



FCC Radio Test Report

FCC ID: WKM-FK413

This report concerns: Original Grant

Project No. : 2412C062
Equipment : Keyboard
Brand Name : matias
Test Model : FK413PCD
Series Model : FK413D
Applicant : Matias Corporation
Address : 221 Narinia Crescent, Newmarket, Ontario, L3X 2E1, Canada
Manufacturer : Matias Corporation
Address : 221 Narinia Crescent, Newmarket, Ontario, L3X 2E1, Canada
Factory : Lita Electronics Technology Co., Ltd
Address : No.6, Kun Ming Road, Yao Le Village, Liaobu Town, Dongguan City, Guangdong Province, China. Post Code: 523418
Date of Receipt : Dec. 05, 2024
Date of Test : Dec. 06, 2024 ~ Jan. 06, 2025
Issued Date : Jan. 14, 2025
Report Version : R00
Test Sample : Engineering Sample No.: SSL2024120599
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 : Chella Zheng
 Chella Zheng

Approved by : Chay Cai
 Chay Cai

Room 108-116, 309-310, Building 2, No.1, Yile Road, Songshan Lake Zone, Dongguan City, Guangdong, People's Republic of China

Tel: +86-769-8318-3000 Web: www.newbtl.com Service mail: btl_qa@newbtl.com

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 A2LA or any agency of the U.S. Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and ourselves, the test report shall not be reproduced, except in full, without our written approval.

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.

Table of Contents	Page
REPORT ISSUED HISTORY	6
1 . APPLICABLE STANDARDS	7
2 . SUMMARY OF TEST RESULTS	7
2.1 TEST FACILITY	8
2.2 MEASUREMENT UNCERTAINTY	8
2.3 TEST ENVIRONMENT CONDITIONS	9
3 . GENERAL INFORMATION	10
3.1 GENERAL DESCRIPTION OF EUT	10
3.2 DESCRIPTION OF TEST MODES	11
3.3 PARAMETERS OF TEST SOFTWARE	11
3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	12
3.5 SUPPORT UNITS	12
3.6 CUSTOMER INFORMATION DESCRIPTION	12
4 . AC POWER LINE CONDUCTED EMISSIONS	13
4.1 LIMIT	13
4.2 TEST PROCEDURE	13
4.3 DEVIATION FROM TEST STANDARD	13
4.4 TEST SETUP	14
4.5 EUT OPERATING CONDITIONS	14
4.6 TEST RESULTS	14
5 . RADIATED EMISSIONS	15
5.1 LIMIT	15
5.2 TEST PROCEDURE	16
5.3 DEVIATION FROM TEST STANDARD	17
5.4 TEST SETUP	17
5.5 EUT OPERATING CONDITIONS	19
5.6 TEST RESULT - 9 KHZ TO 30 MHZ	19
5.7 TEST RESULT - 30 MHZ TO 1000 MHZ	19
5.8 TEST RESULT - ABOVE 1000 MHZ	19
6 . BANDWIDTH	20
6.1 LIMIT	20
6.2 TEST PROCEDURE	20

Table of Contents	Page
6.3 DEVIATION FROM STANDARD	20
6.4 TEST SETUP	20
6.5 EUT OPERATION CONDITIONS	20
6.6 TEST RESULTS	20
7 . MAXIMUM OUTPUT POWER	21
7.1 LIMIT	21
7.2 TEST PROCEDURE	21
7.3 DEVIATION FROM STANDARD	21
7.4 TEST SETUP	21
7.5 EUT OPERATION CONDITIONS	21
7.6 TEST RESULTS	21
8 . CONDUCTED SPURIOUS EMISSION	22
8.1 LIMIT	22
8.2 TEST PROCEDURE	22
8.3 DEVIATION FROM STANDARD	22
8.4 TEST SETUP	22
8.5 EUT OPERATION CONDITIONS	22
8.6 TEST RESULTS	22
9 . POWER SPECTRAL DENSITY	23
9.1 LIMIT	23
9.2 TEST PROCEDURE	23
9.3 DEVIATION FROM STANDARD	23
9.4 TEST SETUP	23
9.5 EUT OPERATION CONDITIONS	23
9.6 TEST RESULTS	23
10 . MEASUREMENT INSTRUMENTS LIST	24
11 . EUT TEST PHOTO	26
APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS	32
APPENDIX B - RADIATED EMISSION - 9 KHZ TO 30 MHZ	35
APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ	40
APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ	43
APPENDIX E - BANDWIDTH	51

Table of Contents	Page
APPENDIX F - MAXIMUM OUTPUT POWER	53
APPENDIX G - CONDUCTED SPURIOUS EMISSION	55
APPENDIX H - POWER SPECTRAL DENSITY	57

REPORT ISSUED HISTORY

Report No.	Version	Description	Issued Date	Note
BTL-FCCP-1-2412C062	R00	Original Report.	Jan. 14, 2025	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 A2LA:

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 1-2/F, 4/F, Building A, 1-2/F, Building B, 3/F, Building C, No.3, Jinshagang 1st Road, Dalang Town, Dongguan City, Guangdong People's Republic of China.

BTL's Registration Number for FCC: 747969

BTL's Designation Number for FCC: CN1377

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	25°C	49%	DC 3.7V	Hayden Chen	Dec. 30, 2024
Radiated Emissions-9 kHz to 30 MHz	26°C	47%	DC 3.7V	Hayden Chen	Dec. 27, 2024
Radiated Emissions-30 MHz to 1000 MHz	20°C	40%	DC 3.7V	Calvin Wen	Dec. 31, 2024
Radiated Emissions-Above 1000 MHz	20°C	40%	DC 3.7V	Calvin Wen	Dec. 31, 2024-Jan. 01, 2025
Bandwidth	24°C	48%	DC 3.7V	Arvin Tong	Dec. 14, 2024
Maximum Output Power	24°C	48%	DC 3.7V	Arvin Tong	Dec. 14, 2024
Conducted Spurious Emission	24°C	48%	DC 3.7V	Arvin Tong	Dec. 14, 2024
Power Spectral Density	24°C	48%	DC 3.7V	Arvin Tong	Dec. 14, 2024

3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	Keyboard
Brand Name	matias
Test Model	FK413PCD
Series Model	FK413D
Model Difference(s)	Only the model name, color, printing are different.
Software Version	V1.31
Hardware Version	AKB-4527-FK413
Power Source	1# DC voltage supplied from external power supply. 2# Supplied from Lithium-ion battery
Power Rating	1# DC 5V 2# DC 3.7V 1600mAh
Operation Frequency	2408 MHz ~ 2474 MHz
Modulation Type	FSK
Bit Rate of Transmitter	2Mbps
Max. Output Power	2Mbps: -3.75 dBm (0.0004 W)

Note:

- 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	2408	17	2442
01	2410	18	2444
02	2412	19	2446
03	2414	20	2448
04	2416	21	2450
05	2418	22	2452
06	2420	23	2454
07	2422	24	2456
08	2424	25	2458
09	2426	26	2460
10	2428	27	2462
11	2430	28	2464
12	2432	29	2466
13	2434	30	2468
14	2436	31	2470
15	2438	32	2472
16	2440	33	2474

3. Table for Filed Antenna:

Ant.	Manufacturer	Model Name	Antenna Type	Connector	Gain (dBi)
1	MOSART SEMICONDUCTOR CORP.	PCBANT005	PCB	N/A	4.5

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_2Mbps Channel 00/16/33
Mode 2	TX Mode_2Mbps Channel 16

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 2	TX Mode_2Mbps Channel 16

Radiated emissions test - Below 1GHz	
Final Test Mode	Description
Mode 2	TX Mode_2Mbps Channel 16

Radiated emissions test - Above 1GHz	
Final Test Mode	Description
Mode 2	TX Mode_2Mbps Channel 16

Conducted test	
Final Test Mode	Description
Mode 1	TX Mode_2Mbps Channel 00/16/33

Note:

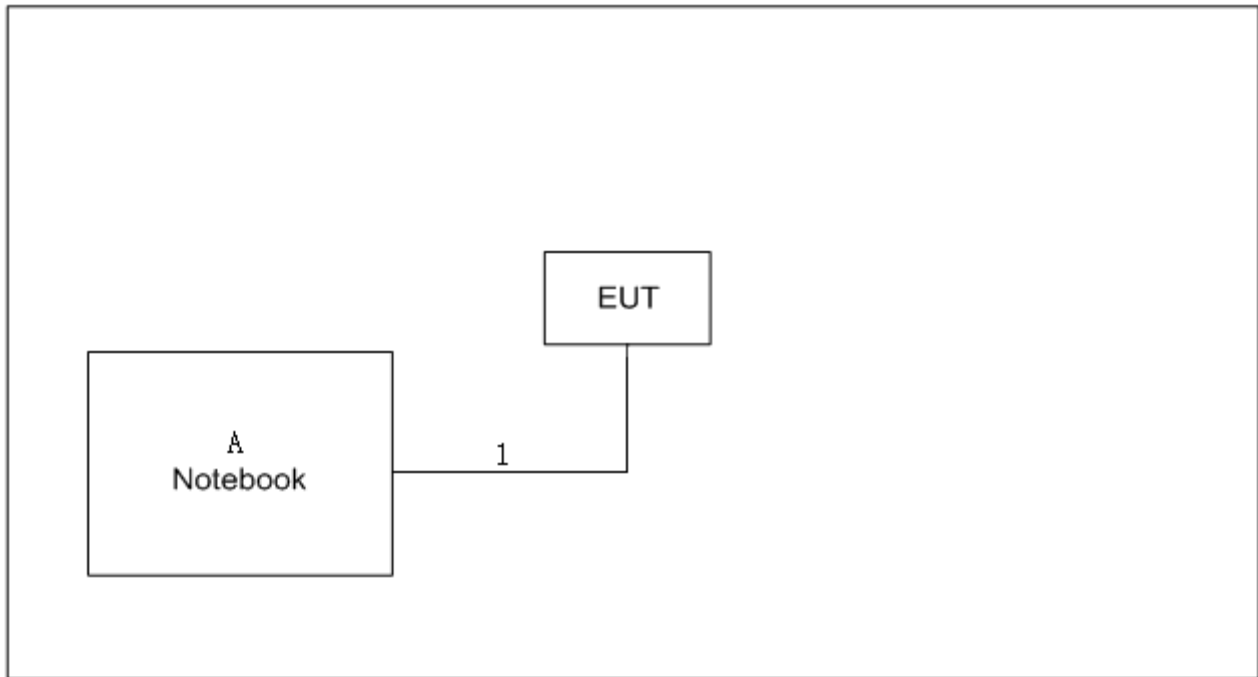
- (1) For radiated emission above 1 GHz test, the spurious points of 1GHz~26.5GHz have been pre-tested and in this report only recorded the worst case. The remaining spurious points are all below the limit value of 20dB.
- (2) For AC power line conducted emissions and radiated emissions below 1 GHz test, the 2Mbps Channel 16 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 and recorded.

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	N/A		
Frequency (MHz)	2408	2440	2474
2Mbps	Default	Default	Default

3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.5 SUPPORT UNITS

Item	Equipment	Brand	Model No.	Series No.
A	Notebook	HUAWEI	WFH9	N/A

Item	Cable Type	Shielded Type	Ferrite Core	Length
1	USB Cable	NO	NO	0.8m

3.6 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 (dB μ 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.

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.

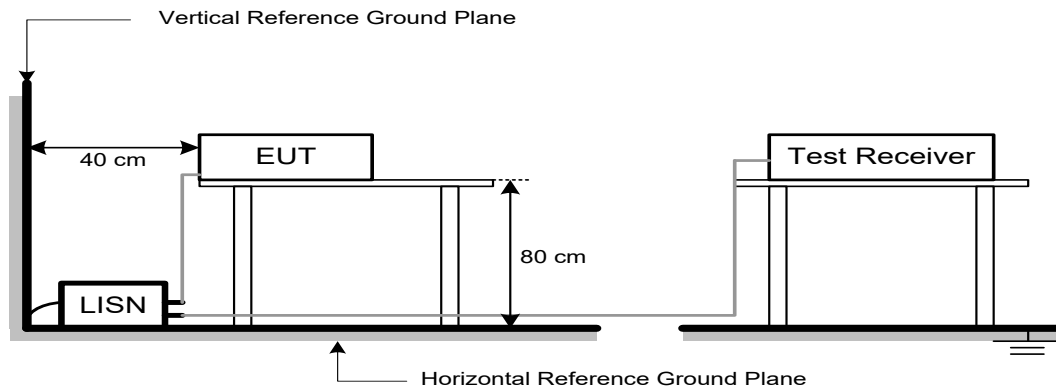
The following table is the setting of the receiver:

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 5)	63.5 (Note 5)

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) The test result calculated as following:
 Measurement Value = Reading Level + Correct Factor
 Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain(if use)
 Margin Level = Measurement Value - Limit Value
- (5)

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

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

FS_{limit} : Harmonic at 3m Peak and Average limit.

FS_{max} : Harmonic at 1m Peak and Average Maximum value.

d_{limit} : Harmonic at 3m test distance.

d_{measure} : Harmonic Actual test distance.

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

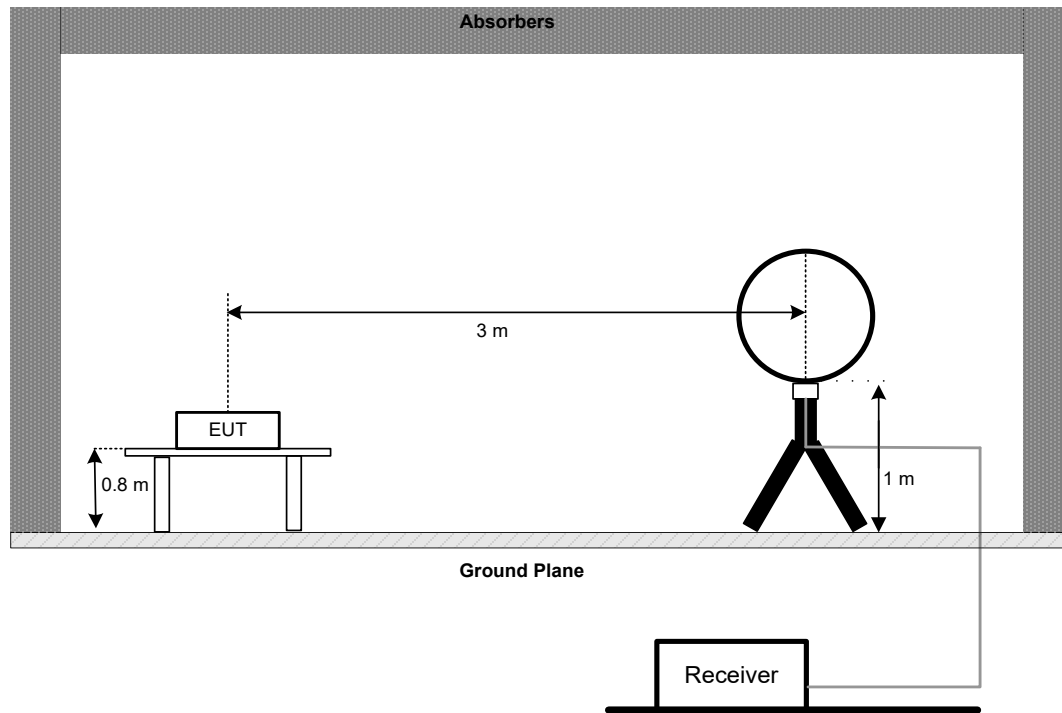
Spectrum Parameters	Setting
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30 MHz~1000 MHz for QP detector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

5.3 DEVIATION FROM TEST STANDARD

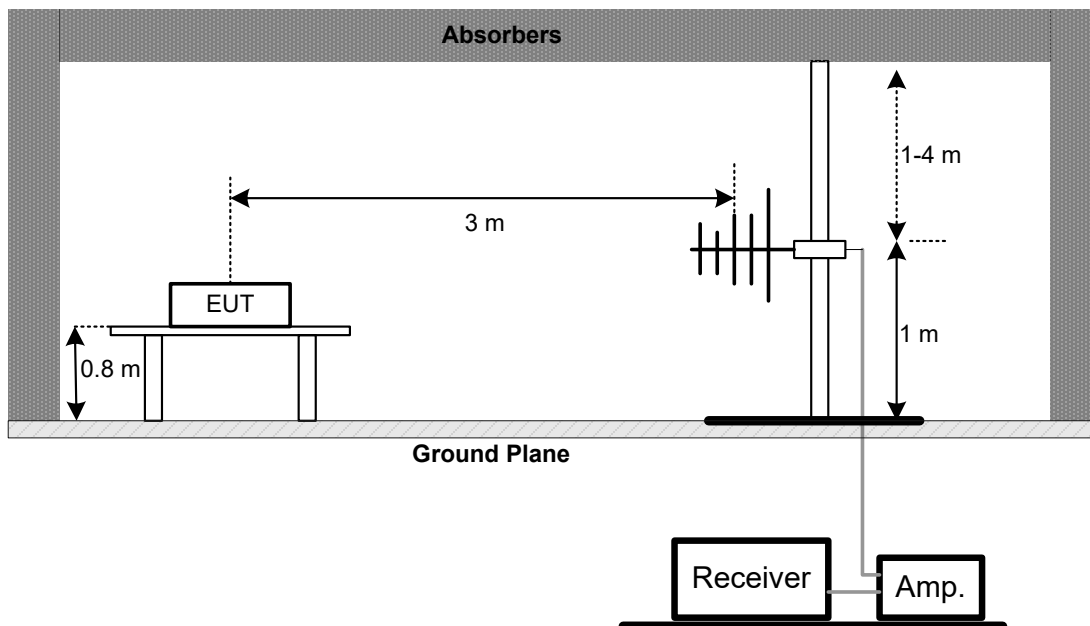
No deviation.

5.4 TEST SETUP

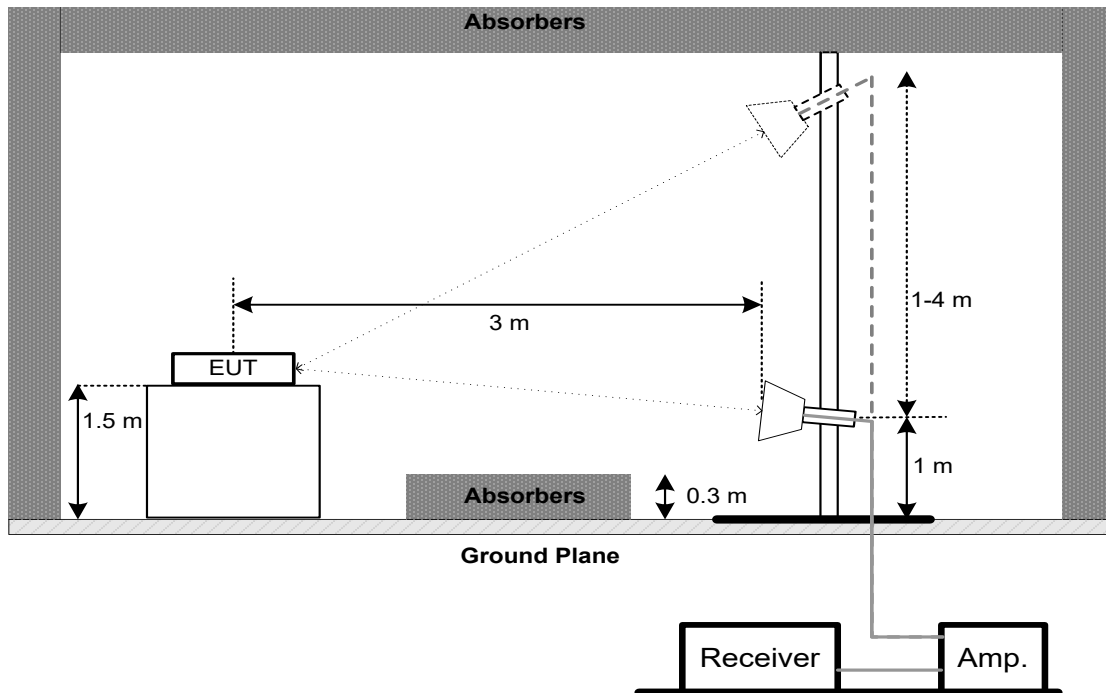
9 kHz to 30 MHz



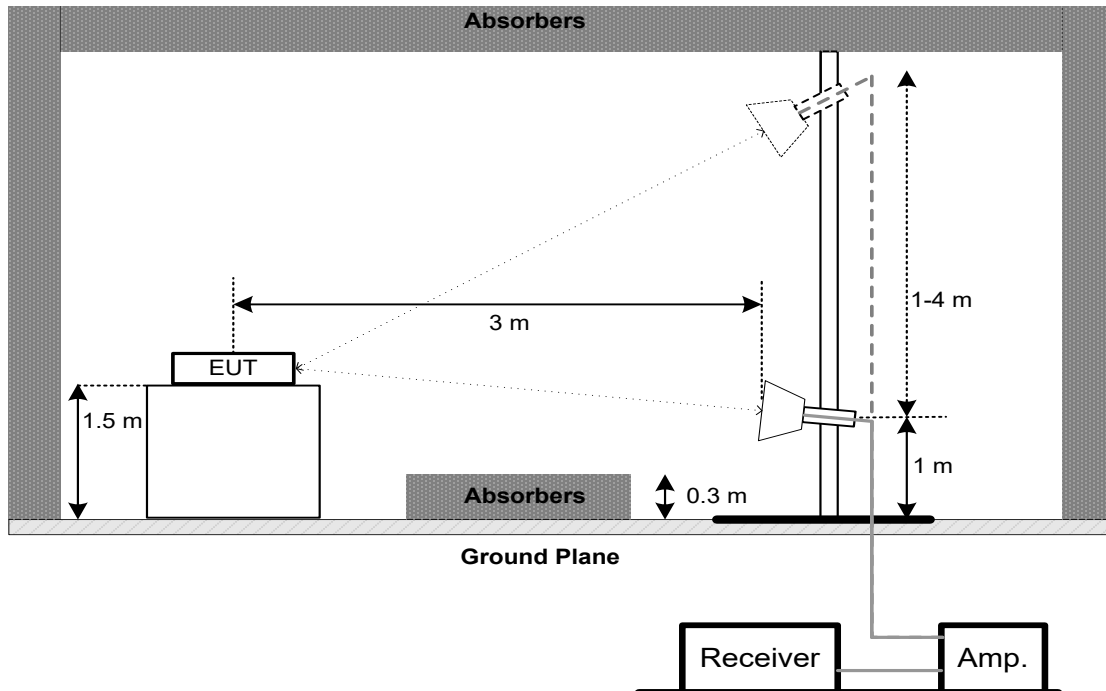
30 MHz to 1 GHz



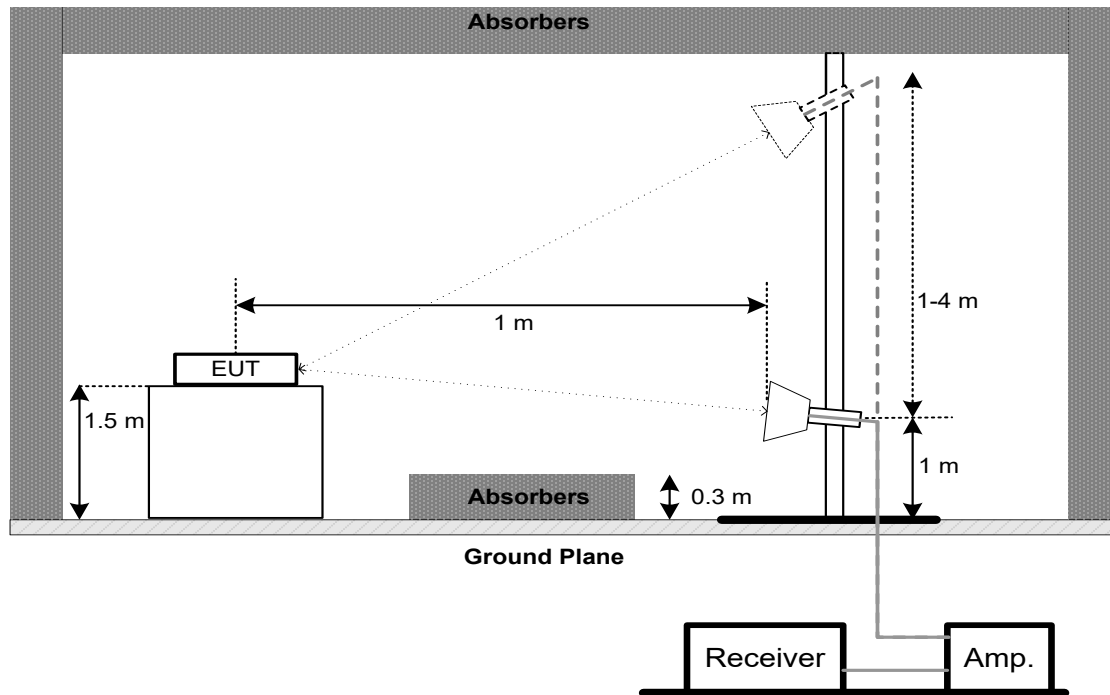
Above 1 GHz Band edge



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 = $40 \log (\text{specific distance} / \text{test distance})$ (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

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- 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

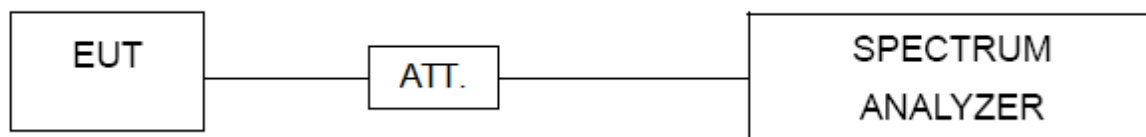
For 99% Emission Bandwidth:

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

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

Spectrum Parameters	Setting
Span Frequency	At least 1.5 times the OBW
RBW	1% to 5% of the OBW, not to exceed 1 MHz
VBW	$\geq 3 \times \text{RBW}$
Detector	RMS
Trace	Max Hold
Sweep Time	$\leq (\text{number of points in sweep}) \times T$ (Note)

Note: Where T is defined in 11.6 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

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- 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

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

Spectrum Parameters	Setting
Span Frequency	2 MHz (1 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	ESCI	100382	Dec. 06, 2025
2	TWO-LINE V-NETWORK	R&S	ENV216	101447	Dec. 06, 2025
3	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
4	Cable	N/A	SFT205-NMNM-9M-001	9M	Nov. 11, 2025
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	Mar. 30, 2025
2	MXE EMI Receiver	Keysight	N9038A	MY56400091	Dec. 06, 2025
3	Cable	N/A	RW4950-3.8A-NMS M-1.5	N/A	Nov. 12, 2025
4	Cable	N/A	LMR400-NMNM-8 M	N/A	Nov. 12, 2025
5	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
6	966 Chamber room	ETS	9*6*6	N/A	May 16, 2025

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	01462	Dec. 14, 2025
2	Attenuator	EMC INSTRUMENT	EMCI-N-6-06	AT-06009	Dec. 14, 2025
3	Preamplifier	EMC INSTRUMENT	EMC001330	980998	May 31, 2025
4	Cable	RegalWay	LMR400-NMNM-12 .5m	N/A	Jun. 06, 2025
5	Cable	RegalWay	LMR400-NMNM-3 m	N/A	Jun. 06, 2025
6	Cable	RegalWay	LMR400-NMNM-0. 5m	N/A	Jun. 06, 2025
7	MXE EMI Receiver	KEYSIGHT	N9038B	MY62210123	Oct. 29, 2025
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 16, 2025

Radiated Emissions - Above 1 GHz					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	MXA Signal Analyzer	KEYSIGHT	N9020B	MY63380204	Oct. 29, 2025
2	Preamplifier	EMC INSTRUMENT	EMC118A45SE	980878	Nov. 25, 2025
3	Double Ridged Guide Antenna	ETS	3115	75789	Jun. 15, 2025
4	Cable	RegalWay	RWLP50-4.0A-SMS M-12.5M	N/A	Jul. 03, 2025
5	Cable	RegalWay	RWLP50-4.0A-NM RASM-2.5M	N/A	Jul. 03, 2025
6	Cable	RegalWay	RWLP50-4.0A-NM RASMRA-0.8M	N/A	Jul. 03, 2025
7	966 Chamber room	CM	9*6*6	N/A	May 19, 2025
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	Filter	STI	STI15-9912	N/A	May 31, 2025
11	EXA Spectrum Analyzer	Keysight	N9010A	MY55150209	Aug. 20, 2025
12	Preamplifier	EMC INSTRUMENT	EMC184045SE	980905	Oct. 29, 2025
13	Cable	RegalWay	RWLP50-2.6A-2.92 M2.92M-1.1M	N/A	Jul. 25, 2025
14	Cable	Tonscend	HF160-KMKM-3M	N/A	Jul. 25, 2025
15	Broad-Band Horn Antenna	Schwarzbeck	BBHA9170(3m)	9170-319	Jun. 16, 2025

Bandwidth & Maximum Output Power & Power Spectral Density & Conducted Spurious Emission					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP40	100185	May 31, 2025
2	Measurement Software	BTL	BTL Conducted Test	N/A	N/A
3	Isolation attenuator	Z-Link	ASMA-16-18-2W	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.

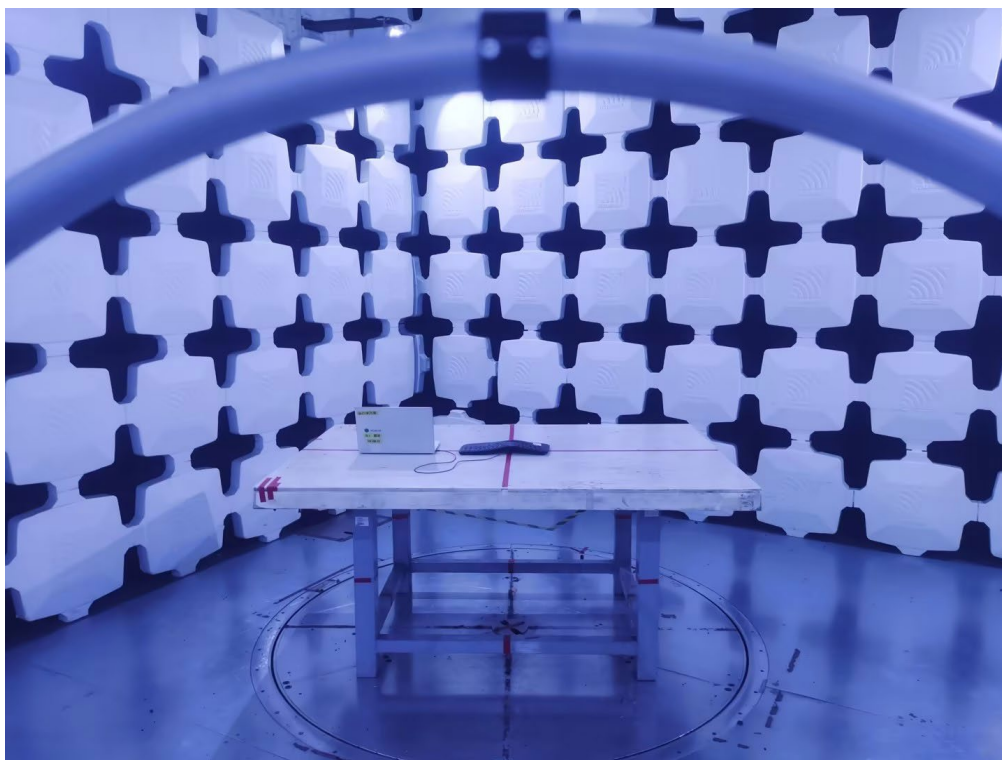
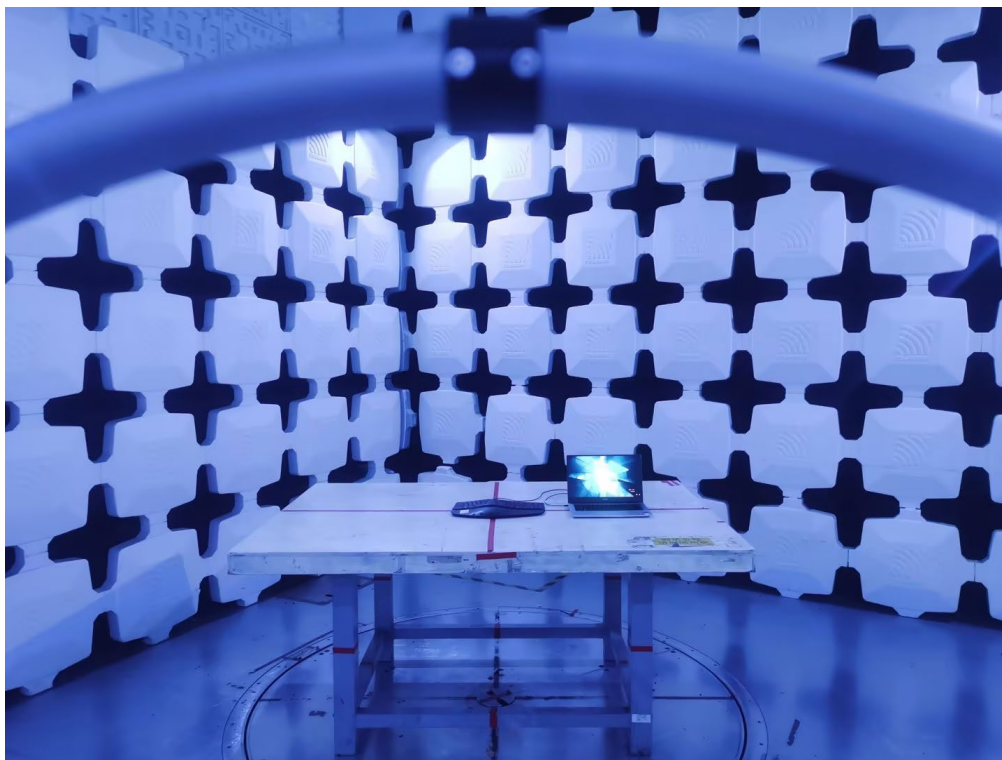
11. EUT TEST PHOTO

AC Power Line Conducted Emissions Test Photos



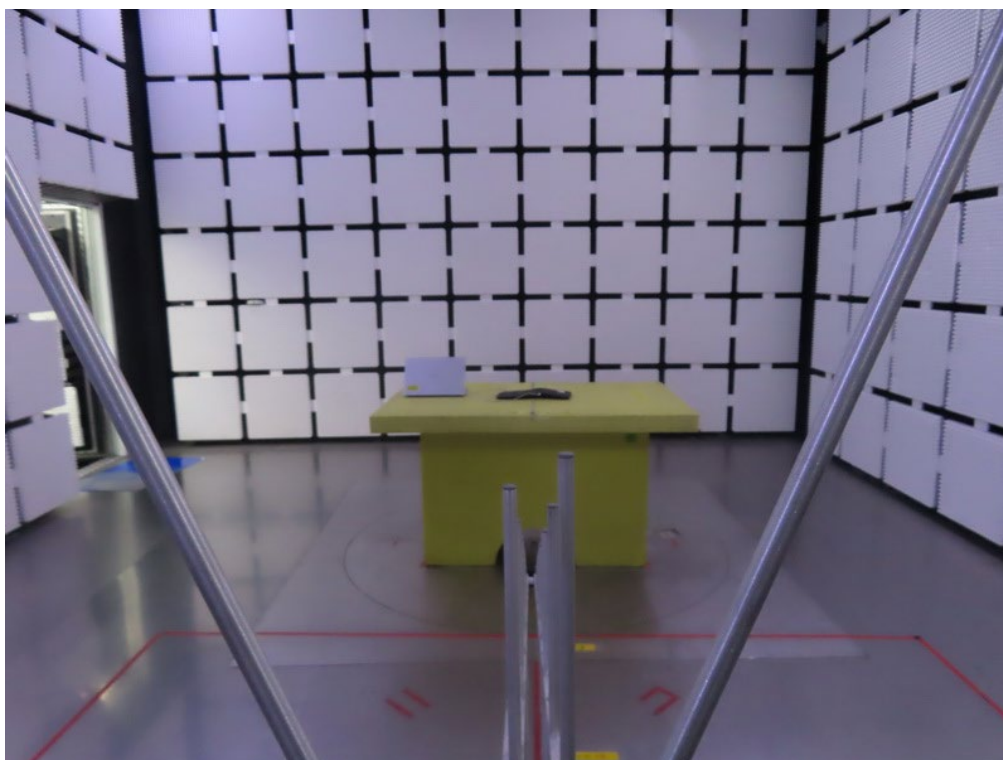
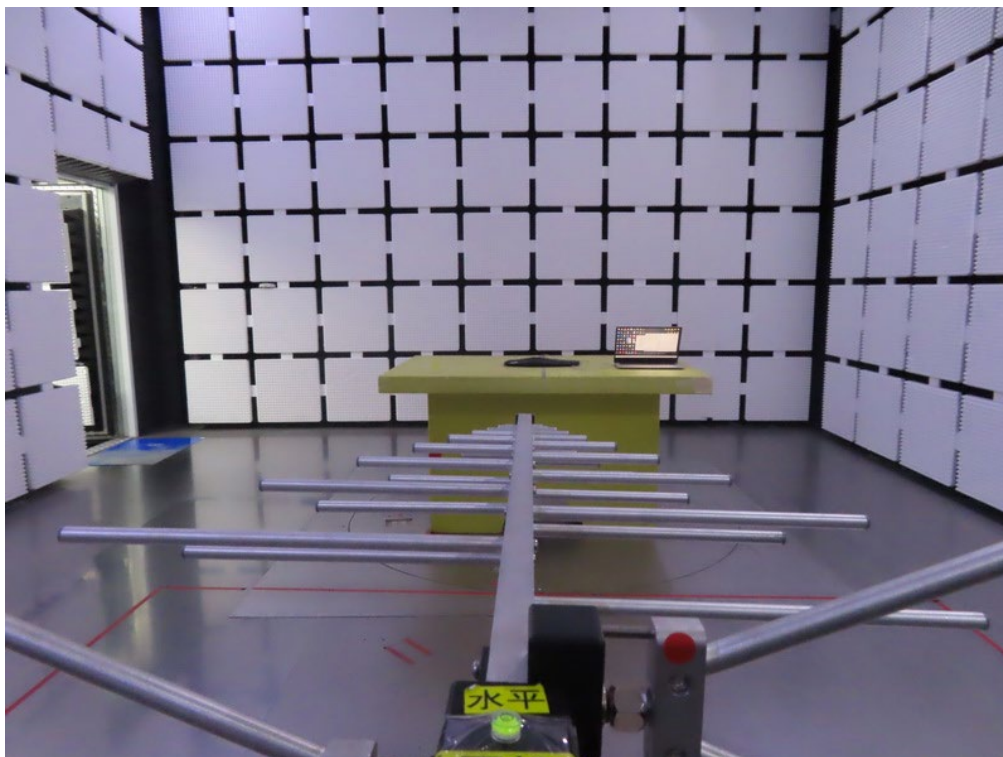
Radiated Emissions Test Photos

9 kHz to 30 MHz



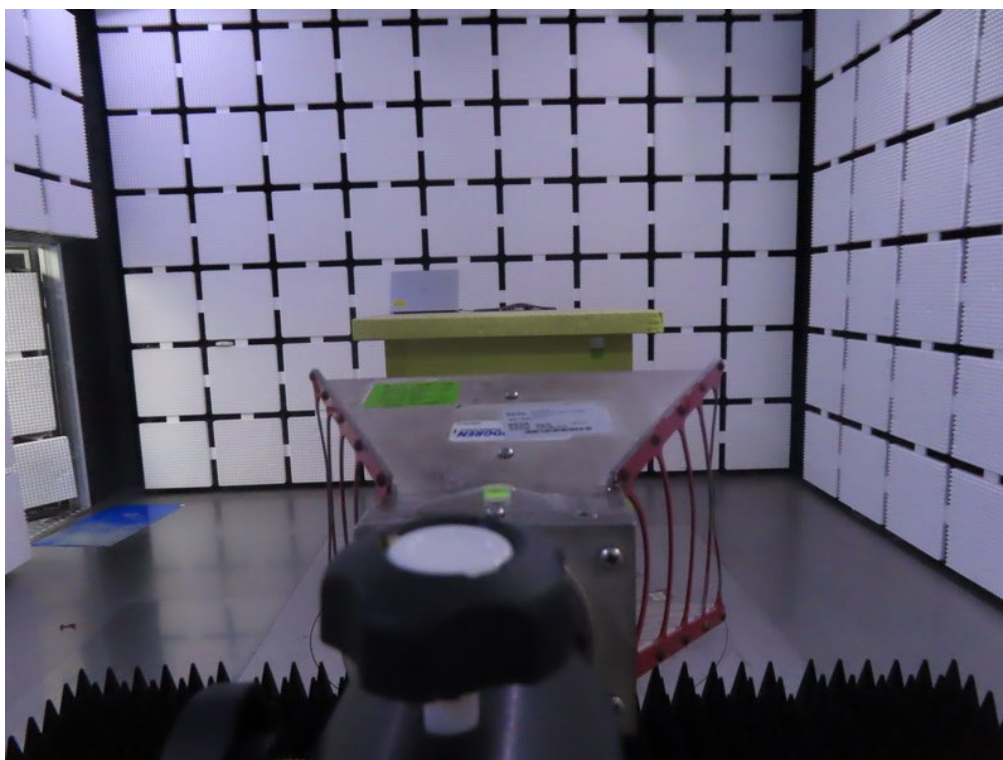
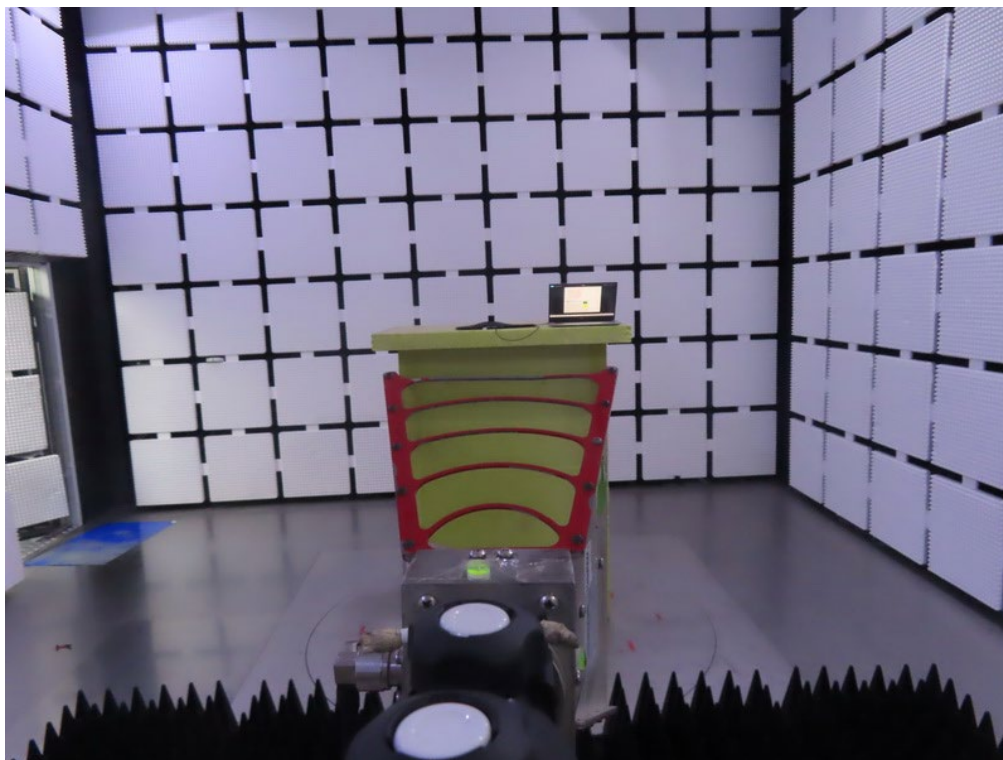
Radiated Emissions Test Photos

30 MHz to 1000 MHz



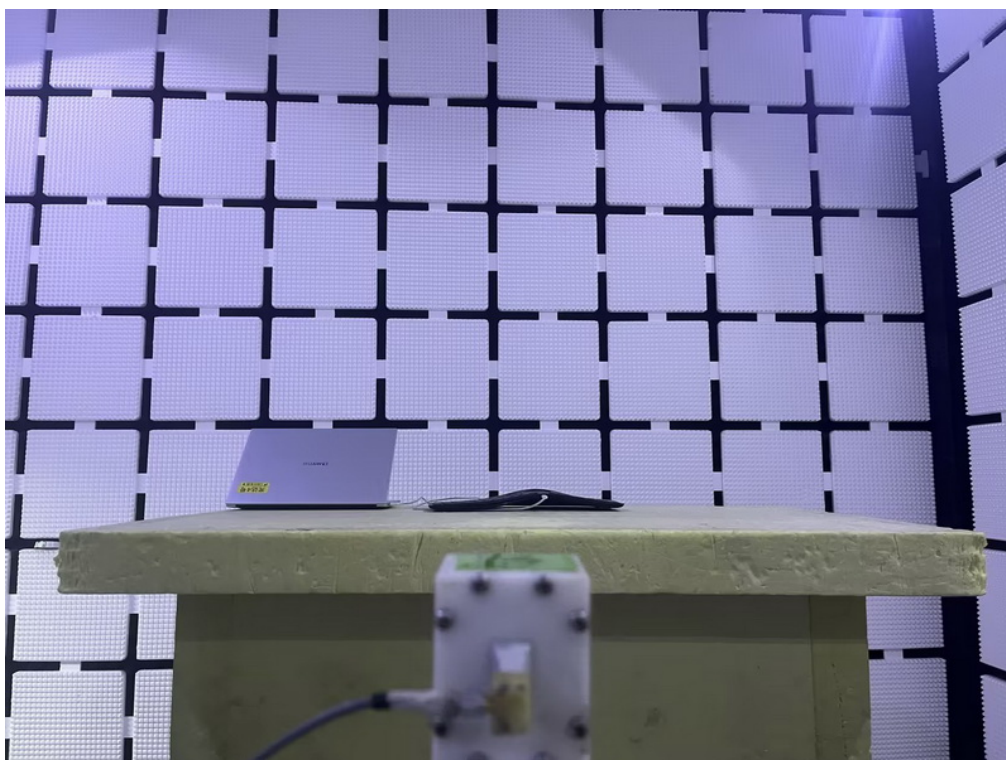
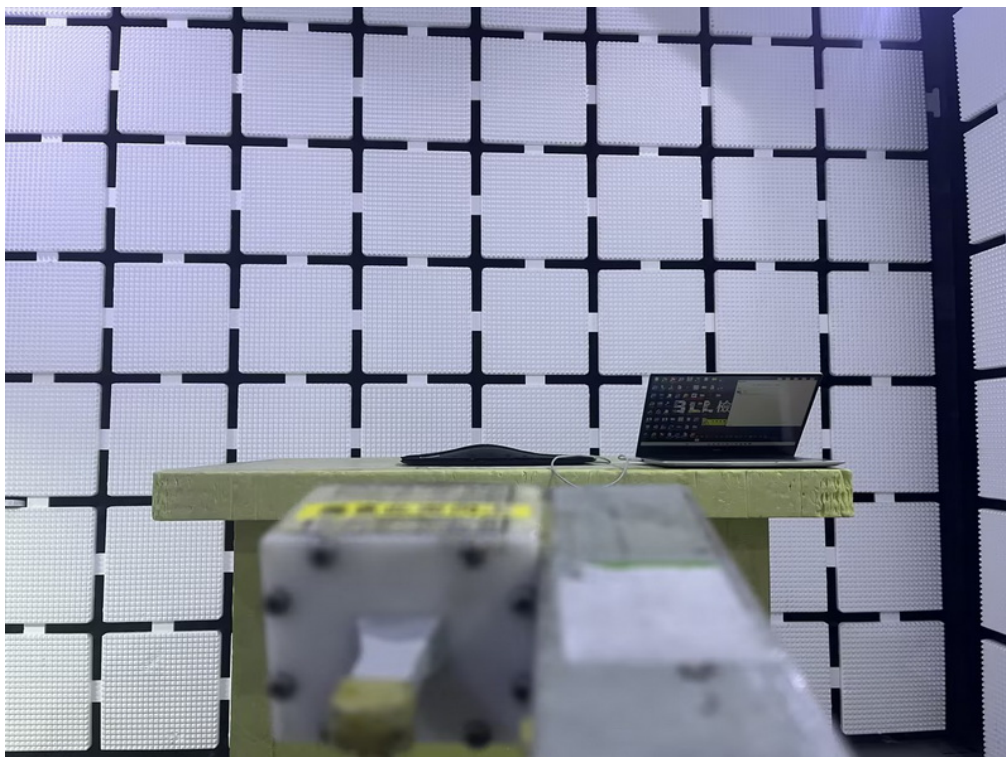
Radiated Emissions Test Photos

Harmonic(1 GHz to 18 GHz) & Band edge

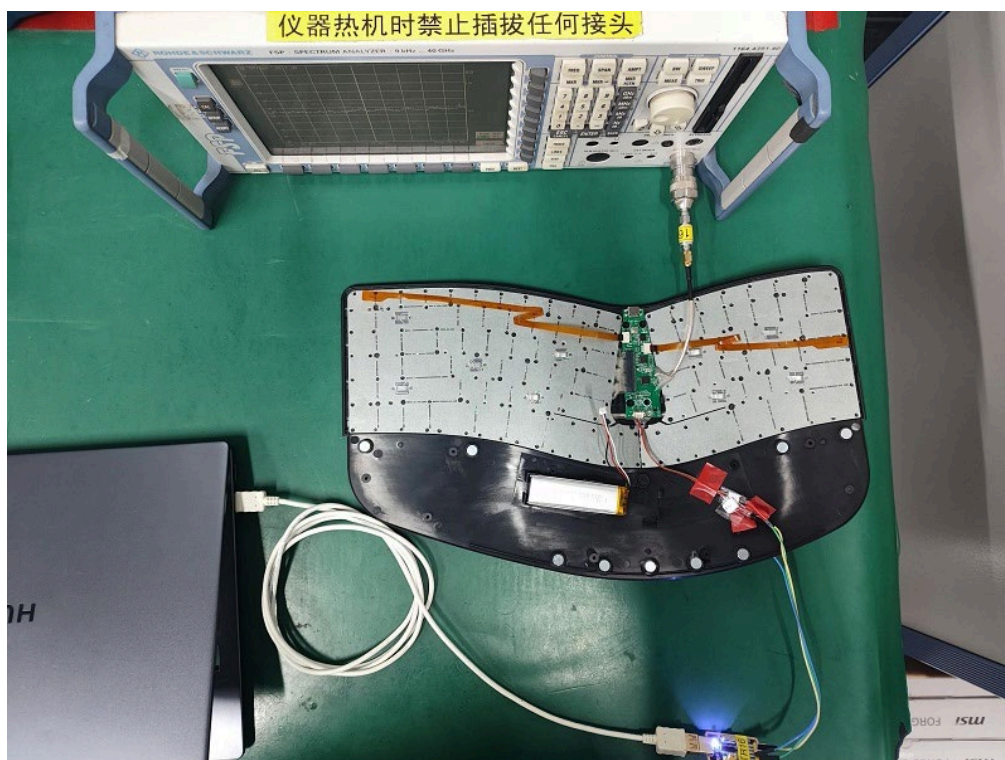
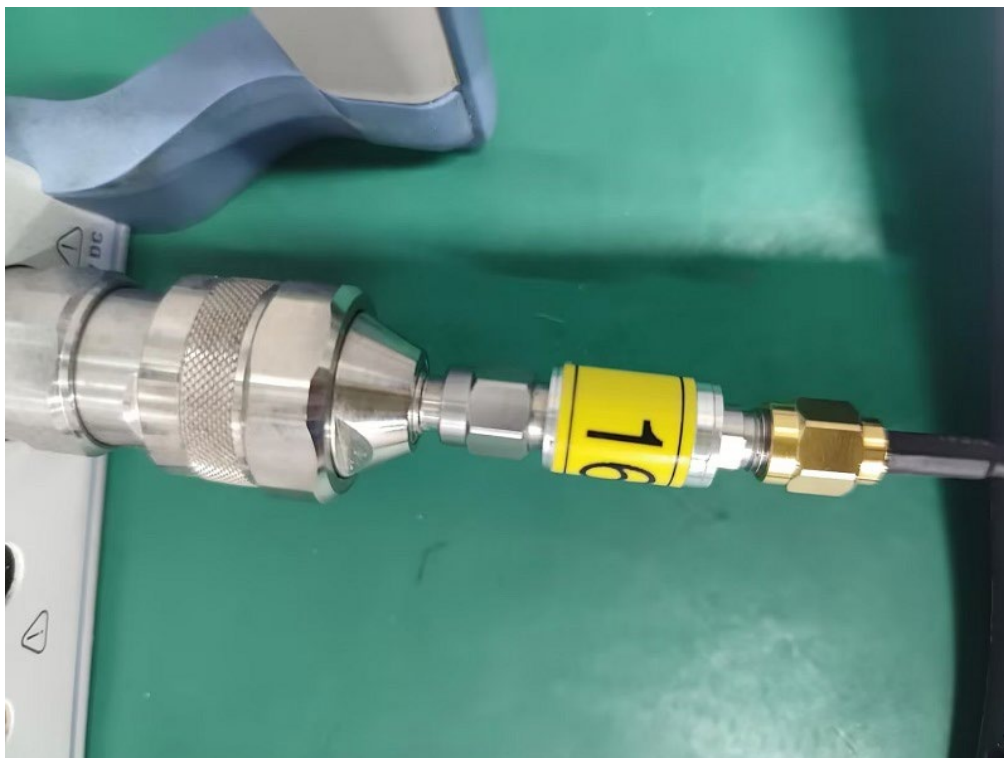


Radiated Emissions Test Photos

Harmonic(Above 18 GHz)

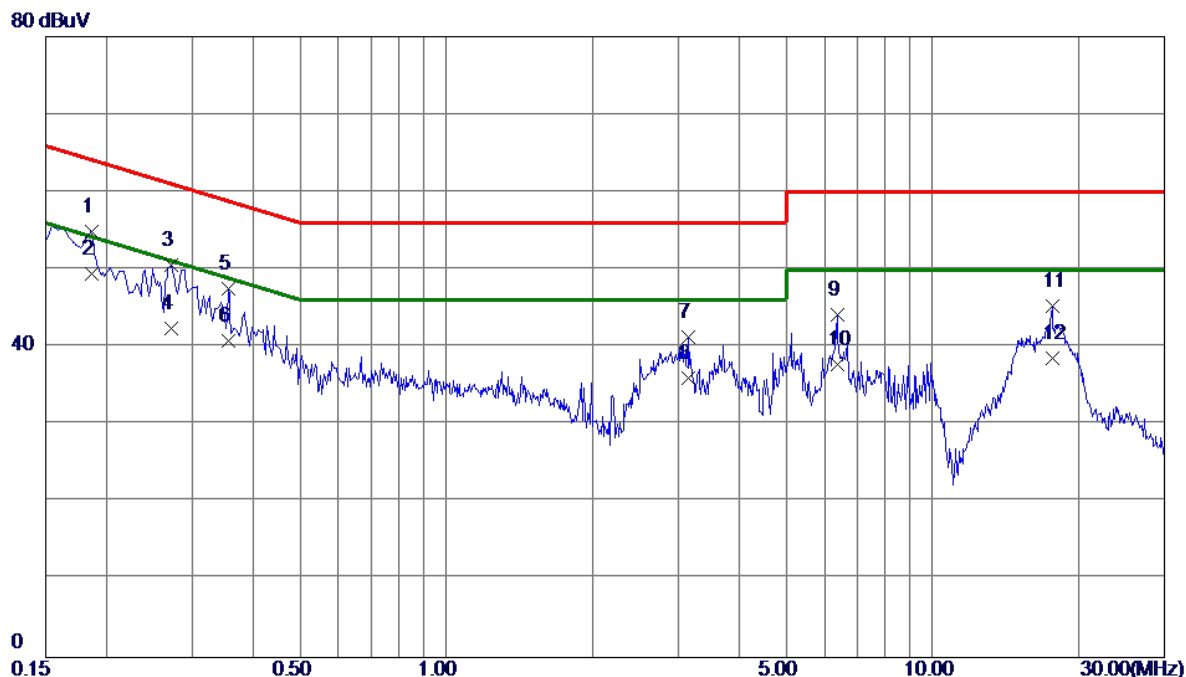


Conducted Test Photos



APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS

Test Mode	TX Mode_2Mbps Channel 16	Phase	Line
-----------	--------------------------	-------	------



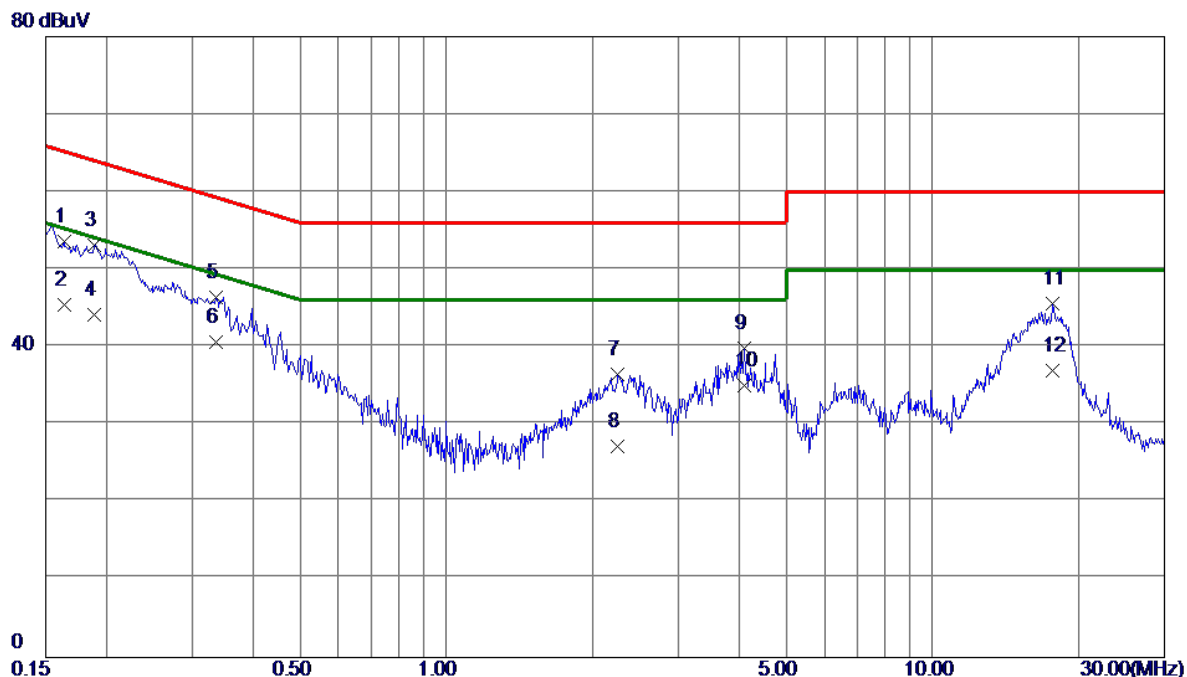
No.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1	0.1860	45.00	9.91	54.91	64.21	-9.30	QP	
2 *	0.1860	39.60	9.91	49.51	54.21	-4.70	AVG	
3	0.2714	40.60	9.91	50.51	61.07	-10.56	QP	
4	0.2714	32.50	9.91	42.41	51.07	-8.66	AVG	
5	0.3570	37.56	9.94	47.50	58.80	-11.30	QP	
6	0.3570	30.80	9.94	40.74	48.80	-8.06	AVG	
7	3.1470	30.92	10.38	41.30	56.00	-14.70	QP	
8	3.1470	25.60	10.38	35.98	46.00	-10.02	AVG	
9	6.3645	33.15	11.02	44.17	60.00	-15.83	QP	
10	6.3645	26.80	11.02	37.82	50.00	-12.18	AVG	
11	17.6505	30.76	14.47	45.23	60.00	-14.77	QP	
12	17.6505	24.11	14.47	38.58	50.00	-11.42	AVG	

REMARKS:

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

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

Test Mode	TX Mode_2Mbps Channel 16	Phase	Neutral
-----------	--------------------------	-------	---------



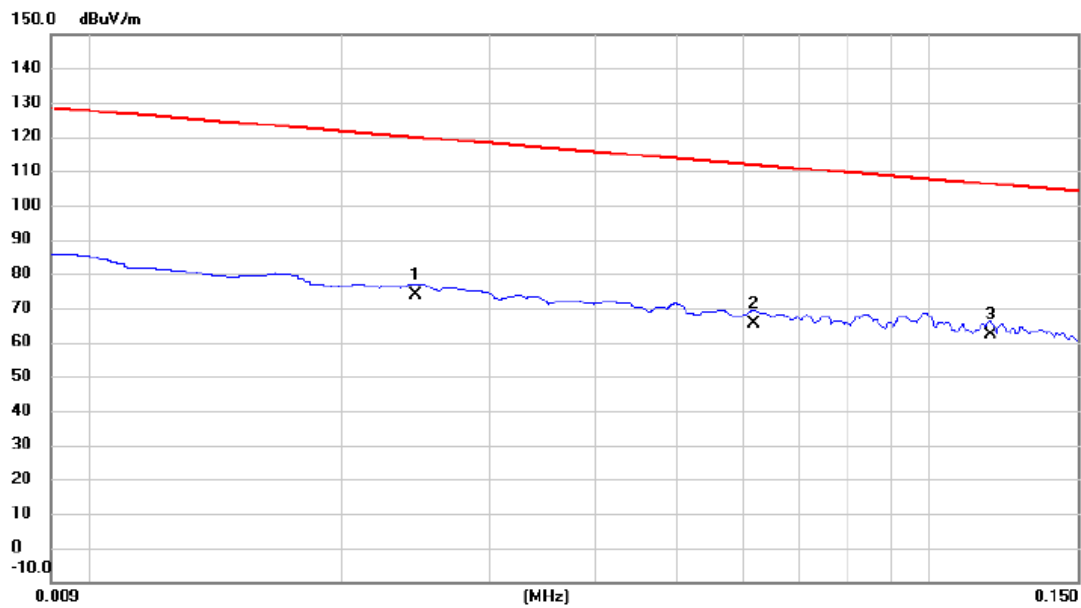
No.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure ment dBuV	Limit dBuV	Margin dB	Detector	Comment
1	0.1635	43.65	9.97	53.62	65.28	-11.66	QP	
2	0.1635	35.40	9.97	45.37	55.28	-9.91	AVG	
3	0.1884	43.13	9.97	53.10	64.11	-11.01	QP	
4	0.1884	34.20	9.97	44.17	54.11	-9.94	AVG	
5	0.3356	36.47	9.98	46.45	59.31	-12.86	QP	
6 *	0.3356	30.60	9.98	40.58	49.31	-8.73	AVG	
7	2.2515	26.17	10.29	36.46	56.00	-19.54	QP	
8	2.2515	16.90	10.29	27.19	46.00	-18.81	AVG	
9	4.0920	29.26	10.58	39.84	56.00	-16.16	QP	
10	4.0920	24.49	10.58	35.07	46.00	-10.93	AVG	
11	17.6685	31.26	14.38	45.64	60.00	-14.36	QP	
12	17.6685	22.61	14.38	36.99	50.00	-13.01	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_2Mbps Channel 16	Polarization	Ant 0°
-----------	--------------------------	--------------	--------



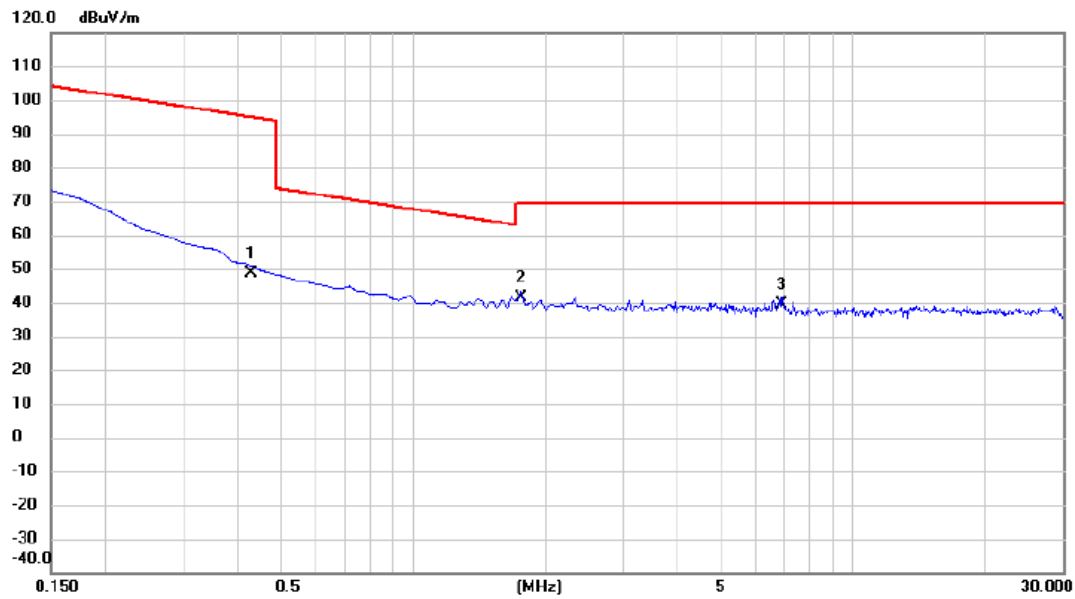
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.0245	52.64	20.98	73.62	119.82	-46.20	AVG	
2		0.0617	44.23	21.28	65.51	111.80	-46.29	AVG	
3	*	0.1180	41.03	21.31	62.34	106.17	-43.83	AVG	

REMARKS:

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

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Ant 0°
-----------	--------------------------	--------------	--------

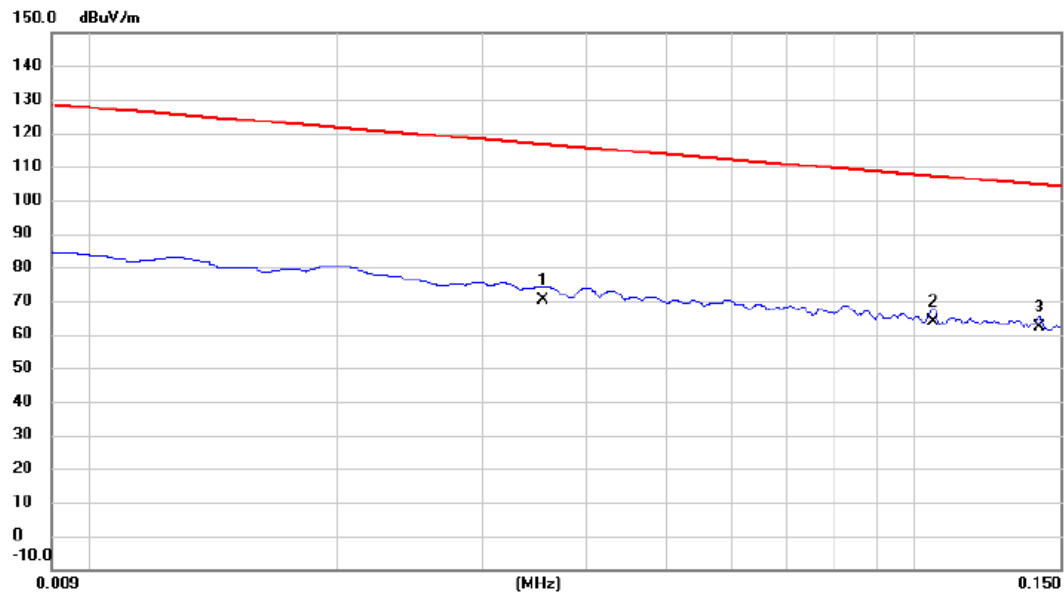


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.4282	27.36	21.05	48.41	94.97	-46.56	AVG	
2	*	1.7620	20.31	21.13	41.44	69.54	-28.10	QP	
3		6.8961	18.34	21.13	39.47	69.54	-30.07	QP	

REMARKS:

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Ant 90°
-----------	--------------------------	--------------	---------

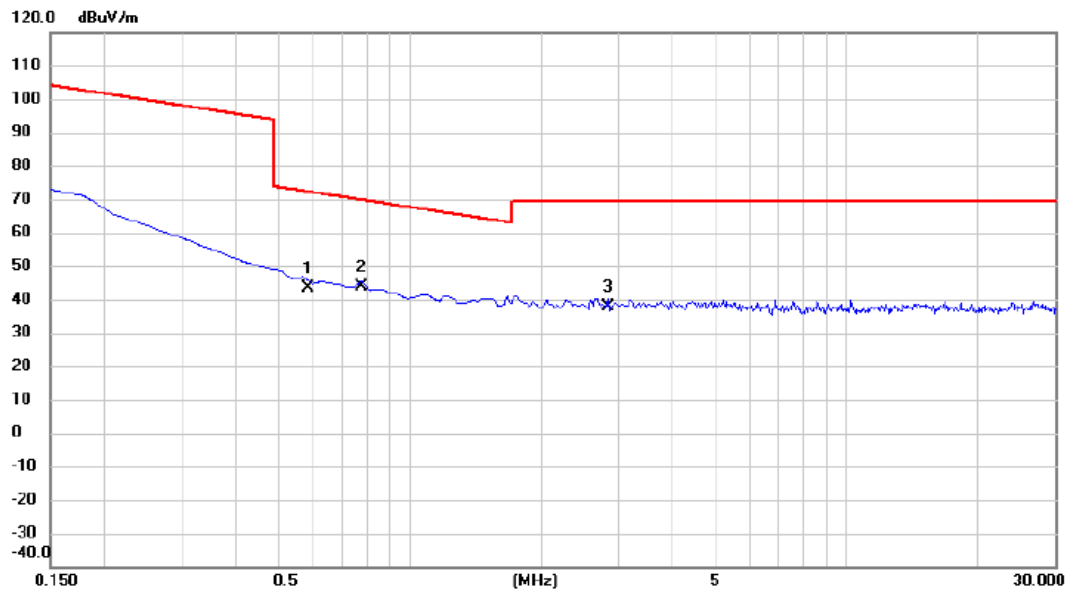


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.0355	48.91	21.17	70.08	116.60	-46.52	AVG	
2		0.1053	42.64	21.33	63.97	107.16	-43.19	QP	
3	*	0.1415	41.00	21.28	62.28	104.59	-42.31	AVG	

REMARKS:

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Ant 90°
-----------	--------------------------	--------------	---------



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1		0.5854	22.16	21.09	43.25	72.25	-29.00	QP	
2	*	0.7768	22.47	21.16	43.63	69.80	-26.17	QP	
3		2.8365	16.49	21.12	37.61	69.54	-31.93	QP	

REMARKS:

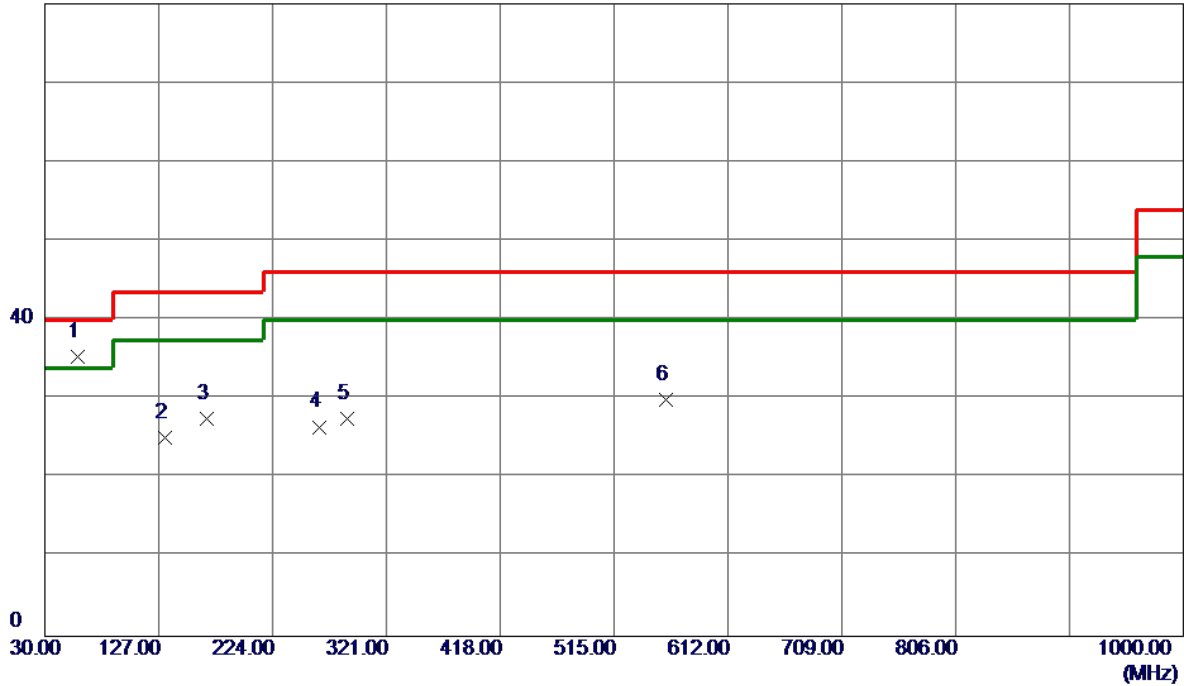
(1) Measurement Value = Reading Level + Correct Factor.

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

APPENDIX C - RADIATED EMISSION - 30 MHZ TO 1000 MHZ

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Vertical
-----------	--------------------------	--------------	----------

80 dBuV/m



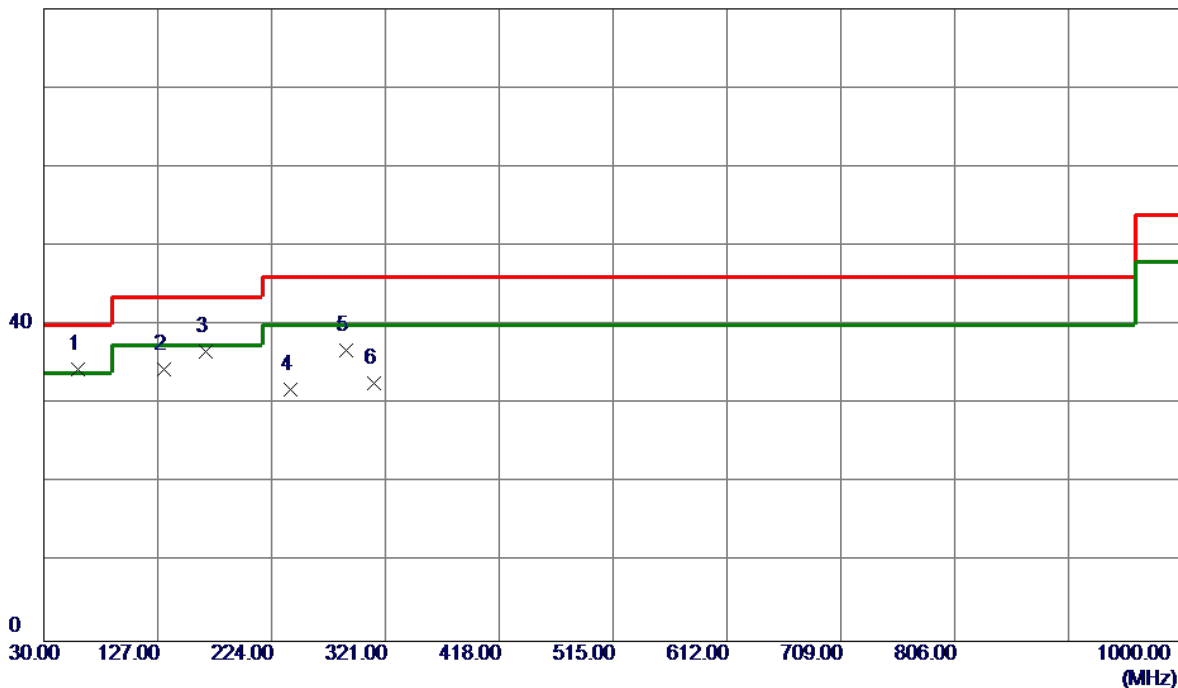
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	57.6450	46.95	-11.66	35.29	40.00	-4.71	QP	
2	132.8200	37.55	-12.38	25.17	43.52	-18.35	Peak	
3	168.2250	38.95	-11.45	27.50	43.52	-16.02	Peak	
4	264.2550	38.35	-11.87	26.48	46.02	-19.54	Peak	
5	288.0200	38.31	-10.72	27.59	46.02	-18.43	Peak	
6	559.1350	34.70	-4.77	29.93	46.02	-16.09	Peak	

REMARKS:

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Horizontal
-----------	--------------------------	--------------	------------

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 *	59.1000	46.12	-11.79	34.33	40.00	-5.67	QP	
2	132.8200	46.78	-12.38	34.40	43.52	-9.12	Peak	
3	168.2250	48.02	-11.45	36.57	43.52	-6.95	Peak	
4	240.0050	44.51	-12.71	31.80	46.02	-14.22	Peak	
5	288.0200	47.48	-10.72	36.76	46.02	-9.26	Peak	
6	311.7850	42.85	-10.21	32.64	46.02	-13.38	Peak	

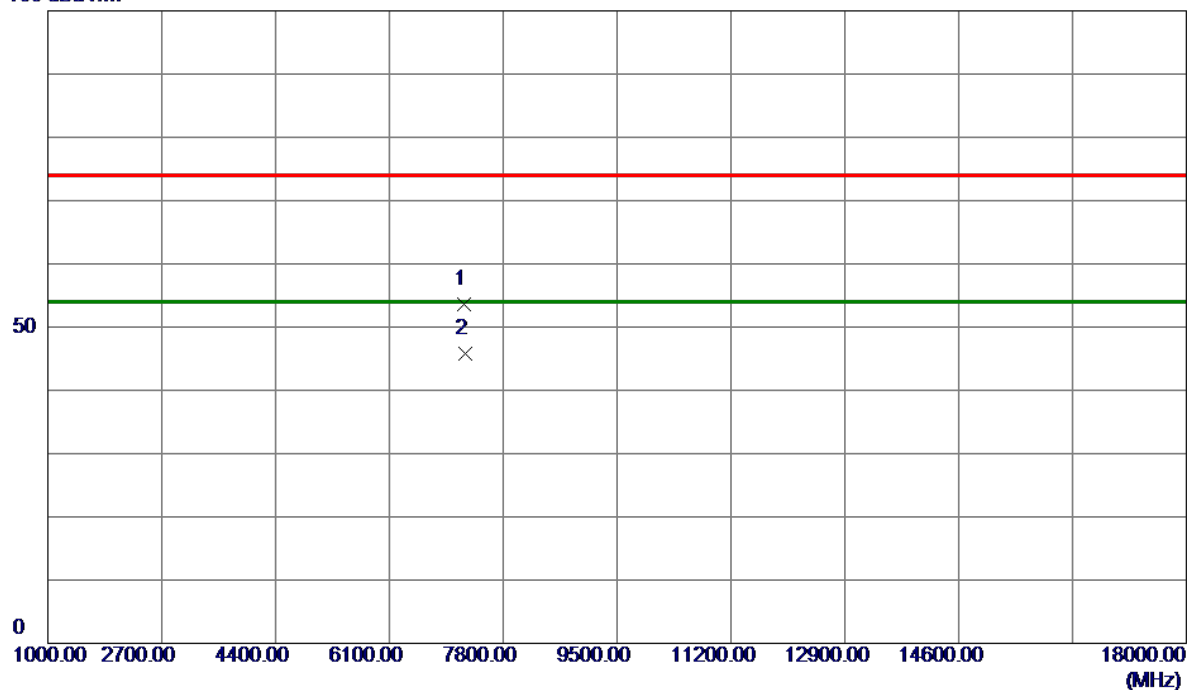
REMARKS:

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

APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ

Test Mode	TX 2408 MHz _CH00_2Mbps	Polarization	Vertical
-----------	-------------------------	--------------	----------

100 dBuV/m



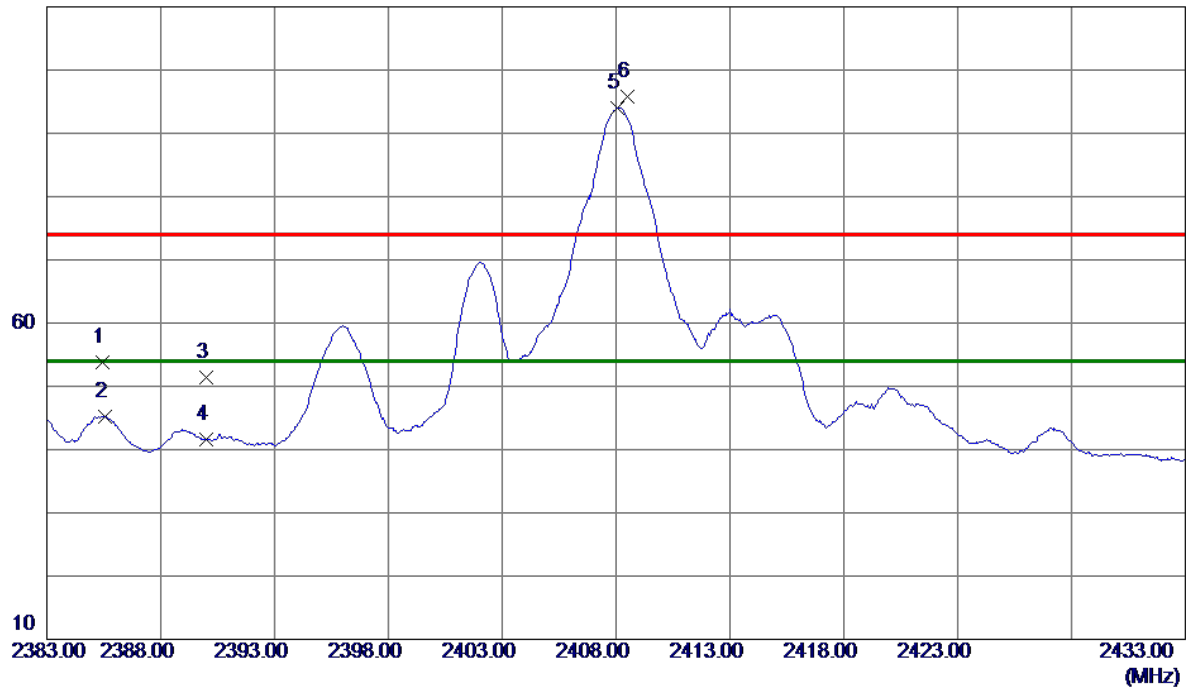
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	7222.4700	43.32	10.27	53.59	74.00	-20.41	Peak	
2 *	7225.3900	35.61	10.27	45.88	54.00	-8.12	AVG	

REMARKS:

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

Test Mode	TX 2408 MHz _CH00_2Mbps	Polarization	Horizontal
-----------	-------------------------	--------------	------------

110 dBuV/m



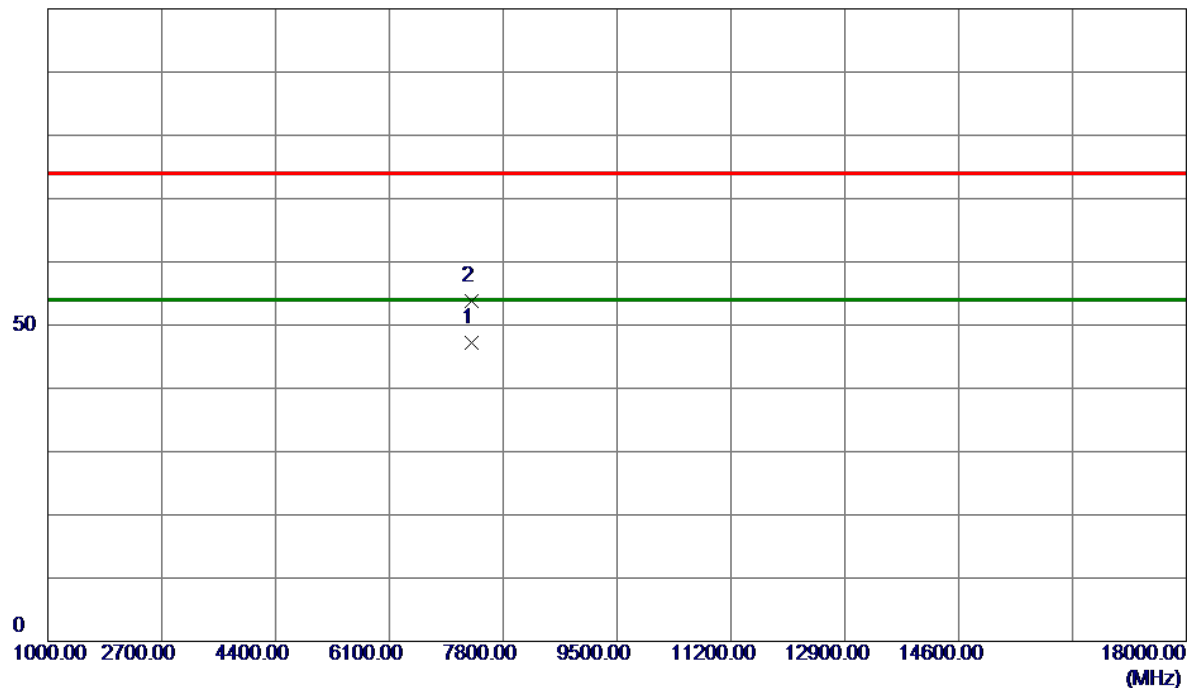
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2385.4250	45.21	8.68	53.89	74.00	-20.11	Peak	
2	2385.5500	36.60	8.68	45.28	54.00	-8.72	AVG	
3	2390.0000	42.81	8.68	51.49	74.00	-22.51	Peak	
4	2390.0000	32.95	8.68	41.63	54.00	-12.37	AVG	
5 *	2408.0750	85.37	8.71	94.08	54.00	40.08	AVG	No Limit
6	2408.5000	87.18	8.71	95.89	74.00	21.89	Peak	No Limit

REMARKS:

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

Test Mode	TX 2440 MHz _CH16_2Mbps	Polarization	Vertical
-----------	-------------------------	--------------	----------

100 dBuV/m



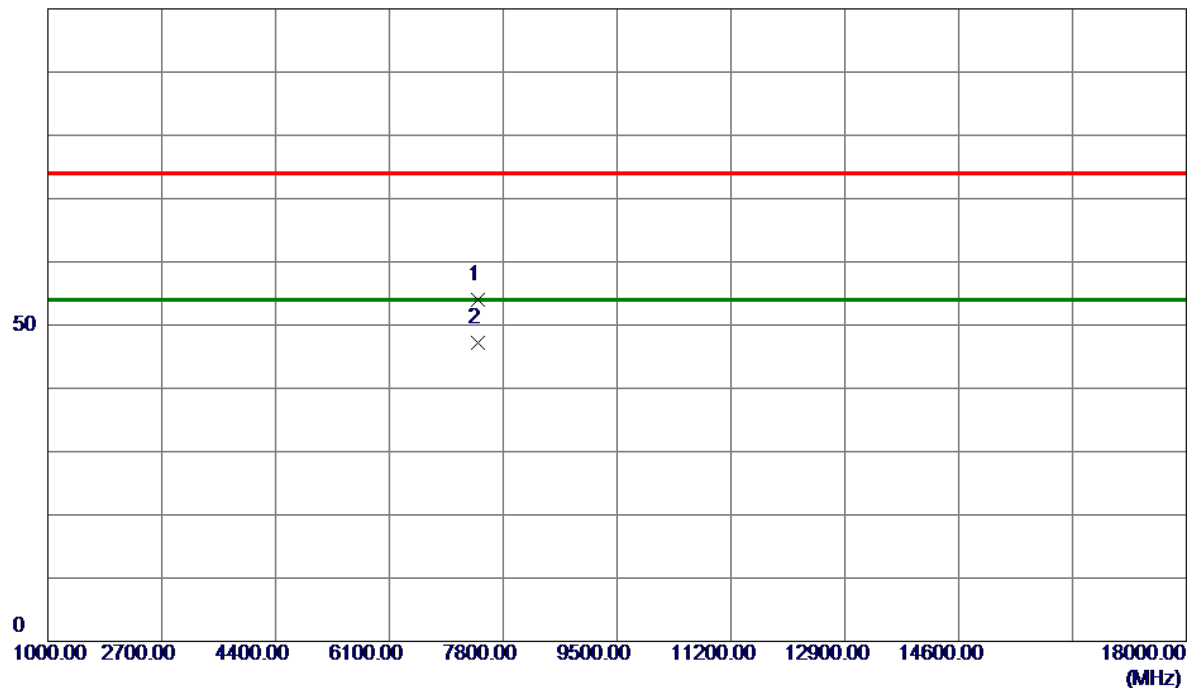
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1 *	7321.5300	36.86	10.30	47.16	54.00	-6.84	AVG	
2	7321.6200	43.42	10.30	53.72	74.00	-20.28	Peak	

REMARKS:

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

Test Mode	TX 2474 MHz _CH33_2Mbps	Polarization	Vertical
-----------	-------------------------	--------------	----------

100 dBuV/m



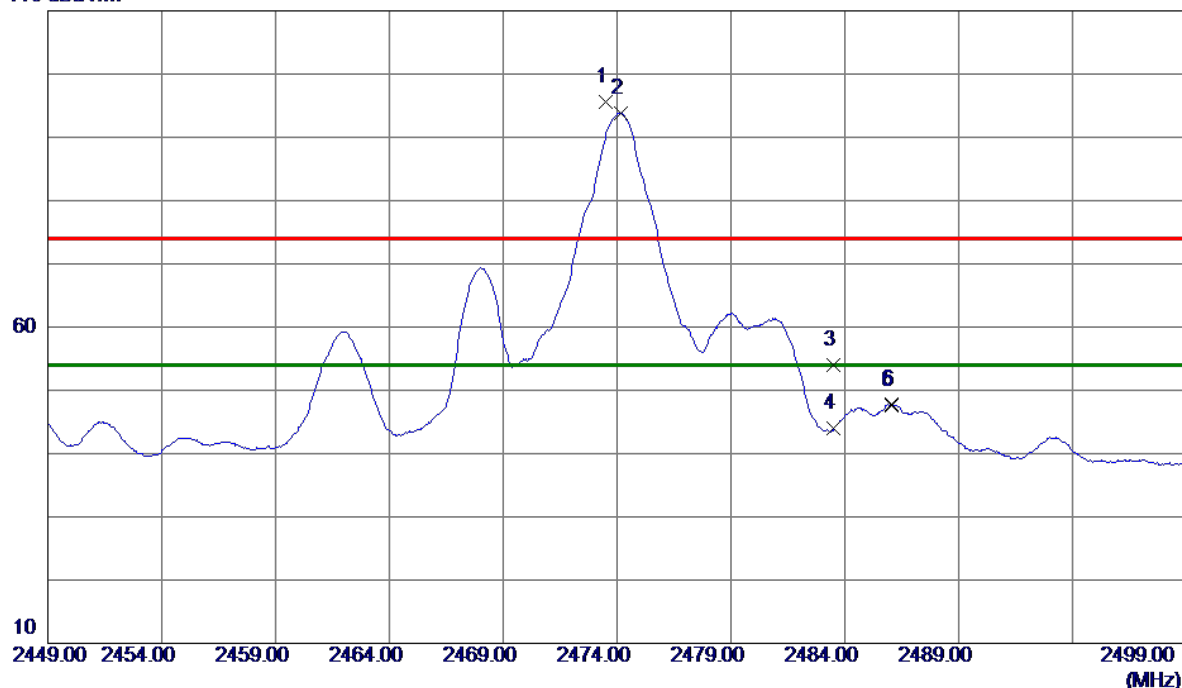
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	7423.3300	43.58	10.33	53.91	74.00	-20.09	Peak	
2 *	7423.4100	36.86	10.33	47.19	54.00	-6.81	AVG	

REMARKS:

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

Test Mode	TX 2474 MHz _CH33_2Mbps	Polarization	Horizontal
-----------	-------------------------	--------------	------------

110 dBuV/m



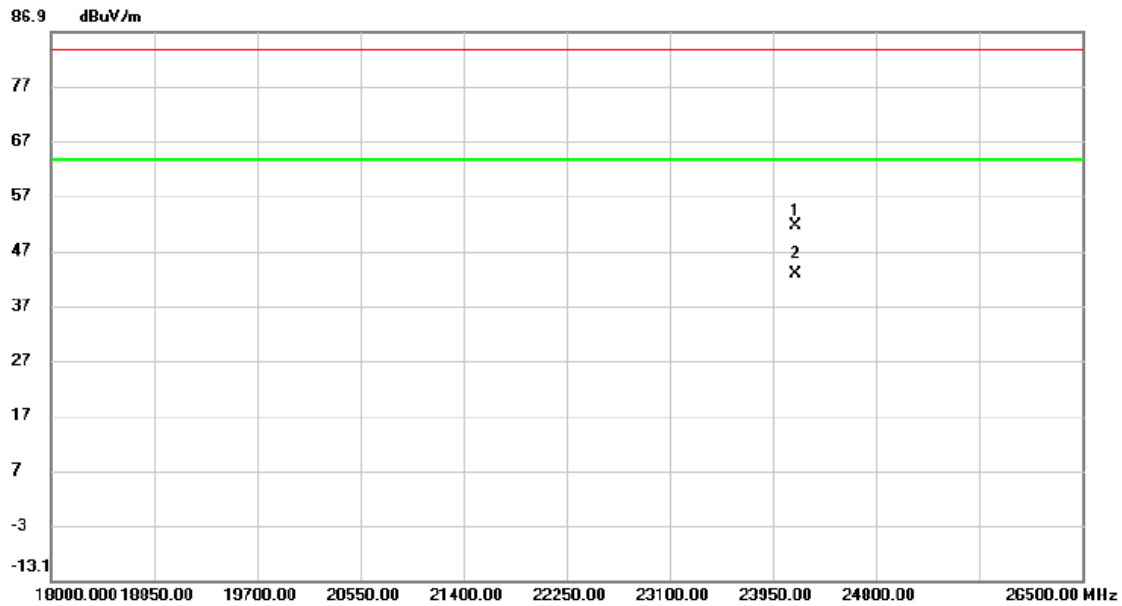
No.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure ment dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
1	2473.5250	86.80	8.82	95.62	74.00	21.62	Peak	No Limit
2 *	2474.1750	85.05	8.82	93.87	54.00	39.87	AVG	No Limit
3	2483.5000	45.23	8.83	54.06	74.00	-19.94	Peak	
4	2483.5000	35.22	8.83	44.05	54.00	-9.95	AVG	
5	2486.0500	38.75	8.84	47.59	74.00	-26.41	Peak	
6	2486.0500	39.04	8.84	47.88	54.00	-6.12	AVG	

REMARKS:

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

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Vertical
-----------	--------------------------	--------------	----------

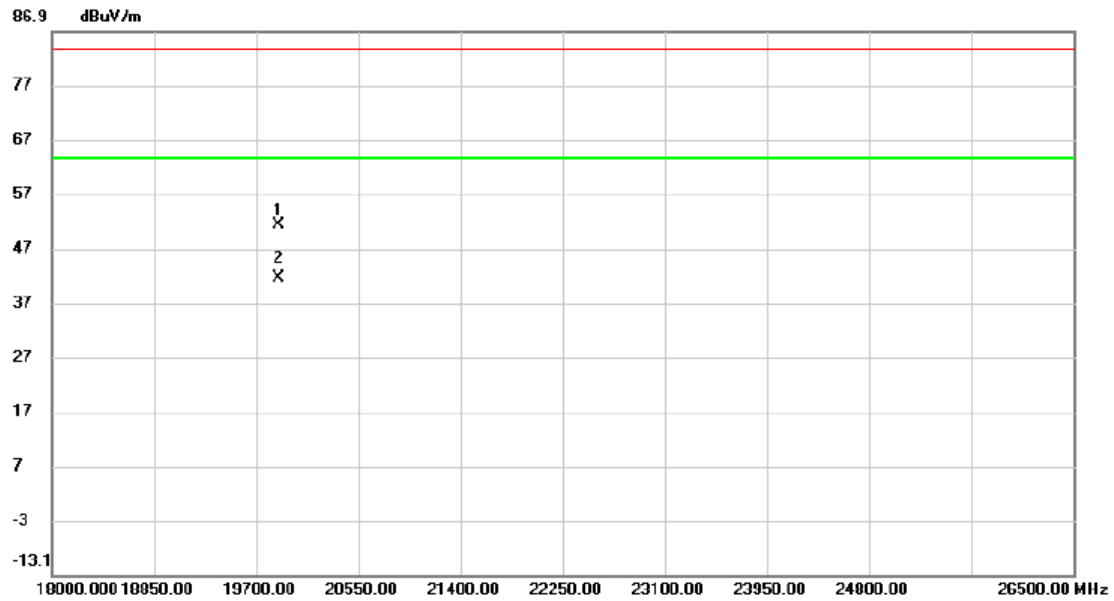


No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		24137.000	49.41	2.02	51.43	83.50	-32.07	peak	
2	*	24137.000	40.88	2.02	42.90	63.50	-20.60	AVG	

REMARKS:

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

Test Mode	TX Mode_2Mbps Channel 16	Polarization	Horizontal
-----------	--------------------------	--------------	------------



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		19891.250	52.27	-0.93	51.34	83.50	-32.16	peak	
2	*	19891.250	42.36	-0.93	41.43	63.50	-22.07	AVG	

REMARKS:

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

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

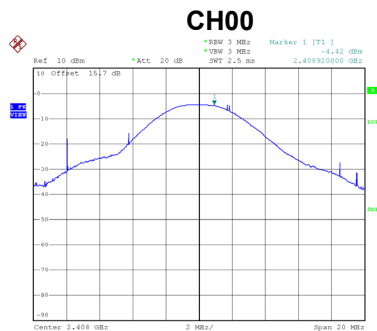
APPENDIX E - BANDWIDTH

APPENDIX F - MAXIMUM OUTPUT POWER

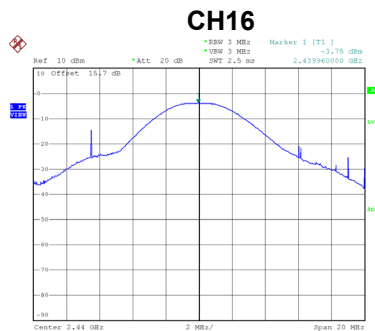
Test Mode	TX Mode _2Mbps
-----------	----------------

Frequency (MHz)	Output Power (dBm)	Output Power (W)	Max. Limit (dBm)	Max. Limit (W)	Test Result
2408	-4.42	0.0004	30.00	1.0000	Pass
2440	-3.75	0.0004	30.00	1.0000	Pass
2474	-4.09	0.0004	30.00	1.0000	Pass

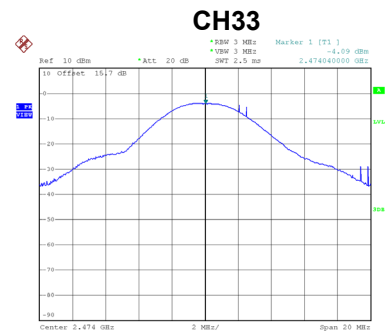
Note: Output power = Measure result + Cable loss



Date: 15.DEC.2024 03:07:20



Date: 15.DEC.2024 02:48:03

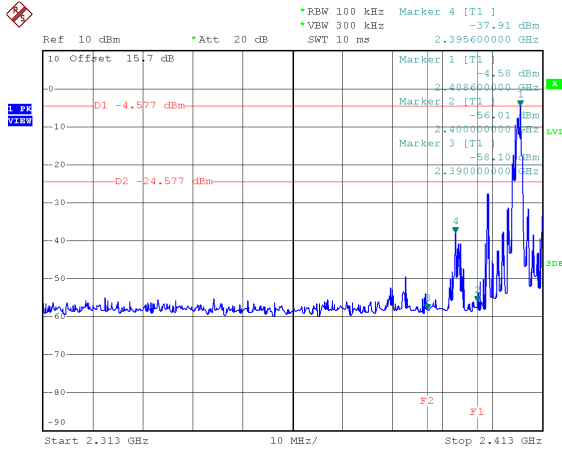


Date: 15.DEC.2024 02:50:45

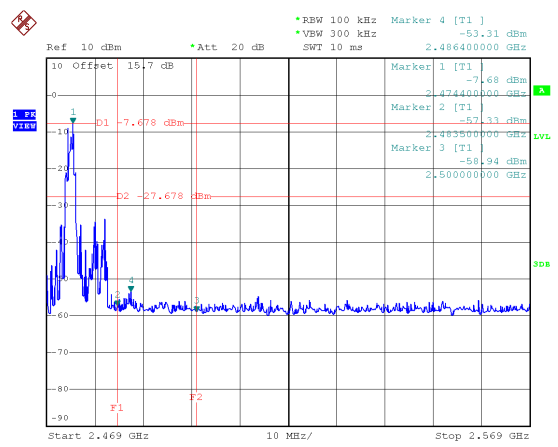
APPENDIX G - CONDUCTED SPURIOUS EMISSION

Test Mode	TX Mode_2Mbps
-----------	---------------

Bandedge CH00 (Lower)



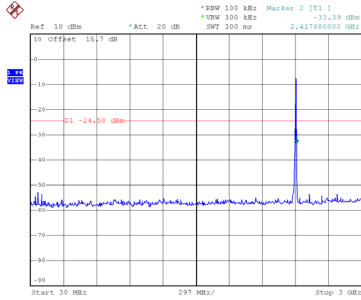
Bandedge CH33 (Upper)



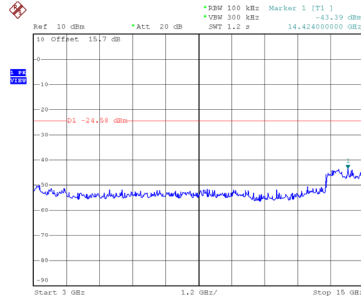
Date: 17.DEC.2024 08:21:41

Date: 17.DEC.2024 08:25:04

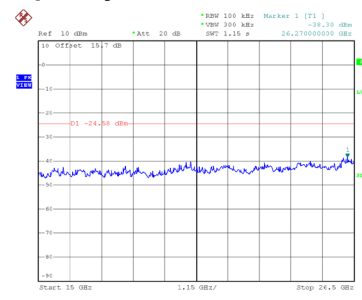
CH00 – 10th Harmonic of the fundamental frequency



Date: 17.DEC.2024 08:21:57

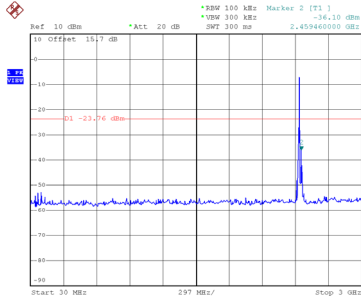


Date: 17.DEC.2024 08:22:05

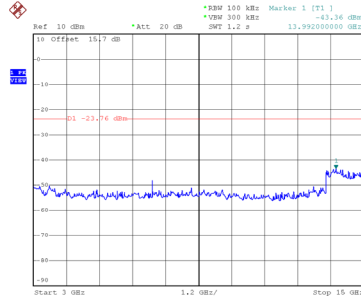


Date: 17.DEC.2024 08:22:13

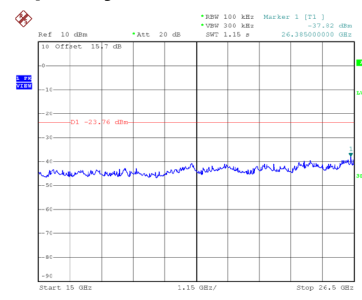
CH16 – 10th Harmonic of the fundamental frequency



Date: 17.DEC.2024 08:22:49

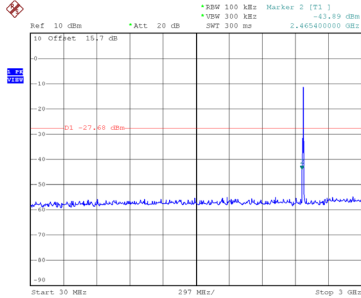


Date: 17.DEC.2024 08:22:58

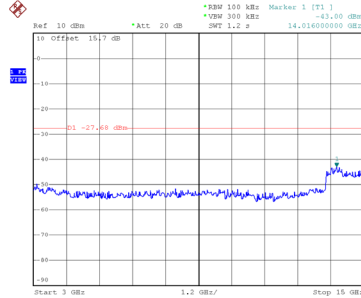


Date: 17.DEC.2024 08:23:06

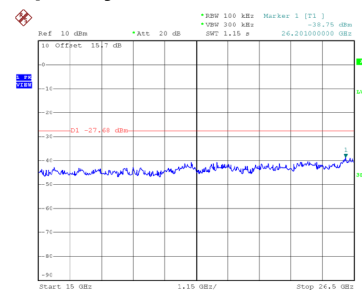
CH33 – 10th Harmonic of the fundamental frequency



Date: 17.DEC.2024 08:25:18



Date: 17.DEC.2024 08:25:26

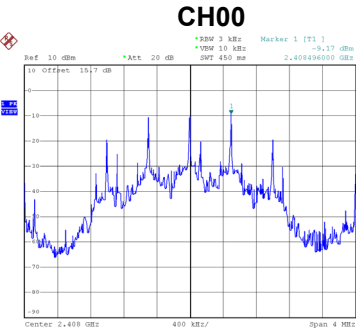


Date: 17.DEC.2024 08:25:34

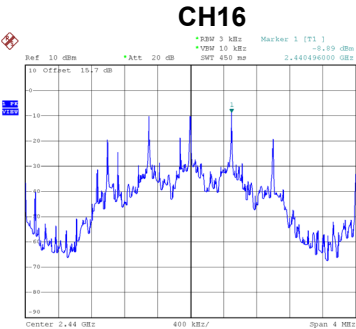
APPENDIX H - POWER SPECTRAL DENSITY

Test Mode	TX Mode _2Mbps
-----------	----------------

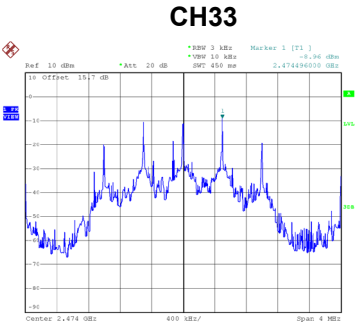
Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Max. Limit (dBm/3 kHz)	Test Result
00	2408	-9.17	8.00	Pass
16	2440	-8.89	8.00	Pass
33	2474	-8.96	8.00	Pass



Date: 15.DEC.2024 02:44:56



Date: 15.DEC.2024 02:47:57



Date: 15.DEC.2024 02:50:39

End of Test Report