Certificate No.: 3745.01

FCC - TEST REPORT

Report Number	:	709502310219-00C	Date of Issue:	March 7, 2024

Model	:	SC162-WCD3
Product Type	:	Smart Battery Doorbell
Applicant	:	Zhejiang Lingzhu Technology Co., Ltd
Address	:	Room 302,No 1 Building Huace Center,Xihu District, Hangzhou City, Zhejiang Province,China
Manufacturer	:	Zhejiang Lingzhu Technology Co., Ltd
Address	:	Room 302,No 1 Building Huace Center,Xihu District, Hangzhou City, Zhejiang Province,China
Test Result	:	■ Positive ☐ Negative
Total pages including Appendices	:	50

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1 Table of Contents

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2 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
-00C	First Issue	03/07/2024

3 Details about the Test Laboratory

Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch No.16 Lane, 1951 Du Hui Road, Shanghai 201108, P.R. China
Telephone:	+86 21 6141 0123
Fax:	+86 21 6140 8600
FCC Registration No.:	820234
FCC Designation Number:	CN1183
ISED CAB identifier	CN0101
IC Registration No.:	31668

4 Description of the Equipment under Test

Product:	Smart Battery Doorbell
Model no.:	SC162-WCD3
FCC ID:	2BEWXSC162
Options and accessories:	NA
Rating:	5V DC by lithium-ion battery, AC 8-24V or 5V Input (type C)
RF Transmission Frequency:	802.11b/g/n-HT20: 2412~2462 MHz (Wi-Fi) 802.11n-HT40: 2422~2452 MHz (Wi-Fi) 2402~2480 MHz (BLE5.0) 433.92MHz (SRD)

No. of Operated Channel:

802.11b/g/n(HT20)					802.11n(HT40)		
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
1	2412	7	2442	3	2422	8	2447MHz
2	2417	8	2447	4	2427	9	2452MHz
3	2422	9	2452	5	2432		
4	2427	10	2457	6	2437		
5	2432	11	2462	7	2442		
6	2437						

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

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Modulation:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g/n; 2.4GHz BLE: GFSK (1Mbps and 2Mbps) 433.92MHz: ASK
Hardware Version:	V1.0.2
Software Version:	V2
Antenna Type:	FPC Antenna for 2.4GHz Spring antenna for 433.92MHz
Antenna Gain:	0.45dBi for 2.4GHz; -2.01dBi for 433.92MHz
Description of the EUT:	The EUT was a Smart Battery Doorbell which has Wi-Fi and BLE function, it also can transmit at 433.92MHz. We tested it and listed the worst data in this report. This report is only for BLE.
Test sample no.:	SHA-781837-2 (RF Radiated and Conducted)

The sample's mentioned in this report is/are submitted/ supplied/ manufactured by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

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5 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2023 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).

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6 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	13-17	Site 1	☒	☐	☐
§15.247 (b) (3)	Conducted peak output power	18-20	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth	21-23	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	24-26	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	27-33	Site 1	☒	☐	☐
§15.247(d)	Band edge	34-38	Site 1	☒	☐	☐
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	39-46	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.
Note 1: The EUT uses a FPC antenna, gain is 0.45dBi for 2.4GHz and spring antenna, gain is -2.01dBi for 433.92MHz. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

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7 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2BEWXSC162 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

This report in only for 2.4GHz BLE.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	January 5, 2024
Testing Start Date:	January 8, 2024
Testing End Date:	January 30, 2024

-TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:	Prepared by:	Tested by:
Hui TONG	Jiaxi XU	Cheng Huali
Review Engineer	Project Engineer	Test Engineer

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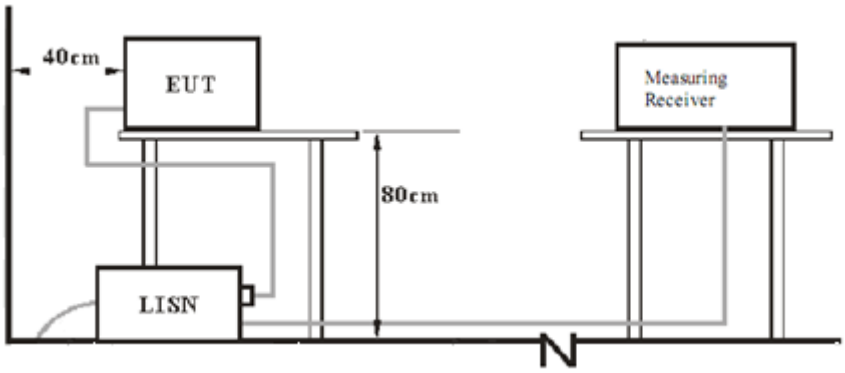
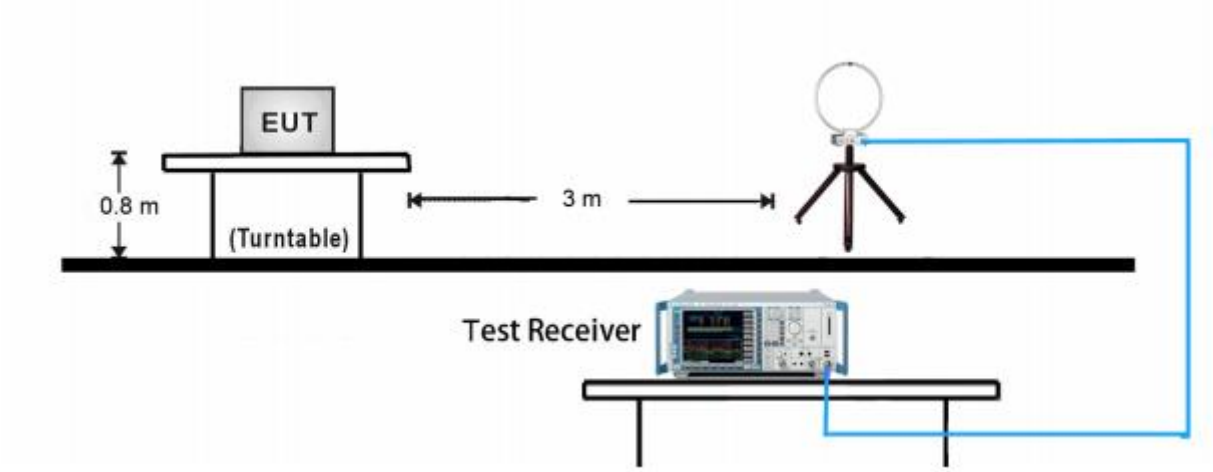
8 Test Setups

7.1 AC Power Line Conducted Emission test setups



7.2 Radiated test setups

9kHz ~ 30MHz Test Setup:



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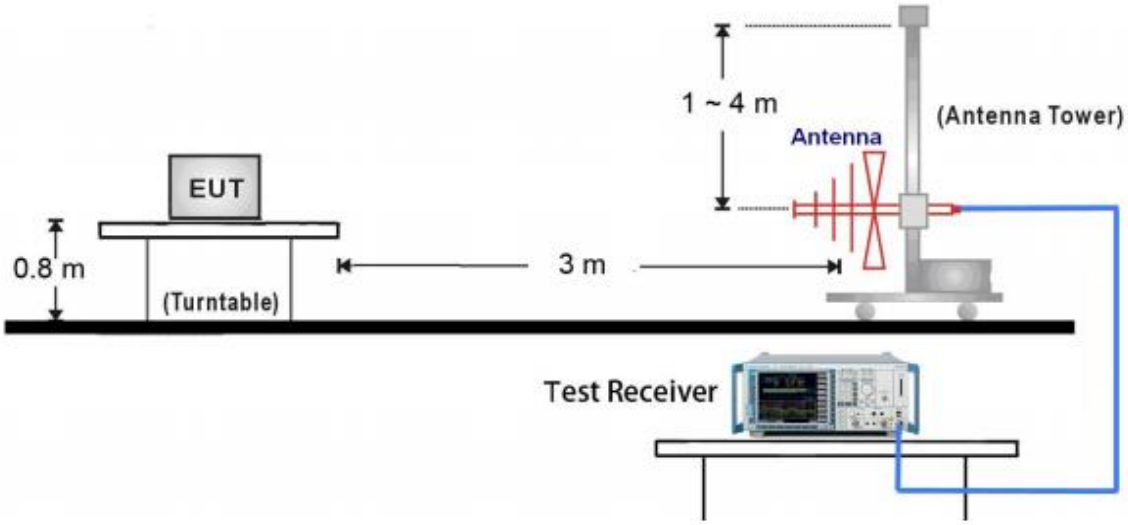
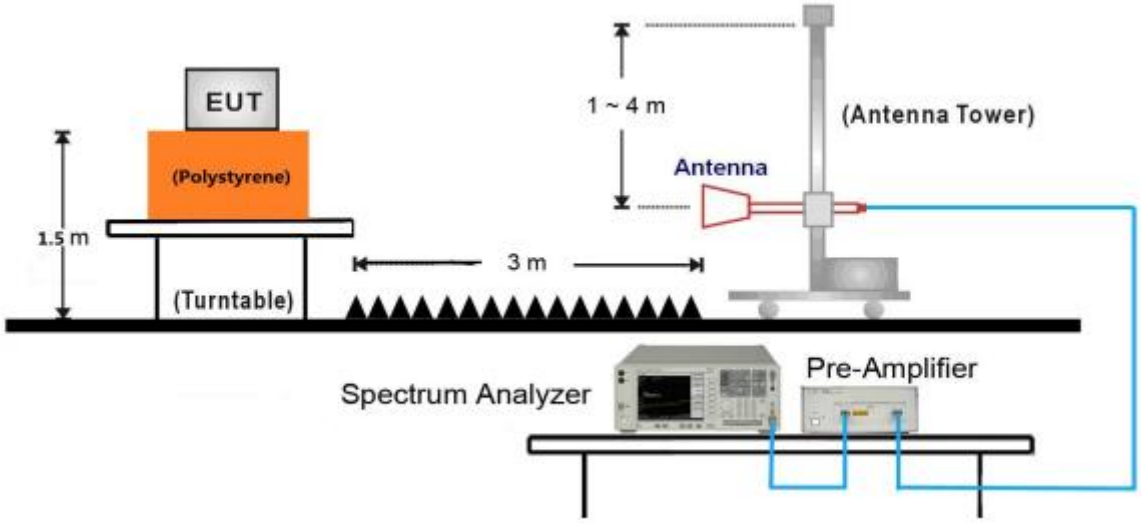
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



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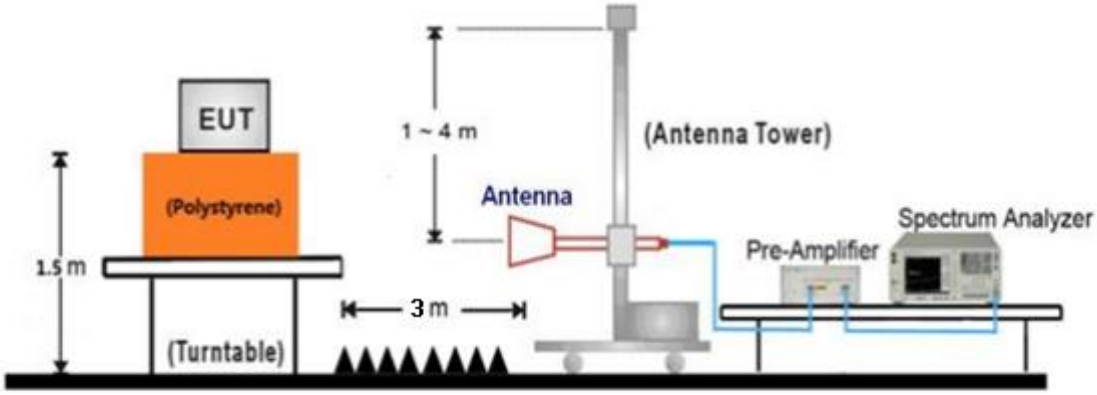
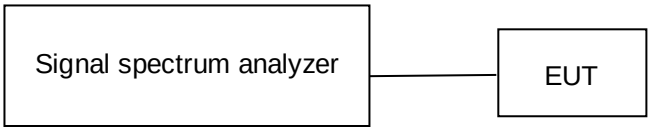
18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



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9 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenovo	E470	PF-OU5TS7 17/09
AC/DC adapter	MLF	MLF-A260502000UU	--
AC/AC adapter	Mu Tang	MT48-0025	--

Test software: RTLBTAPP.exe, which used to control the EUT in continues transmitting mode

The system was configured to channel 0, 19, and 39 for the test.

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Power level setting
Bluetooth LE	0	1	GFSK	06
	19	1	GFSK	06
	39	1	GFSK	06
Bluetooth LE	0	2	GFSK	06
	19	2	GFSK	06
	39	2	GFSK	06

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

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10 Technical Requirement

10.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

According to §15.207, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

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Conducted Emission

150k-30MHz Conducted Emission Test

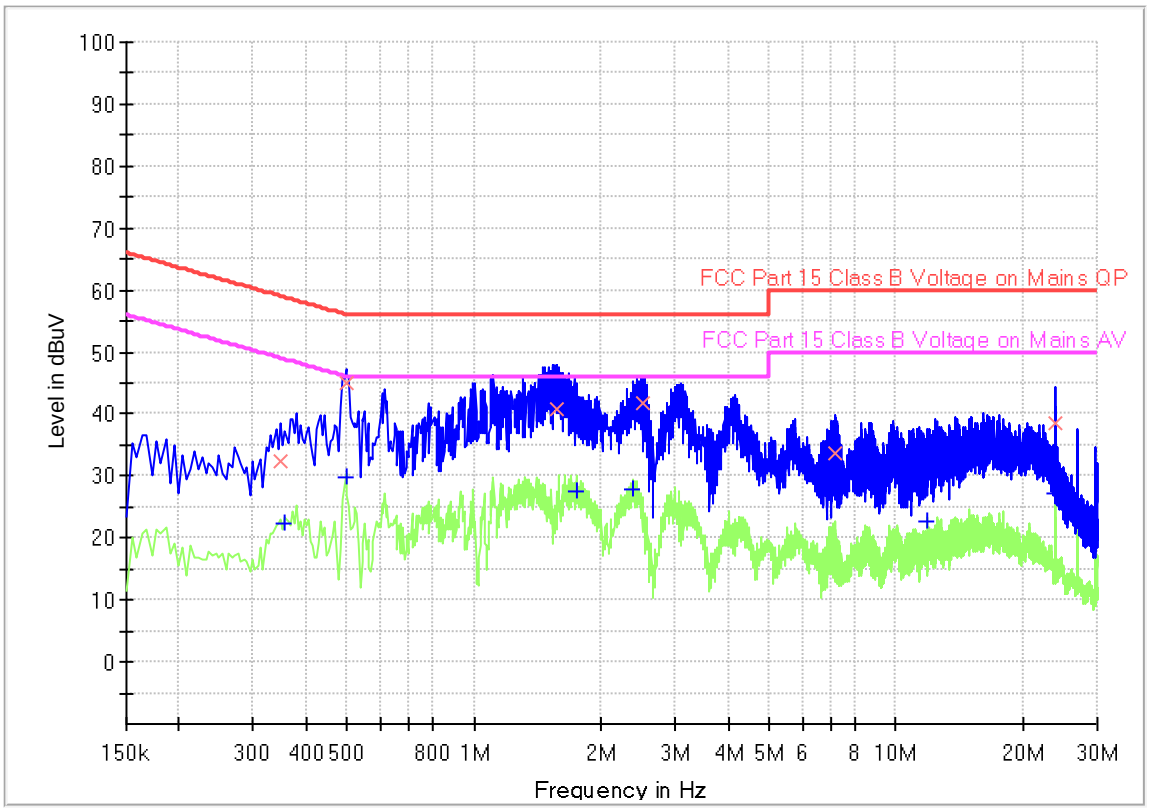
EUT Information

EUT Name:	Smart Battery Doorbell
Model	SC162-WCD3
Client:	Zhejiang Lingzhu Technology Co., Ltd
Op Cond	Power on and charging, TX_2402MHz at 2Mbps mode, AC 120V/60Hz, T21.5, H32.6%, P103.2kPa
Operator:	Huali CHENG
Standard	FCC Part 15.207(a)
Comment:	Phase L
Sample No.:	SHA-781837-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup:	Voltage with 2-Line-LISN
Receiver:	[ESR 3]
Level Unit:	dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB



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Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.348000	32.25	---	59.01	26.76	1000.0	9.000	L1	19.5
0.357000	---	22.34	48.80	26.46	1000.0	9.000	L1	19.5
0.496500	---	29.81	46.06	16.25	1000.0	9.000	L1	19.4
0.496500	45.15	---	56.06	10.91	1000.0	9.000	L1	19.4
1.567500	40.76	---	56.00	15.24	1000.0	9.000	L1	19.5
1.743000	---	27.55	46.00	18.45	1000.0	9.000	L1	19.5
2.391000	---	27.93	46.00	18.07	1000.0	9.000	L1	19.5
2.508000	41.77	---	56.00	14.23	1000.0	9.000	L1	19.5
7.138500	33.56	---	60.00	26.44	1000.0	9.000	L1	19.7
11.913000	---	22.72	50.00	27.28	1000.0	9.000	L1	19.9
23.946000	---	27.29	50.00	22.71	1000.0	9.000	L1	20.9
23.946000	38.53	---	60.00	21.47	1000.0	9.000	L1	20.9

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150k-30MHz Conducted Emission Test

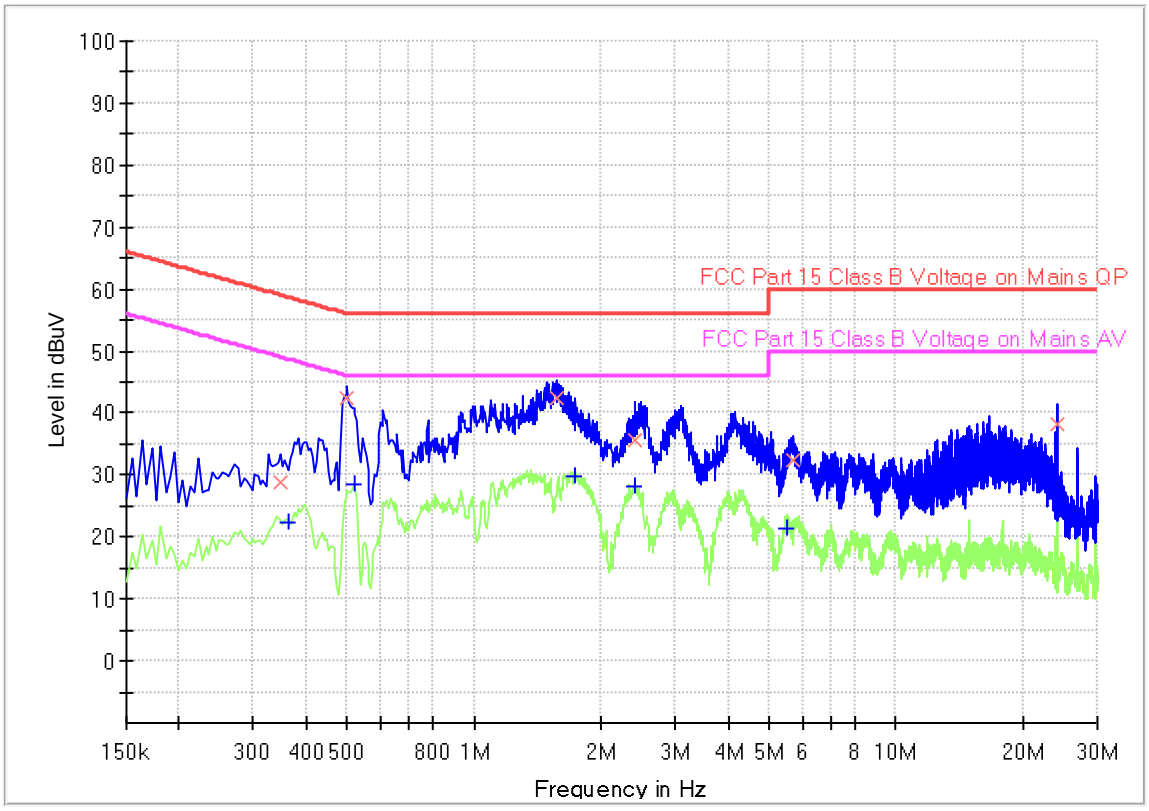
EUT Information

EUT Name:	Smart Battery Doorbell
Model	SC162-WCD3
Client:	Zhejiang Lingzhu Technology Co., Ltd
Op Cond	Power on and charging, TX_2402MHz at 2Mbps mode, AC 120V/60Hz, T21.5, H32.6%, P103.2kPa
Operator:	Huali CHENG
Standard	FCC Part 15.207(a)
Comment:	Phase N
Sample No.:	SHA-781837-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup:	Voltage with 2-Line-LISN
Receiver:	[ESR 3]
Level Unit:	dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB



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Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.348000	28.76	---	59.01	30.25	1000.0	9.000	N	19.5
0.361500	---	22.44	48.69	26.25	1000.0	9.000	N	19.5
0.501000	42.33	---	56.00	13.67	1000.0	9.000	N	19.5
0.519000	---	28.45	46.00	17.55	1000.0	9.000	N	19.5
1.563000	42.37	---	56.00	13.63	1000.0	9.000	N	19.5
1.738500	---	29.68	46.00	16.32	1000.0	9.000	N	19.5
2.404500	---	28.09	46.00	17.91	1000.0	9.000	N	19.5
2.409000	35.70	---	56.00	20.30	1000.0	9.000	N	19.5
5.545500	---	21.42	50.00	28.58	1000.0	9.000	N	19.6
5.685000	32.27	---	60.00	27.73	1000.0	9.000	N	19.6
23.995500	---	26.17	50.00	23.83	1000.0	9.000	N	20.5
23.995500	38.21	---	60.00	21.79	1000.0	9.000	N	20.5

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

Note 2: This test mode (USB input 5V) is worse than AC power on mode, therefore no data about AC power on mode appeared in the report.

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10.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
   RBW > the 6 dB bandwidth of the emission being measured, VBW≥3RBW, Span≥3RBW
   Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

According to §15.247 (b) (3), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

Data transmission rate:1Mbps		
Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	8.14	Pass
Middle channel 2440MHz	7.77	Pass
High channel 2480MHz	6.67	Pass

Data transmission rate:2Mbps		
Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	8.18	Pass
Middle channel 2440MHz	7.32	Pass
High channel 2480MHz	6.27	Pass

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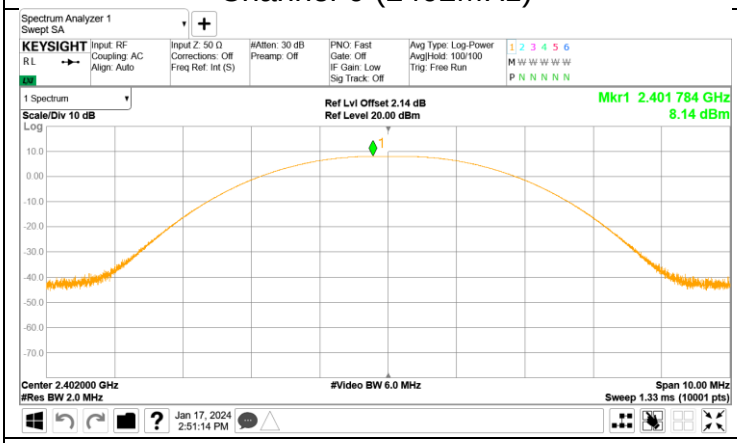
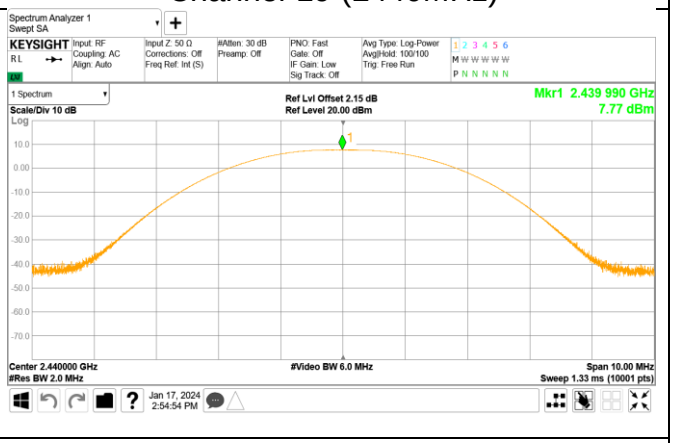
Peak output power (1Mbps)

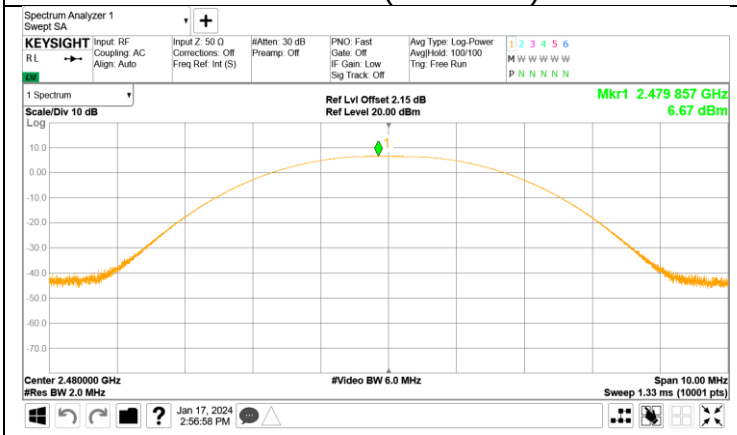
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)



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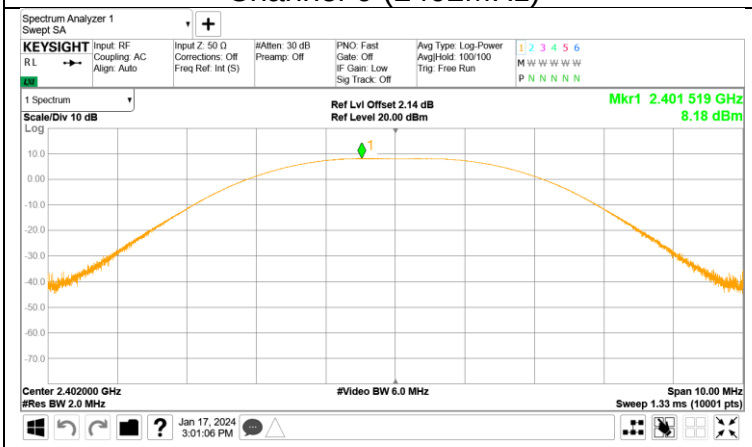
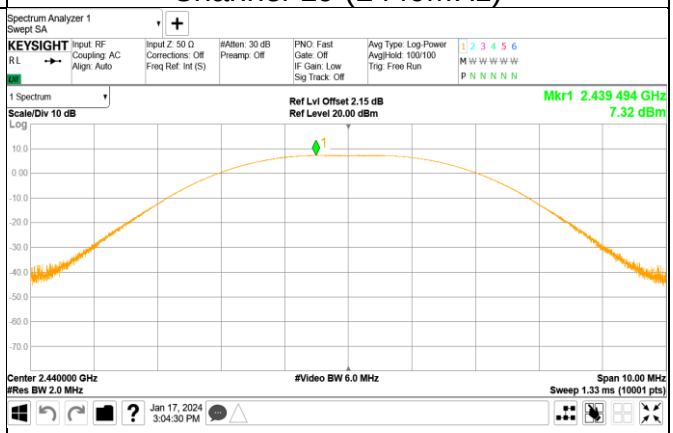
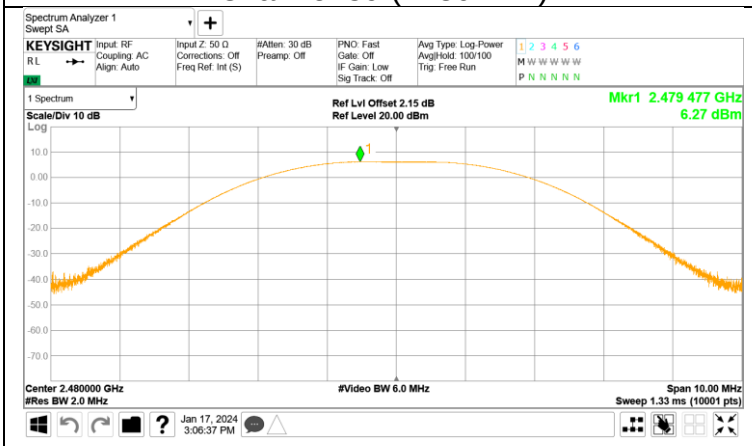
Peak output power (2Mbps)	
Channel 0 (2402MHz)	Channel 19 (2440MHz)
	
Channel 39 (2480MHz)	
	

10.3 6dB bandwidth

Test Method

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW=100KHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Use the automatic bandwidth measurement capability of an instrument, use the X dB bandwidth mode with X set to 6 dB.
5. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Limit

Limit [kHz]
≥500

Test result

Data transmission rate	Frequency MHz	6dB bandwidth (MHz)		Result
		result	limit	verdict
1Mbps	2402	0.65	≥0.5	Pass
	2440	0.638	≥0.5	Pass
	2480	0.636	≥0.5	Pass
2Mbps	2402	1.119	≥0.5	Pass
	2440	1.122	≥0.5	Pass
	2480	0.921	≥0.5	Pass

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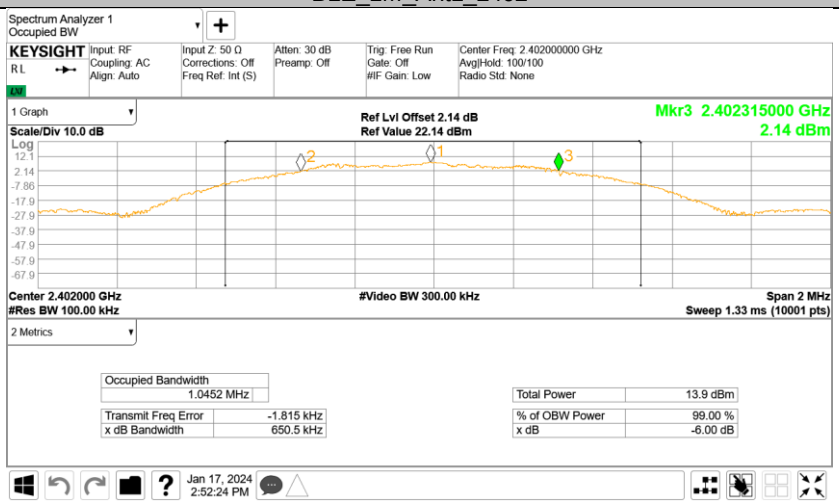
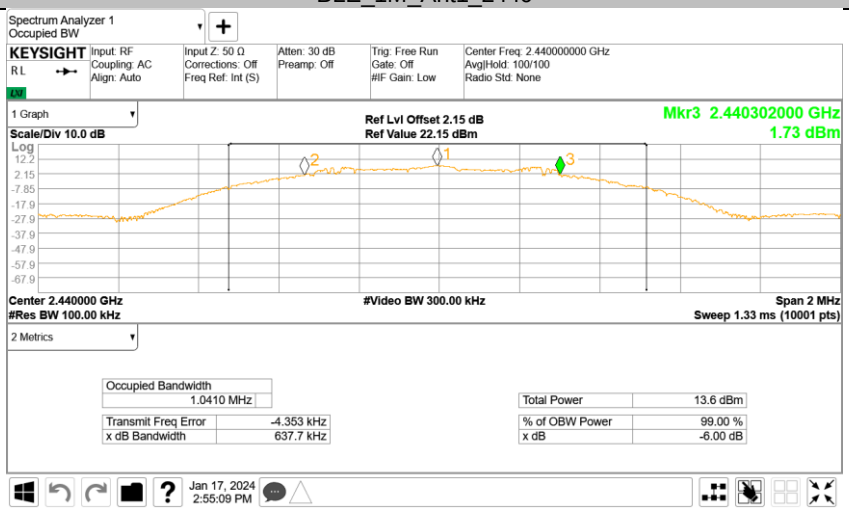
6dB Bandwidth

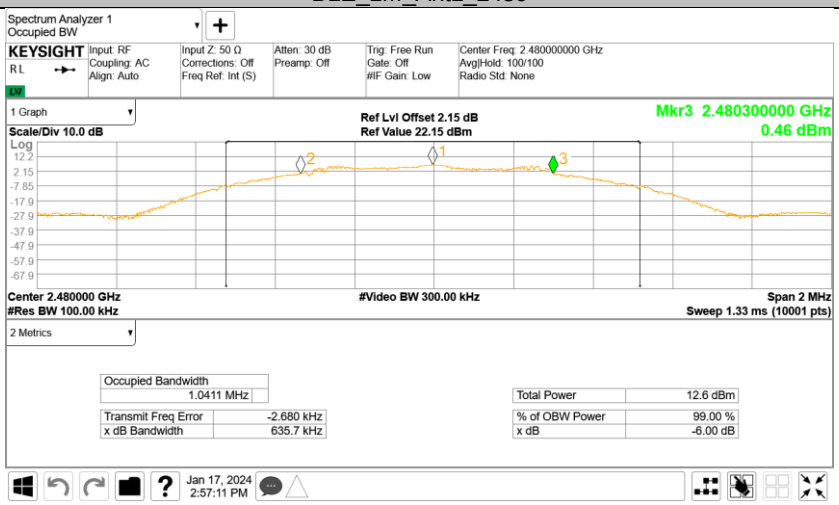
BLE_1M_Ant1_2402



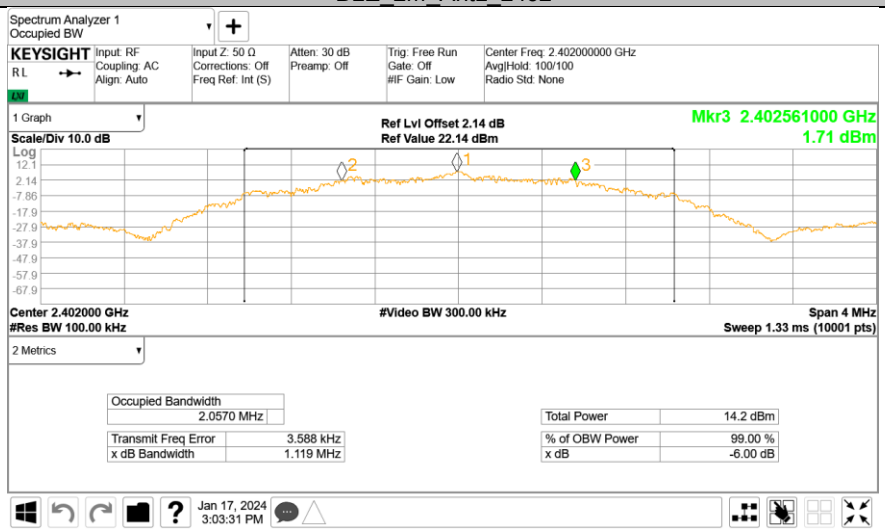
BLE_1M_Ant1_2440



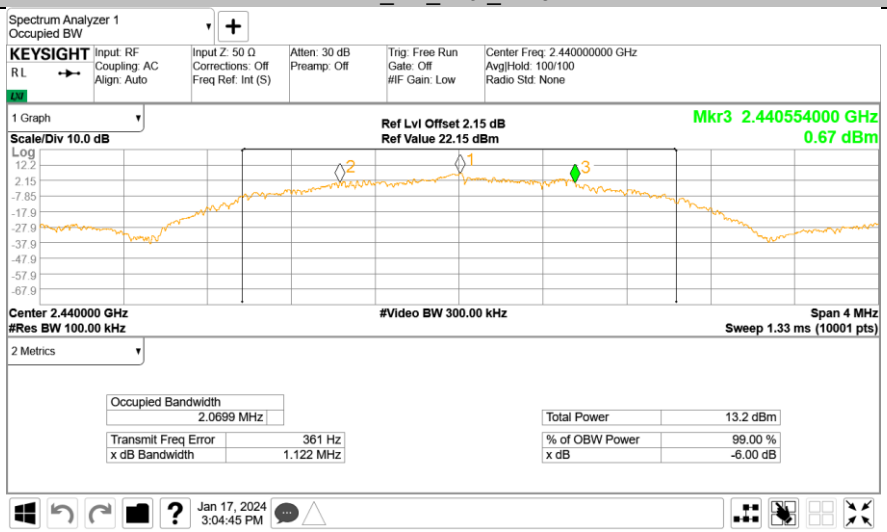
BLE_1M_Ant1_2480



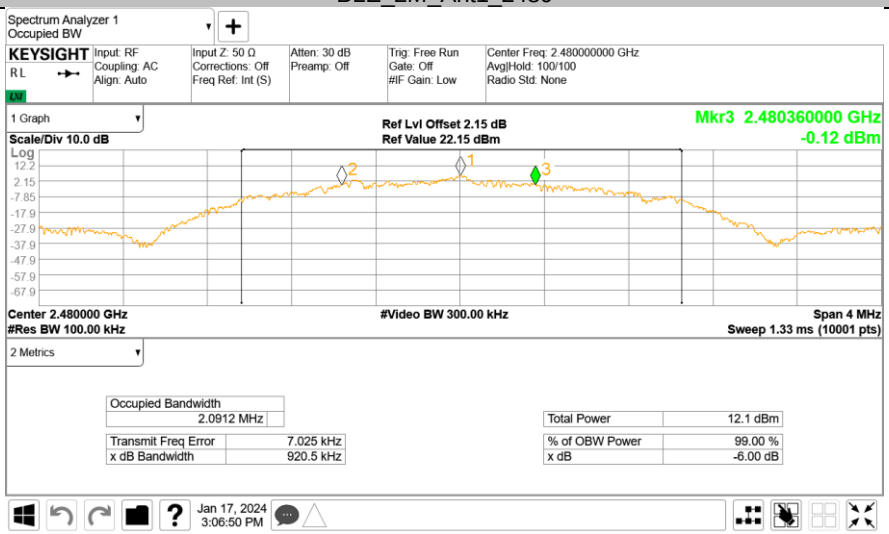
BLE_2M_Ant1_2402



BLE_2M_Ant1_2440



BLE_2M_Ant1_2480



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10.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3kHz]
⩽8

Test result

Data transmission rate	Frequency	Power spectral density	Result
1Mbps	MHz	dBm/3kHz	
	Top channel 2402MHz	-6.45	Pass
	Middle channel 2440MHz	-8.04	Pass
	Bottom channel 2480MHz	-8.41	Pass
2Mbps	Top channel 2402MHz	-8.96	Pass
	Middle channel 2440MHz	-10.4	Pass
	Bottom channel 2480MHz	-10.92	Pass

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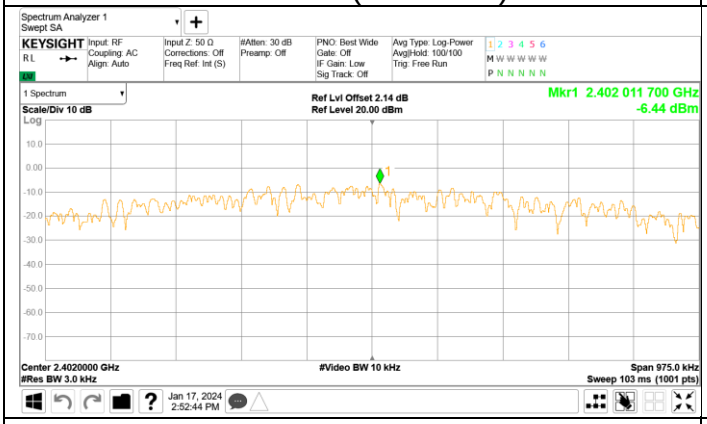
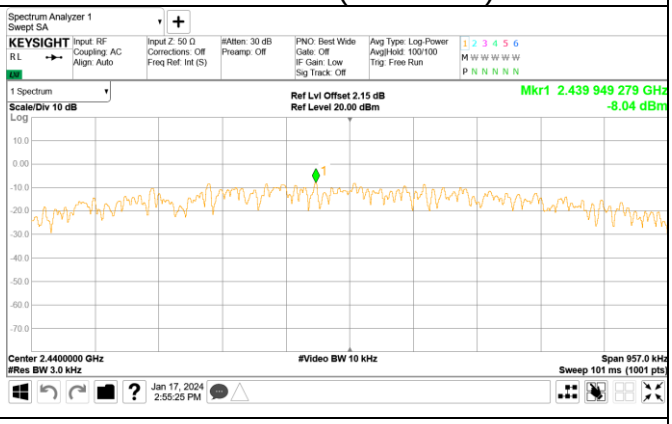
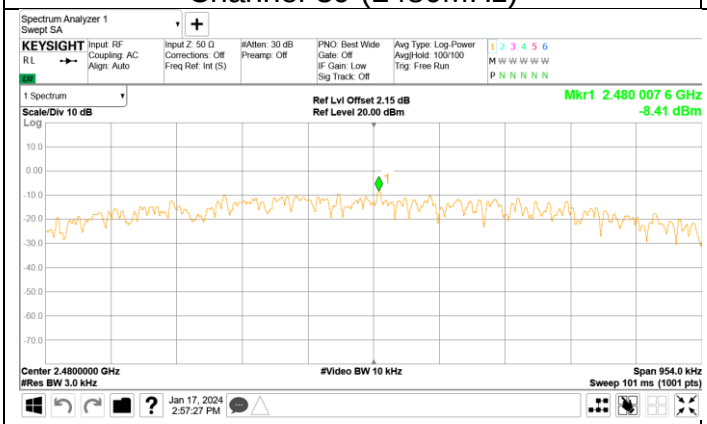
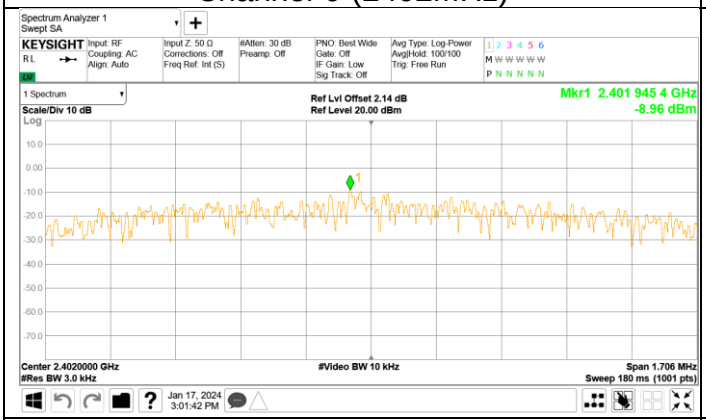
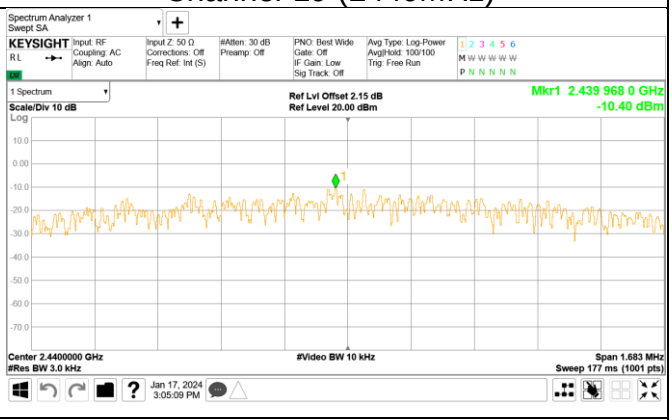
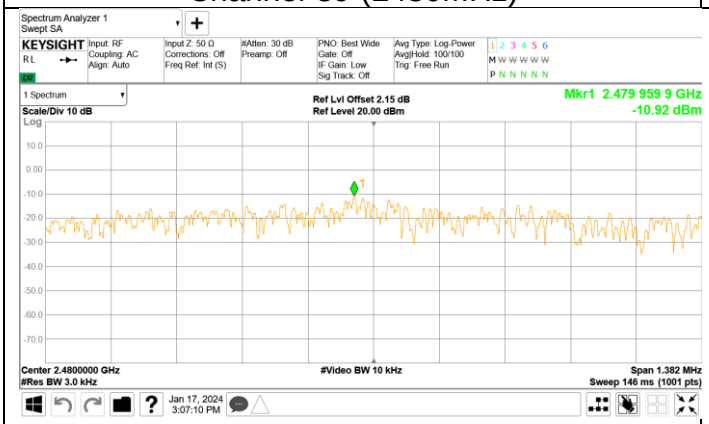
PK PSD (1Mbps)	
Channel 0 (2402MHz)	Channel 19 (2440MHz)
	
Channel 39 (2480MHz)	
	

PK PSD (2Mbps)	
Channel 0 (2402MHz)	Channel 19 (2440MHz)
	
Channel 39 (2480MHz)	
	

10.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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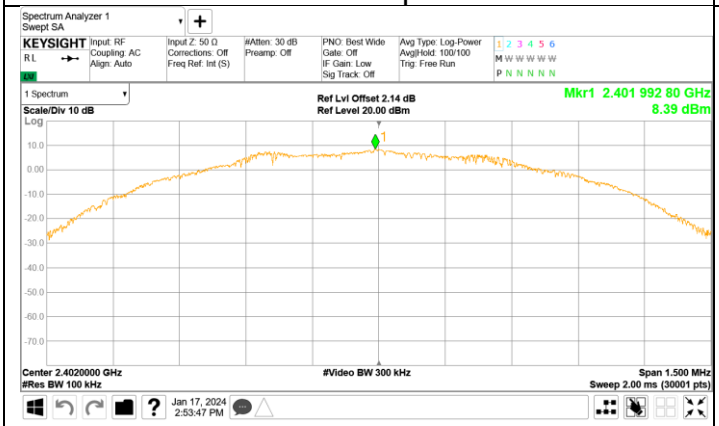
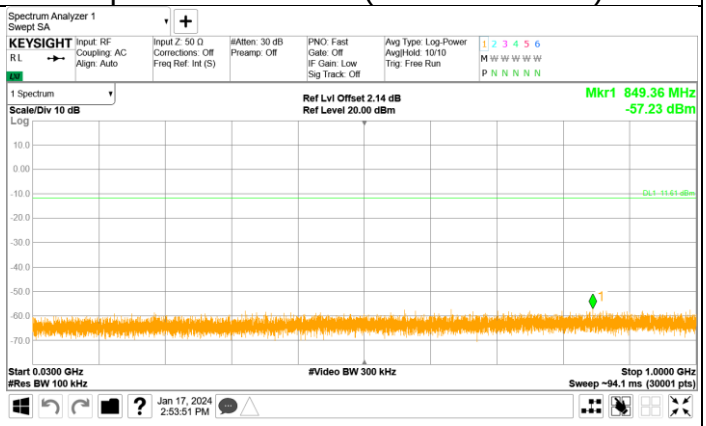
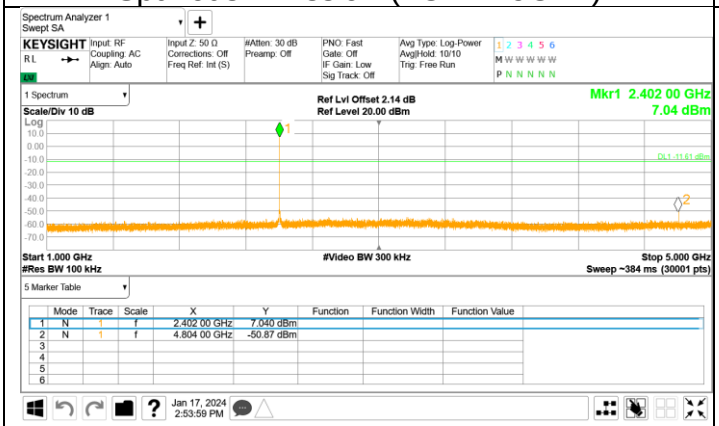
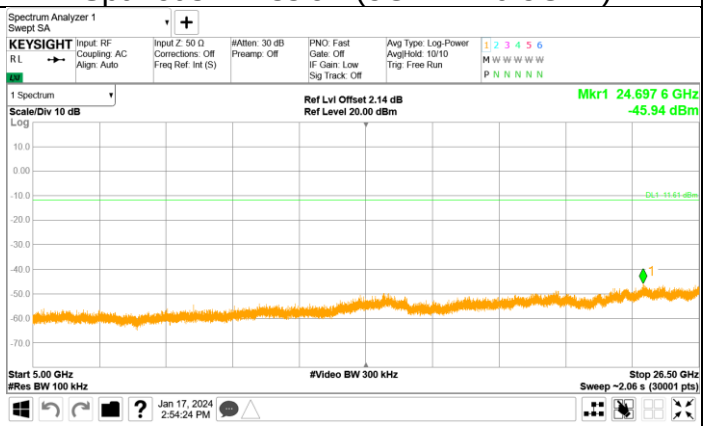
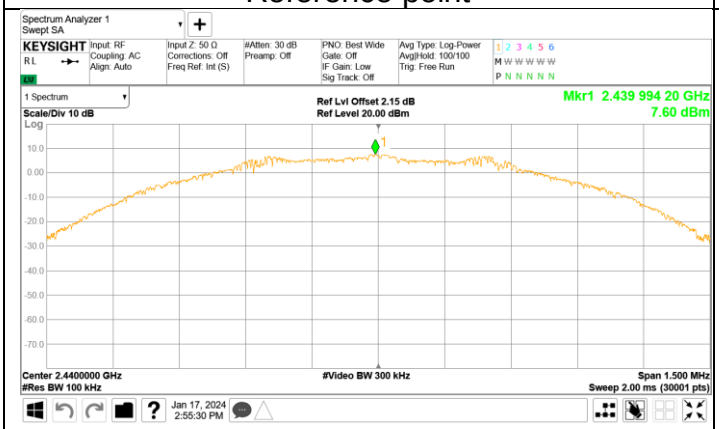
Spurious RF conducted emissions

Out-of-Band Emissions (1Mbps)	
Channel 0 (2402MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

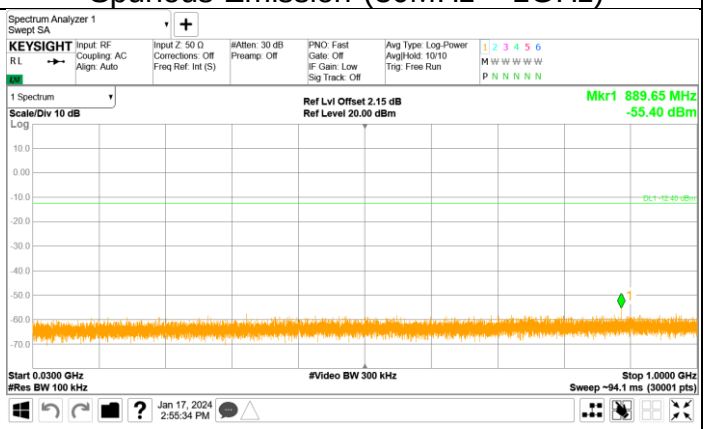
Out-of-Band Emissions (1Mbps)

Channel 19 (2440MHz)

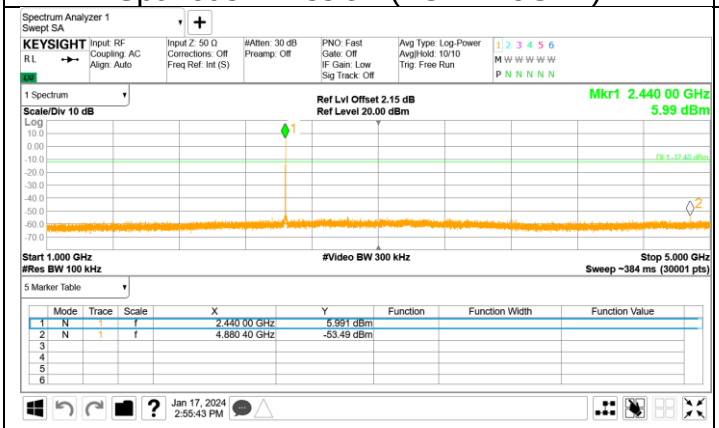
Reference point



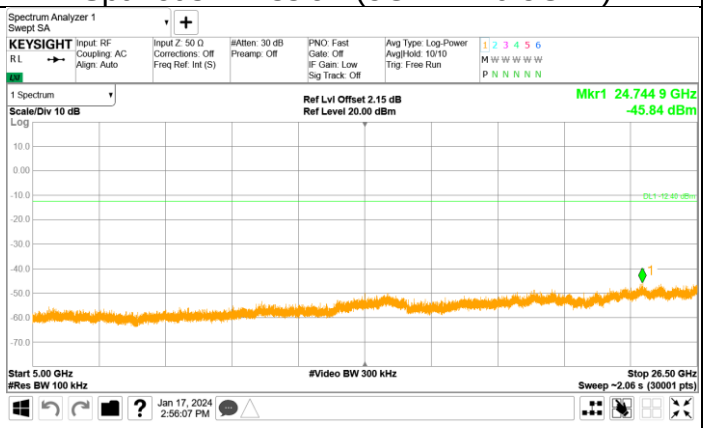
Spurious Emission (30MHz – 1GHz)

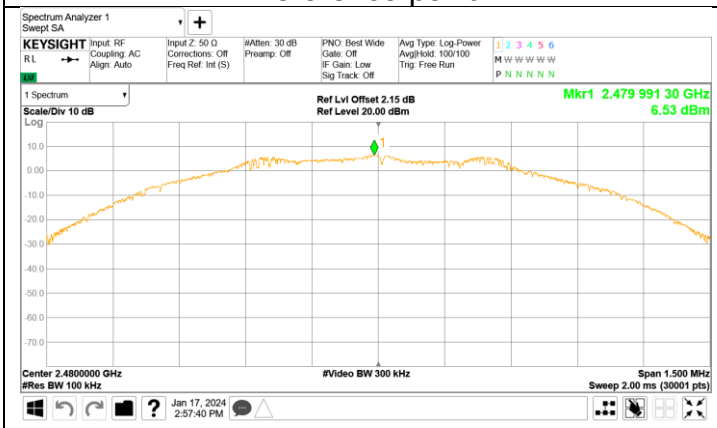
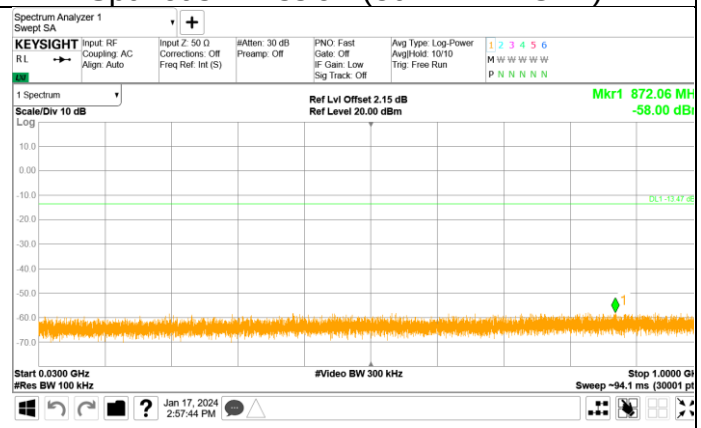
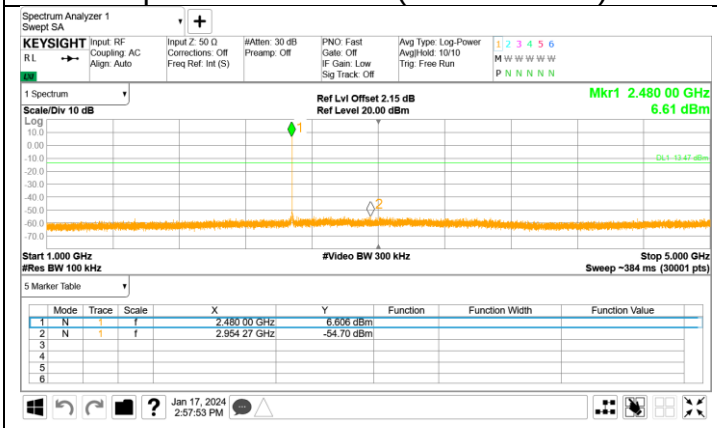
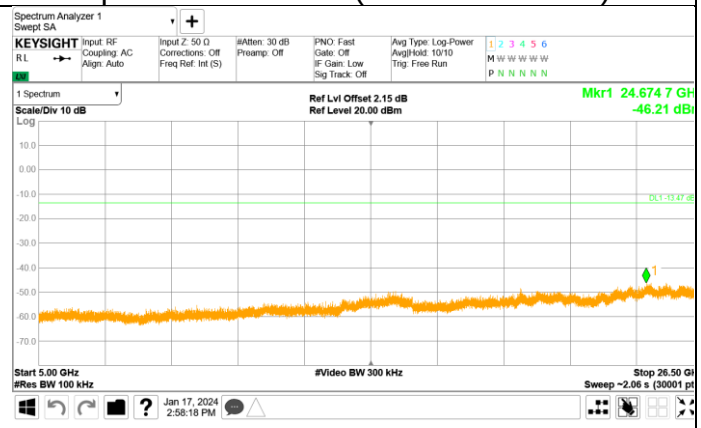


Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



Out-of-Band Emissions (1Mbps)	
Channel 39 (2480MHz)	
Reference point	Spurious Emission (30MHz – 1GHz)
	
Spurious Emission (1GHz –5GHz)	Spurious Emission (5GHz –26.5GHz)
	

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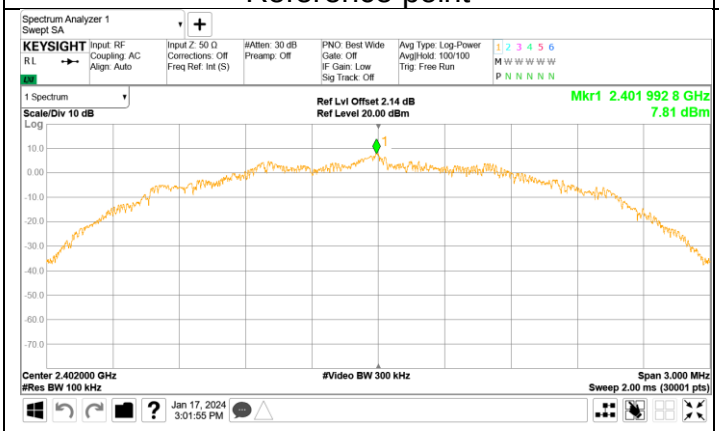
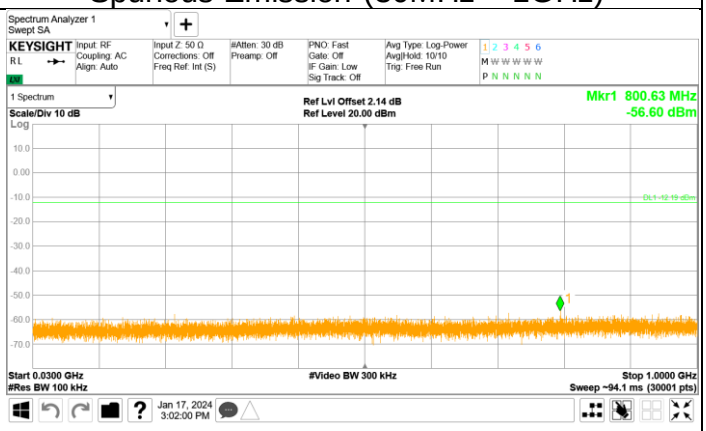
Out-of-Band Emissions (2Mbps)

Channel 0 (2402MHz)

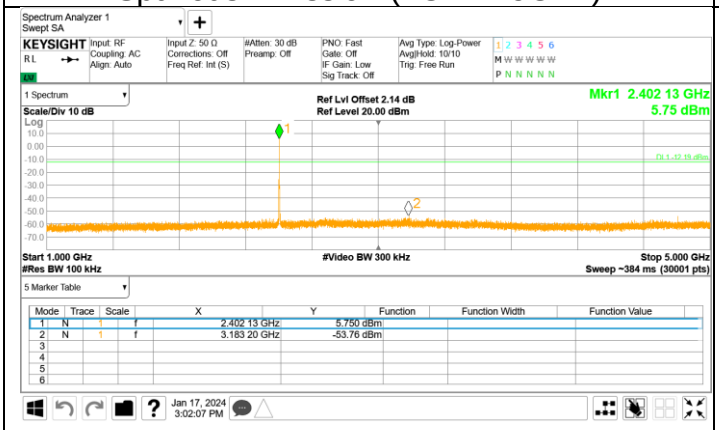
Reference point



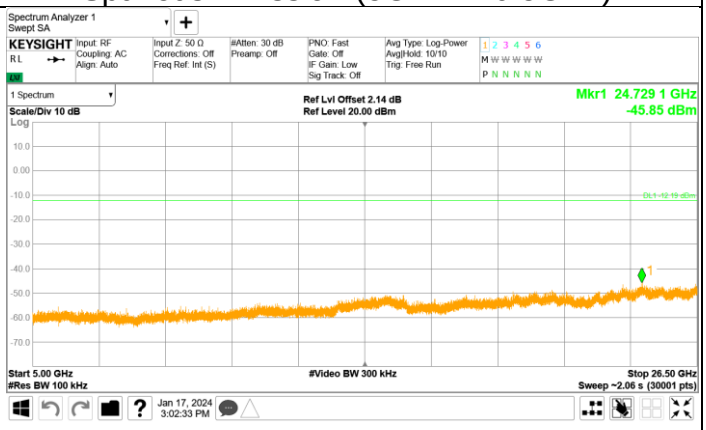
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



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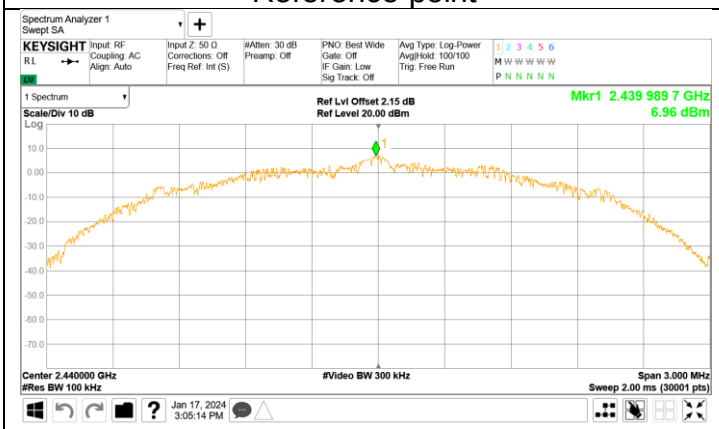
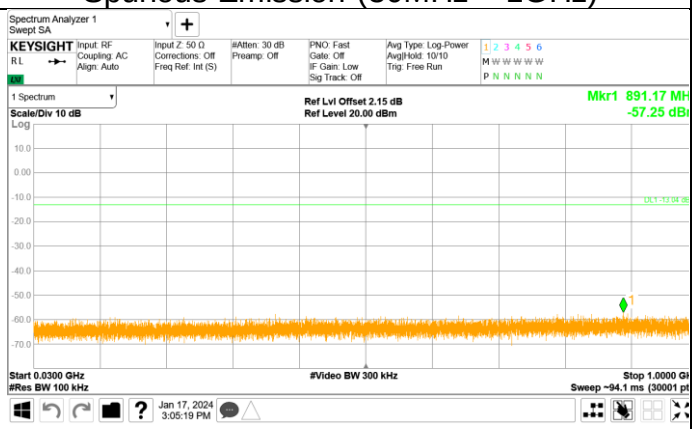
Out-of-Band Emissions (2Mbps)

Channel 19 (2440MHz)

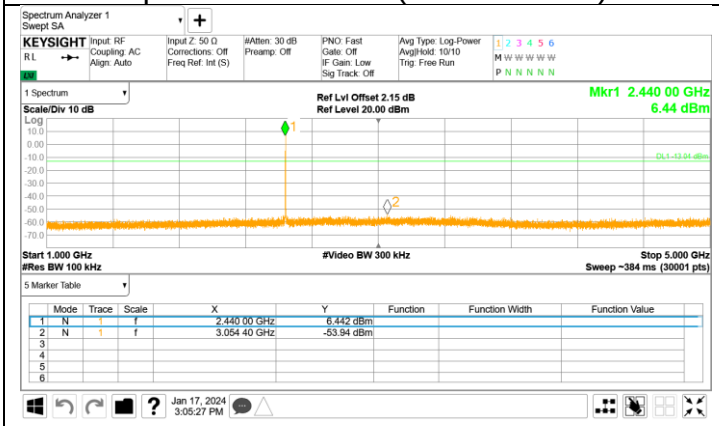
Reference point



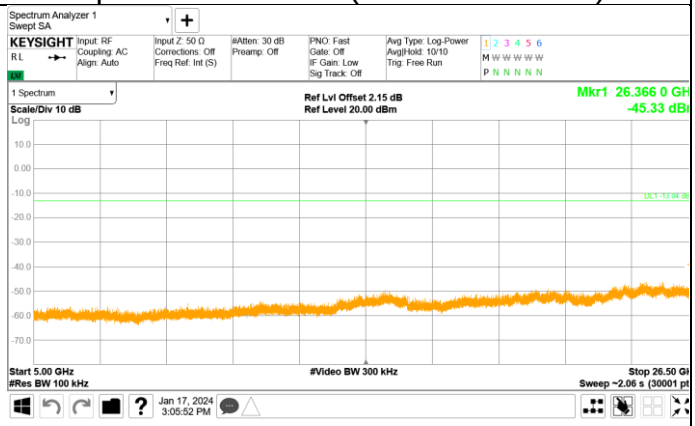
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



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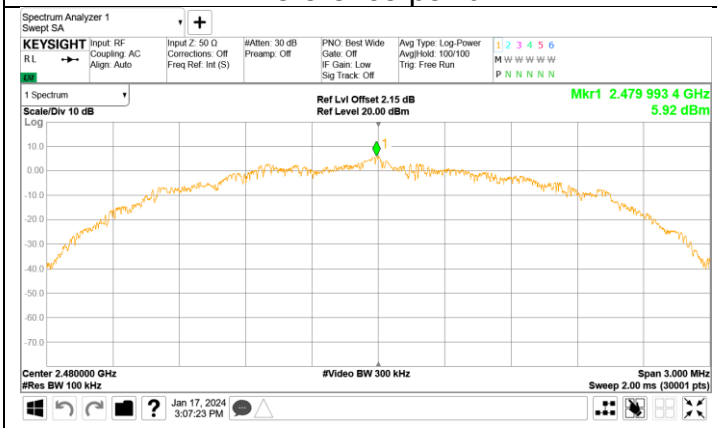
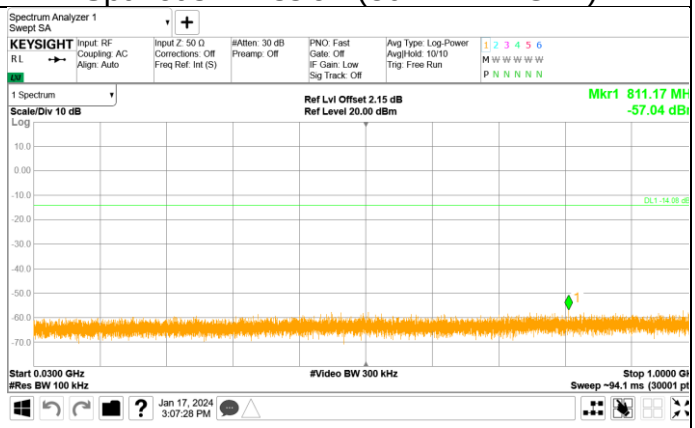
Out-of-Band Emissions (2Mbps)

Channel 39 (2480MHz)

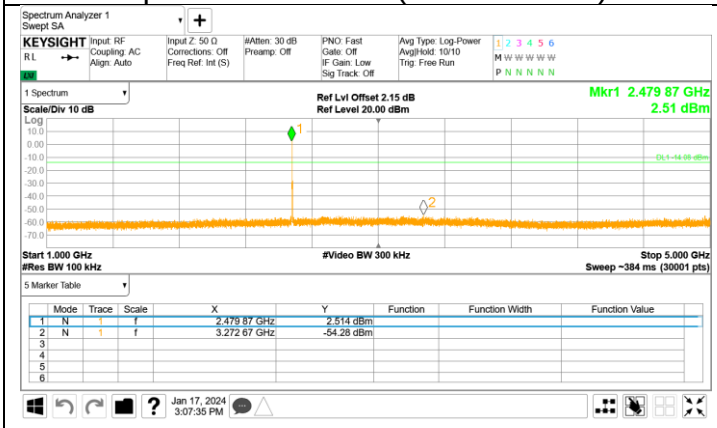
Reference point



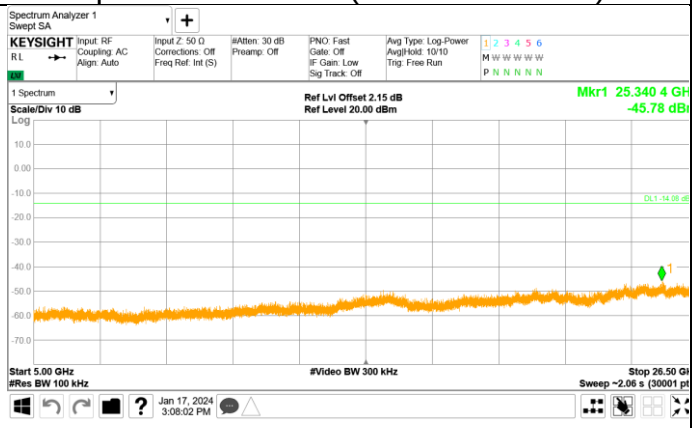
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



10.6 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3), the attenuation required shall be 30 dB instead of 20 dB.

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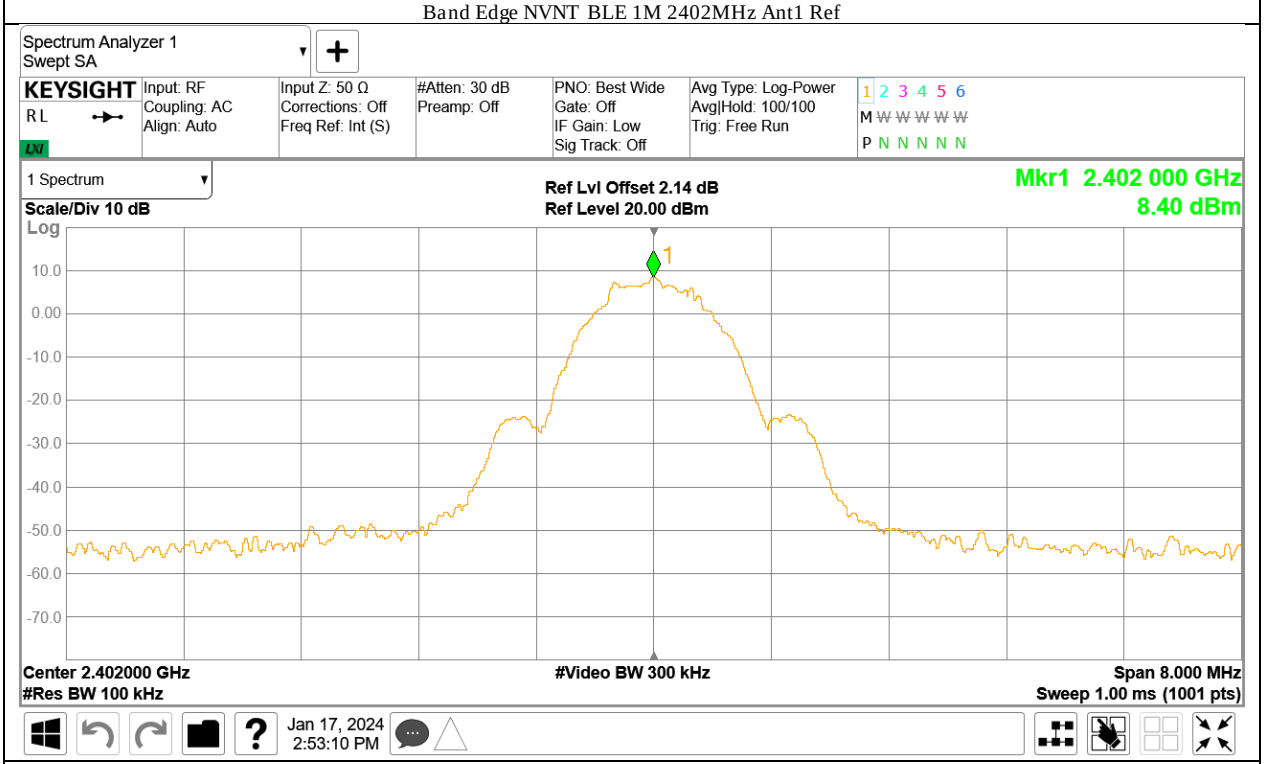
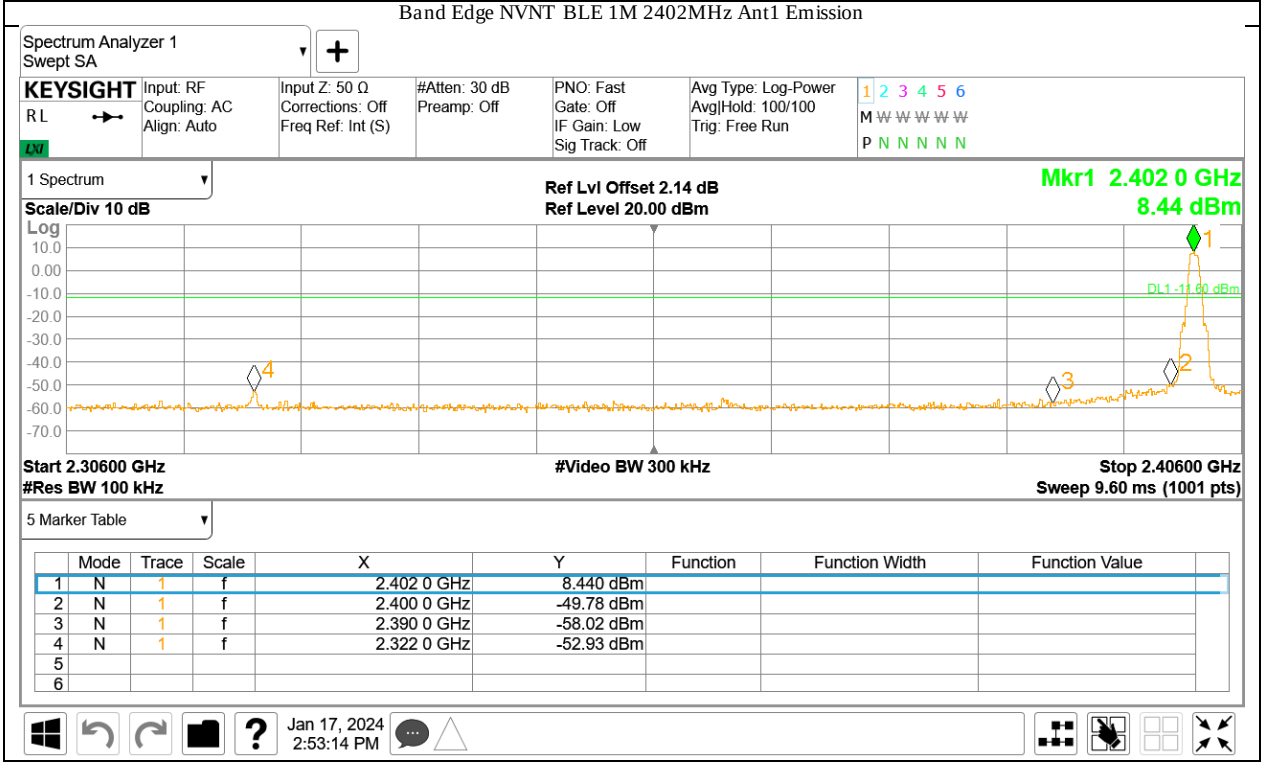
Test result

Test Graphs

Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.402 0 GHz	8.440 dBm			
2	N	1	f	2.400 0 GHz	-49.78 dBm			
3	N	1	f	2.390 0 GHz	-58.02 dBm			
4	N	1	f	2.322 0 GHz	-52.93 dBm			
5								
6								

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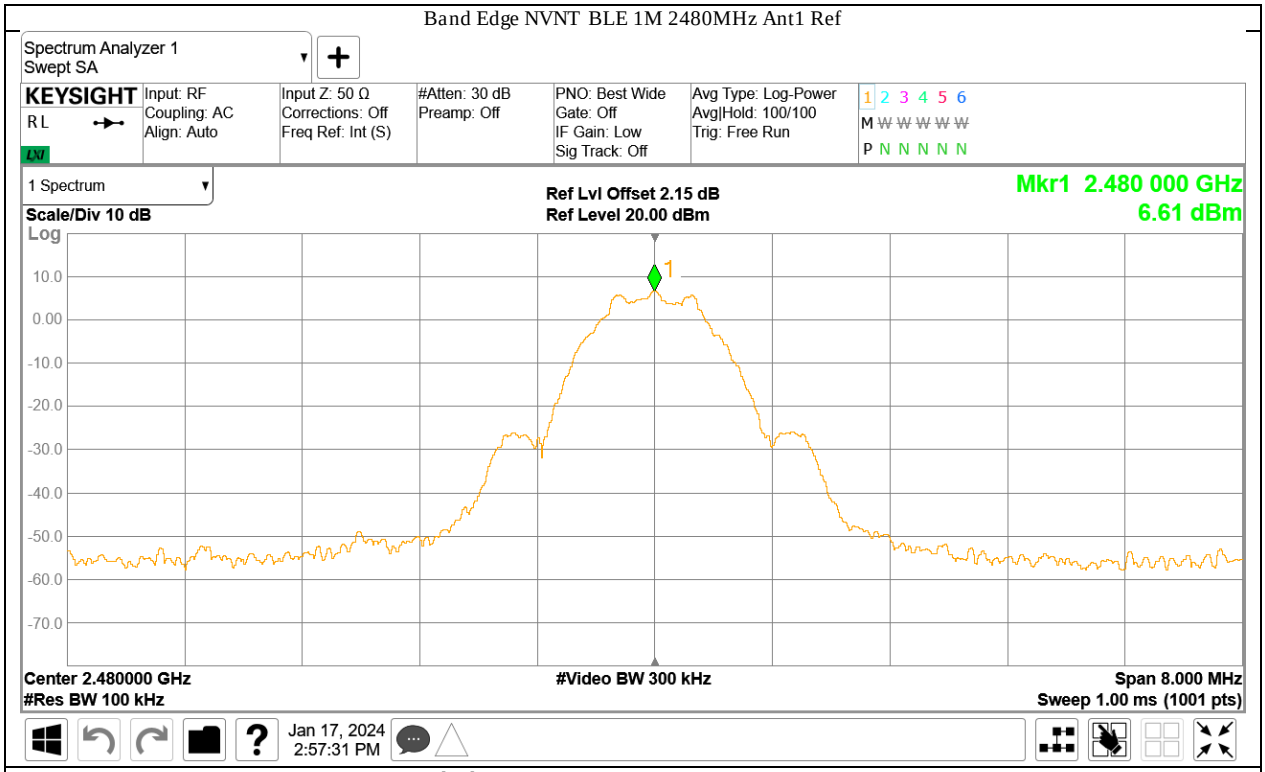
Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



Band Edge NVNT BLE 1M 2480MHz Ant1 Emission

	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.480 0 GHz	6.707 dBm			
2	N	1	f	2.483 5 GHz	-54.64 dBm			
3	N	1	f	2.500 0 GHz	-58.00 dBm			
4	N	1	f	2.484 0 GHz	-53.41 dBm			
5								
6								

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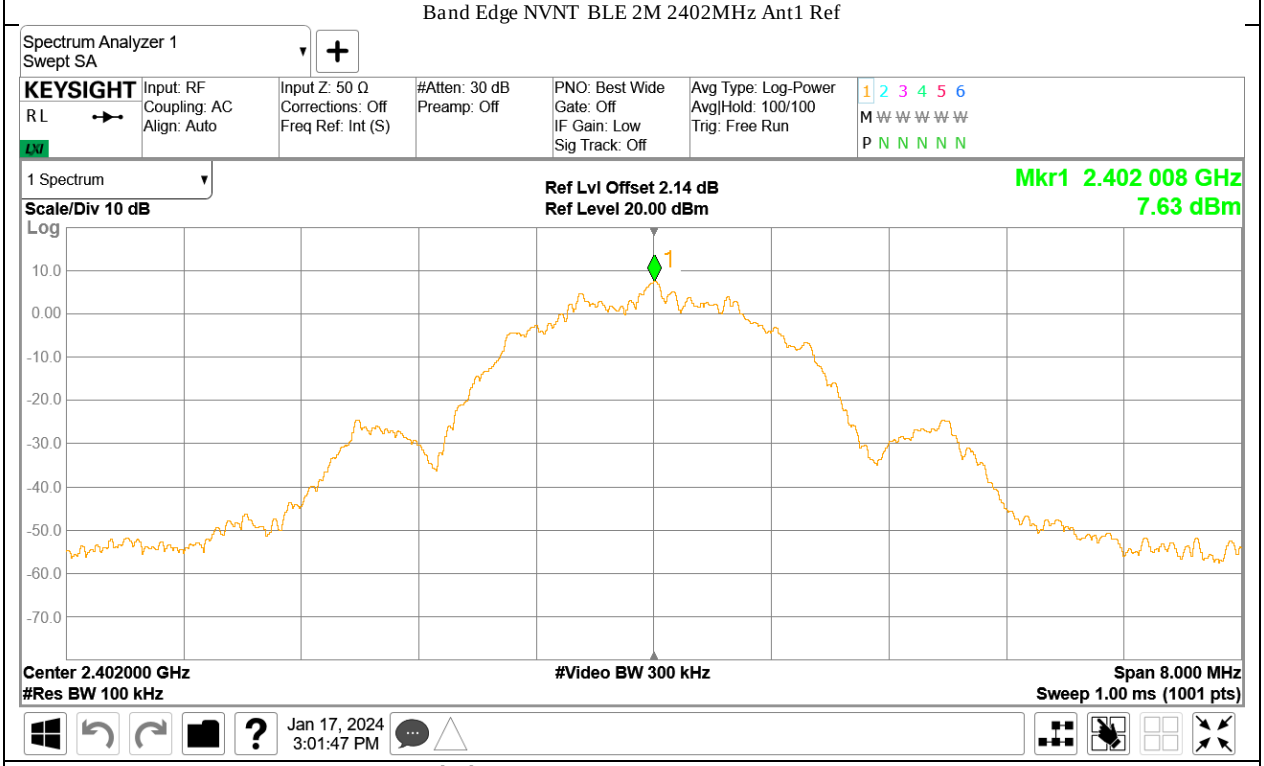
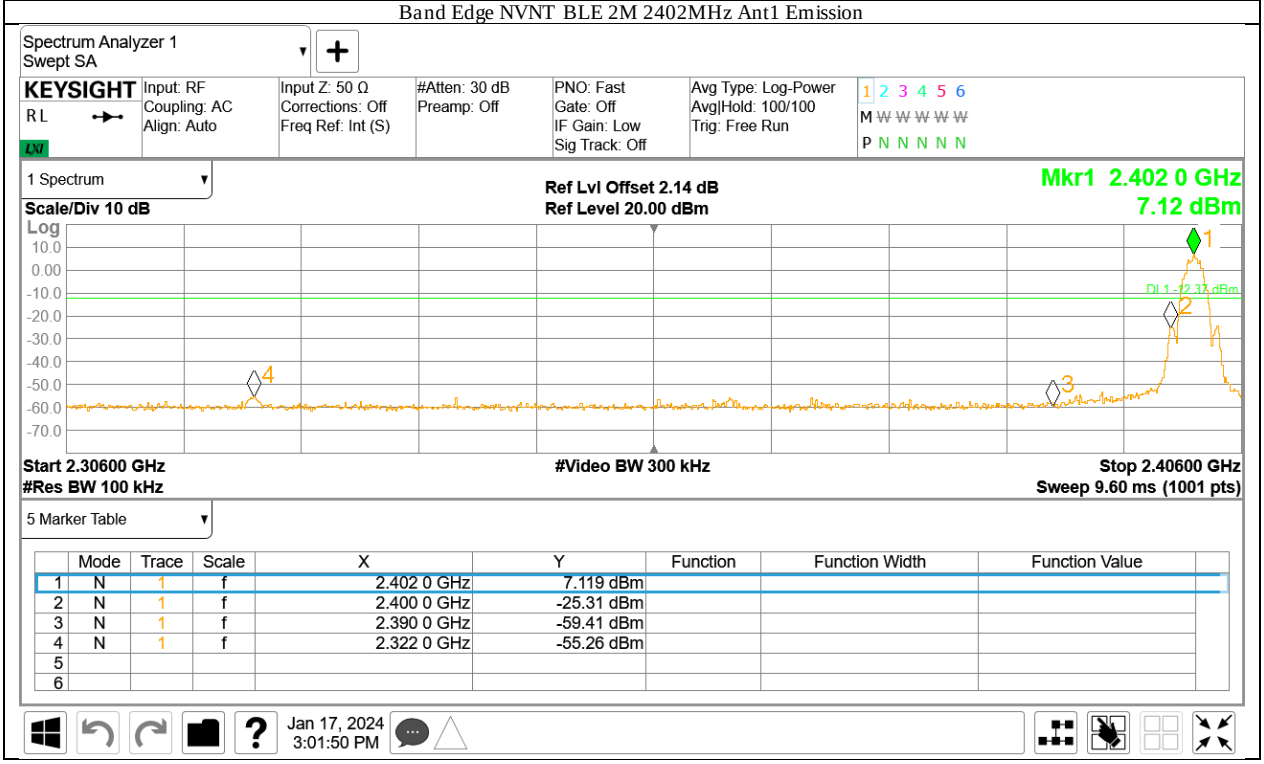
Band Edge NVNT BLE 2M 2402MHz Ant1 Ref



Band Edge NVNT BLE 2M 2402MHz Ant1 Emission



	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.402 0 GHz	7.119 dBm			
2	N	1	f	2.400 0 GHz	-25.31 dBm			
3	N	1	f	2.390 0 GHz	-59.41 dBm			
4	N	1	f	2.322 0 GHz	-55.26 dBm			
5								
6								

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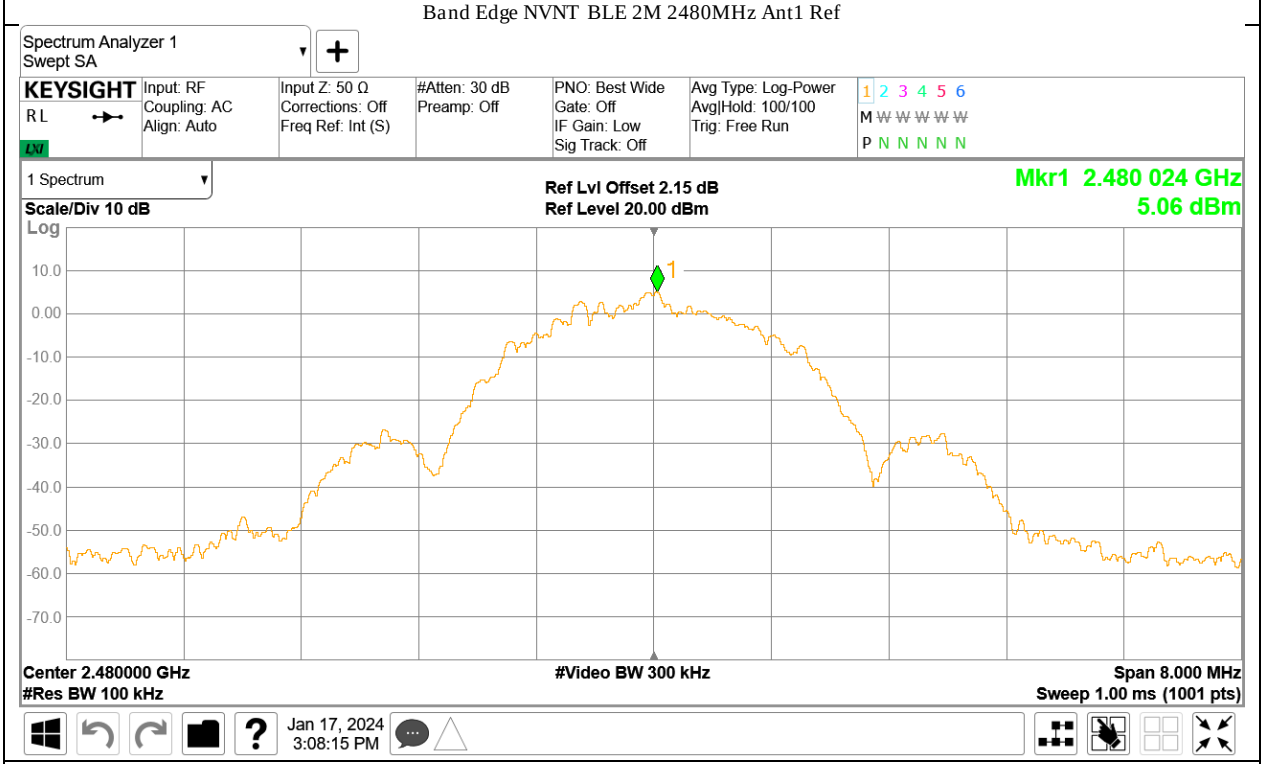
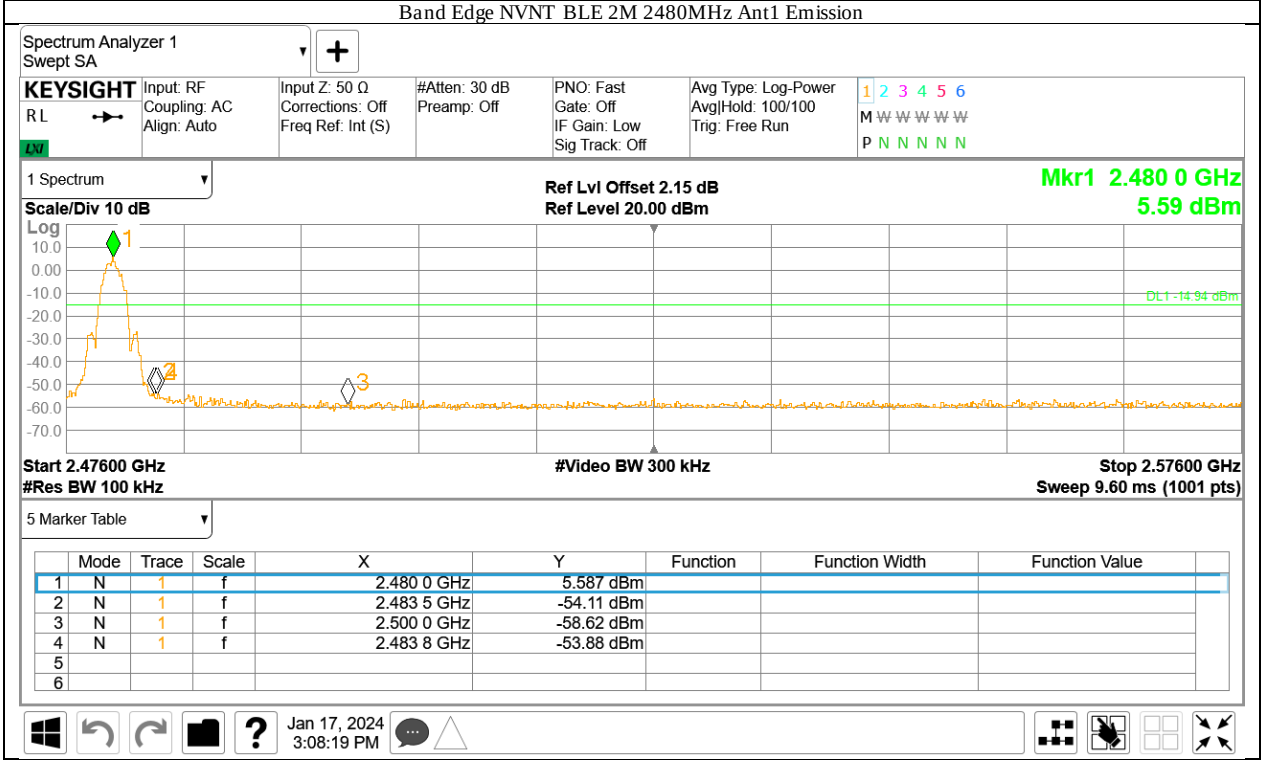
Band Edge NVNT BLE 2M 2480MHz Ant1 Ref



Band Edge NVNT BLE 2M 2480MHz Ant1 Emission



	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.480 0 GHz	5.587 dBm			
2	N	1	f	2.483 5 GHz	-54.11 dBm			
3	N	1	f	2.500 0 GHz	-58.62 dBm			
4	N	1	f	2.483 8 GHz	-53.88 dBm			
5								
6								

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10.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10

   1) Procedure for Unwanted Emissions Measurements Below 1000 MHz

   Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 kHz to 120kHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

   2) For Peak unwanted emissions Above 1GHz:

   Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

   Procedures for average unwanted emissions measurements above 1GHz

   a) RBW = 1MHz.

   b) VBW \ [3 × RBW].

   c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.

   d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)

   e) Sweep time = auto.

   f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)

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

   1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

3) If linear voltage averaging mode was used in the preceding step e), then the correction

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factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission (AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength 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).

Frequency MHz	Field Strength uV/m	Measured Distance Meters
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30	30	30

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.
Data of measurement within frequency range 9kHz-30MHz is the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.

Test result

Test mode:GFSK 1Mbps (2402MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2381.80	44.61	74.00	29.39	PK	Horiznotal
4803.46	43.95	74.00	30.05	PK	Horiznotal
2385.15	43.45	74.00	30.55	PK	Vertical
2655.80	44.23	74.00	29.77	PK	Vertical
4804.03	42.95	74.00	31.05	PK	Vertical

Test mode:GFSK 1Mbps (2440MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4879.40	44.70	74.00	29.30	PK	Horiznotal
4879.96	41.90	74.00	32.10	PK	Vertical

Test mode:GFSK 1Mbps (2480MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.81	46.28	74.00	27.72	PK	Horiznotal
4959.30	44.67	74.00	29.33	PK	Horiznotal
2483.74	47.57	74.00	26.43	PK	Vertical
2658.06	44.79	74.00	29.21	PK	Vertical
4960.43	42.76	74.00	31.24	PK	Vertical

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Test mode:GFSK 2Mbps (2402MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2382.92	43.89	74.00	30.11	PK	Horiznotal
4804.60	41.21	74.00	32.79	PK	Horiznotal
2383.85	43.91	74.00	30.09	PK	Vertical
2659.76	45.19	74.00	28.81	PK	Vertical
4803.46	41.54	74.00	32.46	PK	Vertical

Test mode:GFSK 2Mbps (2440MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
4879.96	43.65	74.00	30.35	PK	Horiznotal
4878.83	41.14	74.00	32.86	PK	Vertical

Test mode:GFSK 2Mbps (2480MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M	Margin (dB)	Detector	Polarization
2483.54	48.79	74.00	25.21	PK	Horiznotal
4958.73	43.17	74.00	30.83	PK	Horiznotal
2483.61	46.90	74.00	27.10	PK	Vertical
4959.86	41.18	74.00	32.82	PK	Vertical

Remark:

(1) Emission level= Original Receiver Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
(3) Margin = limit – Corrected Reading

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The worst case of Radiated Emission below 1GHz: Pre-scan all test mode and only the worst case listed as below.

30-1000MHz Radiated Emission

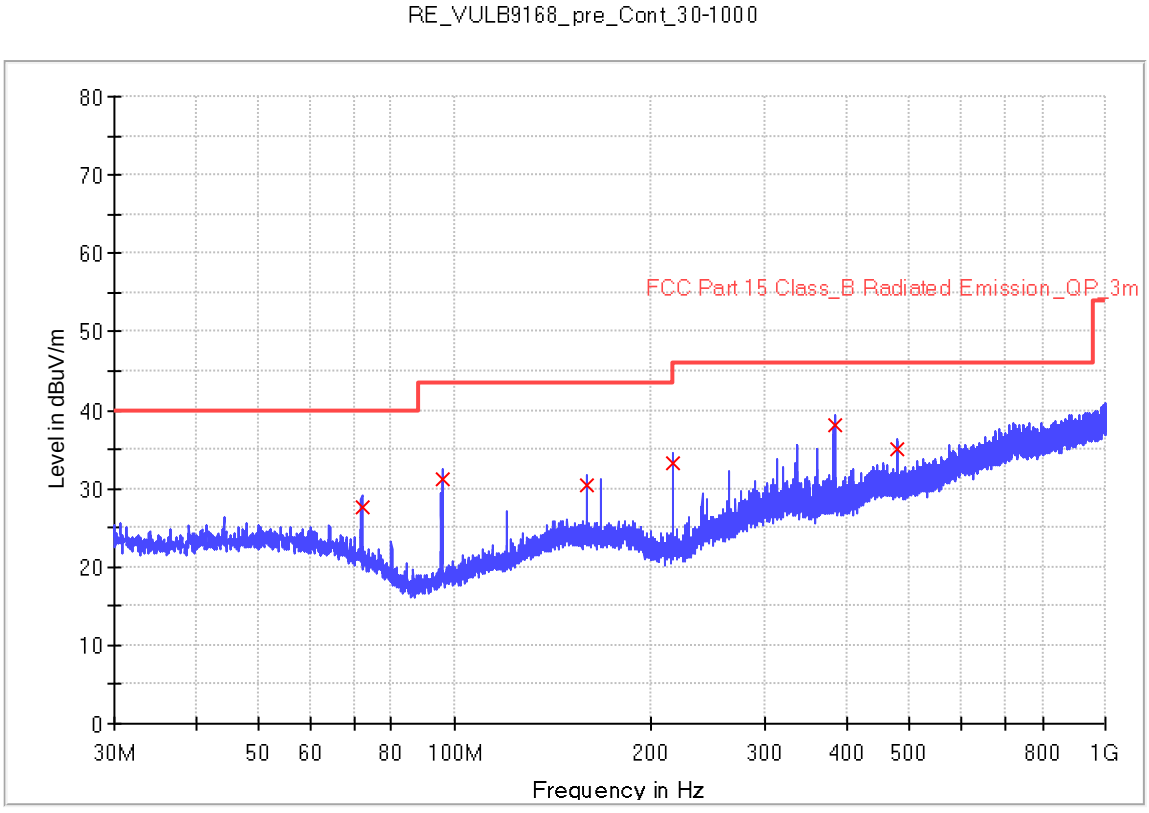
EUT Information

EUT Name:	Smart Battery Doorbell
Model:	SC162-WCD3
Client:	Zhejiang Lingzhu Technology Co., Ltd
Op Cond:	Power on and charging, TX_2402MHz at 2Mbps mode, AC 120V/60Hz. T20.2. 41.4%. P103.2kPa
Operator:	Huali CHENG
Test Spec:	FCC Part 15.209(a)
Comment:	Horizontal
Sample No:	SHA-781837-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB



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Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
71.960000	27.7	1000.0	120.000	159.0	H	15.0	18.2	12.3	40.0
95.720000	31.3	1000.0	120.000	201.0	H	229.0	15.6	12.2	43.5
159.960000	30.5	1000.0	120.000	189.0	H	326.0	20.9	13.0	43.5
216.000000	33.3	1000.0	120.000	168.0	H	105.0	17.5	12.7	46.0
383.760000	38.1	1000.0	120.000	135.0	H	209.0	23.8	7.9	46.0
479.800000	35.0	1000.0	120.000	124.0	H	74.0	26.2	11.0	46.0

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30-1000MHz Radiated Emission

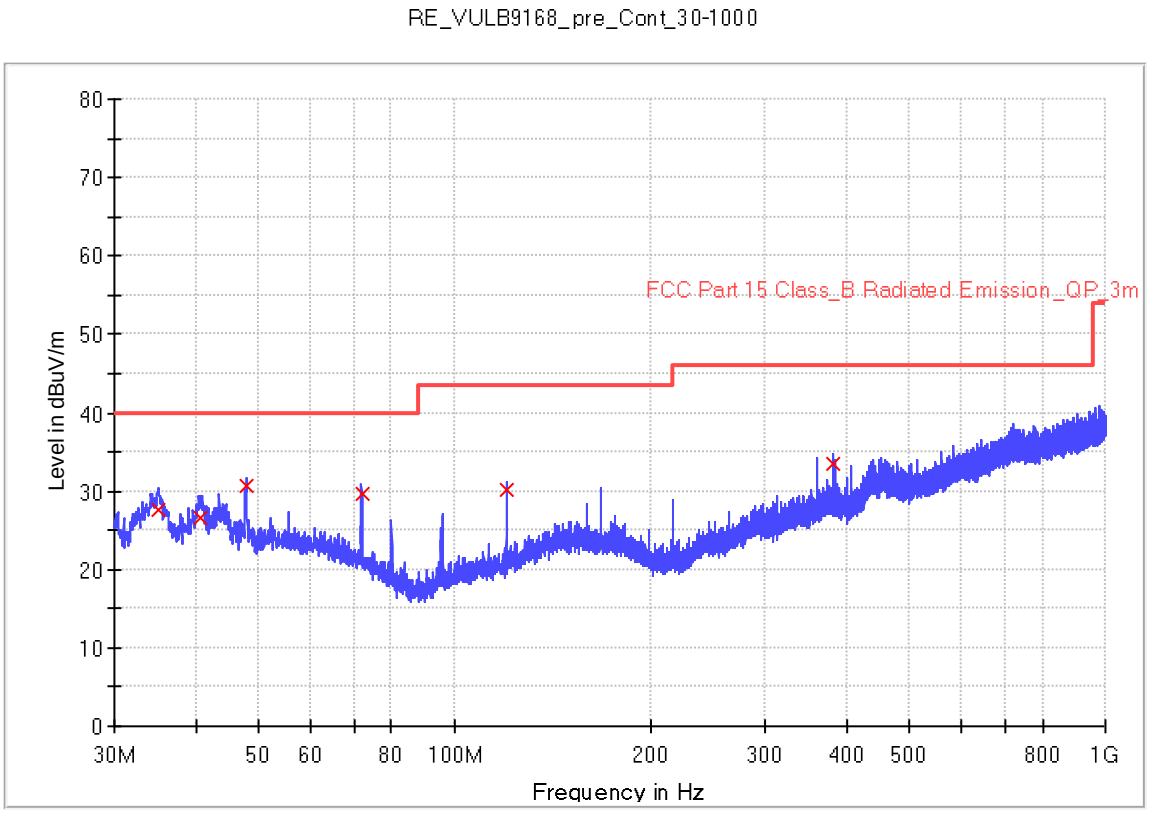
EUT Information

EUT Name:	Smart Battery Doorbell
Model:	SC162-WCD3
Client:	Zhejiang Lingzhu Technology Co., Ltd
Op Cond:	Power on and charging, TX_2402MHz at 2Mbps mode, AC 120V/60Hz. T20.2. 41.4%. P103.2kPa
Operator:	Huali CHENG
Test Spec:	FCC Part 15.209(a)
Comment:	Vertical
Sample No:	SHA-781837-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB



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Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
34.960000	27.7	1000.0	120.000	103.0	V	325.0	19.4	12.3	40.0
40.800000	26.5	1000.0	120.000	120.0	V	183.0	20.1	13.5	40.0
47.940000	30.7	1000.0	120.000	110.0	V	26.0	20.5	9.3	40.0
71.960000	29.7	1000.0	120.000	105.0	V	105.0	18.2	10.3	40.0
119.960000	30.1	1000.0	120.000	106.0	V	98.0	18.1	13.4	43.5
381.920000	33.6	1000.0	120.000	100.0	V	226.0	23.8	12.4	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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11 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal spectrum analyzer	Agilent	N9020B	MY59050168	2023-2-10	2024-2-9
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2023-8-1	2024-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2023-8-1	2024-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2021-9-23	2024-9-22
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102868	2021-3-15	2024-3-14
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2023-8-1	2024-7-31
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2023-6-15	2024-6-14
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	00246076	2023-7-7	2026-7-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-8	2024-5-7
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2023-8-1	2024-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2023-8-1	2024-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFtest	3.0.0.0
RE	EMC 32	Rohde & Schwarz	V10.50.40
CE	EMC 32	Rohde & Schwarz	V9.15.03

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

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12 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, 3.16dB
Radiated Disturbance	9kHz to 30MHz, 3.52dB 30MHz to 1GHz, 5.03dB (Horizontal) 5.12dB (Vertical) 1GHz to 18GHz, 5.49dB 18GHz to 40GHz, 5.63dB
RF Conducted Measurement	Power related： 1.16dB Frequency related： 6.00×10^{-8}

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2021, clause 4.4.3 and 4.5.1.

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13 Photographs of Test Set-ups

Refer to the < Test Setup photos >.

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14 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

----------End of Test Report----------

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