

# CFR 47 FCC PART 15 SUBPART C(DSS) TEST REPORT

For

**Commercial Storage Batteries** 

**MODEL NUMBER: SK-48V100Ah-16S, E-48V-5K** 

REPORT NUMBER: E04A23080897F00401

**ISSUE DATE: August 17, 2024** 

FCC ID: 2BK65-SK

Prepared for

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Prepared by

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This report is based on a single evaluation of the submitted sample(s) of the above mentioned product, it does not imply an assessment of the production of the products. This report shall not be reproduced, except in full, without the written approval of Guangdong GTG Testing Technology Co., Ltd.

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REPORT NO.: E01A23080897F00401 Page 2 of 73

# Revision History

Rev.	Issue Date	Revisions	Revised By
V0	August 17, 2024	Initial Issue	_

REPORT NO.: E01A23080897F00401 Page 3 of 73

# **Summary of Test Results**

Test Item	Clause	Limit/Requirement	Result
Antenna Requirement	N/A	FCC Part 15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	ANSI C63.10-2013 Clause 6.2	FCC Part 15.207	Pass
Conducted Output Power	ANSI C63.10-2013 Clause 7.8.5	FCC Part 15.247 (b)(1)	Pass
20 dB Bandwidth and 99% Occupied Bandwidth	ANSI C63.10-2013 Clause 6.9.2	FCC Part 15.247 (a)(1)	Pass
Carrier Hopping Channel Separation	ANSI C63.10-2013 Clause 7.8.2	FCC Part 15.247 (a)(1)	Pass
Number of Hopping Frequency	ANSI C63.10-2013 Clause 7.8.3	FCC Part 15.247 (b)(1)	Pass
Time of Occupancy (Dwell Time)	ANSI C63.10-2013 Clause 7.8.4	FCC Part 15.247 (a)(1)	Pass
Conducted Bandedge and Spurious Emission	ANSI C63.10-2013 Clause 6.10.4 & Clause 7.8.8	FCC Part 15.247(d)	Pass
Radiated Band edge and Spurious Emission	ANSI C63.10-2013 Clause 6.3 & 6.5 & 6.6	FCC Part 15.205/15.209	Pass

<sup>\*</sup>This test report is only published to and used by the applicant, and it is not for evidence purpose in China.

<sup>\*</sup>The measurement result for the sample received is <Pass> according to <CFR 47 FCC PART 15 SUBPART C(DSS)> when <Accuracy Method> decision rule is applied.

# **CONTENTS**

1. ATT	ATTESTATION OF TEST RESULTS					
2. TES	T METHODOLOGY	6				
3. FAC	ILITIES AND ACCREDITATION	6				
4. CAL	IBRATION AND UNCERTAINTY	7				
4.1.	MEASURING INSTRUMENT CALIBRATION	7				
4.2.	MEASUREMENT UNCERTAINTY	7				
5. EQU	IIPMENT UNDER TEST	8				
5.1.	DESCRIPTION OF EUT	8				
5.2.	CHANNEL LIST	8				
5.3.	MAXIMUM PEAK OUTPUT POWER	9				
5.4.	TEST CHANNEL CONFIGURATION	9				
5.5.	THE WORSE CASE POWER SETTING PARAMETER	9				
5.6.	DESCRIPTION OF AVAILABLE ANTENNAS	10				
5.7.	SUPPORT UNITS FOR SYSTEM TEST	10				
5.8.	SETUP DIAGRAM	10				
6. MEA	SURING EQUIPMENT AND SOFTWARE USED	11				
7. ANT	ENNA PORT TEST RESULTS	12				
7.1.	Conducted Output Power	12				
7.2.	20 dB Bandwidth and 99% Occupied Bandwidth	13				
7.3.	Carrier Hopping Channel Separation	14				
7.4.	Number of Hopping Frequency	16				
7.5.	Time of Occupancy (Dwell Time)	17				
7.6.	Conducted Bandedge and Spurious Emission	19				
8. RAD	NATED TEST RESULTS	21				
8.1.	Radiated Band edge and Spurious Emission	27				
9. ANT	ENNA REQUIREMENT	39				
10.	AC POWER LINE CONDUCTED EMISSION	40				
11.	TEST DATA - Appendix A	43				
APPEND	IX: PHOTOGRAPHS OF TEST CONFIGURATION	71				

REPORT NO.: E01A23080897F00401 Page 5 of 73

# 1. ATTESTATION OF TEST RESULTS

**Applicant Information** 

Company Name: Shenzhen Southking Technology Co.,Ltd

Address: 2nd/4th Floor, Building 1, No. 596 Zhoushi Road, Jiuwei

Community, Hangcheng Street, Baoan District, Shenzhen

**Manufacturer Information** 

Company Name: Shenzhen Southking Technology Co.,Ltd

Address: 2nd/4th Floor, Building 1, No. 596 Zhoushi Road, Jiuwei

Community, Hangcheng Street, Baoan District, Shenzhen

**EUT Information** 

Product Description: Commercial Storage Batteries Model: SK-48V100Ah-16S, E-48V-5K

Brand: /

Sample Received Date: November 21, 2024

Sample Status: Normal

Sample ID: A23080897 001

Date of Tested: November 21, 2024 to August 17, 2024

APPLICABLE STANDARDS					
STANDARD TEST RESULTS					
CFR 47 FCC PART 15 SUBPART C(DSS)	Pass				

Prepared By:

al Chen

Checked By:

Joson Peng

**Laboratory Leader** 

Tiger Xu

Laboratory Manager

REPORT NO.: E01A23080897F00401 Page 6 of 73

# 2. TEST METHODOLOGY

All tests were performed in accordance with the standard CFR 47 FCC PART 15 SUBPART C(DSS)

# 3. FACILITIES AND ACCREDITATION

	Guangdong GTG Testing Technology Co., Ltd.
Test Location 1	1-2/F., Building A, and 1/F., Building B, No. 11, Zongbu 2nd Road, Songshan Lake
	High-Tech Industrial Development Zone, Dongguan, Guangdong, China
	A2LA (Certificate No.: 4422.01)
	Guangdong GTG Testing Technology Co., Ltd. has been assessed and proved to be
	in compliance with A2LA.
Accreditation Certificate	FCC (FCC Designation No.: CN1230) Guangdong GTG 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.: 22768)
	Guangdong GTG Testing Technology Co., Ltd. has been registered and fully
	described in a report filed with ISED. The Company Number is 22768 and the test
	lab Conformity Assessment Body Identifier (CABID) is CN0079.

Note: All tests measurement facilities use to collect the measurement data except Radiated Immunity & Conducted Immunity are located at 1-2/F., Building A, and 1/F., Building B, No. 11, Zongbu 2nd Road, Songshan Lake High-Tech Industrial Development Zone, Dongguan, Guangdong, China.

REPORT NO.: E01A23080897F00401 Page 7 of 73

# 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 Items	k	Uncertainty
DTS Bandwidth	1.96	±9.2 PPM
20dB Emission Bandwidth	1.96	±9.2 PPM
Carrier Frequency Separation	1.96	±9.2 PPM
Time of Occupancy	1.96	±0.57%
Conducted Output Power	1.96	±1.5 dB
Power Spectral Density Level	1.96	±1.9 dB
		9 kHz-30 MHz: ± 0.95 dB
Conducted Spurious Emission	1.96	30 MHz-1 GHz: ± 1.5 dB
Conducted Spunous Emission	1.90	1GHz-12.75GHz: ± 1.8 dB
		12.75 GHz-26.5 GHz: ± 2.1dB

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)
Conducted emissions from the AC mains power ports (AMN)	150 kHz ~ 30 MHz	2	3.36
Radiated emissions	9 kHz ~ 30 MHz	2	4.59
Radiated emissions	30 MHz ~ 1 GHz	2	4.26
Radiated emissions	1 GHz ~ 18 GHz	2	5.69
Radiated emissions	18 GHz ~ 40 GHz	2	5.54

Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

REPORT NO.: E01A23080897F00401 Page 8 of 73

# **5. EQUIPMENT UNDER TEST**

# **5.1. DESCRIPTION OF EUT**

EUT Name		Commercial Storage Batteries	
Model		SK-48V100Ah-16S	
Series Model		E-48V-5K	
Hardware Version		V1.0	
Software Version		V1.0	
Ratings		DC 48V / Battery 51.2V	
Power Supply	DC	48V	
	Battery	51.2V	

Frequency Band:	2400 MHz to 2483.5 MHz
Frequency Range:	2402 MHz to 2480 MHz
Bluetooth Version:	5.0
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK
Number of Channels:	79
Channel Separation:	1 MHz
Maximum Peak Power:	-4.42 dBm
Antenna Type:	Internal antenna
Antenna Gain:	-3.68 dBi
EUT Test software:	RF Test_V1.8
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. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476

REPORT NO.: E01A23080897F00401 Page 9 of 73

15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	1	1

### 5.3. MAXIMUM PEAK OUTPUT POWER

Test Mode	Frequency (MHz)	Channel Number	Maximum Peak Output Power (dBm)
GFSK	2402 ~ 2480	0-78[79]	-4.42

# 5.4. TEST CHANNEL CONFIGURATION

Test Mo	de	Test Channel	Frequency
GFSk	(	CH 0(Low Channel), CH 39(MID Channel), CH 78(High Channel)	2402 MHz, 2441 MHz, 2480 MHz

Note: The hop is hopping mode.

# **PACKET TYPE CONFIGURATION**

Test Mode	Packet Type	Setting (Packet Length)
	DH1	27
GFSK	DH3	183
	DH5	339

### 5.5. THE WORSE CASE POWER SETTING PARAMETER

#### **WORST-CASE CONFIGURATIONS**

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BR	FHSS	GFSK	1Mbit/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 RF Test_V1.8					
Modulation Type	Transmit Antenna	Test Software setting value			
Wodulation Type	Number	CH 00	CH 39	CH 78	
GFSK	1	0	0	0	

REPORT NO.: E01A23080897F00401 Page 10 of 73

# 5.6. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2402-2480	Internal antenna	-3.68

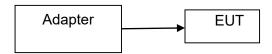
Test Mode	Transmit and Receive Mode	Description
GFSK	⊠1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.

# 5.7. SUPPORT UNITS FOR SYSTEM TEST

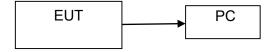
No.	Equipment	Manufacturer	Model No.	Serial No.
1	PC	Lenovo	T14	1
2	Adapter	Shenzhen Southking Technology Co.,Ltd	1	1
3	Test board	1	/	1

# 5.8. SETUP DIAGRAM

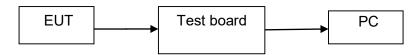
AC conducted emission:



Radiated Emission:



RF conducted:



REPORT NO.: E01A23080897F00401 Page 11 of 73

# 6. MEASURING EQUIPMENT AND SOFTWARE USED

#### **RF Conducted Measurement**

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40N	102257	2023-09-18	2024-09-18
WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-12-13	2024-12-13
MXG Vector Signal Generator	KEYSIGHT	N5182B	MY61250185	2023-12-13	2024-12-13
EXG Analog Signal Generator	KEYSIGHT	N5173B	My61252603	2024-05-08	2025-05-08
RF Power detector box	MWRF-test	MW100-PSB	MW220912	2023-12-13	2024-12-13
Radio Frequency control box	MWRF-test	MW200-RFCB	MW220111	2023-12-13	2024-12-13
Radio Frequency control box	MWRF-test	MW200-RFCB 2#	/	2023-12-13	2024-12-13
RF Test Software	MWRF-test	MTS 8310(V.3.0)	N/A	N/A	N/A

Conducted Emission Measurement- AC mains power ports

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
LISN	ROHDE&SCHWARZ	ENV216	101413	2023-09-18	2024-09-18
EMI Test Receiver	ROHDE&SCHWARZ	ESCI	101358	2024-05-08	2025-05-08
Test Software	Farad	EZ-EMC 1.1.4.2	N/A	N/A	N/A

#### 3m Radiated Emission Measurement 30M-1G

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100302	2024-05-08	2025-05-08
Pre-Amplifier	Anritsu	MH648A	M57886	2024-05-08	2025-05-08
Bilog Antenna	Schwarzbeck	VULB9163	VULB9163- 1290	2021-11-11	2024-11-11
Test Software	Farad	EZ-EMC 1.1.4.2	N/A	N/A	N/A

3m Radiated Emission Measurement above 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
Spectrum Analyzer	Rohde & Schwarz	FSV40N	101413	2023-12-13	2024-12-13
Low noise Amplifiers	A-INFO	LA1018N4009	J1013130524001	2024-05-08	2025-05-08
Horn antenna	A-INFO	LB-10180-SF	J2031090612123	2022-05-14	2025-05-14
Pre-Amplifier	HzEMC	HPA-184057	HYPA21004	2024-05-08	2025-05-08
DRG Horn	ETS	3116C	00246265	2022-03-28	2025-03-28
Test Software	Farad	EZ-EMC 1.1.4.2	N/A	N/A	N/A

REPORT NO.: E01A23080897F00401 Page 12 of 73

# 7. ANTENNA PORT TEST RESULTS

# 7.1. CONDUCTED OUTPUT POWER

# **LIMITS**

CFR 47 FCC Part15 (15.247) Subpart C					
Section Test Item Limit Frequency Range (MHz)					
CFR 47 FCC 15.247(b)(3)	Peak Conduct Output Power	1 watt or 30 dBm	2400-2483.5		

### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 7.8.5.

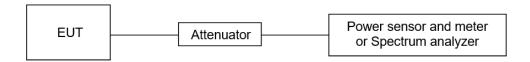
Connect the EUT to the spectrum Analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test	
Detector	Peak	
RBW	>20 dB bandwidth of the emission being measured	
VBW	≥RBW	
Span	Approximately five times the 20 dB bandwidth, centered on a hopping channel.	
Trace	Max hold	
Sweep time	Auto	

Allow trace to stabilize.

Use the marker-to-peak function to set the marker to the peak of the emission.

#### **TEST SETUP**



### **TEST ENVIRONMENT**

Temperature	<b>24.3</b> ℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

### **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401

Page 13 of 73

# 7.2. 20 DB BANDWIDTH AND 99% OCCUPIED BANDWIDTH

### **LIMITS**

CFR 47FCC Part15 (15.247) Subpart C			
Section Test Item Limit Frequency Rang (MHz)			
CFR 47 FCC 15.247 (a) (1)	20 dB Bandwidth	None; for reporting purposes only.	2400-2483.5

### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 6.9.2.

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

Center Frequency	The center frequency of the channel under test	
Detector	Peak	
	For 20 dB Bandwidth: 1 % to 5 % of the 20 dB bandwidth For 99 % Occupied Bandwidth: 1 % to 5 % of the occupied bandwidth	
	For 20 dB Bandwidth: approximately 3×RBW For 99 % Occupied Bandwidth: ≥ 3×RBW	
Span	Approximately 2 to 3 times the 20dB bandwidth	
Trace	Max hold	
Sweep	Auto couple	

a) Use the occupied bandwidth function of the instrument, allow the trace to stabilize and report the measured 99 % occupied bandwidth and 20 dB Bandwidth.

# **TEST SETUP**



#### **TEST ENVIRONMENT**

Temperature	<b>24.3</b> ℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

### **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401 Page 14 of 73

# 7.3. CARRIER HOPPING CHANNEL SEPARATION

### **LIMITS**

CFR 47 FCC Part15 (15.247),				
Section	Test Item	Limit	Frequency Range (MHz)	
CFR 47 FCC 15.247 (a) (1)	Carrier Frequency Separation	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.  Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel.	2400-2483.5	

#### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 7.8.2.

Connect the EUT to the spectrum analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test	
Span	wide enough to capture the peaks of two adjacent channels	
Detector	Peak	
RBW	Start with the RBW set to approximately 30 % of the channel spacing; adjust as necessary to best identify the center of each individual channel.	
VBW	≥RBW	
Trace	Max hold	
Sweep time	Auto couple	

Allow the trace to stabilize and use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Compliance of an EUT with the appropriate regulatory limit shall be determined.

### **TEST SETUP**



#### **TEST ENVIRONMENT**

Temperature	24.3℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

REPORT NO.: E01A23080897F00401 Page 15 of 73

# **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401 Page 16 of 73

# 7.4. NUMBER OF HOPPING FREQUENCY

### **LIMITS**

CFR 47 FCC Part15 (15.247), Subpart C			
Section Test Item Limit			
CFR 47 15.247 (a) (1) III	Number of Hopping Frequency	at least 15 hopping channels	

#### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 7.8.3.

Connect the EUT to the spectrum Analyzer and use the following settings:

Detector	Peak
RBW	To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW	≥RBW
Span	The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
Trace	Max hold
Sweep time	Auto couple

Set EUT to transmit maximum output power and switch on frequency hopping function. then set enough count time (larger than 5000 times) to get all the hopping frequency channel displayed on the screen of spectrum analyzer, count the quantity of peaks to get the number of hopping channels.

### **TEST SETUP**



#### **TEST ENVIRONMENT**

Temperature	<b>24.3</b> ℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

#### **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401 Page 17 of 73

# 7.5. TIME OF OCCUPANCY (DWELL TIME)

### **LIMITS**

CFR 47 FCC Part15 (15.247), Subpart C			
Section Test Item Limit			
CFR 47 15.247 (a) (1) III	Time of Occupancy (Dwell Time)	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.	

#### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 7.8.4.

Connect the EUT to the spectrum Analyzer and use the following settings:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	1 MHz
VBW	≥RBW
Span	Zero span, centered on a hopping channel
Trace	Max hold
Sweep time	As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel

Use the marker-delta function to determine the transmit time per hop (Burst Width). If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

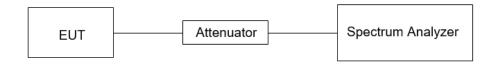
For FHSS Mode (79 Channel):

DH1/3DH1 Dwell Time: Burst Width \* (1600/2) \* 31.6 / (channel number) DH3/3DH3 Dwell Time: Burst Width \* (1600/4) \* 31.6 / (channel number) DH5/3DH5 Dwell Time: Burst Width \* (1600/6) \* 31.6 / (channel number)

For AFHSS Mode (20 Channel):

DH1/3DH1 Dwell Time: Burst Width \* (1600/2) \* 8 / (channel number) DH3/3DH3 Dwell Time: Burst Width \* (1600/4) \* 8 / (channel number) DH5/3DH5 Dwell Time: Burst Width \* (1600/6) \* 8 / (channel number)

#### **TEST SETUP**



REPORT NO.: E01A23080897F00401 Page 18 of 73

# **TEST ENVIRONMENT**

Temperature	24.3℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

# **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401 Page 19 of 73

# 7.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSION

### **LIMITS**

CFR 47 FCC Part15 (15.247), Subpart C		
Section	Test Item	Limit
CFR 47 FCC §15.247 (d)	Conducted Spurious Emission	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

#### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 7.8.6 and 7.8.8.

Connect the EUT to the spectrum analyser and use the following settings for reference level measurement:

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	100 kHz
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum PSD level.

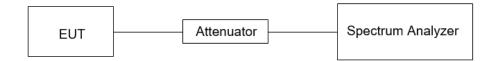
Change the settings for emission level measurement:

isnan	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100 kHz
VBW	≥3 × RBW
measurement points	≥span/RBW
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum PSD level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum

REPORT NO.: E01A23080897F00401 Page 20 of 73

# **TEST SETUP**



# **TEST ENVIRONMENT**

Temperature	24.3℃	Relative Humidity	44%
Atmosphere Pressure	101kPa		

# **TEST RESULTS**

Please refer to section "Test Data" - Appendix A

REPORT NO.: E01A23080897F00401 Page 21 of 73

# 8. RADIATED TEST RESULTS

# **LIMITS**

Please refer to CFR 47 FCC §15.205 and §15.209.

Radiation Disturbance Test Limit for FCC (Class B) (9 kHz-1 GHz)

Emissions radiated outside of the specified frequency bands above 30 MHz			
Frequency Range	Field Strength Limit	Field Stre	ngth Limit
(MHz)	(uV/m) at 3 m	(dBuV/m	) at 3 m
(1411 12)	(av/m) at o m	Quasi-Peak	
30 - 88	100	40	0
88 - 216	150	43	.5
216 - 960	200	40	ô
Above 960	500	54	4
Above 1000	500	Peak	Average
Above 1000	300	74	54

FCC Emissions radiated outside of the specified frequency bands below 30 MHz		
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30

FCC Restricted bands of operation refer to FCC §15.205 (a):

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
<sup>1</sup> 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	( <sup>2</sup> )
13.36-13.41			

Note:  $^1$ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup>Above 38.6c

REPORT NO.: E01A23080897F00401 Page 22 of 73

#### **TEST PROCEDURE**

Below 30 MHz

The setting of the spectrum analyser

RBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
VBW	200 Hz (From 9 kHz to 0.15 MHz)/ 9 kHz (From 0.15 MHz to 30 MHz)
Sweep	Auto

- 1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.4.
- 2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both Horizontal, Face-on and Face-off polarizations of the antenna are set to make the measurement.
- 3. The EUT was placed on a turntable with 80 cm above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a 1 m height antenna tower.
- 5. The radiated emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.
- 6. For measurement below 1 GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak and average detector mode remeasured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak and average detector and reported.
- 7. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field site based on KDB 414788.
- 8. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of  $377\Omega$ . For example, the measurement frequency X KHz resulted in a level of Y dBuV/m, which is equivalent to Y-51.5 = Z dBuA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to be 15.209(a) limit.

REPORT NO.: E01A23080897F00401 Page 23 of 73

### Below 1 GHz and above 30 MHz

The setting of the spectrum analyser

RBW	120 kHz
VBW	300 kHz
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

- 1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.5.
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 3. The EUT was placed on a turntable with 80 cm above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. For measurement below 1 GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

REPORT NO.: E01A23080897F00401 Page 24 of 73

#### Above 1 GHz

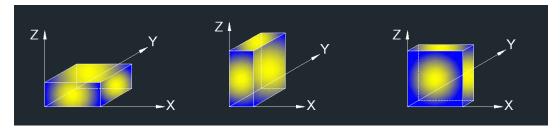
The setting of the spectrum analyser

RBW	1 MHz
IV/BW	PEAK: 3 MHz AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

- 1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.6.
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 3. The EUT was placed on a turntable with 1.5 m above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. For measurement above 1 GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.
- 6. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 7.1.ON TIME AND DUTY CYCLE.

REPORT NO.: E01A23080897F00401 Page 25 of 73

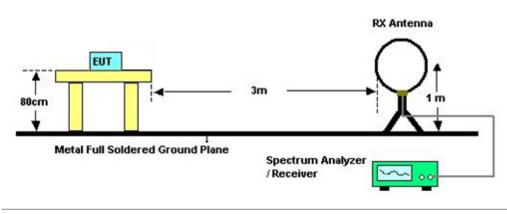
X axis, Y axis, Z axis positions:

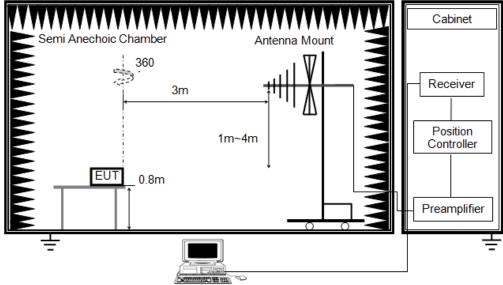


Note 1: For all radiated test, EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

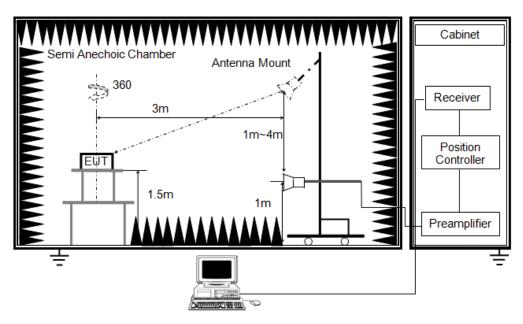
Note 2: The EUT was fully exercised with external accessories during the test. In the case of multiple accessory external ports, an external accessory shall be connected to one of each type of port.

### **TEST SETUP**





REPORT NO.: E01A23080897F00401 Page 26 of 73



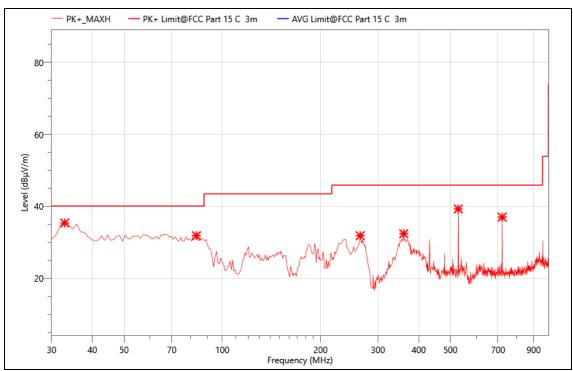
# **TEST ENVIRONMENT**

Temperature	<b>23.2</b> ℃	Relative Humidity	51%
Atmosphere Pressure	101kPa		

# **TEST RESULTS**

# 8.1. RADIATED BAND EDGE AND SPURIOUS EMISSION

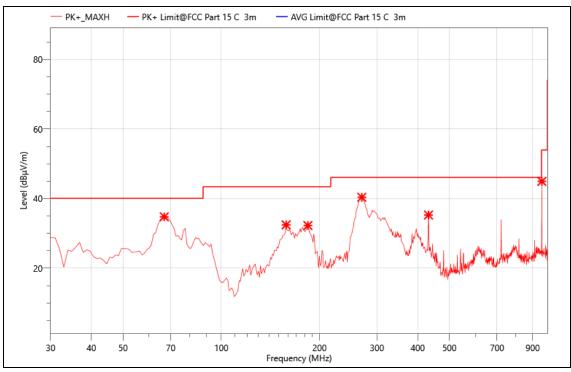
Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



# Critical\_Freqs

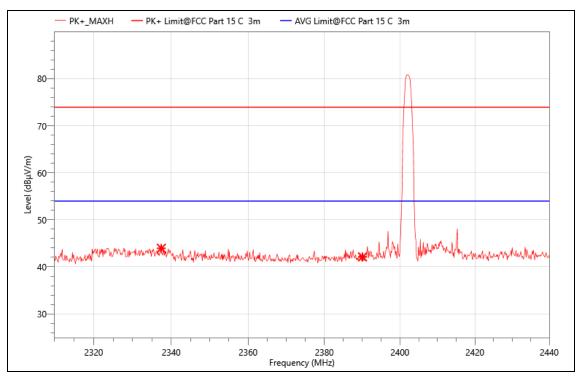
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	32.910	51.30	-15.91	35.39	40.00	4.61	PK+	V
2	83.350	57.44	-25.59	31.85	40.00	8.15	PK+	V
3	264.740	50.12	-18.26	31.86	46.00	14.14	PK+	V
4	359.800	48.30	-15.88	32.42	46.00	13.58	PK+	V
5	528.580	50.07	-10.79	39.28	46.00	6.72	PK+	V
6	720.640	43.97	-6.94	37.03	46.00	8.97	PK+	V

Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



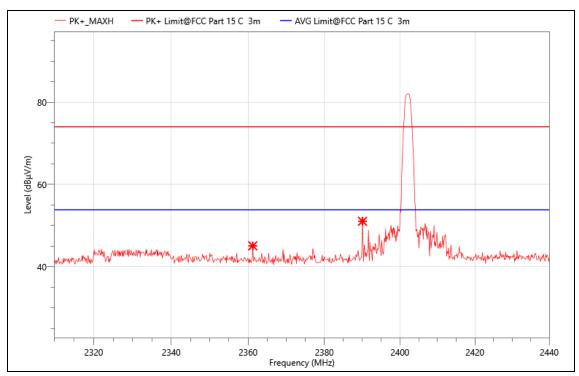
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	66.860	59.66	-24.89	34.77	40.00	5.23	PK+	Η
2	158.040	53.97	-21.51	32.46	43.50	11.04	PK+	Н
3	184.230	54.65	-22.37	32.28	43.50	11.22	PK+	I
4	269.590	58.95	-18.56	40.39	46.00	5.61	PK+	Τ
5	431.580	49.45	-14.16	35.29	46.00	10.71	PK+	Η
6	960.230	48.79	-3.82	44.97	53.90	8.93	PK+	Н

Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



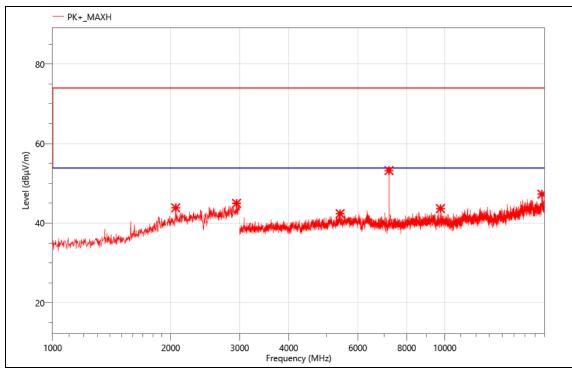
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2337.430	21.31	22.63	43.94	74.00	30.06	PK+	V
2	2390.080	19.39	22.72	42.11	74.00	31.89	PK+	V

Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



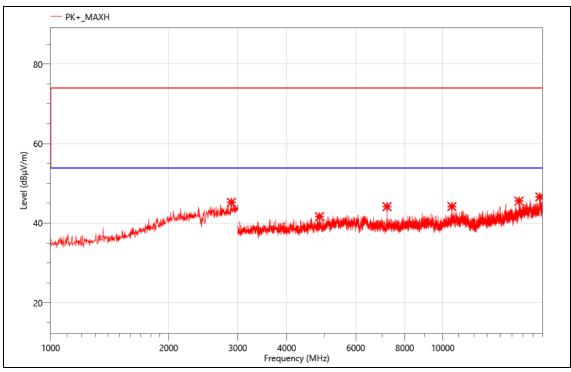
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2361.220	22.38	22.71	45.09	74.00	28.91	PK+	Н
2	2390.080	28.34	22.72	51.06	74.00	22.94	PK+	Н

Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2°C/51%/101Kpa



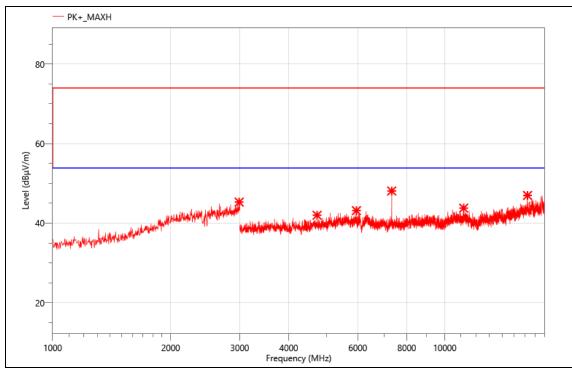
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2060.000	53.18	-9.33	43.85	74.00	30.15	PK+	Н
2	2944.000	52.43	-7.46	44.97	74.00	29.03	PK+	Н
3	5409.000	51.96	-9.59	42.37	74.00	31.63	PK+	Н
4	7206.000	61.21	-8	53.21	74.00	20.79	PK+	Н
5	9750.000	50.28	-6.63	43.65	74.00	30.35	PK+	Н
6	17689.500	47.04	0.24	47.28	74.00	26.72	PK+	Н

Mode:	DH5 2402
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



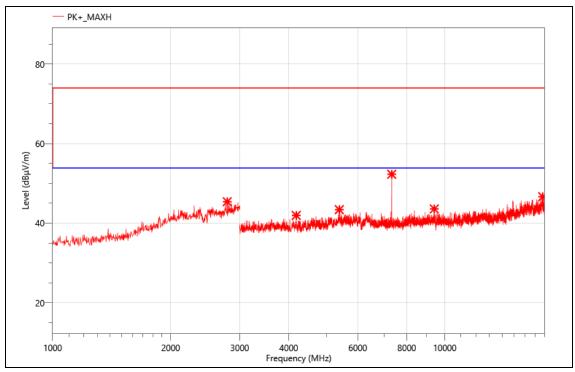
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2890.000	53.31	-8.09	45.22	74.00	28.78	PK+	V
2	4848.000	52.93	-11.3	41.63	74.00	32.37	PK+	V
3	7206.000	52.15	-8	44.15	74.00	29.85	PK+	V
4	10551.000	49.36	-5.18	44.18	74.00	29.82	PK+	V
5	15643.500	47.57	-2.02	45.55	74.00	28.45	PK+	V
6	17676.000	46.28	0.31	46.59	74.00	27.41	PK+	V

Mode:	DH5 2441
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2°C/51%/101Kpa



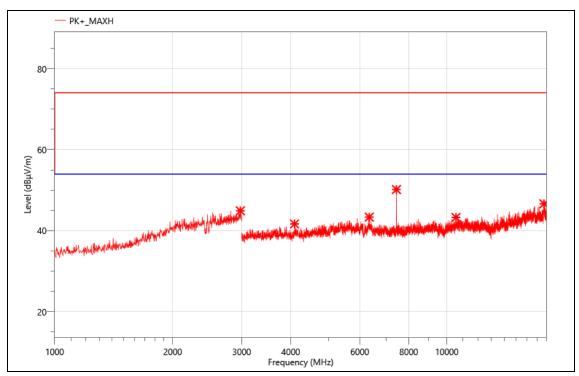
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2990.000	52.27	-6.98	45.29	74.00	28.71	PK+	V
2	4725.000	53.60	-11.62	41.98	74.00	32.02	PK+	V
3	5952.000	51.79	-8.65	43.14	74.00	30.86	PK+	V
4	7323.000	56.03	-7.95	48.08	74.00	25.92	PK+	V
5	11172.000	48.16	-4.39	43.77	74.00	30.23	PK+	V
6	16255.500	47.69	-0.72	46.97	74.00	27.03	PK+	V

Mode:	DH5 2441
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



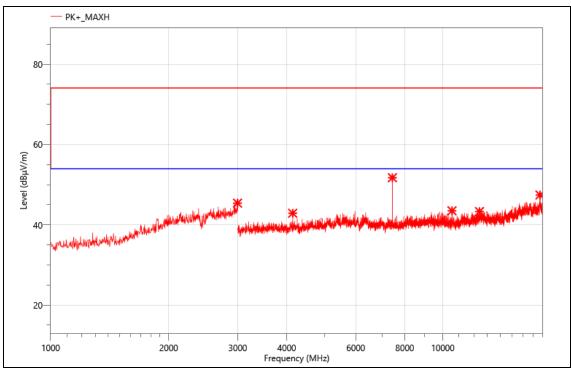
No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2788.000	53.82	-8.43	45.39	74.00	28.61	PK+	Н
2	4180.500	54.29	-12.35	41.94	74.00	32.06	PK+	Н
3	5382.000	52.44	-9.05	43.39	74.00	30.61	PK+	Н
4	7323.000	60.23	-7.95	52.28	74.00	21.72	PK+	Н
5	9402.000	50.75	-7.17	43.58	74.00	30.42	PK+	Η
6	17773.500	47.14	-0.49	46.65	74.00	27.35	PK+	Η

Mode:	DH5 2480
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2976.000	51.98	-7.06	44.92	74.00	29.08	PK+	V
2	4090.500	54.33	-12.65	41.68	74.00	32.32	PK+	V
3	6343.500	51.35	-7.98	43.37	74.00	30.63	PK+	V
4	7440.000	58.13	-7.96	50.17	74.00	23.83	PK+	V
5	10555.500	48.44	-5.15	43.29	74.00	30.71	PK+	V
6	17691.000	46.41	0.23	46.64	74.00	27.36	PK+	V

Mode:	DH5 2480
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa

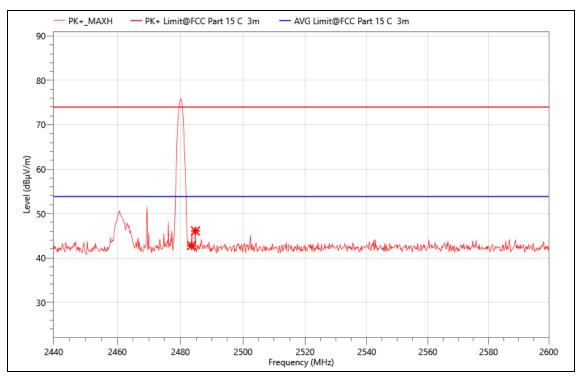


No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2996.000	52.40	-7	45.40	74.00	28.60	PK+	Н
2	4143.000	55.60	-12.72	42.88	74.00	31.12	PK+	Н
3	7440.000	59.69	-7.96	51.73	74.00	22.27	PK+	Н
4	10555.500	48.64	-5.15	43.49	74.00	30.51	PK+	Н
5	12403.500	48.01	-4.7	43.31	74.00	30.69	PK+	Н
6	17692.500	47.20	0.22	47.42	74.00	26.58	PK+	Η

Note: [Margin=Limit-Meas.]; [Meas.=Reading+Corr.]

For the frequency above 18 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.

Mode:	DH5 2480
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa

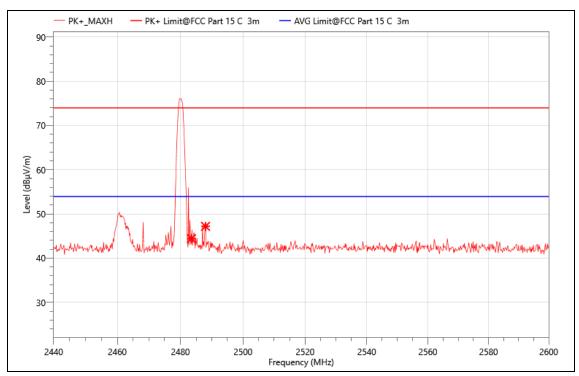


## Critical\_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2483.520	19.62	23.15	42.77	74.00	31.23	PK+	Н
2	2484.800	22.92	23.15	46.07	74.00	27.93	PK+	Н

Note: [Margin=Limit-Meas.]; [Meas.=Reading+Corr.]

Mode:	DH5 2480
Power:	Battery 48V
TE:	Big
Date	2024/04/11
T/A/P	23.2℃/51%/101Kpa



# Critical\_Freqs

No.	Freq. (MHz)	Reading (dBµV)	Corr. (dB)	Meas. (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Det.	Pol.
1	2483.520	21.25	23.15	44.40	74.00	29.60	PK+	V
2	2488.000	24.05	23.14	47.19	74.00	26.81	PK+	V

Note: [Margin=Limit-Meas.]; [Meas.=Reading+Corr.]

REPORT NO.: E01A23080897F00401 Page 39 of 73

### 9. ANTENNA REQUIREMENT

#### REQUIREMENT

Please refer to FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

### Please refer to FCC §15.247(b)(4)

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### **DESCRIPTION**

**Pass** 

REPORT NO.: E01A23080897F00401 Page 40 of 73

### 10. AC POWER LINE CONDUCTED EMISSION

#### **LIMITS**

Please refer to CFR 47 FCC §15.207 (a) and ISED RSS-Gen Clause 8.8

FREQUENCY (MHz)	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

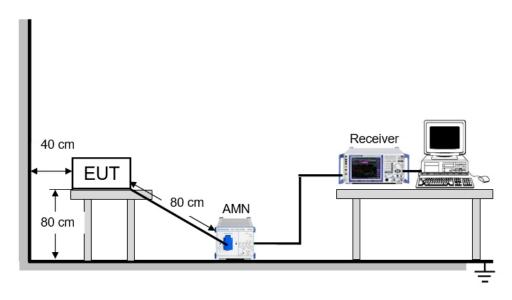
#### **TEST PROCEDURE**

Refer to ANSI C63.10-2013 clause 6.2.

The EUT is put on a table of non-conducting material that is 80 cm high. The vertical conducting wall of shielding is located 40 cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver is used to test the emissions from the AC line. According to the requirements in Section 6.2 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9 kHz.

The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.

### **TEST SETUP**

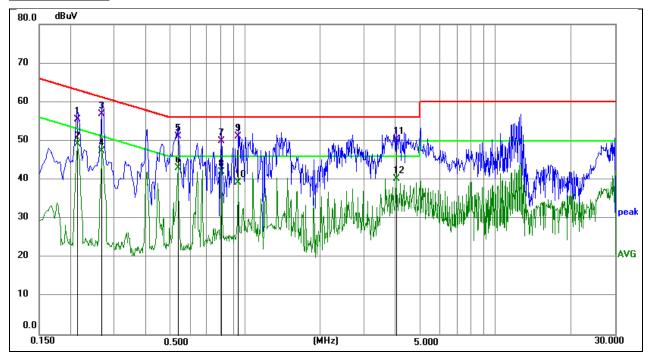


#### **TEST ENVIRONMENT**

Temperature	24.6℃	Relative Humidity	54%
Atmosphere Pressure	101kPa		

REPORT NO.: E01A23080897F00401 Page 41 of 73

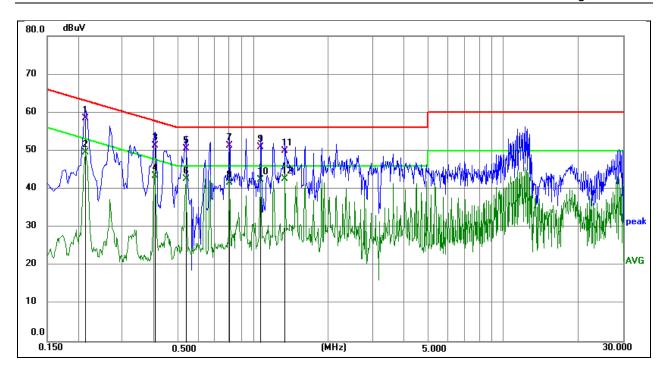
### **TEST RESULTS**



Phase: N Mode: DH5 2402MHz

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	
1	0.2130	45.53	9.87	55.40	63.09	-7.69	QP
2	0.2130	39.21	9.87	49.08	53.09	-4.01	AVG
3	0.2670	47.06	9.86	56.92	61.21	-4.29	QP
4	0.2670	37.47	9.86	47.33	51.21	-3.88	AVG
5	0.5370	41.27	9.85	51.12	56.00	-4.88	QP
6	0.5370	33.04	9.85	42.89	46.00	-3.11	AVG
7	0.8070	40.05	9.95	50.00	56.00	-6.00	QP
8	0.8070	32.10	9.95	42.05	46.00	-3.95	AVG
9	0.9420	41.07	9.95	51.02	56.00	-4.98	QP
10	0.9420	29.32	9.95	39.27	46.00	-6.73	AVG
11	4.0243	40.25	9.99	50.24	56.00	-5.76	QP
12	4.0243	30.28	9.99	40.27	46.00	-5.73	AVG

REPORT NO.: E01A23080897F00401 Page 42 of 73



Phase: L1	Mode: DH5 2402MHz

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	
1	0.2130	48.69	9.81	58.50	63.09	-4.59	QP
2	0.2130	39.81	9.81	49.62	53.09	-3.47	AVG
3	0.4020	41.57	9.79	51.36	57.81	-6.45	QP
4	0.4020	33.54	9.79	43.33	47.81	-4.48	AVG
5	0.5370	40.73	9.83	50.56	56.00	-5.44	QP
6	0.5370	32.66	9.83	42.49	46.00	-3.51	AVG
7	0.8070	41.41	9.81	51.22	56.00	-4.78	QP
8	0.8070	31.78	9.81	41.59	46.00	-4.41	AVG
9	1.0725	41.08	9.82	50.90	56.00	-5.10	QP
10	1.0725	32.52	9.82	42.34	46.00	-3.66	AVG
11	1.3425	40.18	9.82	50.00	56.00	-6.00	QP
12	1.3425	32.68	9.82	42.50	46.00	-3.50	AVG

Note: 1. Result = Reading + Correct Factor.

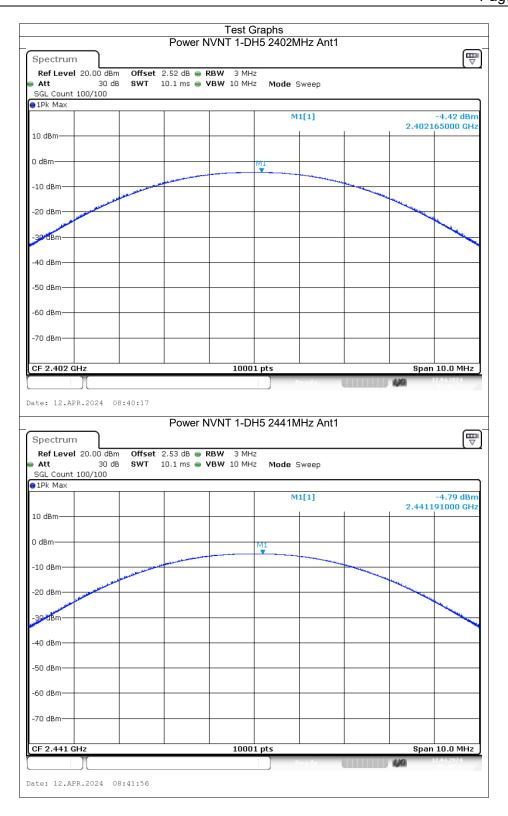
- 2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
- 3. Test setup: RBW: 200 Hz (9 kHz ~ 150 kHz), 9 kHz (150 kHz ~ 30 MHz).
- 4. Step size: 80 Hz (0.009 MHz ~ 0.15 MHz), 4 kHz (0.15 MHz ~ 30 MHz), Scan time: auto.

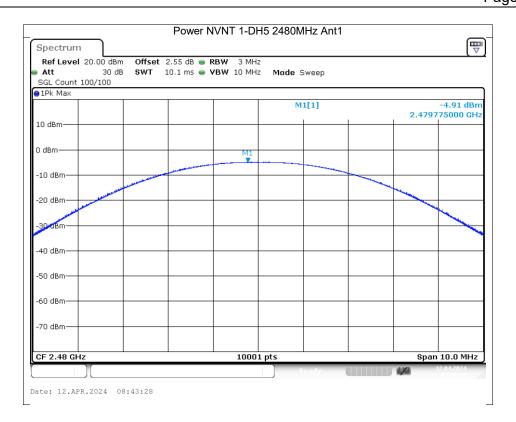
REPORT NO.: E01A23080897F00401 Page 43 of 73

## 11. TEST DATA - Appendix A

**Maximum Conducted Output Power** 

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	1-DH5	2402	Ant1	-4.42	21	Pass
NVNT	1-DH5	2441	Ant1	-4.79	21	Pass
NVNT	1-DH5	2480	Ant1	-4.91	21	Pass

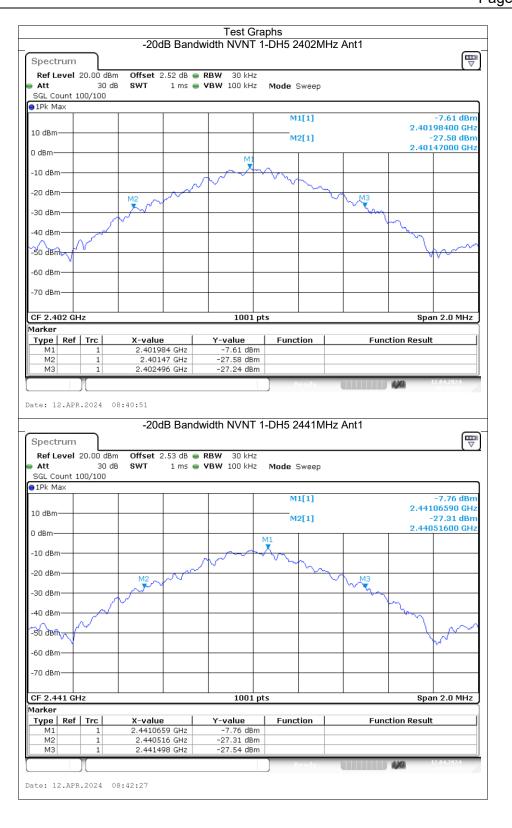


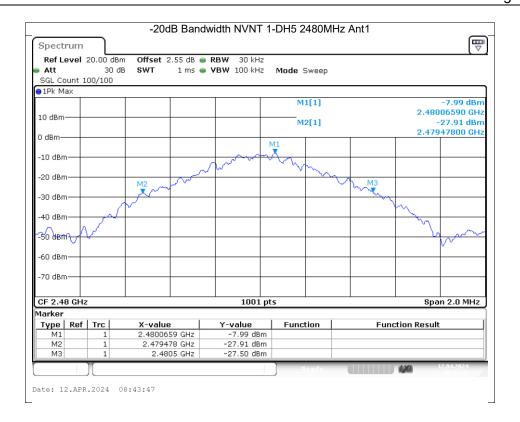


REPORT NO.: E01A23080897F00401 Page 46 of 73

## -20dB Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
NVNT	1-DH5	2402	Ant1	1.03	N/A	N/A
NVNT	1-DH5	2441	Ant1	0.98	N/A	N/A
NVNT	1-DH5	2480	Ant1	1.02	N/A	N/A

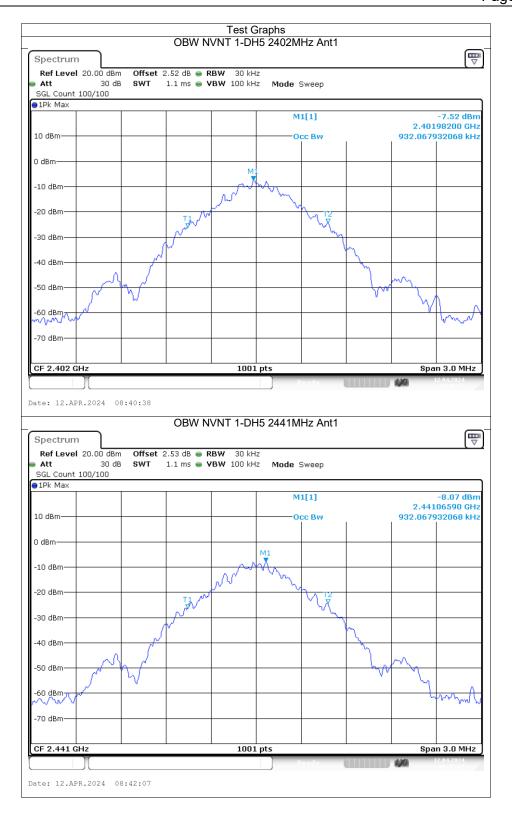




REPORT NO.: E01A23080897F00401 Page 49 of 73

**Occupied Channel Bandwidth** 

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)
NVNT	1-DH5	2402	Ant1	0.932
NVNT	1-DH5	2441	Ant1	0.932
NVNT	1-DH5	2480	Ant1	0.92

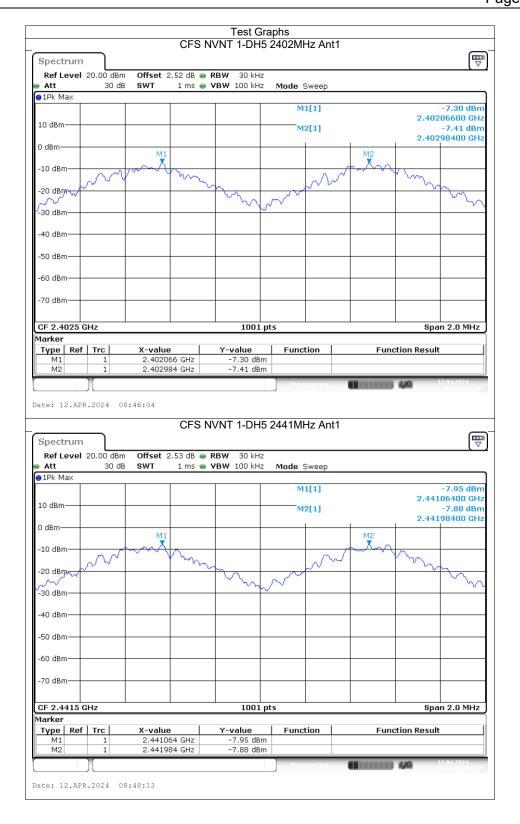


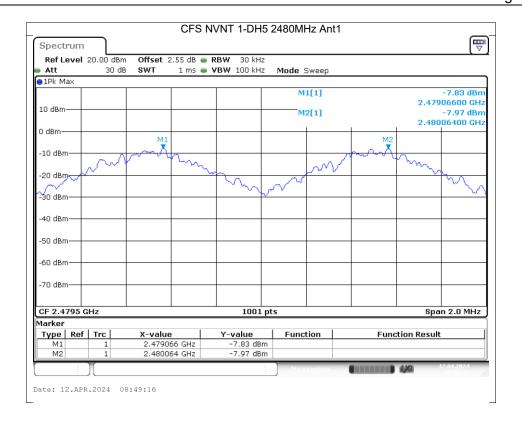


REPORT NO.: E01A23080897F00401 Page 52 of 73

**Carrier Frequencies Separation** 

			_				
Condition	Mode	Antenna	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	1-DH5	Ant1	2402.066	2402.984	0.918	0.687	Pass
NVNT	1-DH5	Ant1	2441.064	2441.984	0.92	0.653	Pass
NVNT	1-DH5	Ant1	2479.066	2480.064	0.998	0.68	Pass

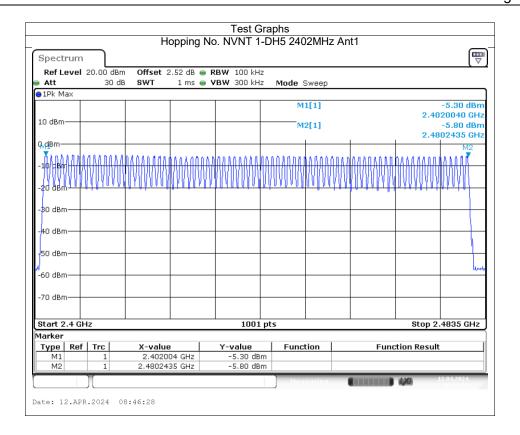




REPORT NO.: E01A23080897F00401 Page 55 of 73

**Number of Hopping Channel** 

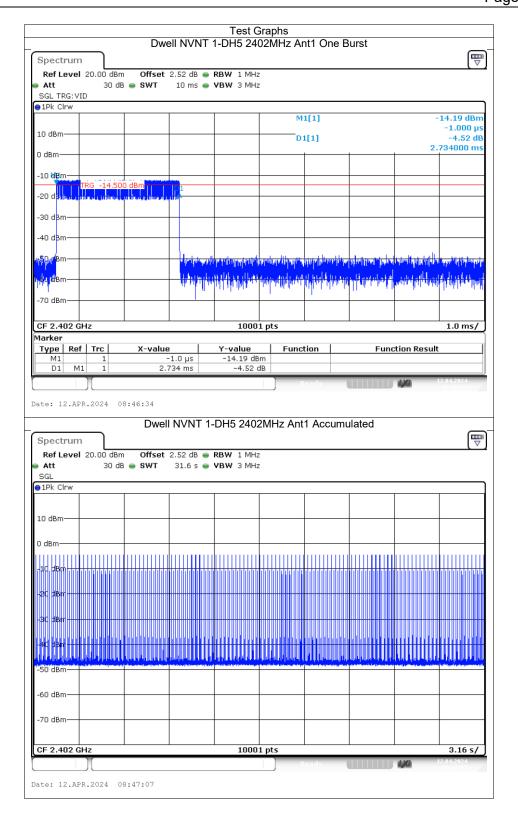
Condition	Mode	Antenna	Hopping Number	Limit	Verdict
NVNT	1-DH5	Ant1	79	15	Pass

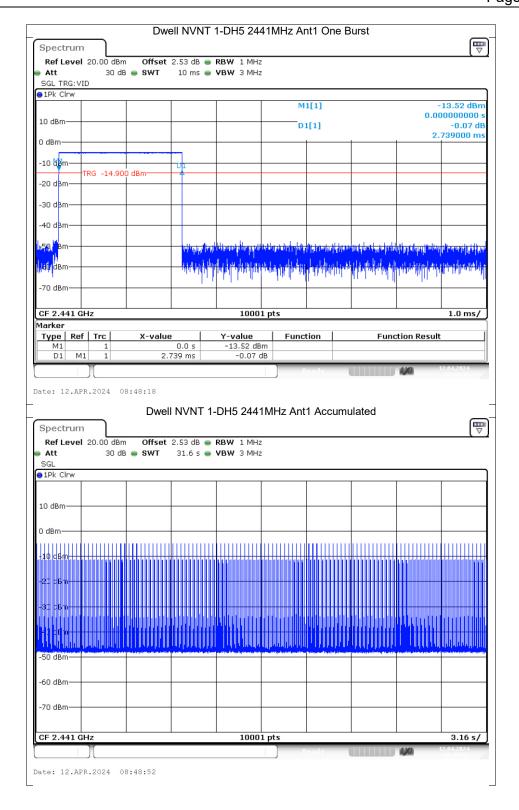


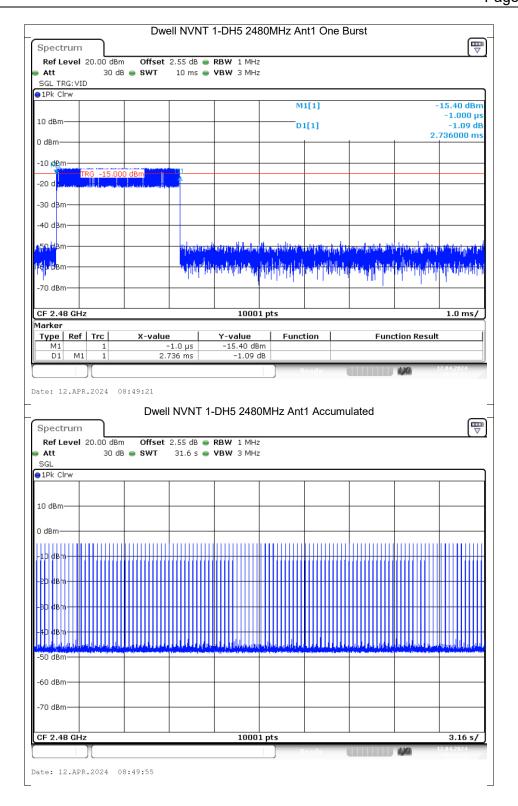
REPORT NO.: E01A23080897F00401 Page 57 of 73

## **Dwell Time**

Condition	Mode	Frequency (MHz)	Antenna	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	1-DH5	2402	Ant1	2.734	306.208	112	31600	400	Pass
NVNT	1-DH5	2441	Ant1	2.739	309.507	113	31600	400	Pass
NVNT	1-DH5	2480	Ant1	2.736	306.432	112	31600	400	Pass



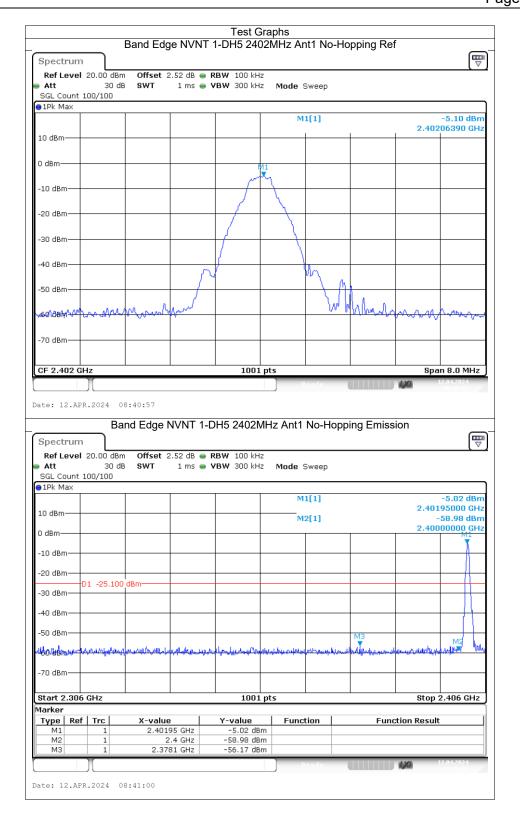


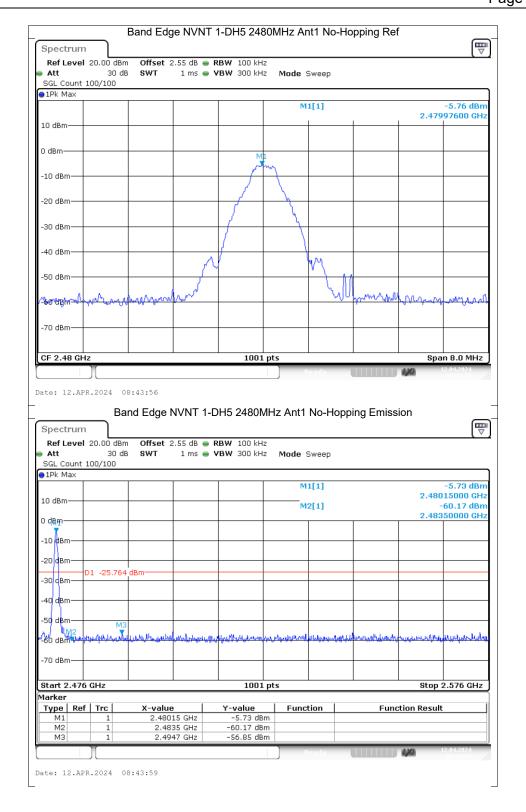


REPORT NO.: E01A23080897F00401 Page 61 of 73

**Band Edge** 

Condition	Mode	Frequency (MHz)	Antenna	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	1-DH5	2402	Ant1	No-Hopping	-51.07	-20	Pass
NVNT	1-DH5	2480	Ant1	No-Hopping	-51.09	-20	Pass



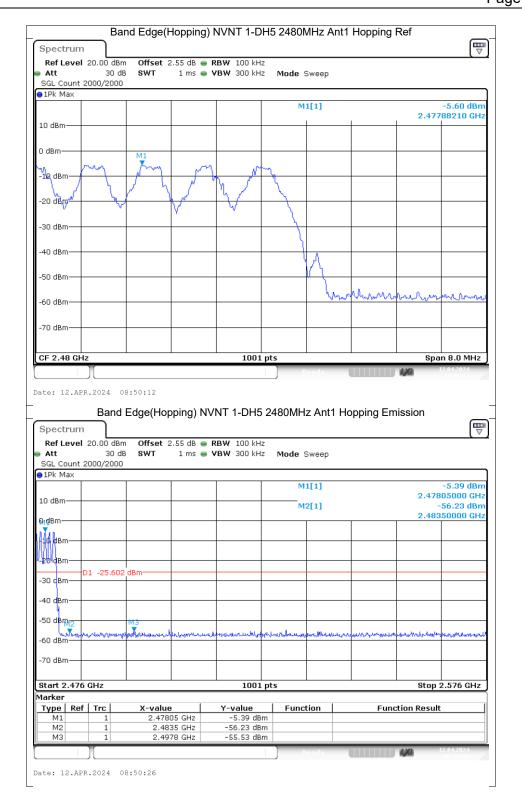


REPORT NO.: E01A23080897F00401 Page 64 of 73

Band Edge(Hopping)

Condition	Mode	Frequency (MHz)	Antenna	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	1-DH5	2402	Ant1	Hopping	-50.36	-20	Pass
NVNT	1-DH5	2480	Ant1	Hopping	-49.93	-20	Pass

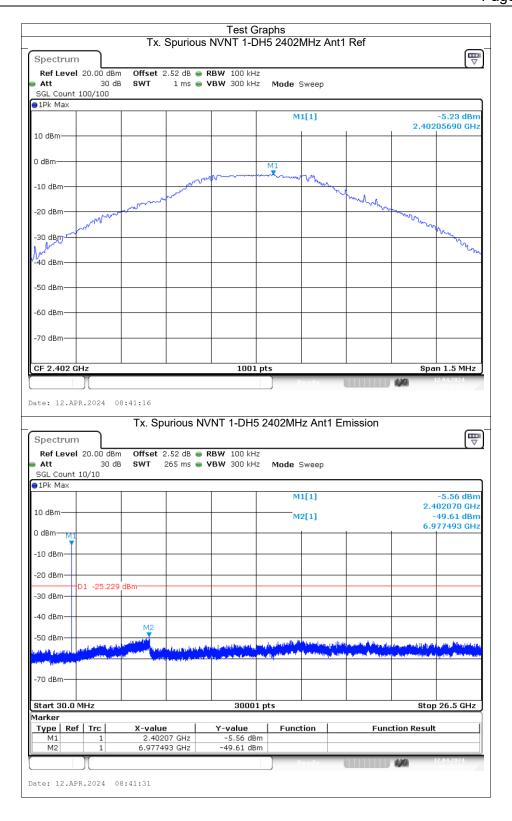


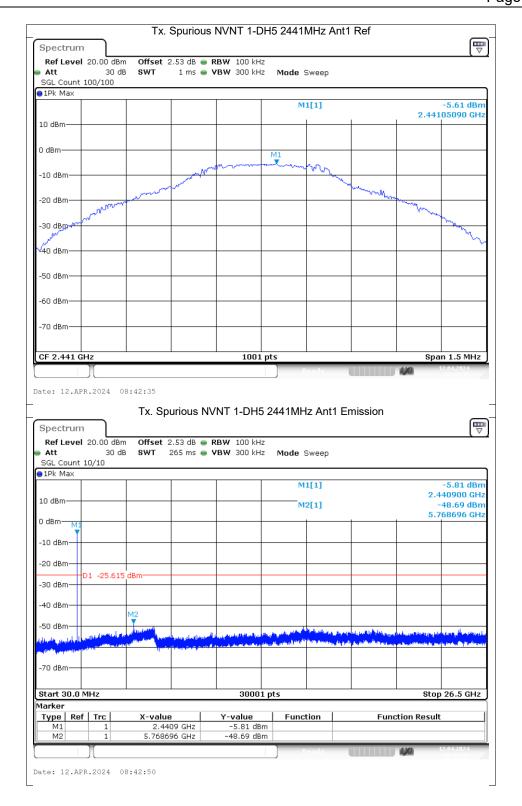


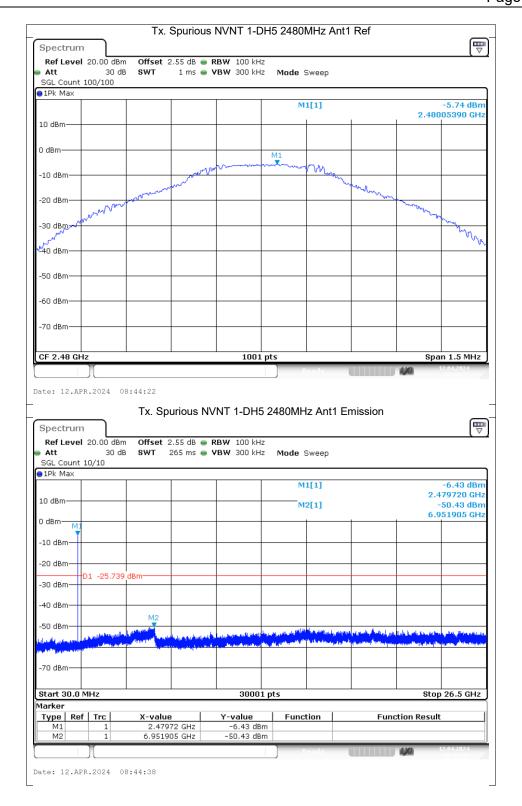
REPORT NO.: E01A23080897F00401 Page 67 of 73

**Conducted RF Spurious Emission** 

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	1-DH5	2402	Ant1	-44.38	-20	Pass
NVNT	1-DH5	2441	Ant1	-43.08	-20	Pass
NVNT	1-DH5	2480	Ant1	-44.69	-20	Pass



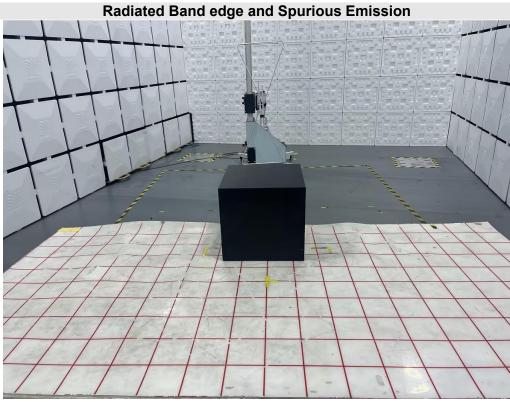


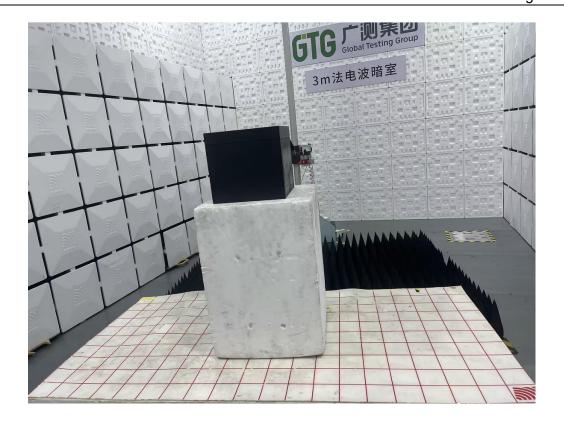


REPORT NO.: E01A23080897F00401 Page 71 of 73

### **APPENDIX: PHOTOGRAPHS OF TEST CONFIGURATION**







REPORT NO.: E01A23080897F00401 Page 73 of 73

### **END OF REPORT**