FCC Test Report

Test Report

On Behalf of

ShenZhen YuManYing Technology Co., Ltd

For

Smart Tag

Model No.: HiTag

FCC ID: 2BGRB-HITAG

Prepared For:	**ShenZhen YuManYing Technology Co., Ltd** **812, Information Building, BaoYunDa Logistics Center, FuHua Community, XiXiang Street, BaoAn, ShenZhen, China**
Prepared By:	**Shenzhen DL Testing Technology Co., Ltd.** **101-201, Building C, Shuanghuan, No.8, Baoqing Road, Baolong Industrial Zone, Baolong Street, Longgang District, Shenzhen, Guangdong, China**
Date of Test:	**May 21, 2024 ~ May 29, 2024**
Date of Report:	**May 29, 2024**
Report Number:	**DL-240604012ER**

Test Result Certification

Applicant's Name.....:	ShenZhen YuManYing Technology Co., Ltd
Address.....:	812, Information Building, BaoYunDa Logistics Center, FuHua Community, XiXiang Street, BaoAn, ShenZhen, China
Manufacturer's Name.....:	ShenZhen YuManYing Technology Co., Ltd
Address.....:	812, Information Building, BaoYunDa Logistics Center, FuHua Community, XiXiang Street, BaoAn, ShenZhen, China
Product Description	
Trade Mark.....:	N/A
Product Name.....:	Smart Tag
Model and/or Type Reference ..:	HiTag
Standards.....:	**47 CFR FCC Part 15 Subpart C 15.247** **KDB 558074 D01 15.247 Meas Guidance v05r02** **ANSI C63.10: 2013**

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Date of Test .....:	
Date (s) of Performance of Tests.....:	**May 21, 2024 ~ May 29, 2024**
Date of Issue.....:	**May 29, 2024**
Test Result.....:	**Pass**

Testing Engineer	:	Randy Xie
		Randy Xie
Technical Manager	:	Jack Bu
		Jack Bu
Authorized Signatory	:	Jade Yang
		Jade Yang

Shenzhen DL Testing Technology Co., Ltd. Approved

Contents Page

1 Test Summary 5

1.1 Test Description 5
1.2 Measurement Uncertainty 6
1.3 Information of the Test Laboratory 6

2 General Information 7

2.1 General Description of EUT 7
2.2 Description of Test Conditions 9
2.3 Description of Test Setup 10
2.4 Description of Support Units 11

3 Equipments List for All Test Items 12

4 Test Result 13

4.1 Antenna Requirement 13
4.2 Conduction Emissions Measurement 14
4.3 Radiated Emissions Measurement 17
4.4 Maximum Output Power Measurement 26
4.5 Power Spectral Density 27
4.6 6dB Bandwidth 30
4.7 Occupied Bandwidth 33
4.8 Band Edge 34
4.9 Conducted Spurious Emissions 36

5 Test Setup Photos 42

6 Photos of the EUT 43

** Modified History **

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	May 29, 2024	

1 Test Summary

1.1 Test Description

Test Item	Test Requirement	Result
Antenna Requirement	§15.203/§15.247(b)(4)	PASS
Conducted Emission	FCC Part 15.207	N/A
Radiated Emissions	FCC Part 15.205/15.209	PASS
Maximum Peak Output Power	FCC Part 15.247(b)	PASS
Power Spectral Density	FCC Part 15.247(e)	PASS
6dB Bandwidth & 99% Bandwidth	FCC Part 15.247(a)(2)	PASS
Spurious RF Conducted Emission	FCC Part 15.247(d)	PASS
Band Edge	FCC Part 15.247(d)	PASS

1.2 Measurement Uncertainty

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	±2.71dB
2	All emissions, radiated(<1G)	±3.90dB
3	All emissions, radiated(>1G)	±4.28dB

1.3 Information of the Test Laboratory

Shenzhen DL Testing Technology Co., Ltd.
Add.: 101-201, Building C, Shuanghuan, No.8, Baoqing Road, Baolong Industrial Zone, Baolong Street, Longgang District, Shenzhen, Guangdong, China

Testing Laboratory Authorization：

FCC Test Firm Registration Number: 854456
Designation Number: CN1307
IC Registered No.: 27485
CAB ID.: CN0118

2 General Information

2.1 General Description of EUT

Equipment:	Smart Tag
Model No:	HiTag
Series Model:	N/A
Model Difference:	N/A
Trade Mark:	N/A
Operation Frequency:	2402 MHz to 2480 MHz
Channel Separation:	2MHz
Number of Channel:	40
Modulation Technology:	GFSK
Hardware Version:	V2
Software Version:	1.7.25
Antenna Type:	Chip Antenna
Antenna Gain:	2.7dBi
Power Supply:	DC 3V From button battery
Note:	
1. For a more detailed features description, please refer to the manufacturer’s specifications or the User's Manual. 2. Antenna gain Refer to the antenna specifications. 3. The cable loss data is obtained from the supplier. 4. The test results in the report only apply to the tested sample.	

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

The EUT has been operated in modulations: GFSK independently.

No.	Test Mode Description
1	Low channel TX
2	Middle channel TX
3	High channel TX

Note:
1. All the test modes can be supply by Built-in Li-ion battery, only the result of the worst case was recorded in the report if no any records.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

2.2 Description of Test Conditions

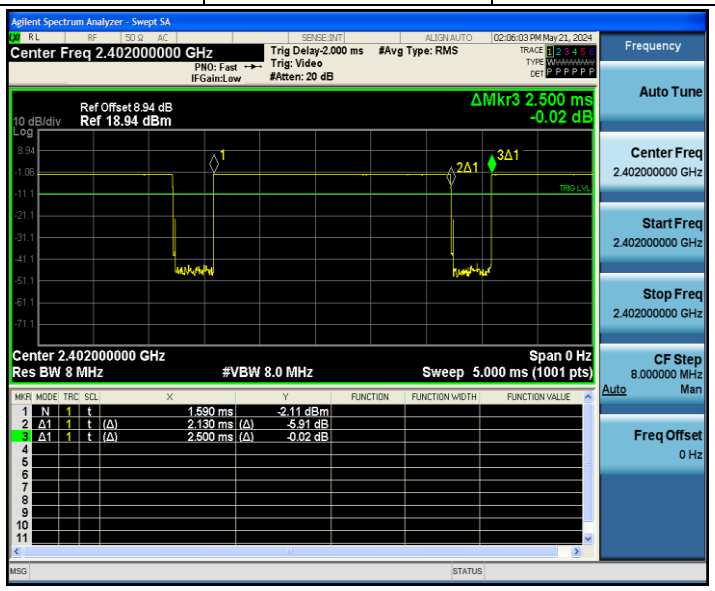
(1) E.U.T. test conditions:
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(2) Frequency range of radiated measurements:
The test range will be up to the tenth harmonic of the highest fundamental frequency.

(3) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode, only the worst-case results are recorded in this report.

(4) Mode Test Duty Cycle

Mode	Duty Cycle	Duty Cycle Factor (dB)
BT-LE(1Mbps)	0.852	-0.696



2.3 Description of Test Setup

Operation of EUT during Radiation testing:

EUT

The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. The worst case is X position.

2.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Trade Mark	Model/Type No.	Specification	Note
1	Smart Tag	N/A	HiTag	N/A	EUT

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3. For conducted measurements (Output Power, 6dB Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

3 Equipments List for All Test Items

Radiation test, Band-edge test and 20db bandwidth test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer (9kHz-26.5GHz)	Agilent	E4408B	MY50140780	Nov. 04, 2023	Nov. 03, 2024
2	Test Receiver (9kHz-7GHz)	R&S	ESRP7	101393	Nov. 04, 2023	Nov. 03, 2024
3	Bilog Antenna (30MHz-1GHz)	R&S	VULB9162	00306	Nov. 04, 2023	Nov. 03, 2024
4	Horn Antenna (1GHz-18GHz)	Schwarzbeck	BBHA9120D	02139	Nov. 04, 2023	Nov. 03, 2024
5	Horn Antenna (18GHz-40GHz)	A.H. Systems	SAS-574	588	Nov. 04, 2023	Nov. 03, 2024
6	Amplifier (9KHz-6GHz)	Schwarzbeck	BBV9743B	00153	Nov. 04, 2023	Nov. 03, 2024
7	Amplifier (1GHz-18GHz)	EMEC	EM01G8GA	00270	Nov. 04, 2023	Nov. 03, 2024
8	Amplifier (18GHz-40GHz)	Quanjuda	DLE-161	97	Nov. 04, 2023	Nov. 03, 2024
9	Loop Antenna (9KHz-30MHz)	Schwarzbeck	FMZB1519B	00014	Nov. 04, 2023	Nov. 03, 2024
10	RF cables1 (9kHz-1GHz)	ChengYu	966	004	Nov. 04, 2023	Nov. 03, 2024
11	RF cables2 (1GHz-40GHz)	ChengYu	966	003	Nov. 04, 2023	Nov. 03, 2024
12	Antenna connector	Florida RF Labs	N/A	RF 01#	Nov. 04, 2023	Nov. 03, 2024
13	Power probe	KEYSIGHT	U2021XA	MY55210018	Nov. 04, 2023	Nov. 03, 2024
14	Signal Analyzer 9kHz-26.5GHz	Agilent	N9020A	MY55370280	Nov. 04, 2023	Nov. 03, 2024
15	Test Receiver 20kHz-40GHz	R&S	ESU 40	100376	Nov. 04, 2023	Nov. 03, 2024
16	D.C. Power Supply	LongWei	PS-305D	010964729	Nov. 04, 2023	Nov. 03, 2024

Conduction Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	843 Shielded Room	ChengYu	843 Room	843	Sep. 20, 2022	Sep. 19, 2025
2	EMI Receiver	R&S	ESR	101421	Nov. 04, 2023	Nov. 03, 2024
3	LISN	R&S	ENV216	102417	Nov. 04, 2023	Nov. 03, 2024
4	843 Cable 1#	ChengYu	CE Cable	001	Nov. 04, 2023	Nov. 03, 2024
5	10dB Attenuator	Schwarzbeck	VTSD9561F	00154	Nov. 04, 2023	Nov. 03, 2024

Other

Item	Name	Manufacturer	Model	Software version
1	EMC Conduction Test System	FALA	EZ_EMC	EMC-CON 3A1.1
2	EMC radiation test system	FALA	EZ_EMC	FA-03A2
3	RF test system	MAIWEI	MTS8310	2.0.0.0
4	RF communication test system	MAIWEI	MTS8200	2.0.0.0

4 Test Result

4.1 Antenna Requirement

4.1.1 Standard Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 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 FCC 47 CFR Section 15.247, if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

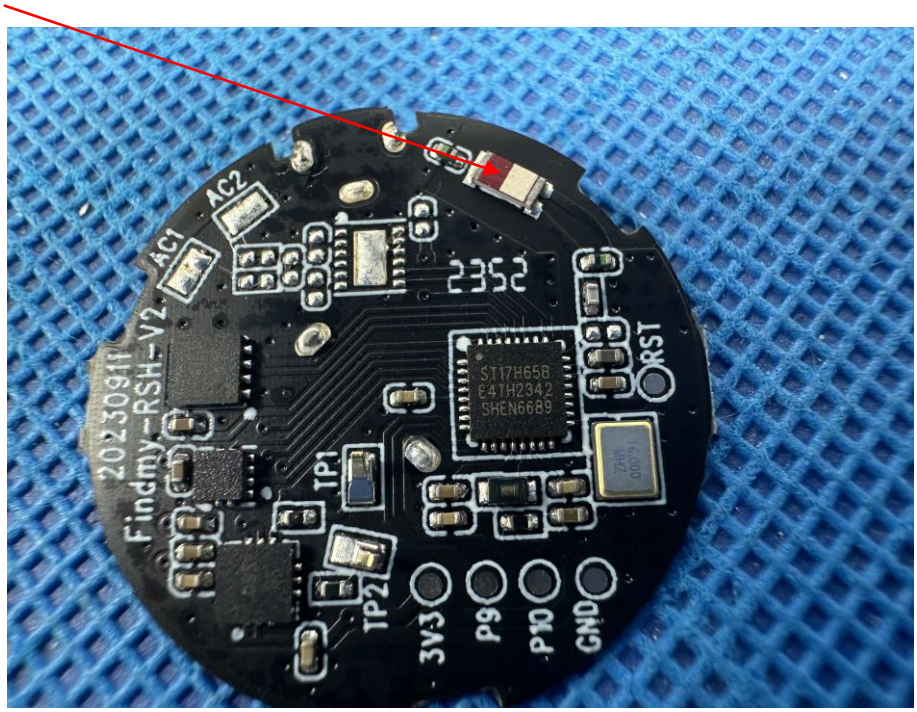
Refer to statement below for compliance.

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Antenna Connected Construction

The antenna used in this product is a Chip Antenna, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 2.7dBi.

4.1.2 EUT Antenna



4.2 Conduction Emissions Measurement

4.2.1 Applied Procedures / Limit

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

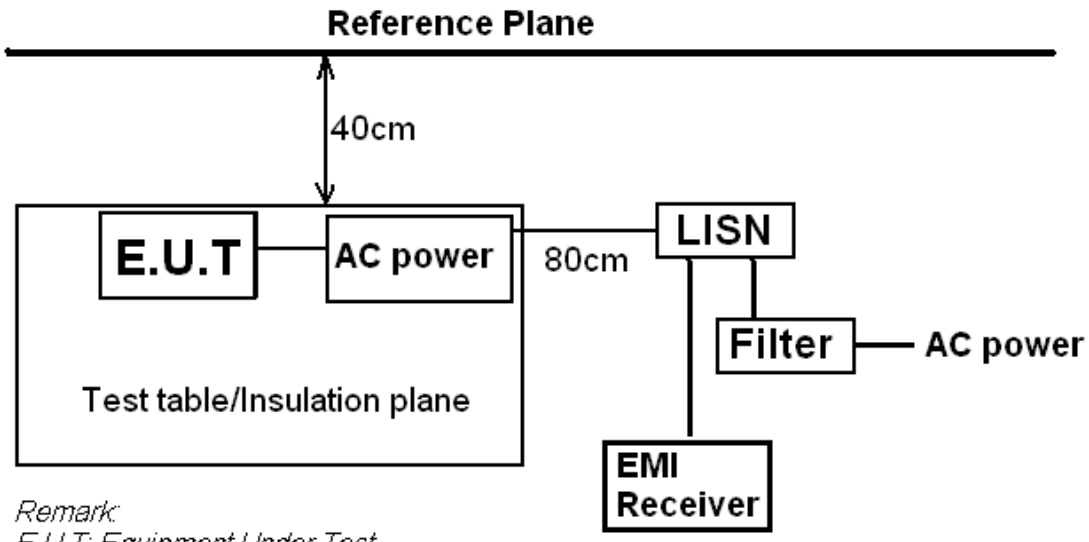
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

4.2.2 Test Procedure

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

4.2.3 Test Setup



Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

4.2.4 Test Results

Not applicable.

Note: EUT power supply by DC Power, so this test item not applicable.

4.3 Radiated Emissions Measurement

4.3.1 Applied Procedures / Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Except when the requirements applicable to a given device state otherwise, emissions from license-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

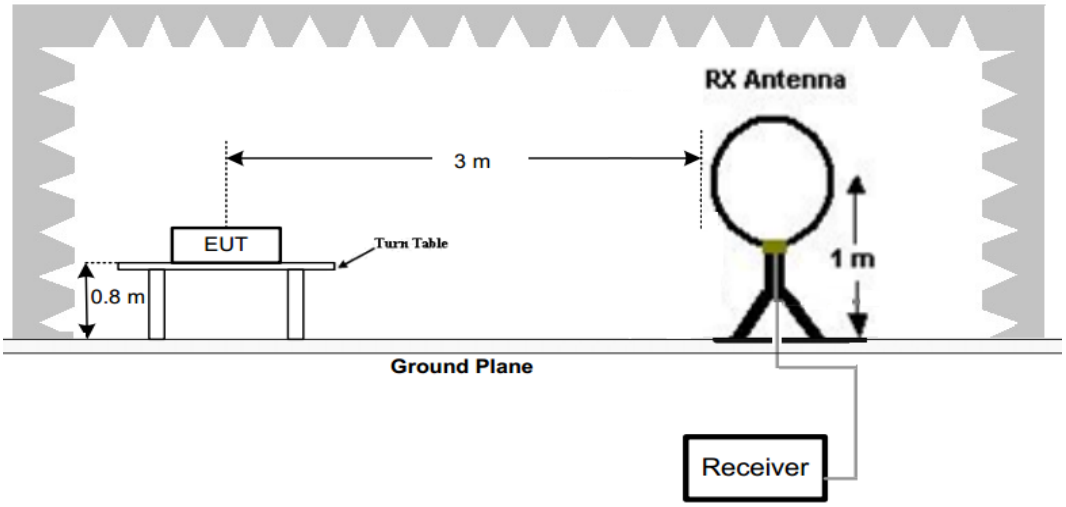
Radiated emission limits

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

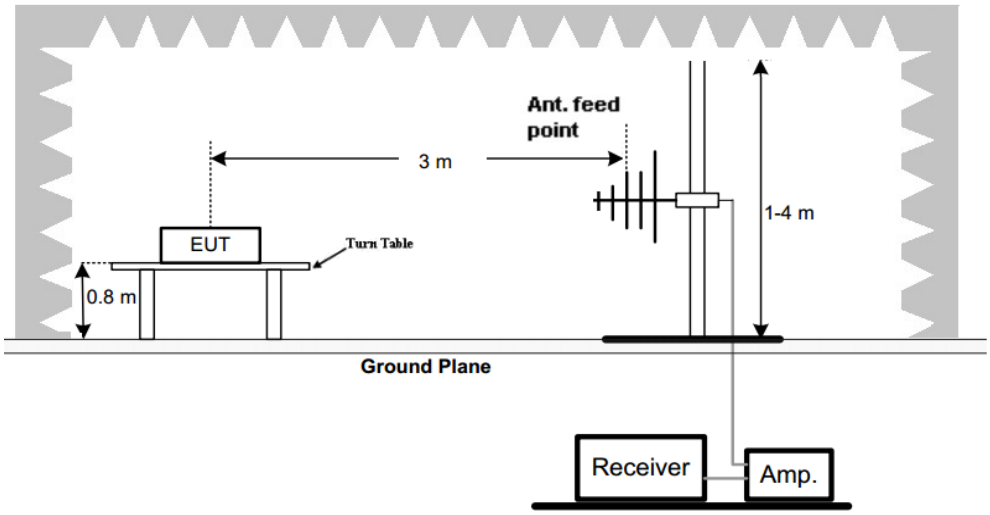
4.3.2 Test Setup

Test Configuration:

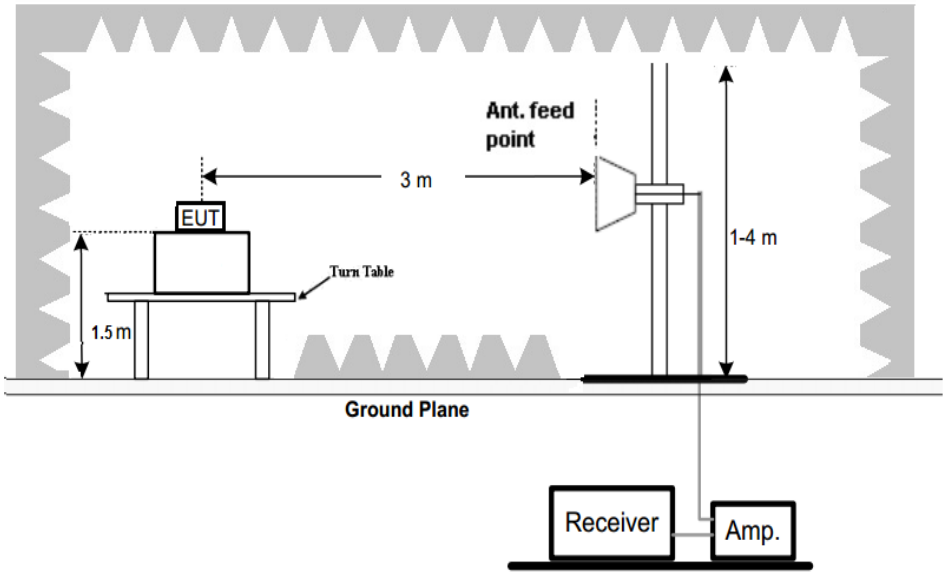
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



Test Procedure

1. The EUT was placed on turn table which is 0.8m above ground plane for below 1GHz test, and on a low permittivity and low loss tangent turn table which is 1.5m above ground plane for above 1GHz test.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°to 360°to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

4.3.3 Test Result

Below 1GHz Test Results:

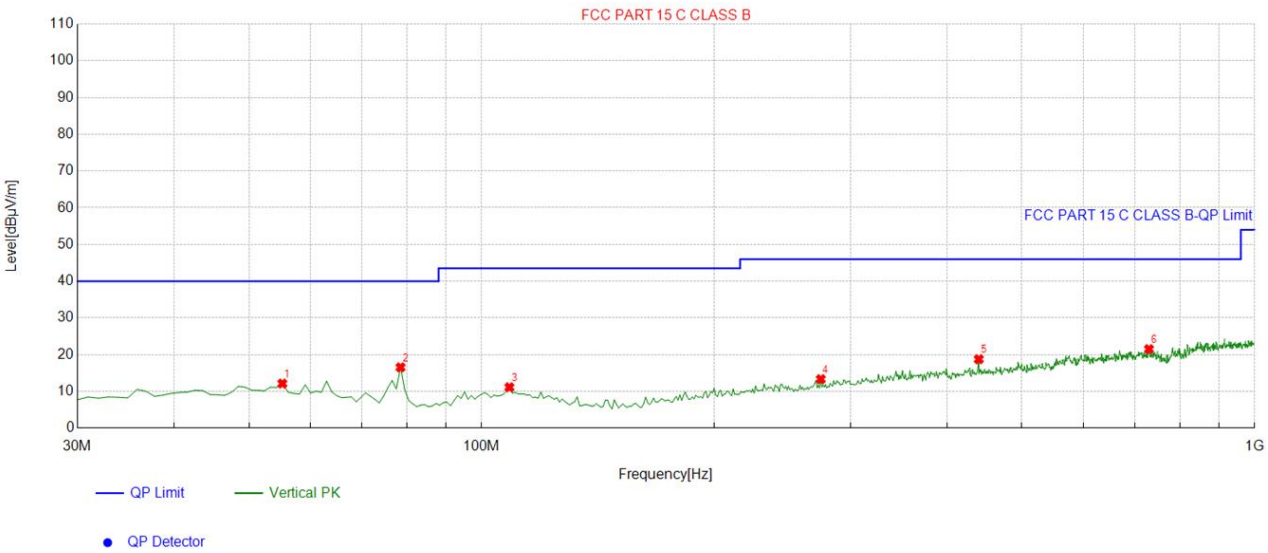
All modes have been tested, only the worst mode of GFSK Low channel TX is reflected.

Antenna polarity: H

Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	42.622623	-13.31	24.69	11.38	40.00	28.62	100	136	Horizontal
2	99.90991	-14.70	25.11	10.41	43.50	33.09	100	314	Horizontal
3	249.43943	-13.41	25.55	12.14	46.00	33.86	100	46	Horizontal
4	359.15915	-9.94	25.72	15.78	46.00	30.22	100	139	Horizontal
5	613.55355	-5.55	26.03	20.48	46.00	25.52	100	327	Horizontal
6	942.71271	-0.67	25.28	24.61	46.00	21.39	100	333	Horizontal

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.

Antenna polarity: V



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	55.245245	-14.00	26.13	12.13	40.00	27.87	100	66	Vertical
2	78.548549	-17.92	34.46	16.54	40.00	23.46	100	333	Vertical
3	108.64864	-14.02	25.13	11.11	43.50	32.39	100	195	Vertical
4	274.68468	-12.70	26.03	13.33	46.00	32.67	100	1	Vertical
5	439.74975	-8.70	27.45	18.75	46.00	27.25	100	324	Vertical
6	730.07007	-3.46	24.96	21.50	46.00	24.50	100	88	Vertical

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.

Harmonics and Spurious Emissions

Frequency Range (9kHz-30MHz)

Frequency (MHz)	Level@3m (dBµV/m)	Limit@3m (dBµV/m)
--	--	--
--	--	--
--	--	--
--	--	--

Note: *1. Emission Level=Reading+ Cable loss+ Antenna factor-Amp factor.*

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement.

For 1GHz to 25GHz

CH Low (2402MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4804.00	54.33	-3.65	50.68	74.00	-23.32	peak
4804.00	45.31	-3.65	41.66	54.00	-12.34	AVG
7206.00	51.84	-0.95	50.89	74.00	-23.11	peak
7206.00	42.53	-0.95	41.58	54.00	-12.42	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4804.00	55.17	-3.65	51.52	74.00	-22.48	peak
4804.00	45.28	-3.65	41.63	54.00	-12.37	AVG
7206.00	49.06	-0.95	48.11	74.00	-25.89	peak
7206.00	43.67	-0.95	42.72	54.00	-11.28	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

CH Middle (2440MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4880.00	51.12	-3.54	47.58	74.00	-26.42	peak
4880.00	45.69	-3.54	42.15	54.00	-11.85	AVG
7320.00	52.33	-0.81	51.52	74.00	-22.48	peak
7320.00	40.57	-0.81	39.76	54.00	-14.24	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4880.00	55.17	-3.54	51.63	74.00	-22.37	peak
4880.00	43.88	-3.54	40.34	54.00	-13.66	AVG
7320.00	51.07	-0.81	50.26	74.00	-23.74	peak
7320.00	41.97	-0.81	41.16	54.00	-12.84	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

CH High (2480MHz)

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4960.00	52.45	-3.43	49.02	74.00	-24.98	peak
4960.00	46.38	-3.44	42.94	54.00	-11.06	AVG
7440.00	49.07	-0.77	48.30	74.00	-25.70	peak
7440.00	41.26	-0.77	40.49	54.00	-13.51	AVG

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4960.00	54.32	-3.43	50.89	74.00	-23.11	peak
4960.00	45.06	-3.44	41.62	54.00	-12.38	AVG
7440.00	51.97	-0.77	51.20	74.00	-22.80	peak
7440.00	40.26	-0.77	39.49	54.00	-14.51	AVG

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency; “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) The emissions are attenuated more than 20dB below the permissible limits are not recorded in the report.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions are reported.

Radiated Band Edge Test:

Operation Mode: TX CH Low (2402MHz)

Horizontal (Worst case):

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310.00	54.15	-5.81	48.34	74	-25.66	peak
2310.00	/	-5.81	/	54	/	AVG
2390.00	54.63	-5.84	48.79	74	-25.21	peak
2390.00	/	-5.84	/	54	/	AVG
2400.00	55.98	-5.84	50.14	74	-23.86	peak
2400.00	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310.00	54.74	-5.81	48.93	74	-25.07	peak
2310.00	/	-5.81	/	54	/	AVG
2390.00	53.62	-5.84	47.78	74	-26.22	peak
2390.00	/	-5.84	/	54	/	AVG
2400.00	55.86	-5.84	50.02	74	-23.98	peak
2400.00	/	-5.84	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Operation Mode: TX CH High (2480MHz)

Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	53.05	-5.81	47.24	74	-26.76	peak
2483.50	/	-5.81	/	54	/	AVG
2500.00	51.64	-6.06	45.58	74	-28.42	peak
2500.00	/	-6.06	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	51.15	-5.81	45.34	74	-28.66	peak
2483.50	/	-5.81	/	54	/	AVG
2500.00	51.36	-6.06	45.3	74	-28.7	peak
2500.00	/	-6.06	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Remark:

1. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
2. In restricted bands of operation, the spurious emissions below the permissible value more than 20dB.
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

4.4 Maximum Output Power Measurement

4.4.1 Limit

The Maximum Peak Output Power Measurement is 30dBm.

4.4.2 Test Procedure

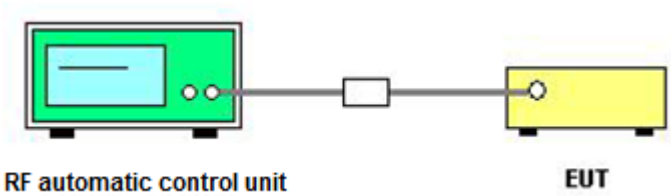
The maximum peak conducted output power may be measured using a broadband peak RF automatic control unit. The RF automatic control unit shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

The maximum Average conducted output power may be measured using a wideband RF automatic control unit with a thermocouple detector or equivalent. The RF automatic control unit shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

4.4.3 Deviation from Standard

No deviation.

4.4.4 Test Setup



4.4.5 Test Results

Channel	Channel Frequency (Mhz)	Maximum Peak Conducted Output Power (dBm)	Limit (dBm)	Result
Low	2402	5.80	30.00	Pass
Middle	2440	6.01		Pass
High	2480	6.00		Pass

Note: The test results including the cable loss.

4.5 Power Spectral Density

4.5.1 Limit

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

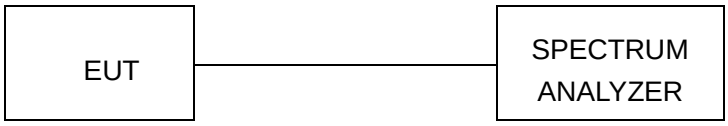
4.5.2 Test Procedure

Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
Set the RBW =10 kHz.
Set the VBW =30 KHz.
Set the span to 1.5 times the DTS channel bandwidth.
Detector = peak.
Sweep time = auto couple.
Trace mode = max hold.
Allow trace to fully stabilize.
Use the peak marker function to determine the maximum power level.
If measured value exceeds limit, reduce RBW(no less than 3 kHz)and repeat.
The resulting peak PSD level must be 8 dBm.

4.5.3 Deviation from Standard

No deviation.

4.5.4 Test Setup

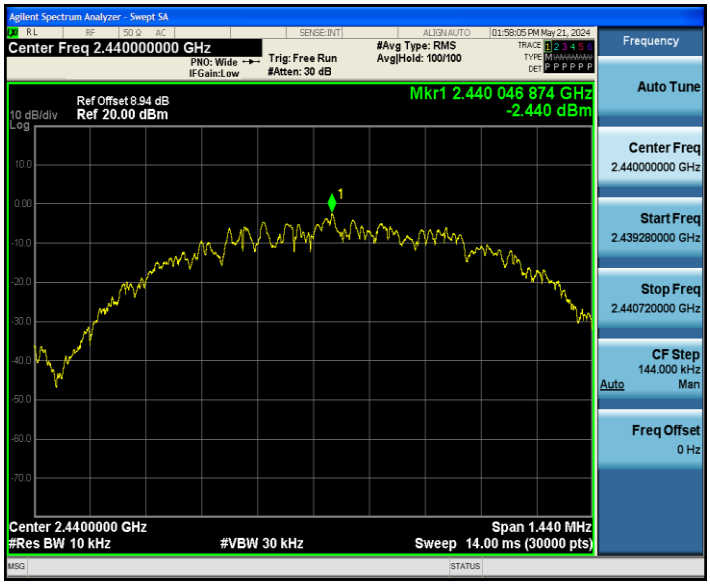


4.5.5 Test Results

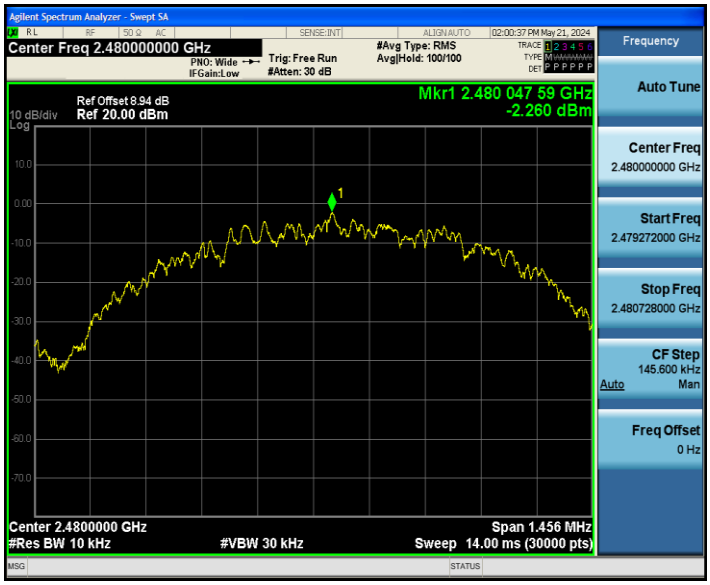
Channel	Channel frequency (MHz)	Result (dBm/10kHz)	10log (3/10)	Test Result (dBm/3kHz)
Low	2402	-2.82	-5.23	-8.05
Middle	2440	-2.44	-5.23	-7.67
High	2480	-2.26	-5.23	-7.49
Limit : 8dBm/3KHz Test Result (dBm/3kHz)= Result (dBm/10kHz)+10log (3/10)				
Test Result	PASS			

CH 00

CH 19


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.440000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
01:58:05 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.440 046 874 GHz
-2.440 dBm
Center 2.4400000 GHz
#Res BW 10 kHz
#VBW 30 kHz
Span 1.440 MHz
Sweep 14.00 ms (30000 pts)
Frequency
Auto Tune
Center Freq
2.440000000 GHz
Start Freq
2.439280000 GHz
Stop Freq
2.440720000 GHz
CF Step
144.000 kHz
Auto
Man
Freq Offset
0 Hz

CH 39


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
02:00:37 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.480 047 59 GHz
-2.260 dBm
Center 2.4800000 GHz
#Res BW 10 kHz
#VBW 30 kHz
Span 1.456 MHz
Sweep 14.00 ms (30000 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.479272000 GHz
Stop Freq
2.480728000 GHz
CF Step
145.600 kHz
Auto
Man
Freq Offset
0 Hz

4.6 6dB Bandwidth

4.6.1 Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

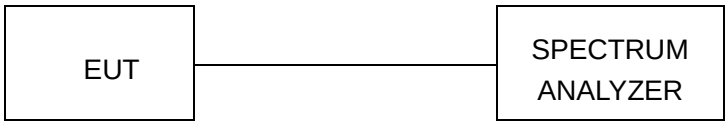
4.6.2 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300 KHz.
The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

4.6.3 Deviation from Standard

No deviation.

4.6.4 Test Setup



4.6.5 Test Result

Channel	Channel frequency (MHz)	6dB Bandwidth (MHz)	Limit (KHz)	Result
Low	2402	0.672	≥500	Pass
Middle	2440	0.720		Pass
High	2480	0.728		Pass

CH 00

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.402000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
01:55:37 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 30.00 dBm
ΔMkr3 672 kHz
0.762 dB
Center 2.402000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
Sweep 1.000 ms (1001 pts)
1 N 1 f 2.401 744 GHz -0.256 dBm
2 N 1 f 2.402 344 GHz 5.632 dBm
3 Δ1 1 f (Δ) 672 kHz (Δ) 0.762 dB
Frequency
Auto Tune
Center Freq
2.402000000 GHz
Start Freq
2.400000000 GHz
Stop Freq
2.404000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz

CH 19

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.440000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
01:57:39 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 30.00 dBm
ΔMkr3 720 kHz
-0.279 dB
Center 2.440000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
Sweep 1.000 ms (1001 pts)
1 N 1 f 2.439 732 GHz -0.865 dBm
2 N 1 f 2.439 836 GHz 4.782 dBm
3 Δ1 1 f (Δ) 720 kHz (Δ) -0.279 dB
Frequency
Auto Tune
Center Freq
2.440000000 GHz
Start Freq
2.438000000 GHz
Stop Freq
2.442000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz

CH 39

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 40 dB
#Avg Type: RMS
Avg|Hold: 100/100
02:00:10 PM May 21, 2024
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478000000 GHz
Stop Freq
2.482000000 GHz
CF Step
400.000 kHz
Auto Man
Freq Offset
0 Hz
Ref Offset 8.94 dB
10 dB/div Ref 30.00 dBm
Log
ΔMkr3 728 kHz
-0.174 dB
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
Sweep 1.000 ms (1001 pts)
1 N 1 f 2.479 724 GHz -0.575 dBm
2 N 1 f 2.479 828 GHz 4.979 dBm
3 Δ1 1 f (Δ) 728 kHz (Δ) -0.174 dB
MSG
STATUS

4.7 Occupied Bandwidth

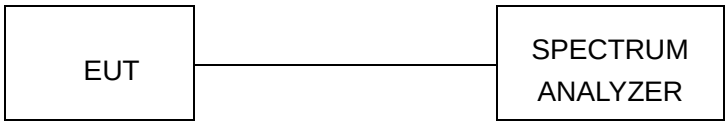
4.7.1 Test Procedure

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:
RBW=1% to 5% of the OBW
VBW=approximately 3 X RBW
Detector=Peak
Trace Mode: Max Hold
Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recorded.

4.7.2 Deviation from Standard

No deviation.

4.7.3 Test Setup



4.7.4 Test Result

N/A

4.8 Band Edge

4.8.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under FCC rules in section 5.8.1, the attenuation required shall be 30 dB instead of 20 dB.

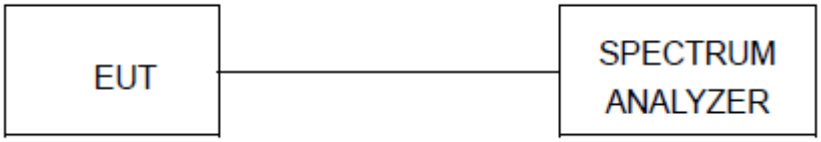
4.8.2 Test Procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.

4.8.3 Deviation from Standard

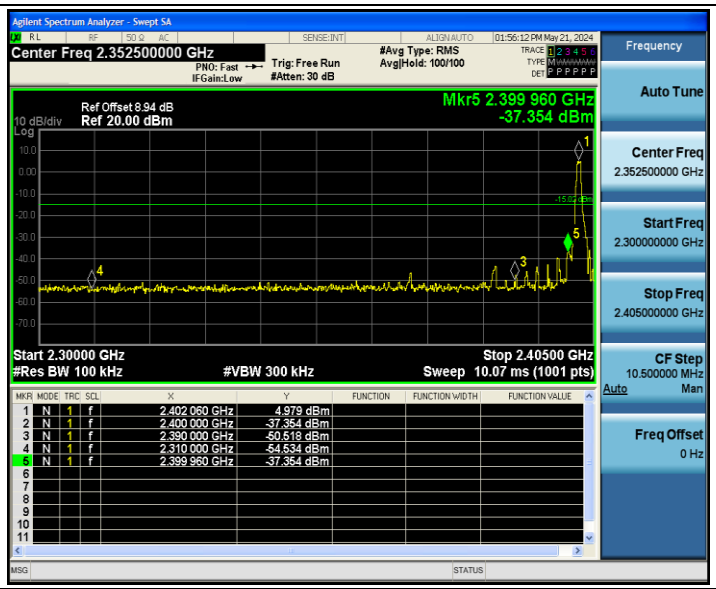
No deviation.

4.8.4 Test Setup

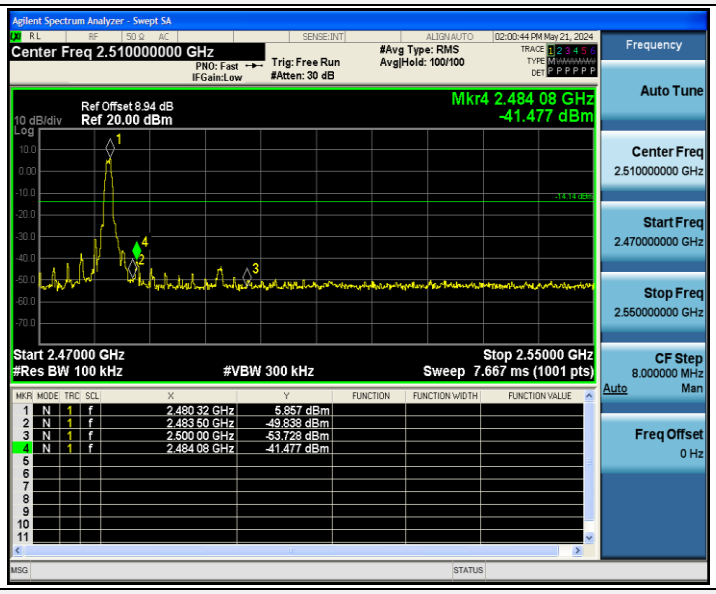


4.8.5 Test Results

PASS



2402



2480

4.9 Conducted Spurious Emissions

4.9.1 Applied Procedures / Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section (b)(3) of RSS 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.
For below 30MHz,For 9KHz-150kHz,150K-10MHz,We use the RBW 1KHz,10KHz, So the limit need to calculated by “10lg(BW1/BW2)“. for example For9KHz-150kHz,RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

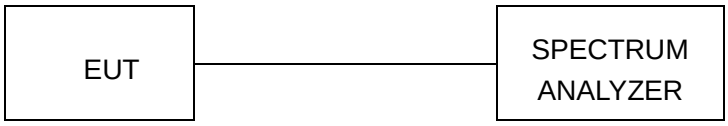
4.9.2 Test Procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold.

4.9.3 Deviation from Standard

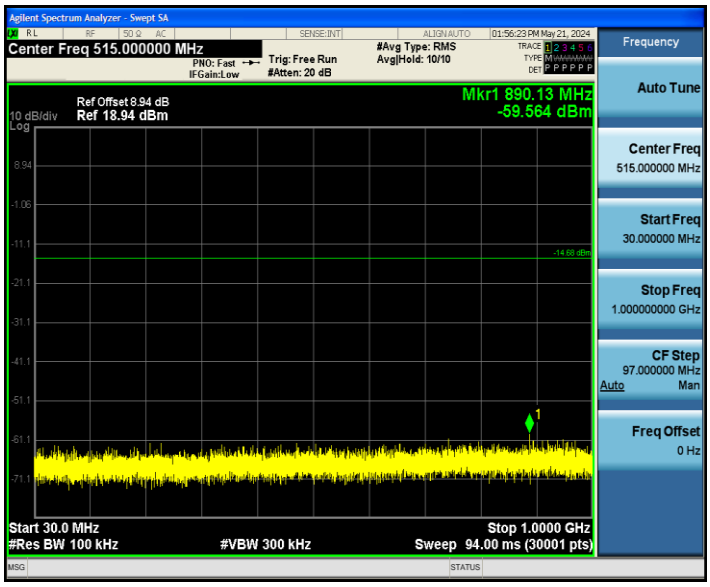
No deviation.

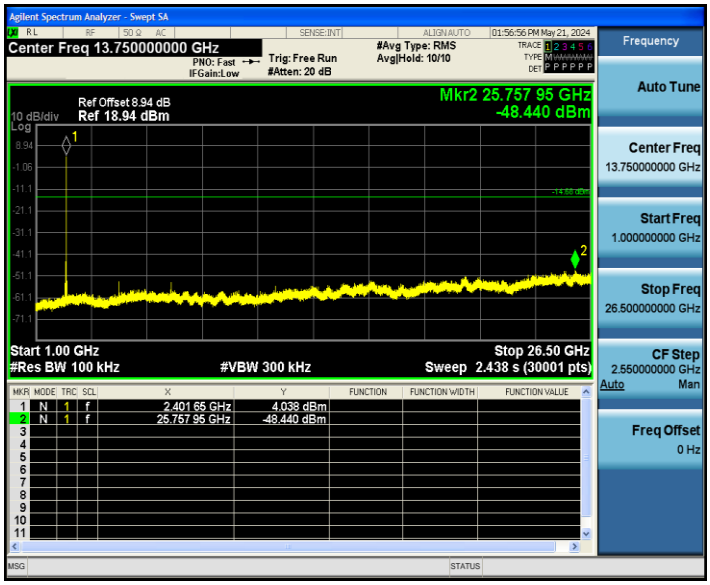
4.9.4 Test Setup



4.9.5 Test Results

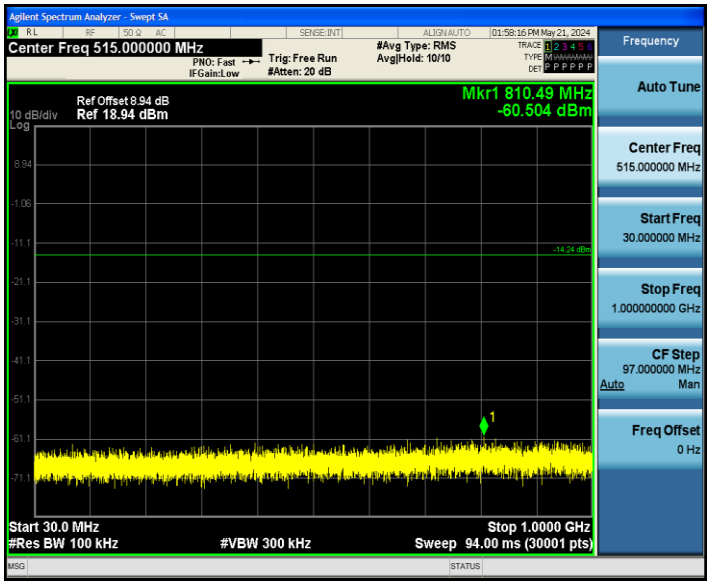
CH 00

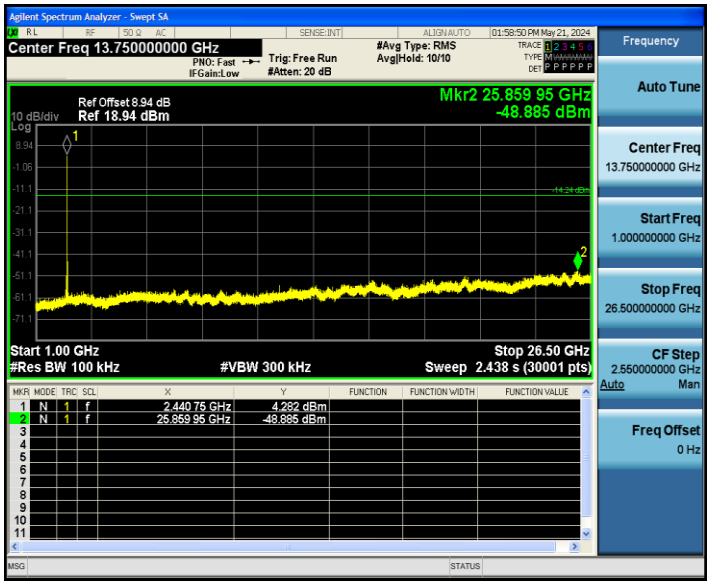



Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
01:56:56 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 18.94 dBm
Mkr2 25.757 95 GHz
-48.440 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.401 65 GHz 4.038 dBm
2 N 1 f 25.757 95 GHz -48.440 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto Man
Freq Offset
0 Hz

CH 19

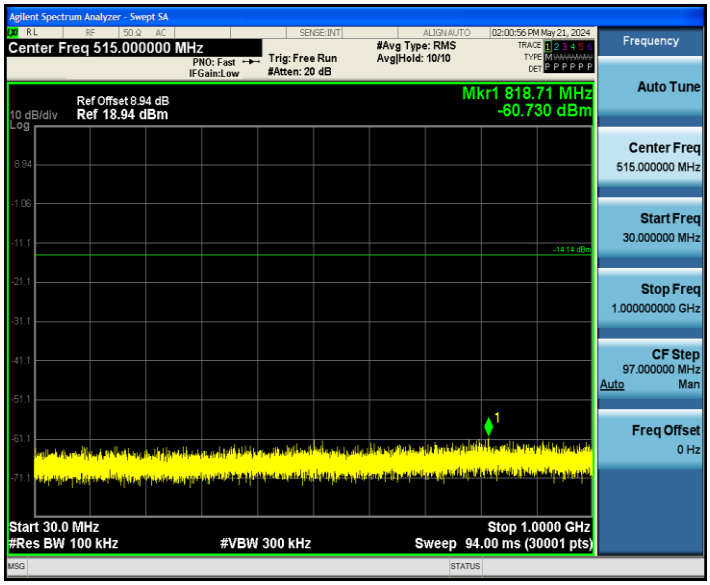
Agilent Spectrum Analyzer - Swept SA
Center Freq 2.440000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
01:58:12 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 28.94 dBm
Mkr1 2.440 348 GHz
5.762 dBm
Center 2.440000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.440000000 GHz
Start Freq
2.438500000 GHz
Stop Freq
2.441500000 GHz
CF Step
300.000 kHz
Auto Man
Freq Offset
0 Hz

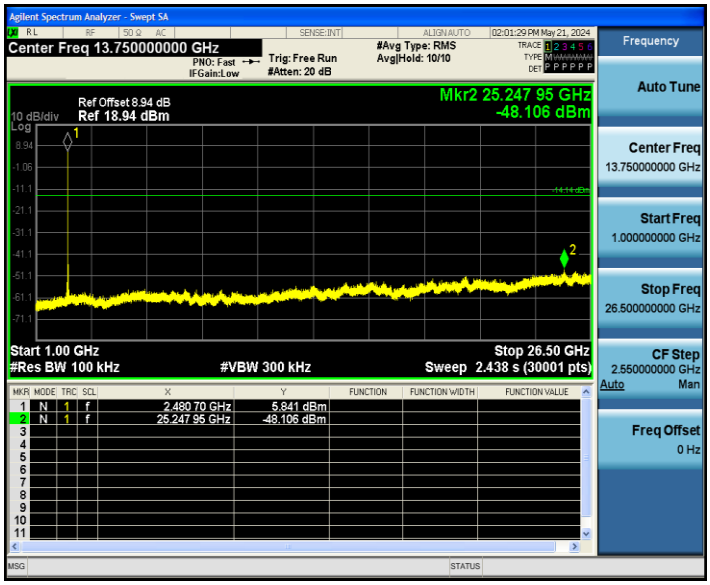

Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
01:58:16 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 18.94 dBm
Mkr1 810.49 MHz
-60.504 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
01:58:50 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 18.94 dBm
Mkr2 25.859 95 GHz
-48.885 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.440 75 GHz 4.282 dBm
2 N 1 f 25.859 95 GHz -48.885 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto
Man
Freq Offset
0 Hz

CH 39

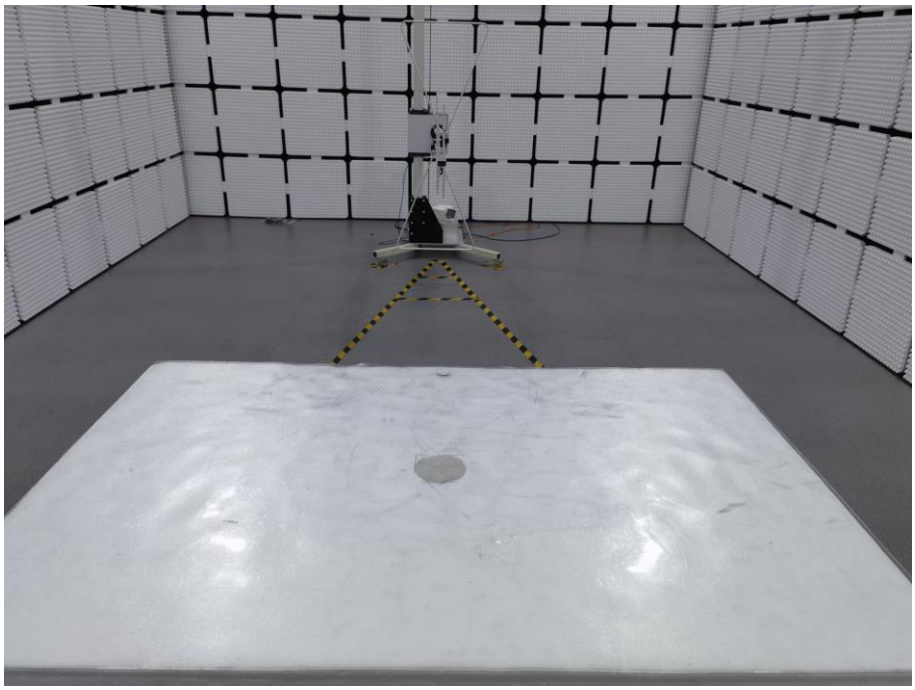
Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
#Avg Type: RMS
Avg|Hold: 100/100
02:00:51 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 28.94 dBm
Mkr1 2.480 345 GHz
5.855 dBm
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Center Freq 515.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
02:00:56 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 18.94 dBm
Mkr1 818.71 MHz
-60.730 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 1.0000 GHz
Sweep 94.00 ms (30001 pts)
Frequency
Auto Tune
Center Freq
515.000000 MHz
Start Freq
30.000000 MHz
Stop Freq
1.000000000 GHz
CF Step
97.000000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
02:01:29 PM May 21, 2024
Ref Offset 8.94 dB
10 dB/div
Ref 18.94 dBm
Log
Mkr2 25.247 95 GHz
-48.106 dBm
Start 1.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.438 s (30001 pts)
1 N 1 f 2.480 70 GHz 5.841 dBm
2 N 1 f 25.247 95 GHz -48.106 dBm
Frequency
Auto Tune
Center Freq
13.750000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
26.500000000 GHz
CF Step
2.550000000 GHz
Auto Man
Freq Offset
0 Hz

5 Test Setup Photos

Radiated Emission



6 Photos of the EUT

Reference to the report: ANNEX A of external photos and ANNEX B of internal photos.

---------End of test report---------