NVLAP TESTING NVLAP LAB CODE 600354-0 ilac-MRA

FCC Radio Test Report

FCC ID: 2BFBC-M01

This report concerns: Original Grant

Project No.	:	2312C186
Equipment	:	Harbor Monitor
Brand Name	:	Harbor
Test Model	:	M01
Series Model	:	N/A
Applicant	:	PROJECT MONITOR INC
Address	:	4516 Lovers Lane STE 392, DALLAS Texas, United States 75225
Manufacturer	:	Thundercomm Technology Co., Ltd.
Address	:	No. 107, Data Valley Middle Road,Xiantao District, Yubei District Chongqing, China
Factory	:	HuaZhuang Electronics (Vietnam) Co.,LTD.
Address	:	A part of lot J, Dong Van II Industrial park, Bach Thuong ward, Duy Tien town, Ha Nam Province, Vietnam
Date of Receipt	:	Feb. 05, 2024
Date of Test	:	Feb. 06, 2024 ~ Mar. 26, 2024
Issued Date	:	Apr. 26, 2024
Report Version	:	R00
Test Sample	:	Engineering Sample No.: DG2024020563 for AC power line conducted emissions and radiated emissions, DG2024020564 for others.
Standard(s)	:	FCC CFR Title 47, Part 15, Subpart C

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

Prepared by : Sheldon Ou

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Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

BTL's reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. BTL assumes no responsibility for the data provided by the customer, any statements, inferences or generalizations drawn by the customer or others from the reports issued by BTL.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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BTL's laboratory quality assurance procedures are in compliance with the ISO/IEC 17025: 2017 requirements, and accredited by the conformity assessment authorities listed in this test report.

BTL is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.
Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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REPORT ISSUED HISTORY

Report No.	Version	Description	Issued Date	Note
BTL-FCCP-2-2312C186	R00	Original Report.	Apr. 26, 2024	Valid

1. APPLICABLE STANDARDS

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:
ANSI C63.10-2013
The following reference test guidance is not within the scope of accreditation of NVLAP:
KDB 558074 D01 15.247 Meas Guidance v05r02

2. 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 Emissions	APPENDIX B APPENDIX C APPENDIX D	PASS	------
15.247(a)(2)	Bandwidth	APPENDIX E	PASS	------
15.247(b)(3)	Maximum Output Power	APPENDIX F	PASS	------
15.247(d)	Conducted Spurious Emission	APPENDIX G	PASS	------
15.247(e)	Power Spectral Density	APPENDIX H	PASS	------
15.203	Antenna Requirement	------	PASS	**Note(2)**

Note:
(1) “N/A” denotes test is not applicable to this device.
(2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.

2.1 TEST FACILITY

The test facilities used to collect the test data in this report is at the location of No. 3 Jinshagang 1st Rd. Shixia, Dalang Town, Dongguan City, Guangdong 523792
BTL's Registration Number for FCC: 162128
BTL's Designation Number for FCC: CN5042

2.2 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 95.45% confidence level (based on a coverage factor (k=2))
The BTL measurement uncertainty as below table:

A. AC power line conducted emissions Measurement:

Test Site	Method	Measurement Frequency Range	*U*,(dB)
DG-C02	CISPR	150kHz ~ 30MHz	2.88

B. Radiated emissions Measurement:

Test Site	Method	Measurement Frequency Range	*U*,(dB)
DG-CB01	CISPR	9kHz ~ 30MHz	2.36

Test Site	Method	Measurement Frequency Range	Ant. H / V	*U*,(dB)
DG-CB03 (3m)	CISPR	30MHz ~ 200MHz	V	4.40
		30MHz ~ 200MHz	H	3.62
		200MHz ~ 1,000MHz	V	4.58
		200MHz ~ 1,000MHz	H	3.98

Test Site	Method	Measurement Frequency Range	*U*,(dB)
DG-CB03 (3m)	CISPR	1GHz ~ 6GHz	4.08
		6GHz ~ 18GHz	4.62

Test Site	Method	Measurement Frequency Range	*U*,(dB)
DG-CB03 (1m)	CISPR	18 ~ 26.5 GHz	3.36

C. Other Measurement:

Test Item	Uncertainty
Bandwidth	0.90 %
Maximum Output Power	1.3 dB
Conducted Spurious Emission	1.9 dB
Power Spectral Density	1.4 dB
Temperature	0.8 °C
Humidity	2.2 %

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

2.3 TEST ENVIRONMENT CONDITIONS

Test Item	Temperature	Humidity	Test Voltage	Tested By	Test Date
AC Power Line Conducted Emissions	24°C	68%	AC 120V/60Hz	Hayden Chen	Feb. 21, 2024
Radiated Emissions -9 kHz to 30 MHz	22°C	53%	AC 120V/60Hz	Hayden Chen	Feb. 20, 2024
Radiated Emissions -30 MHz to 1000 MHz	22°C	43%	AC 120V/60Hz	Allen Tong	Feb. 26, 2024
Radiated Emissions -Above 1000 MHz	21-22°C	40-43%	AC 120V/60Hz	Allen Tong	Feb. 27, 2024-Mar. 10, 2024
Bandwidth	24-25°C	52%	DC 12V	Parker Yang Steve Zhou	Mar. 05, 2024-Mar. 14, 2024
Maximum Output Power	20-24°C	55-56%	DC 12V	Oliver Wang	Feb. 24, 2024-Mar. 21, 2024
Conducted Spurious Emission	24-25°C	52%	DC 12V	Parker Yang Steve Zhou	Mar. 05, 2024-Mar. 14, 2024
Power Spectral Density	24-25°C	52%	DC 12V	Parker Yang Steve Zhou	Mar. 05, 2024-Mar. 14, 2024

3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	Harbor Monitor
Brand Name	Harbor
Test Model	M01
Series Model	N/A
Model Difference(s)	N/A
HVIN	M01
FVIN	FlatBuild_Turbox-CM6125_DK.V03_la3.0.D.userdebug.20240423.1023.zip
Power Source	1# DC voltage supplied from AC adapter. Model: S-TR-151PU4 2# Supplied from battery. Model: GSP297987HV-1S2P
Power Rating	1# I/P: 100-240V~, 50/60Hz 0.5A Max Type-C O/P: 5.0V ⎓ 3.0A, 9.0V ⎓ 2.22A, 12.0V ⎓ 1.67A 2# 6200mAh, 3.8V, 23.56Wh
Operation Frequency	2402 MHz ~ 2480 MHz
Modulation Type	GFSK
Bit Rate of Transmitter	1Mbps, 2Mbps
Max. Output Power	1Mbps: 6.49 dBm (0.0045 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)
00	2402	20	2442
01	2404	21	2444
02	2406	22	2446
03	2408	23	2448
04	2410	24	2450
05	2412	25	2452
06	2414	26	2454
07	2416	27	2456
08	2418	28	2458
09	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

3. Table for Filed Antenna:

Ant.	Manufacturer	P/N	Antenna Type	Connector	Gain (dBi)
1	Etheta Communication Technoloies (china) Co., LTD.	RD1202305NB87-1	PIFA	N/A	2.20

3.2 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 00/19/39
Mode 2	TX Mode_2Mbps Channel 00/19/39
Mode 3	TX Mode_1Mbps Channel 39

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_1Mbps Channel 39

Radiated emissions test - Below 1GHz	
Final Test Mode	Description
Mode 3	TX Mode_1Mbps Channel 39

Radiated emissions test - Above 1GHz	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/19/39
Mode 2	TX Mode_2Mbps Channel 00/19/39

Conducted test	
Final Test Mode	Description
Mode 1	TX Mode_1Mbps Channel 00/19/39
Mode 2	TX Mode_2Mbps Channel 00/19/39

Note:

(1) 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.

(2) For AC power line conducted emissions and radiated emissions below 1 GHz test, the 1Mbps Channel 39 is found to be the worst case and recorded.

(3) For radiated emission Harmonic 18-26.5GHz test, only tested the worst case and recorded.

(4) For radiated emission above 1 GHz test, the polarization of Vertical and Horizontal are evaluated, the worst case is Horizontal for Band edge, Vertical for Harmonic. In this report only recorded the worst case.

3.3 PARAMETERS OF TEST SOFTWARE

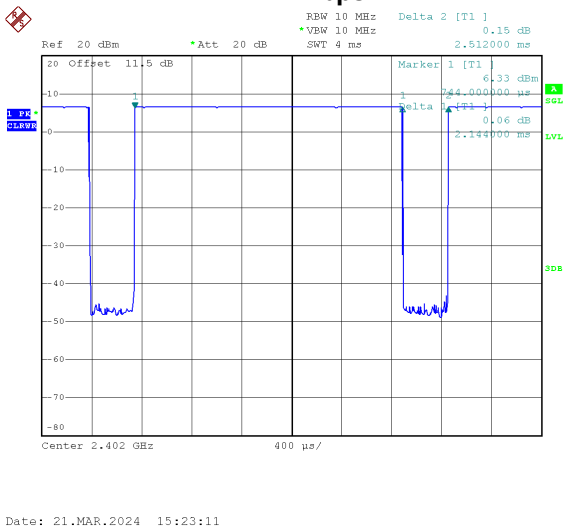
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

Test Software Version	QRCT4.0		
Frequency (MHz)	2402	2440	2480
1Mbps	default	default	default
2Mbps	default	default	default

3.4 DUTY CYCLE

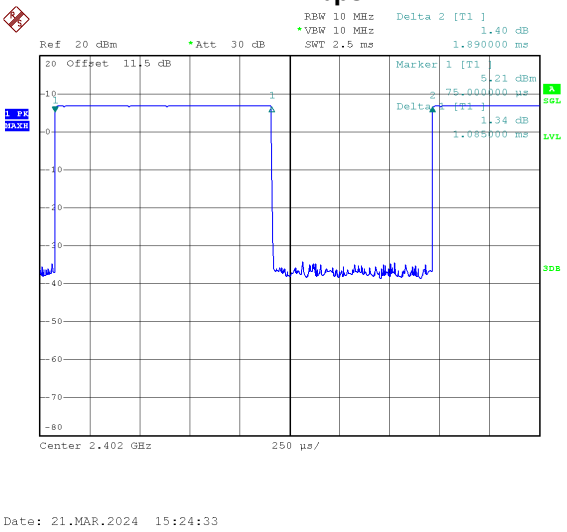
If duty cycle is ≥ 98 %, duty factor is not required.
If duty cycle is < 98 %, duty factor shall be considered.
The output power = measured power + duty factor.

1Mbps



Duty cycle = 2.144 ms / 2.512 ms = 85.35%
Duty Factor = 10 log(1/Duty cycle) = 0.69

2Mbps

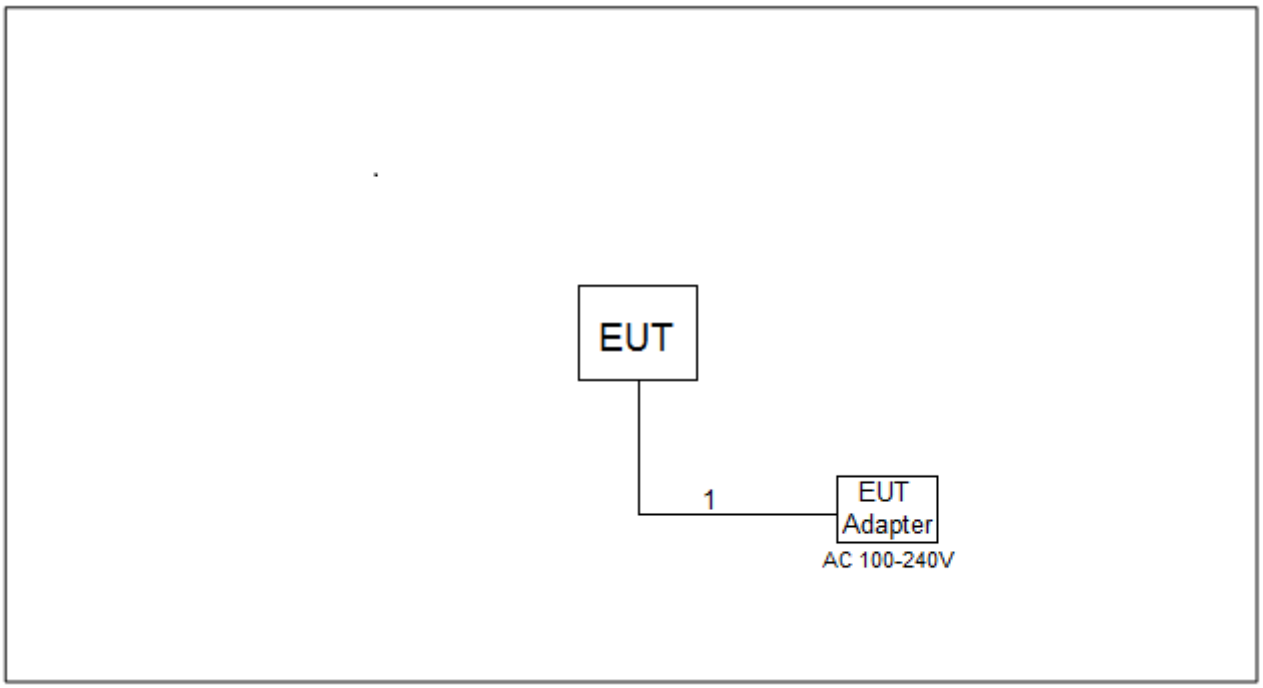


Duty cycle = 1.085 ms / 1.890 ms = 57.41%
Duty Factor = 10 log(1/Duty cycle) = 2.41

NOTE:
For 1Mbps:
For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 466 Hz.

For 2Mbps:
For radiated emissions frequency above 1 GHz, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 922 Hz.

3.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.6 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.
-	-	-	-	-

Item	Cable Type	Shielded Type	Ferrite Core	Length
1	DC Cable	NO	NO	1.2m

3.7 CUSTOMER INFORMATION DESCRIPTION

1) The antenna gain is provided by the manufacturer.
2) Except for AC power line conducted emissions and radiated emissions, the results of all test items include cable losses. All cable losses are provided by the testing laboratory.

4. AC POWER LINE CONDUCTED EMISSIONS

4.1 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.

4.2 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.

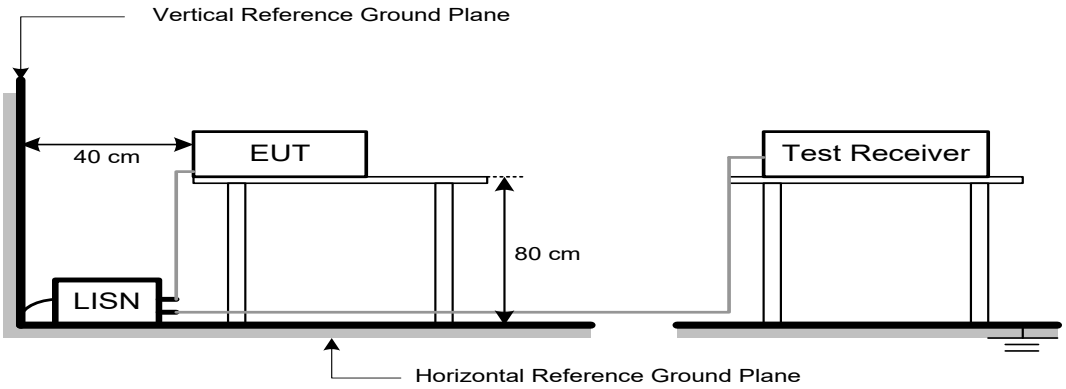
The following table is the setting of the receiver:

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

4.3 DEVIATION FROM TEST STANDARD

No deviation.

4.4 TEST SETUP



4.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

4.6 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.

5. RADIATED EMISSIONS

5.1 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)	Band edge/ Harmonic at 3m (dBμV/m)		Harmonic at 1m (dBμV/m)	
	Peak	Average	Peak	Average
Above 1000	74	54	83.5 (Note 4)	63.5 (Note 4)

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)

$$FS_{\text{limit}} = FS_{\max} - 20\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right)$$

20log ($d_{limit}/d_{measure}$)=20log (3/1)=9.5 dB.

5.2 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 or 1m 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 1GHz)
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

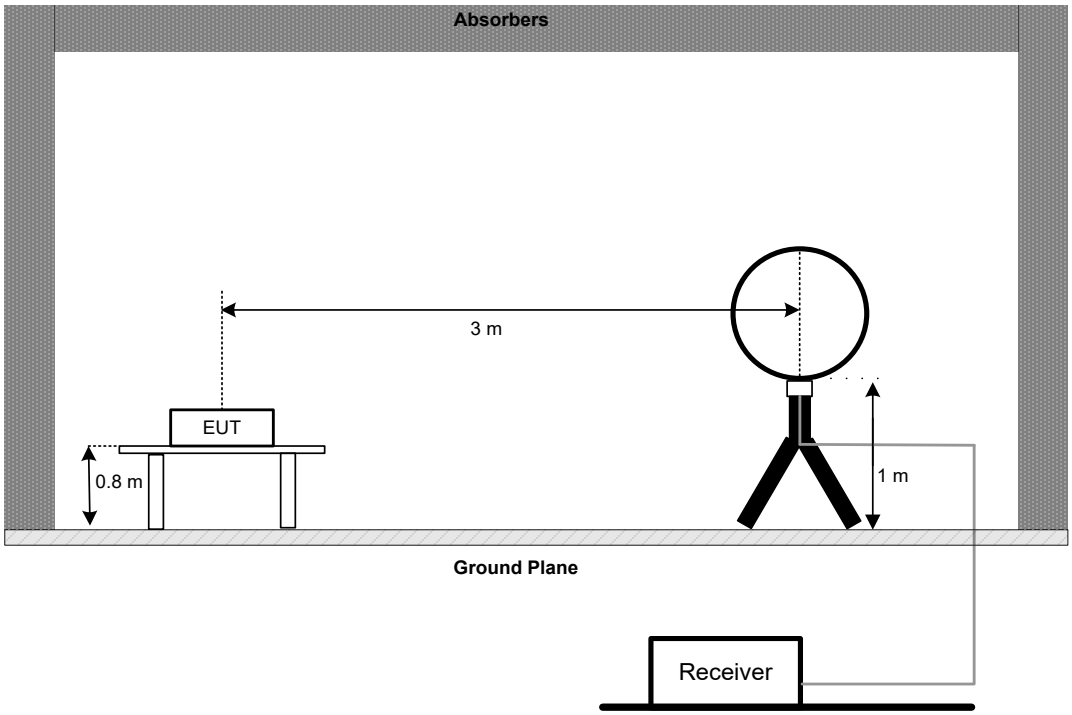
Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector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

5.3 DEVIATION FROM TEST STANDARD

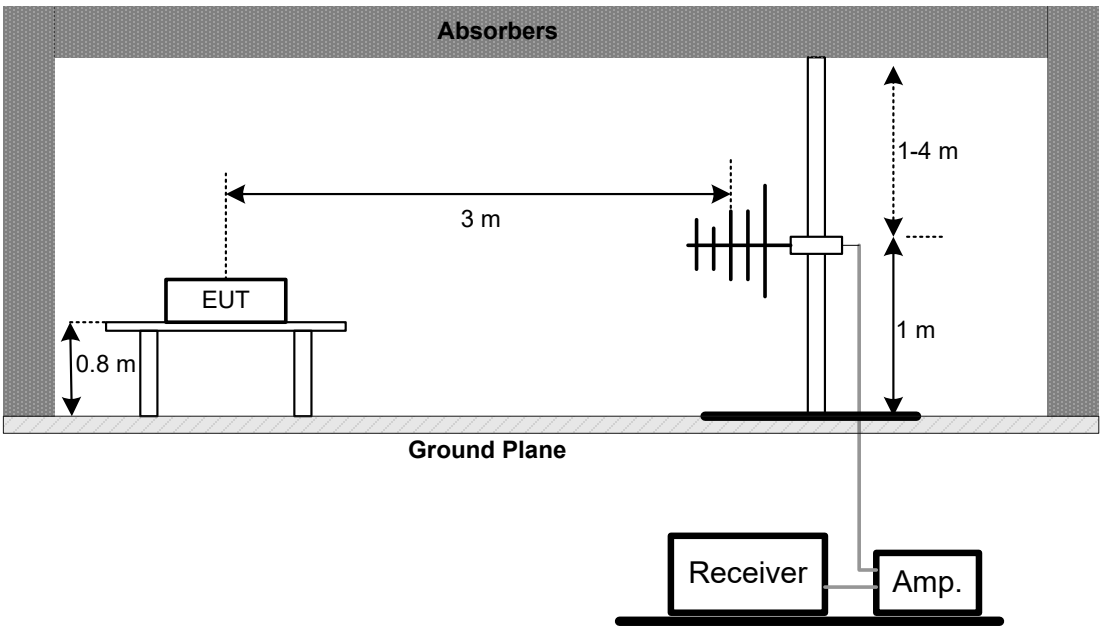
No deviation.

5.4 TEST SETUP

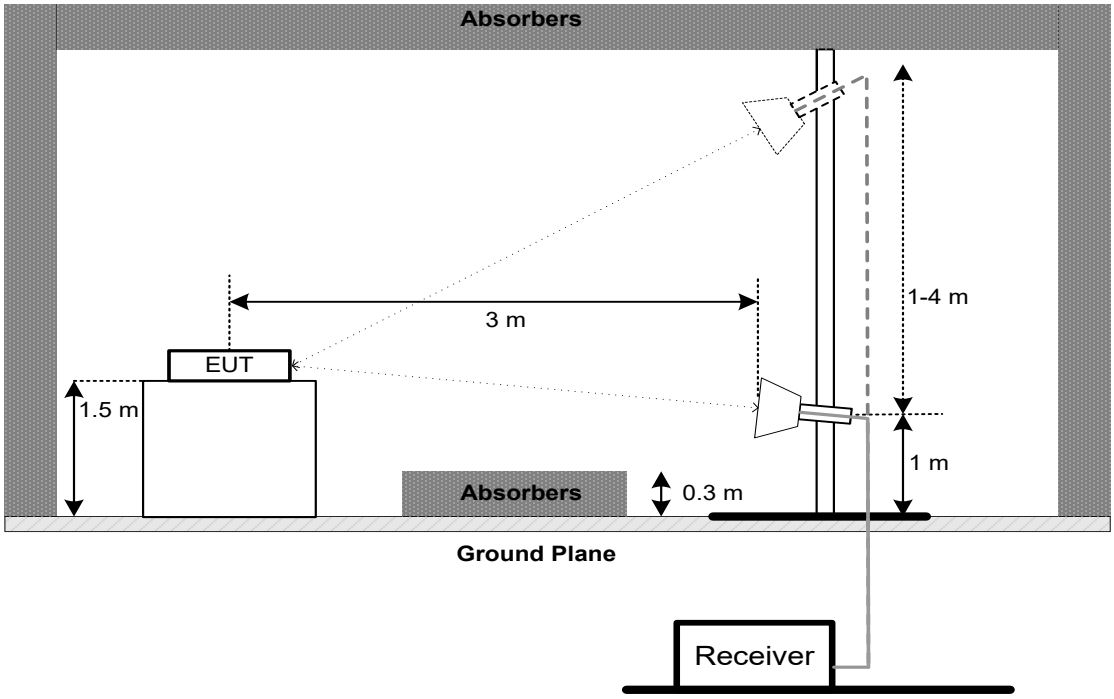
9 kHz to 30 MHz



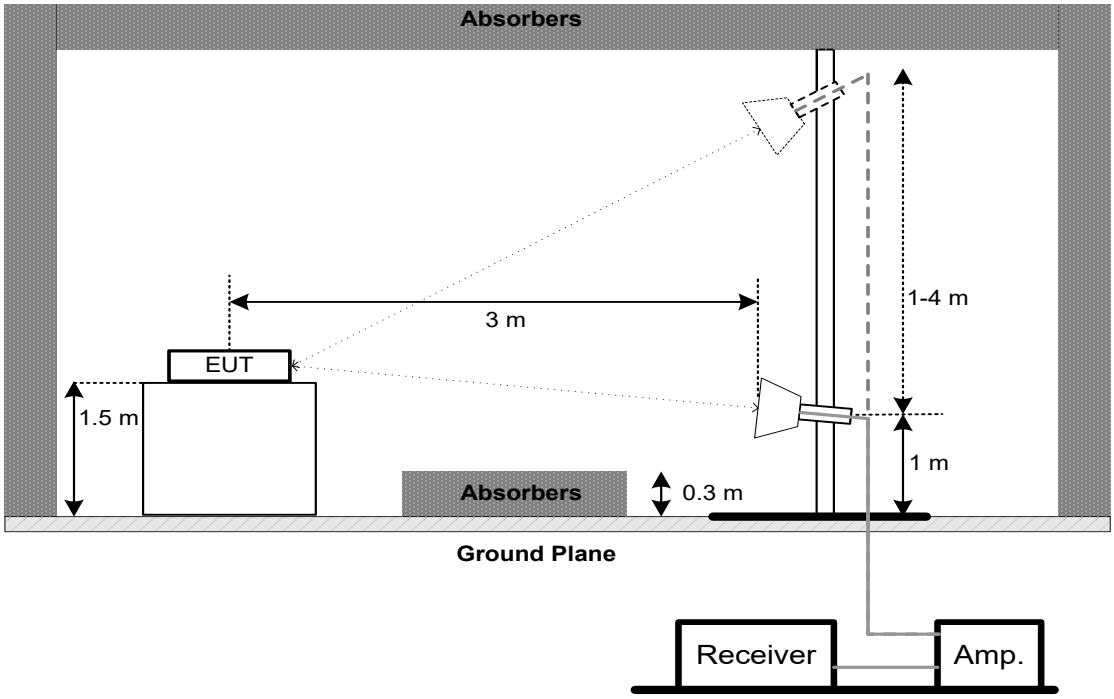
30 MHz to 1 GHz



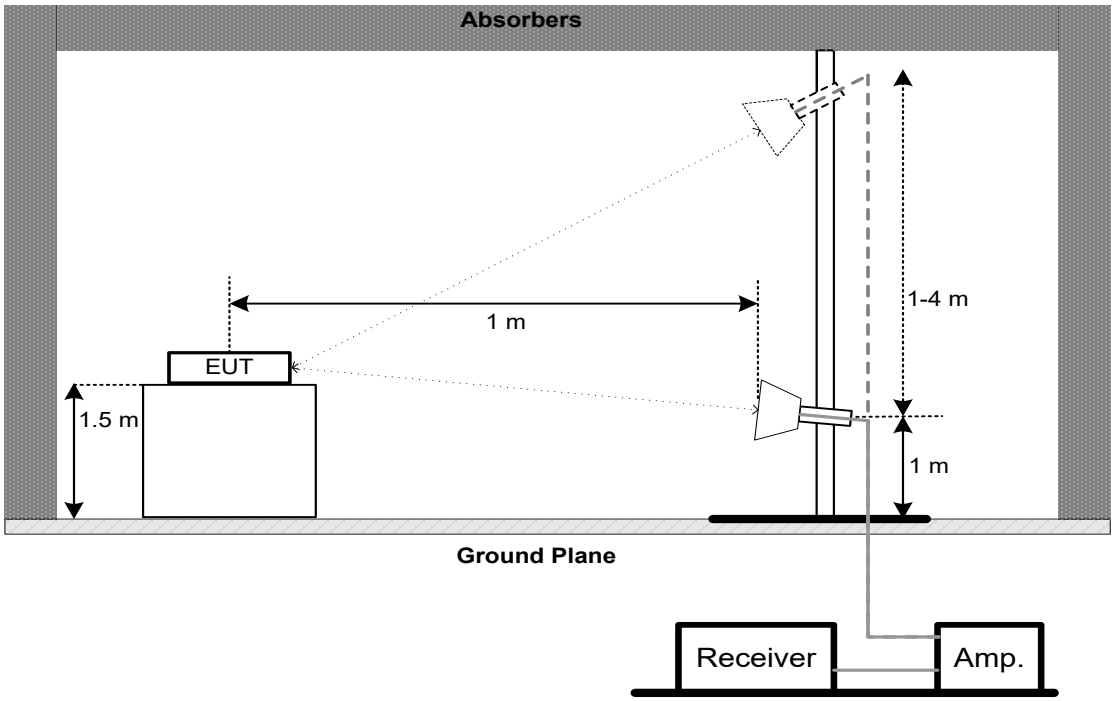
Above 1 GHz
Band edge



Harmonic (1 GHz to 18 GHz)



Harmonic (18 GHz to 26.5 GHz)



5.5 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6 TEST RESULT - 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.

5.7 TEST RESULT - 30 MHz TO 1000 MHz

Please refer to the APPENDIX C.

5.8 TEST RESULT - 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.

6. BANDWIDTH

6.1 LIMIT

Section	Test Item	Limit
FCC 15.247(a)(2)	6 dB Bandwidth	>= 500 kHz
	99% Emission Bandwidth	-

6.2 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:

For 6 dB Bandwidth:

Spectrum Parameters	Setting
Span Frequency	> Measurement Bandwidth
RBW	100 kHz
VBW	300 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

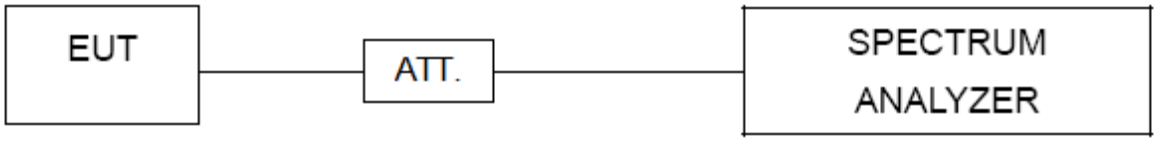
For 99% Emission Bandwidth:

Spectrum Parameters	Setting
Span Frequency	Between 1.5 times and 5.0 times the OBW
RBW	30 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

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 E.

7. MAXIMUM OUTPUT POWER

7.1 LIMIT

Section	Test Item	Limit
FCC 15.247(b)(3)	Maximum Output Power	1.0000 watt or 30.00 dBm

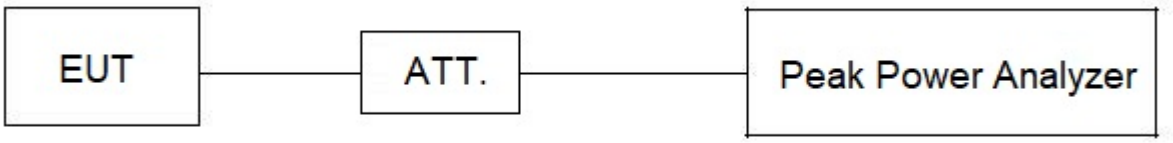
7.2 TEST PROCEDURE

a. The EUT was directly connected to the peak power analyzer and antenna output port as show in the block diagram below.
b. The maximum conducted output power was performed in accordance with method 11.9.2.3.1 of ANSI C63.10-2013.

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 F.

8. CONDUCTED SPURIOUS EMISSION

8.1 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.

8.2 TEST PROCEDURE

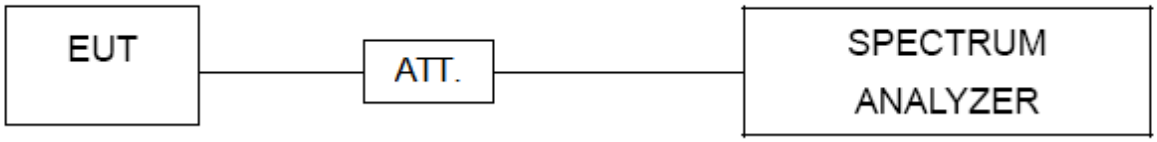
a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Start Frequency	30 MHz
Stop Frequency	26.5 GHz
RBW	100 kHz
VBW	300 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 G.

9. POWER SPECTRAL DENSITY

9.1 LIMIT

Section	Test Item	Limit
FCC 15.247(e)	Power Spectral Density	8 dBm (in any 3 kHz)

9.2 TEST PROCEDURE

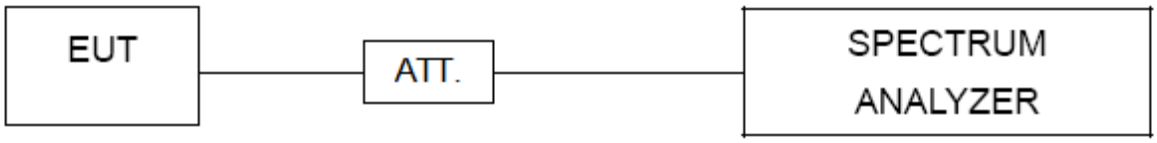
a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. The following table is the setting of the spectrum analyzer:

Spectrum Parameters	Setting
Span Frequency	2 MHz (1 Mbps) / 4 MHz (2 Mbps)
RBW	3 kHz
VBW	10 kHz
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 H.

10. MEASUREMENT INSTRUMENTS LIST

AC Power Line Conducted Emissions					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	EMI Test Receiver	R&S	ESR3	103027	Jun. 16, 2024
2	TWO-LINE V-NETWORK	R&S	ENV216	101447	Dec. 22, 2024
3	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
4	Cable	N/A	SFT205-NMNM-9M -001	9M	Nov. 27, 2024
5	643 Shield Room	ETS	6*4*3	N/A	N/A

Radiated Emissions - 9 kHz to 30 MHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Active Loop Antenna	Schwarzbeck	FMZB 1513-60B	1513-60 B-034	Apr. 01, 2024
2	MXE EMI Receiver	Keysight	N9038A	MY56400091	Dec. 22, 2024
3	Cable	N/A	RW2350-3.8A-NMB M-1.5M	N/A	Jun. 10, 2024
4	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
5	966 Chamber room	ETS	9*6*6	N/A	Jul. 11, 2024

Radiated Emissions - 30 MHz to 1 GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	1462	Dec. 13, 2024
2	Attenuator	EMC INSTRUMENT	EMCI-N-6-06	AT-06009	Dec. 13, 2024
3	Preamplifier	EMC INSTRUMENT	EMC001330	980863	Nov. 17, 2024
4	Cable	RegalWay	LMR400-NMNM-12 .5m	N/A	Jul. 04, 2024
5	Cable	RegalWay	LMR400-NMNM-3 m	N/A	Jul. 04, 2024
6	Cable	RegalWay	LMR400-NMNM-0. 5m	N/A	Jul. 04, 2024
7	Receiver	Agilent	N9038A	MY52130039	Dec. 22, 2024
8	Positioning Controller	MF	MF-7802	N/A	N/A
9	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
10	966 Chamber room	CM	9*6*6	N/A	May 17, 2024

Radiated Emissions - Above 1 GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Receiver	Agilent	N9038A	MY52130039	Dec. 22, 2024
2	Preamplifier	EMC INSTRUMENT	EMC118A45SE	980888	Nov. 17, 2024
3	EXA Spectrum Analyzer	Keysight	N9010A	MY55150209	Jun. 16, 2024
4	Double Ridged Guide Antenna	ETS	3115	75789	May 31, 2024
5	Cable	RegalWay	RWLP50-4.0A-SMSM-12.5M	N/A	Feb. 19, 2025
6	Cable	RegalWay	RWLP50-4.0A-NMRASM-2.5M	N/A	Aug. 08, 2024
7	Cable	RegalWay	RWLP50-4.0A-NMRASMRA-0.8M	N/A	Aug. 08, 2024
8	Low Noise Amplifier	CONNPHY	CLN-18G40G-4330-K	619413	Jul. 06, 2024
9	Cable	RegalWay	RWLP50-2.6A-2.92M2.92M-1.1M	N/A	Jul. 26, 2024
10	Cable	Tonscend	HF160-KMKM-3M	N/A	Jul. 26, 2024
11	Broad-Band Horn Antenna	Schwarzbeck	BBHA9170(3m)	9170-319	Jun. 20, 2024
12	966 Chamber room	CM	9*6*6	N/A	May 17, 2024
13	Attenuator	Talent Microwave	TA10A2-S-18	N/A	N/A
14	Filter	STI	STI15-9912	N/A	Jun. 16, 2024
15	Positioning Controller	MF	MF-7802	N/A	N/A
16	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

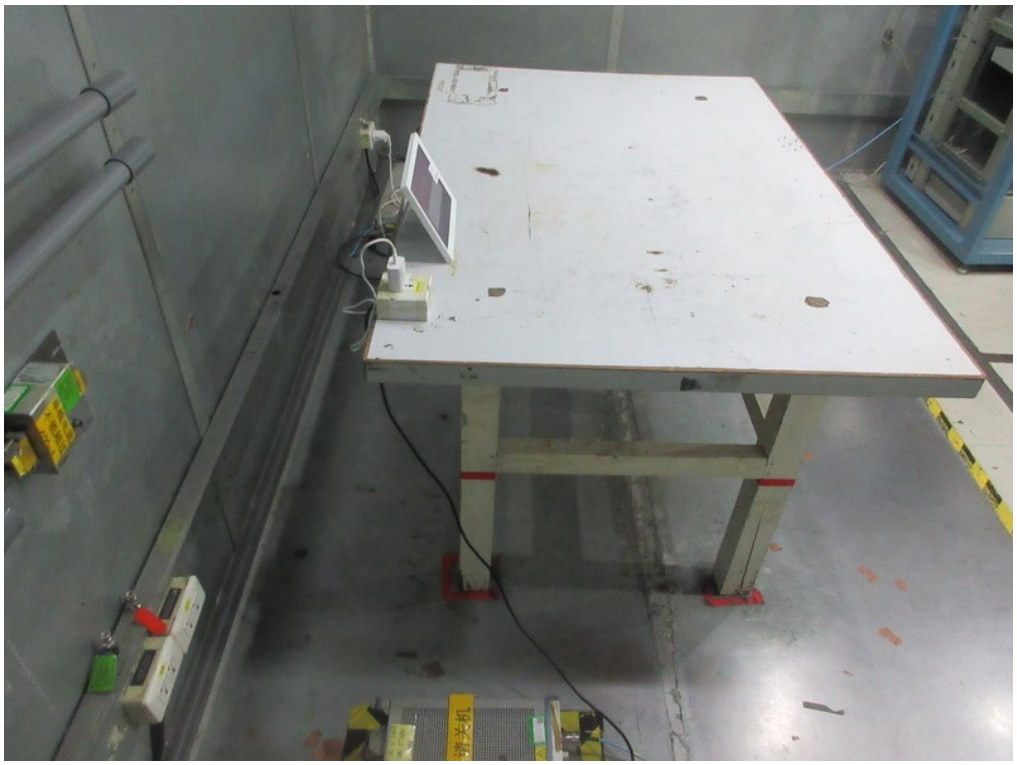
Maximum Output Power					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Peak Power Analyzer	Keysight	8990B	MY51000506	Jun. 17, 2024
2	Wideband power sensor	Keysight	N1923A	MY58310004	Jun. 17, 2024
3	Attenuator	Talent Microwave	TA10A2-S-18	N/A	N/A

Bandwidth & Power Spectral Density & Conducted Spurious Emission					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	Jun. 16, 2024
2	Attenuator	Talent Microwave	TA10A0-S-26.5	N/A	N/A
3	DC Block	N/A	N/A	N/A	N/A
4	Measurement Software	BTL	BTL Conducted Test	N/A	N/A

Remark: “N/A” denotes no model name, serial no. or calibration specified.
All calibration period of equipment list is one year.

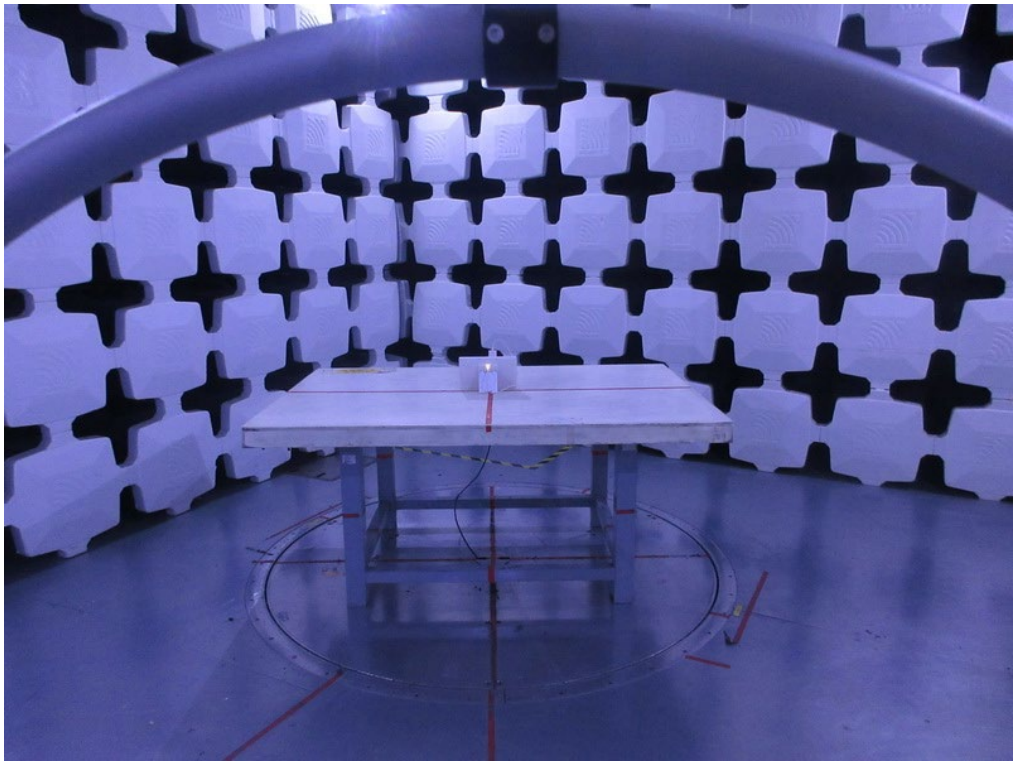
11. EUT TEST PHOTO

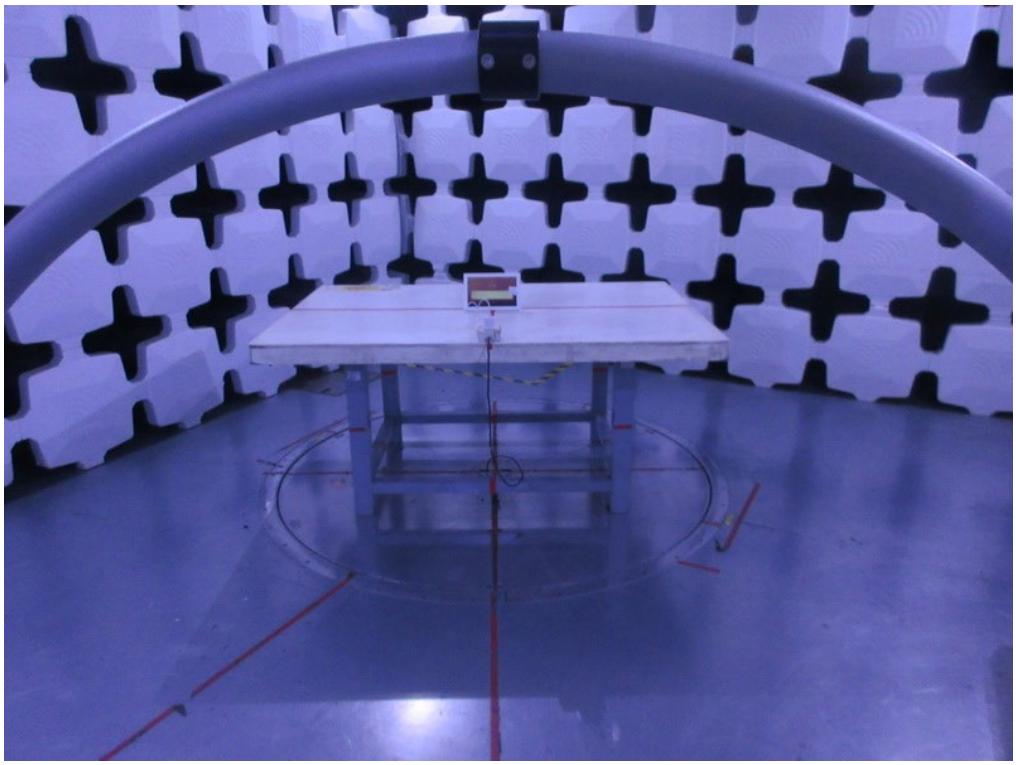
AC Power Line Conducted Emissions Test Photos



Radiated Emissions Test Photos

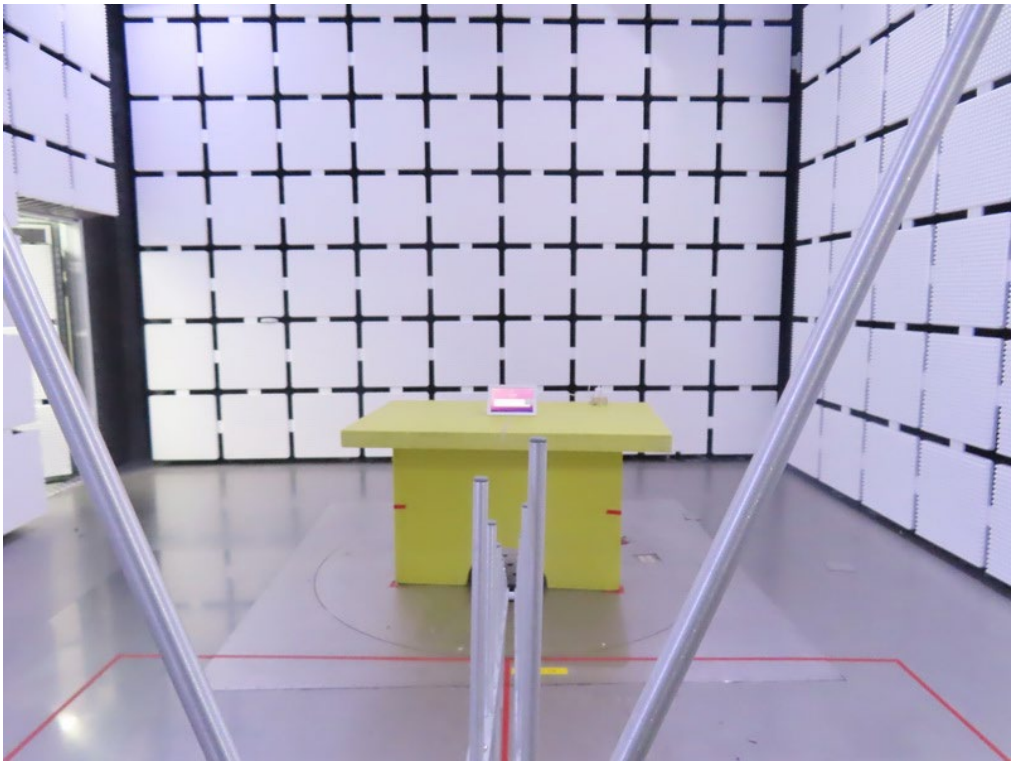
9 kHz to 30 MHz

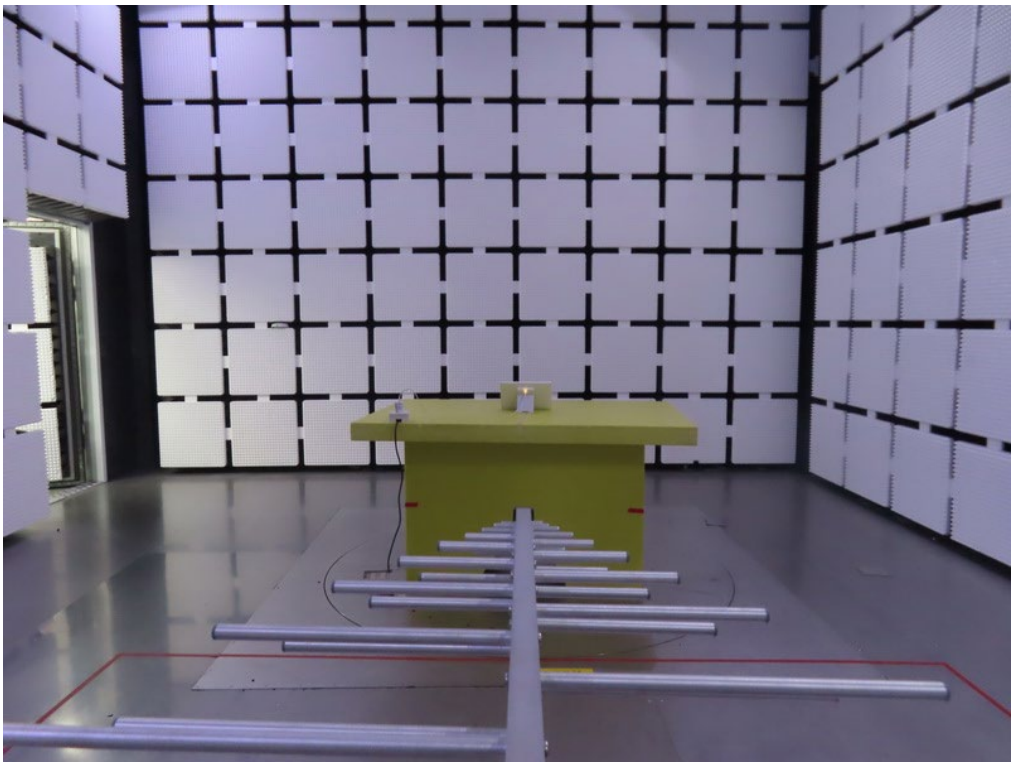




Radiated Emissions Test Photos

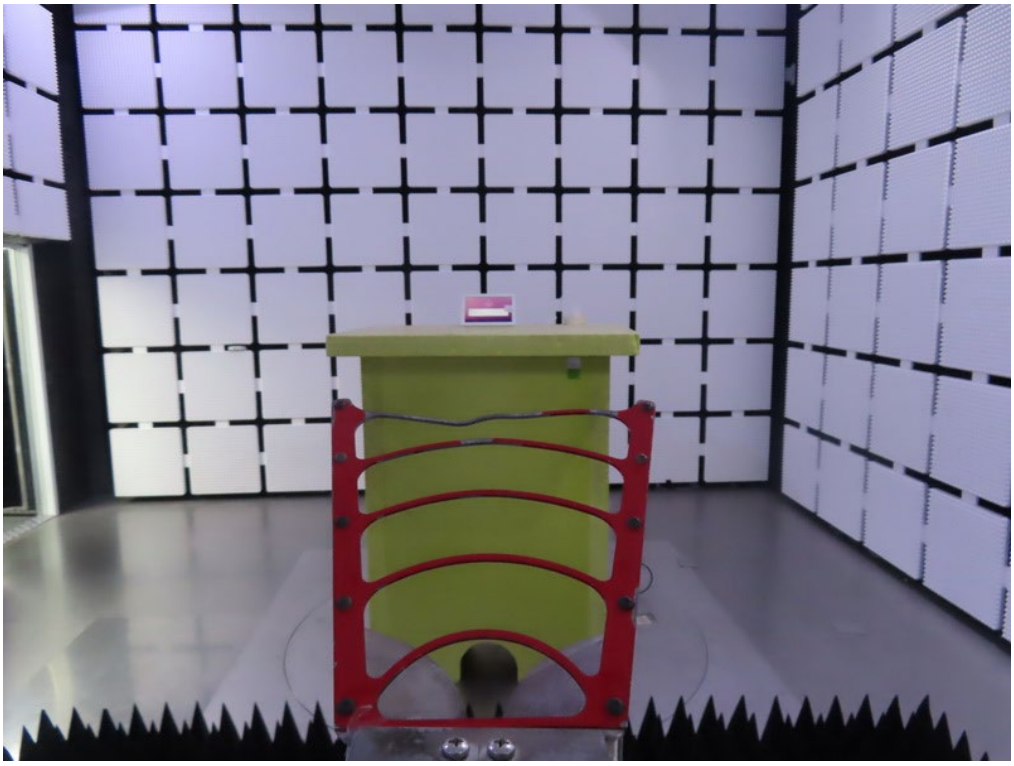
30 MHz to 1000 MHz

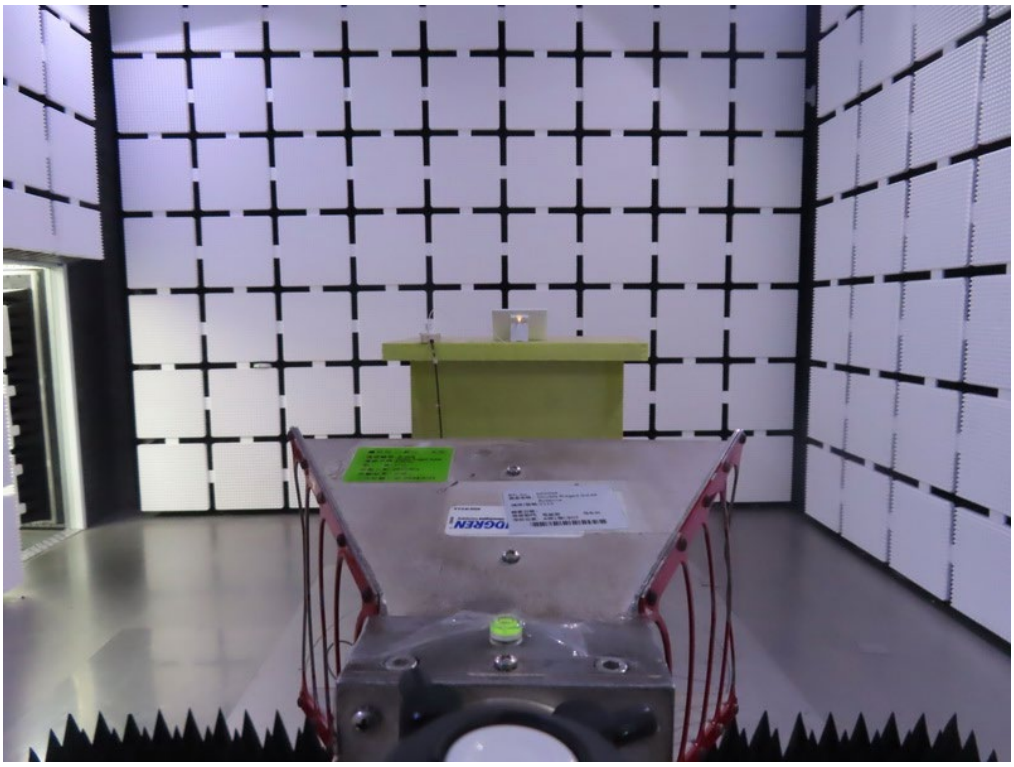




Radiated Emissions Test Photos

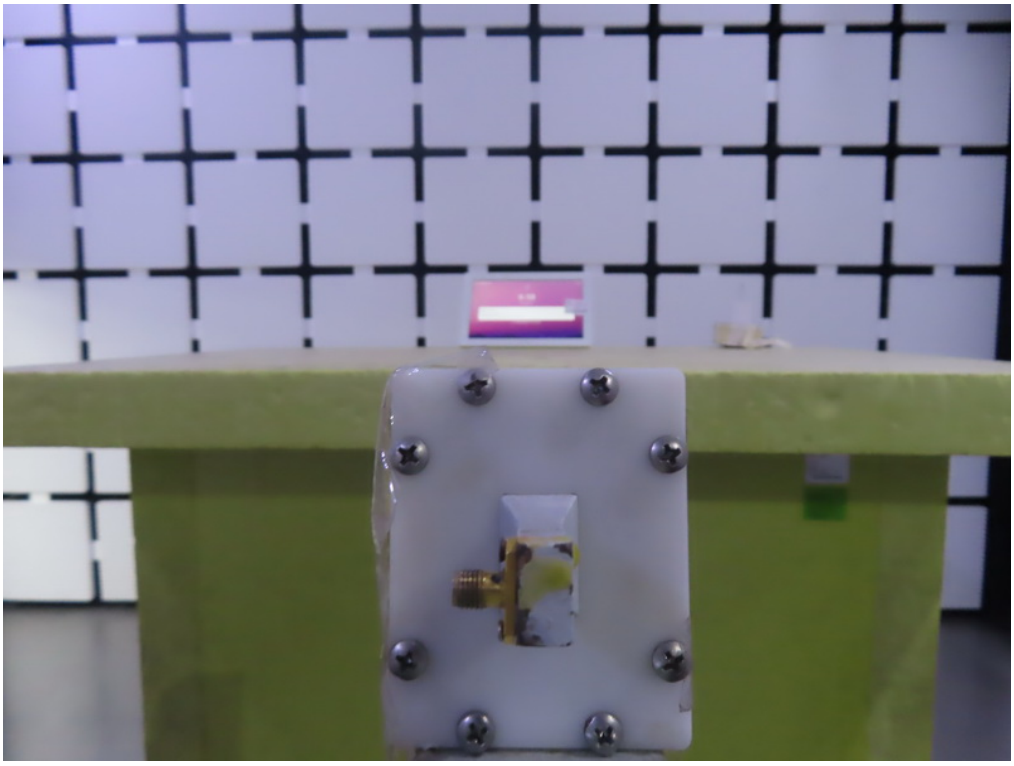
Band edge & Harmonic (1 GHz - 18GHz)

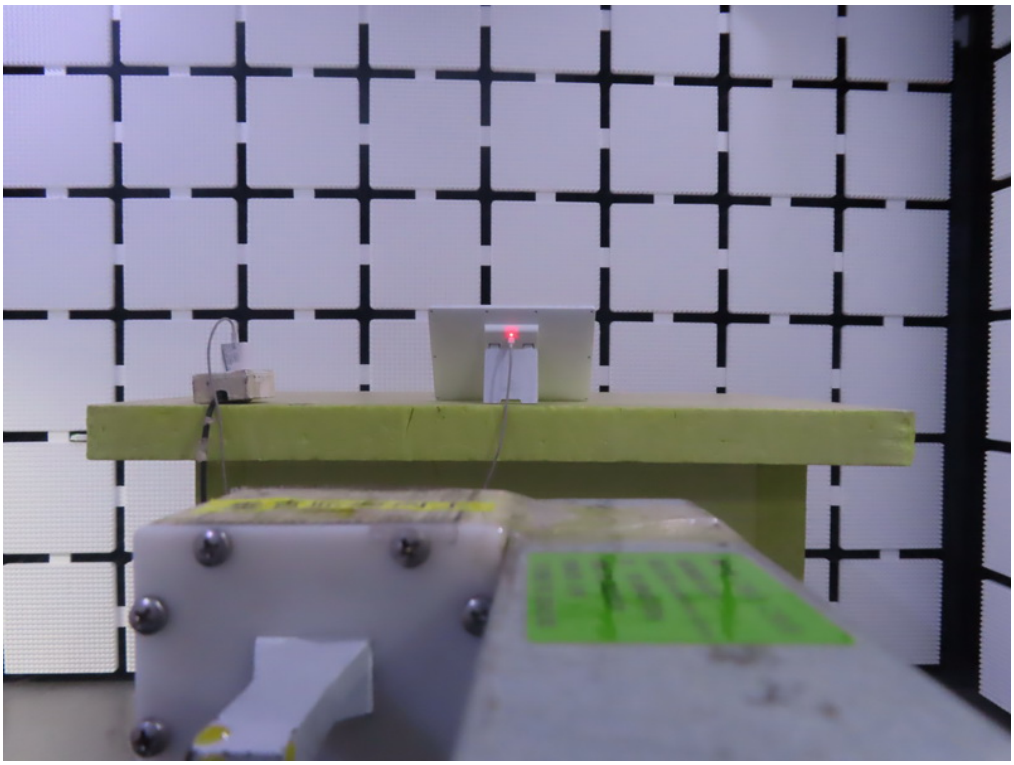




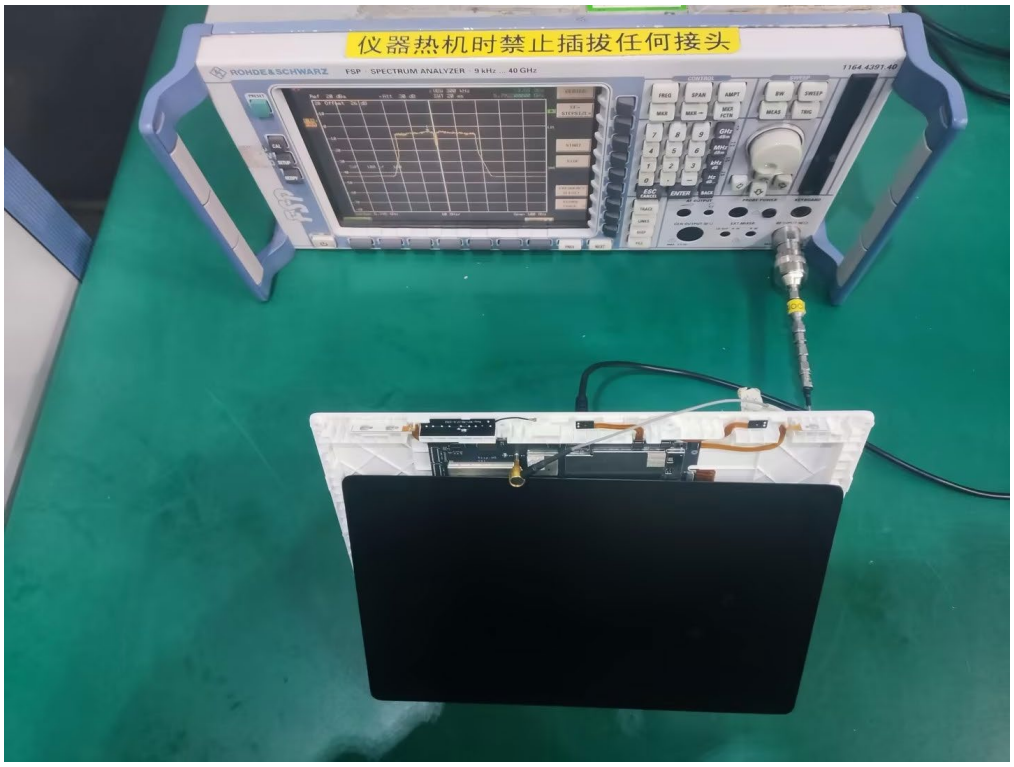
Radiated Emissions Test Photos

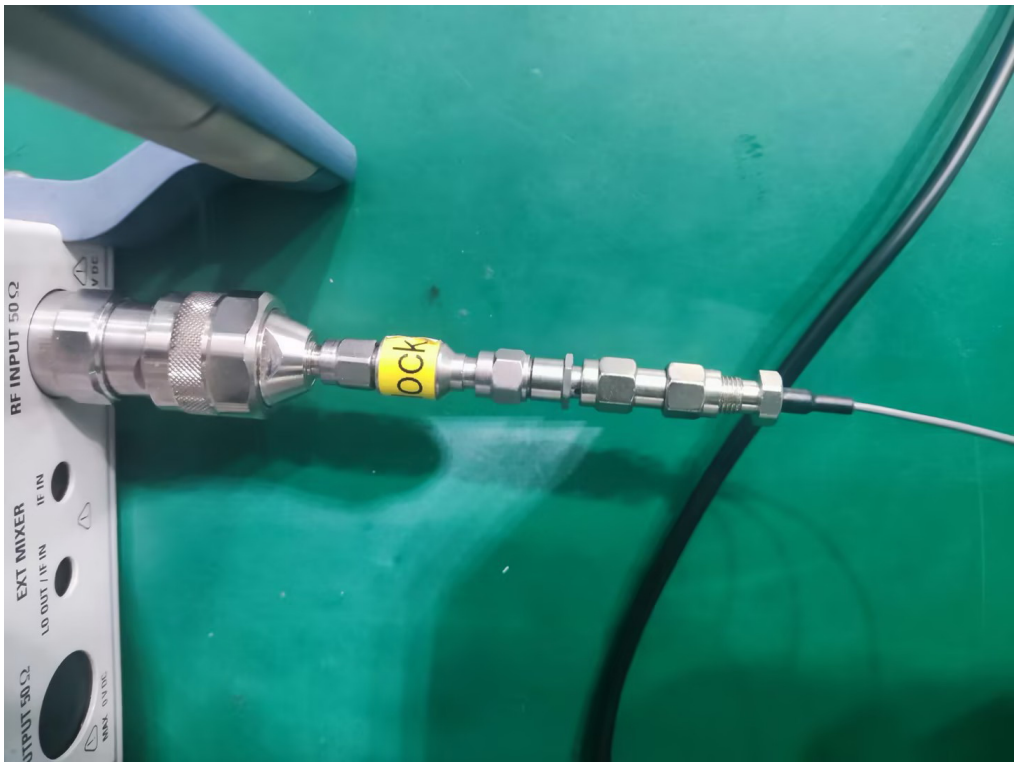
Harmonic (Above 18 GHz)





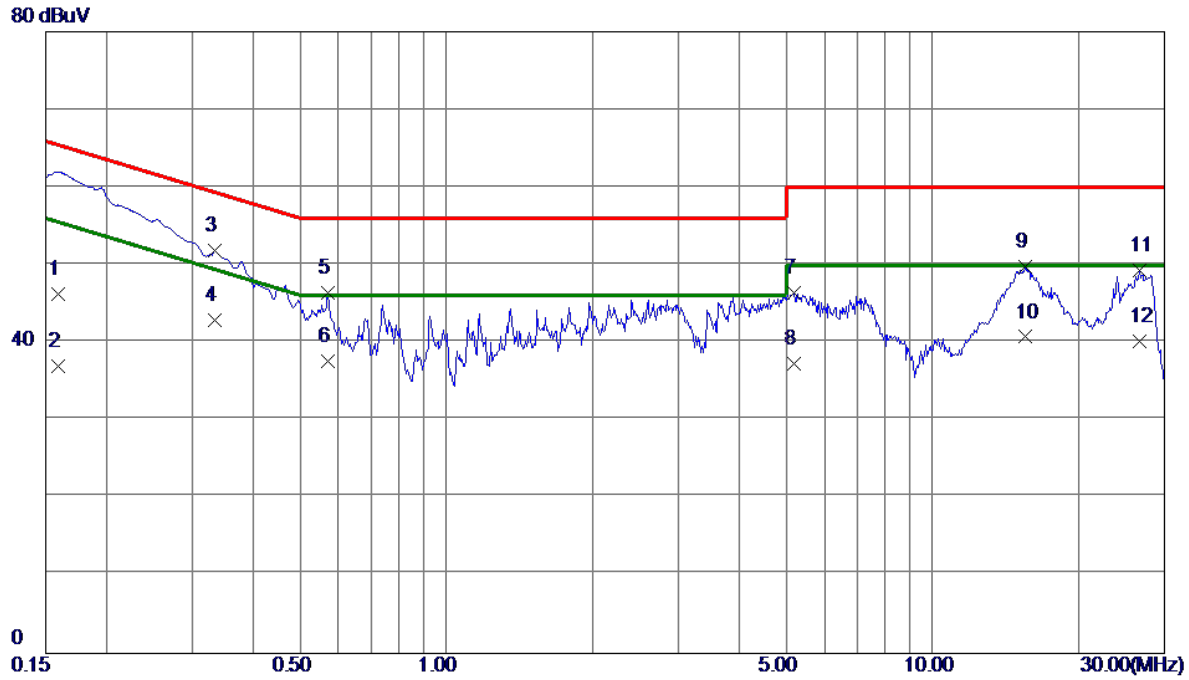
Conducted Test Photos





APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

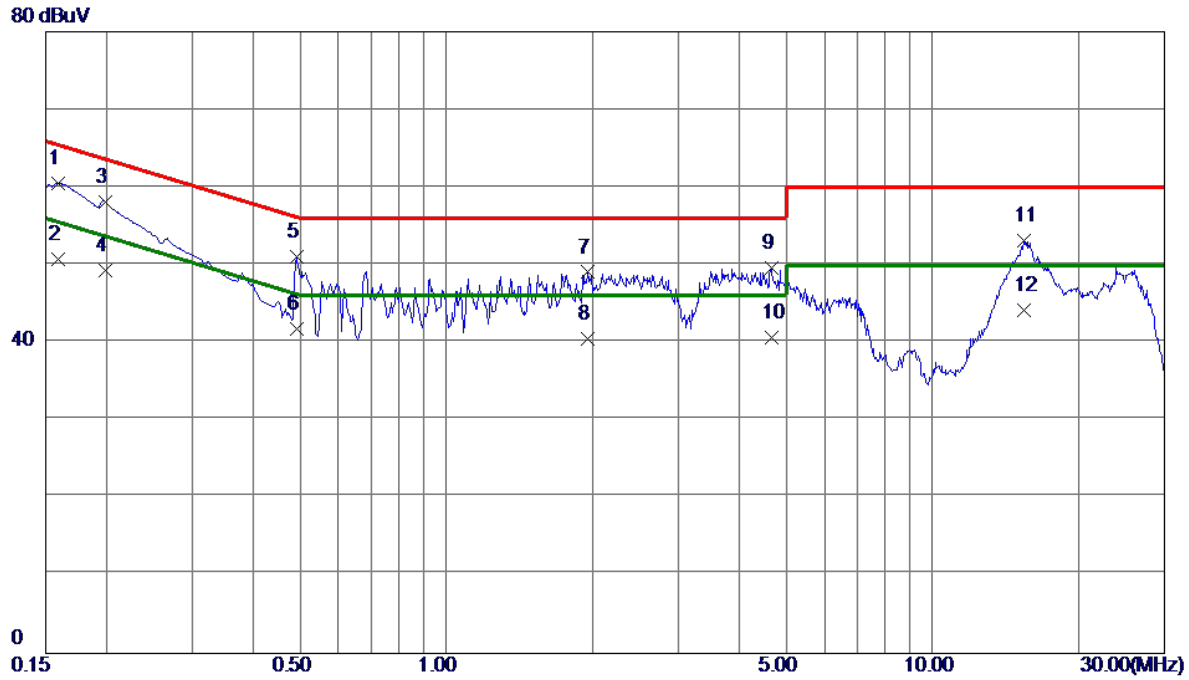
Test Mode	TX Mode_1Mbps Channel 39	Phase	Line



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1590	36.50	9.74	46.24	65.52	-19.28	QP	
2	0.1590	27.20	9.74	36.94	55.52	-18.58	AVG	
3	0.3345	42.02	9.77	51.79	59.34	-7.55	QP	
4 *	0.3345	33.10	9.77	42.87	49.34	-6.47	AVG	
5	0.5707	36.55	9.79	46.34	56.00	-9.66	QP	
6	0.5707	27.80	9.79	37.59	46.00	-8.41	AVG	
7	5.1788	36.39	10.00	46.39	60.00	-13.61	QP	
8	5.1788	27.30	10.00	37.30	50.00	-12.70	AVG	
9	15.4928	39.39	10.32	49.71	60.00	-10.29	QP	
10	15.4928	30.40	10.32	40.72	50.00	-9.28	AVG	
11	26.6910	38.59	10.61	49.20	60.00	-10.80	QP	
12	26.6910	29.60	10.61	40.21	50.00	-9.79	AVG	

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

Test Mode	TX Mode_1Mbps Channel 39	Phase	Neutral

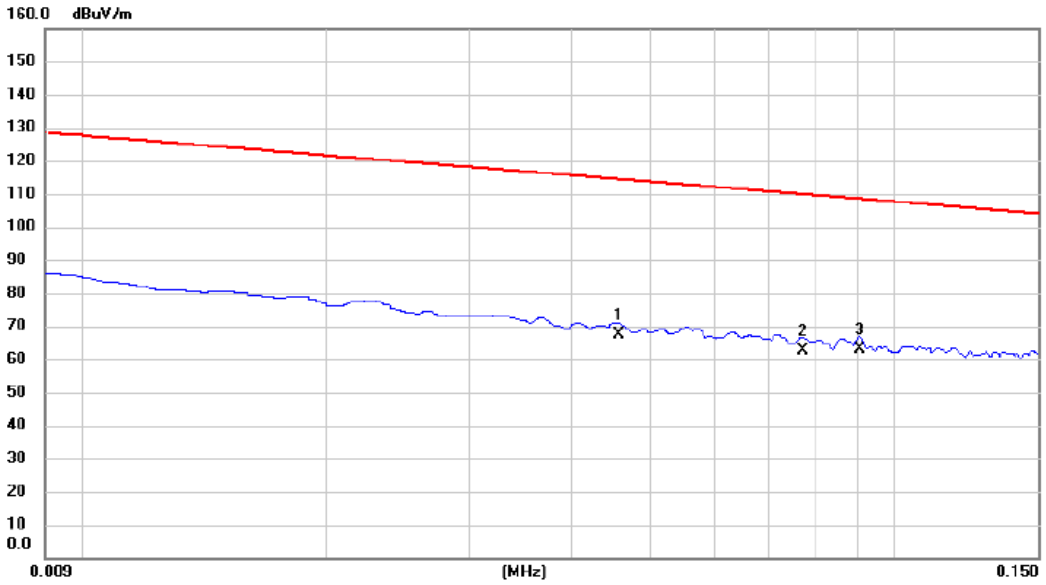


No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	0.1590	50.91	9.59	60.50	65.52	-5.02	QP	
2	0.1590	41.20	9.59	50.79	55.52	-4.73	AVG	
3	0.1995	48.46	9.60	58.06	63.63	-5.57	QP	
4	0.1995	39.60	9.60	49.20	53.63	-4.43	AVG	
5	0.4920	41.39	9.65	51.04	56.13	-5.09	QP	
6 *	0.4920	32.10	9.65	41.75	46.13	-4.38	AVG	
7	1.9568	39.33	9.71	49.04	56.00	-6.96	QP	
8	1.9568	30.70	9.71	40.41	46.00	-5.59	AVG	
9	4.6680	39.72	9.83	49.55	56.00	-6.45	QP	
10	4.6680	30.81	9.83	40.64	46.00	-5.36	AVG	
11	15.4208	42.95	10.19	53.14	60.00	-6.86	QP	
12	15.4208	33.90	10.19	44.09	50.00	-5.91	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

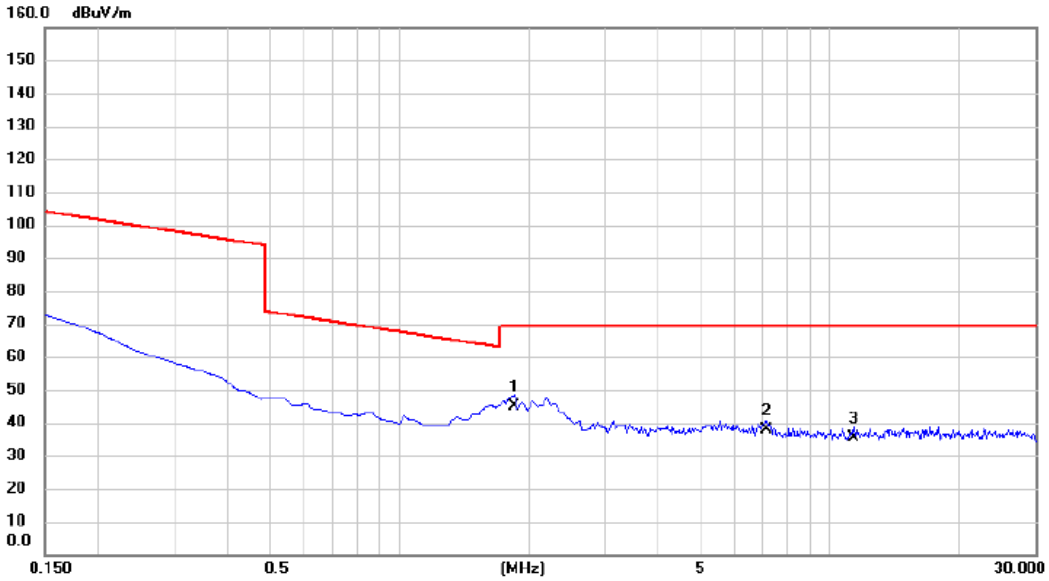
Test Mode	TX Mode_1Mbps Channel 39	Polarization	Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.0458	47.62	19.80	67.42	114.39	-46.97	AVG	
2		0.0770	42.85	19.89	62.74	109.88	-47.14	AVG	
3	*	0.0906	43.21	19.88	63.09	108.46	-45.37	QP	

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

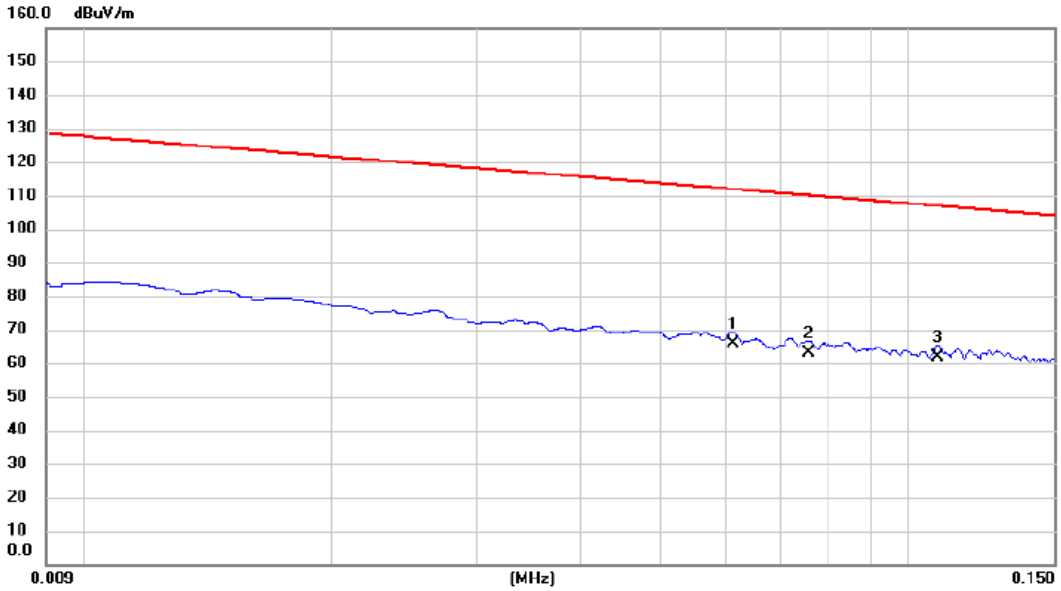
Test Mode	TX Mode_1Mbps Channel 39	Polarization	Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	1.8515	25.31	19.80	45.11	69.54	-24.43	QP	
2		7.1051	17.68	20.03	37.71	69.54	-31.83	QP	
3		11.3288	15.36	20.22	35.58	69.54	-33.96	QP	

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

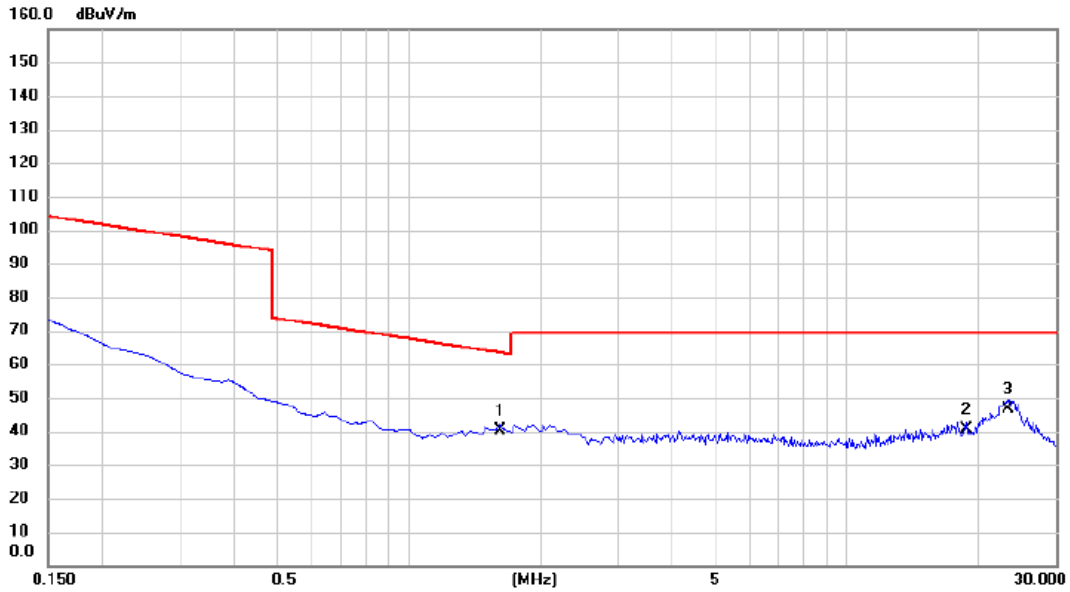
Test Mode	TX Mode_1Mbps Channel 39	Polarization	Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.0612	45.84	19.84	65.68	111.87	-46.19	AVG	
2		0.0756	42.94	19.89	62.83	110.03	-47.20	AVG	
3	*	0.1085	41.85	19.83	61.68	106.90	-45.22	QP	

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

Test Mode	TX Mode_1Mbps Channel 39	Polarization	Ant 90°

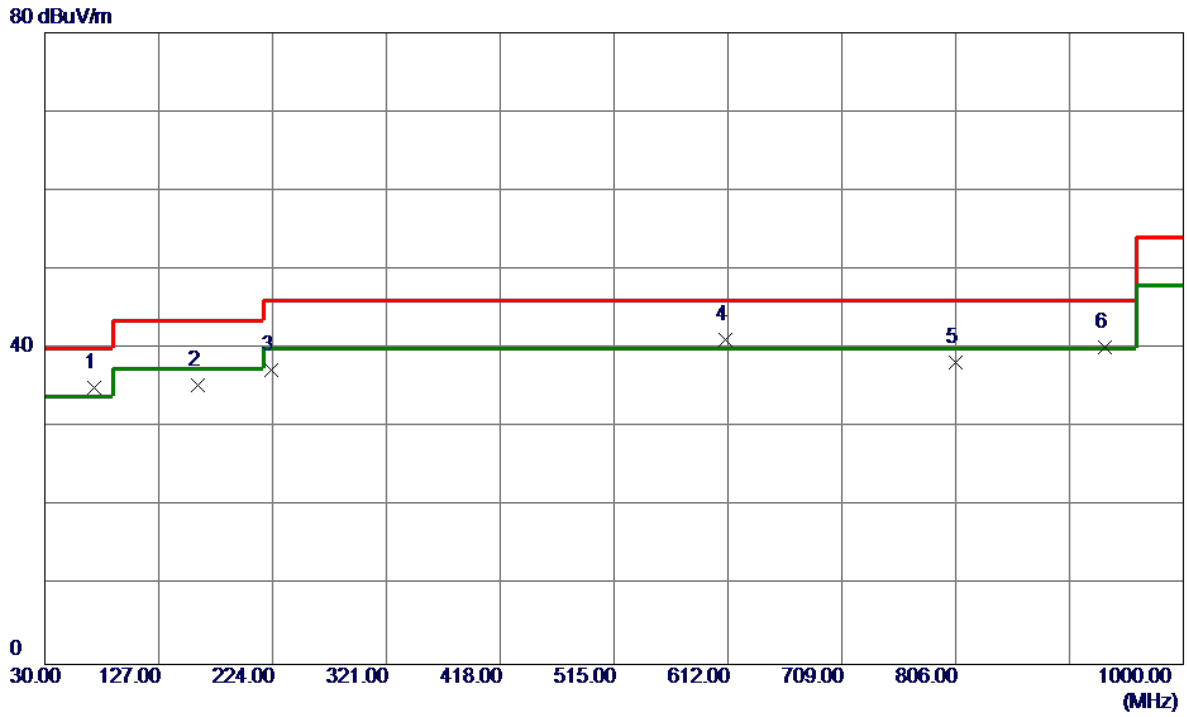


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		1.6126	20.32	19.82	40.14	63.45	-23.31	QP	
2		18.7465	19.89	20.54	40.43	69.54	-29.11	QP	
3	*	23.3584	25.84	20.81	46.65	69.54	-22.89	QP	

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

APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ

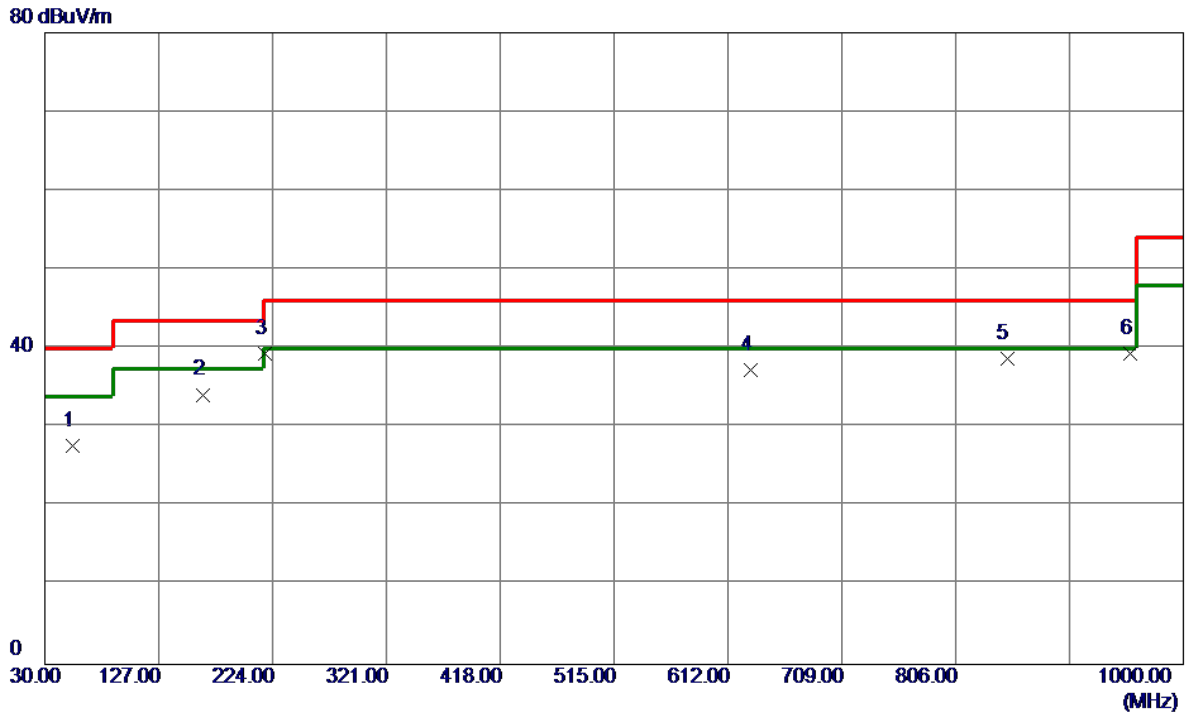
Test Mode	TX Mode_1Mbps Channel 39	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	71.7100	48.91	-13.85	35.06	40.00	-4.94	Peak	
2	159.9800	46.23	-10.88	35.35	43.50	-8.15	Peak	
3	222.5450	51.48	-14.21	37.27	46.00	-8.73	Peak	
4 *	610.0600	44.69	-3.52	41.17	46.00	-4.83	Peak	
5	805.5150	39.57	-1.28	38.29	46.00	-7.71	Peak	
6	933.0700	39.87	0.31	40.18	46.00	-5.82	Peak	

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

Test Mode	TX Mode_1Mbps Channel 39	Polarization	Horizontal

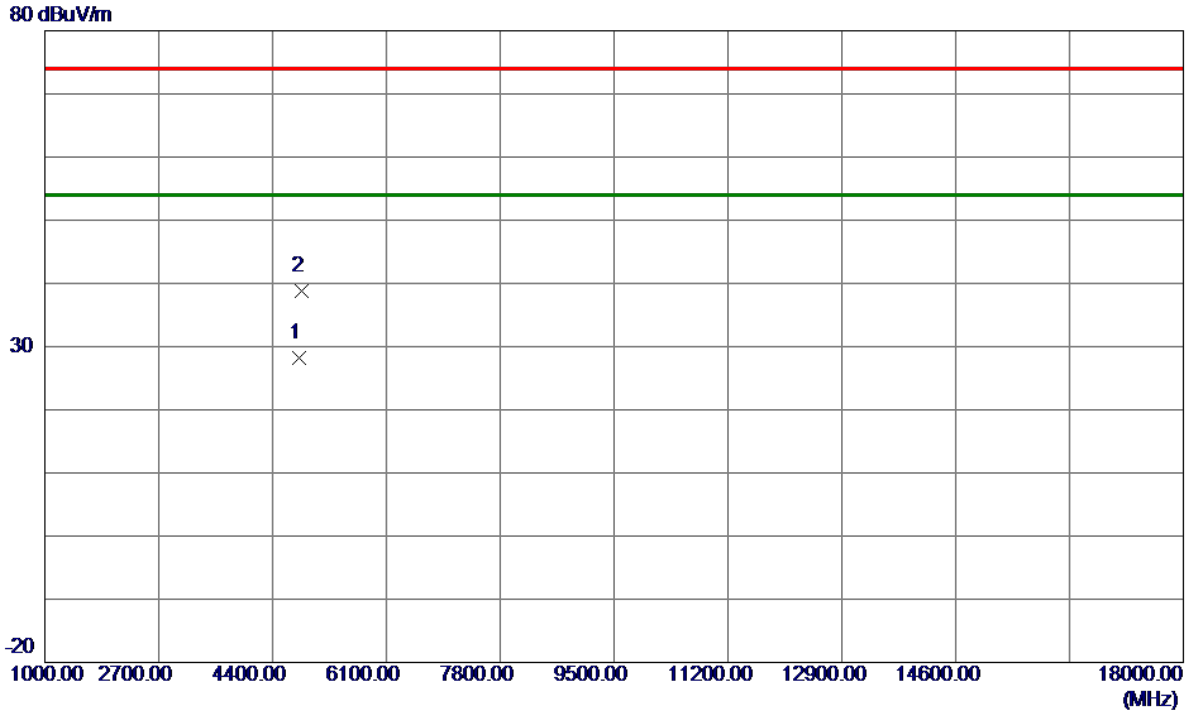


No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	53.2800	39.13	-11.45	27.68	40.00	-12.32	Peak	
2	164.3450	45.22	-11.06	34.16	43.50	-9.34	Peak	
3	217.6950	53.73	-14.41	39.32	46.00	-6.68	Peak	
4	631.4000	40.48	-3.20	37.28	46.00	-8.72	Peak	
5	849.6500	39.22	-0.53	38.69	46.00	-7.31	Peak	
6 *	954.4100	38.91	0.42	39.33	46.00	-6.67	Peak	

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

APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

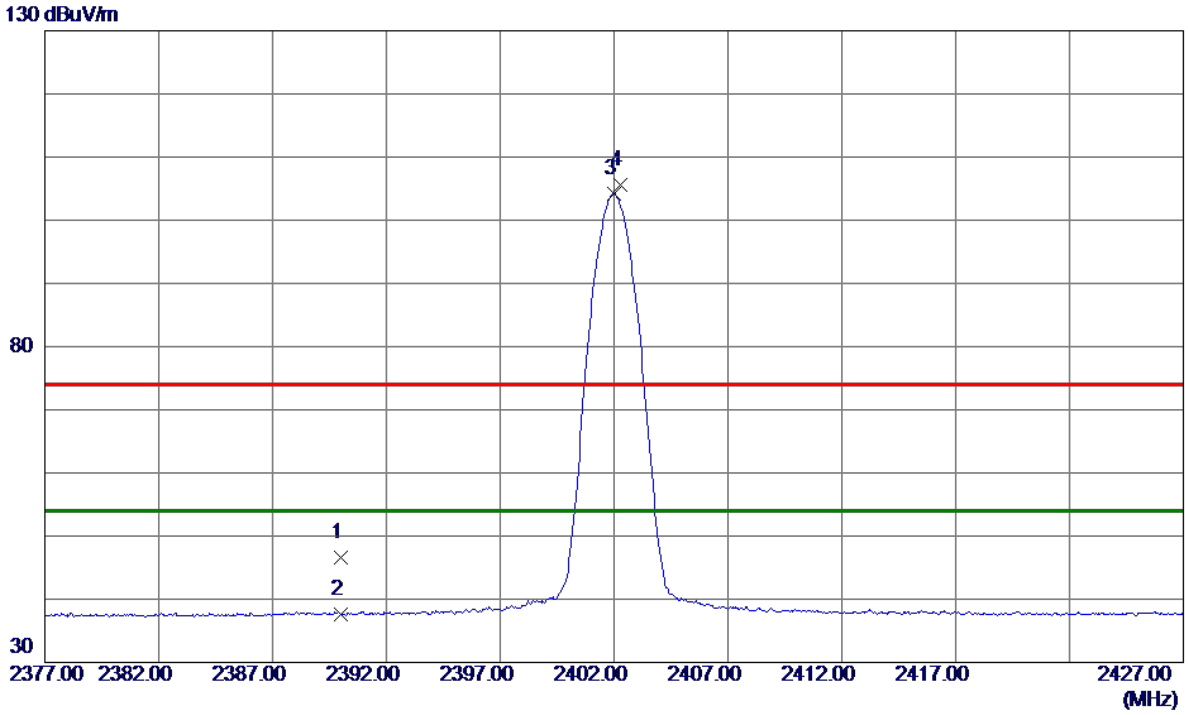
Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	4800.0000	27.60	0.65	28.25	54.00	-25.75	AVG	
2	4825.9250	38.04	0.72	38.76	74.00	-35.24	Peak	

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

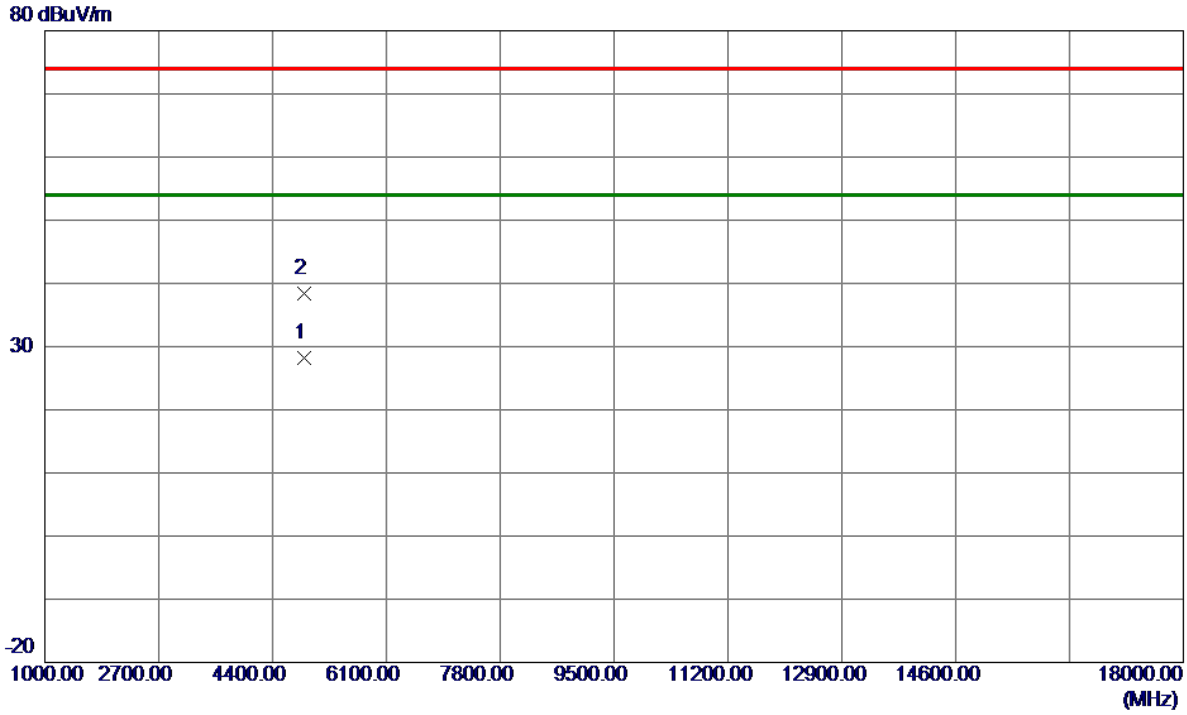
Test Mode	TX 2402 MHz _CH00_1Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2390.0000	40.62	6.00	46.62	74.00	-27.38	Peak	
2	2390.0000	31.68	6.00	37.68	54.00	-16.32	AVG	
3 *	2402.0000	98.18	6.00	104.18	54.00	50.18	AVG	No Limit
4	2402.2750	99.55	6.00	105.55	74.00	31.55	Peak	No Limit

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

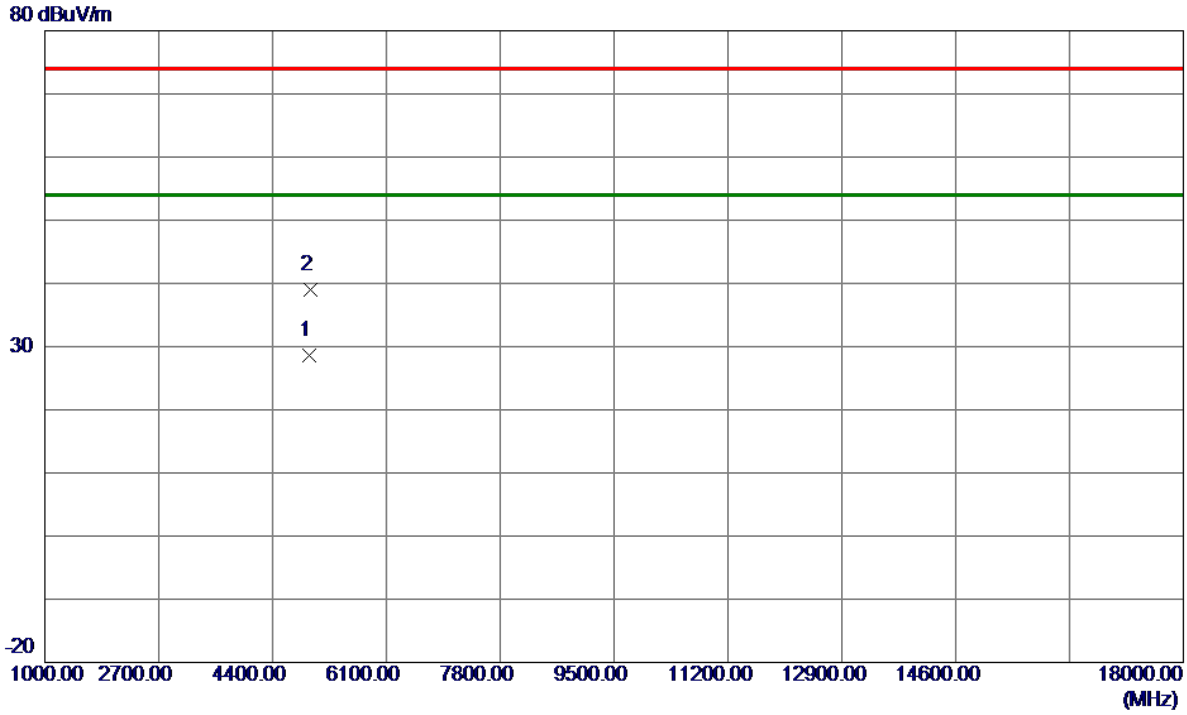
Test Mode	TX 2440 MHz _CH19_1Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	4868.7000	27.36	0.85	28.21	54.00	-25.79	AVG	
2	4870.9000	37.48	0.85	38.33	74.00	-35.67	Peak	

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

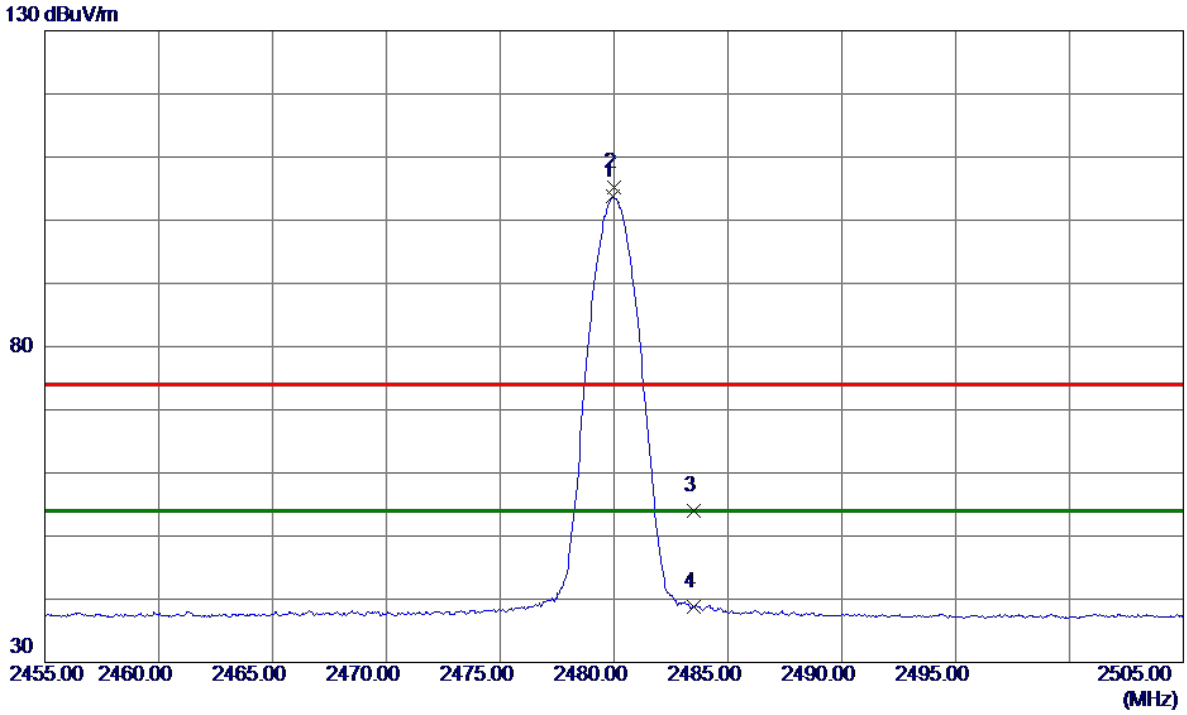
Test Mode	TX 2480 MHz _CH39_1Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	4942.8250	27.62	1.06	28.68	54.00	-25.32	AVG	
2	4963.2250	37.87	1.12	38.99	74.00	-35.01	Peak	

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

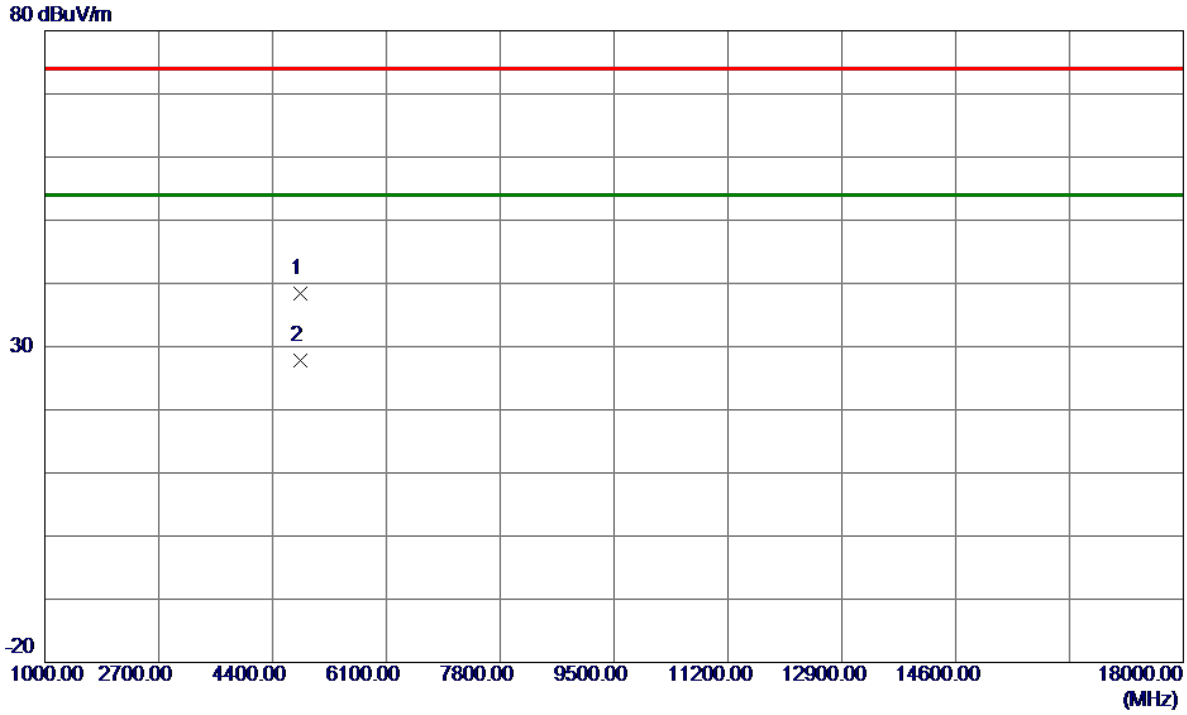
Test Mode	TX 2480 MHz _CH39_1Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	2479.9500	97.80	6.00	103.80	54.00	49.80	AVG	No Limit
2	2480.0250	99.13	6.00	105.13	74.00	31.13	Peak	No Limit
3	2483.5000	47.91	6.00	53.91	74.00	-20.09	Peak	
4	2483.5000	32.86	6.00	38.86	54.00	-15.14	AVG	

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

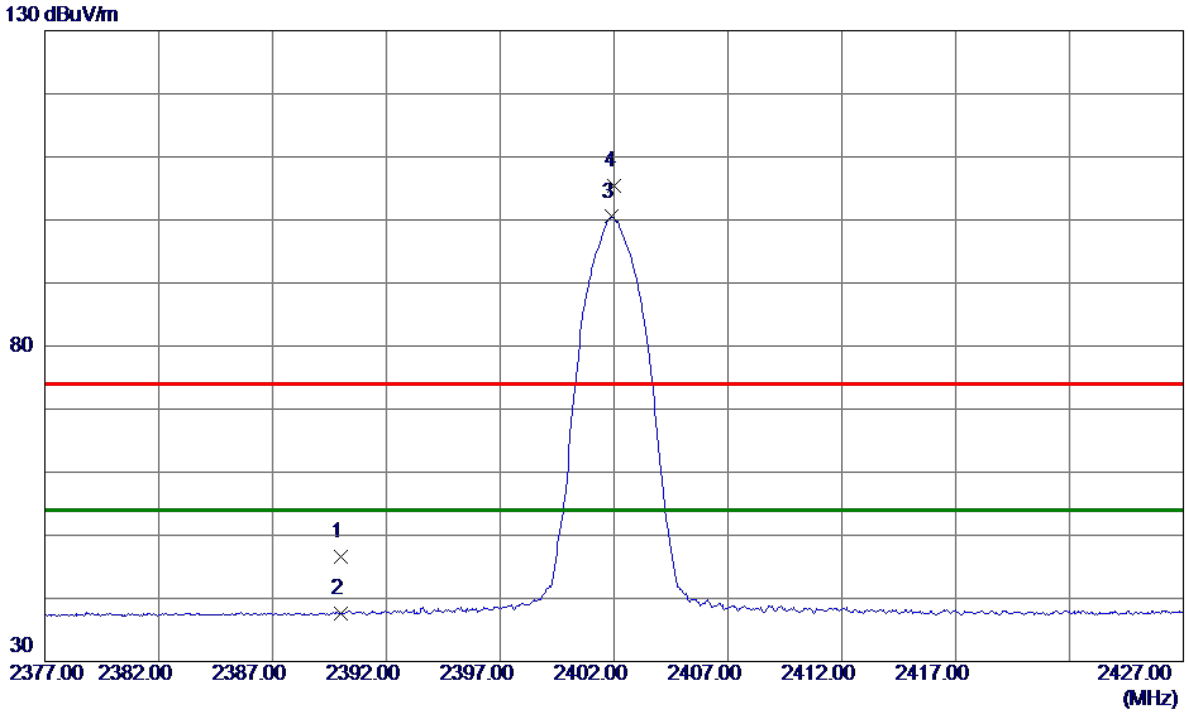
Test Mode	TX 2402 MHz _CH00_2Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	4816.6750	37.78	0.70	38.48	74.00	-35.52	Peak	
2 *	4824.9750	26.99	0.72	27.71	54.00	-26.29	AVG	

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

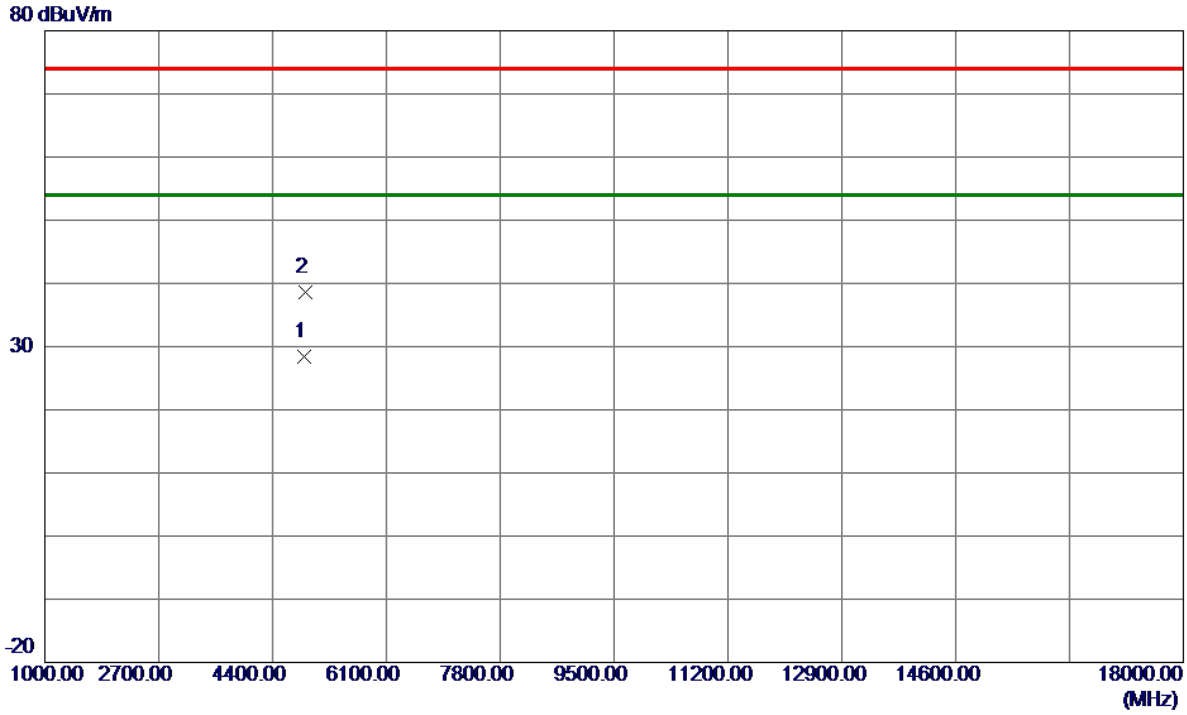
Test Mode	TX 2402 MHz _CH00_2Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	2390.0000	40.56	6.00	46.56	74.00	-27.44	Peak	
2	2390.0000	31.55	6.00	37.55	54.00	-16.45	AVG	
3 *	2401.9000	94.50	6.00	100.50	54.00	46.50	AVG	No Limit
4	2402.0250	99.43	6.00	105.43	74.00	31.43	Peak	No Limit

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

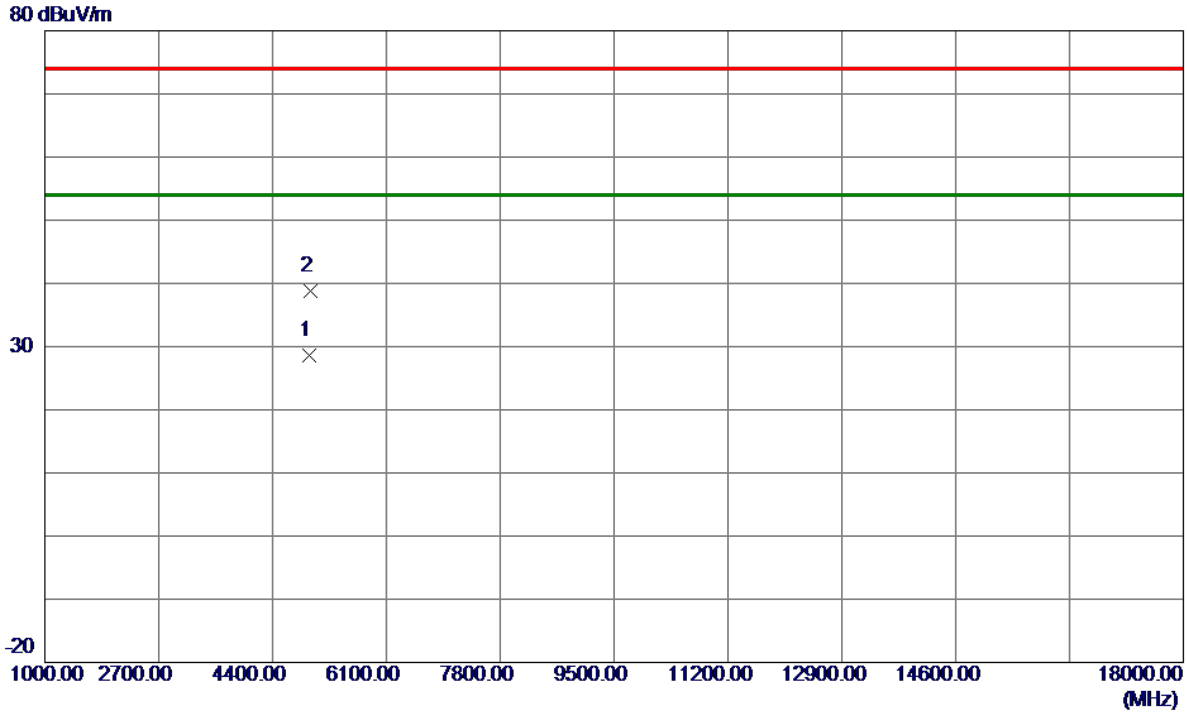
Test Mode	TX 2440 MHz _CH19_2Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	4864.9250	27.51	0.83	28.34	54.00	-25.66	AVG	
2	4886.7500	37.66	0.90	38.56	74.00	-35.44	Peak	

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

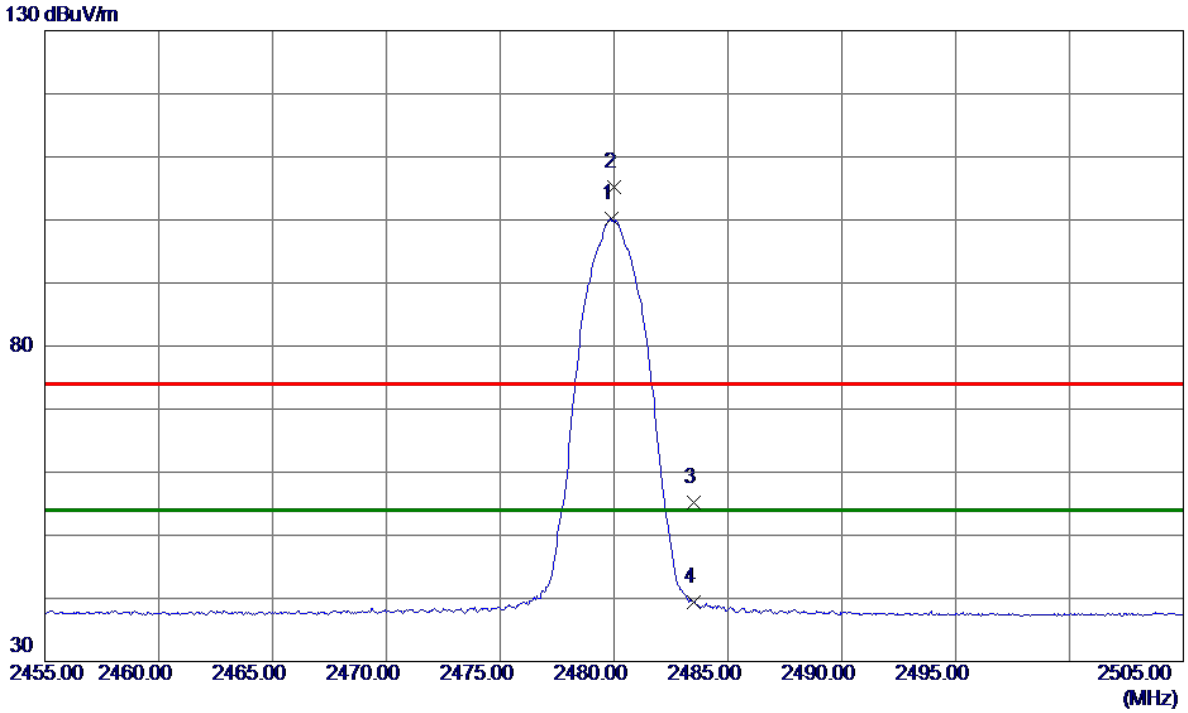
Test Mode	TX 2480 MHz _CH39_2Mbps	Polarization	Vertical



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	4943.6250	27.61	1.06	28.67	54.00	-25.33	AVG	
2	4958.9250	37.69	1.10	38.79	74.00	-35.21	Peak	

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

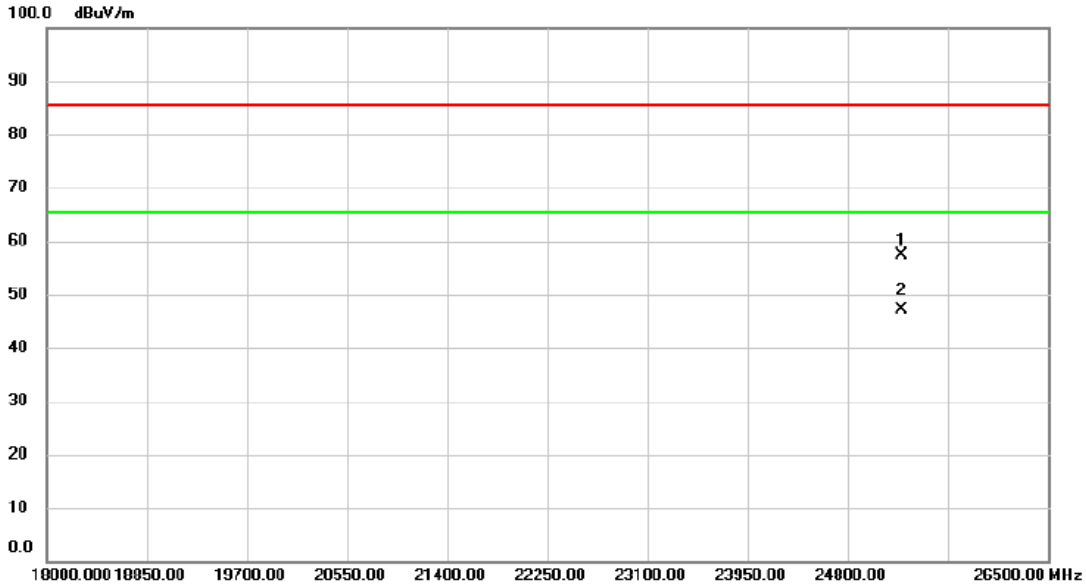
Test Mode	TX 2480 MHz _CH39_2Mbps	Polarization	Horizontal



No.	Freq.	Reading Level	Correct Factor	Measure ment	Limit	Margin		
	MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1 *	2479.8750	94.26	6.00	100.26	54.00	46.26	AVG	No Limit
2	2480.0250	99.16	6.00	105.16	74.00	31.16	Peak	No Limit
3	2483.5000	49.19	6.00	55.19	74.00	-18.81	Peak	
4	2483.5000	33.43	6.00	39.43	54.00	-14.57	AVG	

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

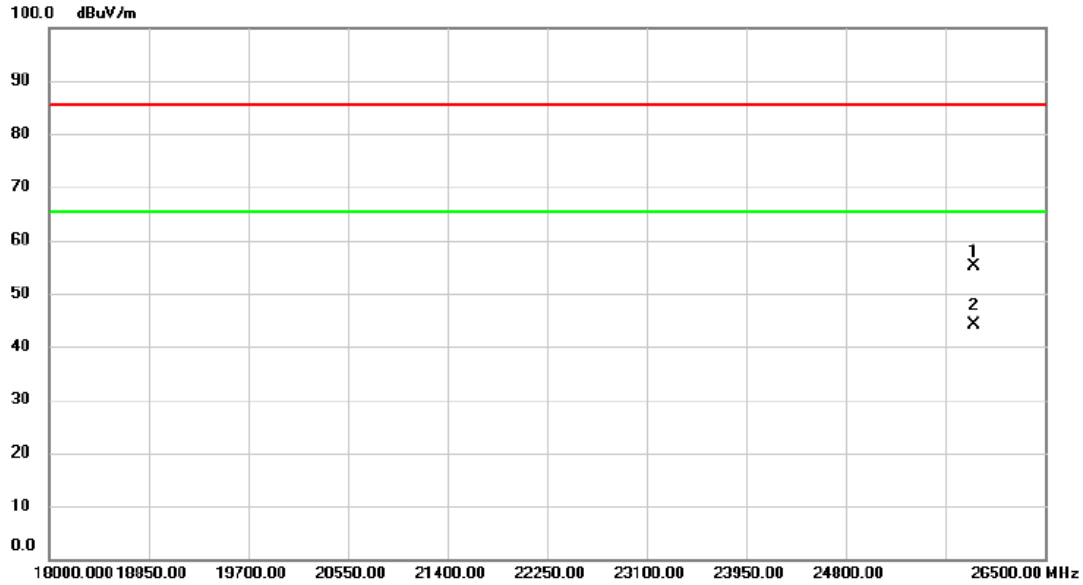
Test Mode	TX 2480 MHz _CH39_1Mbps	Polarization	Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		25259.00	48.20	9.23	57.43	85.30	-27.87	peak	
2	*	25259.00	37.84	9.23	47.07	65.30	-18.23	AVG	

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

Test Mode	TX 2480 MHz _CH39_1Mbps	Polarization	Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		25888.00	44.71	10.30	55.01	85.30	-30.29	peak	
2	*	25888.00	33.87	10.30	44.17	65.30	-21.13	AVG	

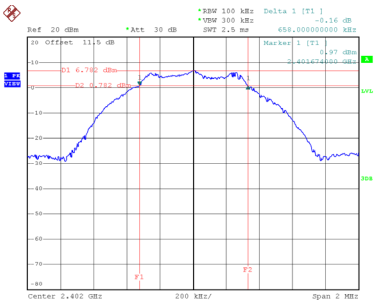
REMARKS:
(1) Measurement Value = Reading Level + Correct Factor.
(2) Margin Level = Measurement Value - Limit Value.

APPENDIX E - BANDWIDTH

Test Mode	TX Mode _1Mbps

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	6 dB Bandwidth Min. Limit (MHz)	Test Result
00	2402	0.658	1.032	0.5	Pass
19	2440	0.656	1.028	0.5	Pass
39	2480	0.660	1.036	0.5	Pass

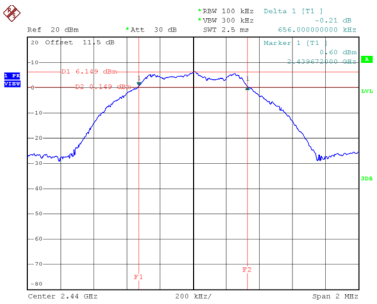
CH00



Date: 5.MAR.2024 19:21:13

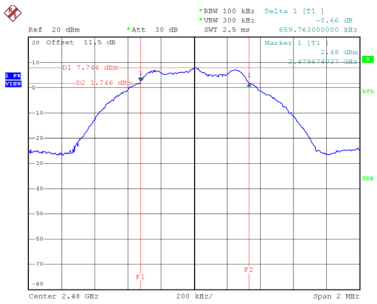
CH19

6 dB Bandwidth

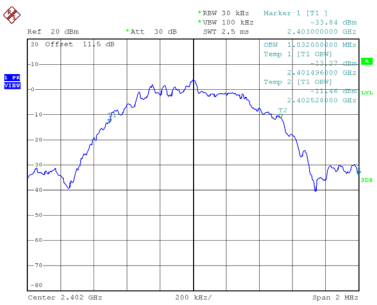


Date: 5.MAR.2024 19:23:21

CH39

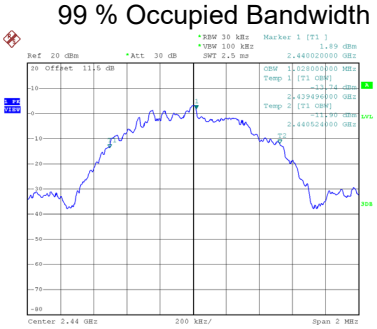


Date: 5.MAR.2024 19:19:05

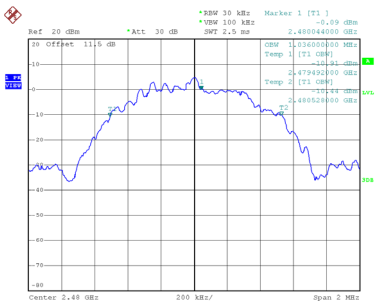


Date: 5.MAR.2024 19:20:26

99 % Occupied Bandwidth



Date: 5.MAR.2024 19:23:27

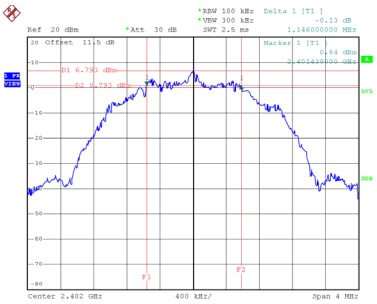


Date: 5.MAR.2024 19:19:12

Test Mode	TX Mode _2Mbps

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	6 dB Bandwidth Min. Limit (MHz)	Test Result
00	2402	1.146	2.048	0.5	Pass
19	2440	1.116	2.040	0.5	Pass
39	2480	1.116	2.040	0.5	Pass

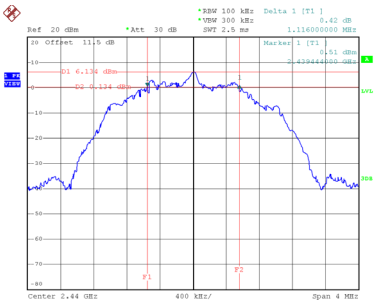
CH00



Date: 5.MAR.2024 19:26:15

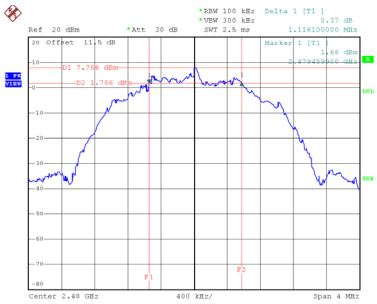
CH19

6 dB Bandwidth



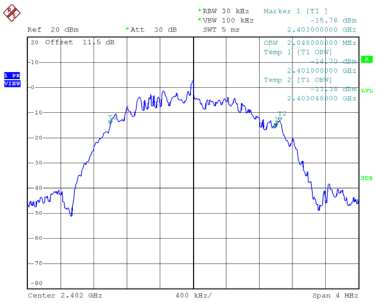
Date: 5.MAR.2024 19:29:13

CH39

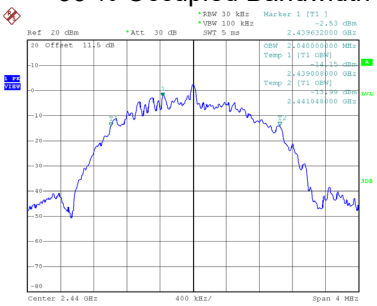


Date: 5.MAR.2024 19:31:26

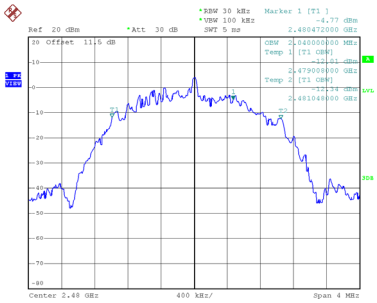
99 % Occupied Bandwidth



Date: 5.MAR.2024 19:25:24



Date: 5.MAR.2024 19:29:20



Date: 5.MAR.2024 19:31:33

APPENDIX F - MAXIMUM OUTPUT POWER

Test Mode	TX Mode _1Mbps

Frequency (MHz)	Output Power (dBm)	Duty Factor	Output Power + Duty Factor (dBm)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	4.60	0.69	5.29	30.00	1.0000	Pass
2440	4.02	0.69	4.71	30.00	1.0000	Pass
2480	5.80	0.69	6.49	30.00	1.0000	Pass

Test Mode	TX Mode _2Mbps

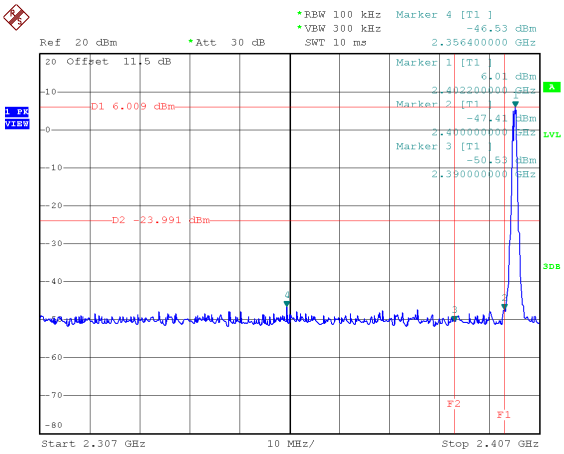
Frequency (MHz)	Output Power (dBm)	Duty Factor	Output Power + Duty Factor (dBm)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2402	1.14	2.41	3.55	30.00	1.0000	Pass
2440	1.11	2.41	3.52	30.00	1.0000	Pass
2480	2.91	2.41	5.32	30.00	1.0000	Pass

Note: Output power = Measure result + Cable loss

APPENDIX G - CONDUCTED SPURIOUS EMISSION

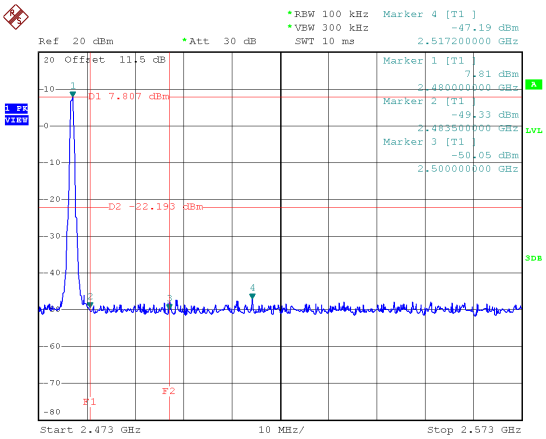
Test Mode	TX Mode _1Mbps

Bandedge CH00 (Lower)



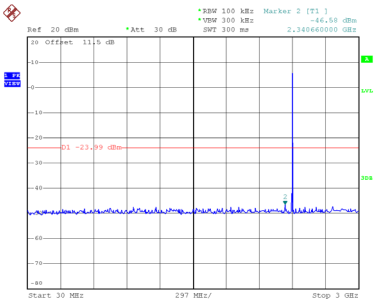
Date: 14.MAR.2024 00:49:48

Bandedge CH39 (Upper)

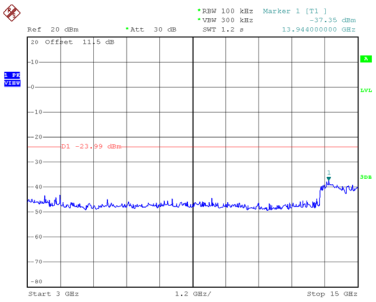


Date: 26.MAR.2024 13:53:19

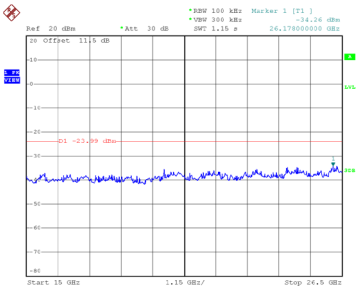
CH00 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 00:56:48

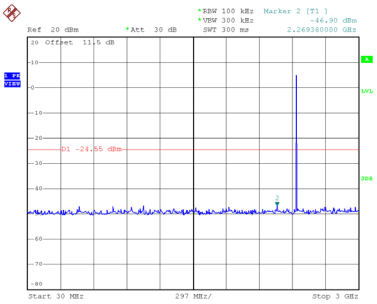


Date: 14.MAR.2024 00:50:12

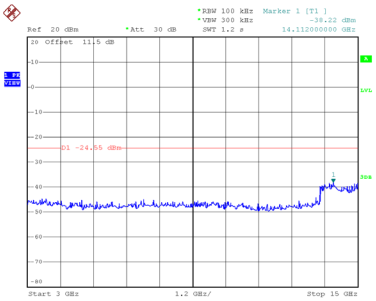


Date: 14.MAR.2024 00:50:20

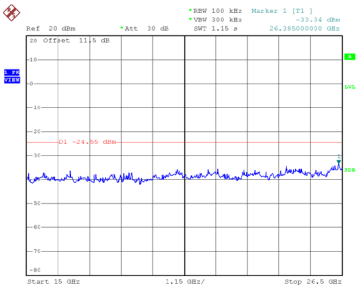
CH19 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 00:57:38

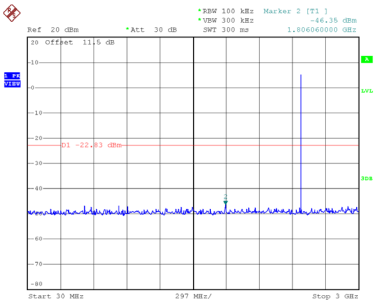


Date: 14.MAR.2024 00:51:15

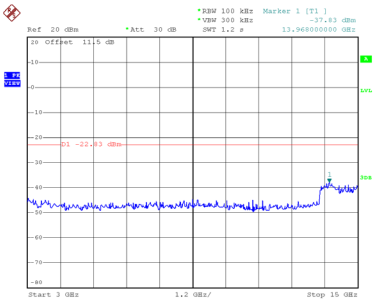


Date: 14.MAR.2024 00:51:24

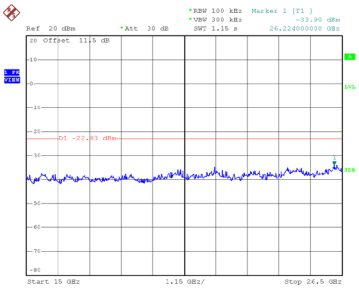
CH39 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 00:58:18



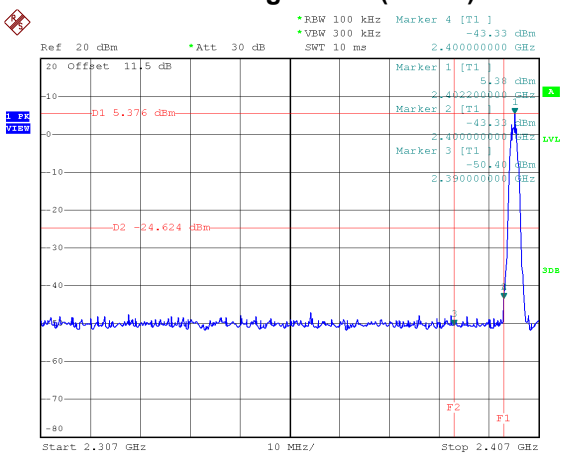
Date: 14.MAR.2024 00:52:05



Date: 14.MAR.2024 00:52:14

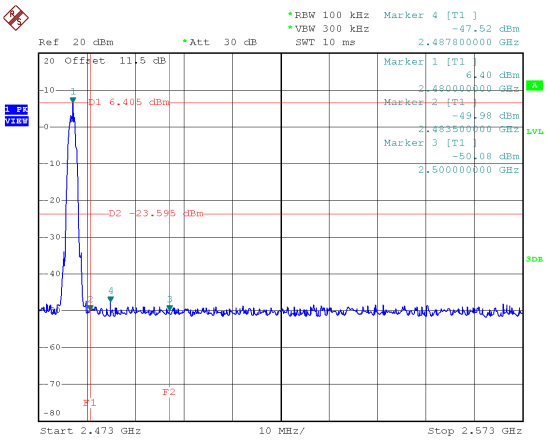
Test Mode	TX Mode _2Mbps

Bandedge CH00 (Lower)



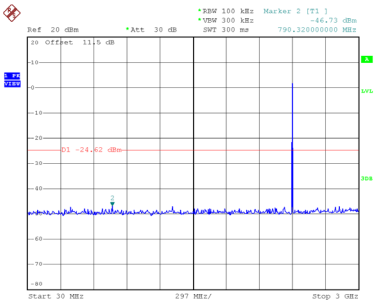
Date: 14.MAR.2024 00:52:41

Bandedge CH39 (Upper)

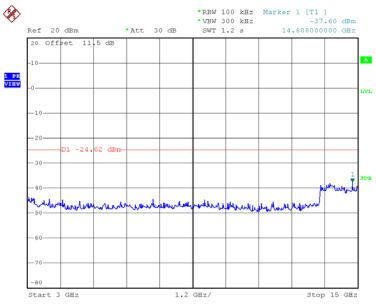


Date: 14.MAR.2024 00:54:21

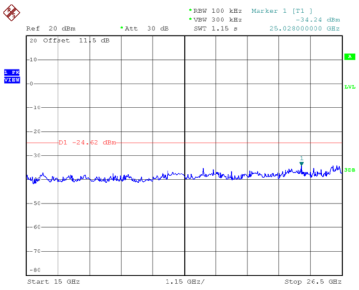
CH00 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 00:58:58

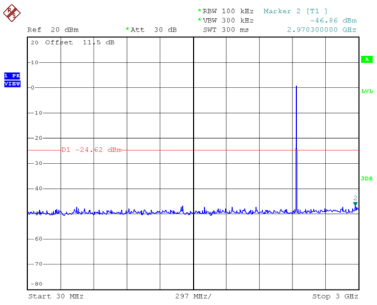


Date: 14.MAR.2024 00:53:04

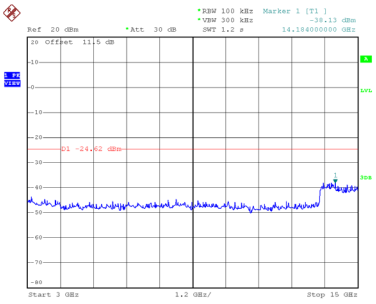


Date: 14.MAR.2024 00:53:13

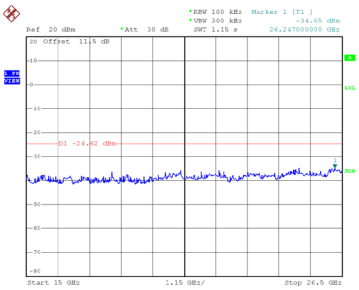
CH19 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 00:59:37

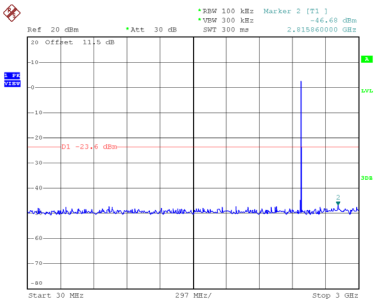


Date: 14.MAR.2024 00:53:52

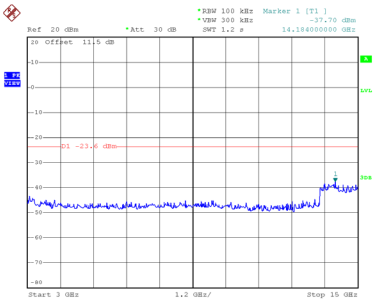


Date: 14.MAR.2024 00:54:01

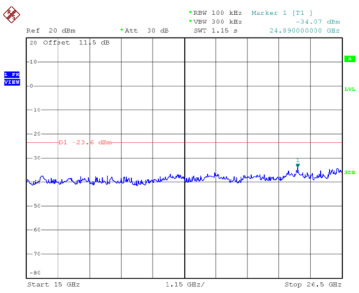
CH39 – 10th Harmonic of the fundamental frequency



Date: 14.MAR.2024 01:00:15



Date: 14.MAR.2024 00:54:45



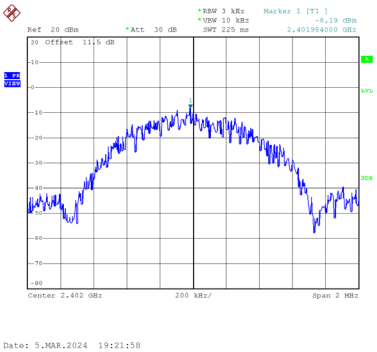
Date: 14.MAR.2024 00:54:53

APPENDIX H - POWER SPECTRAL DENSITY

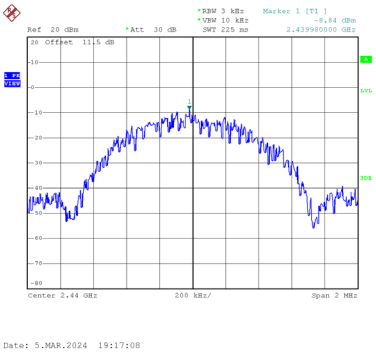
Test Mode	TX Mode _1Mbps

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Max. Limit (dBm/3 kHz)	Test Result
00	2402	-8.19	8.00	Pass
19	2440	-8.84	8.00	Pass
39	2480	-7.16	8.00	Pass

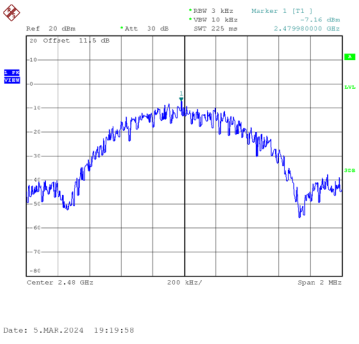
CH00



CH19



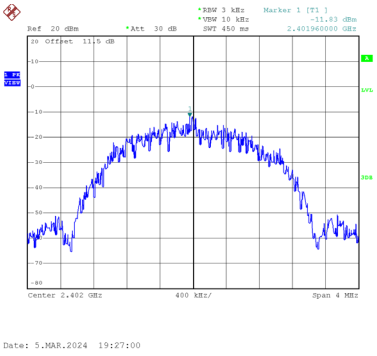
CH39



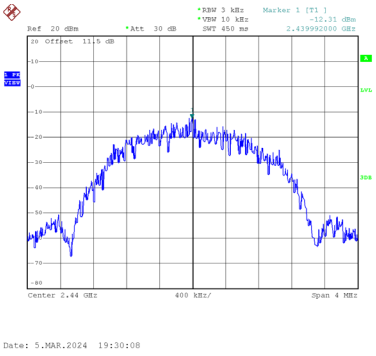
Test Mode	TX Mode _2Mbps

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Max. Limit (dBm/3 kHz)	Test Result
00	2402	-11.83	8.00	Pass
19	2440	-12.31	8.00	Pass
39	2480	-10.73	8.00	Pass

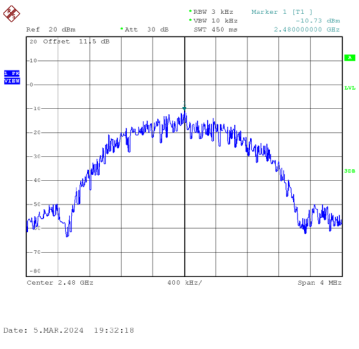
CH00



CH19



CH39



End of Test Report