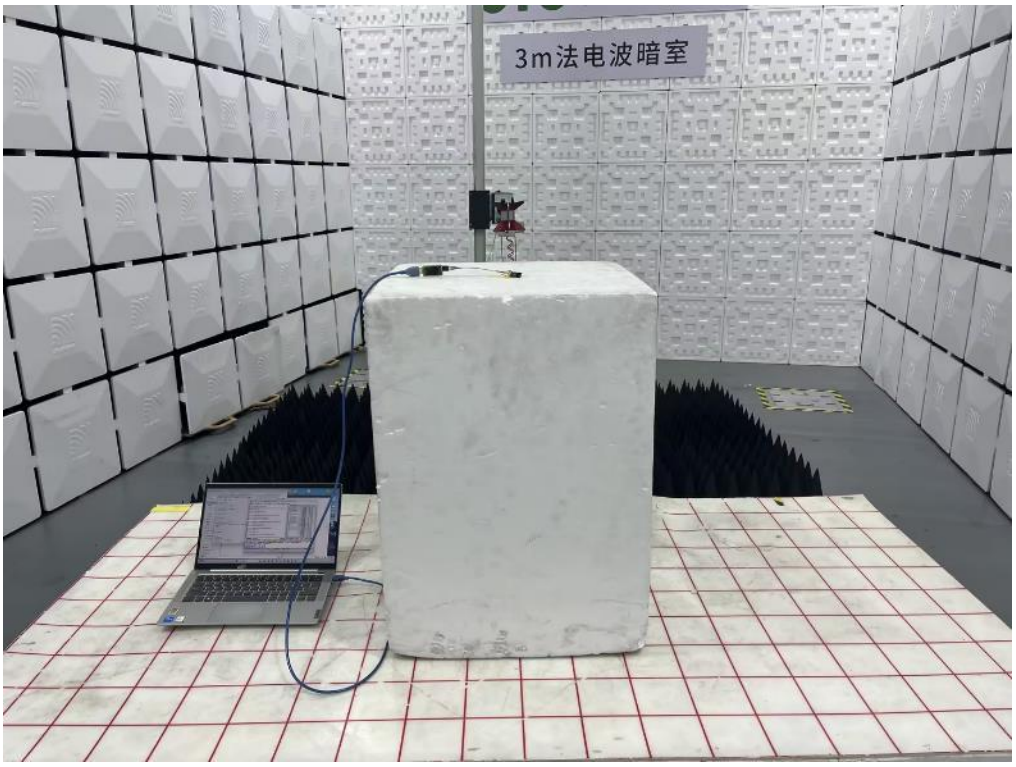
9. TEST DATA

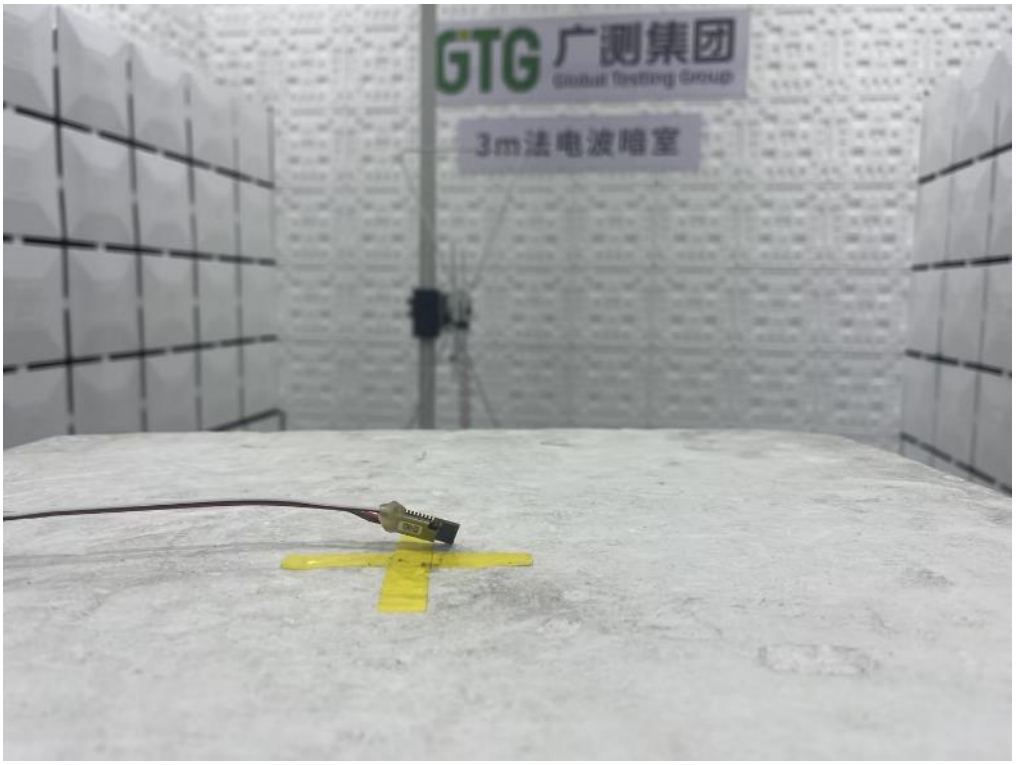
Please refer to section "Test Data" - Appendix A

APPENDIX: PHOTOGRAPHS OF TEST CONFIGURATION

Radiated Spurious Emission






GTG 广测集团
Global Testing Group
3m法电波暗室

APPENDIX: PHOTOGRAPHS OF THE EUT

Please refer to the report: E04A24020079E00101.

END OF REPORT