MEASUREMENT REPORT

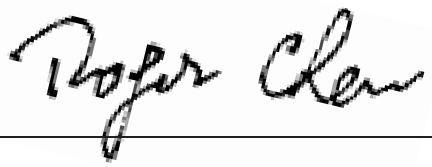
(FCC : Part 15 Subpart C (15.247) / ANSI C63.4-2014 /C63.10-2013)
Classification : (DTS) Digital Transmission System

Testing Laboratory
1288

Product	:	Dimensioner
Trade Name	:	CIPHERLAB
Model No.	:	2565
Applicant	:	CIPHERLAB Co., Ltd.
Applicant Address	:	12F., No. 333,Sec. 2,Dunhua S. Rd., Taipei City 106033, Taiwan

Report Number	MLT2406P15001A1-BLE
Applicant	CIPHERLAB Co., Ltd.
Product	Dimensioner
Sample Received Date	2024/06/24
Sample Tested Date	2024/08/09

Report Prepared By	Jesse Tien
Signature	
Date Prepared	2024/08/22

Report Authorized By	Roger Chen
Signature	
Date Authorized	2024/08/22

Test By

Max Light Technology Co., Ltd.
No.74-4, Shibachong Xi, Shiding Dist., New Taipei City 223,
Taiwan R.O.C.
Office : Tel: 886-2-2363-2447 Fax: 886-2-2363-2597
Lab. : Tel: 886-2-2663-3486 Fax: 886-2-2663-3582

This test report not include the evaluation of MU.
The test results only relate to the submitted test sample.

Table of Contents :

History of Test Report

Original Report Issue Date: 2024/08/15
■ No additional attachment
□ additional attachments were issued as in the following record:

Attachment No.	Issue Date	Description
MLT2406P15001-BLE	2024/08/15	Original Report
MLT2406P15001A1-BLE	2024/08/22	Change of Applicant (Details below): This is a case of forwarding report, and the test report will be forwarded by Champtek Incorporated to CIPHERLAB Co., Ltd. and the test data will be used in the original report MLT2406P15001-BLE except for the differences described below. (1) Applicant: Champtek Incorporated changed to CIPHERLAB Co., Ltd. (2) Applicant's address: From 1F, No. 4, Alley 2, Shih-Wei Lane, Chung-Cheng Rd., Xindian Dist., New Taipei City 231, Taiwan changed to 12F., No. 333, Sec. 2, Dunhua S. Rd., Taipei City 106033, Taiwan (3) Model: VM200 changed to 2565 (4) Product name: Handheld Volume Measurement Reader changed to Dimensioner (5) Trademark: Changed from Champtek and SCANTECH ID to CIPHERLAB

1. General

1.1 Introduction

The following measurement report is submitted on behalf of CIPHERLAB Co., Ltd. In support of a Class B Digital Device certification in accordance with Part2 Subpart J and Part 15 Subpart C of the Commission's and Regulations.

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

Parameter	MU
Radio Frequency	12.3Hz
Total RF power (conducted)	3.65 dB
RF power density (conducted)	3.65 dB
Spurious emissions (conducted)	3.65 dB
All emissions (radiated)	3.95 dB

1.2 Customer Details

Applicant Name	CIPHERLAB Co., Ltd.
Applicant Address	12F., No. 333,Sec. 2,Dunhua S. Rd., Taipei City 106033, Taiwan
Manufacturer Name	Champtek Incorporated
Manufacturer Address	1F, No. 4, Alley 2, Shih-Wei Lane, Chung-Cheng Rd., Xindian Dist., New Taipei City 231,Taiwan

1.3 Technical data of EUT

Equipment	Dimensioner
Model No	2565
Series Model Number	N/A
Model Difference	N/A
FCC ID	Q3N-2565
Power Type	3.6 Vdc (From Li-ion Battery)
Type of Modulation	GFSK
Transfer rate	1 Mbps
Type of Antenna	CHIP Antenna
Max Antenna Gain	1.3 dBi
Frequency of Channel	See Next page 7

During testing the EUT was operated at Tx or Rx mode for each emission measured. This was done in order to ensure that maximum emission levels were attained.

Frequency of Each Channel (Working Frequency)

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

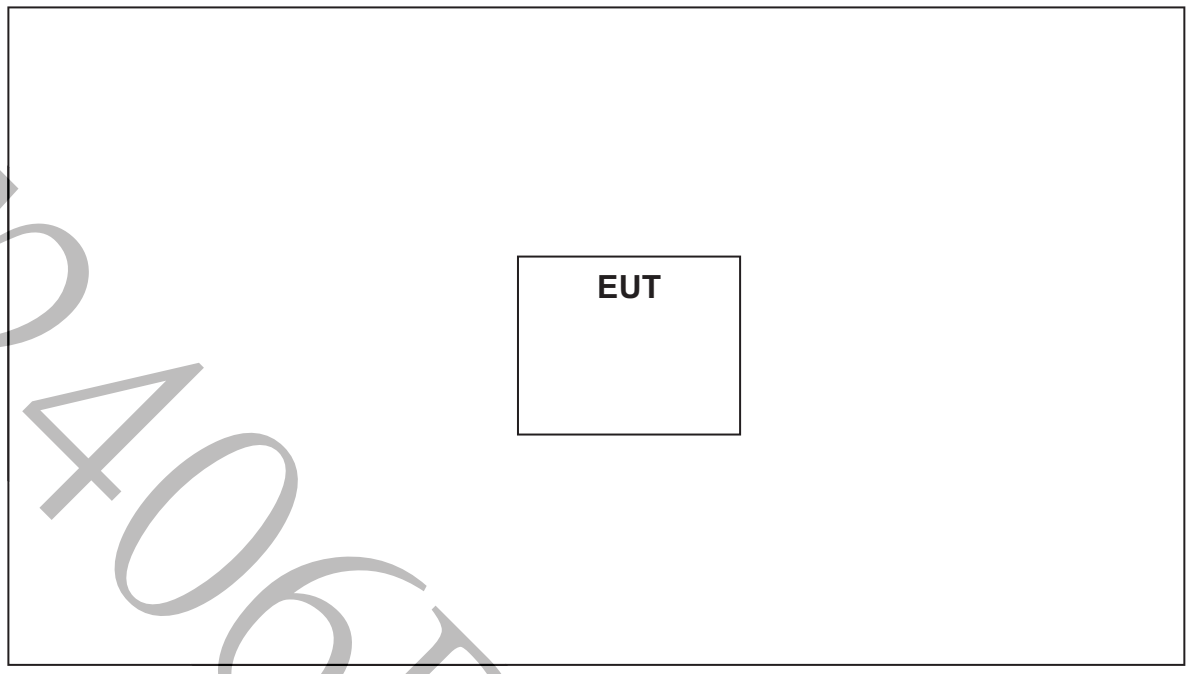
1.4 Summary Of Tests

47 CFR Part 15 Subpart C			
Reference	**Test**	**Results**	**Note**
15.207	Conducted Emission	PASS	
15.209	Radiated Emission	PASS	
15.247(c)	Transmitter Radiated Emissions	PASS	
15.247(b)	Max. Output Power	PASS	
15.247(a)(2)	6dB RF Bandwidth	PASS	
15.247(e)	Max. Power Density	PASS	
15.247(c)	Out of Band Conducted Spurious Emission	PASS	
15.247(d)	Band Edge Measurement	PASS	
15.203	Antenna Requirement	PASS	

1.5 Description of Support Equipment

In order to construct the minimum system which required by the ANSI C63.4-2014 / ANSI C63.10-2013, following equipments were used as the support units.

1.6 Configuration of System Under Test



Operate

1.7 Test Procedure

All measurements contained in this report were performed according to the techniques described in Measurement procedure ANSI C63.4-2014 / ANSI C63.10-2013 followed KDB 558074 D01 15.247 Meas Guidance v05r02 and KDB 662911 for this testing.

1.8 General Test Condition

The conditions under which the EUT operates were varied to determine their effect on the equipment's emission characteristics. The final configuration of the test system and the mode of operation used during these tests were chosen as that which produced the highest emission levels. However, only those conditions which the EUT was considered likely to encounter in normal use were investigated. The systems radiated and conducted emissions were investigated while the computer alternately transferred data to the EUT as well as to the monitor and printer. Using a test program which sent a continuous data and transferred data to and from the EUT was proven to worst case emissions. The system's physical layout and cabling was randomly arranged to ensure that maximum emission levels were attained.

This assessment of the maximum conducted output power tests is based on the minimum transfer rate will produce a maximum output power.

Note: Since the transmitter is considered a portable unit, it was pre-tested on the positioned in each of 3 axis. It was found that the Z Axis was the worst. It was the worst. It was taken as the representative condition for testing and its data are recorded in the present document.

2. Conducted Emissions Requirements

2.1 General & Setup:

The power line conducted emission measurements were performed in a shielded enclosure. The EUT was assembled on a wooden table which is 80 centimeters high, was placed 40 centimeters from the back wall and at least 1 meter from the sidewall.

Power was fed to the EUT from the public utility power grid through a line filter and EMCO Model 3825/2 Line Impedance Stabilization Networks (LISN). The LISN housing, measuring instrumentation case, ground plane, etc., were electrically bonded together at the same RF potential. The Spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the LISN was connected to the spectrum analyzer directly. Conducted emission levels were in the CISPER quasi-peak detection mode. The analyzer's 6 dB bandwidth was set to 9 kHz. No post-detector video filter was used.

The spectrum was scanned from 150 kHz to 30 MHz. The physical arrangement of the test system and associated cabling was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude and frequency. All spurious emission frequencies were observed. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in paragraph 2.5.

2.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	R&S	EMI Receiver	100085	ESPI	2024/03/12	2025/03/12
2.	EMCO	LISN	2654	3825/2	2023/12/14	2024/12/14

2.3 Test condition:

EUT tested in accordance with the specifications given by the manufacturer, and exercised in the most unfavorable manner.

2.4 Conducted Emissions Limits:

FCC Part 15

Frequency range (MHz)	Limits (dBuV)			
	Class A		Class B	
	QP	Avg.	QP	Avg.
0.15 to 0.50	79	66	66 to 56	56 to 46
0.50 to 5.0	73	60	56	46
5.0 to 30	73	60	60	50

2.5 Measurement Data Of Conducted Emissions:

2.5.1 Conducted Emissions

The following table show a summary of the highest emissions of power line conducted emissions to the HOT and NEUTRAL conductor of the EUT power.

Test Mode : Charger Test Date : July 23, 2024

Conducted Emissions (Class B)										
Test Port	Freq (MHz)	Read(dBuV)		Factor	Limits (dBuV)		Amplitude (dBuV)		Margin (dBuV)	
		QP	AV		QP	AV	QP	AV	QP	AV
L1	0.1898	55.12	45.35	0.06	64.05	54.05	55.18	45.41	-8.87	-8.64
	0.2495	50.60	37.45	0.05	61.77	51.77	50.65	37.50	-11.12	-14.27
	0.3092	45.34	33.02	0.04	59.99	49.99	45.38	33.06	-14.61	-16.93
	0.3689	44.30	31.60	0.03	58.53	48.53	44.33	31.63	-14.20	-16.90
	0.4286	39.48	26.54	0.03	57.28	47.28	39.51	26.57	-17.77	-20.71
	0.4983	41.25	29.95	0.03	56.03	46.03	41.28	29.98	-14.75	-16.05
	0.6177	39.54	28.26	0.03	56.00	46.00	39.57	28.29	-16.43	-17.71
L2	0.1898	51.80	--	0.07	64.05	54.05	51.87	--	-12.18	--
	0.2495	50.77	--	0.05	61.77	51.77	50.82	--	-10.95	--
	0.3192	45.99	--	0.05	59.73	49.73	46.04	--	-13.69	--
	0.3689	47.96	--	0.04	58.53	48.53	48.00	--	-10.53	--
	0.4983	46.23	27.89	0.04	56.03	46.03	46.27	27.93	-9.76	-18.10
	0.5978	46.30	27.89	0.04	56.00	46.00	46.34	27.93	-9.66	-18.07
	0.7868	44.38	--	0.03	56.00	46.00	44.41	--	-11.59	--

Notes : 1.L1: One end & Ground L2: The other end & Ground

2. Height of table on which the EUT was placed : 0.8 m.
3. The Quasi-Peak Value have already met the Average Value Limit showed on above limits.
4. The above test results are obtained under the normal condition.
5. Amplitude = Read + Factor
6.Margin<0 is Pass , Margin≧0 is Fail ,

3. Radiated Emissions Requirements (Below 1GHz)

3.1 General & Setup:

Prior to open-field testing, the EUT was placed in a shielded enclosure and scanned at a close distance to determine its emission characteristics. The physical arrangement of the EUT was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude, directivity, and frequency. The exact system configuration which produced the highest emissions was noted so it could be reproduced later during the open-field tests. This was done to ensure that the final measurements would demonstrate the worst-case interference potential of the EUT. The radiated emissions test is made at a 3 meters open site from 30MHz to 1GHz. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 30 MHz to 1000 MHz using an Hewlett Packard E7403A Spectrum Analyzer, EMCO Biconilog Antenna (Model 3142C) for 30MHz -1GHz. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization. Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post-detector video filters were used in the test. The spectrum analyzer's 6 dB bandwidth was set to 120 KHz, and the analyzer was operated in the quasi-peak detection mode. The highest emission amplitudes relative to the appropriate limit were measured and recorded in paragraph 3.5.

3.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US40240137	E7403A	2024/01/12	2025/01/12
2.	Agilent	Spectrum Analyzer	MY46471764	N0920A	2023/12/22	2024/12/22
3.	EMCO	Biconilog Antenna	00044568	3142C	2023/09/21	2024/09/21
4.	MLT	Pre Amplifier	20110301	PREAMP6G-02	2024/03/12	2025/03/12
5.	MLT	Pre Amplifier	20110209	PREAMP6G-01	2024/03/12	2025/03/12
6.	MLT	Pre Amplifier	RF-01	0.10~19.1GHz 60dBm	2024/03/12	2025/03/12

3.3 Test Condition:

EUT tested in accordance with the specifications given by the manufacturer, and exercised in the most unfavorable manner.

3.4 Radiated Emissions Limits:

FCC Part 15

Frequency range (MHz)	Limits (dBuV)			
	Class A		Class B	
	Distance (Meter)	Limits (dBuV/m)	Distance (Meter)	Limits (dBuV/m)
30 to 88	10	39	3	40
88 to 216	10	43.5	3	43.5
216 to 960	10	46.5	3	46
Above 960	10	49.5	3	54

5th harmonic of the highest frequency or 40 GHz, whichever is lower.

3.5 Measurement Data Of Radiated Emissions:

3.5.1 Open Field Radiated Emissions

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : Worst case (Z Axis) Test Date : Aug. 06, 2024
2480MHz 3M Rate Mode

Radiated Emissions (VERTICAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
31.82	34.67	-13.05	100	39	21.62	40	-18.38
67.06	42.42	-23.51	100	354	18.91	40	-21.09
228.12	42.40	-18.57	100	91	23.83	46	-22.17
232.68	43.54	-18.25	100	360	25.29	46	-20.71
244.12	42.24	-17.72	100	128	24.52	46	-21.48
444.34	43.82	-10.87	100	345	32.95	46	-13.05

Radiated Emissions (HORIZONTAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
30.89	36.27	-12.57	100	38	23.70	40	-16.30
286.30	41.44	-17.13	400	230	24.31	46	-21.69
383.43	38.76	-12.47	100	360	26.29	46	-19.71
471.91	38.30	-9.17	100	50	29.13	46	-16.87
897.09	28.21	1.30	100	335	29.51	46	-16.49
952.38	31.01	2.25	100	0	33.26	46	-12.74

Notes :
1. Margin= Amplitude - Limits
2. Distance of Measurement : 3 Meter
3. Height of table for EUT placed: 0.8 Meter
4. Amplitude= Reading Amplitude + Factor
5. Pre amplifier Gain :38dB to 42dB
6. Margin<0 is Pass , Margin≧0 is Fail

4. Maximum Conducted Output Power Requirements

4.1 Test Condition & Setup:

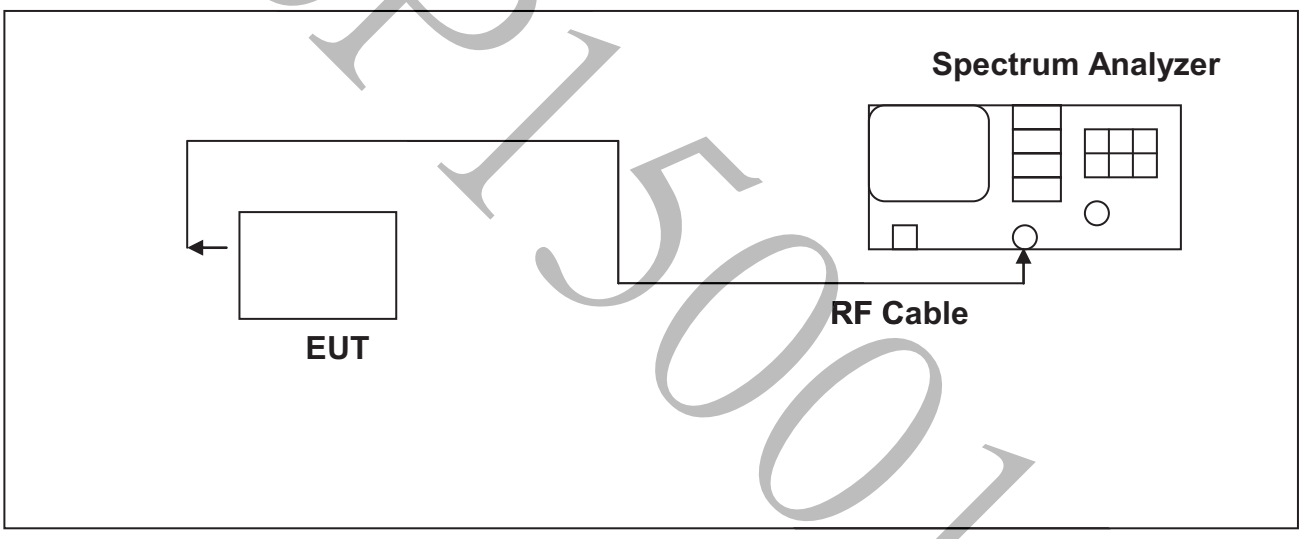
While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to spectrum analyzer. The maximum peak output power shall not exceed 1 watt.

The antenna port of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6)/3 dBm.

Measurement procedure is followed KDB 558074 D01 15.247 Meas Guidance v05r02 (9.1.2 : Integrated band power method)

4.2 Test Instruments Configuration:



4.3 Test Equipment List:

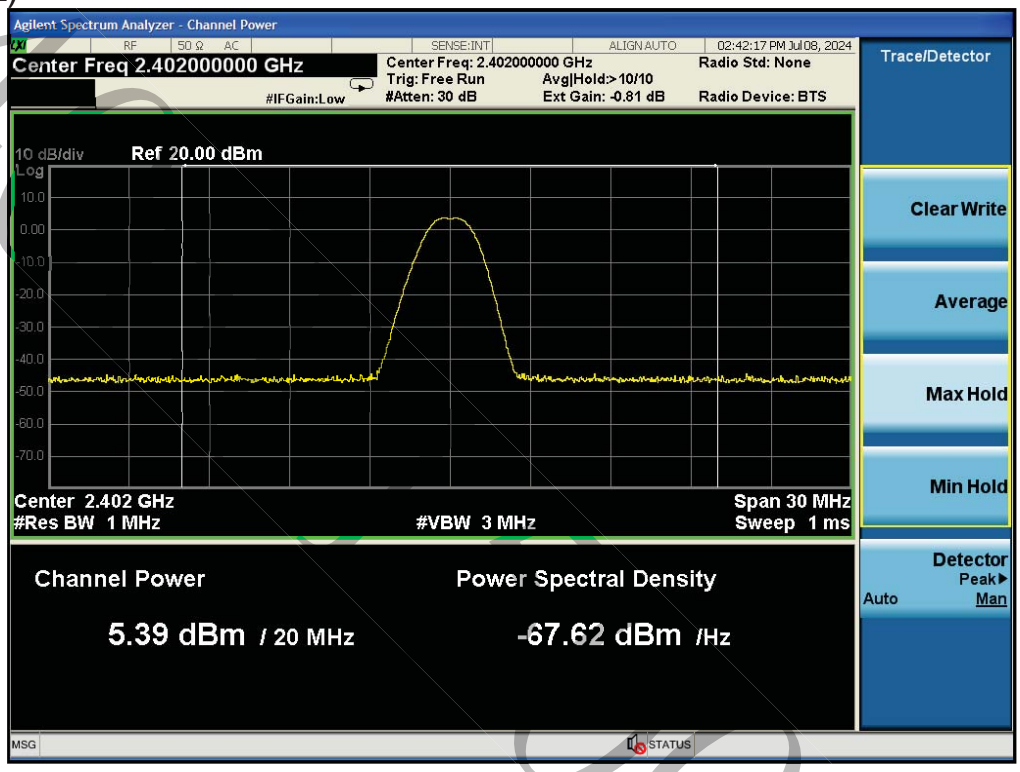
Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	MY46471764	N9020A	2023/12/22	2024/12/22

4.4 Test Result:

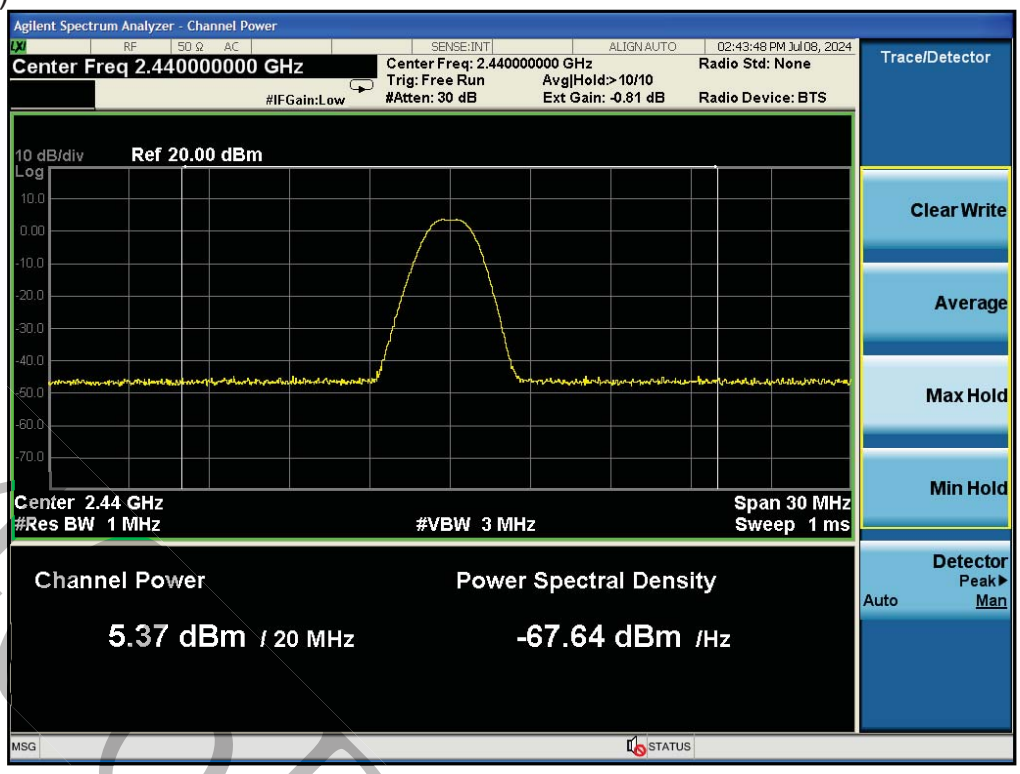
Channel	Frequency (MHz)	Results (dBm)	Limit (dBm)
0	2402	5.39	<30
19	2440	5.37	<30
39	2480	5.93	<30

Note : 1. Cable Loss = 0.5dB.
2. Result= Instrument reading value + Cable Loss

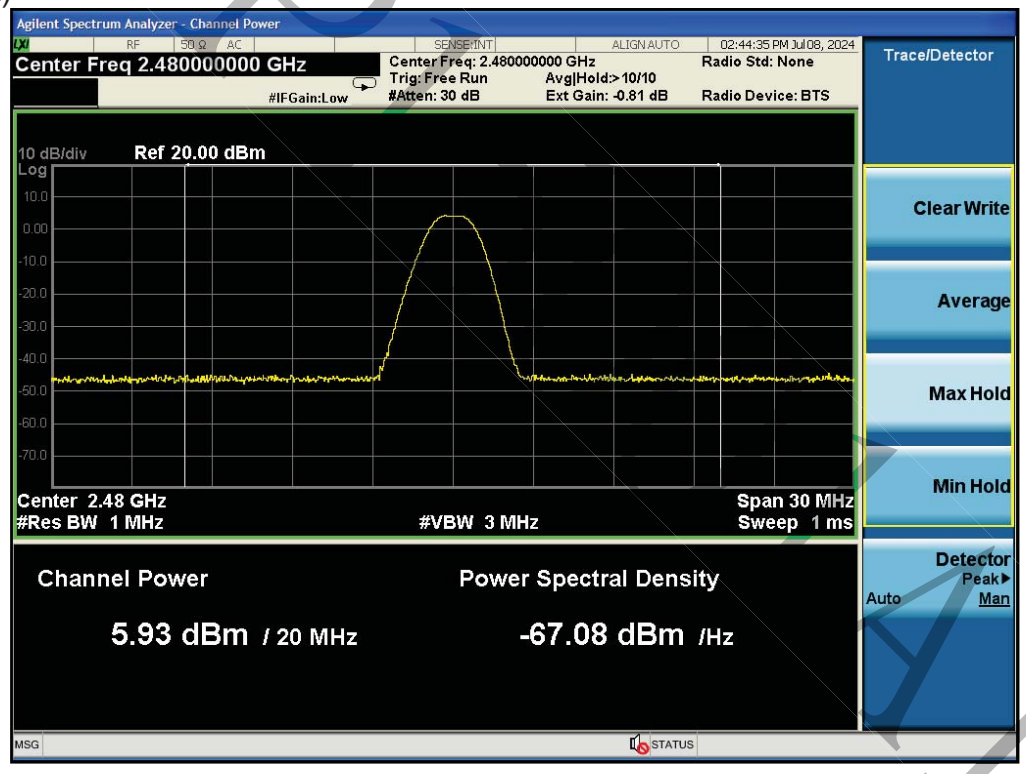
(2402MHz)



(2440MHz)



(2480MHz)



5. Minimum 6dB RF Bandwidth Requirements

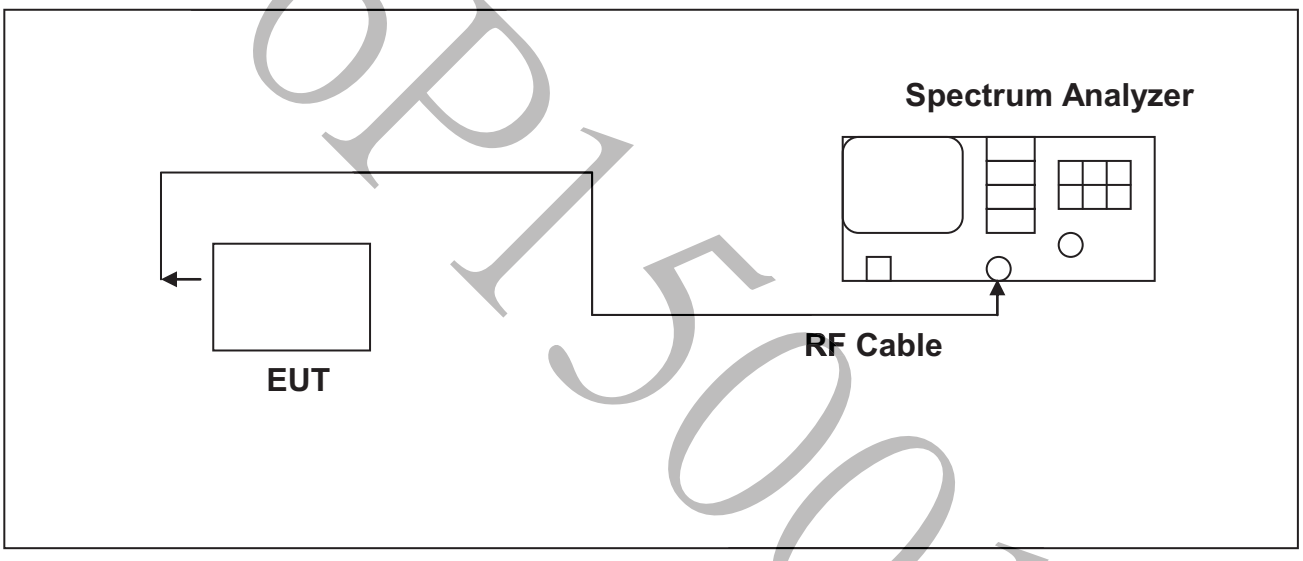
5.1 Test Condition & Setup:

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW set to 100 kHz .VBW set to 300kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel 0, 19, 39)

Measurement procedure is followed KDB 558074 D01 15.247 Meas Guidance v05r02 (8.1 option 1: DTS bandwidth)

5.2 Test Instruments Configuration:



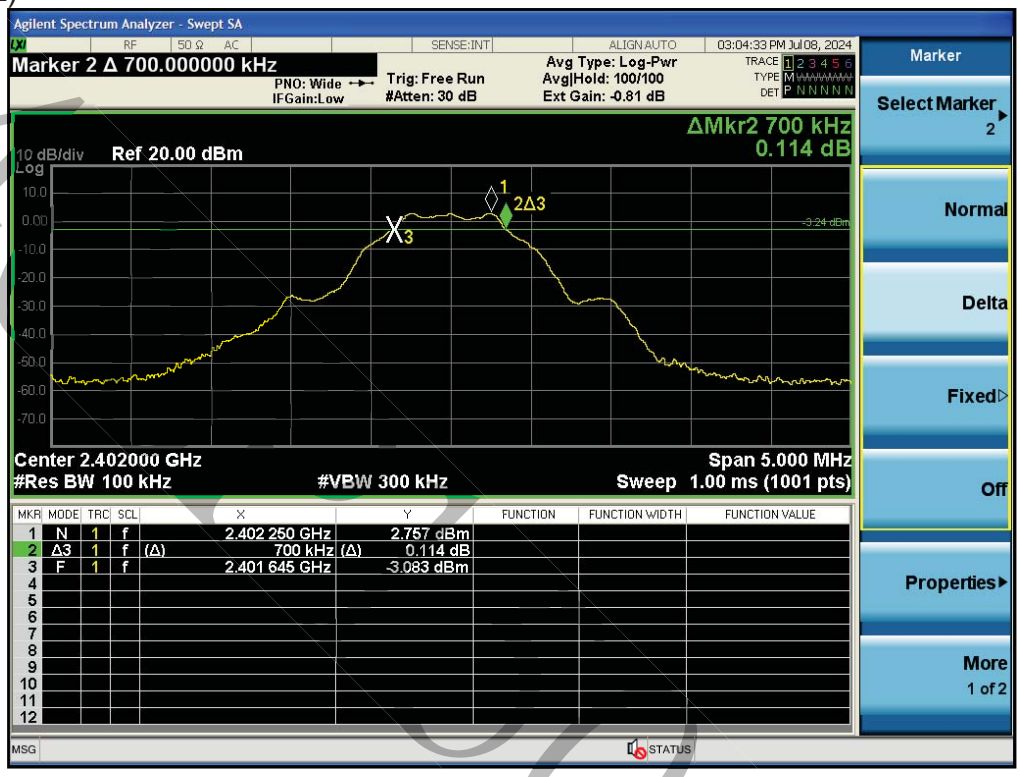
5.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	MY46471764	N9020A	2023/12/22	2024/12/22

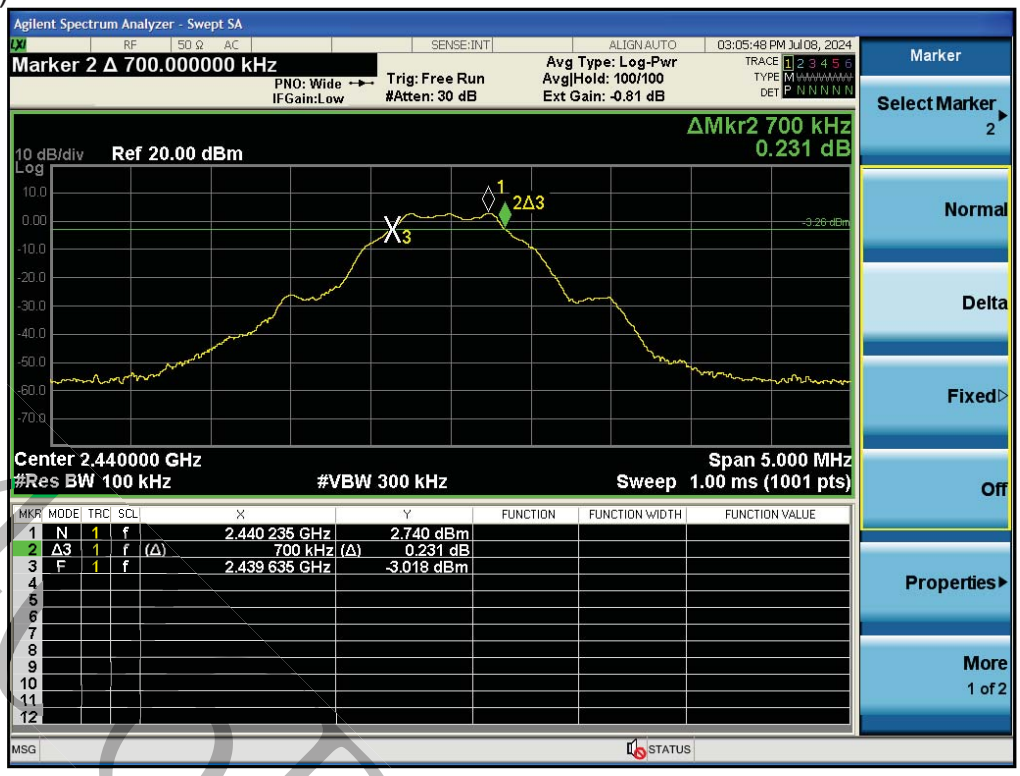
5.4 Test Result:

Channel	Frequency (MHz)	Results (MHz)	Limit
0	2402	0.700	>500kHz
19	2440	0.700	>500kHz
39	2480	0.705	>500kHz

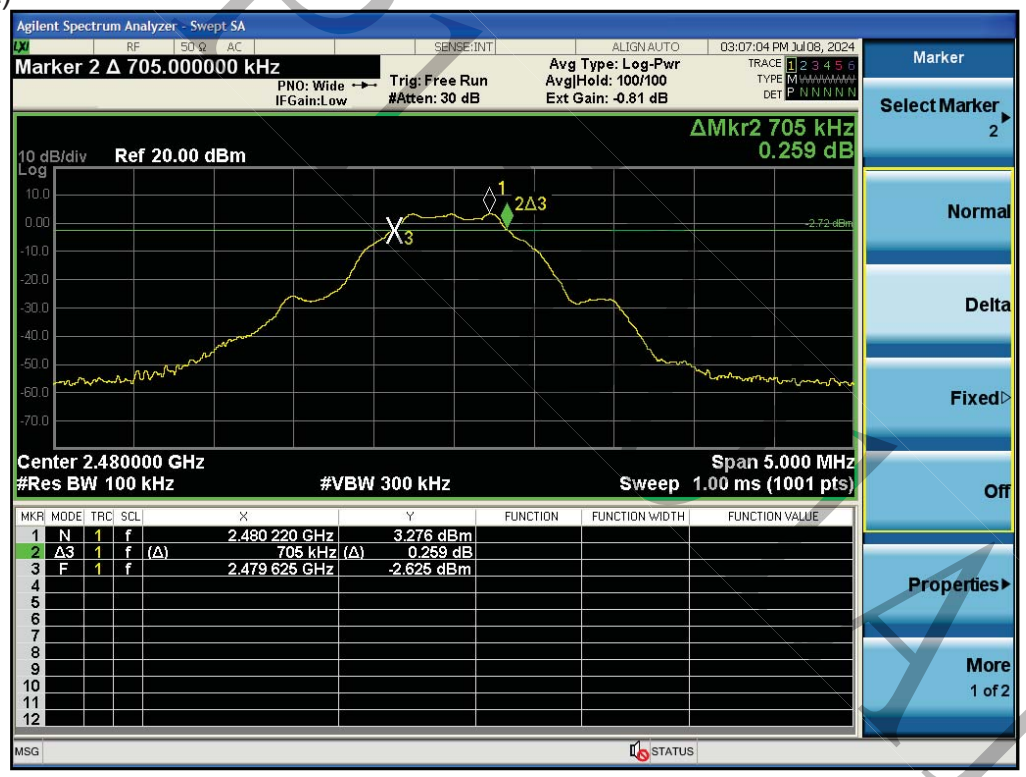
(2402MHz)



(2440MHz)



(2480MHz)



6. Maximum Power Density Requirements

6.1 Test Condition & Setup:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RBW =3kHz , VBW=30kHz ,

Detector = peak , Sweep time = auto couple , Trace Mode = max hold , Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level in any 3kHz band segment within the fundamental EBW.

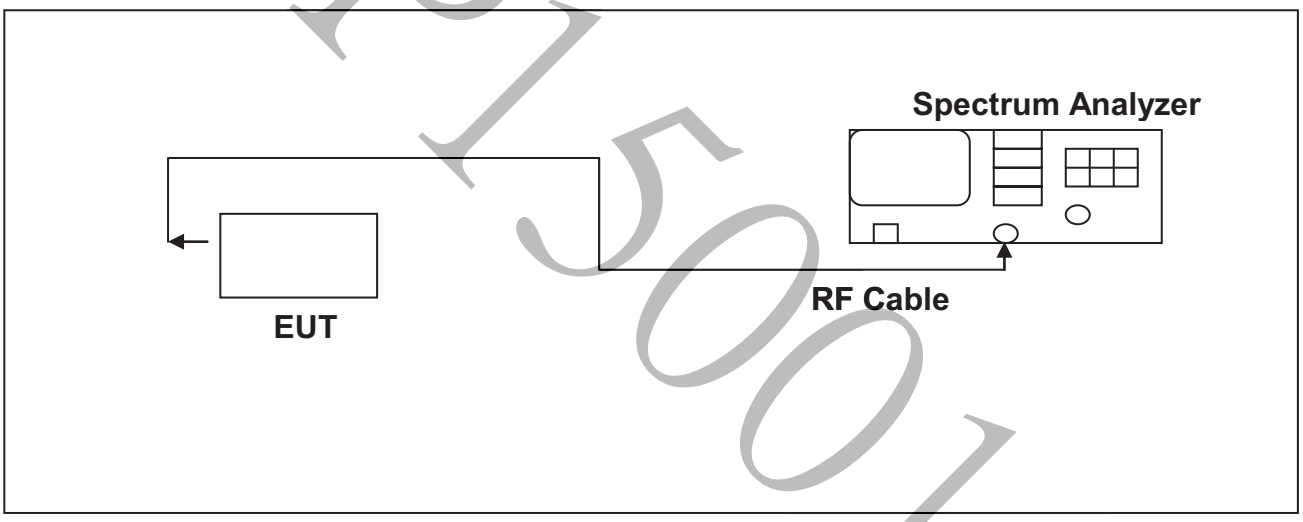
Measurement procedure is followed KDB 558074 D01 15.247 Meas Guidance v05r02 (10.2 Method PKPSD (peak PSD)

2) In-Band Power Spectral Density (PSD) Measurements

a) Measure and sum the spectra across the outputs.

c) add 10 log(Nant) dB .

6.2 Test Instruments Configuration:



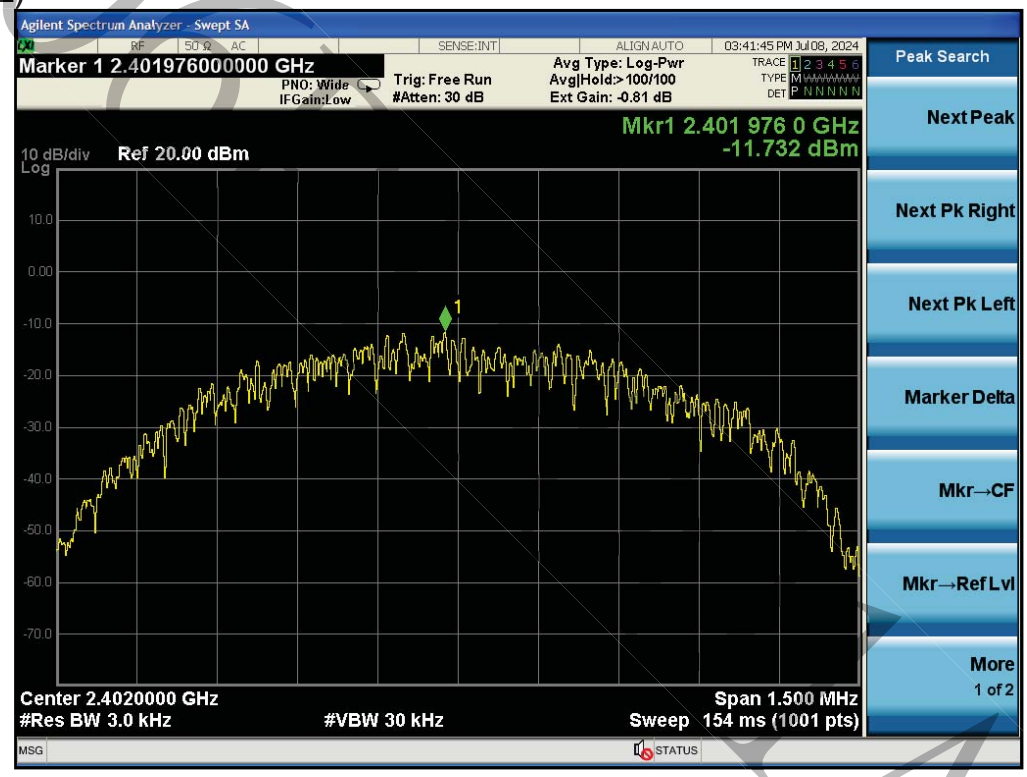
6.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	MY46471764	N9020A	2023/12/22	2024/12/22

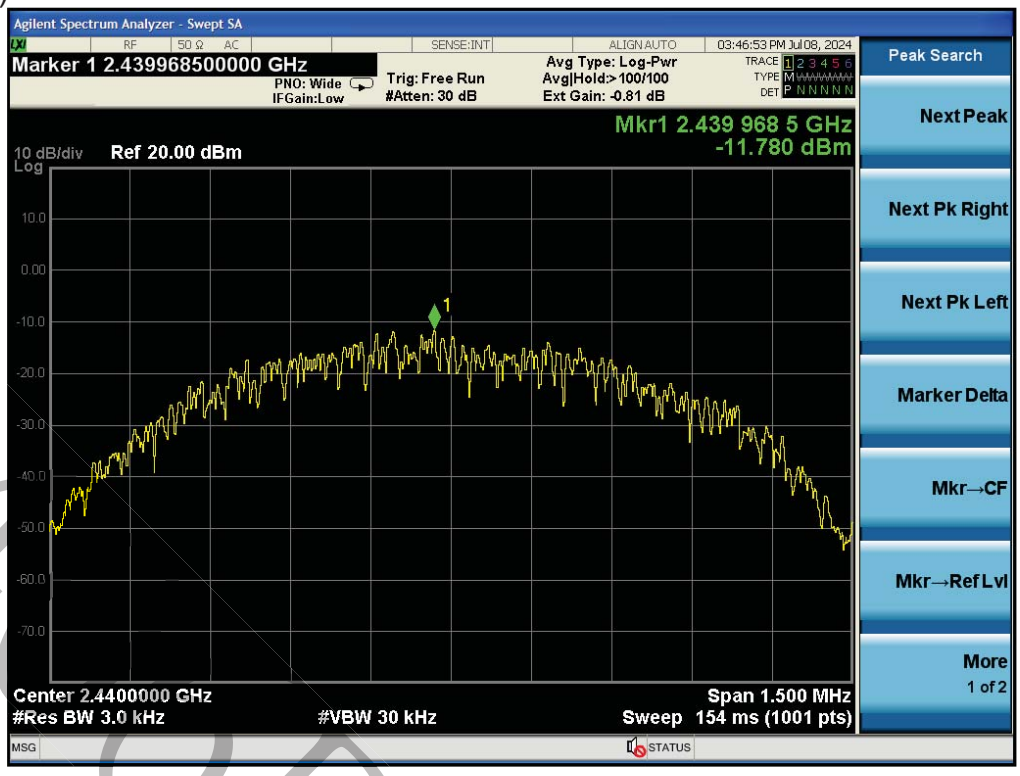
6.4 Test Result:

Frequency (MHz)	Power Density (dBm)	Limit
2402	-11.73	<8dBm
2440	-11.78	<8dBm
2480	-11.12	<8dBm

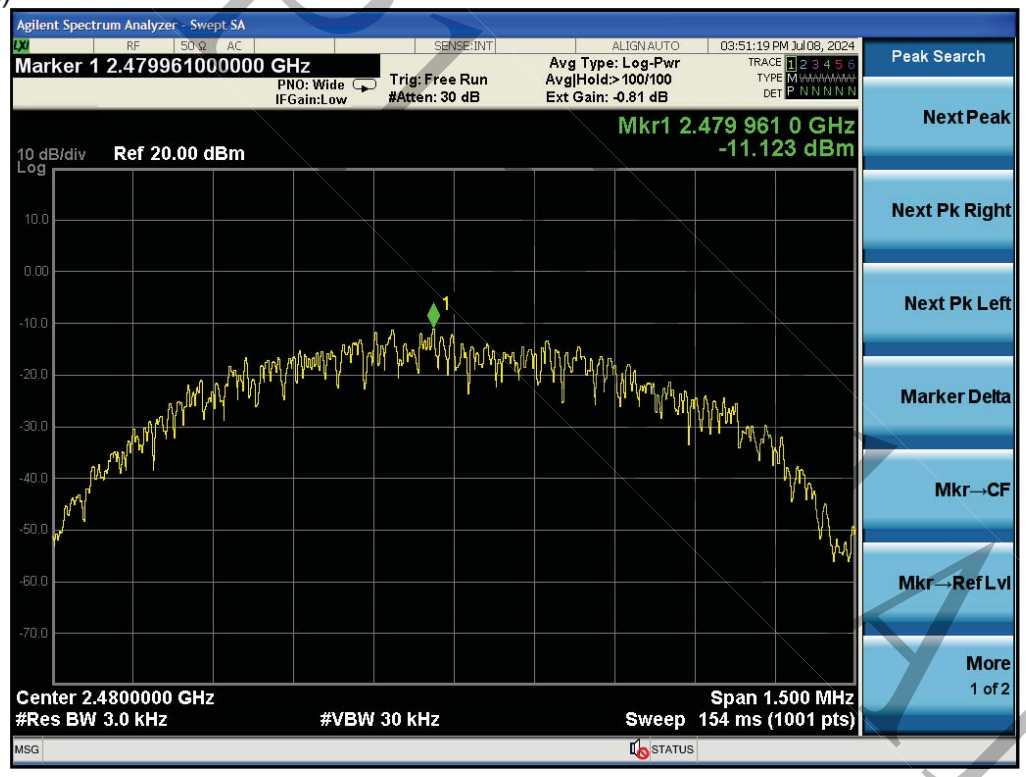
(2402MHz)



(2440MHz)



(2480MHz)



7. Out of Band Conducted Spurious Emissions Requirements

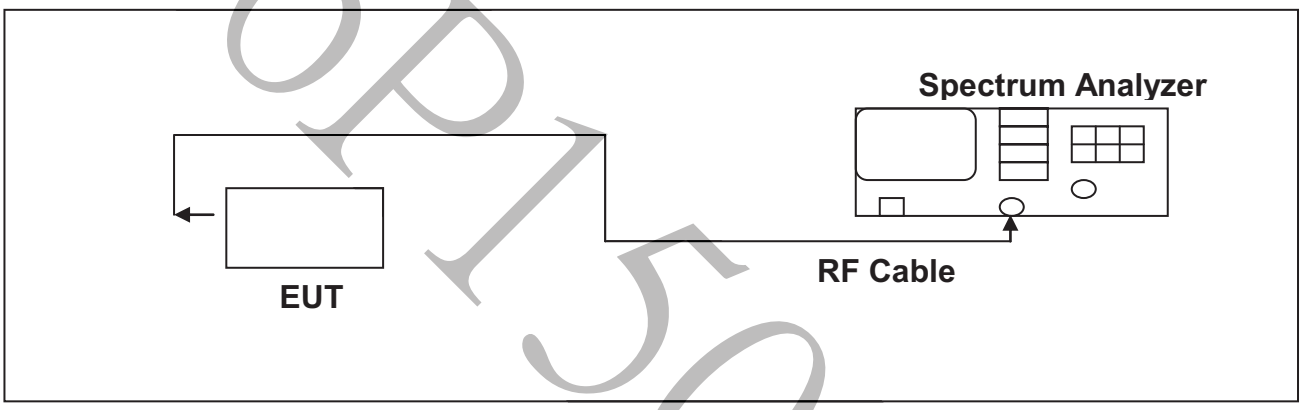
7.1 Test Condition & Setup:

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels.

Measurement procedure is followed KDB 558074 D01 15.247 Meas Guidance v05r02 (11.3 Emission level measurement)

7.2 Test Instruments Configuration:



7.3 Test Equipment List:

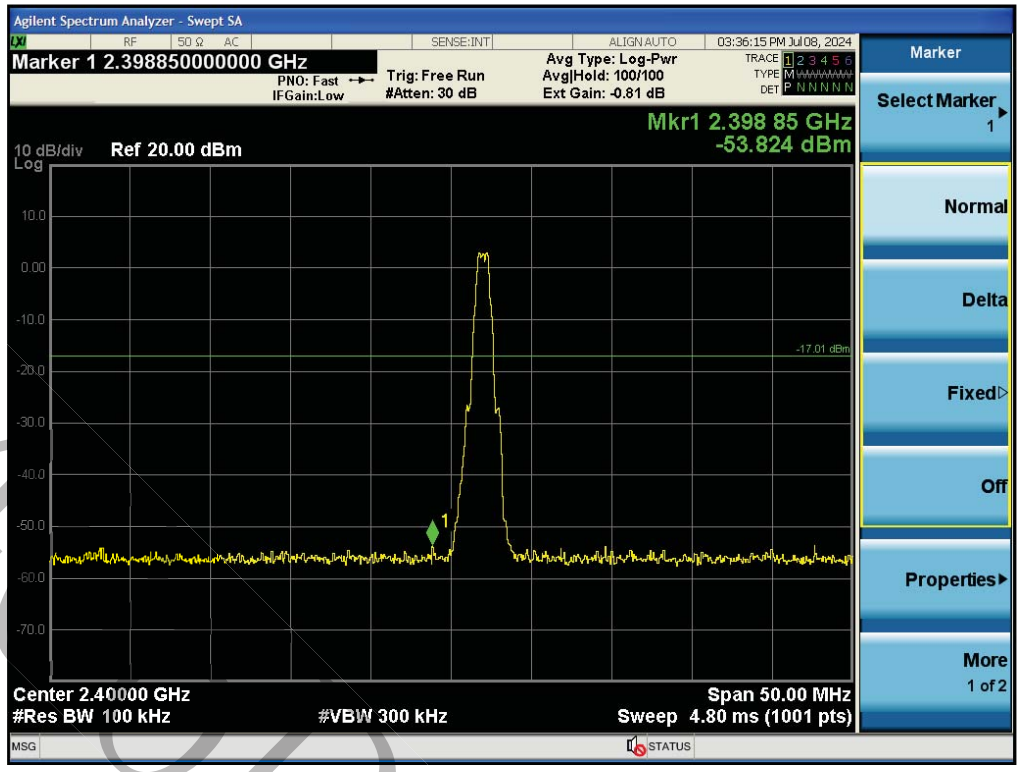
Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	MY46471764	N9020A	2023/12/22	2024/12/22

7.4 Test Result:

Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

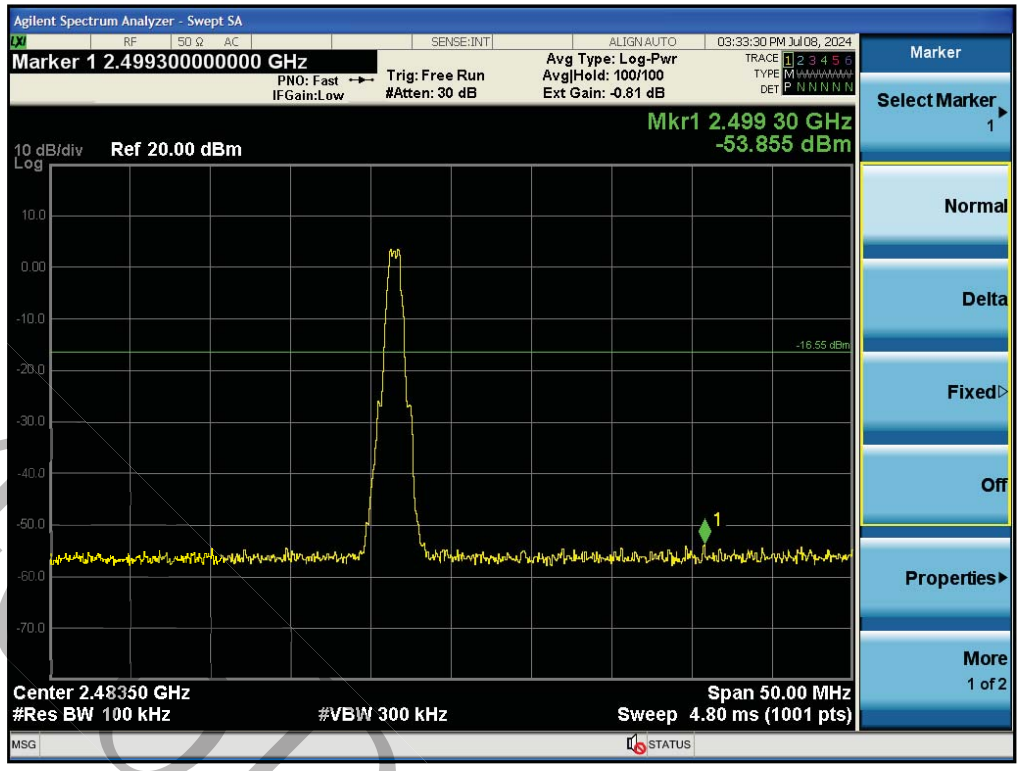
For the result, if the spurious emission of two antennas have the same frequency, we choice the worst one and add 3dB to be the final result, otherwise, use the graph to represent it.

(2402MHz)


Agilent Spectrum Analyzer - Swept SA
Marker 1 2.398850000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
Ext Gain: -0.81 dB
03:36:15 PM Jul 08, 2024
Mkr1 2.398 85 GHz
-53.824 dBm
10 dB/div
Log
Ref 20.00 dBm
-17.01 dBm
Center 2.40000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 50.00 MHz
Sweep 4.80 ms (1001 pts)
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Marker 1 24.800240000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 11/100
Ext Gain: -0.81 dB
03:37:10 PM Jul 08, 2024
Mkr1 24.800 GHz
-37.428 dBm
10 dB/div
Log
Ref 20.00 dBm
-17.01 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (1001 pts)
Marker
Select Marker
1
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS

(2480MHz)


Agilent Spectrum Analyzer - Swept SA
Marker 1 2.499300000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
Ext Gain: -0.81 dB
03:33:30 PM Jul 08, 2024
Mkr1 2.499 30 GHz
-53.855 dBm
10 dB/div
Log
Ref 20.00 dBm
-16.55 dBm
Center 2.48350 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 50.00 MHz
Sweep 4.80 ms (1001 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Marker 1 24.650420000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 11/100
Ext Gain: -0.81 dB
03:34:20 PM Jul 08, 2024
Mkr1 24.650 GHz
-38.008 dBm
10 dB/div
Log
Ref 20.00 dBm
-16.55 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.39 s (1001 pts)
Marker
Select Marker
Normal
Delta
Fixed
Off
Properties
More
1 of 2
MSG
STATUS

8. Band Edges Requirements

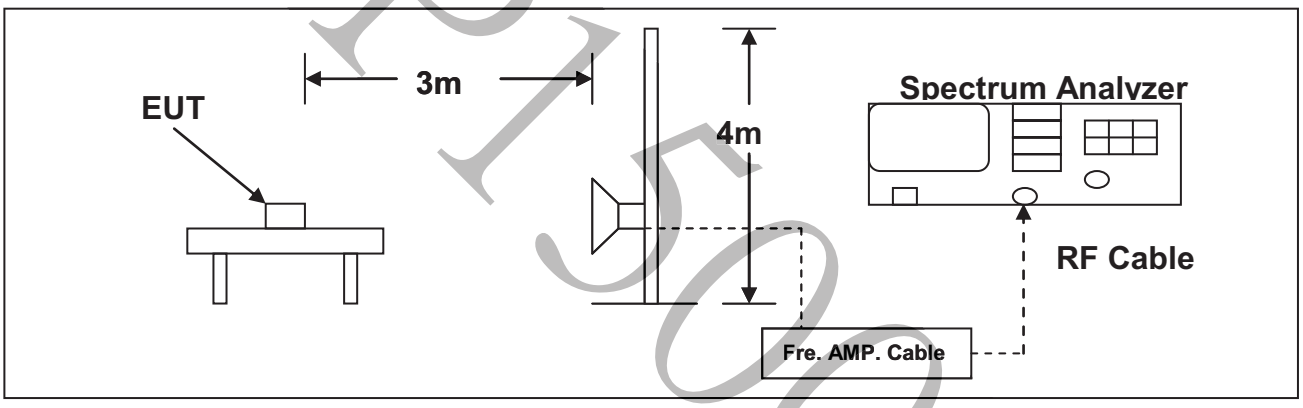
8.1 Test Condition & Setup:

The emissions on the harmonics frequencies, the limits, and the margin of compliance are presented. These tests were made when the transmitter was in full radiated power. The additional test was performed to show compliance with the requirement at the band edge frequency 2400 MHz and up to 2483.5 MHz.

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 conducted power limits.

Measurement procedure followed KDB 558074 D01 15.247 Meas Guidance v05r02 (13.3.1 Band-edge measurements)

8.2 Test Instruments Configuration:



8.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US44300422	E4446A	2024/03/12	2025/03/12
2.	TA	Pre Amplifier	RF-01	0.10~19.1GHz 60dBm	2024/03/12	2025/03/12
3.	SCHWARZBECK	Horn Antenna	304	BBHA 9120 D	2024/02/16	2025/02/16
4.	Agilent	Spectrum Analyzer	US40240137	E7403A	2024/01/12	2025/01/12
5.	MLT	Pre Amplifier	20110209	PREAMP6G-01	2024/03/12	2025/03/12

8.4 Test Result:

Test Date : July 17, 2024

Radiated Emissions (HORIZONTAL) CH00							
Frequency (MHz)	Amplitude (dBuV/m)		Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2320.08	45.23	(PK)	1.5	180	0	74.0(PK)	-28.77
--	--	(AV)	--	--	--	54.0(AV)	--

Radiated Emissions (VERTICAL) CH00							
Frequency (MHz)	Amplitude (dBuV/m)		Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2326.74	46.28	(PK)	1.5	199	0	74.0(PK)	-27.72
--	--	(AV)	--	--	--	54.0(AV)	--

Radiated Emissions (HORIZONTAL) CH39							
Frequency (MHz)	Amplitude (dBuV/m)		Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2492.62	44.38	(PK)	1.5	190	0	74.0(PK)	-29.62
--	--	(AV)	--	--	--	54.0(AV)	--

Radiated Emissions (VERTICAL) CH39							
Frequency (MHz)	Amplitude (dBuV/m)		Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2494.155	46.79	(PK)	1.5	200	0	74.0(PK)	-27.21
--	--	(AV)	--	--	--	54.0(AV)	--

Notes : 1.Margin= Amplitude - Limits

2. Height of table for EUT placed: 1.5 Meter
3. ANT= Antenna height
4. Duty= Duty cycle correction factor
5. Amplitude= Reading Amplitude – Amplifier gain+ Cable loss+ Antenna factor (Auto calculate in spectrum analyzer)
6. Margin<0 is Pass , Margin≧0 is Fail

9. Radiated Emissions Requirements (Above 1GHz)

9.1 General and setup:

Prior to open-field testing, the EUT was placed in a shielded enclosure and scanned at a close distance to determine its emission characteristics. The physical arrangement of the EUT was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude, directivity, and frequency. The exact system configuration which produced the highest emissions was noted so it could be reproduced later during the open field tests. This was done to ensure that the final measurements would demonstrate the worst-case interference potential of the EUT.

Final radiation measurements were made on a three-meter, open-field test site. The EUT system was placed on a nonconductive turntable which was 1.5 meters height, top surface 1.0 x 1.5 meter. During the test, EUT was set to transmit continuously & measurements spectrum range from 30 MHz to 26.5 GHz is investigated.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvlt (dBuV) into field intensity in microvolts pre meter(uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in microcolts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

Amplitude (dBuV/m)= FI(dBuV)+AF(dBuV)+CL(dBuV)-Gain(dB)

FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(1) For fundamental frequency : Transmitter Output < +30dBm

(2) For spurious frequency : Spurious emission limits = fundamental emission limit /10

9.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US44300422	E4446A	2024/03/12	2025/03/12
2.	TA	Pre Amplifier	RF-01	0.10~19.1GHz 60dBm	2024/03/12	2025/03/12
3.	SCHWARZBECK	Horn Antenna	304	BBHA 9120 D	2024/02/16	2025/02/16
4.	Agilent	Spectrum Analyzer	US40240137	E7403A	2024/01/12	2025/01/12
5.	MLT	Pre Amplifier	20110209	PREAMP6G-01	2024/03/12	2025/03/12

9.3 Test Condition:

EUT tested in accordance with the specifications given by the manufacturer , and exercised in the most unfavorable manner.

Peak Measurement RBW set to 1MHz , VBW set to 1MHz

Average Measurement RBW set to 1MHz , VBW set to 10Hz

The X axial at Pre-test procedure is the worst case, the final result shown on this report is based on this condition.

9.4 Radiated Emissions Limits:

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

9.5 Measurement Data Of Radiated Emissions:

9.5.1 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : 2402MHz Test Date : July 17, 2024

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1006.67	76.31	--	-25.89	50.42	--	74	54	-23.58	--
1416.67	73.54	--	-24.37	49.17	--	74	54	-24.83	--
2303.33	67.50	--	-22.00	45.50	--	74	54	-28.50	--
4800.00	56.33	--	-17.66	38.67	--	74	54	-35.33	--
14675.00	46.67	--	3.50	50.17	--	74	54	-23.83	--
17175.00	43.50	--	9.38	52.88	--	74	54	-21.12	--

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1010.00	74.86	--	-25.89	48.97	--	74	54	-25.03	--
1413.33	63.74	--	-24.36	39.38	--	74	54	-34.62	--
1820.00	66.48	--	-24.86	41.62	--	74	54	-32.38	--
10525.00	44.13	--	0.40	44.53	--	74	54	-29.47	--
14650.00	46.51	--	3.37	49.88	--	74	54	-24.12	--
17100.00	42.96	--	9.58	52.54	--	74	54	-21.46	--

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 1.5 Meter.

4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor (Auto calculate in spectrum analyzer)

5.The other emission levels were very low against the limit.

6. Pre Amplifier (RF01) Gain :63dB to 69dB

7. Margin<0 is Pass , Margin≧0 is Fail

9.5.2 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : 2440MHz Test Date : July 17, 2024

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1010.00	76.71	--	-25.89	50.82	--	74	54	-23.18	--
1413.33	73.14	--	-24.36	48.78	--	74	54	-25.22	--
2223.33	67.87	--	-21.99	45.88	--	74	54	-28.12	--
4875.00	57.59	--	-17.62	39.97	--	74	54	-34.03	--
14725.00	45.45	--	3.75	49.20	--	74	54	-24.80	--
17225.00	44.38	--	9.26	53.64	--	74	54	-20.36	--

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1006.67	74.73	--	-25.89	48.84	--	74	54	-25.16	--
1410.00	64.05	--	-24.37	39.68	--	74	54	-34.32	--
1823.33	66.48	--	-24.84	41.64	--	74	54	-32.36	--
10525.00	44.49	--	0.40	44.89	--	74	54	-29.11	--
14800.00	45.05	--	3.94	48.99	--	74	54	-25.01	--
17175.00	44.31	--	9.38	53.69	--	74	54	-20.31	--

Notes : 1.Margin= Amplitude - Limits
2.Distance of Measurement : 3 Meter
3.Height of table for EUT placed: 1.5 Meter.
4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor
(Auto calculate in spectrum analyzer)
5.The other emission levels were very low against the limit.
6. Pre Amplifier (RF01) Gain :63dB to 69dB
7. Margin<0 is Pass , Margin≧0 is Fail

9.5.3 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : 2480MHz Test Date : July 17, 2024

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1010.00	76.56	--	-25.89	50.67	--	74	54	-23.33	--
1413.33	72.56	--	-24.36	48.20	--	74	54	-25.80	--
2220.00	67.38	--	-21.96	45.42	--	74	54	-28.58	--
4950.00	57.79	--	-17.65	40.14	--	74	54	-33.86	--
14800.00	46.64	--	3.94	50.58	--	74	54	-23.42	--
17100.00	43.82	--	9.58	53.40	--	74	54	-20.60	--

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1010.00	74.53	--	-25.89	48.64	--	74	54	-25.36	--
1816.67	65.59	--	-24.87	40.72	--	74	54	-33.28	--
2223.33	61.61	--	-21.99	39.62	--	74	54	-34.38	--
10525.00	43.51	--	0.40	43.91	--	74	54	-30.09	--
14700.00	45.83	--	3.70	49.53	--	74	54	-24.47	--
17125.00	43.93	--	9.45	53.38	--	74	54	-20.62	--

Notes : 1.Margin= Amplitude - Limits
2.Distance of Measurement : 3 Meter
3.Height of table for EUT placed: 1.5 Meter.
4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor
(Auto calculate in spectrum analyzer)
5.The other emission levels were very low against the limit.
6. Pre Amplifier (RF01) Gain :63dB to 69dB
7. Margin<0 is Pass , Margin≧0 is Fail

10. Antenna Requirements

10.1 Standard Applicable:

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

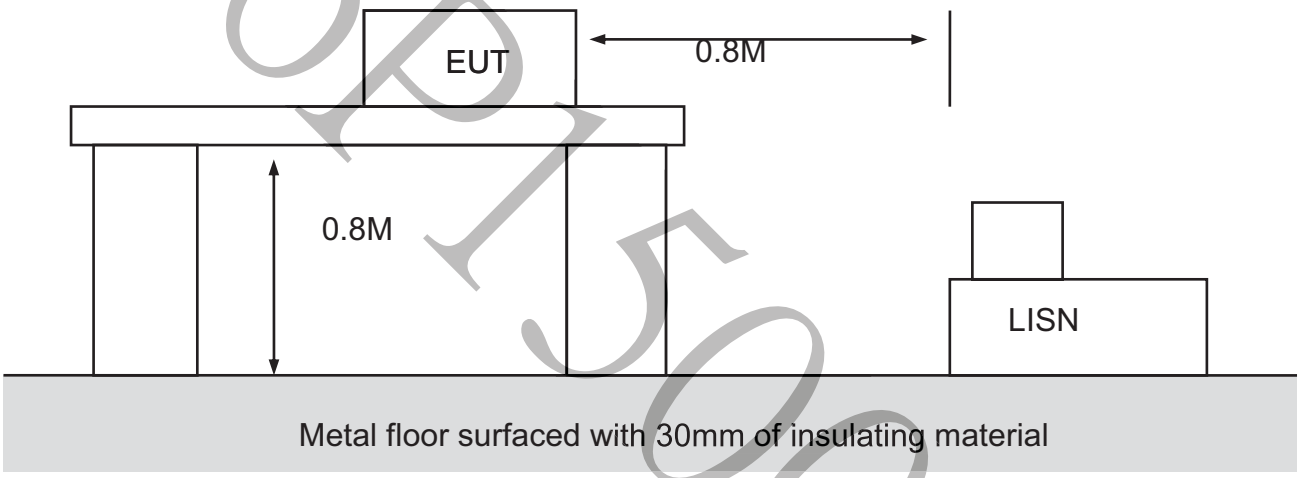
And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2 Antenna Construction:

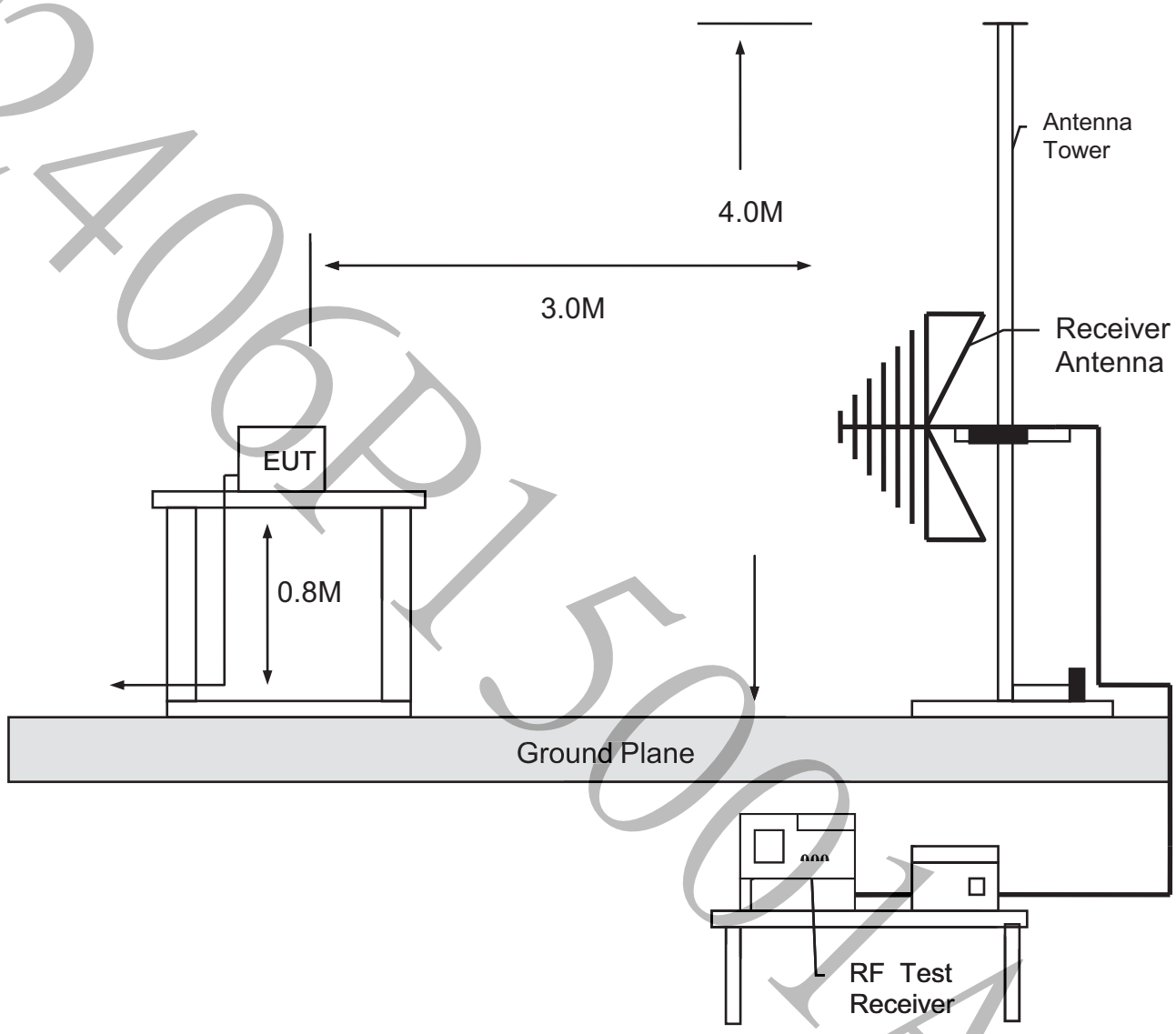
Ant. Type	Gain	type of connector
CHIP antenna	1.3 dBi	CHIP

Appendix I - EUT Test Setup

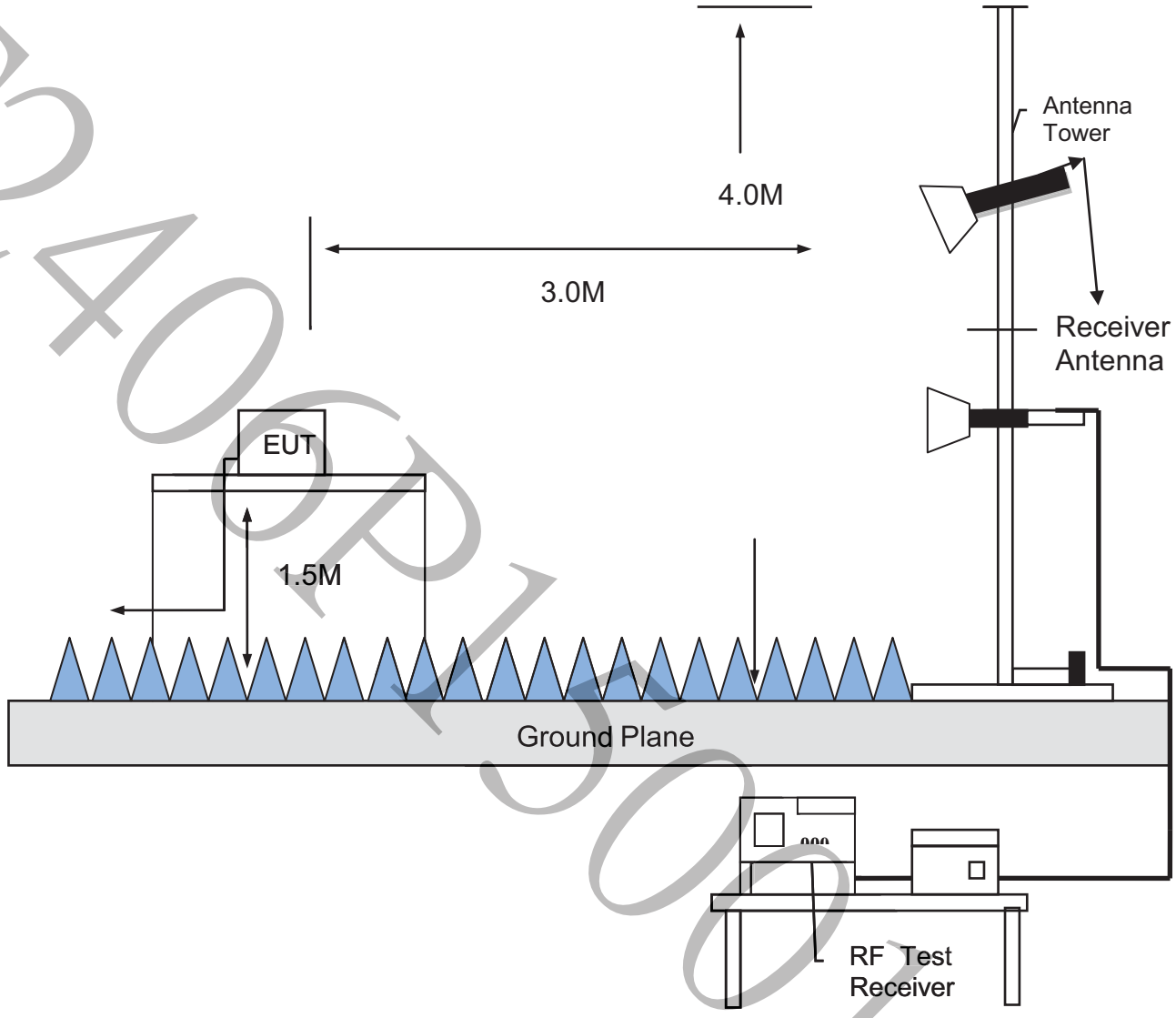
MEASUREMENT OF POWER LINE CONDUCTED RFI VOLTAGE



MEASUREMENT OF RADIATED EMISSION (Below 1GHz)



MEASUREMENT OF RADIATED EMISSION (above > 1GHz)



Appendix II - Brand / Trade Name & Model No. Multiple Listee

Model No.	Trade Name
N/A	N/A