


TEST REPORT

Application No.: SHCR2312002541ME
FCC ID: PQC-WPIM
IC: 3549B-WPIM
Applicant: Philips Medical Systems North America Co. (For FCC)
Philips Medical Systems (For IC)
Address of Applicant: 222 Jacobs Street, Cambridge, Massachusetts 02141, United States
Manufacturer: Philips Medical Systems
Address of Manufacturer: 3000 Minuteman Road Andover, MA 01810-1099 USA
Factory: Philips North America LLC
Address of Factory: 1, 1001 Murry Ridge Lane, STE A, Murrysville PA 15668, USA
2, 1003 Corporate Lane STE B, Export PA 15632, USA

Equipment Under Test (EUT):
EUT Name: Wireless PIM
Model No.: WPIM-001
Trade Mark: 
Standard(s) : 47 CFR Part 15, Subpart C 15.247
RSS-247 Issue 3, August 2023
RSS-Gen Issue 5 Amendment 2 (February 2021)
Date of Receipt: 2023-12-07
Date of Test: 2023-12-11 to 2023-12-14
Date of Issue: 2024-01-09

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

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Revision Record			
Version	Description	Date	Remark
00	Original	2024-01-09	/

Authorized for issue by:			
Tested By		<i>Wade Zhang</i>	
		_____ Wade Zhang/Project Engineer	
Approved By		<i>Parlam Zhan</i>	
		_____ Parlam Zhan / Reviewer	

2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Minimum 6dB Bandwidth		ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Power Spectrum Density		ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Below 1GHz		ANSI C63.10 (2013) Section 6.4,6.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions Above 1GHz		ANSI C63.10 (2013) Section 6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
99% Bandwidth	RSS-247 Issue 3, August 2023	ANSI C63.10 (2013) Section 6.9.3	RSS-Gen Section 6.7	Pass

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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 1.5V (AA Battery*1)
Test Voltage:	DC 1.5V
Operation Frequency:	2405MHz to 2480MHz
Modulation Type:	O-QPSK
Number of Channels:	16(Channel:11~26)
Channel Spacing:	5MHz
Antenna Type:	Ceramic Antenna
Antenna Gain:	3 dBi (Provided by manufacturer)
Antenna Number:	1
S/N:	CN42111005, CN42111007
Firmware Version:	7.38

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	LENOVO	L460	-
SecureCRT	VanDyke	V 6.2.0	-
Serial port adapter plate	-	Test Plate 3	-
AIM	PHILIPS	AIM-001	CN62312014

4.3 Power level setting using in test

Channel	Power setting
11	Default
18	Default
26	Default

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4 x 10 ⁻⁸
2	Timeout	2s
3	Duty cycle	0.4%
4	Occupied Bandwidth	3%
5	RF conducted power	0.6dB
6	RF power density	2.9dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious emission test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-6GHz)
		5.4dB (6GHz-18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%

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

4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab
588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).
3. Sample source: sent by customer.

4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

• **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.
Company Number: 8617A

• **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None

5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2022-12-20	2023-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2023-08-02	2024-08-01
Signal Generator	R&S	SMR20	SHEM006-1	2023-08-02	2024-08-01
Signal Generator	Agilent	N5182A	SHEM182-1	2023-08-02	2024-08-01
Communication Tester	R&S	CMW270	SHEM183-1	2023-06-01	2024-05-31
Communication Tester	R&S	CMW500	SHEM268-1	2023-06-01	2024-05-31
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2023-08-02	2024-08-01
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2022-11-08	2024-11-07
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2022-12-20	2023-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2022-12-20	2023-12-19
Conducted test Cable	/	RF01~RF04	/	2022-12-20	2023-12-19
Switcher	Tonscend	JS0806	SHEM184-1	2023-08-02	2024-08-01
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
Coaxial Cable	TST		SHEM263-1	2023-08-02	2024-08-01
Test software	TST	TST PASS	Version: 2.0	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2022-12-20	2023-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2022-12-20	2023-12-19
Communication Tester	R&S	CMW500	SHEM268-1	2023-06-01	2024-05-31
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2022-12-20	2023-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2022-09-11	2024-09-10
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2022-05-07	2024-05-06
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2022-08-11	2024-08-10
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2022-09-18	2024-09-17
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2022-09-18	2024-09-17
Pre-Amplifier	HP	8447D	SHEM236-1	2023-08-02	2024-08-01
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2022-12-20	2023-12-19
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2021-05-25	2024-05-24
RE test Cable	/	RE01, RE02, RE06	/	2023-01-07	2024-01-06
Test software	ESE	E3	Version: 6.111221a	/	/

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

6.1.2 Conclusion

Standard Requirement:

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is ceramic antenna and no consideration of replacement. The best case gain of the antenna is 3 dBi.

Antenna location: Refer to internal photo.

7 Radio Spectrum Matter Test Results

7.1 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 18.8 °C

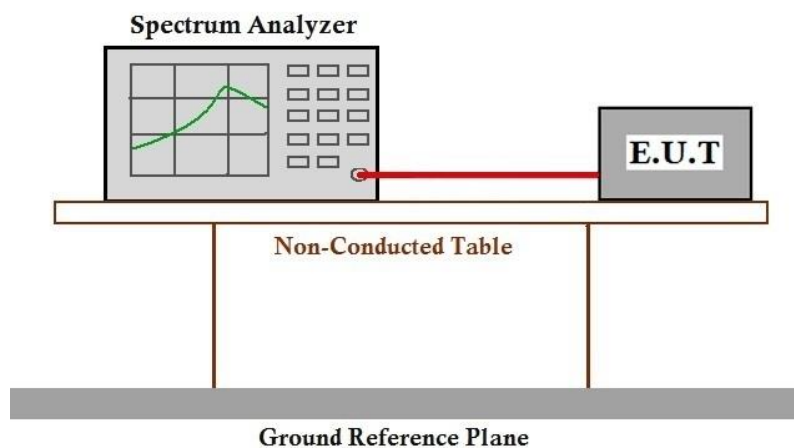
Humidity: 50.8 % RH

Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.1.3 Test Setup Diagram



7.1.4 Measurement Procedure and Data

Note: Since the verify power the same operating range bandwidth and smaller power can be covered by the higher power.

Please Refer to Appendix for Details

7.2 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)
 Test Method: ANSI C63.10 (2013) Section 11.8.1
 Limit: ≥ 500 kHz

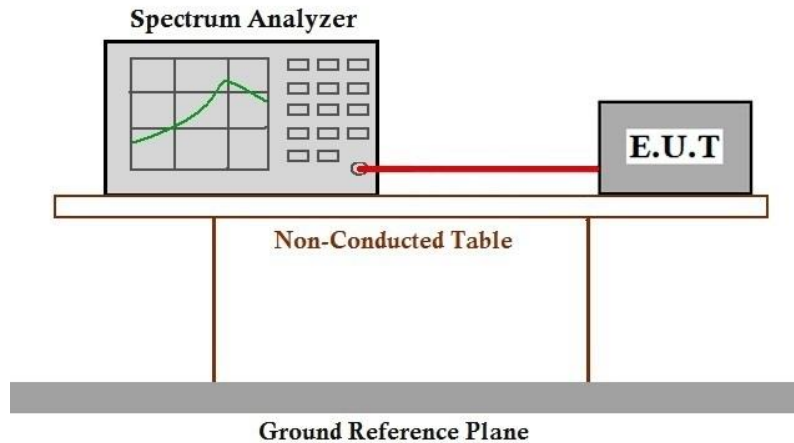
7.2.1 E.U.T. Operation

Operating Environment:
 Temperature: 18.8 °C Humidity: 50.6 % RH Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.2.3 Test Setup Diagram



7.2.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.3 Power Spectrum Density

Test Requirement 47 CFR Part 15, Subpart C 15.247(e)
 Test Method: ANSI C63.10 (2013) Section 11.10.2
 Limit:
 ≤8dBm in any 3 kHz band during any time interval of continuous transmission

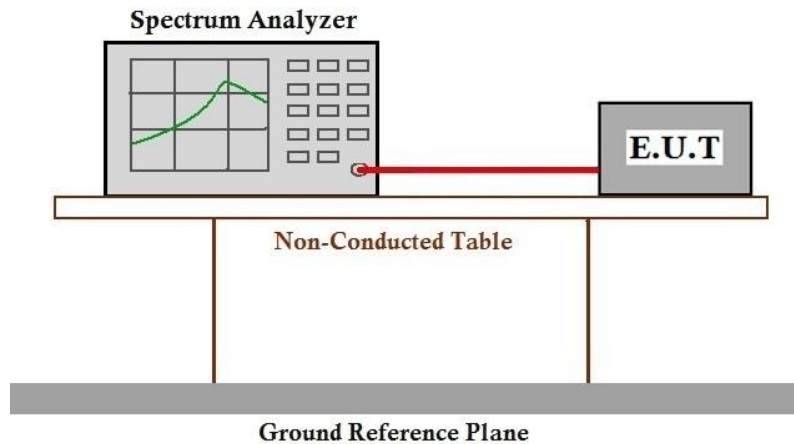
7.3.1 E.U.T. Operation

Operating Environment:
 Temperature: 18.9 °C Humidity: 50.5 % RH Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.4 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)
 Test Method: ANSI C63.10 (2013) Section 11.13.3.2

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 conducted power limits. If the transmitter complies with the conducted 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 §15.209(a) is not required. 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) (see §15.205(c)).

7.4.1 E.U.T. Operation

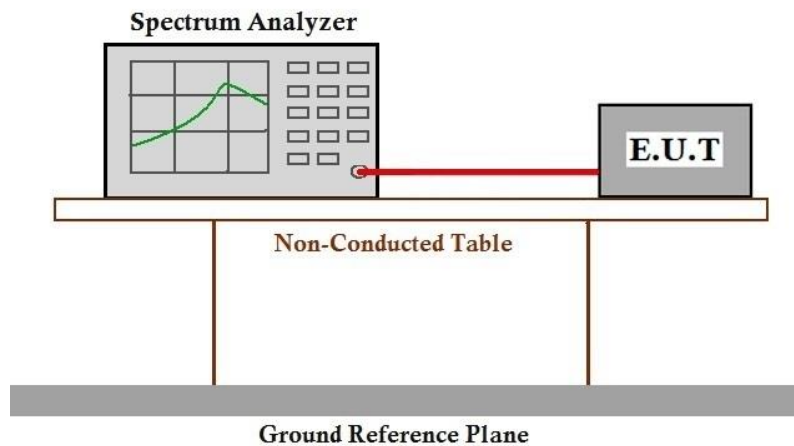
Operating Environment:

Temperature: 18.9 °C Humidity: 50.4 % RH Atmospheric Pressure: 1010 mbar

7.4.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.4.3 Test Setup Diagram



7.4.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.5 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 11.11

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 conducted power limits. If the transmitter complies with the conducted 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 §15.209(a) is not required. 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) (see §15.205(c)).

7.5.1 E.U.T. Operation

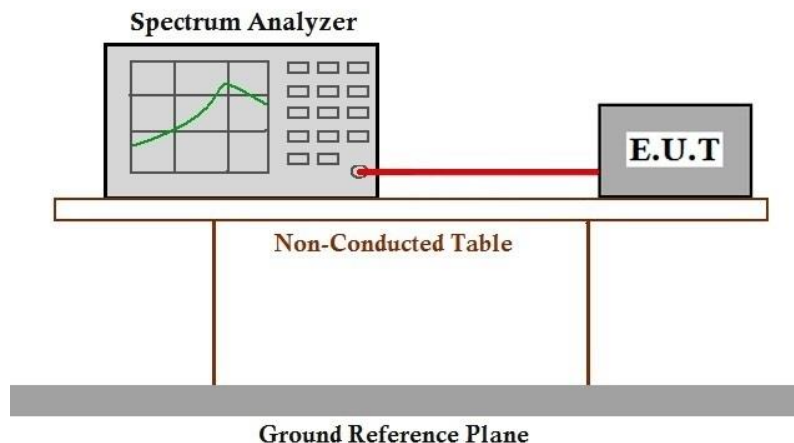
Operating Environment:

Temperature: 18.9 °C Humidity: 50.4 % RH Atmospheric Pressure: 1010 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_ Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.6 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.6.1 E.U.T. Operation

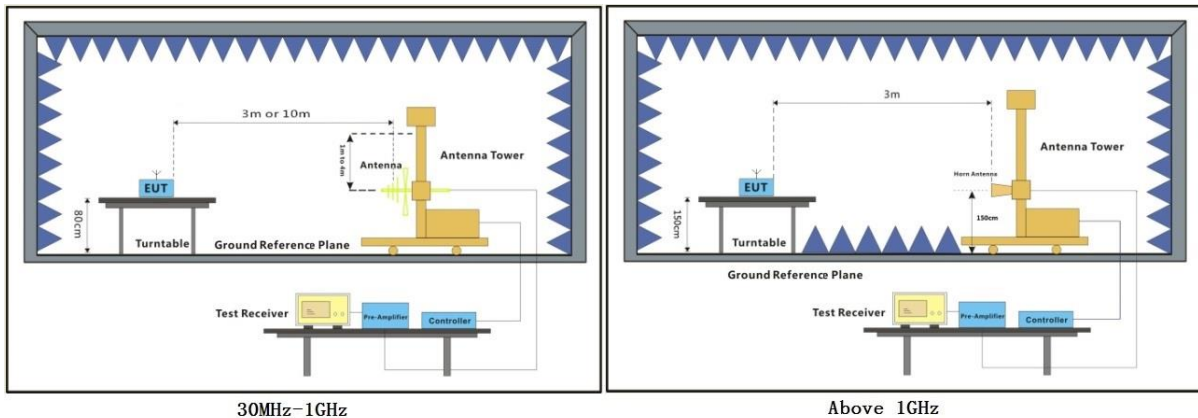
Operating Environment:

Temperature: 18.9 °C Humidity: 50.3 % RH Atmospheric Pressure: 1010 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.6.3 Test Setup Diagram



30MHz-1GHz

Above 1GHz

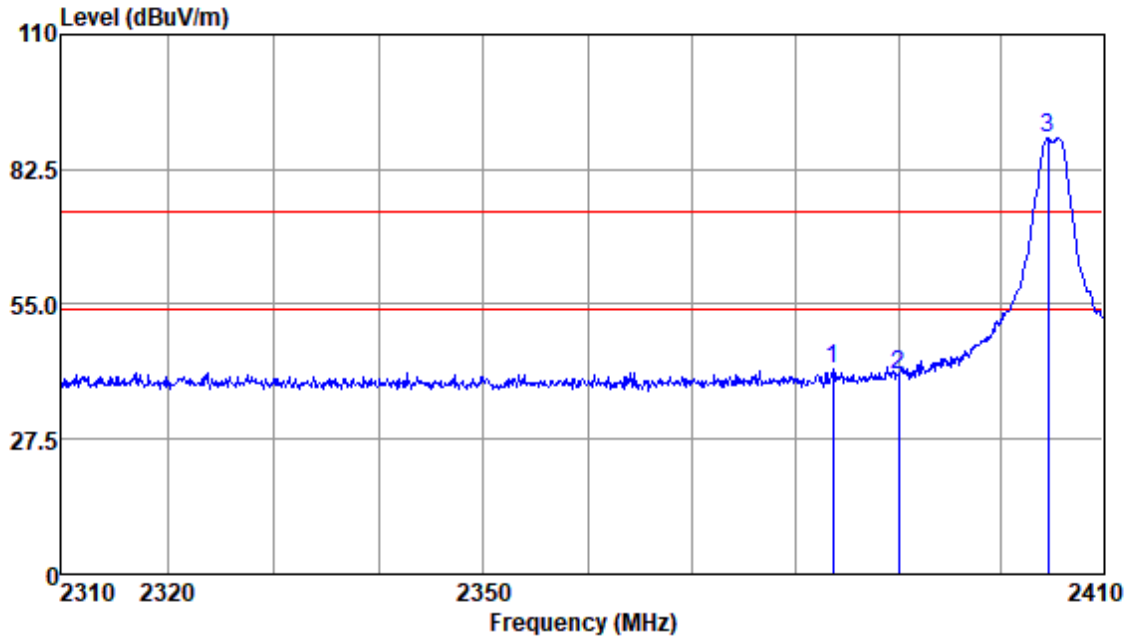
7.6.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low

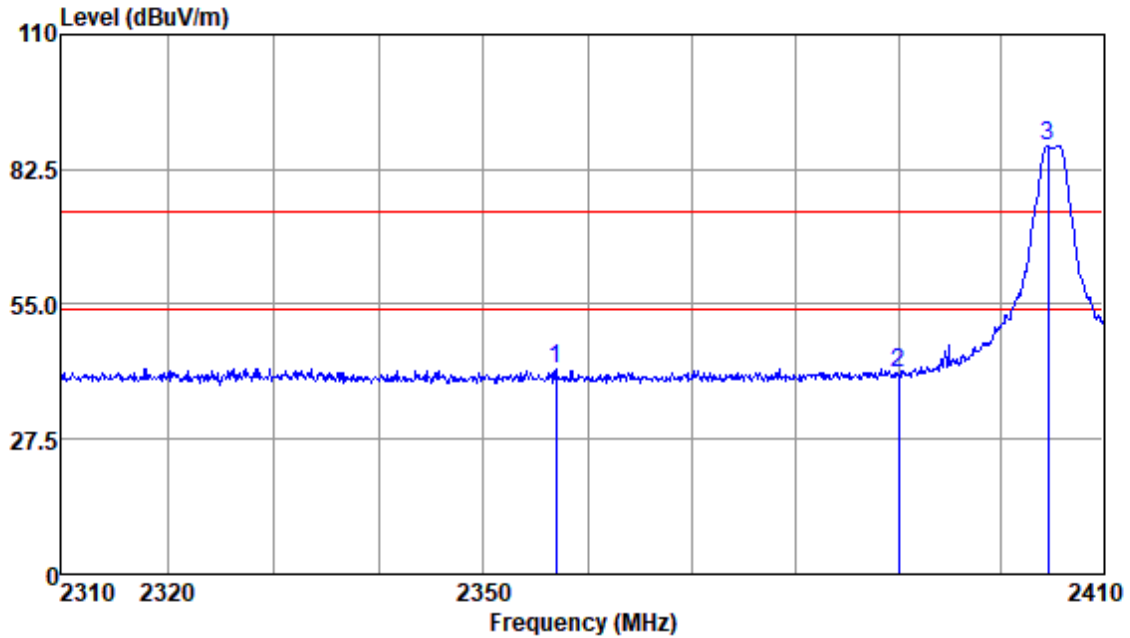


Antenna Polarity :HORIZONTAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2383.59	44.99	28.80	3.14	35.18	41.75	74.00	-32.25	Peak
2390.00	43.76	28.80	3.13	35.18	40.51	74.00	-33.49	Peak
2404.59	91.91	28.89	3.13	35.20	88.73	74.00	14.73	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low

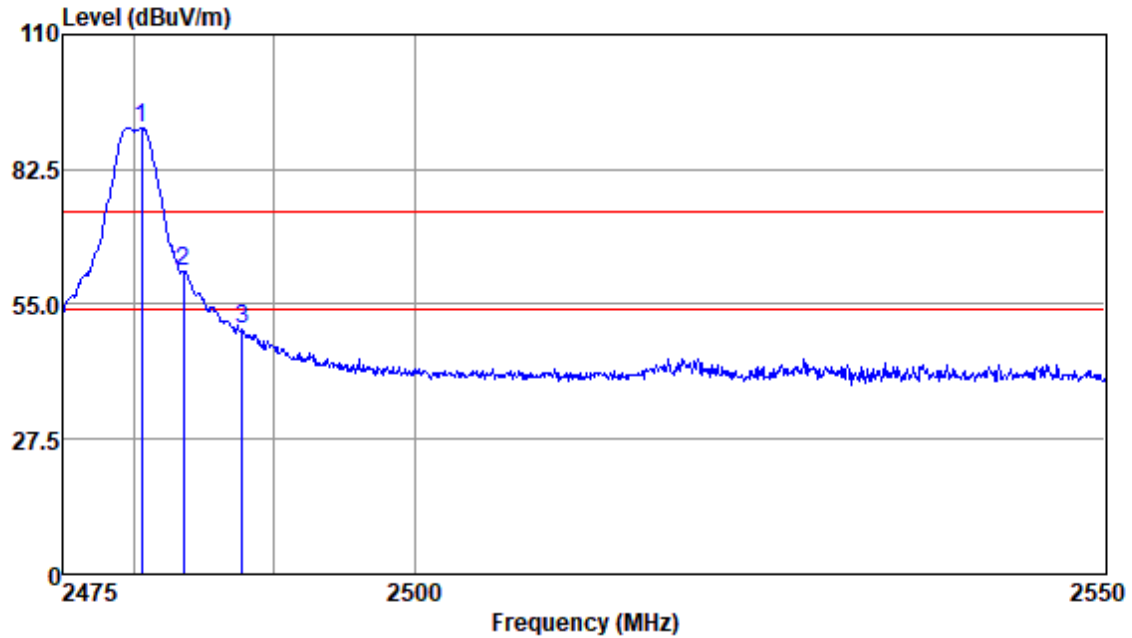


Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2356.97	45.15	28.66	3.14	35.16	41.79	74.00	-32.21	Peak
2390.00	44.32	28.80	3.13	35.18	41.07	74.00	-32.93	Peak
2404.59	90.46	28.89	3.13	35.20	87.28	74.00	13.28	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High

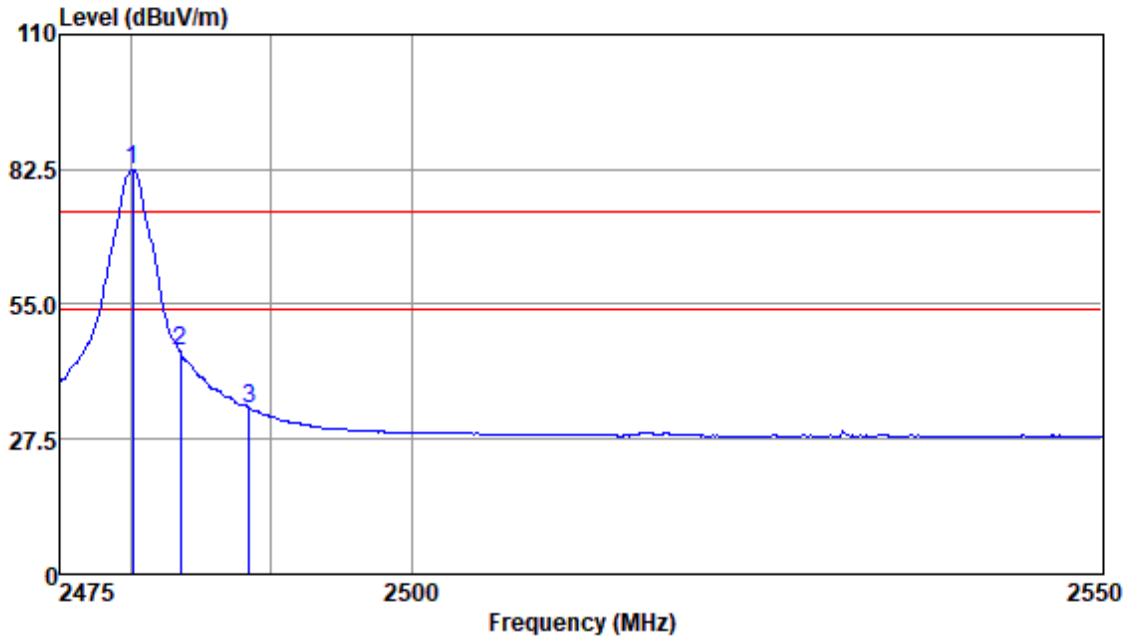


Antenna Polarity :HORIZONTAL
EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.55	93.95	29.08	3.20	35.25	90.98	74.00	16.98	Peak
2483.50	64.60	29.09	3.20	35.26	61.63	74.00	-12.37	Peak
2487.74	53.02	29.09	3.23	35.26	50.08	74.00	-23.92	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High

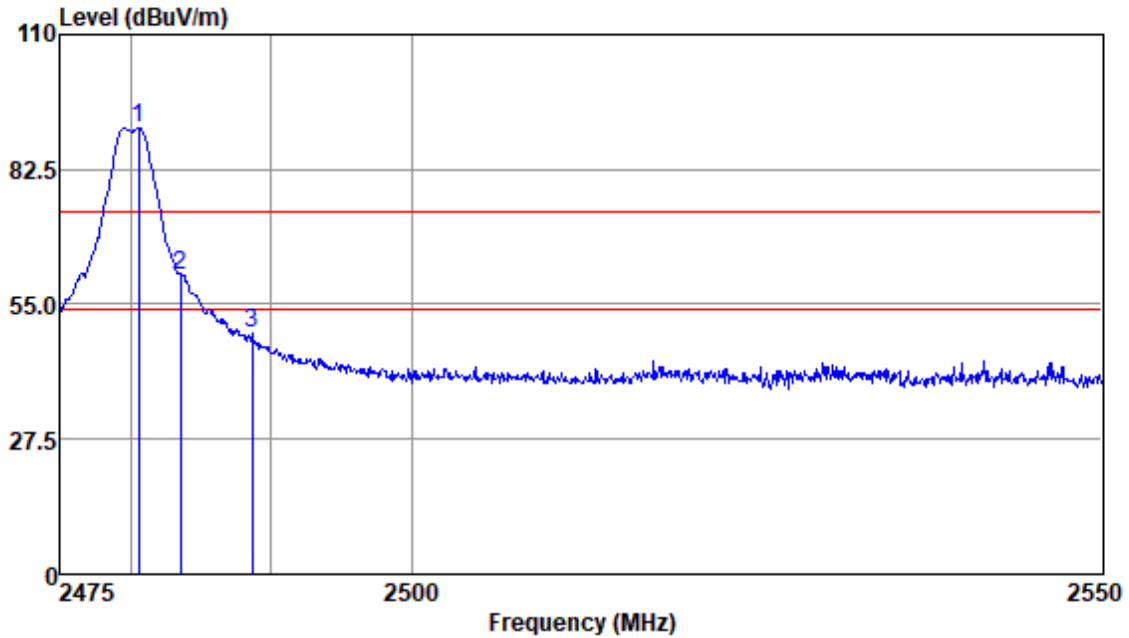


Antenna Polarity :HORIZONTAL
EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.10	85.48	29.08	3.20	35.25	82.51	54.00	28.51	Average
2483.50	48.39	29.09	3.20	35.26	45.42	54.00	-8.58	Average
2488.41	36.79	29.09	3.23	35.26	33.85	54.00	-20.15	Average

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High

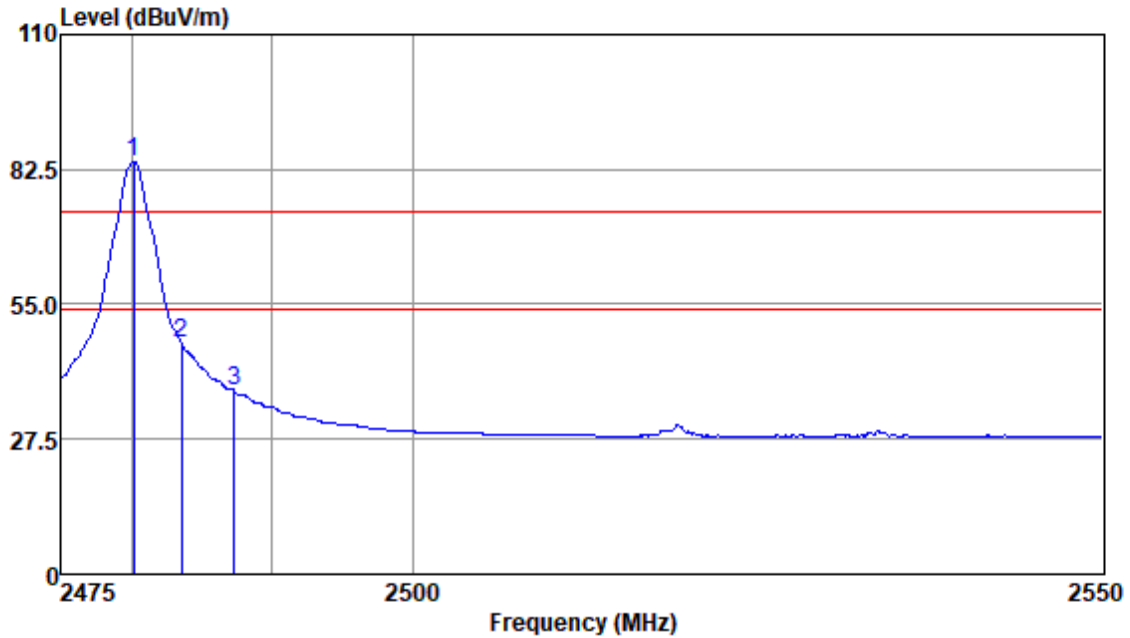


Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.55	93.88	29.08	3.20	35.25	90.91	74.00	16.91	Peak
2483.50	63.98	29.09	3.20	35.26	61.01	74.00	-12.99	Peak
2488.63	52.00	29.09	3.23	35.26	49.06	74.00	-24.94	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.10	87.03	29.08	3.20	35.25	84.06	54.00	30.06	Average
2483.50	50.25	29.09	3.20	35.26	47.28	54.00	-6.72	Average
2487.30	40.30	29.09	3.20	35.26	37.33	54.00	-16.67	Average

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.7 Radiated Spurious Emissions Below 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5

Limit:

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
960-1000	500	3

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 18.8 °C

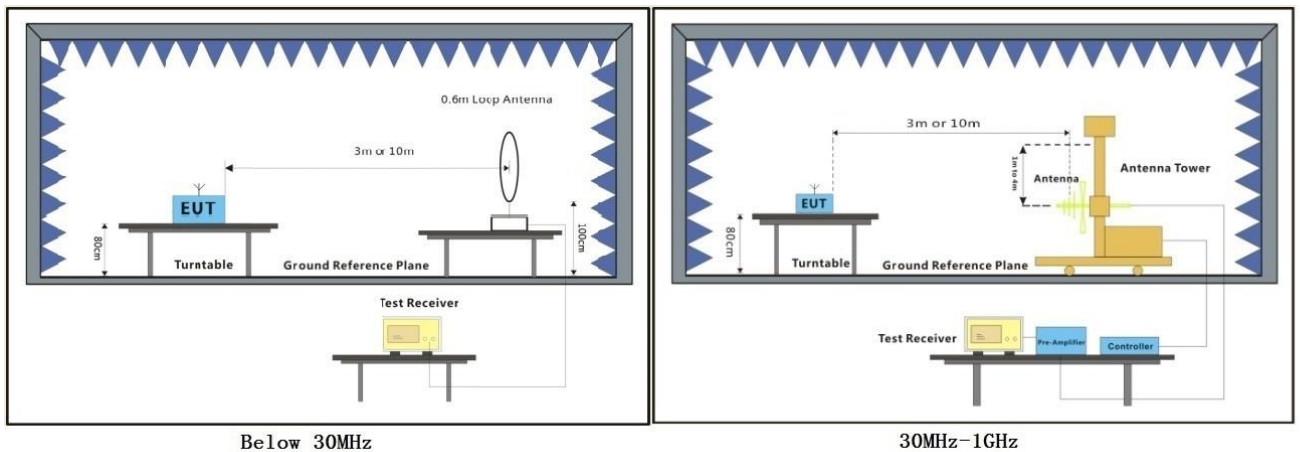
Humidity: 50.3 % RH

Atmospheric Pressure: 1010 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.7.3 Test Setup Diagram



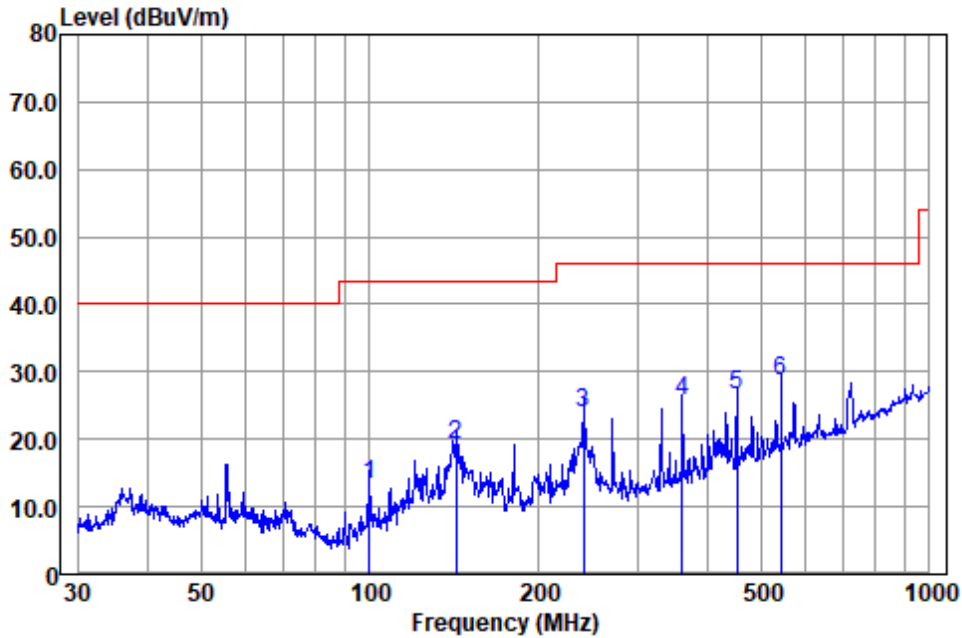
7.7.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. 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 from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using quasi-peak method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$
2. Scan from 9kHz to 30MHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
3. The disturbance below 1GHz was very low and the harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

Test Mode: 00; Polarity: Horizontal

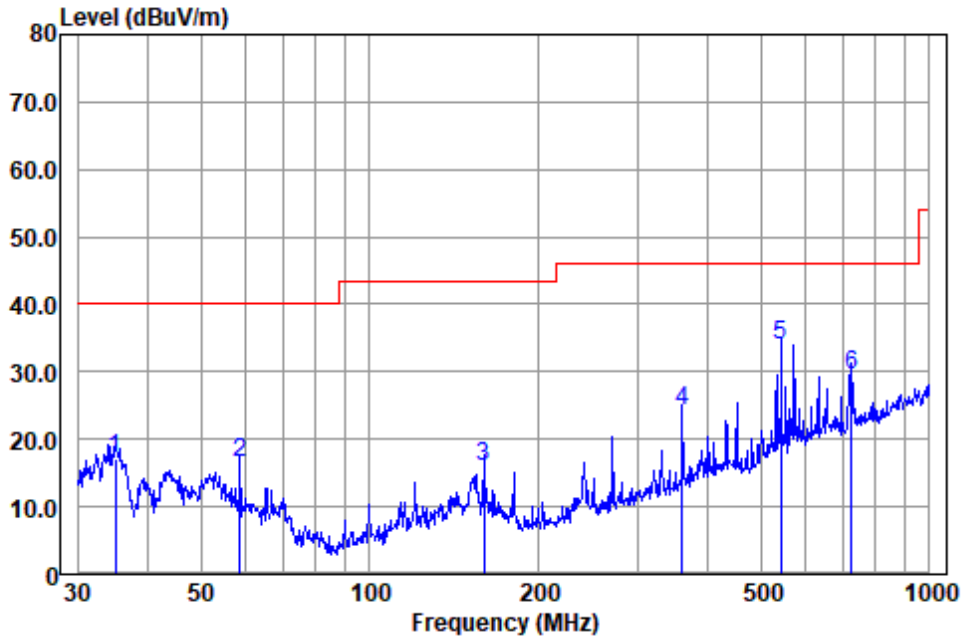


Antenna Polarity :HORIZONTAL
 EUT/Project :2541ME
 Test mode :00

	Read	Antenna	Cable	Preamp	Emission	Limit	Over	
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	99.878	36.04	9.10	1.86	33.60	13.40	43.50	-30.10 QP
2	142.824	36.90	13.30	2.47	33.51	19.16	43.50	-24.34 QP
3	240.830	42.90	11.06	3.15	33.13	23.98	46.00	-22.02 QP
4	361.714	39.43	14.73	4.52	32.97	25.71	46.00	-20.29 QP
5	452.720	37.97	17.26	4.30	33.00	26.53	46.00	-19.47 QP
6	543.274	37.44	18.70	5.48	33.00	28.62	46.00	-17.38 QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical



Antenna Polarity :VERTICAL
 EUT/Project :2541ME
 Test mode :00

	Read	Antenna	Cable	Preamp	Emission	Limit	Over	
Freq	Level	Factor	Loss	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	35.128	37.24	12.59	0.94	33.70	17.07	40.00	-22.93 QP
2	58.613	35.66	13.18	1.18	33.61	16.41	40.00	-23.59 QP
3	159.784	33.19	13.60	2.49	33.45	15.83	43.50	-27.67 QP
4	361.714	37.90	14.73	4.52	32.97	24.18	46.00	-21.82 QP
5	543.274	42.82	18.70	5.48	33.00	34.00	46.00	-12.00 QP
6	724.261	34.00	21.60	6.59	32.76	29.43	46.00	-16.57 QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.8 Radiated Spurious Emissions Above 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
Above 1000	500	3

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 18.9 °C

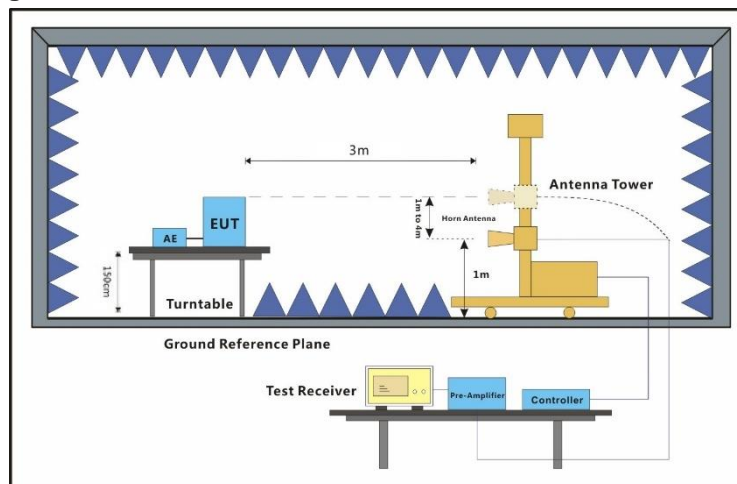
Humidity: 50.3 % RH

Atmospheric Pressure: 1010 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.8.3 Test Setup Diagram



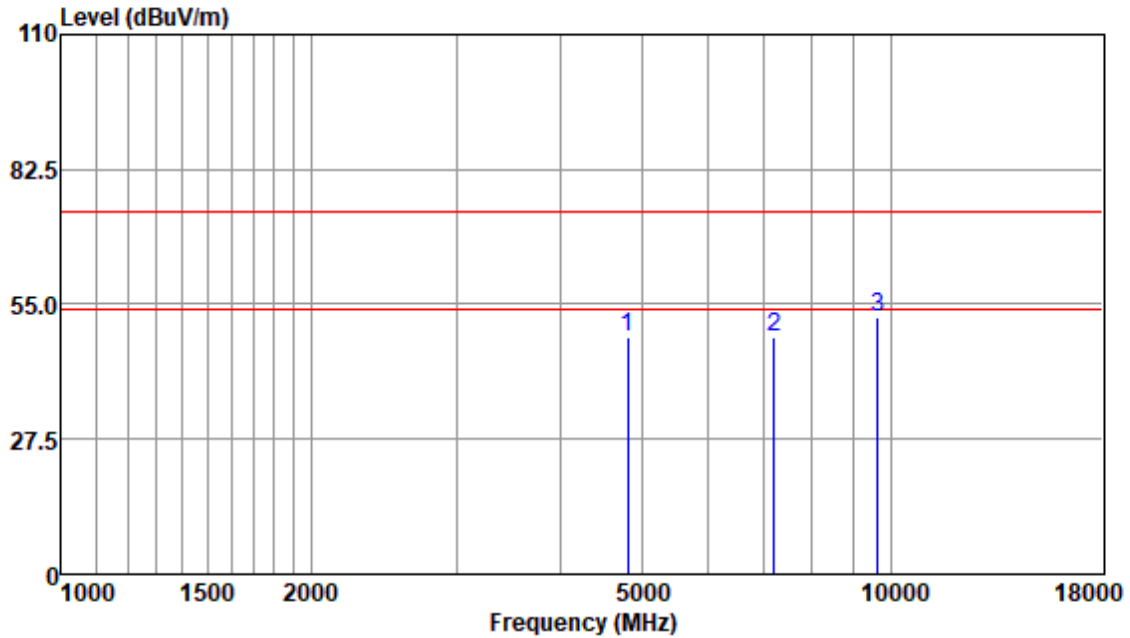
7.8.4 Measurement Procedure and Data

- a. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. 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 from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. $Level = Read\ Level + Cable\ Loss + Antenna\ Factor - Preamp\ Factor$
2. Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
3. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



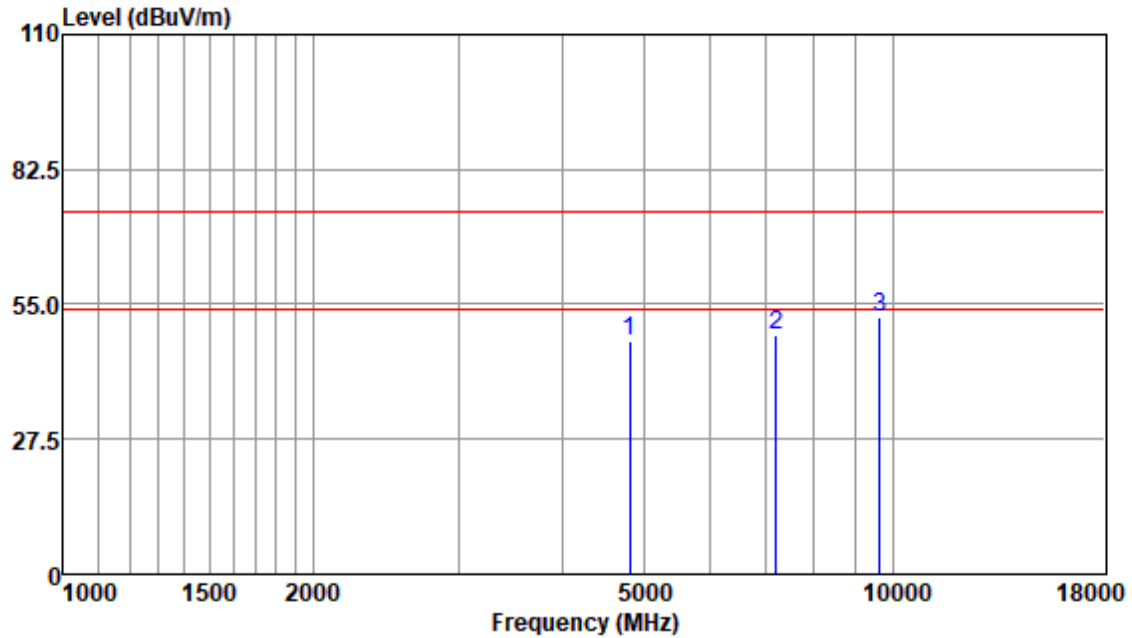
Antenna Polarity :HORIZONTAL

EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4810.11	47.19	33.57	4.53	36.79	48.50	74.00	-25.50	Peak
7215.15	40.90	36.26	6.65	35.51	48.30	74.00	-25.70	Peak
9620.43	39.59	37.75	8.56	33.58	52.32	74.00	-21.68	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low

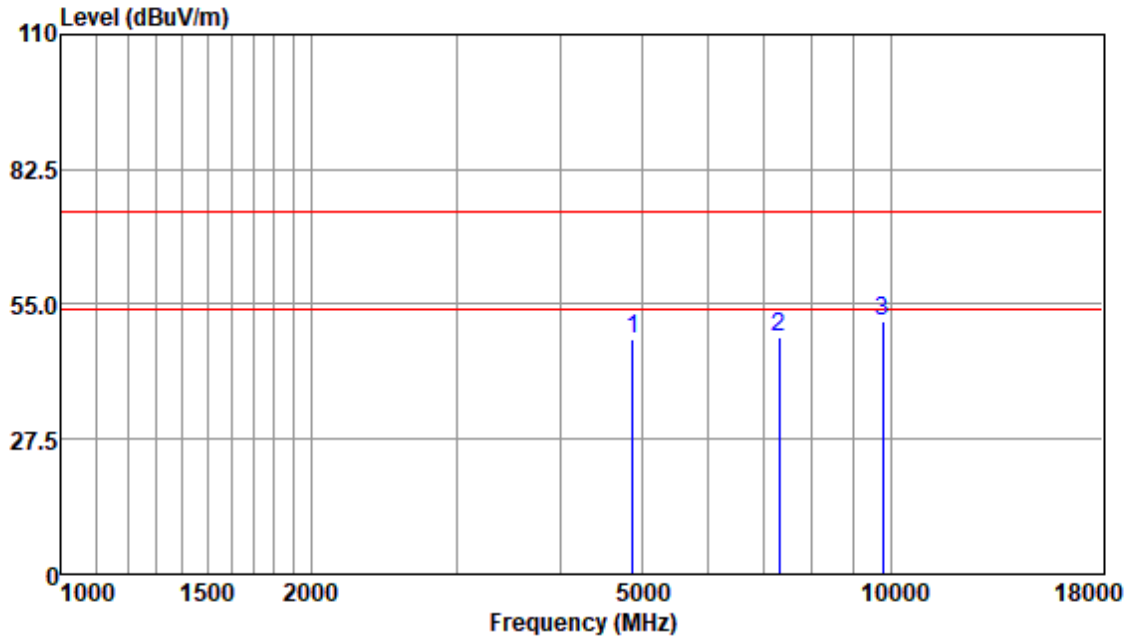


Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4810.11	46.09	33.57	4.53	36.79	47.40	74.00	-26.60	Peak
7215.15	41.18	36.26	6.65	35.51	48.58	74.00	-25.42	Peak
9620.43	39.75	37.75	8.56	33.58	52.48	74.00	-21.52	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:middle



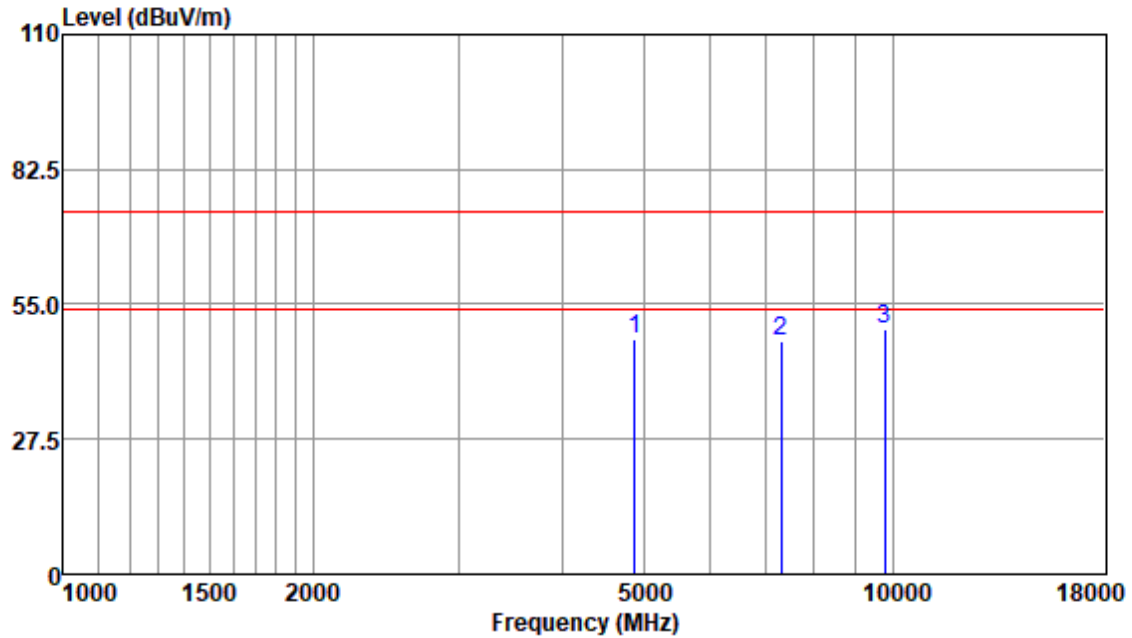
Antenna Polarity :HORIZONTAL

EUT/Project :2541ME

Read Freq	Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4880.04	46.50	33.66	4.73	36.81	48.08	74.00	-25.92	Peak
7320.27	40.97	36.33	6.59	35.42	48.47	74.00	-25.53	Peak
9760.37	38.92	37.54	8.69	33.50	51.65	74.00	-22.35	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:middle

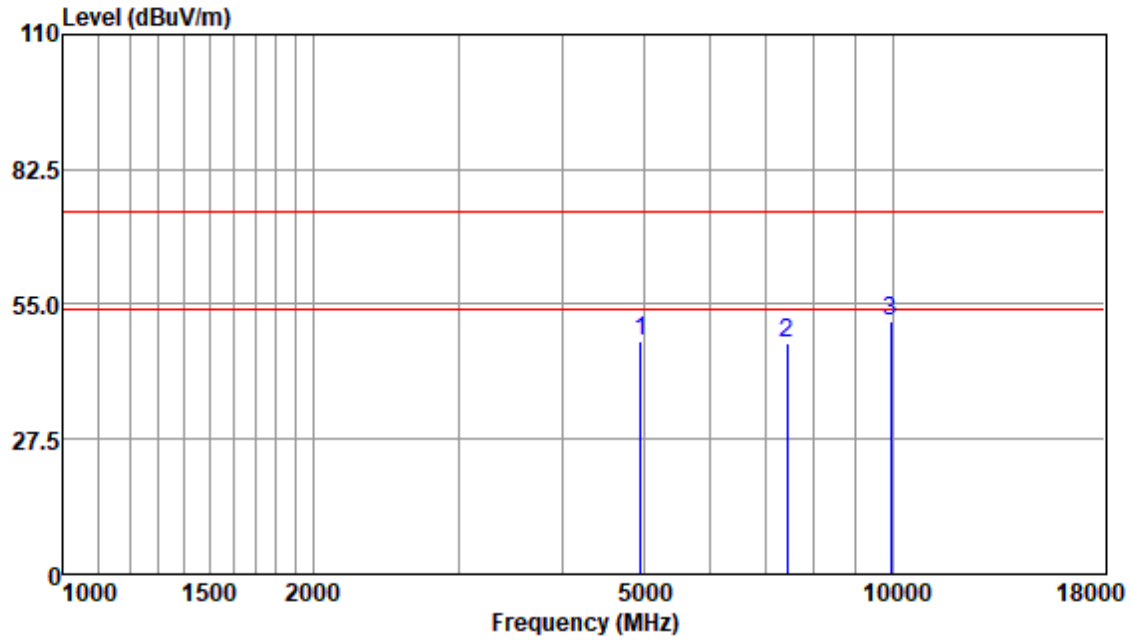


Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4880.04	46.28	33.66	4.73	36.81	47.86	74.00	-26.14	Peak
7320.27	40.19	36.33	6.59	35.42	47.69	74.00	-26.31	Peak
9760.37	37.29	37.54	8.69	33.50	50.02	74.00	-23.98	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High

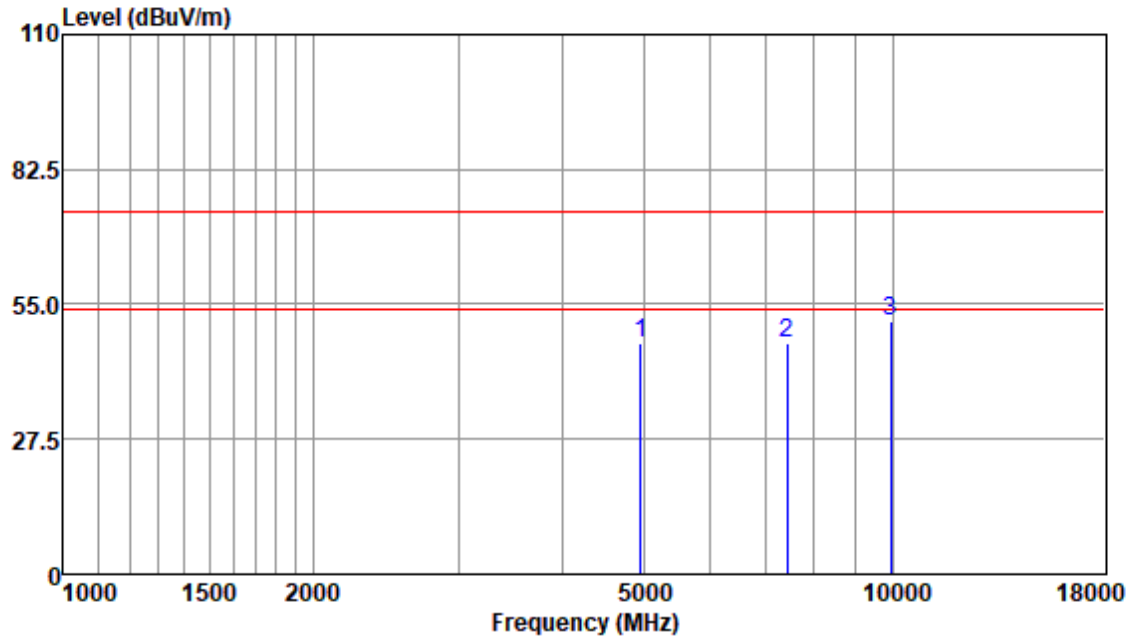


Antenna Polarity :HORIZONTAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.31	45.72	33.65	4.92	36.83	47.46	74.00	-26.54	Peak
7440.91	39.68	36.31	6.61	35.34	47.26	74.00	-26.74	Peak
9920.99	38.60	37.62	8.87	33.41	51.68	74.00	-22.32	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL
EUT/Project :2541ME

Read Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.31	45.33	33.65	4.92	36.83	47.07	74.00	-26.93	Peak
7440.91	39.43	36.31	6.61	35.34	47.01	74.00	-26.99	Peak
9920.99	38.54	37.62	8.87	33.41	51.62	74.00	-22.38	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.9 99% Bandwidth

Test Requirement RSS-Gen Section 6.7
 Test Method: ANSI C63.10 (2013) Section 6.9.3

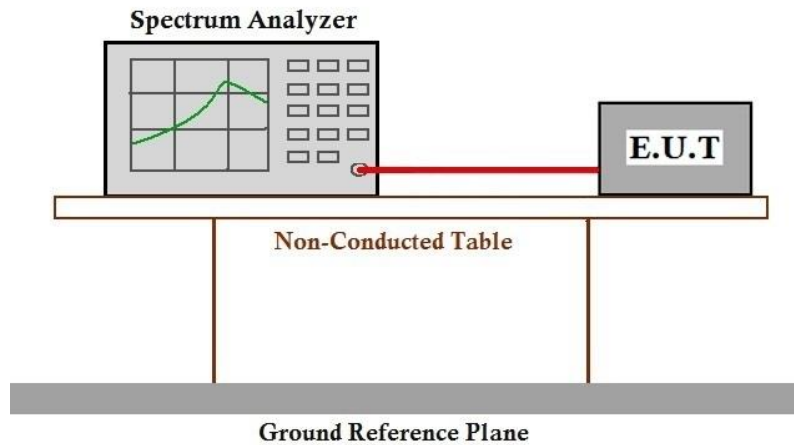
7.9.1 E.U.T. Operation

Operating Environment:
 Temperature: 18.9 °C Humidity: 50.3 % RH Atmospheric Pressure: 1010 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode_Keep the EUT in continuously transmitting with O-QPSK modulation mode.

7.9.3 Test Setup Diagram



7.9.4 Measurement Procedure and Data

Please Refer to Appendix for Details

8 Test Setup Photo

Refer to Appendix - Test Setup Photo for SHCR2312002541ME

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for SHCR2312002541ME

10 Appendix

10.1 Appendix A: DTS Bandwidth

10.1.1 Test Result

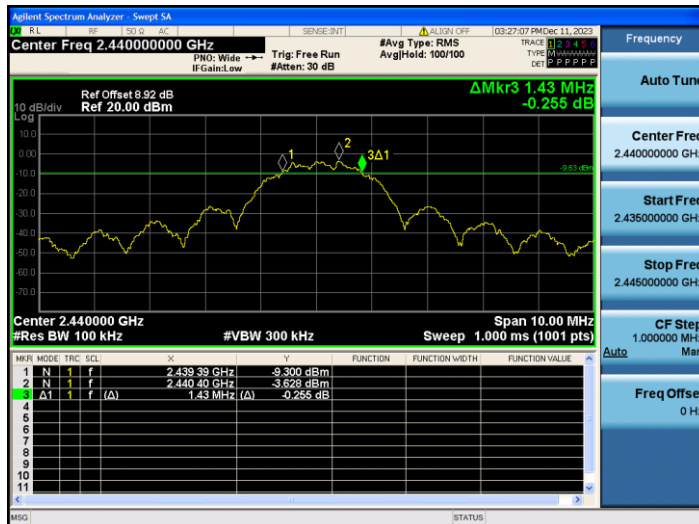
TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
ZIGB	Ant1	2405	1.410	2404.400	2405.810	0.5	PASS
		2440	1.430	2439.390	2440.820	0.5	PASS
		2480	1.450	2479.370	2480.820	0.5	PASS

10.1.2 Test Graphs

ZIGB_Ant1_2405



ZIGB_Ant1_2440



ZIGB_Ant1_2480





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10.2 Appendix B: Occupied Channel Bandwidth

10.2.1 Test Result

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
ZIGB	Ant1	2405	2.3778	2403.8961	2406.2739	---	---
		2440	2.3643	2438.8863	2441.2506	---	---
		2480	2.4530	2478.8483	2481.3013	---	---

10.2.2 Test Graphs





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SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR231200254101

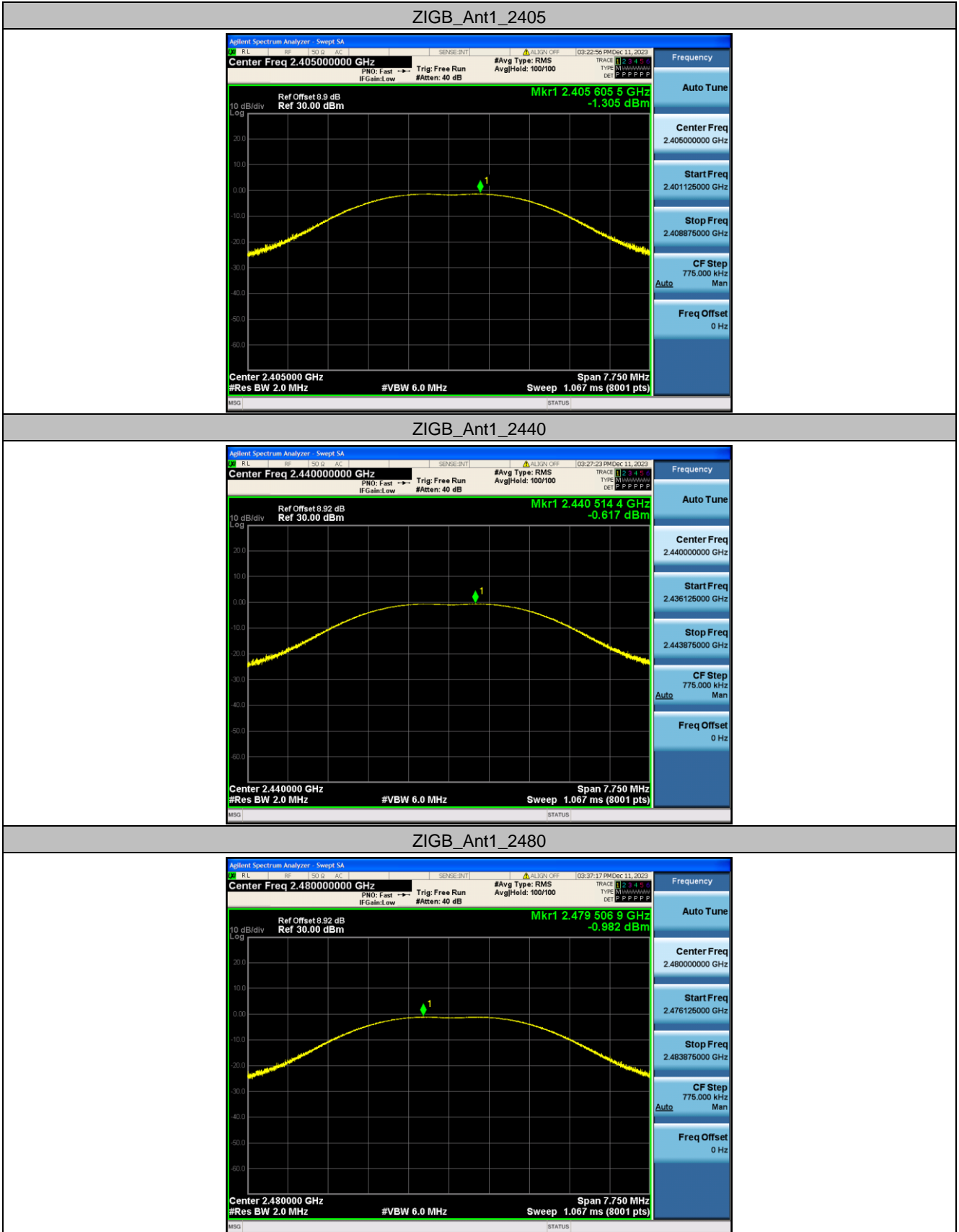
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10.3 Appendix C: Maximum conducted output power

10.3.1 Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
ZIGB	Ant1	2405	-1.31	≤30	PASS
		2440	-0.62	≤30	PASS
		2480	-0.98	≤30	PASS

10.3.2 Test Graphs





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Report No.: SHCR231200254101

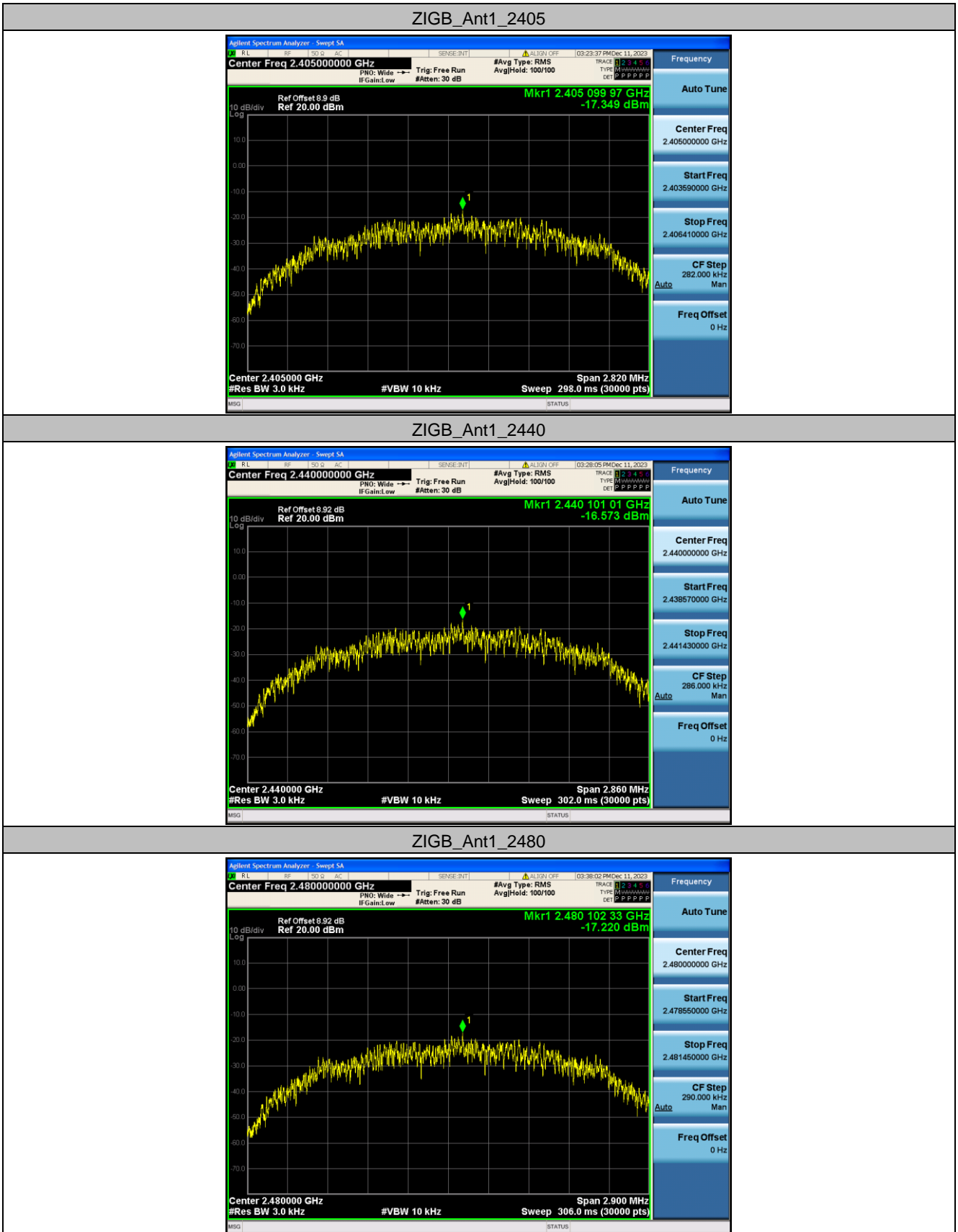
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10.4 Appendix D: Maximum power spectral density

10.4.1 Test Result

TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
ZIGB	Ant1	2405	-17.35	≤8.00	PASS
		2440	-16.57	≤8.00	PASS
		2480	-17.22	≤8.00	PASS

10.4.2 Test Graphs





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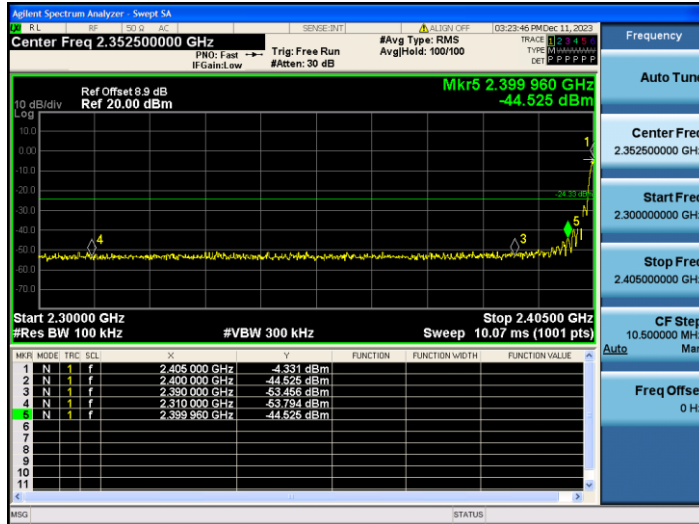
10.5 Appendix E: Band edge measurements

10.5.1 Test Result

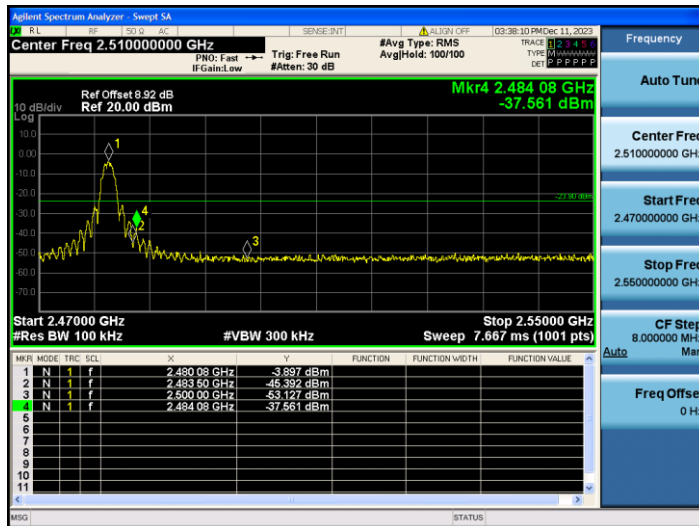
TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
ZIGB	Ant1	Low	2405	-4.33	-44.53	≤ -24.33	PASS
		High	2480	-3.90	-37.56	≤ -23.9	PASS

10.5.2 Test Graphs

ZIGB_Ant1_Low_2405



ZIGB_Ant1_High_2480

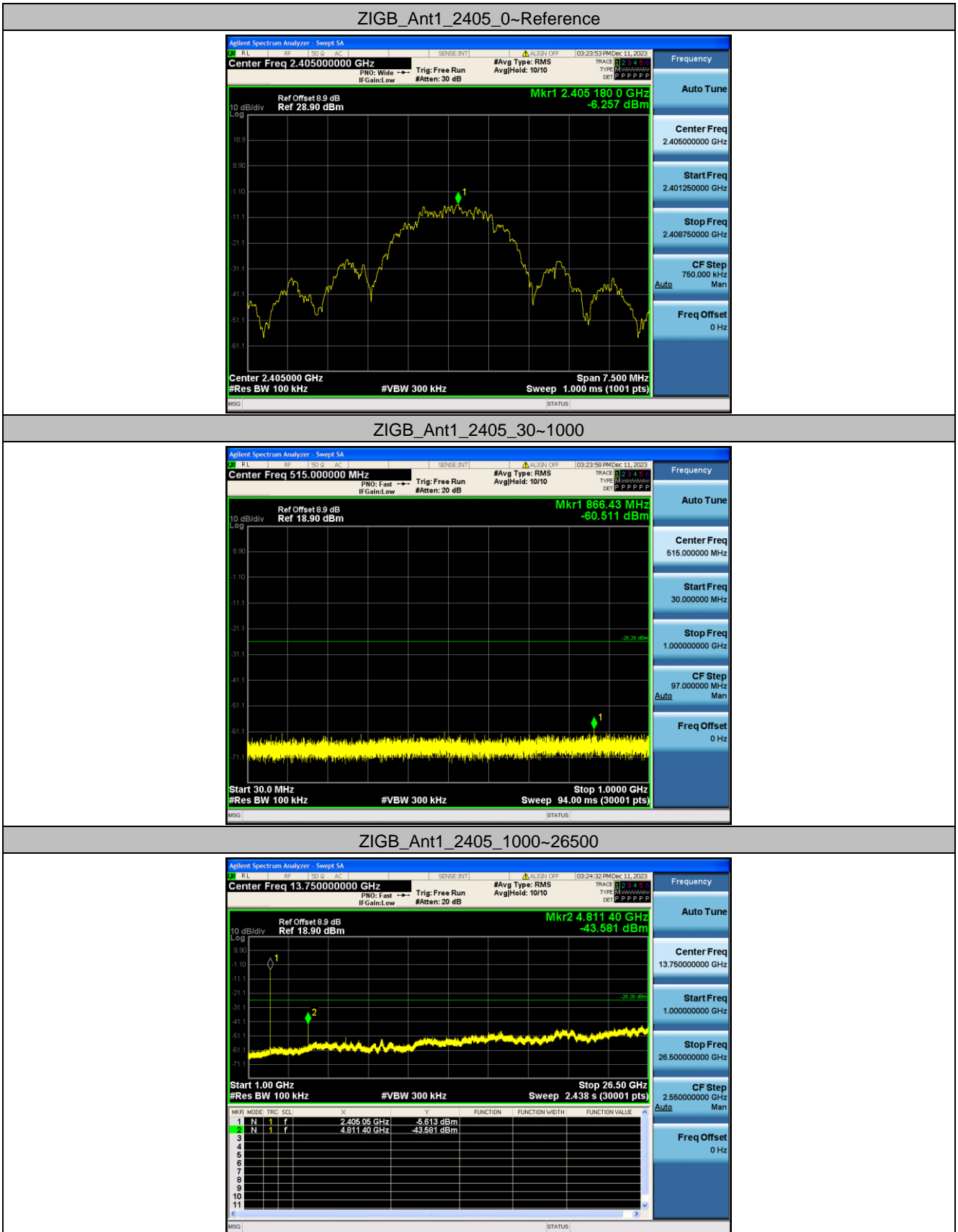


10.6 Appendix F: Conducted Spurious Emission

10.6.1 Test Result

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
ZIGB	Ant1	2405	Reference	-6.26	-6.26	---	PASS
			30~1000	-6.26	-60.51	≤-26.26	PASS
			1000~26500	-6.26	-43.58	≤-26.26	PASS
		2440	Reference	-5.41	-5.41	---	PASS
			30~1000	-5.41	-61.12	≤-25.41	PASS
			1000~26500	-5.41	-42.62	≤-25.41	PASS
		2480	Reference	-5.90	-5.90	---	PASS
			30~1000	-5.90	-60.35	≤-25.9	PASS
			1000~26500	-5.90	-42.85	≤-25.9	PASS

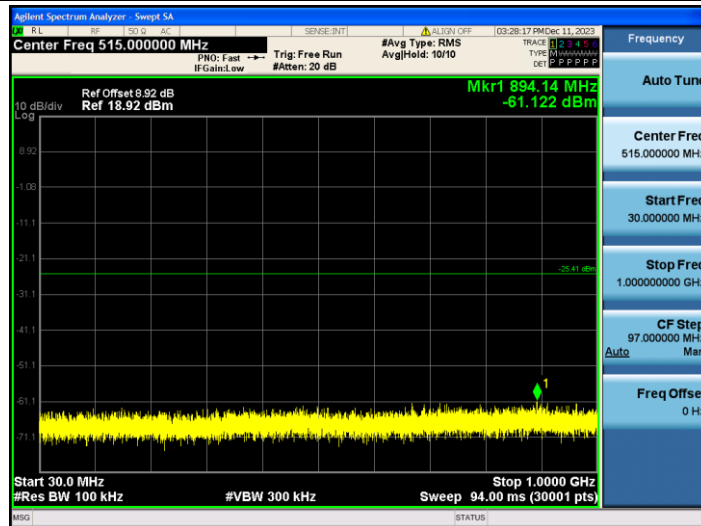
10.6.2 Test Graphs



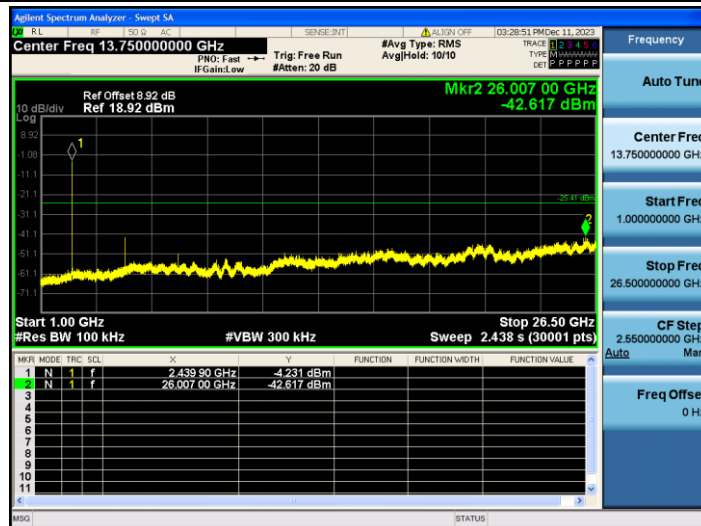
ZIGB_Ant1_2440_0~Reference



ZIGB_Ant1_2440_30~1000



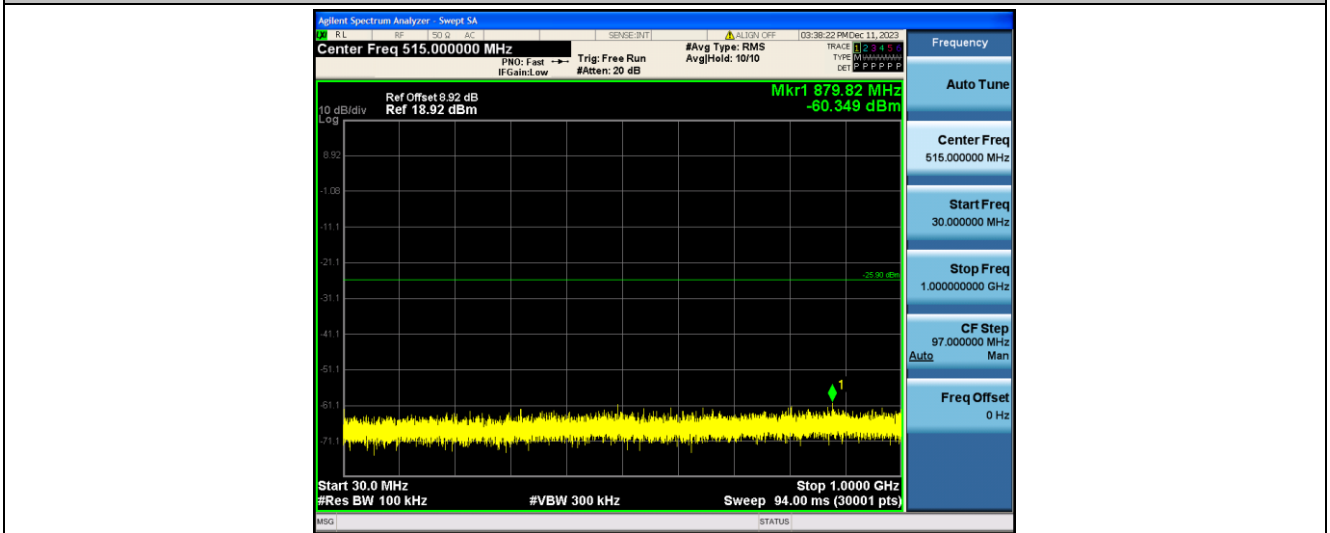
ZIGB_Ant1_2440_1000~26500



ZIGB_Ant1_2480_0~Reference



ZIGB_Ant1_2480_30~1000



ZIGB_Ant1_2480_1000~26500

