

Product Name: Wi-Fi&Bluetooth Module	Report No: FCC022022-06260RF6
Product Model: FC64E	Security Classification: Open
Version: V1.0	Total Page: 85

# TIRT Testing Report



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# FCC Radio Test Report

## FCC ID: XMR202208FC64E

This report concerns: Original Grant

**Project No.** : 2022-06260  
**Equipment** : Wi-Fi&Bluetooth Module  
**Brand Name** : Quectel  
**Test Model** : FC64E  
**Series Model** : NA  
**Applicant** : Quectel Wireless Solutions Co., Ltd  
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**Manufacturer** : Quectel Wireless Solutions Co., Ltd  
**Address** : Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233  
**Date of Receipt** : Sep. 14, 2022  
**Date of Test** : Sep. 14, 2022~Sep. 29, 2022  
**Issued Date** : Dec. 07, 2022  
**Report Version** : V1.0  
**Test Sample** : Engineering Sample No.: 20221207021267  
**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.

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**REPORT ISSUED HISTORY**

Report No.	Version	Description	Issued Date	Note
FCC022022-06260RF6	V1.0	Original Report.	2022.12.07	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:	101, 3 # Factory Building, Gongjin Electronics Shatin Community, Kengzi Street, Pingshan District, Shenzhen, China
CNAS Registration Number:	CNAS L14158
A2LA Registration Number:	6049.01
FCC Accredited Lab. Designation Number:	CN1309
FCC Test Firm Registration Number:	825524
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### 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:

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 ~ 18GHz)	±4.9dB
Conduction Emissions(150kHz~30MHz)	±3.1 dB
Humidity	±4.6%
Temperature	±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°C	52%	AC 120V/60Hz	Stone Tang
Radiated Emissions-9 kHz to 30 MHz	24.5°C	50%	AC 120V/60Hz	Stone Tang
Radiated Emissions-30 MHz to 1000 MHz	24°C	53%	AC 120V/60Hz	Stone Tang
Radiated Emissions-Above 1000 MHz	26°C	53%	AC 120V/60Hz	Stone Tang
Bandwidth	25°C	56%	AC 120V/60Hz	Stone Tang
Maximum Output Power	24°C	54%	AC 120V/60Hz	Stone Tang
Conducted Spurious Emission	25°C	62%	AC 120V/60Hz	Stone Tang
Power Spectral Density	26°C	60%	AC 120V/60Hz	Stone Tang

## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

Equipment	Wi-Fi&Bluetooth Module
Brand Name	Quectel
Test Model	FC64E
Series Model	NA
Model Difference(s)	NA
Software Version	NA
Hardware Version	R1.0
Power Source	DC voltage supplied from AC/DC adapter.
Power Rating	1.8V
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Bit Rate of Transmitter	1Mbps, 2Mbps, 3Mbps
Max. Output Power	1Mbps: 5.86 dBm (0.0039 W)

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	N/A	Dipole	N/A	0.73

## 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
Mode 4	TX Mode_1Mbps Channel 78

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

<b>AC power line conducted emissions test</b>	
Final Test Mode	Description
Mode 4	TX Mode_1Mbps Channel 78

<b>Radiated emissions test - Below 1GHz</b>	
Final Test Mode	Description
Mode 4	TX Mode_1Mbps Channel 78

<b>Radiated emissions test - Above 1GHz</b>	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 3	TX Mode_3Mbps Channel 00/39/78

<b>Maximum Output Power</b>	
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

<b>Other Conducted test</b>	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/39/78
Mode 3	TX Mode_3Mbps Channel 00/39/78

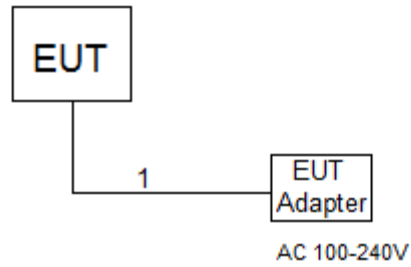
Note:

- (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 1Mbps Channel 78 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	QRCT		
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**

N/A

### 3. AC POWER LINE CONDUCTED EMISSIONS

#### 3.1 LIMIT

Frequency of Emission (MHz)	Limit (dB $\mu$ V)	
	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.

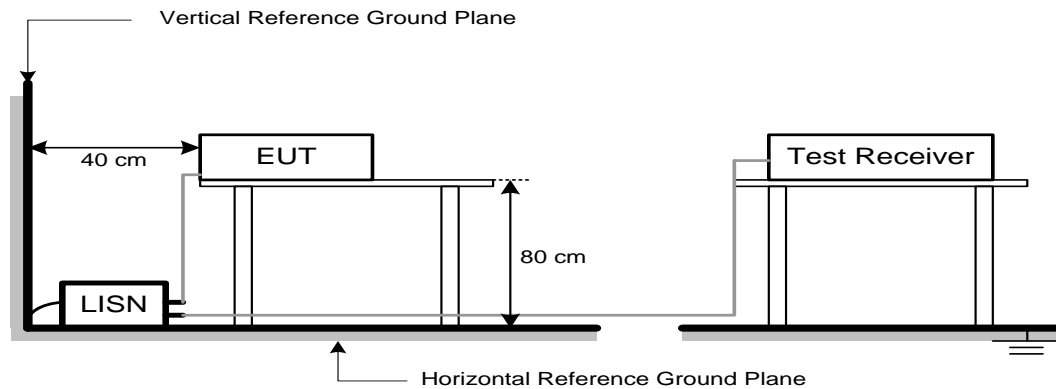
The following table is the setting of the receiver:

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

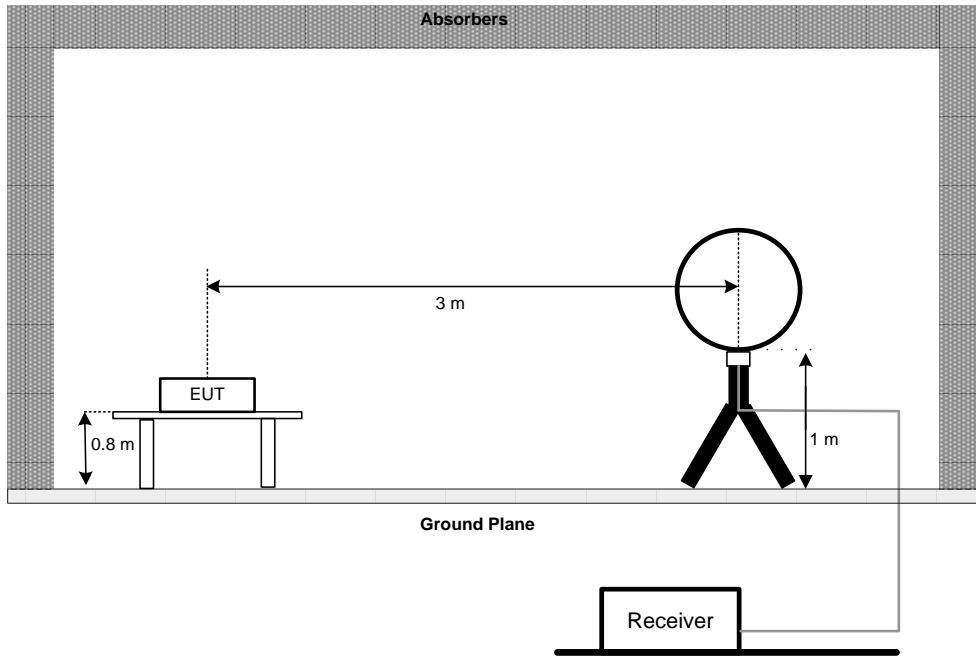
Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector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

### 4.3 DEVIATION FROM TEST STANDARD

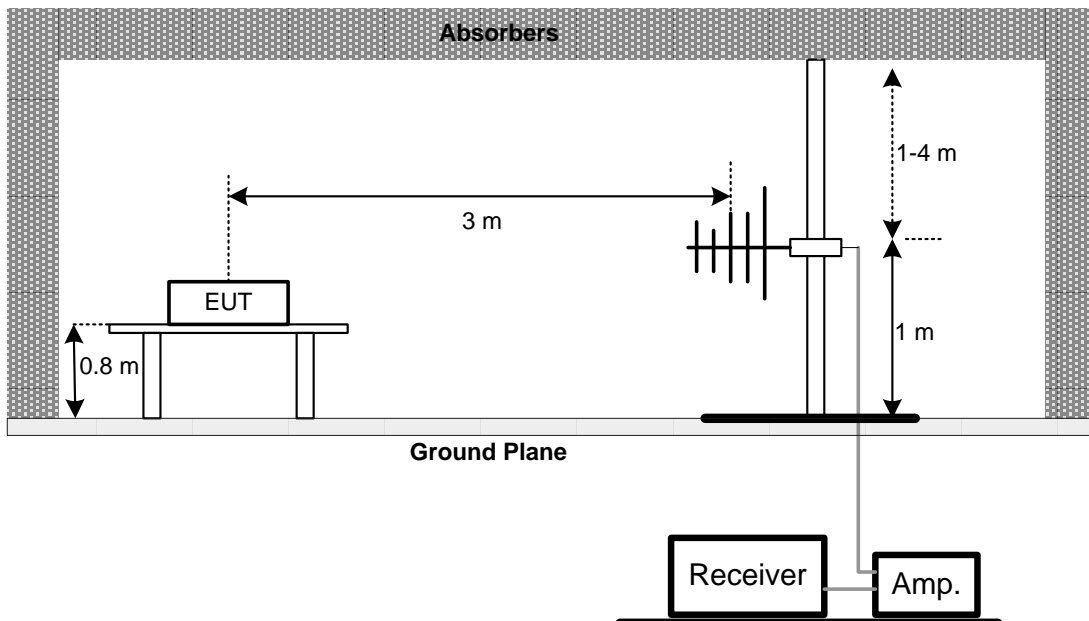
No deviation.

### 4.4 TEST SETUP

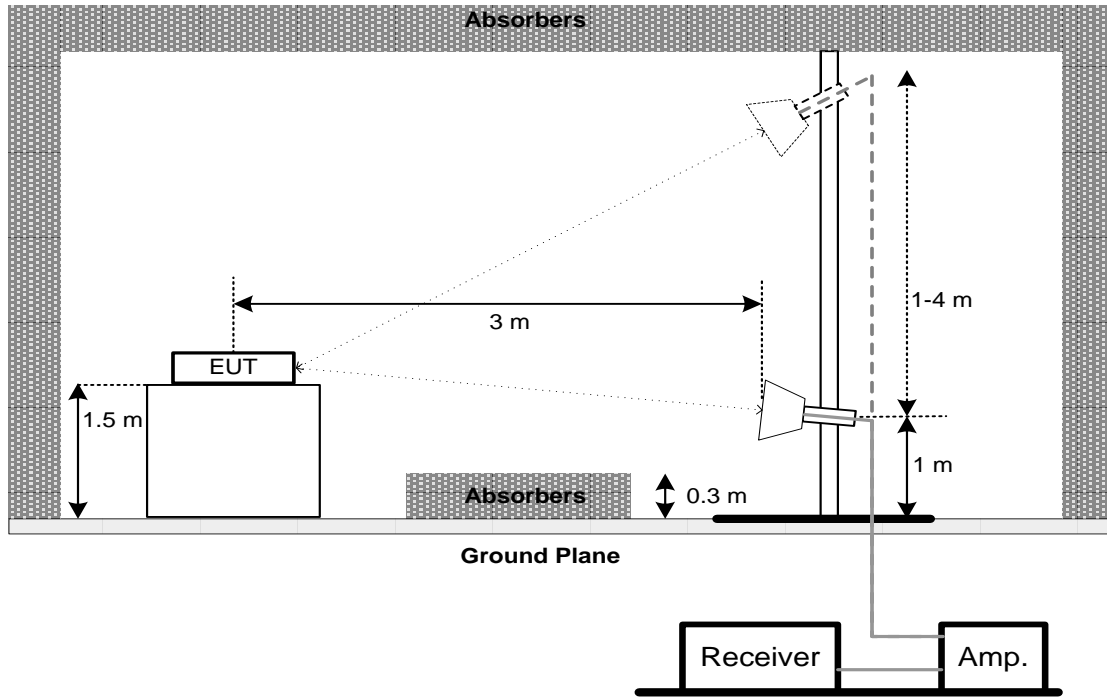
#### 9 kHz to 30 MHz



#### 30 MHz to 1 GHz



**Above 1 GHz**



**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 =  $40 \log(\text{specific distance} / \text{test distance})$  (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  $10.12 \times 31.6 = 320$  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  $5.06 \times 31.6 = 160$  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  $3.37 \times 31.6 = 106.6$  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**

- 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	Approximately five times the 20 dB bandwidth, centered on a hopping channel.
RBW	3 MHz
VBW	3 MHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

**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.

**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	100 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**

No.	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	EMI Receiver	Rohde&Schwarz	ESCI	1166.5950.03	2023/10/14
2	AMN	Rohde&Schwarz	ENV216	3560.6550.05	2023/10/14
3	AMN	Schwarzbeck	NSLK8127	#829	2023/10/14
4	ECSI RF IN RF Cable	Rohde&Schwarz	RP-X1	\	2023/10/14
5	ECSI RF IN RF Cable	Rohde&Schwarz	Sapre sm	\	2023/10/14
6	EMI Receiver	Rohde&Schwarz	ESR7	102013	2023/10/14
7	Spectrum analyzer	Rohde&Schwarz	FSV30	103741	2023/10/17
8	EMI receiver	Rohde&Schwarz	ESU	100184	2023/07/20
9	Spectrum analyzer	KEYSIGHT	N9010A-44	MY51440158	2023/10/17
10	Loop Antenna*	Schwarzbeck	FMZB1519B	00029	2025/07/03
11	Integral Antenna	Schwarzbeck	VULB 9163	VULB 9163-361	2023/10/20
12	Integral Antenna	Schwarzbeck	BBHA 9120D	BBHA 9120D 1201	2023/10/15
13	Integral Antenna	Schwarzbeck	BBHA 9170	9170#685	2023/10/15
14	Preamplifier	CD Systems Inc	PAP-03036-30	85060000	2023/10/15
15	Preamplifier	Schwarzbeck	BBV9721	9721-019	2023/10/15
16	Preamplifier	emci	EMC012645 SE	980417	2023/10/16
17	ECSI RF IN RF Cable	Rohde&Schwarz	AP-X1	\	2023/10/16
18	Spectrum Analyzer	Agilent	N9010A	MY52221119	2023/10/17
19	Power Collection Unit	Tonscend	JS0806-2	188060134	2023/10/16
20	Tonscend Test System	Tonscend	2.6.77.0518	NA	NA
21	10dB Attenuator	Tonscend	10dB	NA	NA
22	Temp&Humidity Recorder	Anymetre	JR900	NA	2023/10/16
23	Temp&Humidity Chamber	ETOMA	NTH1100-30 A	16080628	2023/10/16
24	Filter	STI	STI15-9845	N/A	N/A
25	Filter	STI	5.1G	N/A	N/A
26	Filter	STI	STI15-9845	N/A	N/A
27	Testing Software	EZ-EMC	TW-03A2	N/A	N/A

Remark: "N/A" denotes no model name, serial no. or calibration specified.  
 "\*\*\*" calibration period of equipment list is three year.  
 Except \* item, all calibration period of equipment list is one year.

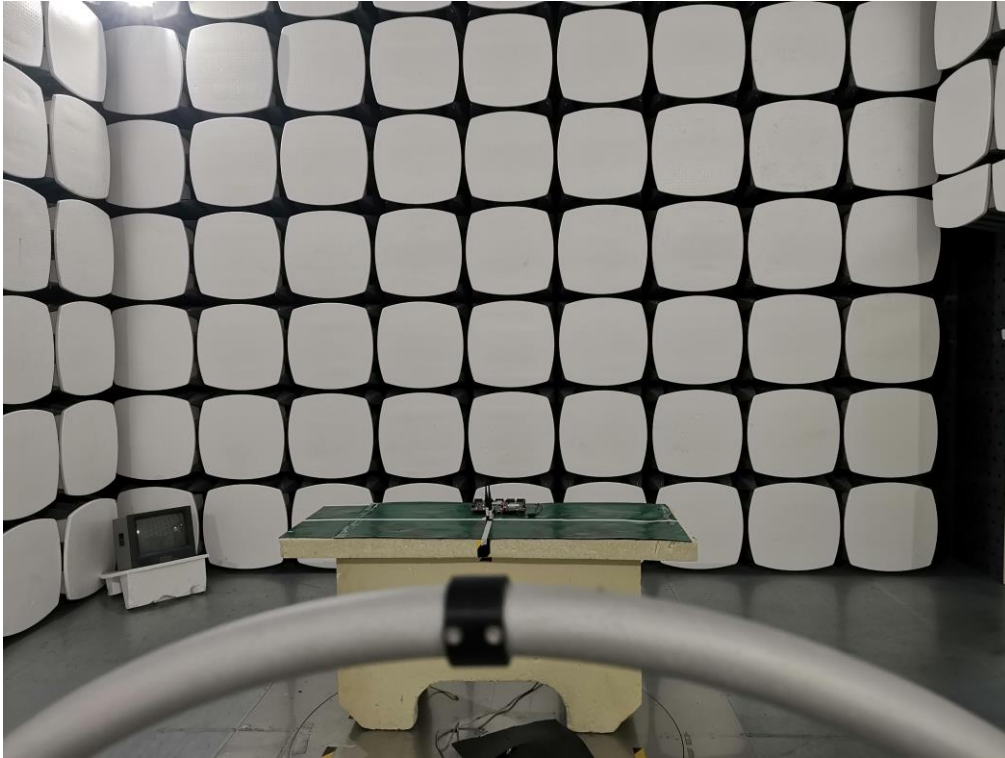
**12. EUT TEST PHOTO**

**AC Power Line Conducted Emissions Test Photos**



**Radiated Emissions Test Photos**

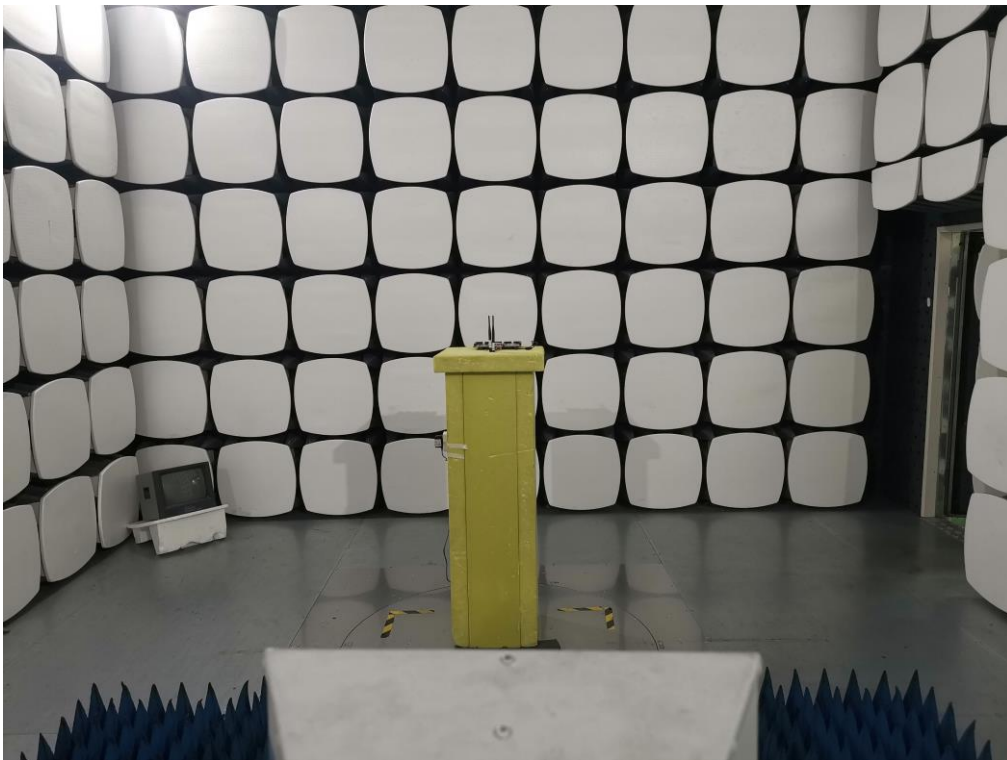
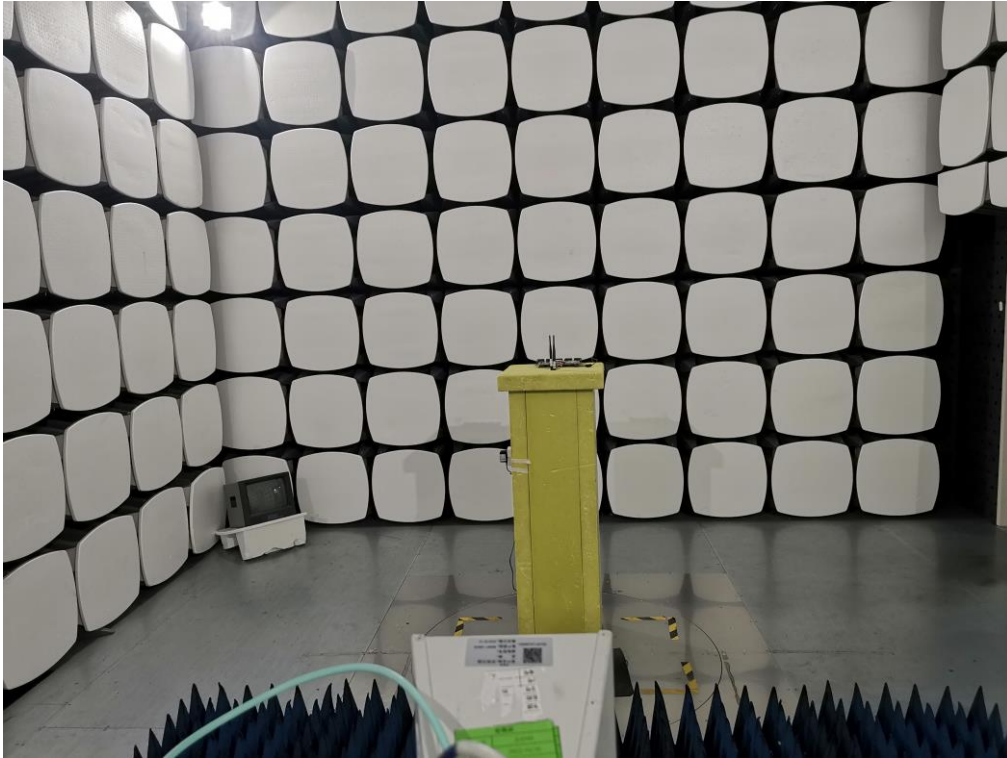
**9 kHz to 30 MHz**



**Radiated Emissions Test Photos**  
**30 MHz to 1000 MHz**

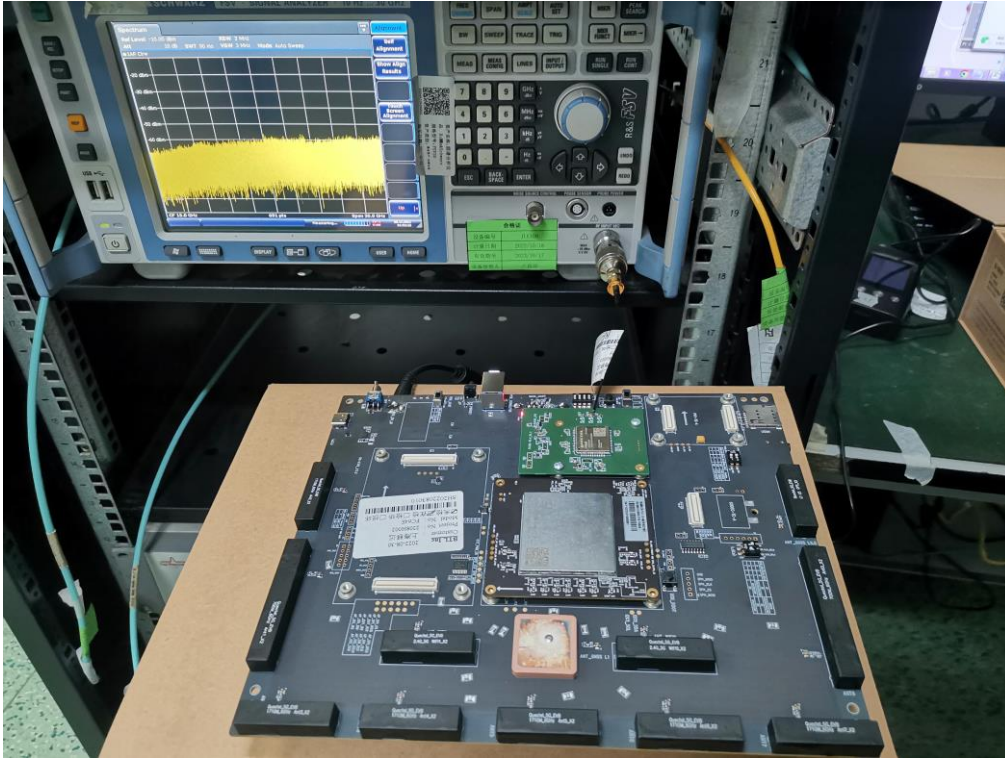


**Radiated Emissions Test Photos**  
**Above 1 GHz**



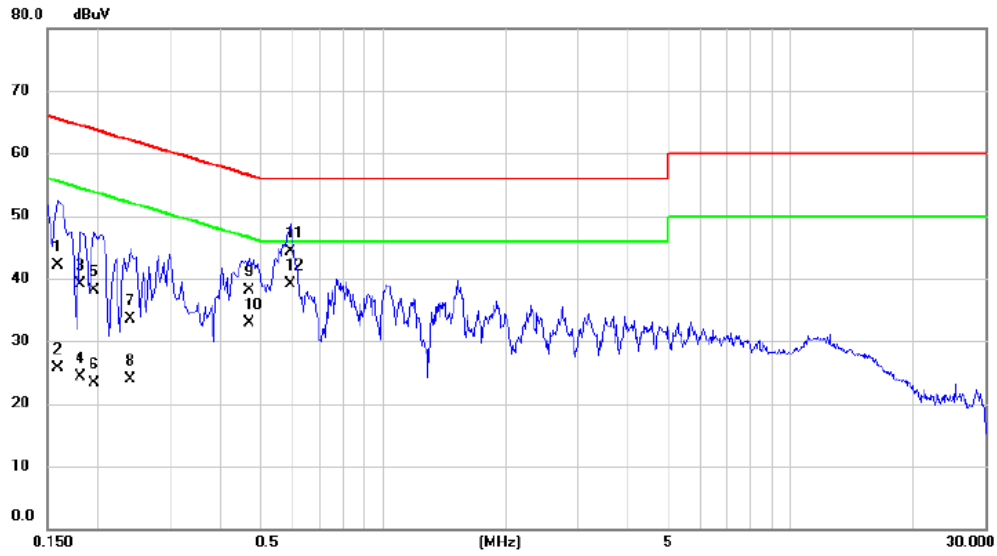


**Conducted Test Photos**



## **APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS**

Test Mode	TX Mode_1Mbps Channel 78	Phase	Line
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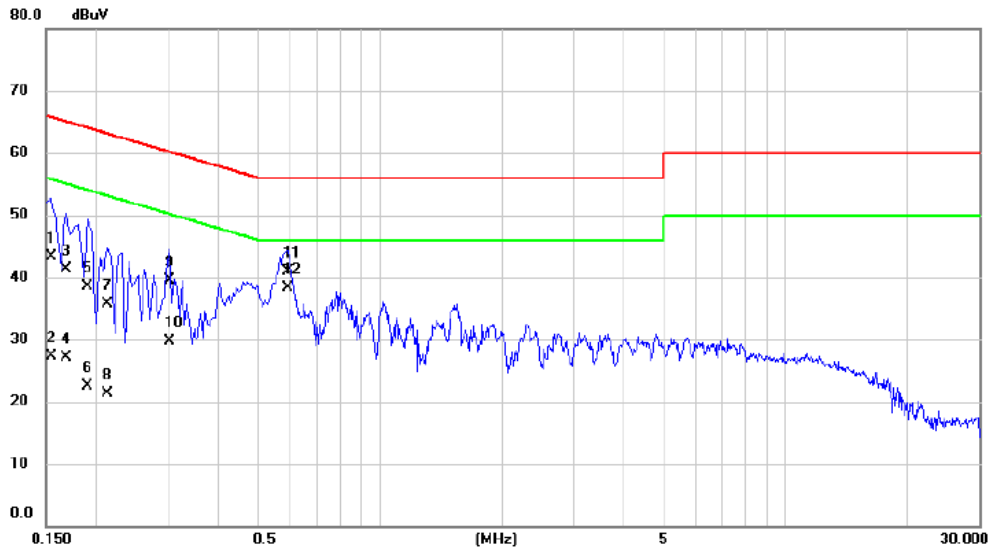


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1		0.1590	32.30	9.78	42.08	65.52	-23.44	QP	
2		0.1590	15.90	9.78	25.68	55.52	-29.84	AVG	
3		0.1815	29.30	9.78	39.08	64.42	-25.34	QP	
4		0.1815	14.60	9.78	24.38	54.42	-30.04	AVG	
5		0.1950	28.40	9.78	38.18	63.82	-25.64	QP	
6		0.1950	13.60	9.78	23.38	53.82	-30.44	AVG	
7		0.2400	23.80	9.78	33.58	62.10	-28.52	QP	
8		0.2400	14.10	9.78	23.88	52.10	-28.22	AVG	
9		0.4695	28.30	9.78	38.08	56.52	-18.44	QP	
10		0.4695	23.10	9.78	32.88	46.52	-13.64	AVG	
11		0.5910	34.50	9.80	44.30	58.00	-11.70	QP	
12	*	0.5910	29.30	9.80	39.10	46.00	-6.90	AVG	

**REMARKS:**

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

Test Mode	TX Mode_1Mbps Channel 78	Phase	Neutral
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No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1		0.1545	33.50	9.78	43.28	65.75	-22.47	QP	
2		0.1545	17.50	9.78	27.28	55.75	-28.47	AVG	
3		0.1680	31.60	9.77	41.37	65.06	-23.69	QP	
4		0.1680	17.40	9.77	27.17	55.06	-27.89	AVG	
5		0.1905	28.80	9.77	38.57	64.01	-25.44	QP	
6		0.1905	12.80	9.77	22.57	54.01	-31.44	AVG	
7		0.2130	25.90	9.77	35.67	63.09	-27.42	QP	
8		0.2130	11.60	9.77	21.37	53.09	-31.72	AVG	
9		0.3030	29.80	9.78	39.58	60.16	-20.58	QP	
10		0.3030	20.00	9.78	29.78	50.16	-20.38	AVG	
11		0.5910	31.10	9.80	40.90	56.00	-15.10	QP	
12	*	0.5910	28.50	9.80	38.30	46.00	-7.70	AVG	

**REMARKS:**

(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

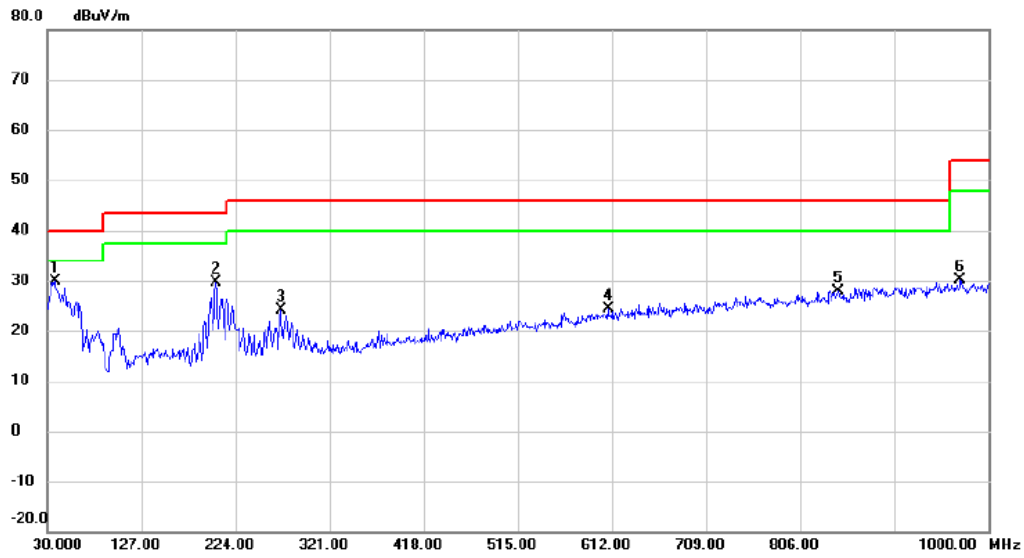
## **APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ**

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_1Mbps Channel 78	Polarization	Vertical
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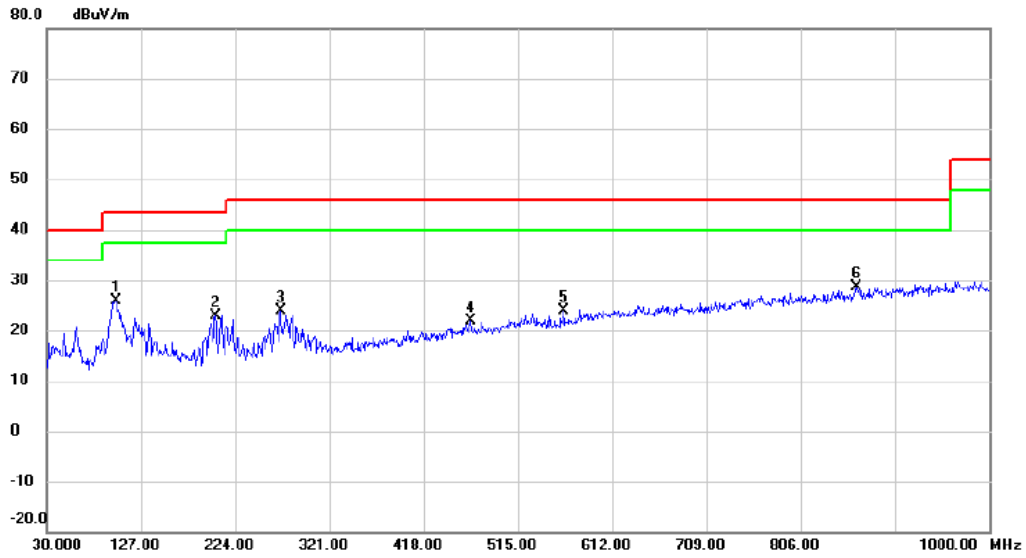
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	*	38.2450	47.99	-18.15	29.84	40.00	-10.16	QP	
2		203.6300	48.52	-18.79	29.73	43.50	-13.77	QP	
3		271.0450	40.13	-15.92	24.21	46.00	-21.79	QP	
4		608.1200	32.58	-8.31	24.27	46.00	-21.73	QP	
5		844.8000	32.92	-5.10	27.82	46.00	-18.18	QP	
6		971.3850	33.90	-3.69	30.21	54.00	-23.79	QP	

**REMARKS:**

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



Test Mode	TX Mode_1Mbps Channel 78	Polarization	Horizontal
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No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		101.2950	46.06	-20.09	25.97	43.50	-17.53	QP	
2		203.6300	41.73	-18.79	22.94	43.50	-20.56	QP	
3		270.5600	39.71	-15.94	23.77	46.00	-22.23	QP	
4		466.9850	33.07	-11.31	21.76	46.00	-24.24	QP	
5		562.5300	33.42	-9.53	23.89	46.00	-22.11	QP	
6	*	863.2300	33.46	-4.81	28.65	46.00	-17.35	QP	

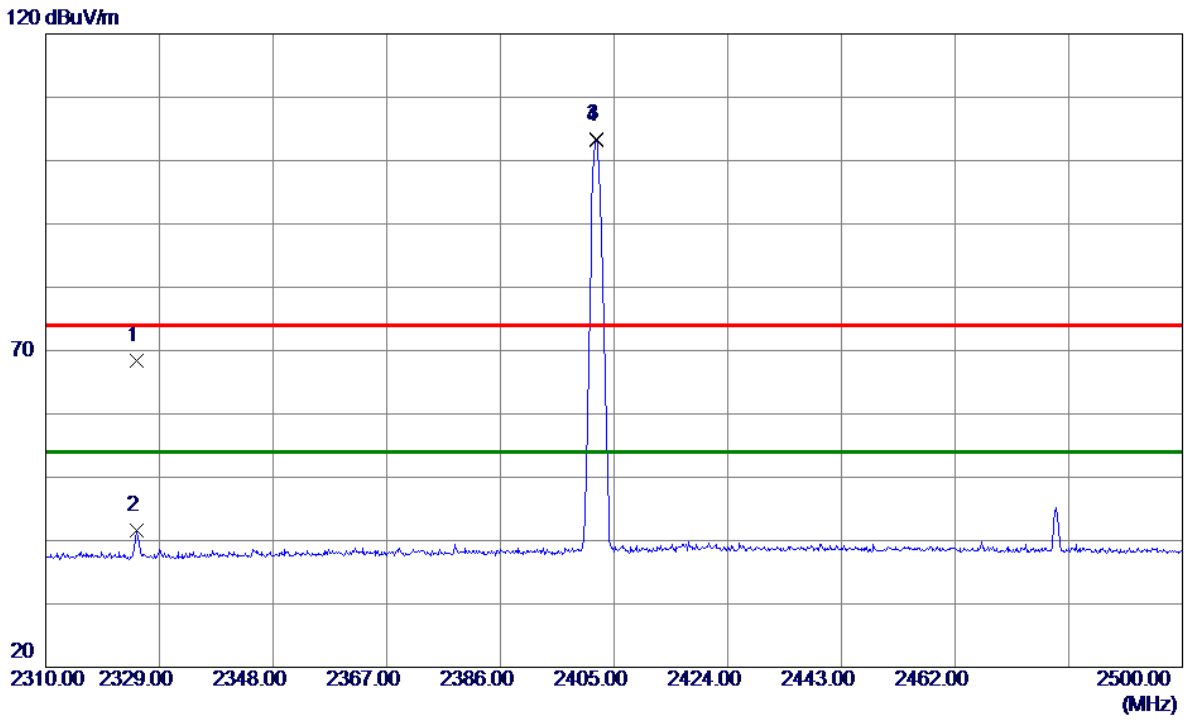
**REMARKS:**

(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

## **APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ**

Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Vertical
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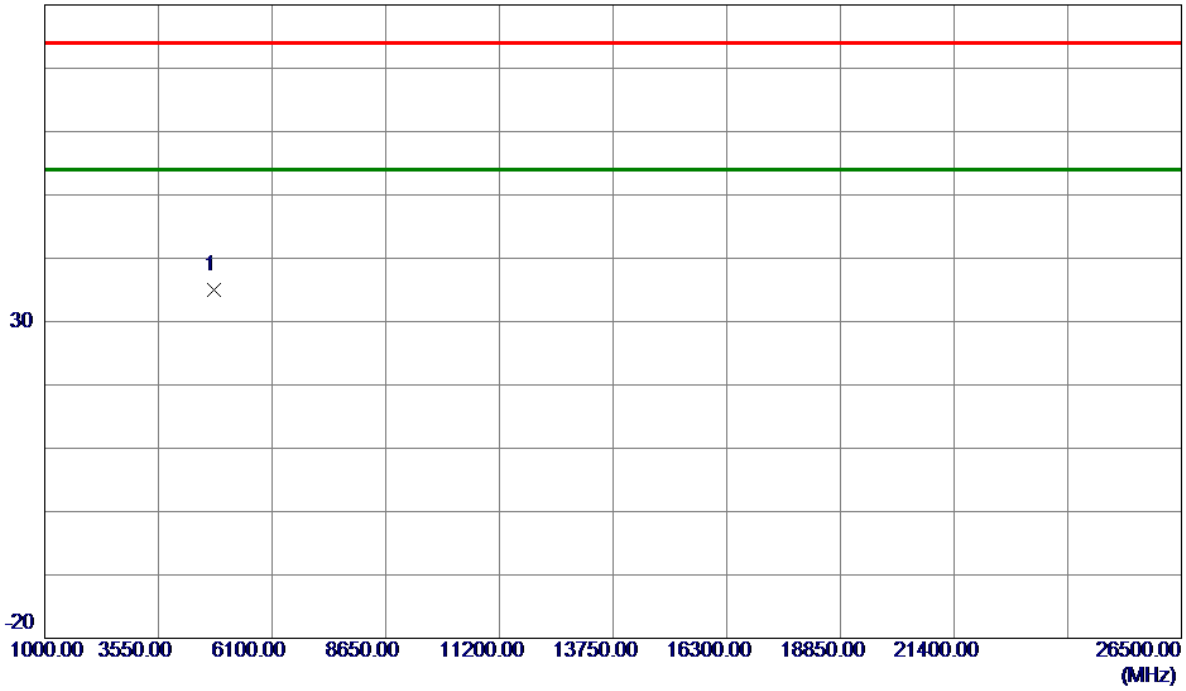
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2325.1050	38.15	30.26	68.41	74.00	-5.59	Peak	
2	2325.1050	11.25	30.26	41.51	54.00	-12.49	AVG	
3	2402.0550	72.87	30.60	103.47	74.00	29.47	Peak	No limit
4 *	2402.0550	72.58	30.60	103.18	54.00	49.18	AVG	No limit

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Vertical
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80 dBuV/m

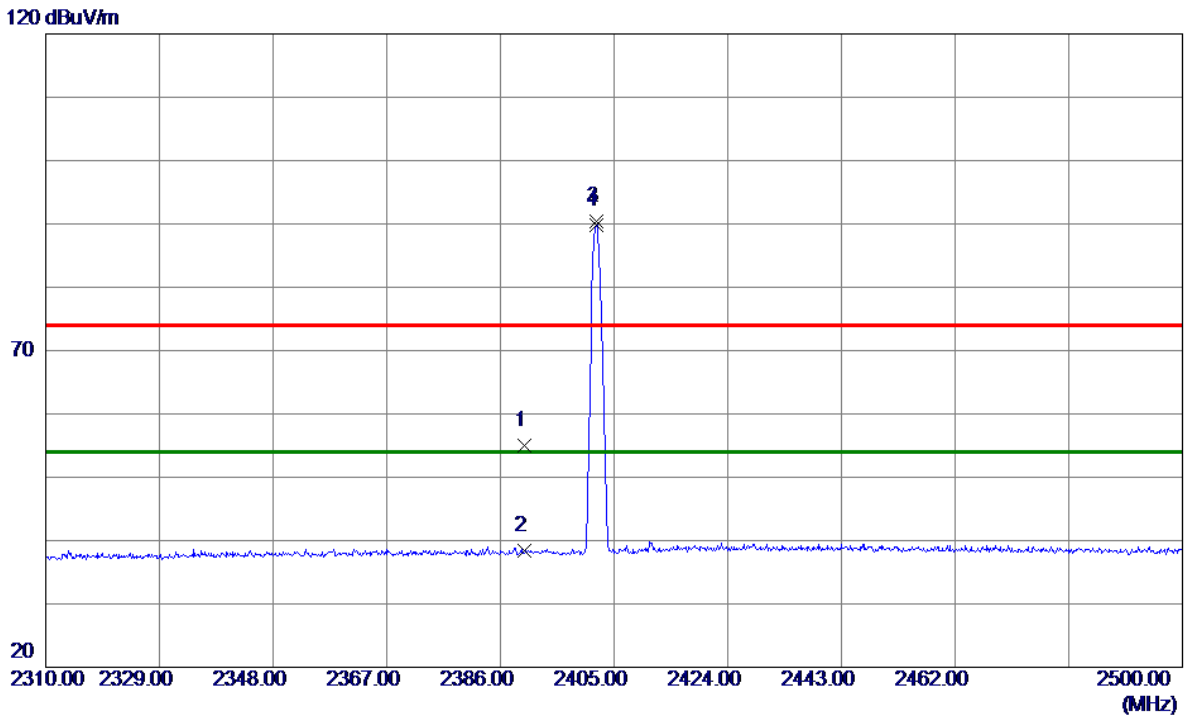


No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4804.0000	52.21	-17.27	34.94	74.00	-39.06	Peak	

## REMARKS:

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

Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Horizontal
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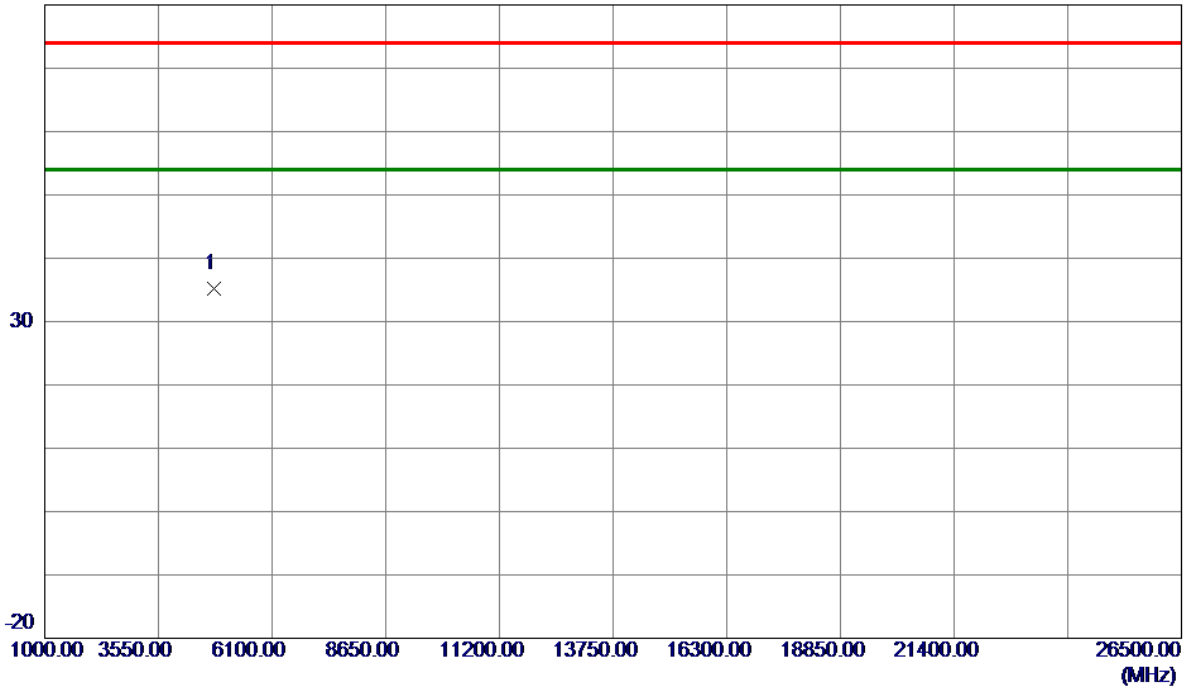
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2390.0000	24.39	30.55	54.94	74.00	-19.06	Peak	
2	2390.0000	7.93	30.55	38.48	54.00	-15.52	AVG	
3	2402.0550	59.74	30.60	90.34	74.00	16.34	Peak	No limit
4 *	2402.0550	59.26	30.60	89.86	54.00	35.86	AVG	No limit

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Horizontal
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80 dBuV/m



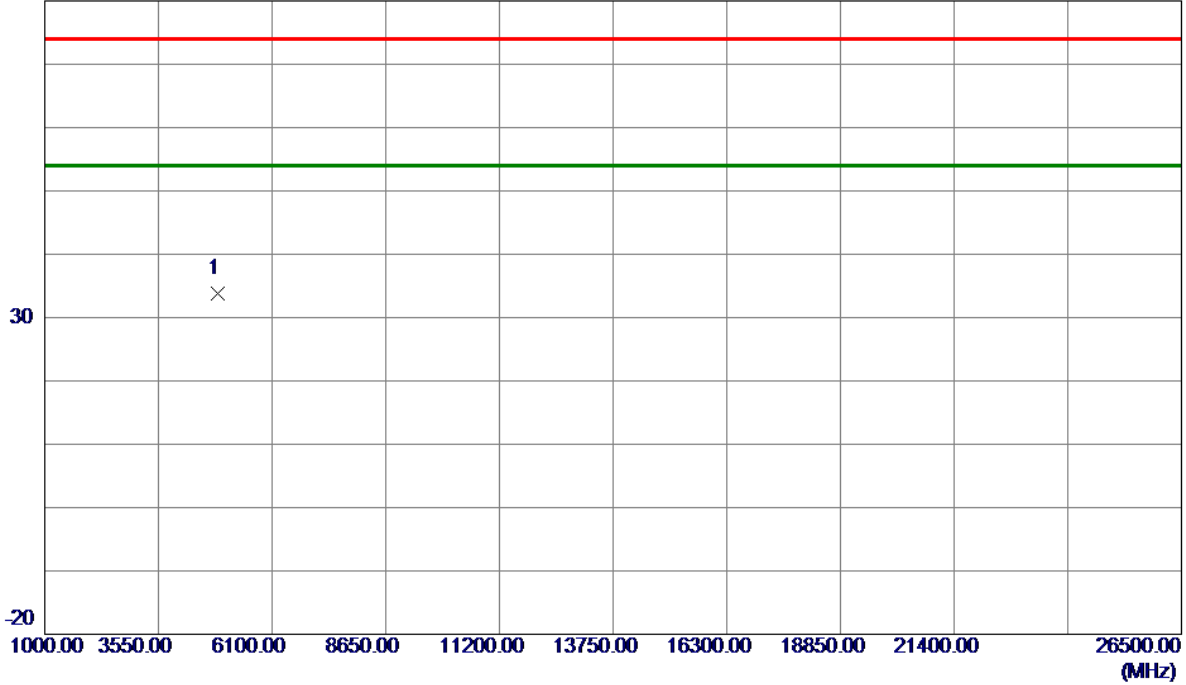
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4804.0000	52.42	-17.27	35.15	74.00	-38.85	Peak	

**REMARKS:**

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

Test Mode	TX 2441 MHz _CH39_1Mbps	Polarization	Vertical
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80 dBuV/m



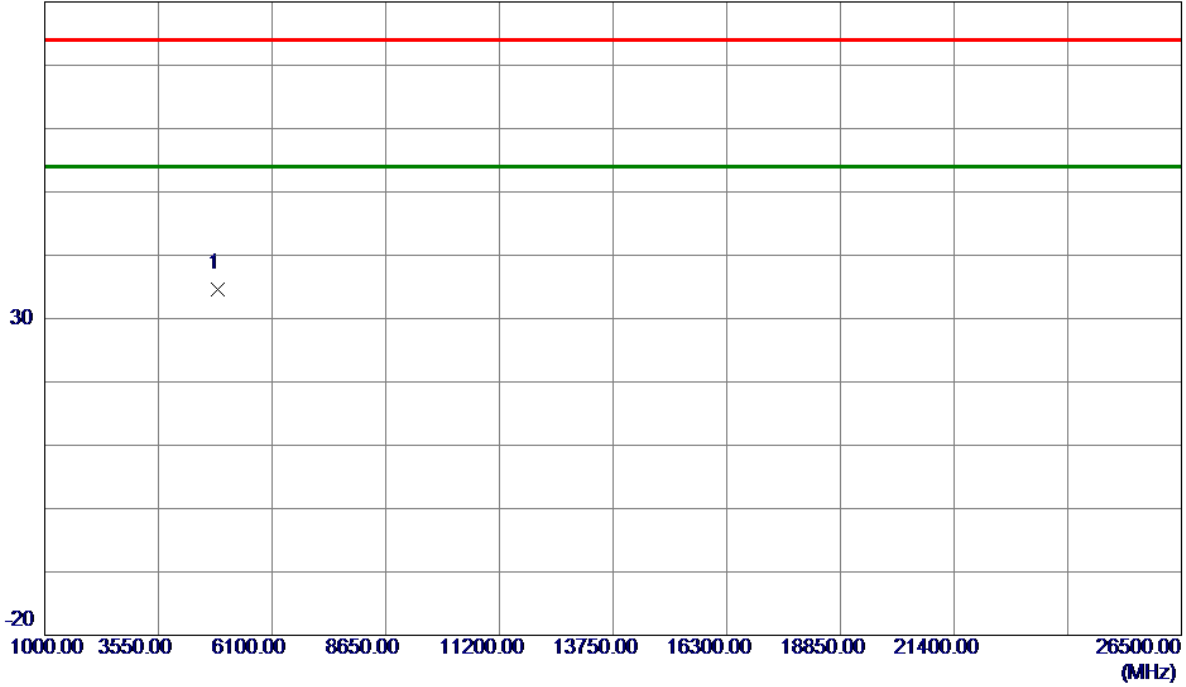
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4882.0000	50.83	-16.97	33.86	74.00	-40.14	Peak	

**REMARKS:**

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

Test Mode	TX 2441 MHz _CH39_1Mbps	Polarization	Horizontal
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80 dBuV/m



No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4882.0000	51.67	-16.97	34.70	74.00	-39.30	Peak	

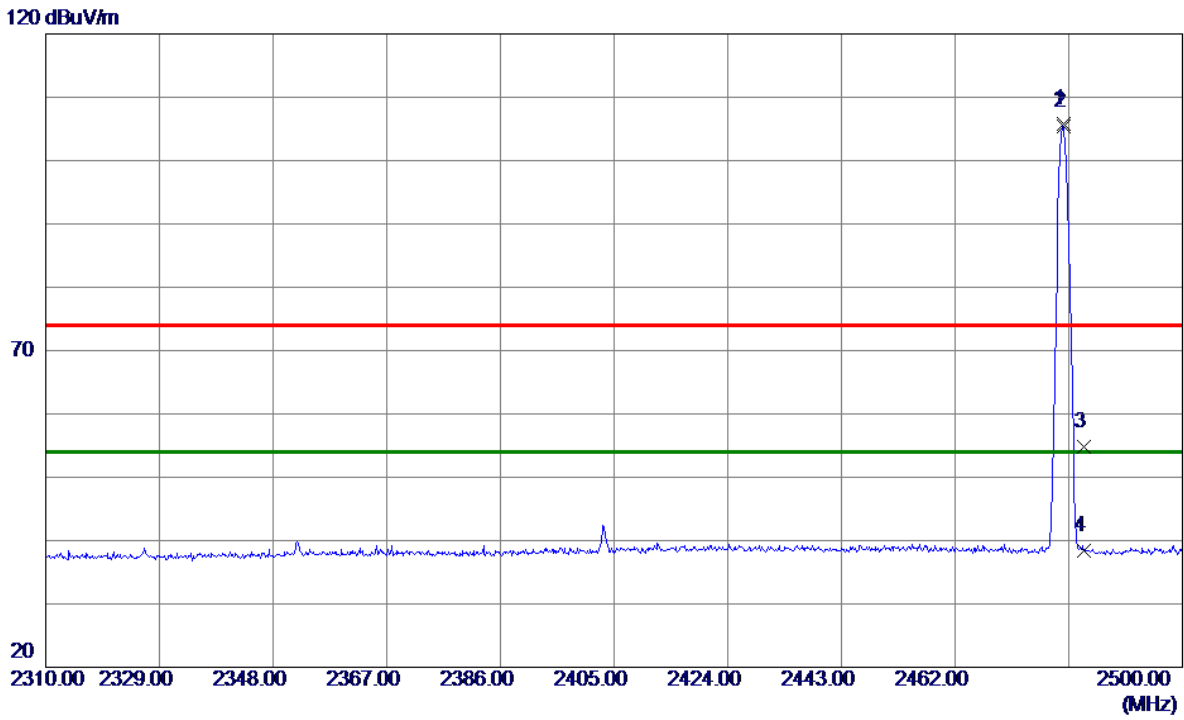
**REMARKS:**

(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.



Test Mode	TX 2480 MHz _CH78_1Mbps	Polarization	Vertical
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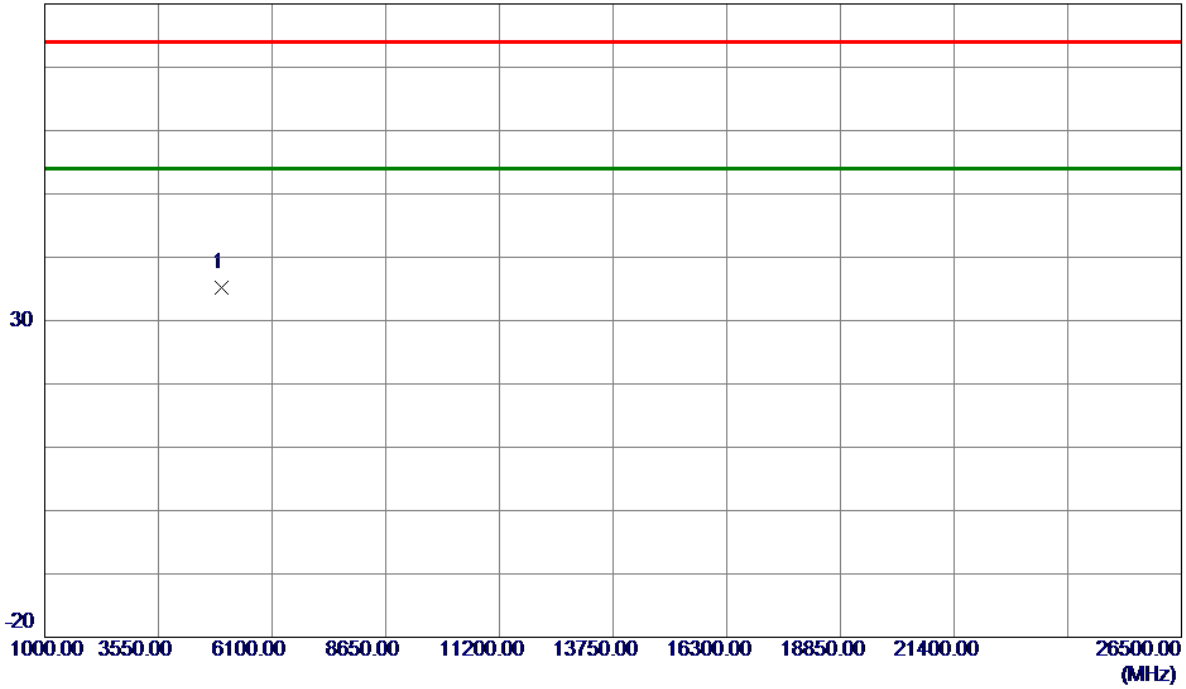
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2480.0500	74.77	30.93	105.70	74.00	31.70	Peak	No limit
2 *	2480.0500	74.49	30.93	105.42	54.00	51.42	AVG	No limit
3	2483.5000	23.90	30.94	54.84	74.00	-19.16	Peak	
4	2483.5000	7.42	30.94	38.36	54.00	-15.64	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
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80 dBuV/m

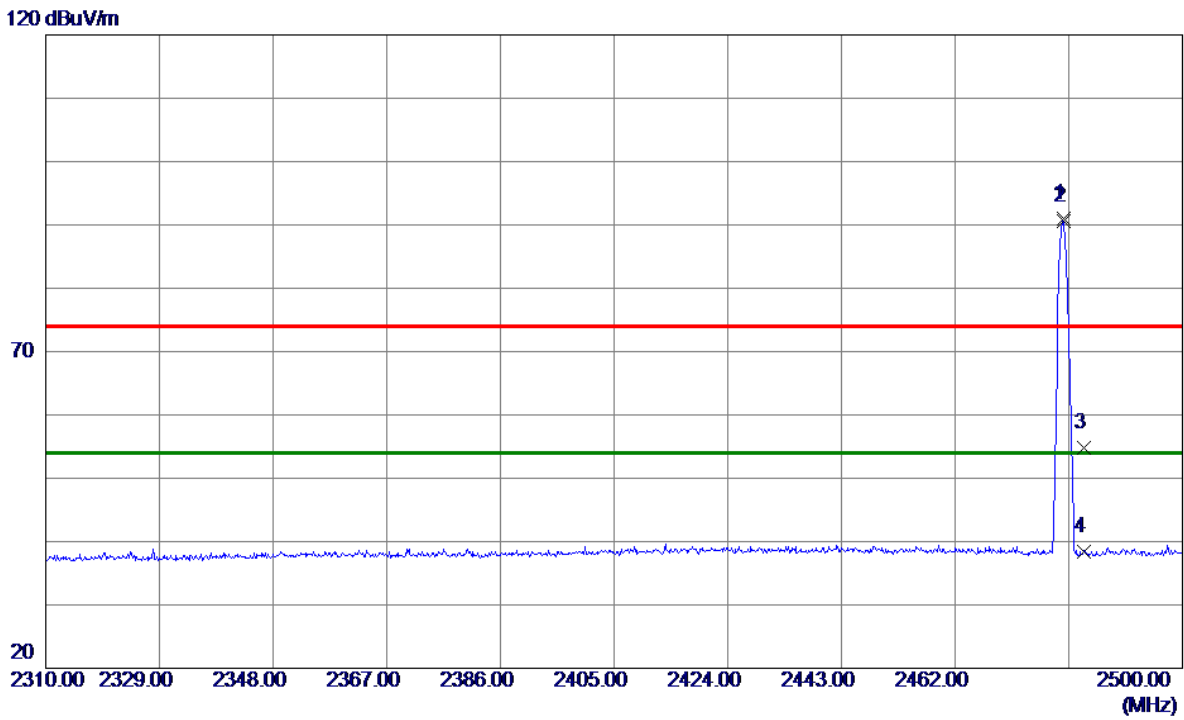


No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4960.0000	51.94	-16.68	35.26	74.00	-38.74	Peak	

**REMARKS:**

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

Test Mode	TX 2480 MHz _CH78_1Mbps	Polarization	Horizontal
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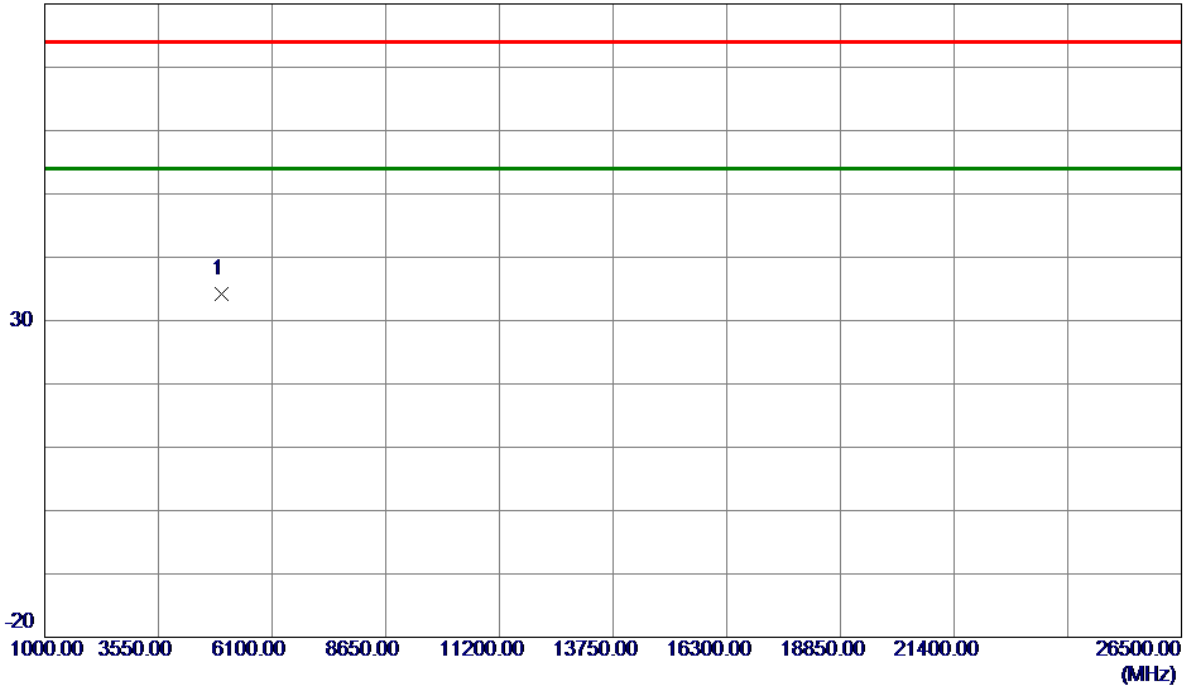
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2480.0500	60.01	30.93	90.94	74.00	16.94	Peak	No limit
2 *	2480.0500	59.65	30.93	90.58	54.00	36.58	AVG	No limit
3	2483.5000	23.88	30.94	54.82	74.00	-19.18	Peak	
4	2483.5000	7.50	30.94	38.44	54.00	-15.56	AVG	

**REMARKS:**

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

Test Mode	TX 2480 MHz _CH78_1Mbps	Polarization	Horizontal
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80 dBuV/m

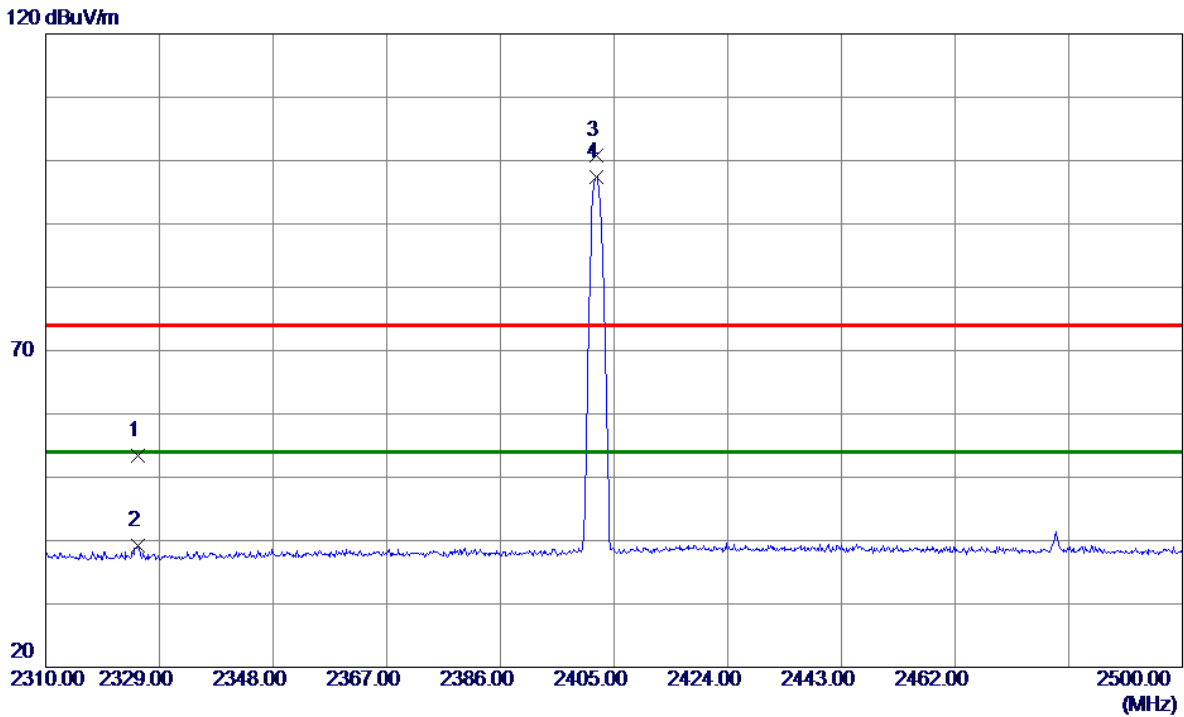


No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4960.0000	50.80	-16.68	34.12	74.00	-39.88	Peak	

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_3Mbps	Polarization	Vertical
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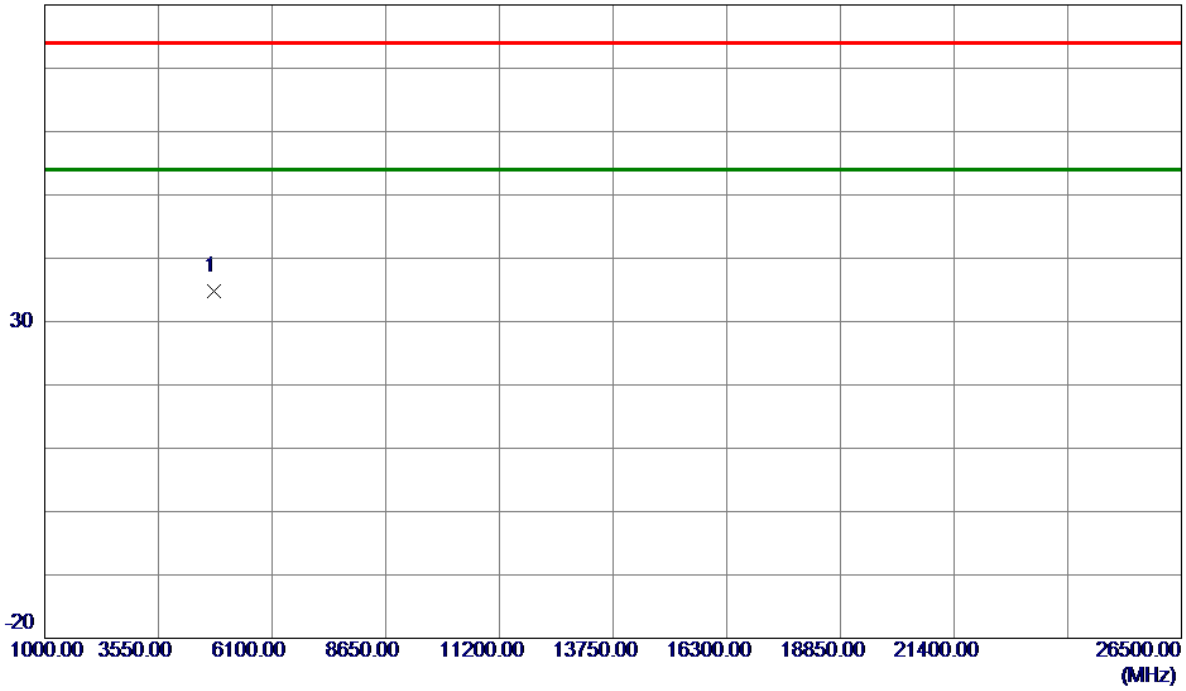
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2325.3899	23.08	30.26	53.34	74.00	-20.66	Peak	
2	2325.3899	9.03	30.26	39.29	54.00	-14.71	AVG	
3	2402.0550	70.21	30.60	100.81	74.00	26.81	Peak	No limit
4 *	2402.0550	66.89	30.60	97.49	54.00	43.49	AVG	No limit

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_3Mbps	Polarization	Vertical
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80 dBuV/m

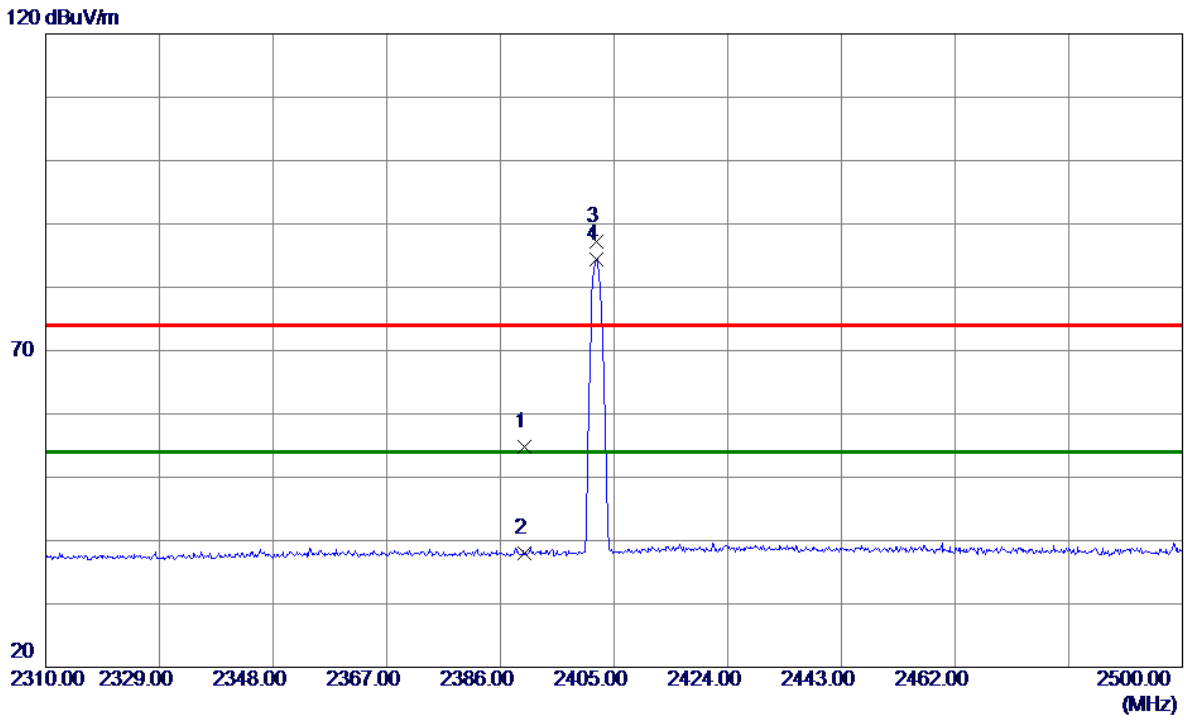


No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4804.0000	52.13	-17.27	34.86	74.00	-39.14	Peak	

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_3Mbps	Polarization	Horizontal
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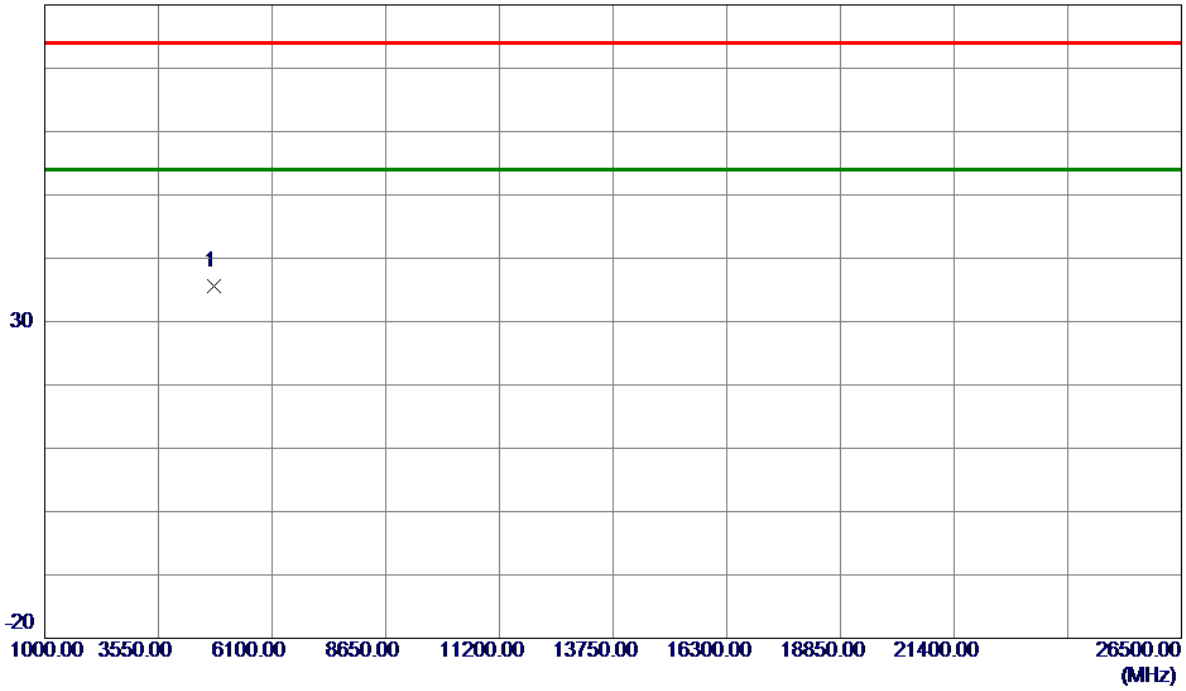
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2390.0000	24.23	30.55	54.78	74.00	-19.22	Peak	
2	2390.0000	7.51	30.55	38.06	54.00	-15.94	AVG	
3	2402.0550	56.68	30.60	87.28	74.00	13.28	Peak	No limit
4 *	2402.0550	53.82	30.60	84.42	54.00	30.42	AVG	No limit

**REMARKS:**

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

Test Mode	TX 2402 MHz _CH00_3Mbps	Polarization	Horizontal
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80 dBuV/m



No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4804.0000	52.96	-17.27	35.69	74.00	-38.31	Peak	

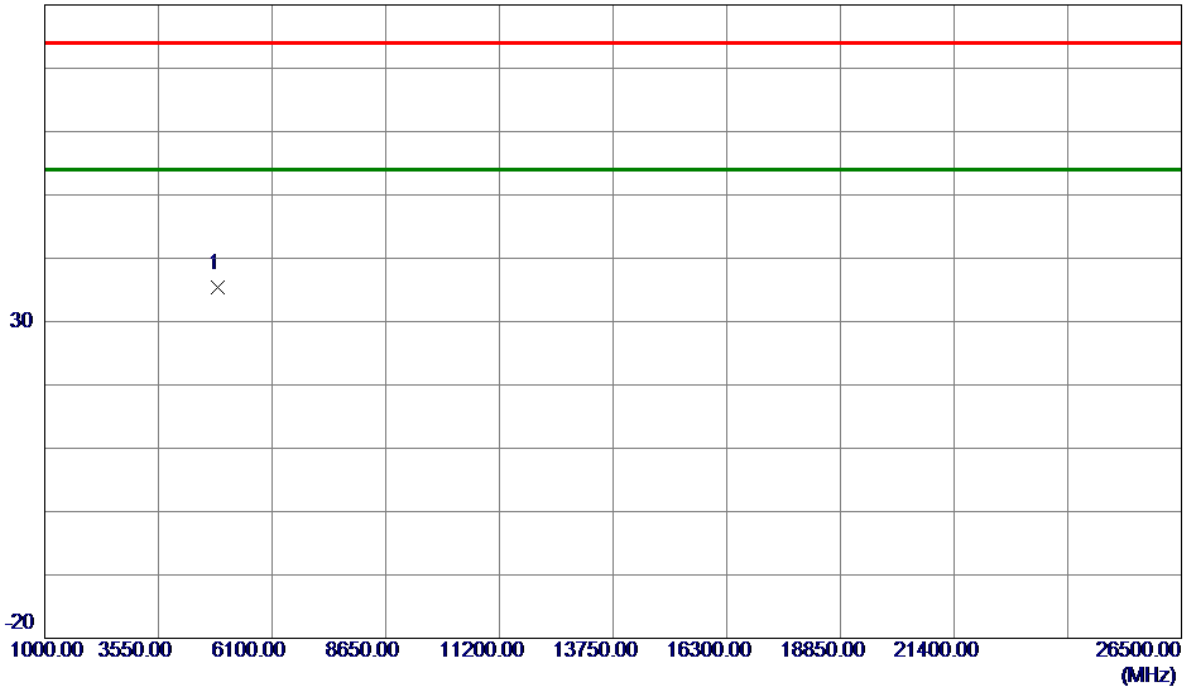
## REMARKS:

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



Test Mode	TX 2441 MHz _CH39_3Mbps	Polarization	Vertical
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80 dBuV/m



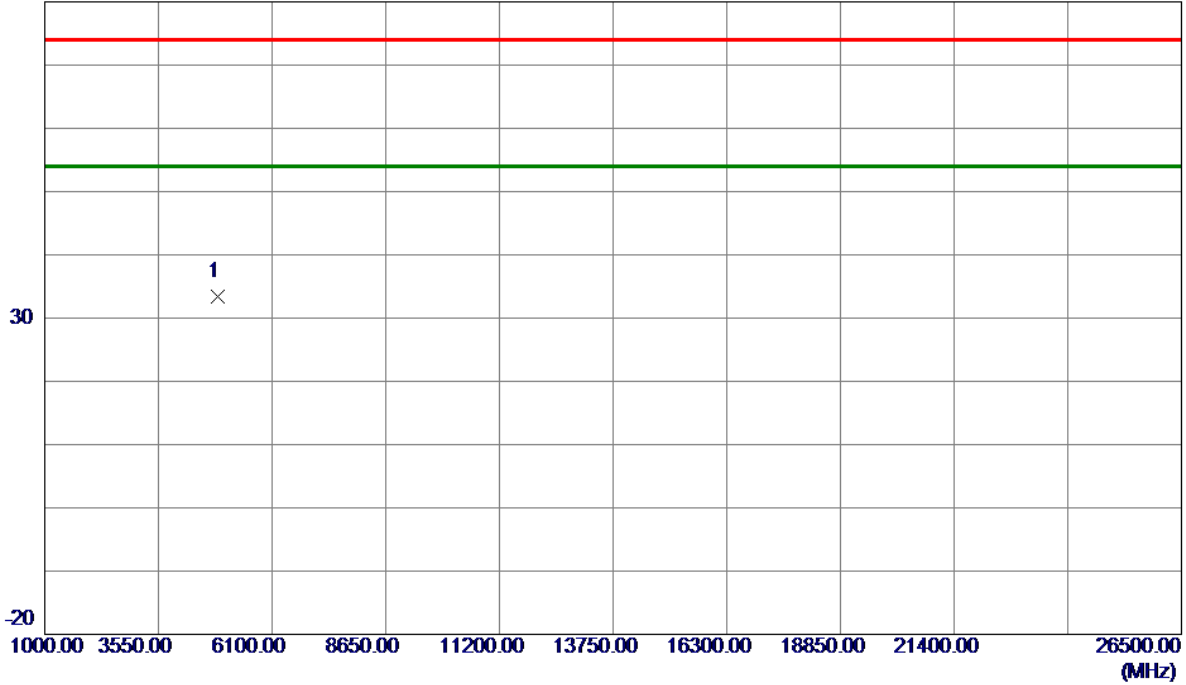
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4882.0000	52.27	-16.97	35.30	74.00	-38.70	Peak	

**REMARKS:**

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

Test Mode	TX 2441 MHz _CH39_3Mbps	Polarization	Horizontal
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80 dBuV/m



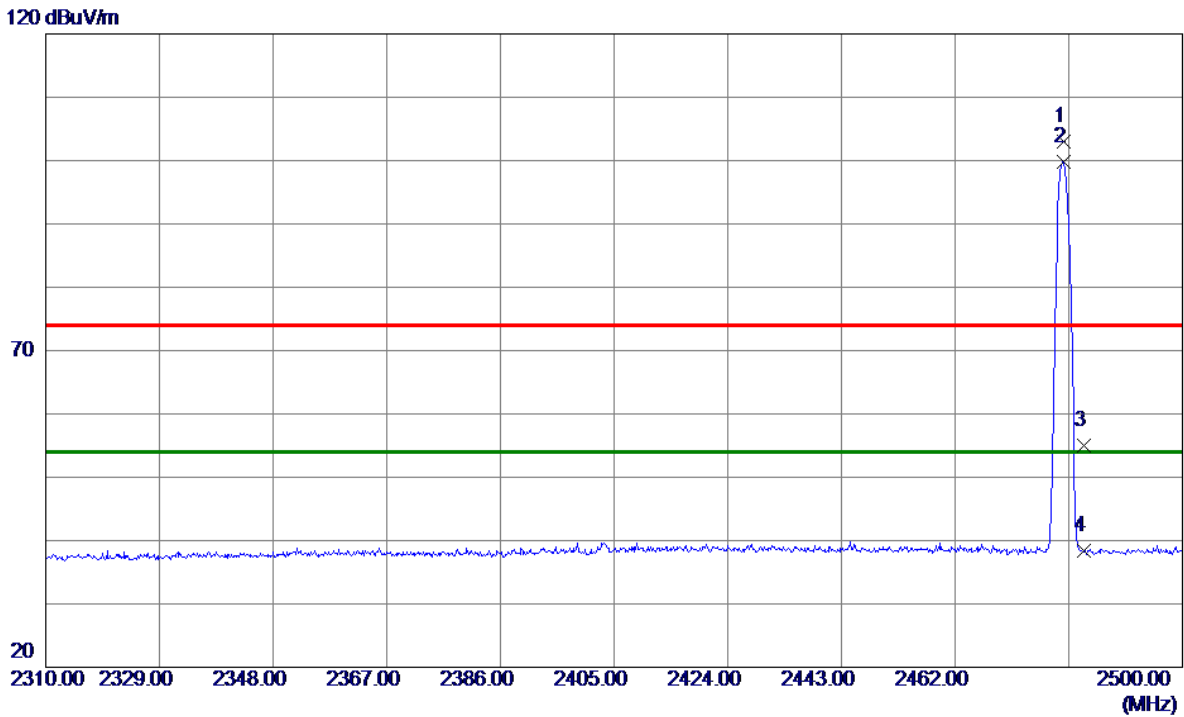
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4882.0000	50.45	-16.97	33.48	74.00	-40.52	Peak	

**REMARKS:**

(1) Measurement Value = Reading Level + Correct Factor.

(2) Margin Level = Measurement Value - Limit Value.

Test Mode	TX 2480 MHz _CH78_3Mbps	Polarization	Vertical
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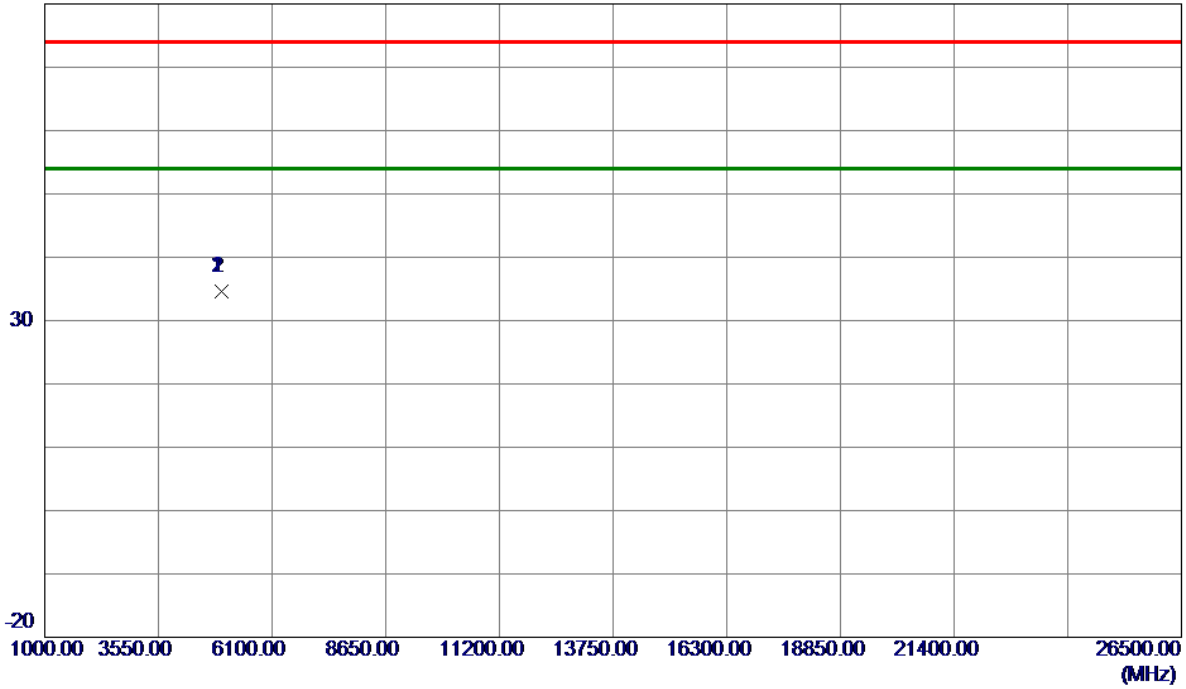
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2480.0500	72.07	30.93	103.00	74.00	29.00	Peak	No limit
2 *	2480.0500	68.89	30.93	99.82	54.00	45.82	AVG	No limit
3	2483.5000	24.11	30.94	55.05	74.00	-18.95	Peak	
4	2483.5000	7.45	30.94	38.39	54.00	-15.61	AVG	

**REMARKS:**

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

Test Mode	TX 2480 MHz _CH78_3Mbps	Polarization	Vertical
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80 dBuV/m

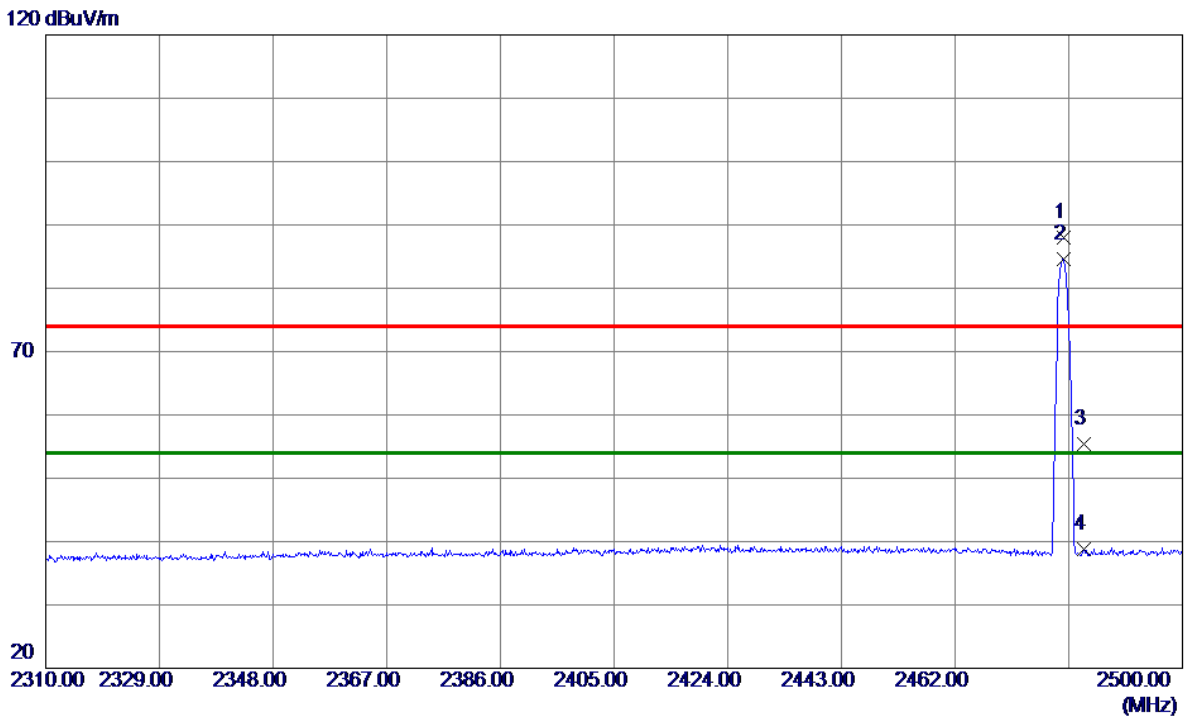


No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4960.0000	51.30	-16.68	34.62	74.00	-39.38	Peak	
2	4960.0000	51.30	-16.68	34.62	74.00	-39.38	Peak	

**REMARKS:**

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

Test Mode	TX 2480 MHz _CH78_3Mbps	Polarization	Horizontal
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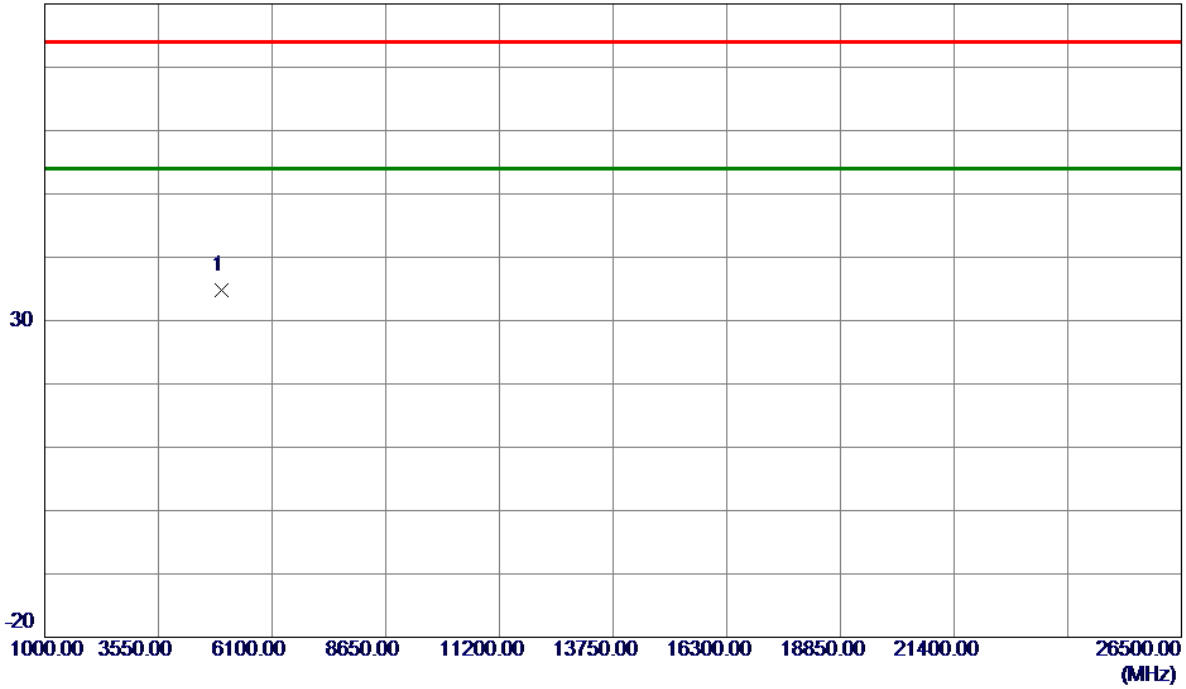
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2480.0500	57.01	30.93	87.94	74.00	13.94	Peak	No limit
2 *	2480.0500	53.69	30.93	84.62	54.00	30.62	AVG	No limit
3	2483.5000	24.42	30.94	55.36	74.00	-18.64	Peak	
4	2483.5000	7.77	30.94	38.71	54.00	-15.29	AVG	

**REMARKS:**

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

Test Mode	TX 2480 MHz _CH78_3Mbps	Polarization	Horizontal
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80 dBuV/m



No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	4960.0000	51.56	-16.68	34.88	74.00	-39.12	Peak	

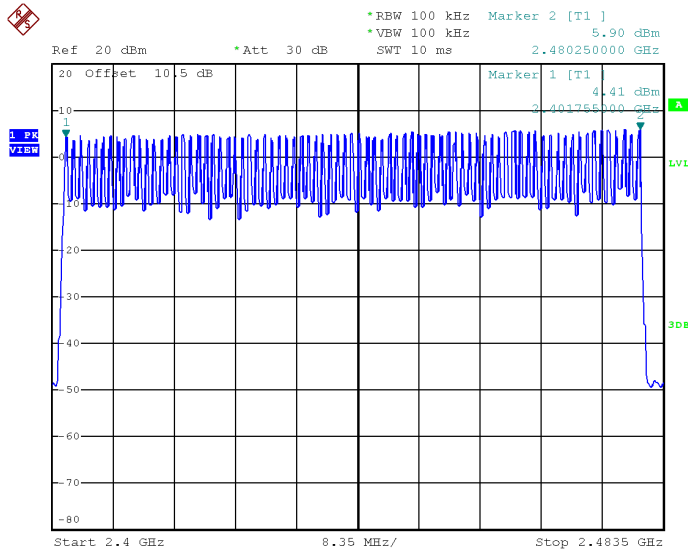
**REMARKS:**

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

## APPENDIX E - NUMBER OF HOPPING FREQUENCY

Test Mode:	TX Mode_1Mbps
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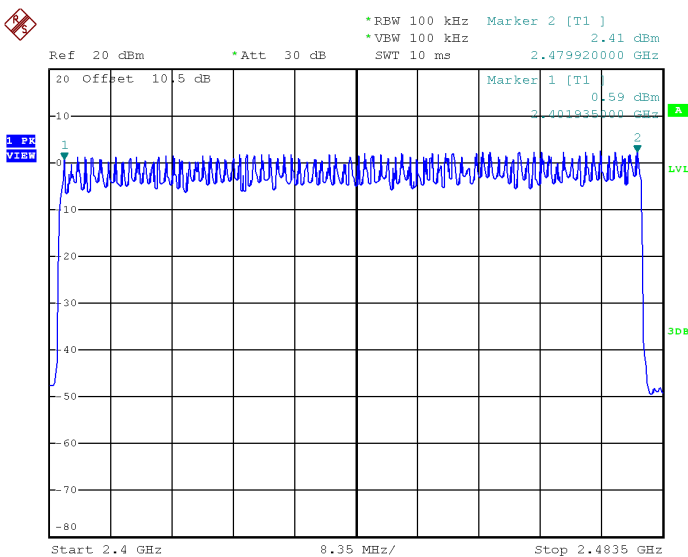
Test Mode	Hopping Mode_1Mbps	Limit	Test Result
Number of Hopping Frequency	79	15	Pass



Date: 9.SEP.2022 15:17:55

Test Mode:	TX Mode_3Mbps
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Test Mode	Hopping Mode_3Mbps	Limit	Test Result
Number of Hopping Frequency	79	15	Pass



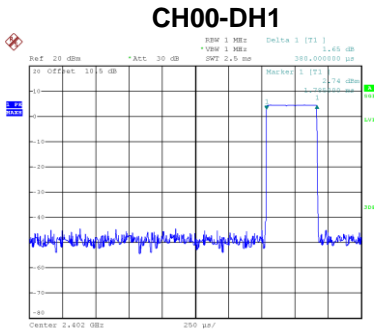
Date: 9.SEP.2022 15:53:03



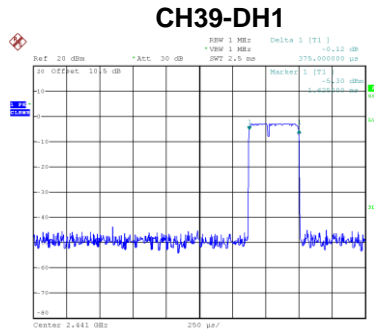
## APPENDIX F - AVERAGE TIME OF OCCUPANCY

Test Mode	Hopping Mode_1Mbps
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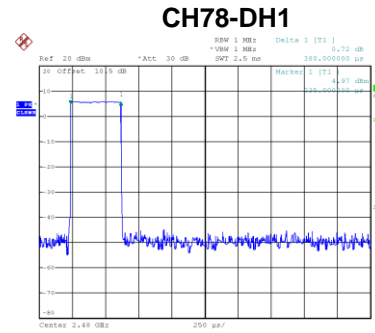
Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Result
DH1	2402	0.3800	0.1216	0.4000	Pass
DH3	2402	1.6400	0.2624	0.4000	Pass
DH5	2402	2.9200	0.3115	0.4000	Pass
DH1	2441	0.3750	0.1200	0.4000	Pass
DH3	2441	1.6400	0.2624	0.4000	Pass
DH5	2441	2.9200	0.3115	0.4000	Pass
DH1	2480	0.3800	0.1216	0.4000	Pass
DH3	2480	1.6400	0.2624	0.4000	Pass
DH5	2480	2.8800	0.3072	0.4000	Pass



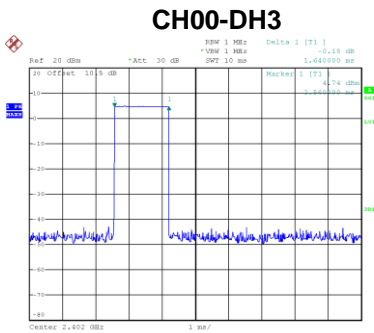
Date: 9.SEP.2022 15:12:39



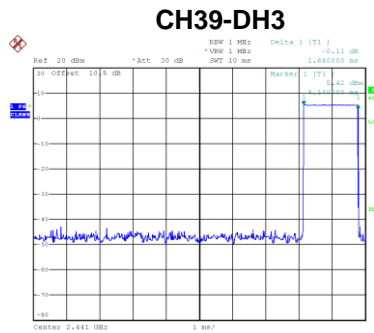
Date: 9.SEP.2022 15:12:44



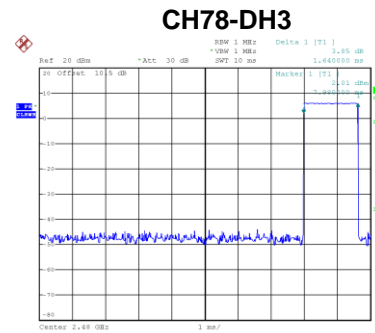
Date: 9.SEP.2022 15:12:48



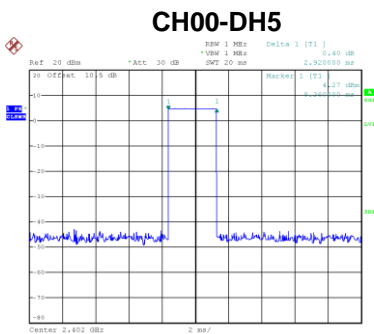
Date: 9.SEP.2022 15:33:53



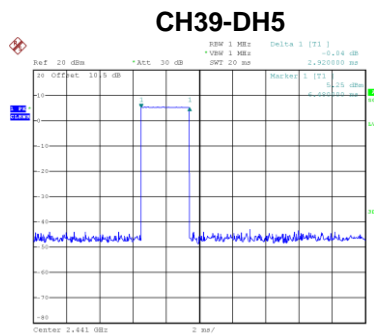
Date: 9.SEP.2022 15:34:06



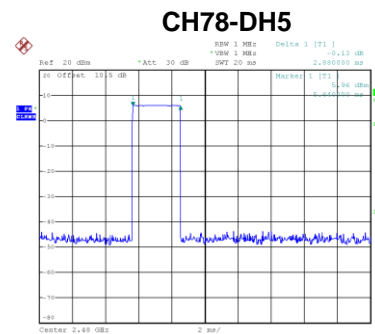
Date: 9.SEP.2022 15:34:12



Date: 9.SEP.2022 15:34:40



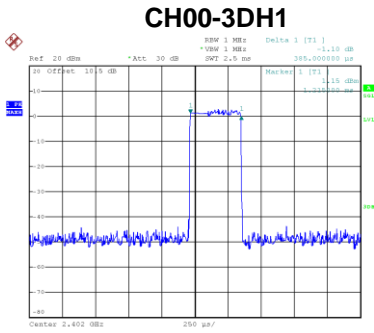
Date: 9.SEP.2022 15:34:53



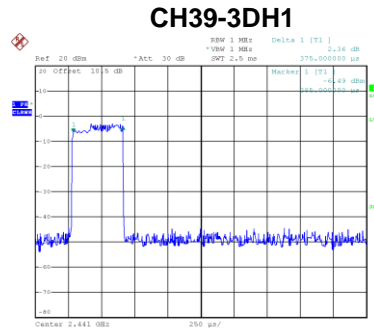
Date: 9.SEP.2022 15:34:58

Test Mode	Hopping Mode_3Mbps
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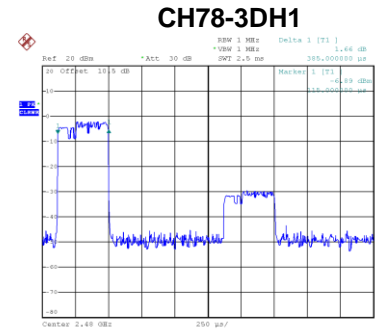
Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell Time (s)	Limits (s)	Test Result
3DH1	2402	0.3850	0.1232	0.4000	Pass
3DH3	2402	1.6400	0.2624	0.4000	Pass
3DH5	2402	2.8800	0.3072	0.4000	Pass
3DH1	2441	0.3750	0.1200	0.4000	Pass
3DH3	2441	1.6400	0.2624	0.4000	Pass
3DH5	2441	2.8800	0.3072	0.4000	Pass
3DH1	2480	0.3850	0.1232	0.4000	Pass
3DH3	2480	1.6400	0.2624	0.4000	Pass
3DH5	2480	2.8800	0.3072	0.4000	Pass



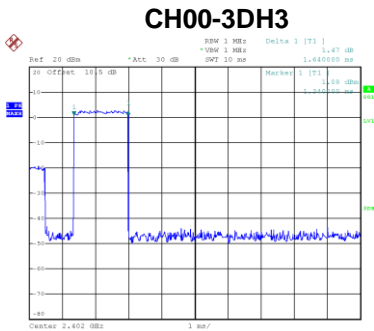
Date: 9.SEP.2022 15:47:41



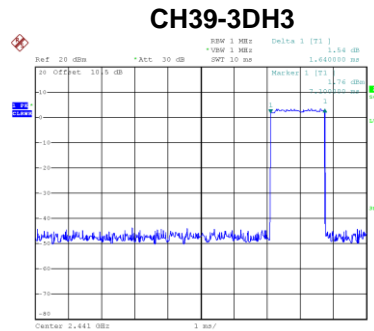
Date: 9.SEP.2022 15:47:46



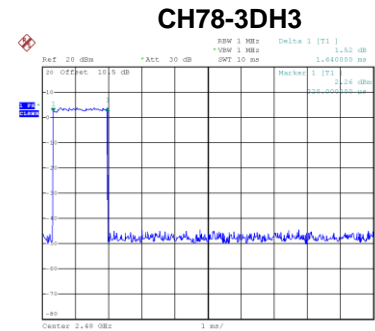
Date: 9.SEP.2022 15:47:51



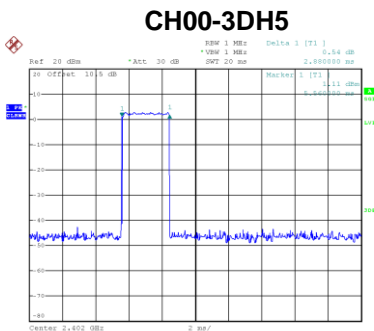
Date: 9.SEP.2022 15:59:36



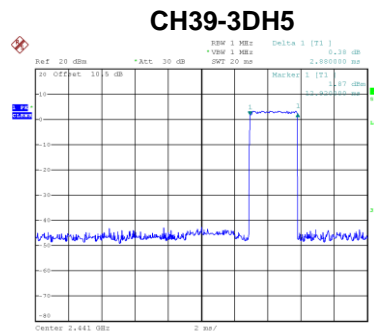
Date: 9.SEP.2022 15:59:42



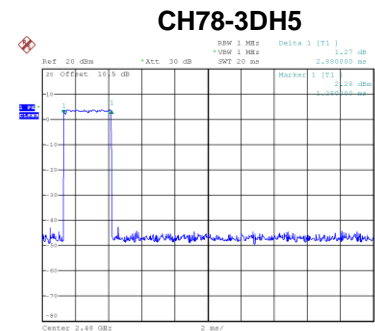
Date: 9.SEP.2022 15:59:46



Date: 9.SEP.2022 16:00:26



Date: 9.SEP.2022 16:00:48

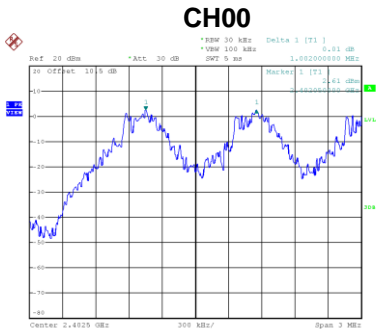


Date: 9.SEP.2022 16:00:36

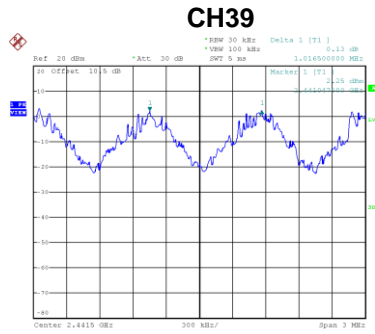
## APPENDIX G - HOPPING CHANNEL SEPARATION

Test Mode	Hopping Mode_1Mbps
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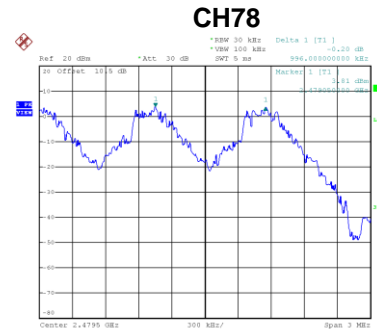
Channel	Frequency (MHz)	Channel Separation (MHz)	2/3 of 20 dB Bandwidth (MHz)	Test Result
00	2402	1.002	0.625	Pass
39	2441	1.017	0.628	Pass
78	2480	0.996	0.612	Pass



Date: 9.SEP.2022 15:13:54



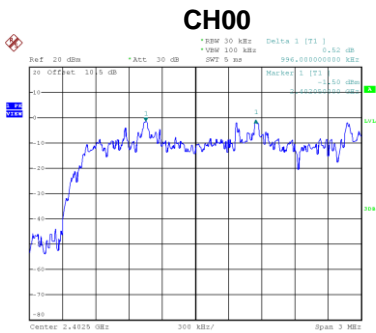
Date: 9.SEP.2022 15:15:02



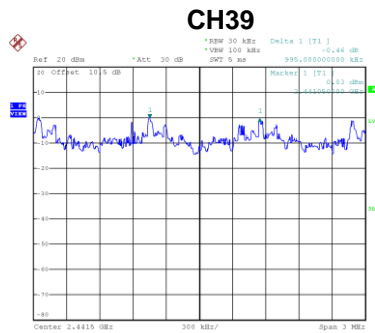
Date: 9.SEP.2022 15:16:06

Test Mode	Hopping Mode_3Mbps
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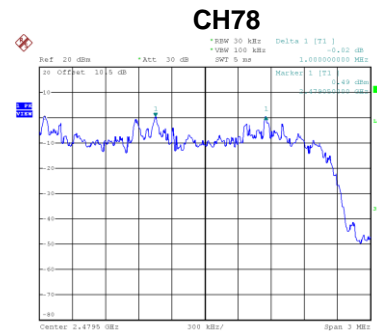
Channel	Frequency (MHz)	Channel Separation (MHz)	2/3 of 20 dB Bandwidth (MHz)	Test Result
00	2402	0.996	0.862	Pass
39	2441	0.995	0.861	Pass
78	2480	1.000	0.873	Pass



Date: 9.SEP.2022 15:14:56



Date: 9.SEP.2022 15:50:05



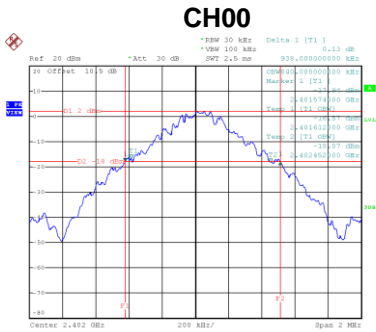
Date: 9.SEP.2022 15:51:15

## APPENDIX H - BANDWIDTH

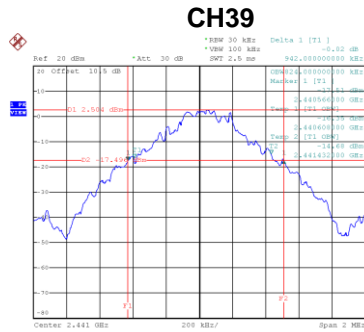


Test Mode	TX Mode _1Mbps
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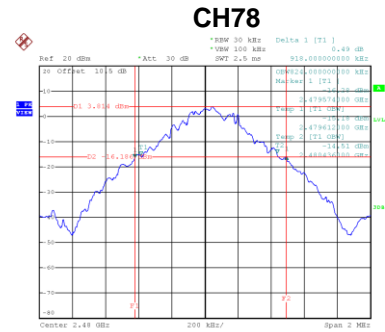
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)
00	2402	0.938	0.840
39	2441	0.942	0.824
78	2480	0.918	0.824



Date: 9.SEP.2022 14:12:53



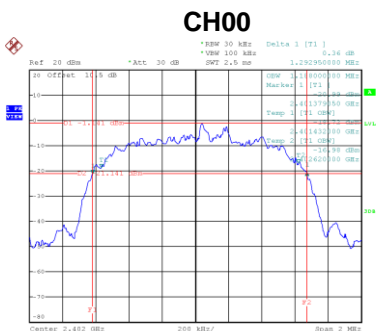
Date: 9.SEP.2022 14:16:18



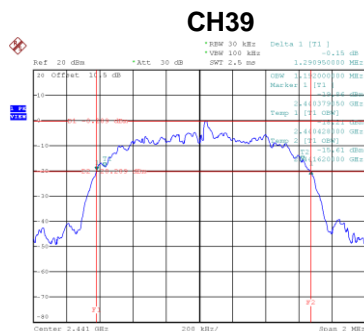
Date: 9.SEP.2022 14:17:40

Test Mode	TX Mode _3Mbps
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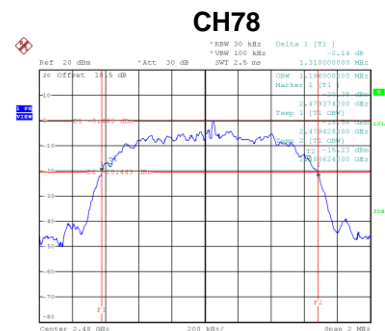
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)
00	2402	1.293	1.188
39	2441	1.291	1.192
78	2480	1.310	1.196



Date: 9.SEP.2022 14:25:49



Date: 9.SEP.2022 14:28:25

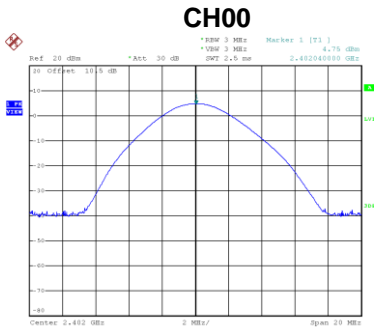


Date: 9.SEP.2022 14:29:32

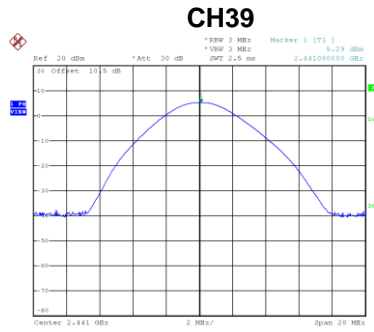
## APPENDIX I - MAXIMUM OUTPUT POWER

Test Mode	TX Mode _1Mbps
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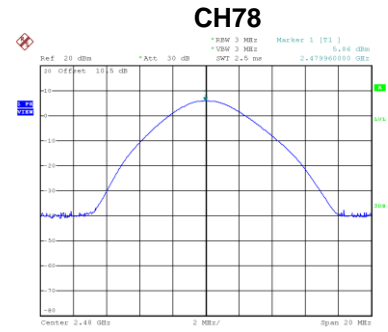
Channel	Frequency (MHz)	Output Power (dBm)	Max. Limit (dBm)	Max. Limit (W)	Test Result
00	2402	4.75	20.97	0.1250	Pass
39	2441	5.29	20.97	0.1250	Pass
78	2480	5.86	20.97	0.1250	Pass



Date: 9-SEP-2022 14:13:29



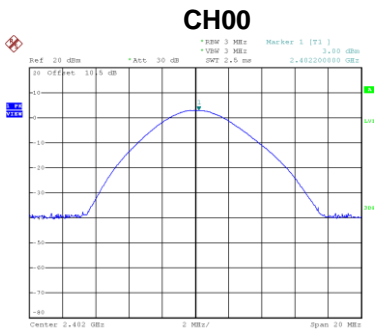
Date: 9-SEP-2022 14:16:25



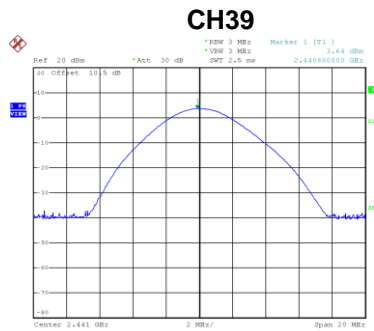
Date: 9-SEP-2022 14:18:16

Test Mode	TX Mode _2Mbps
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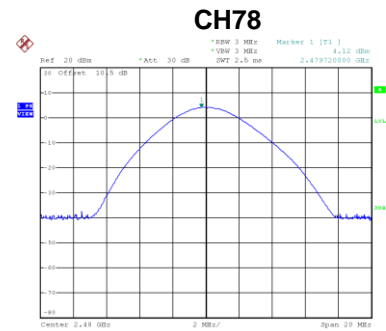
Channel	Frequency (MHz)	Output Power (dBm)	Max. Limit (dBm)	Max. Limit (W)	Test Result
00	2402	3.00	20.97	0.1250	Pass
39	2441	3.64	20.97	0.1250	Pass
78	2480	4.12	20.97	0.1250	Pass



Date: 9-SEP-2022 14:20:42



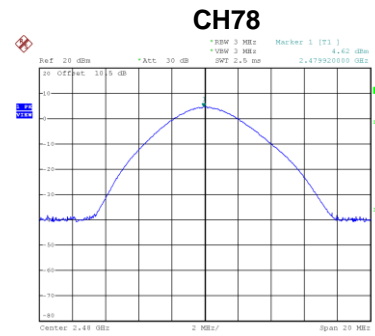
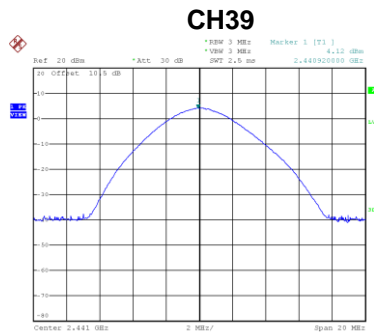
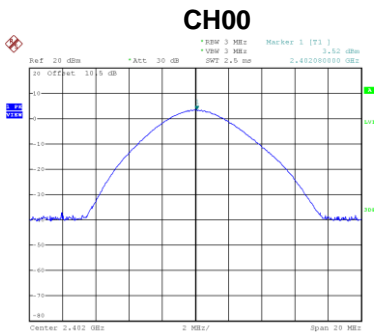
Date: 9-SEP-2022 14:22:00



Date: 9-SEP-2022 14:23:10

Test Mode	TX Mode _3Mbps
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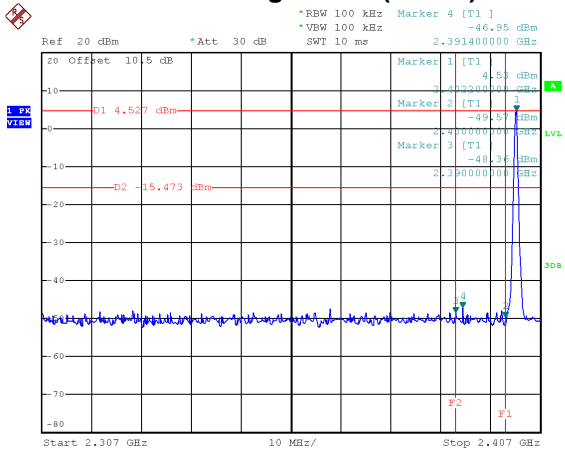
Channel	Frequency (MHz)	Output Power (dBm)	Max. Limit (dBm)	Max. Limit (W)	Test Result
00	2402	3.52	20.97	0.1250	Pass
39	2441	4.12	20.97	0.1250	Pass
78	2480	4.62	20.97	0.1250	Pass



## **APPENDIX J - CONDUCTED SPURIOUS EMISSION**

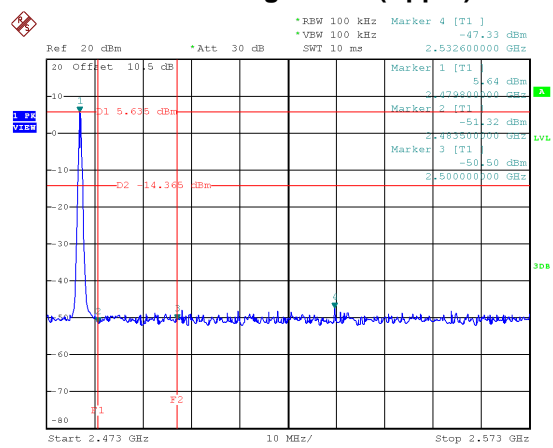
Test Mode TX Mode \_1Mbps

### Bandedge CH00 (Lower)



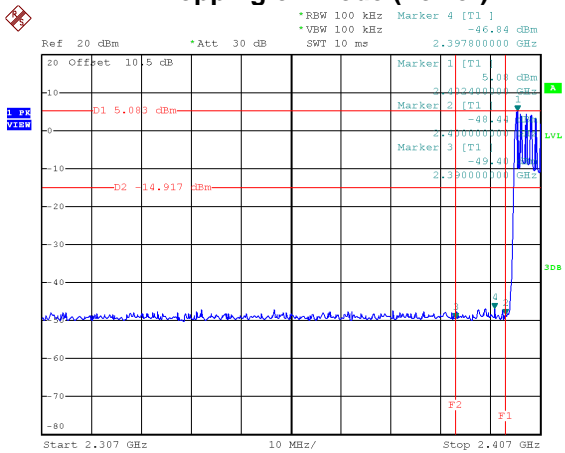
Date: 9.SEP.2022 14:12:21

### Bandedge CH78 (Upper)



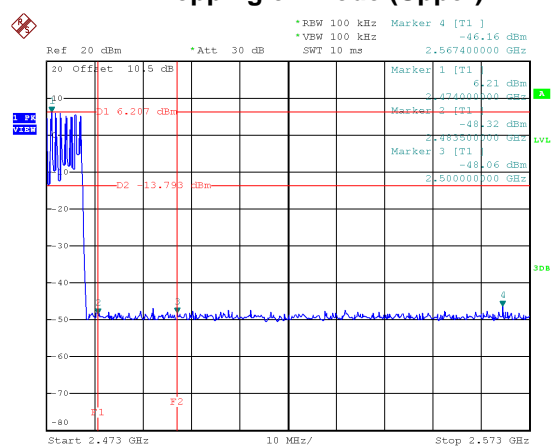
Date: 9.SEP.2022 14:17:07

### Hopping on mode (Lower)



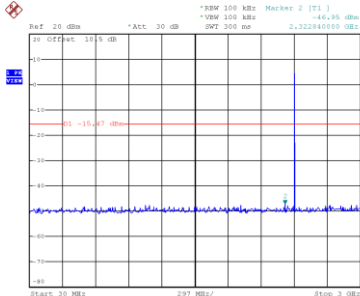
Date: 9.SEP.2022 15:32:49

### Hopping on mode (Upper)

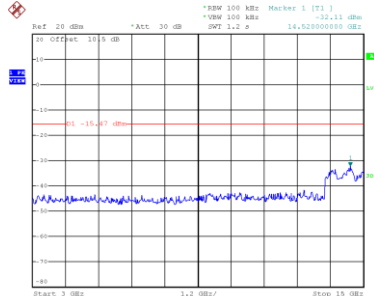


Date: 9.SEP.2022 15:33:24

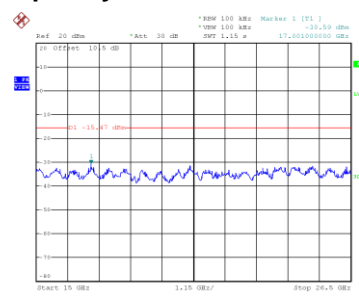
### CH00 – 10th Harmonic of the fundamental frequency



Date: 9.SEP.2022 14:13:07

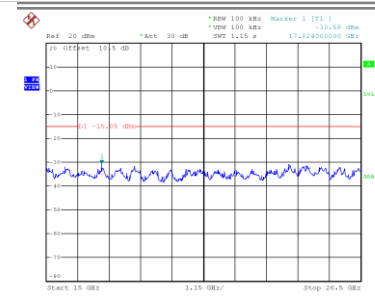
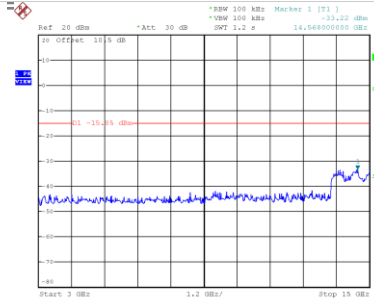
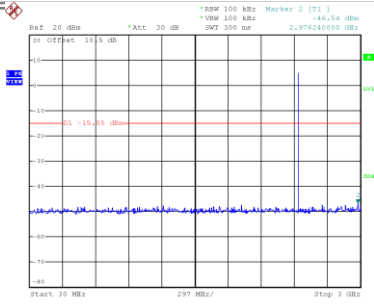


Date: 9.SEP.2022 14:13:15



Date: 9.SEP.2022 14:13:23

### CH39 – 10th Harmonic of the fundamental frequency

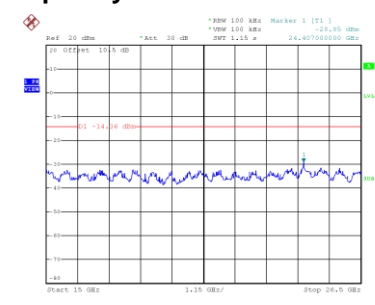
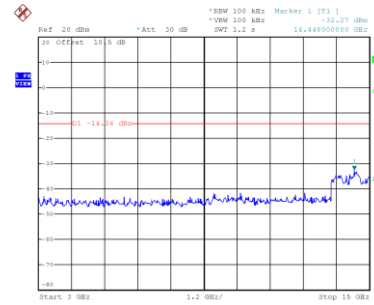
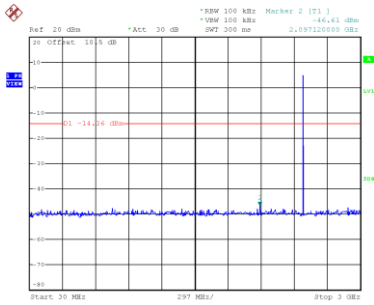


Date: 9.SEP.2022 14:15:11

Date: 9.SEP.2022 14:15:19

Date: 9.SEP.2022 14:15:17

### CH78 – 10th Harmonic of the fundamental frequency



Date: 9.SEP.2022 14:17:54

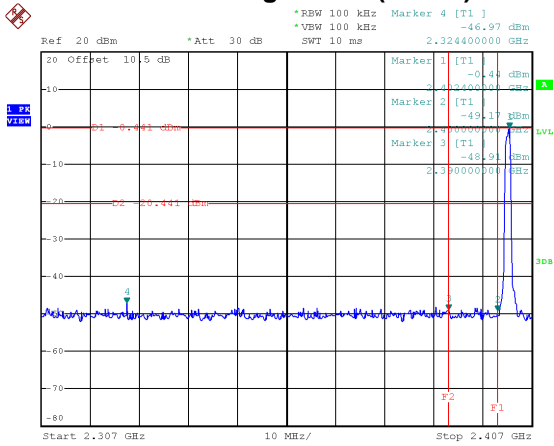
Date: 9.SEP.2022 14:18:02

Date: 9.SEP.2022 14:18:10



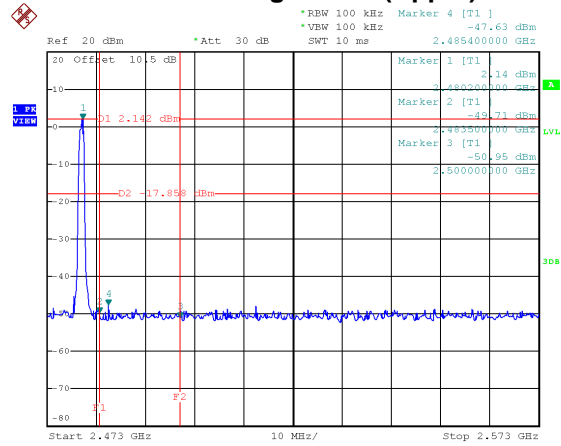
Test Mode TX Mode \_3Mbps

**Bandedge CH00 (Lower)**



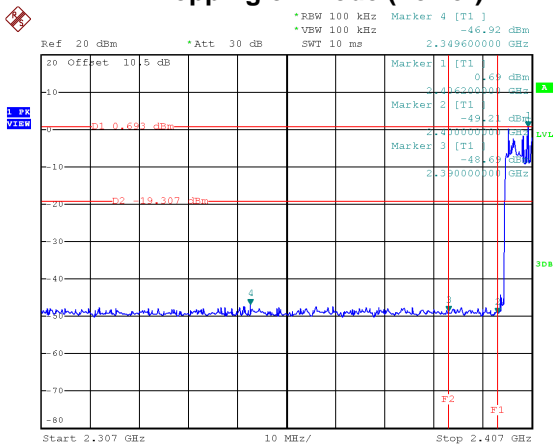
Date: 9.SEP.2022 14:25:25

**Bandedge CH78 (Upper)**



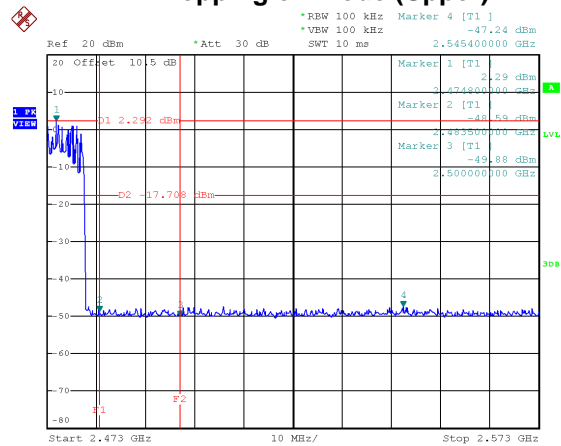
Date: 9.SEP.2022 14:29:09

**Hopping on mode (Lower)**



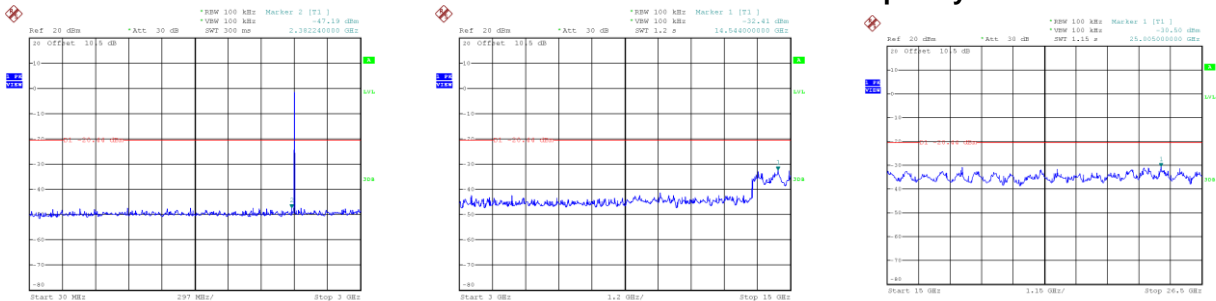
Date: 9.SEP.2022 15:53:37

**Hopping on mode (Upper)**



Date: 9.SEP.2022 15:54:12

**CH00 – 10th Harmonic of the fundamental frequency**

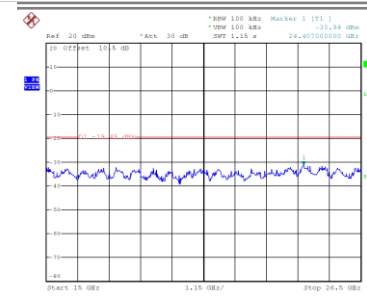
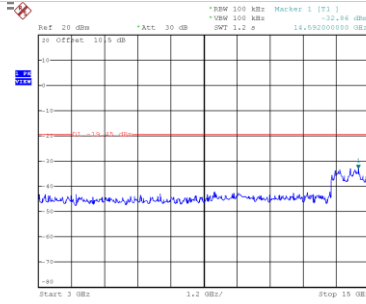
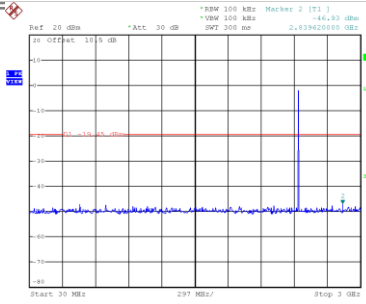


Date: 9.SEP.2022 14:26:03

Date: 9.SEP.2022 14:26:10

Date: 9.SEP.2022 14:26:18

**CH39 – 10th Harmonic of the fundamental frequency**

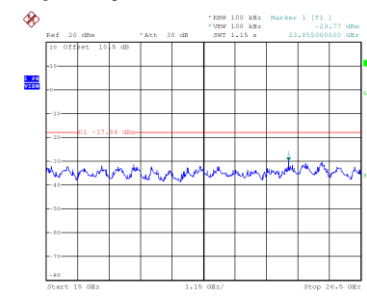
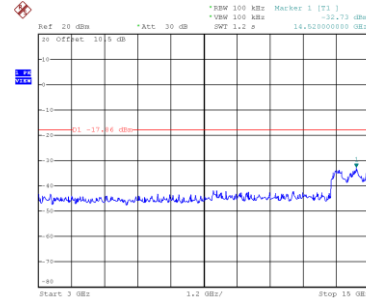
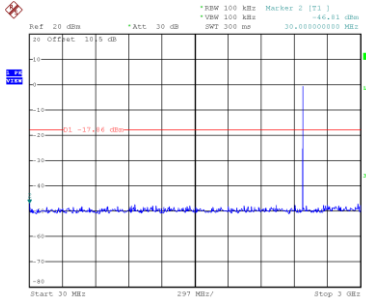


Date: 9.SEP.2022 14:27:43

Date: 9.SEP.2022 14:27:51

Date: 9.SEP.2022 14:27:59

**CH78 – 10th Harmonic of the fundamental frequency**



Date: 9.SEP.2022 14:29:46

Date: 9.SEP.2022 14:29:54

Date: 9.SEP.2022 14:30:02

## **APPENDIX K - DECLARATION FOR BLUETOOTH DEVICE**

**1. Output power and channel separation of a Bluetooth device in the different operating modes:**

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device has no influence on the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters.  
Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

**2. Frequency range of a Bluetooth device:**

Hereby we declare that the maximum frequency of this device is: 2402 - 2480MHz. This is according to the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

**3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:**

Bluetooth units which want to communicate with other units must be organised in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

**4. Example of a hopping sequence in data mode:**

Example of a 79 hopping sequence in data mode:  
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

**5. Equally average use of frequencies in data mode and behaviour for short transmissions:**

The generation of the hopping sequence in connection mode depends essentially on two input values:

- a) LAP/UAP of the master of the connection.
- b) Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD\_ADDRESS. The BD\_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD\_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronisation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5  $\mu$ s. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire.

LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR- operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviour:

The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5  $\mu$ s). The hopping sequence will always differ from the first one.

**6. Receiver input bandwidth and behaviour for repeated single or multiple packets:**

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.

Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

**End of Test Report**