Product Name: Projector	**Report No: ITEZA2-202300405RF2**
Product Model: ZMLF2001, ZMLF2002, ZMLF2003, ZMLF2004, ZMLF2005, ZMLF2006，ZMLF2007, ZMLF2008, ZMLF2009, ZMLF2010	**Security Classification: Open**
Version: V1.0	**Total Page: 81**

TIRT Testing Report

Prepared By:	**Checked By:**	**Approved By:**	
Aaron Long	Stone Tang	Joky Wang	
Aaron Long	Stone Tang	Joky Wang	

FCC Radio Test Report

FCC ID: 2A6K3-ZMLF2001

This report concerns: Original Grant

Equipment	:	Projector
Brand Name	:	ZEEMR
Test Model	:	ZMLF2001, ZMLF2002, ZMLF2003, ZMLF2004, ZMLF2005, ZMLF2006, ZMLF2007, ZMLF2008, ZMLF2009, ZMLF2010
Applicant	:	Jiangsu Golden Vision Legend Technology Co.,Ltd
Address	:	Room 105-7, Building 17, Phase I, HR Service Industrial Park, Nanjing Jiangbei New District, No. 1, Qiliqiaobei Road Jiangbei New District, Nanjing, China
Manufacturer	:	Jiangsu Golden Vision Legend Technology Co.,Ltd
Address	:	Room 105-7, Building 17, Phase I, HR Service Industrial Park, Nanjing Jiangbei New District, No. 1, Qiliqiaobei Road Jiangbei New District, Nanjing, China
Date of Receipt	:	Dec. 13, 2023
Date of Test	:	Dec. 13, 2023~ Dec. 28, 2023
Issued Date	:	Jan. 12, 2024
Report Version	:	V1.0
Test Sample	:	Engineering Sample No.: 1000024292
Standard(s)	:	FCC CFR Title 47, Part 15, Subpart C FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10-2013

- The test result referred exclusively to the presented test model /sample.
- Without written approval of TIRT Inc. the test report shall not reproduced except in full.

Lab: Beijing TIRT Technology Service Co.,Ltd Shenzhen
Add: 104 Building C, Xinmingsheng Industrial Park No.132, Zhangge Old Village East Zone, Zhangge Community, Fucheng Street, Longhua District, Shenzhen, Guangdong, P. R. China
TEL: +86-0755-27087573

Table of Contents Page

Table of Contents Page

Table of Contents Page

REPORT ISSUED HISTORY

Report No.	Version	Description	Issued Date	Note
ITEZA2-202300405RF2	V1.0	Original Report.	2024.01.12	Valid

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC CFR Title 47, Part 15, Subpart C				
Standard(s) Section	**Test Item**	**Test Result**	**Judgment**	**Remark**
15.207	AC Power Line Conducted Emissions	APPENDIX A	PASS	------
15.247(d) 15.205(a) 15.209(a)	Radiated Emission	APPENDIX B APPENDIX C APPENDIX D	PASS	------
15.247 (a)(1)(iii)	Number of Hopping Frequency	APPENDIX E	PASS	------
15.247 (a)(1)(iii)	Average Time of Occupancy	APPENDIX F	PASS	------
15.247(a)(1)	Hopping Channel Separation	APPENDIX G	PASS	------
15.247(a)(1)	Bandwidth	APPENDIX H	PASS	------
15.247(a)(1)	Maximum Output Power	APPENDIX I	PASS	------
15.247(d)	Conducted Spurious Emission	APPENDIX J	PASS	------
15.203	Antenna Requirement	------	PASS	Note(2)

Note:

(1) “N/A” denotes test is not applicable in this test report

(2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.

1.1 TEST FACILITY

Company:	Beijing TIRT Technology Service Co.,Ltd Shenzhen
Address:	104 Building C, Xinmingsheng Industrial Park No.132, Zhangge Old Village East Zone, Zhangge Community, Fucheng Street, Longhua District, Shenzhen, Guangdong, P. R. China
CNAS Registration Number:	CNAS L14158
A2LA Registration Number:	6049.01
FCC Accredited Lab. Designation Number:	CN1366
FCC Test Firm Registration Number:	820690
Telephone:	+86-0755-27087573

1.2 MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))
The BTL measurement uncertainty as below table:

Uncertainty	
Parameter	Uncertainty
Occupied Channel Bandwidth	±142.12 KHz
RF power conducted	±0.74 dB
RF power radiated	±3.25dB
Spurious emissions, conducted	±1.78dB
Spurious emissions, radiated (30MHz～1GHz)	±4.6dB
Spurious emissions, radiated (1GHz ~ 26.5GHz)	±4.9dB
Conduction Emissions(150kHz~30MHz)	±3.1 dB
Humidity	±4.6%
Temprature	±0.7°C
Time	±1.25%

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

1.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By
AC Power Line Conducted Emissions	25.1°C	53%	AC 120V/60Hz	Stone Tang
Radiated Emission	24.5°C	51%	AC 120V/60Hz	Stone Tang
Number of Hopping Frequency	24.2°C	51%	AC 120V/60Hz	Stone Tang
Average Time of Occupancy	26.0°C	51%	AC 120V/60Hz	Stone Tang
Hopping Channel Separation	25.0°C	65%	AC 120V/60Hz	Stone Tang
Bandwidth	24.9°C	60%	AC 120V/60Hz	Stone Tang
Maximum Output Power	25.1°C	58%	AC 120V/60Hz	Stone Tang
Conducted Spurious Emission	26.0°C	52%	AC 120V/60Hz	Stone Tang

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	Projector
Brand Name	ZEEMR
Test Model	ZMLF2001
Series Model	ZMLF2001, ZMLF2002, ZMLF2003, ZMLF2004, ZMLF2005, ZMLF2006, ZMLF2007, ZMLF2008, ZMLF2009, ZMLF2010
Model Difference(s)	There is no difference except the name of the model
Software Version	v2.1.2
Hardware Version	v1.0.0
Power Source	AC 100-240V, 50/60Hz 2.3A
Power Rating	AC 120V/60Hz
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK, π/4-DQPSK, 8-DPSK
Bit Rate of Transmitter	1Mbps, 2Mbps, 3Mbps
Max. Output Power	1Mbps: 19.01dBm (0.079616W)

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

3. Table for Filed Antenna:

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	N/A	BBT076-S7C-I	FPC	N/A	1.75

Note:
1. The antenna gain is provided by the manufacturer.
2. The antenna is for testing purposes only.

2.2 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

Pretest Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78
Mode 3	TX Mode_3Mbps Channel 00/39/78

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

AC power line conducted emissions test	
Final Test Mode	Description
Mode 3	TX Mode_3Mbps Channel 00

Radiated emissions test - Below 1GHz	
Final Test Mode	Description
Mode 3	TX Mode_3Mbps Channel 00

Radiated emissions test - Above 1GHz	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78

Maximum Output Power	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78
Mode 3	TX Mode_3Mbps Channel 00/39/78

Other Conducted test	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 2	TX Mode_2Mbps Channel 00/39/78
Mode 3	TX Mode_3Mbps Channel 00/39/78

Note:

(1) The measurements for Output Power were tested with DH1/3/5 during 1Mbps, 2Mbps and 3Mbps, the worst case were 1Mbps (DH5) and 3Mbps (DH5), only worst case were documented for other test items except Average Time of Occupancy.

(2) For radiated emission above 1 GHz test, the spurious points of 1GHz~26.5GHz have been pre-tested and in this report only recorded the worst case. The remaining spurious points are all below the limit value of 20dB.

(3) This product has the mode of BT AFH, which was considered during testing. 800/20/X(X = 2 of DH1, X = 4 of DH3 or X = 6 of DH5) with 20, 10 or 6.67 hops per second in a channel, and then multiply 0.4*20 (20 # of hopping). But this mode is not the worst case mode as duration of the packet is same, and this report only shows the worst case mode.

(4) For AC power line conducted emissions and radiated spurious emissions below 1 GHz test, the 3Mbps Channel 00 are found to be the worst case and recorded.

2.3 PARAMETERS OF TEST SOFTWARE

During testing, channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

Test Software Version	Secure CRT		
Frequency (MHz)	2402	2441	2480
1Mbps	default	default	default
2Mbps	default	default	default
3Mbps	default	default	default

2.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

2.5 SUPPORT UNITS

Item	Cable Type	Shielded Type	Ferrite Core	Length
N/A	N/A	N/A	N/A	N/A

2.6 ANCILLARY EQUIPMENT DETAILS

No.	Description	Manufacturer	Model	Serial Number	Certification or SDoC
1.	Notebook PC	Lenovo	ThinkPad S3-S440	N/A	N/A

3. AC POWER LINE CONDUCTED EMISSIONS

3.1 LIMIT

Frequency of Emission (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

Note:

(1) The tighter limit applies at the band edges.
(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

3.2 TEST PROCEDURE

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

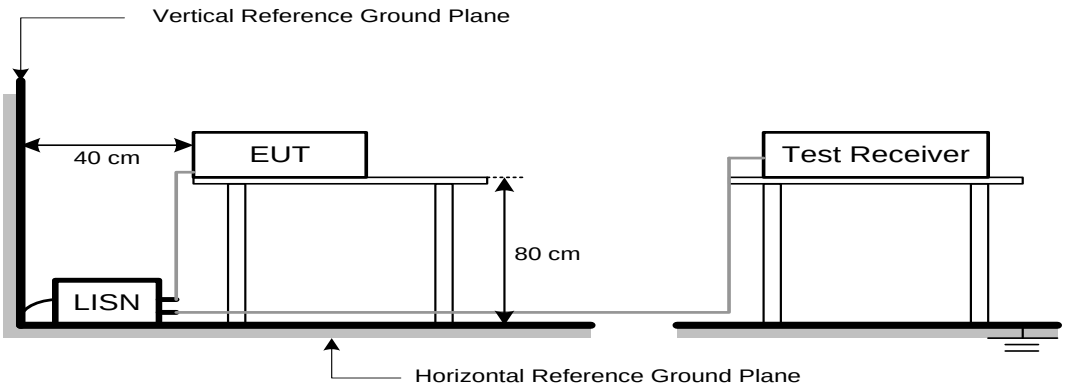
The following table is the setting of the receiver:

Receiver Parameters	Setting
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.3 DEVIATION FROM TEST STANDARD

No deviation.

3.4 TEST SETUP



3.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical function (as a customer would normally use it), EUT was programmed to be in continuously transmitting data or hopping on mode.

3.6 TEST RESULTS

Please refer to the APPENDIX A.

Remark:

(1) All readings are QP Mode value unless otherwise stated AVG in column of『Note』. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform in this case, a "*" marked in AVG Mode column of Interference Voltage Measured.

(2) Measuring frequency range from 150 kHz to 30 MHz.

4. RADIATED EMISSIONS

4.1 LIMIT

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-1000 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
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000 MHz)

Frequency (MHz)	(dBuV/m at 3 m)	
	Peak	Average
Above 1000	74	54

Note:

(1) The limit for radiated test was performed according to FCC CFR Title 47, Part 15, Subpart C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

4.2 TEST PROCEDURE

a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1 GHz)
b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1 GHz)
c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.
f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn‘t perform. (below 1 GHz)
h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn‘t perform. (above 1 GHz)
i. For the actual test configuration, please refer to the related Item –EUT Test Photos.

The following table is the setting of the receiver:

Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~150 kHz for RBW 200 Hz
Start ~ Stop Frequency	0.15 MHz~30 MHz for RBW 9 kHz
Start ~ Stop Frequency	30 MHz~1000 MHz for RBW 100 kHz

Spectrum Parameters	Setting
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	1 MHz / 3 MHz for PK value 1 MHz / 1/T Hz for AVG value

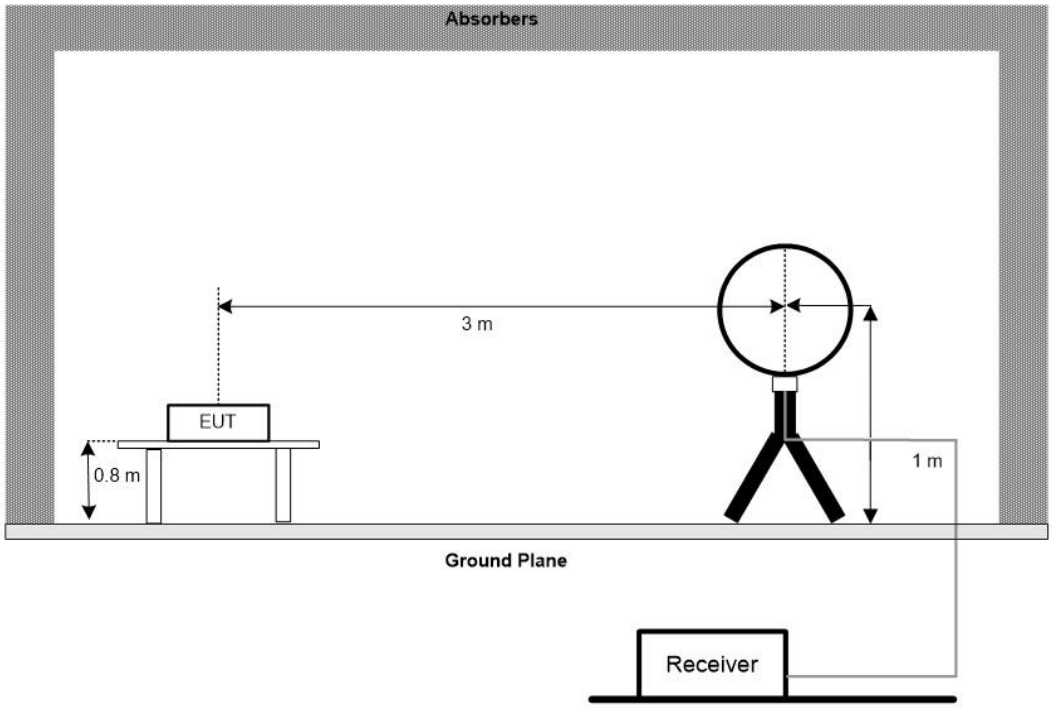
Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector
Start ~ Stop Frequency	1 GHz~26.5 GHz for PK/AVG detector

4.3 DEVIATION FROM TEST STANDARD

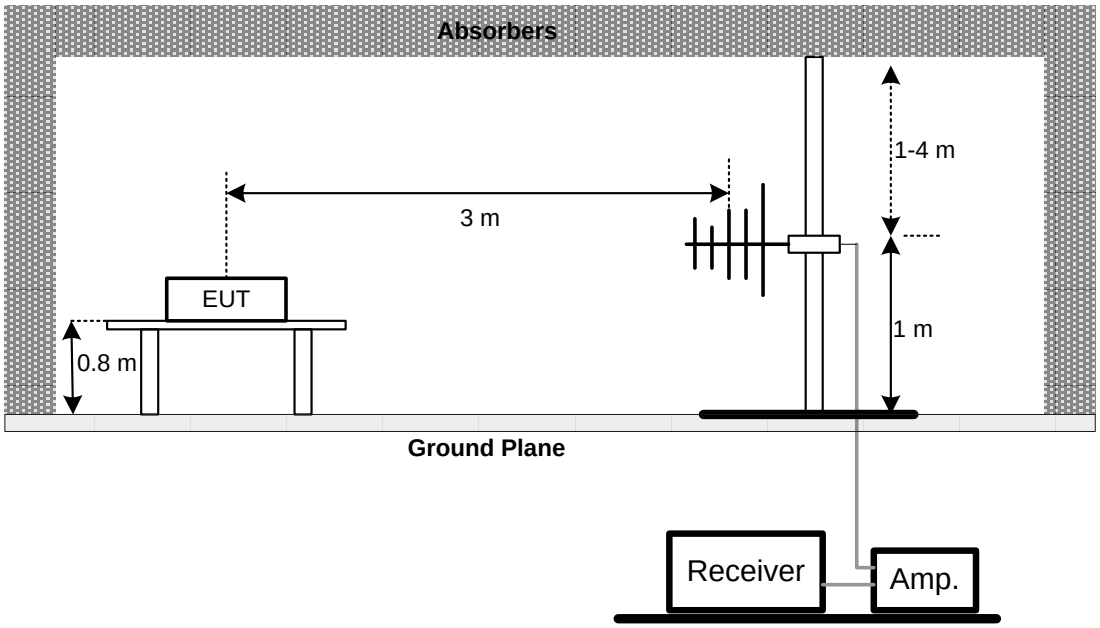
No deviation.

4.4 TEST SETUP

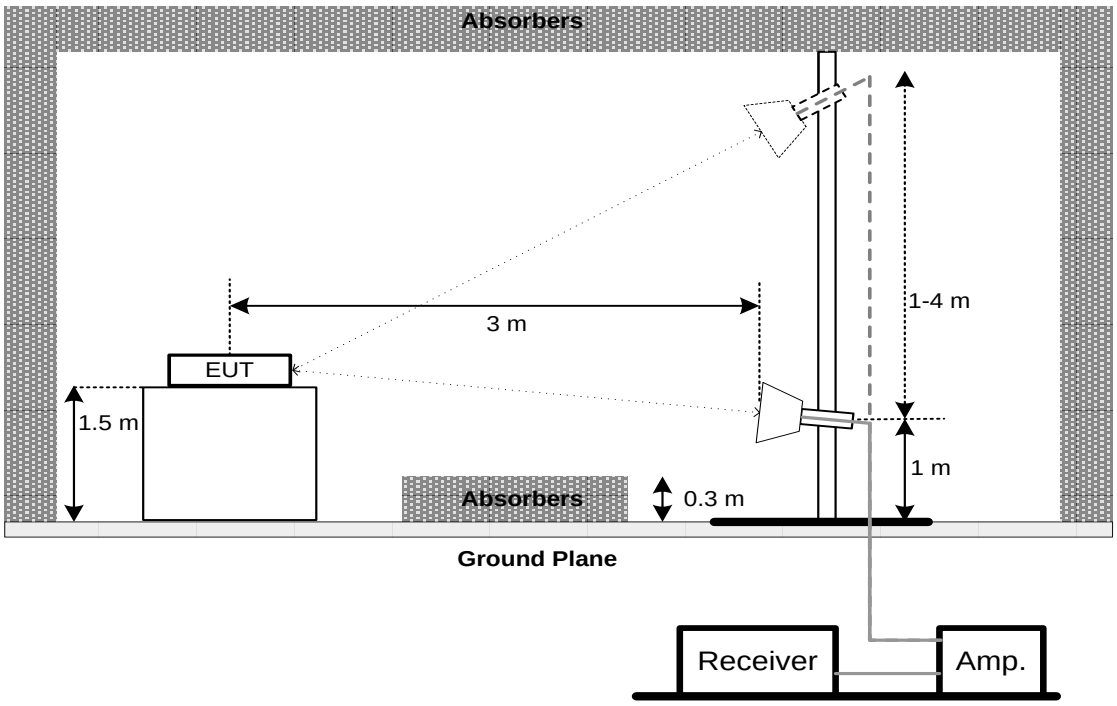
9 kHz to 30 MHz



30 MHz to 1 GHz



Above 1 GHz


Absorbers
3 m
1-4 m
EUT
1.5 m
Absorbers
0.3 m
1 m
Ground Plane
Receiver
Amp.

4.5 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

4.6 TEST RESULTS - 9 kHz TO 30 MHz

Please refer to the APPENDIX B.

Remark:

(1) Distance extrapolation factor = 40 log (specific distance / test distance) (dB).
(2) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.7 TEST RESULTS - 30 MHz TO 1000 MHz

Please refer to the APPENDIX C.

4.8 TEST RESULTS - ABOVE 1000 MHz

Please refer to the APPENDIX D.

Remark:

(1) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5. NUMBER OF HOPPING FREQUENCY

5.1 LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)(iii)	Number of Hopping Frequency	15

5.2 TEST PROCEDURE

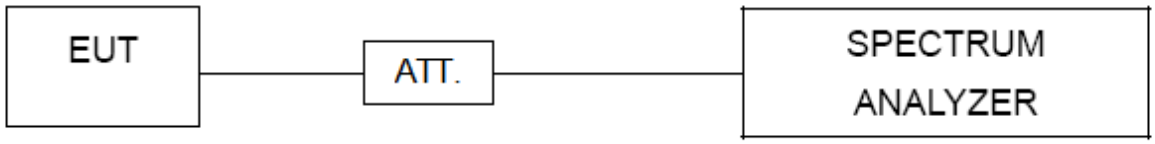
a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	> Operating Frequency Range
RBW	100 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.3 DEVIATION FROM STANDARD

No deviation.

5.4 TEST SETUP



5.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6 TEST RESULTS

Please refer to the APPENDIX E.

6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)(iii)	Average Time of Occupancy	0.4sec

6.2 TEST PROCEDURE

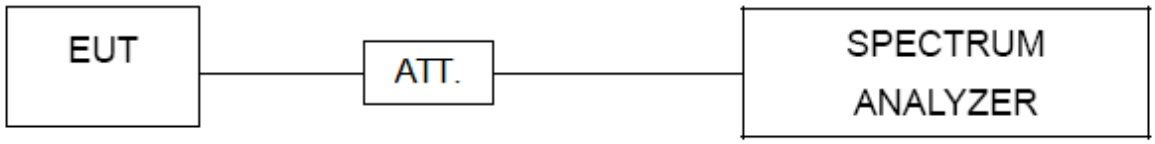
a. Set the EUT for DH1, DH3 and DH5 packet transmitting.
b. Measure the maximum time duration of one single pulse.
c. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
d. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
e. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
f. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
g. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	0 MHz
RBW	1 MHz
VBW	1 MHz
Detector	Peak
Trace	Max Hold
Sweep Time	As necessary to capture the entire dwell time per hopping channel

6.3 DEVIATION FROM STANDARD

No deviation.

6.4 TEST SETUP



6.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

6.6 TEST RESULTS

Please refer to the APPENDIX F.

7. HOPPING CHANNEL SEPARATION

7.1 LIMIT

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, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.2 TEST PROCEDURE

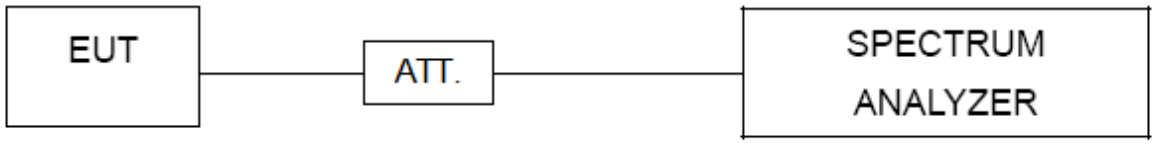
a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	Wide enough to capture the peaks of two adjacent channels
RBW	30 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

7.6 TEST RESULTS

Please refer to the APPENDIX G.

8. BANDWIDTH

8.1 LIMIT

Section	Test Item
FCC 15.247(a)(1)	Bandwidth

8.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	> Measurement Bandwidth
RBW	30 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP

8.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

8.6 TEST RESULTS

Please refer to the APPENDIX H.

9. MAXIMUM OUTPUT POWER

9.1 LIMIT

Section	Test Item	Limit
FCC 15.247(a)(1)	Maximum Output Power	0.1250 Watt or 20.97 dBm

Note: 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, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

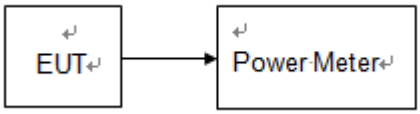
9.2 TEST PROCEDURE

The transmitter output is connected to the RF Power Meter. The RF Power Meter is set to the peak power detection.

9.3 DEVIATION FROM STANDARD

No deviation.

9.4 TEST SETUP



9.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

9.6 TEST RESULTS

Please refer to the APPENDIX I.

EUT

10. CONDUCTED SPURIOUS EMISSION

10.1 LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output Power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required.

10.2 TEST PROCEDURE

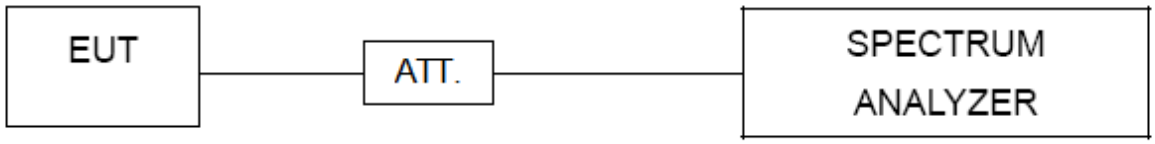
a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Start Frequency	30 MHz
Stop Frequency	26.5 GHz
RBW	100 kHz
VBW	300 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

10.3 DEVIATION FROM STANDARD

No deviation.

10.4 TEST SETUP



10.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

10.6 TEST RESULTS

Please refer to the APPENDIX J.

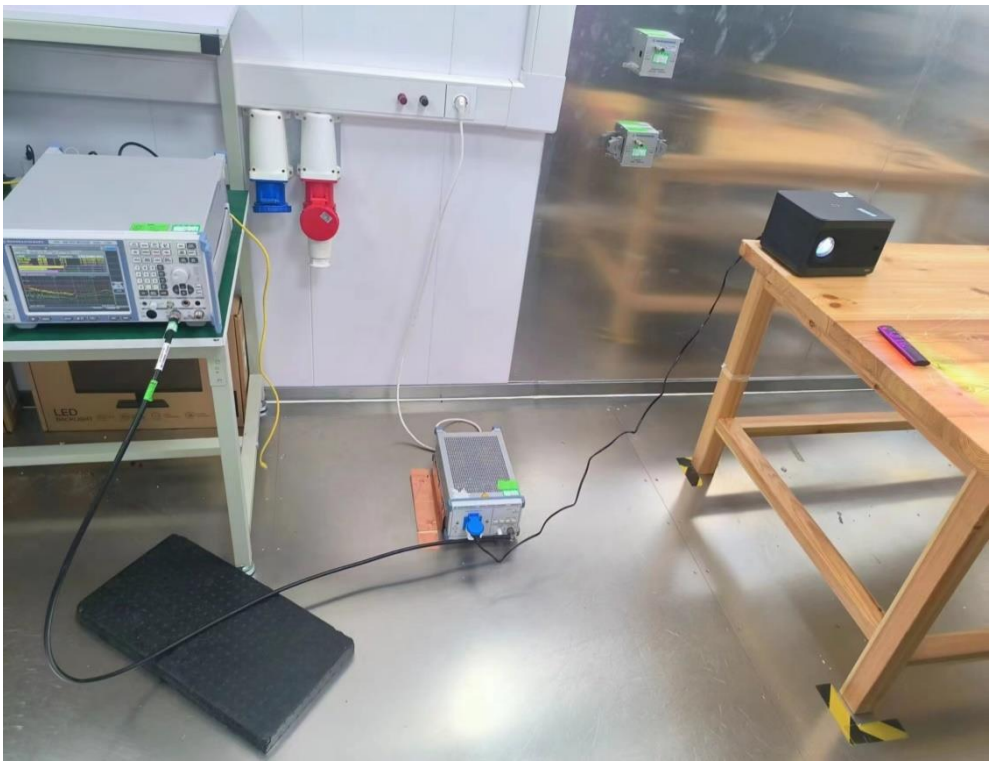
11. MEASUREMENT INSTRUMENTS LIST

Name of Equipment	Manufacturer	Model Number	Serial Number	Last Calibration	Due Calibration
EMI Receiver	Rohde&Schwarz	ESIB 40	YH-TIRT-SAC-966-20220911	2023/01/05	2024/01/04
Integral Antenna	Schwarzbeck	VULB 9168	01314	2023.12.16	2024.12.15
Integral Antenna	Rohde&Schwarz	HF907	RSM2991424	2023.12.16	2024.12.15
Preamplifier	Emtrace	RP01A	02017	2023/01/05	2024/01/04
Preamplifier	Schwarzbeck	BBV9744	00143	2023/01/05	2024/01/04
Loop Antenna	ZHINAN	ZN30900A	12024	2023/01/05	2024/01/04
Exposure Level Tester	narda	ELT-400	N-0925	2023/01/05	2024/01/04
Horn Antenna	Schwarzbeck	BBHA9170	00956	2023/01/05	2024/01/04
RF Cable	/	LMR400UF-NMNM-7.0M	/	2023/01/05	2024/01/04
RF Cable	/	SFT2050PUR-NMNM-7.0M	/	2023/01/05	2024/01/04
EMI Receiver	Rohde&Schwarz	ESR7	1316.3003K07-102611-mk	2023.12.24	2024.10.23
LISN	Rohde&Schwarz	ENV216	3560.655.12-102915-Bp	2023/12/24	2024/12/23
ISN	Schwarzbeck	ENY81	1309.8510.03	2023/03/08	2024/03/07
ISN	Schwarzbeck	ENY81-CAT6	1309.8526.03-101976-kh	2023/03/08	2024/03/07
RF Cable	\	SFT2050PUR-NMNM-2.0M	\	2023/01/05	2024/01/04
CMW500	ROHDE&SCHWARZ	CMW500	120434	2023/01/05	2024/01/04
Spectrum analyzer	ROHDE&SCHWARZ	FSU26	200732	2023/10/25	2024/10/24
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	101722	2023/10/25	2024/10/24
vector Signal Generator	KEYSIGHT	N5182B	MY56200458	2023/01/05	2024/01/04
vector Signal Generator	HEWLETT PACKARD	83752A	3610A02458	2023/10/25	2024/10/24
Filter	Tonscend	JS0806-F	19K8060209	/	/
RF Control Unit	Tonscend	JS0806-2	19K8060209	2023/01/05	2024/01/04
Wireless comprehensive tester	ANRISTU	MT8821C	SN6262170409	2023/01/05	2024/01/04
Wireless comprehensive tester	ANRISTU	MT8000A	SN6262166782	2023/01/05	2024/01/04
Wireless broadband test system	Tonscend	JS1120-3	/	/	/

Remark: “/” denotes no model name, serial no. or calibration specified.

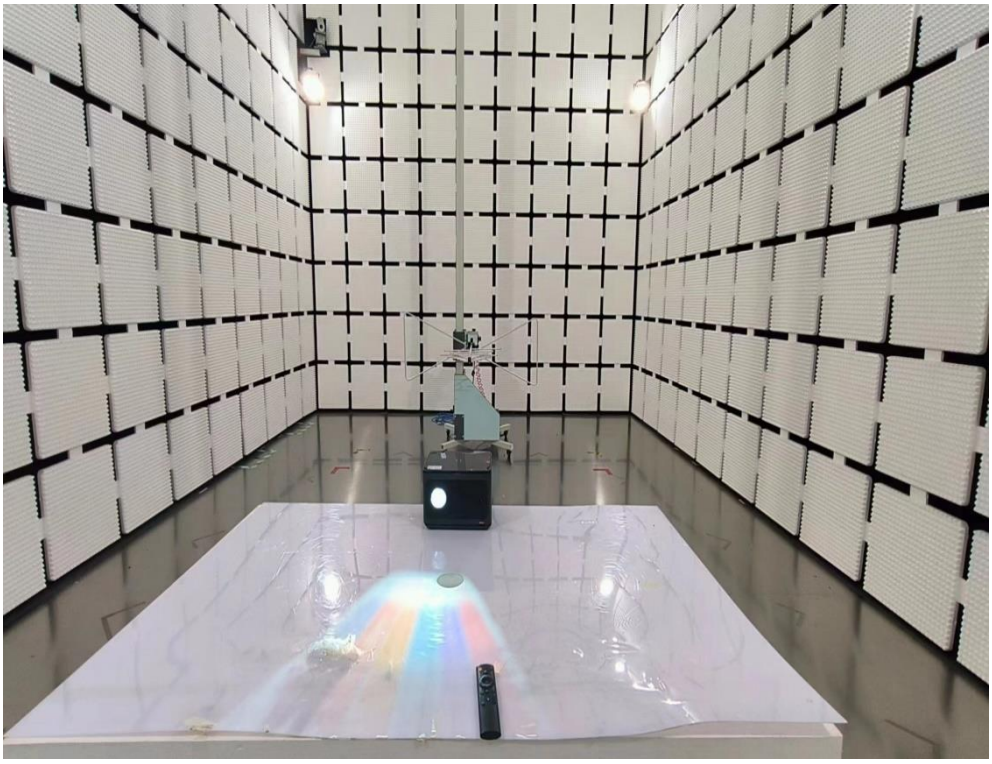
11.1. EUT TEST PHOTO

AC Power Line Conducted Emissions Test Photos



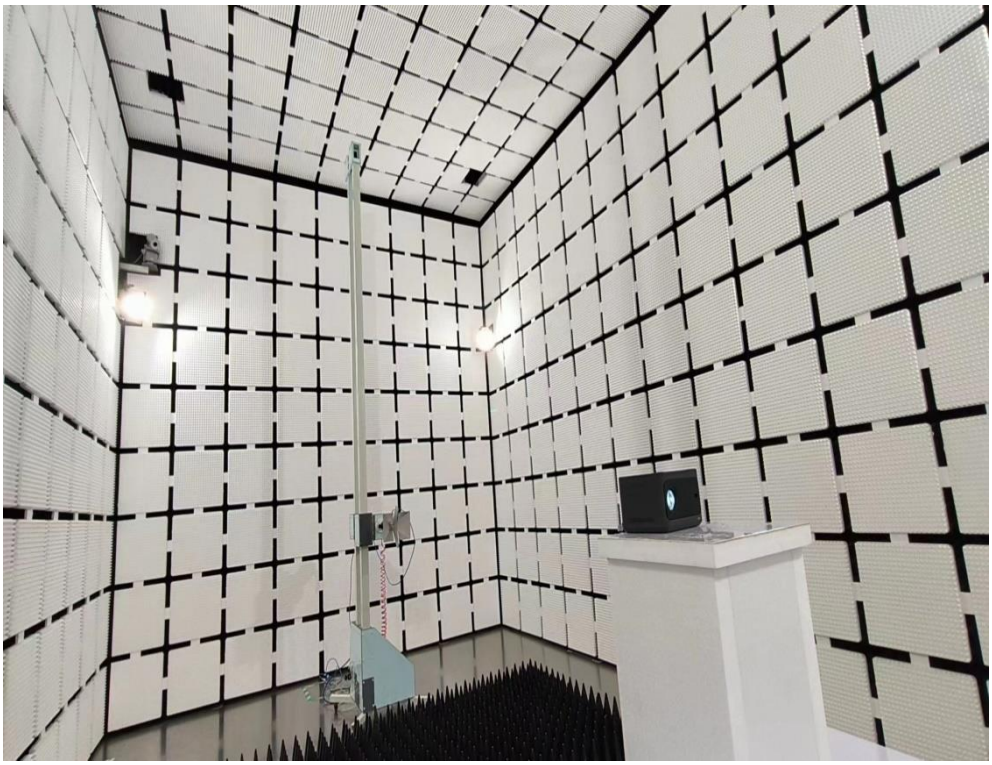
Radiated Emissions Test Photos

30 MHz to 1000 MHz



Radiated Emissions Test Photos

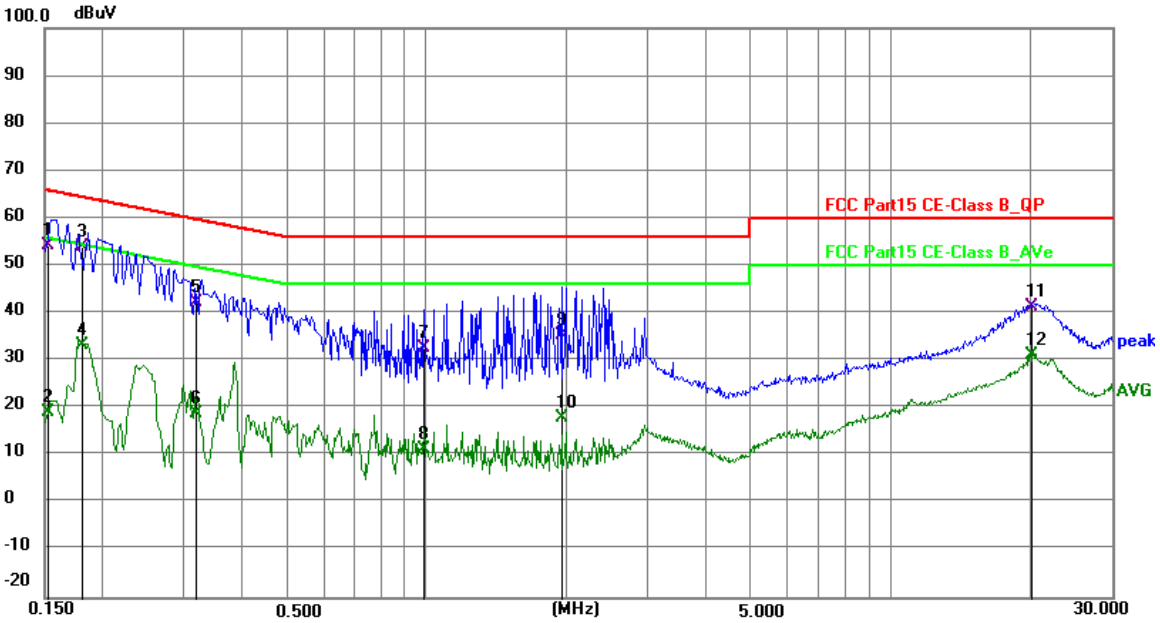
Above 1 GHz



Conducted Test Photos

APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

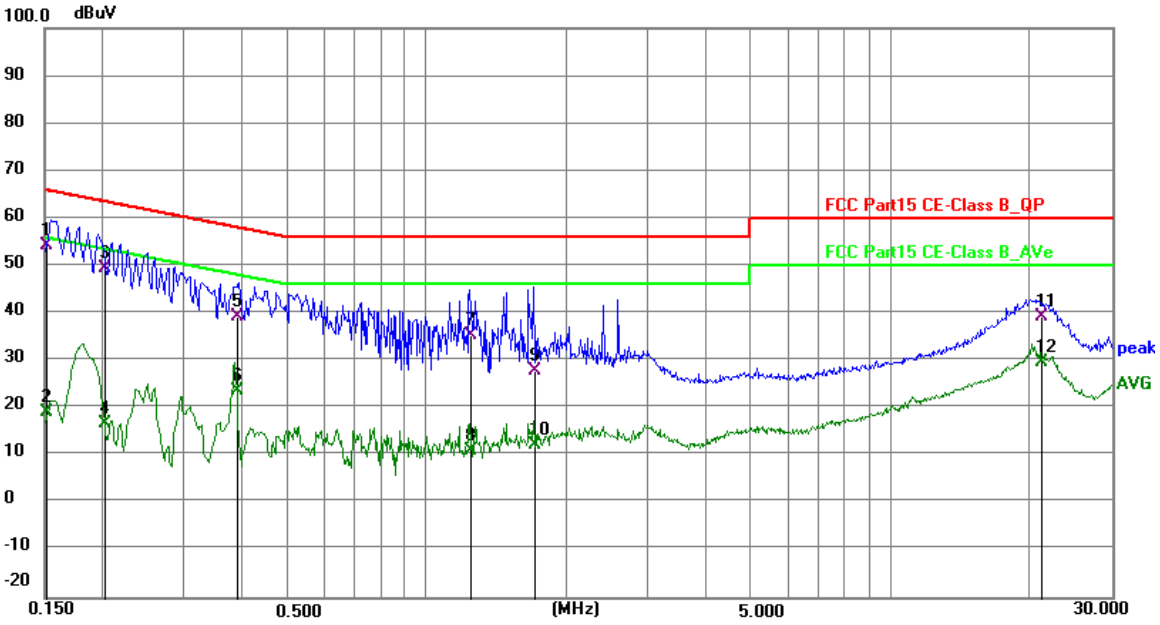
Test Mode	TX Mode_3Mbps Channel 00	Phase	Line



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1525	44.60	9.63	54.23	65.86	-11.63	QP	P
2	0.1525	9.42	9.63	19.05	55.86	-36.81	AVG	P
3 *	0.1807	44.22	9.63	53.85	64.45	-10.60	QP	P
4	0.1807	23.52	9.63	33.15	54.45	-21.30	AVG	P
5	0.3190	32.63	9.63	42.26	59.73	-17.47	QP	P
6	0.3190	9.33	9.63	18.96	49.73	-30.77	AVG	P
7	0.9890	22.93	9.64	32.57	56.00	-23.43	QP	P
8	0.9890	1.80	9.64	11.44	46.00	-34.56	AVG	P
9	1.9611	25.76	9.65	35.41	56.00	-20.59	QP	P
10	1.9611	8.21	9.65	17.86	46.00	-28.14	AVG	P
11	20.2987	31.43	9.78	41.21	60.00	-18.79	QP	P
12	20.2987	21.47	9.78	31.25	50.00	-18.75	AVG	P

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	TX Mode_3Mbps Channel 00	Phase	Neutral



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1 *	0.1522	44.70	9.62	54.32	65.88	-11.56	QP	P
2	0.1522	9.40	9.62	19.02	55.88	-36.86	AVG	P
3	0.2021	39.68	9.63	49.31	63.52	-14.21	QP	P
4	0.2021	7.17	9.63	16.80	53.52	-36.72	AVG	P
5	0.3887	29.59	9.62	39.21	58.09	-18.88	QP	P
6	0.3887	13.97	9.62	23.59	48.09	-24.50	AVG	P
7	1.2446	25.70	9.64	35.34	56.00	-20.66	QP	P
8	1.2446	1.32	9.64	10.96	46.00	-35.04	AVG	P
9	1.7155	18.14	9.65	27.79	56.00	-28.21	QP	P
10	1.7155	2.64	9.65	12.29	46.00	-33.71	AVG	P
11	21.3310	29.49	9.82	39.31	60.00	-20.69	QP	P
12	21.3310	19.79	9.82	29.61	50.00	-20.39	AVG	P

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

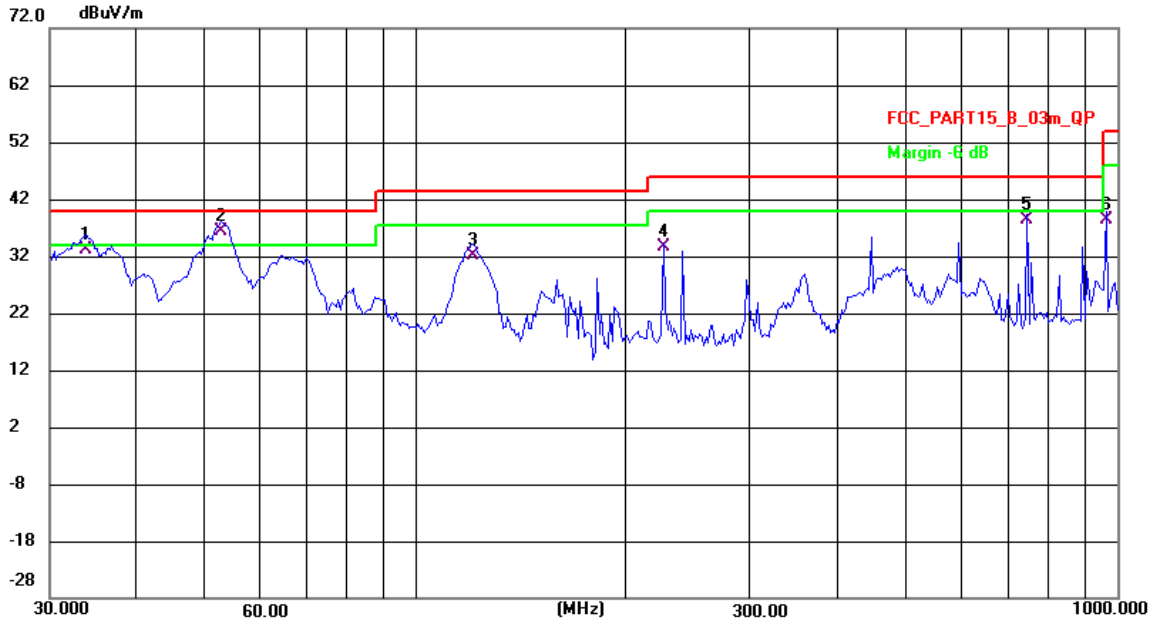
APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ

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

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ

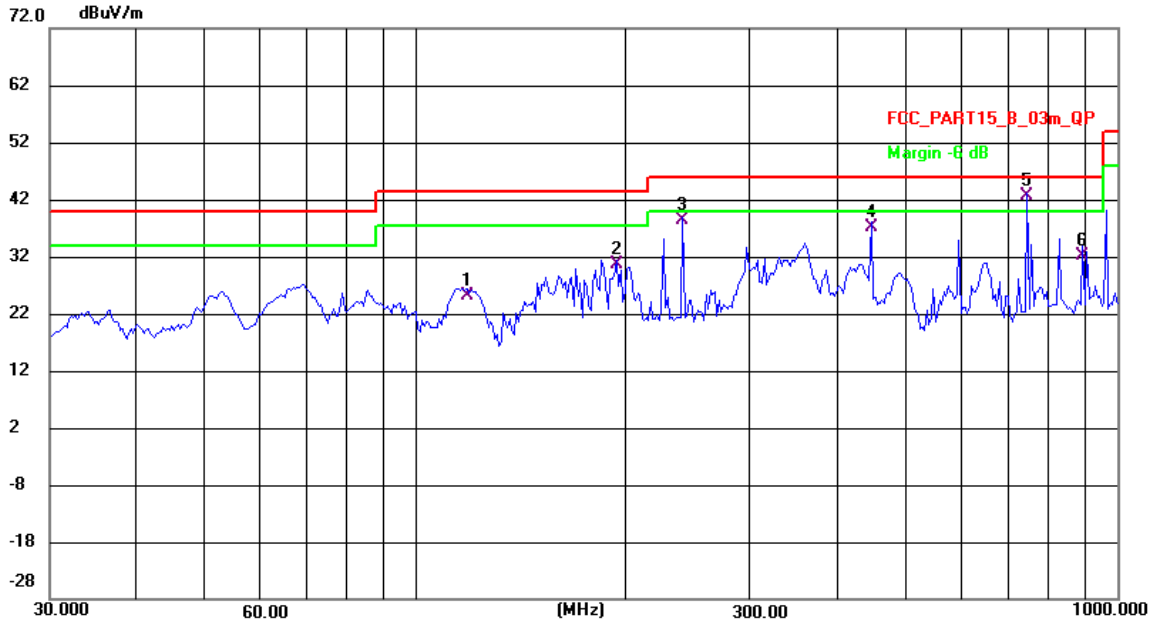
Test Mode	TX Mode_3Mbps Channel 00	Polarization	Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	33.8066	53.11	-19.97	33.14	40.00	-6.86	QP
2 *	52.6343	56.18	-19.76	36.42	40.00	-3.58	QP
3	120.6115	54.10	-22.09	32.01	43.50	-11.49	QP
4	225.4267	58.90	-25.36	33.54	46.00	-12.46	QP
5	744.4265	49.48	-11.12	38.36	46.00	-7.64	QP
6	965.4741	46.74	-8.46	38.28	54.00	-15.72	QP

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	TX Mode_3Mbps Channel 00	Polarization	Horizontal



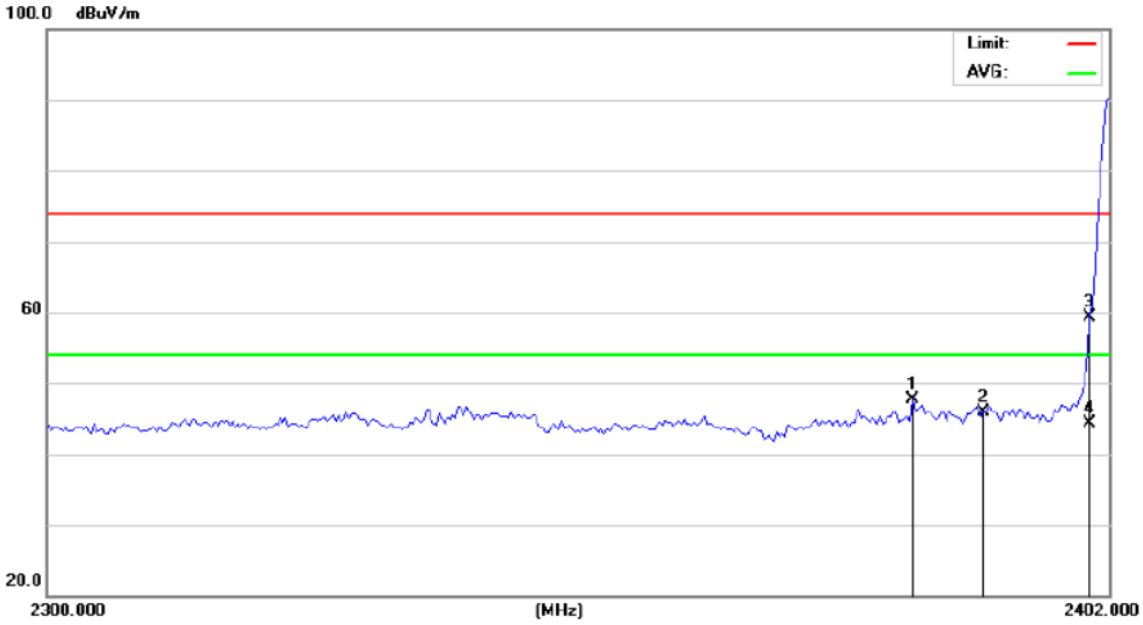
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	118.0956	47.43	-22.29	25.14	43.50	-18.36	QP
2	193.1365	55.11	-24.37	30.74	43.50	-12.76	QP
3	240.1442	62.54	-24.22	38.32	46.00	-7.68	QP
4	445.6931	55.23	-18.22	37.01	46.00	-8.99	QP
5 *	744.4265	53.70	-11.12	42.58	46.00	-3.42	QP
6	893.6556	40.99	-8.98	32.01	46.00	-13.99	QP

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

Test Result of Radiated Spurious at Band edges
Note: only show the worst mode data

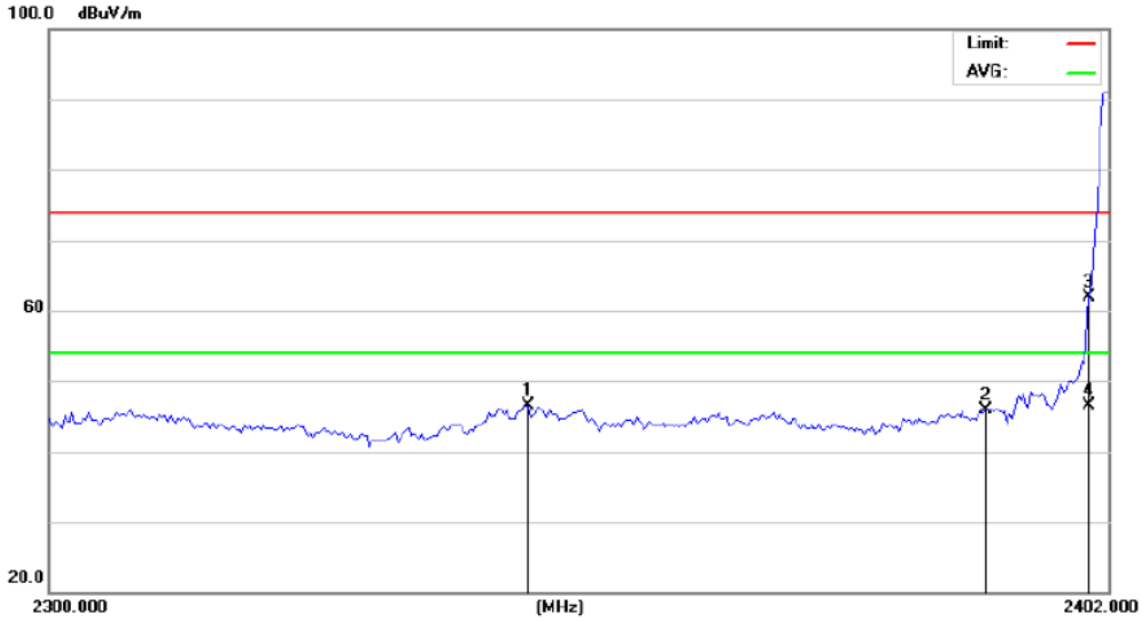
Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2382.795	52.50	-4.87	47.63	74.00	-26.37	peak			
2		2390.000	50.68	-4.82	45.86	74.00	-28.14	peak			
3		2400.000	64.00	-4.75	59.25	74.00	-14.75	peak			
4	*	2400.000	48.96	-4.75	44.21	54.00	-9.79	AVG			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

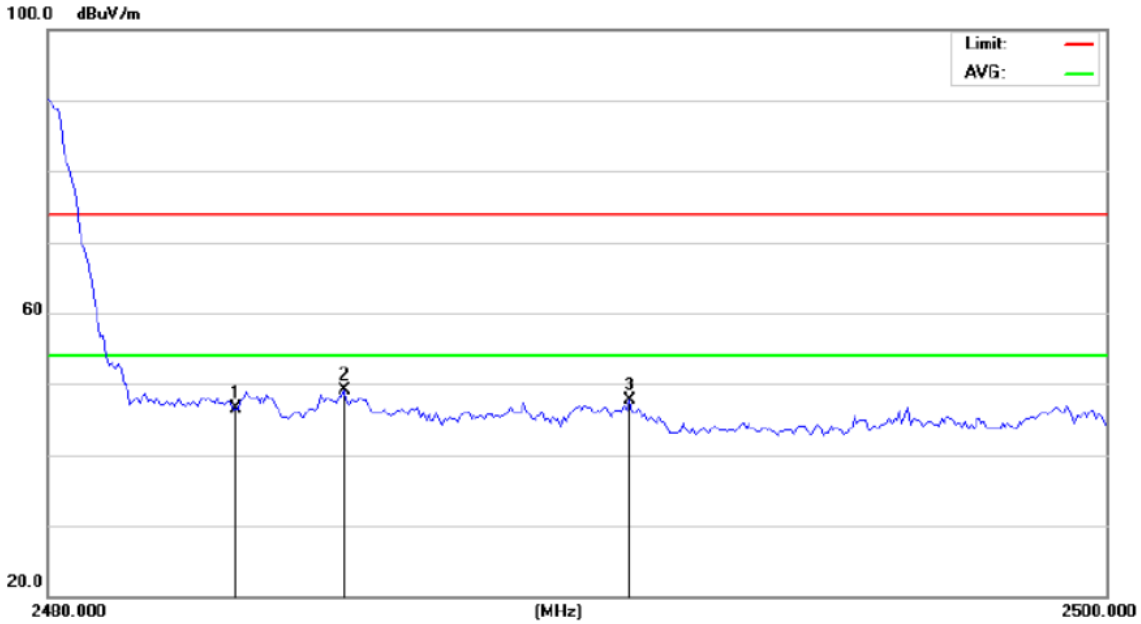
Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2345.607	51.66	-5.12	46.54	74.00	-27.46	peak			
2		2390.000	50.74	-4.82	45.92	74.00	-28.08	peak			
3		2400.000	66.69	-4.75	61.94	74.00	-12.06	peak			
4	*	2400.000	51.26	-4.75	46.51	54.00	-7.49	AVG			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

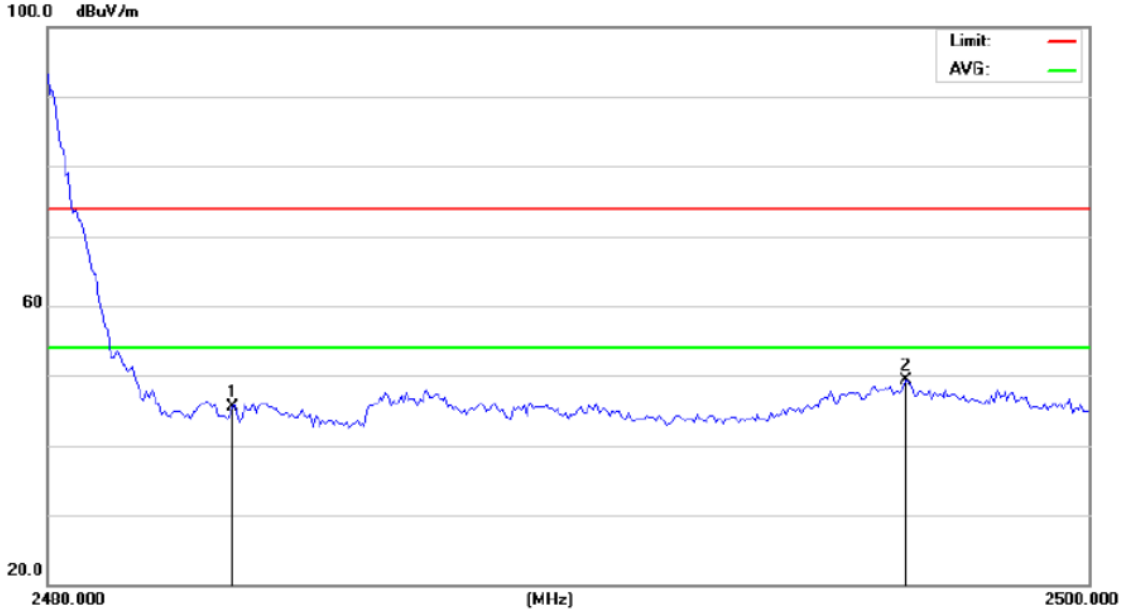
Test Mode	TX 2480 MHz _CH78_1Mbps	Polarization	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2483.500	50.72	-4.19	46.53	74.00	-27.47	peak			
2	*	2485.584	53.28	-4.18	49.10	74.00	-24.90	peak			
3		2490.980	51.78	-4.15	47.63	74.00	-26.37	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

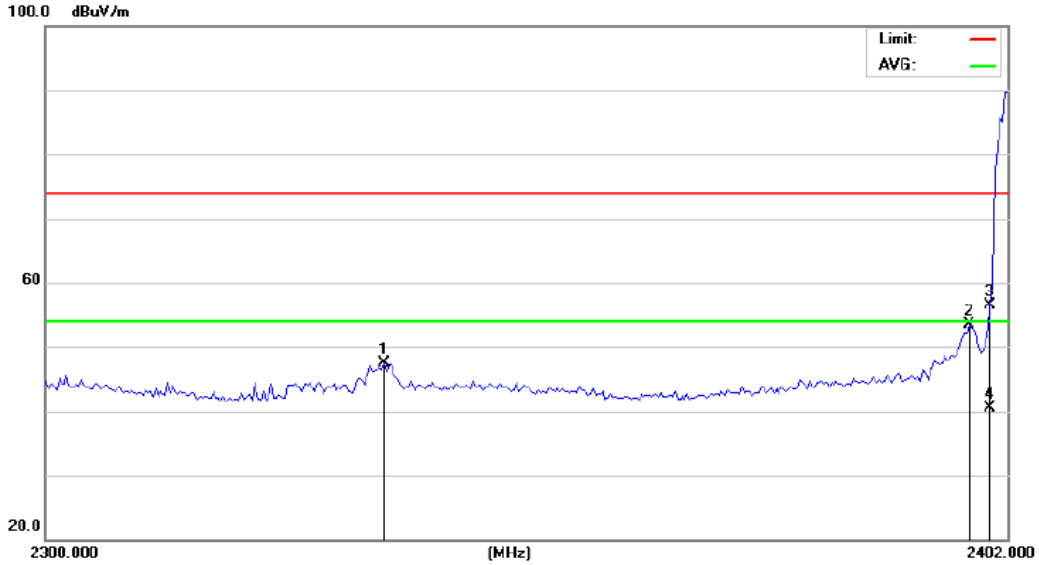
Test Mode	TX 2480 MHz _CH78_1Mbps	Polarization	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2483.500	49.62	-4.19	45.43	74.00	-28.57	peak			
2	*	2496.488	53.33	-4.11	49.22	74.00	-24.78	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	Hopping	Polarization	Horizontal



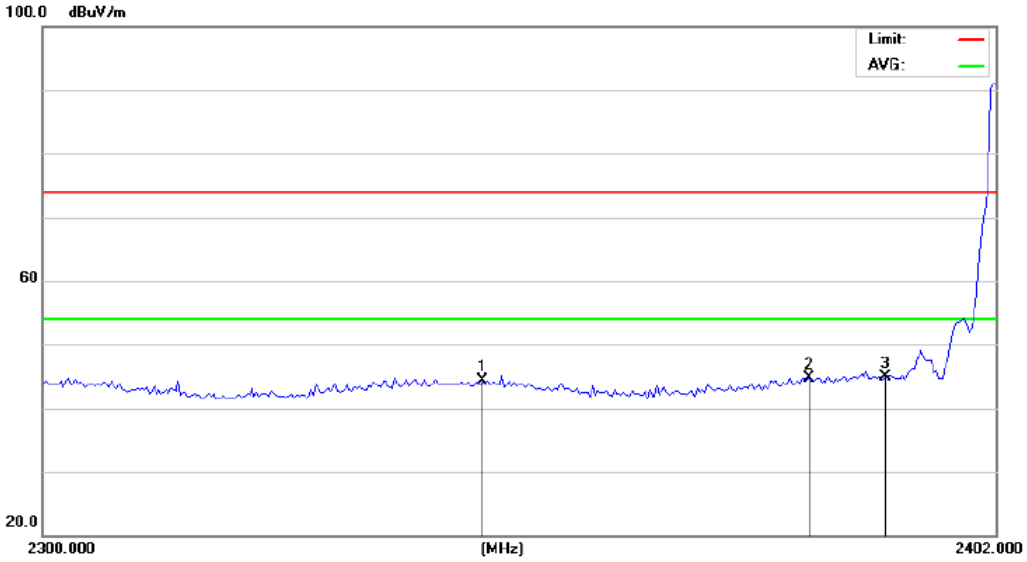
Mode: Hopping

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2335.451	52.66	-5.19	47.47	74.00	-26.53	peak			
2		2397.834	58.23	-4.77	53.46	74.00	-20.54	peak			
3		2400.000	61.20	-4.75	56.45	74.00	-17.55	peak			
4	*	2400.000	45.25	-4.75	40.50	54.00	-13.50	AVG			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	Hopping	Polarization	Vertical



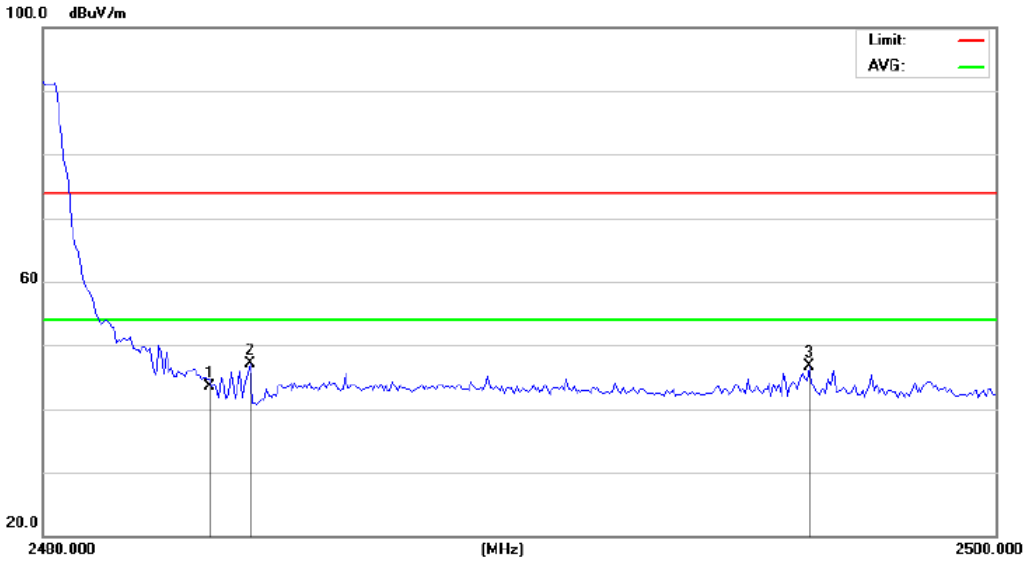
Mode: Hopping

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2346.625	49.40	-5.11	44.29	74.00	-29.71	peak			
2		2381.761	49.68	-4.88	44.80	74.00	-29.20	peak			
3	*	2390.000	49.68	-4.82	44.86	74.00	-29.14	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	Hopping	Polarization	Horizontal



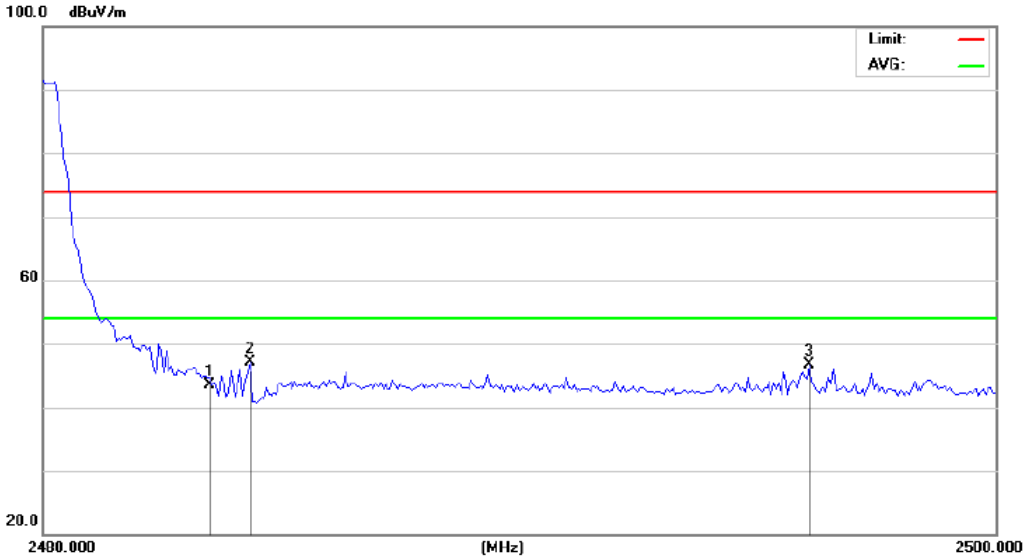
Mode: Hopping

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2483.500	47.72	-4.19	43.53	74.00	-30.47	peak			
2	*	2484.336	51.29	-4.19	47.10	74.00	-26.90	peak			
3		2496.087	50.84	-4.11	46.73	74.00	-27.27	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

Test Mode	Hopping	Polarization	Vertical



Mode: Hopping

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		2483.500	47.72	-4.19	43.53	74.00	-30.47	peak			
2	*	2484.336	51.29	-4.19	47.10	74.00	-26.90	peak			
3		2496.087	50.84	-4.11	46.73	74.00	-27.27	peak			

REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

ABOVE 1000 MHz
Mode: TX Mode_1Mbps Channel 00/39/78
Note: All the modes have been tested and recorded worst mode in the report.

Low channel:2402									
Frequency	Ant.Pol. H/V	Peak reading (dBuV)	AV reading (dBuV)	Correction Factor	Emission Level		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
					Peak (dBuV/m)	AV (dBuV/m)			
4804	H	45.62	---	0.66	46.28	---	74	54	-27.72
7206	H	37.29	---	9.5	46.79	---	74	54	-27.21
---	H	---	---	---	---	---	---	---	---
4804	V	44.43	---	0.66	45.09	---	74	54	-28.91
7206	V	37.75	---	9.5	47.25	---	74	54	-26.75
---	V	---	---	---	---	---	---	---	---

Low channel:2441									
Frequency	Ant.Pol. H/V	Peak reading (dBuV)	AV reading (dBuV)	Correction Factor	Emission Level		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
					Peak (dBuV/m)	AV (dBuV/m)			
4882.01	H	47.41	---	0.99	48.40	---	74	54	-25.60
7323.04	H	38.70	---	9.87	48.57	---	74	54	-25.43
---	H	---	---	---	---	---	---	---	---
4882.12	V	46.80	---	0.99	47.79	---	74	54	-26.21
7323.14	V	38.23	---	9.87	48.10	---	74	54	-25.90
---	V	---	---	---	---	---	---	---	---

Low channel:2480									
Frequency	Ant.Pol. H/V	Peak reading (dBuV)	AV reading (dBuV)	Correction Factor	Emission Level		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)
					Peak (dBuV/m)	AV (dBuV/m)			
4959.31	H	46.20	---	1.33	47.53	---	74	54	-26.47
7440.00	H	36.10	---	10.22	46.32	---	74	54	-27.68
---	H	---	---	---	---	---	---	---	---
4959.29	V	48.07	---	1.33	49.21	---	74	54	-24.79
7440.00	V	36.61	---	10.22	46.39	---	74	54	-27.61
---	V	---	---	---	---	---	---	---	---

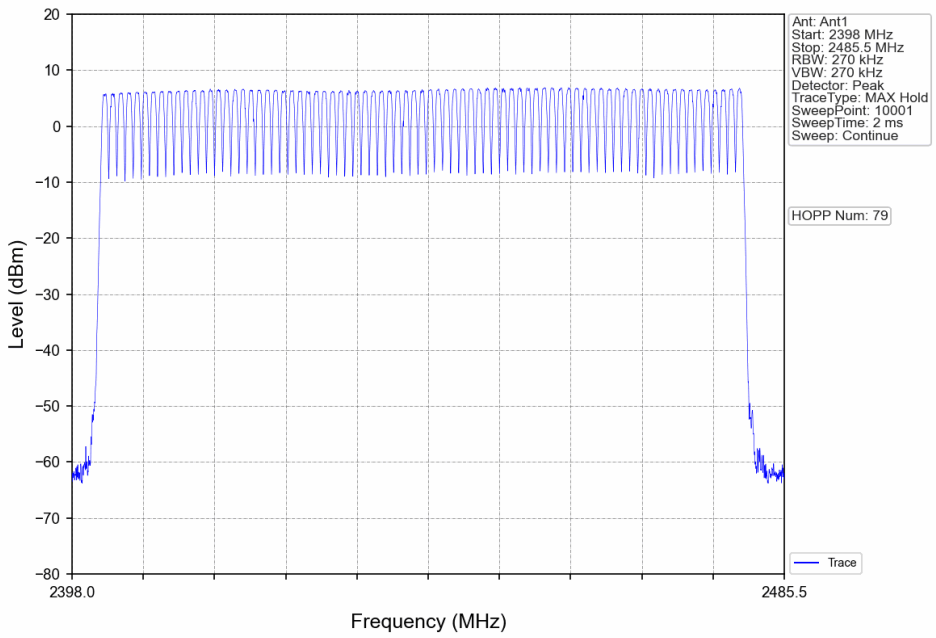
Notes:
1). Radiated emissions measured in frequency range from 9 KHz~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
2). Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
3). Measured Level = Reading Level + Correction Factor, Margin = Measured Level – Limit
4). Worst case data at 1Mbps at DH5(GFSK).

APPENDIX E - NUMBER OF HOPPING FREQUENCY

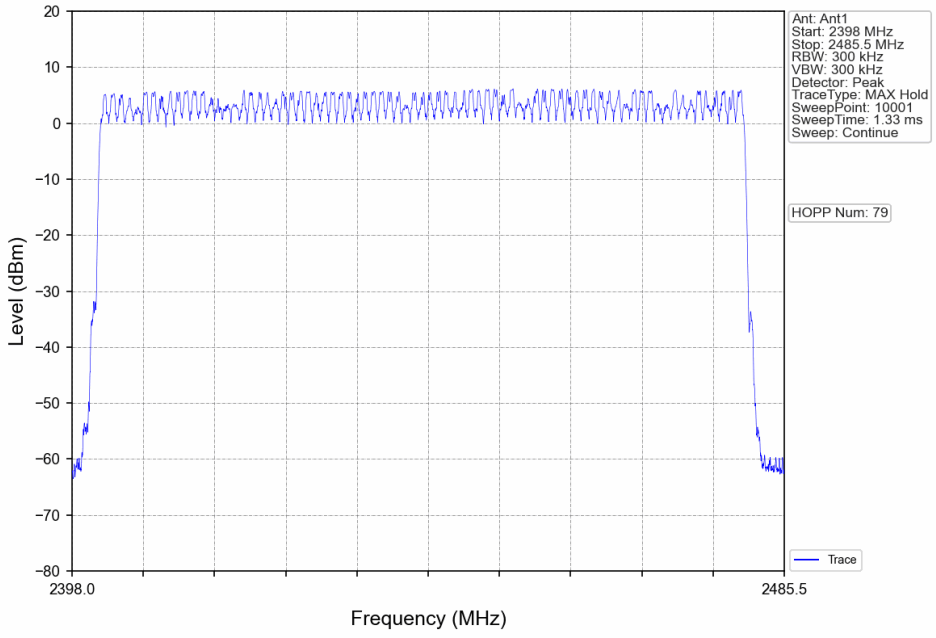
TestMode	Antenna	Freq(MHz)	Result[Num]	Limit[Num]	Verdict
DH5	Ant1	Hop	79	≥15	PASS
2DH5	Ant1	Hop	79	≥15	PASS
3DH5	Ant1	Hop	79	≥15	PASS

Test Graphs

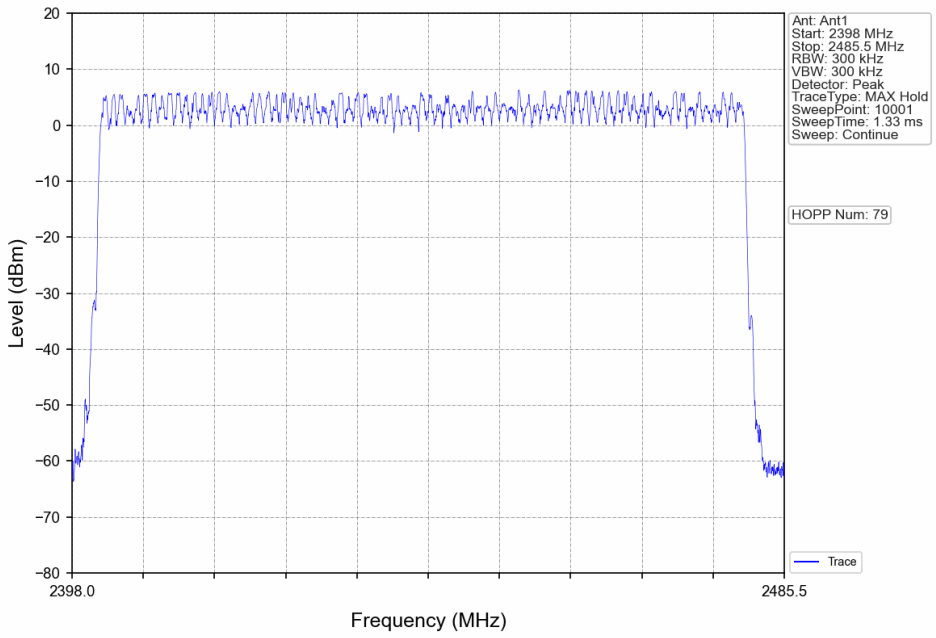
DH5_Ant1_Hop



2DH5_Ant1_Hop



3DH5_Ant1_Hop

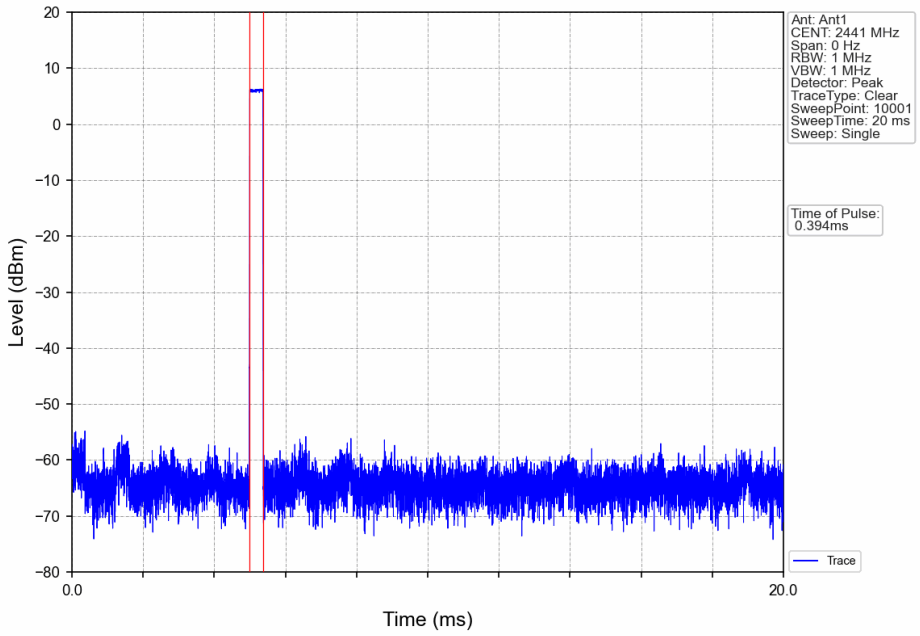


APPENDIX F - AVERAGE TIME OF OCCUPANCY

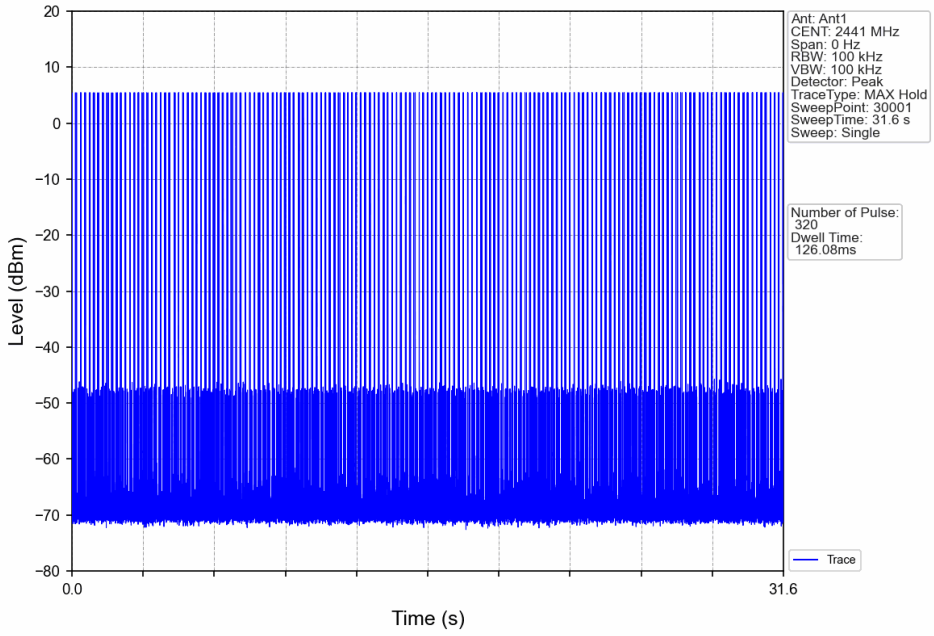
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH1	0.394	31.600	320	126.080	<=400	Pass
			DH3	1.652	31.600	160	264.320	<=400	Pass
			DH5	2.898	31.600	106	307.188	<=400	Pass
Pi/4DQPSK	SISO	HOPP	2DH1	0.402	31.600	320	128.640	<=400	Pass
			2DH3	1.640	31.600	160	262.400	<=400	Pass
			2DH5	2.902	31.600	113	327.926	<=400	Pass
8DPSK	SISO	HOPP	3DH1	0.388	31.600	320	124.160	<=400	Pass
			3DH3	1.638	31.600	160	262.080	<=400	Pass
			3DH5	2.904	31.600	104	302.016	<=400	Pass

Test Graphs

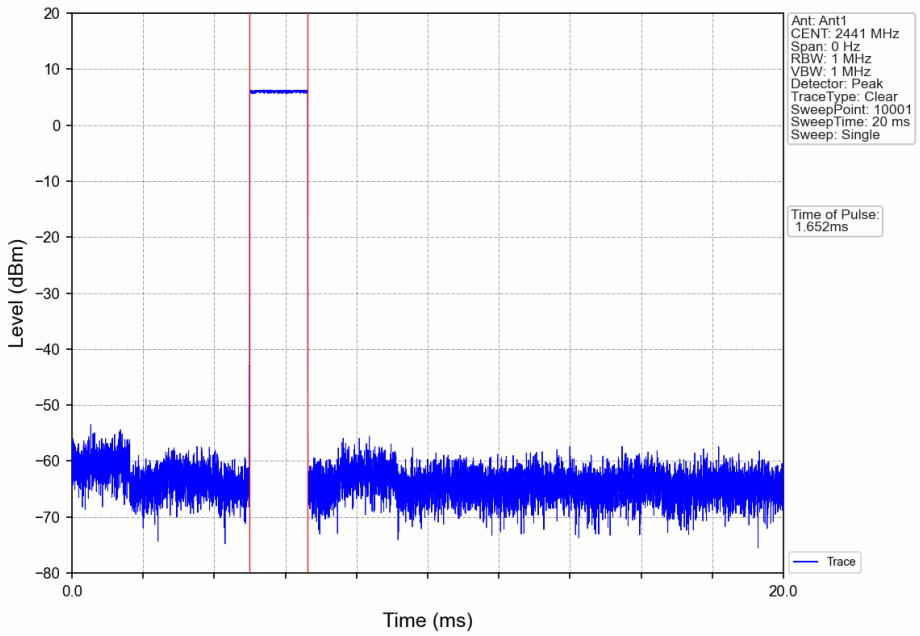
GFSK_DH1_HOPP_Ant1_NTNV



GFSK_DH1_HOPP_Ant1_NTNV



GFSK_DH3_HOPP_Ant1_NTNV



GFSK_DH3_HOPP_Ant1_NTNV