Armatura LLC

RF TEST REPORT

Report Type:
FCC Part 15.225 RF report

Model:
OmniAC20

REPORT NUMBER:
230402194SHA-004

ISSUE DATE:
July 5, 2023

DOCUMENT CONTROL NUMBER:
TTRF15.225_V1 © 2018 Intertek

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TEST REPORT

Report no.: 230402194SHA-004

Applicant:	Armatura LLC
	190 Bluegrass Valley Parkway Alpharetta, GA 30005
Manufacturer:	Armatura LLC
	190 Bluegrass Valley Parkway Alpharetta, GA 30005
FCC ID:	2A5UQ-OMNIAC20W

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2021): Radio Frequency Devices (Subpart C) **ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

PREPARED BY:	**REVIEWED BY:**
Project Engineer Damon Ding	Reviewer Erick Liu

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Revision History

Report No.	Version	Description	Issued Date
230402194SHA-004	Rev. 01	Initial issue of report	July 5, 2023

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Measurement result summary

TEST ITEM	FCC REFERENCE	RESULT
Fundamental emission	15.225(a) (b) (c)	Pass
Spurious emission	15.225(d)	Pass
Frequency stability	15.225(e)	Pass
Conducted emissions	15.207	Pass
20dB Bandwidth	15.215(c)	Pass
Antenna requirement	15.203	Pass

Notes: 1: NA =Not Applicable

2: Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.

TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Smart Access Control Terminal
Type/Model:	OmniAC20
Description of EUT:	Smart Access Control Terminal
EUT type:	☒ Table top ☐ Floor standing
Rating:	Powered from adapter: Input: 100V-240~50/60Hz, 1.0A Max Output: DC12V, 3.0A
Software Version:	Not provided
Hardware Version:	Not provided
Normal Test Voltage:	120V ~60Hz
Sample received date:	March 8, 2023
Date of test:	April 13, 2023 to June 01, 2023

1.2 Technical Specification

Frequency Range:	13.56 MHz ~ 13.56 MHz
Nominal Operating Frequency:	13.56 MHz
Max. Data Rates:	106 Kbps
Number of Channels:	1
Work in Modes:	☐ Card Emulation, ☐ Peer-to-Peer, ☒ Reader/Writer
NFC Type:	☒ NFC A Type, ☒ NFC B Type, ☐ NFC F Type, ☐ NFC V Type
Modulation:	ASK
Antenna:	induction coil antenna

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN0175
	IC Registration Lab CAB identifier.: CN0014
	VCCI Registration Lab Member No: 3598 (Registration No.: R-14243, G-10845, C-14723, T-12252)
	A2LA Accreditation Lab Certificate Number: 3309.02

All tests were sub-contracted.

Name:	Shenzhen UnionTrust Quality and Technology Co., Ltd.
Address:	Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng Science and Technology Park, Longhua District, Shenzhen, China
Telephone:	+86 (0) 755 2823 0888
Telefax:	+86 (0) 755 2823 0886

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L9069
	FCC Accredited Lab Designation Number: CN1194
	A2LA Accreditation Lab Certificate Number: 4312.01

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2021)
ANSI C63.10 (2013)

2.2 Mode of operation during the test

Within this test report, EUT was tested under all available operation modes and tested under its rating voltage and frequency. The below test modes in boldface were the worst cases, only the test data of these modes were reported.

Test Mode 1: AC120~60Hz+ 13.56MHz Tx mode

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	e3	Audix	9.20151119i
Radiated emission	e3	Audix	9.160323

2.4 Test peripherals list

Item No	Description	Band and Model	S/No	rating
1	Advanced Look	N/A, AL-280 (LED)	N/A	NA
2	Card Reader	ZKTeco, KR503E	N/A	AC100-240V 50/60Hz 1.0A
3	Advanced ID Card	ZKTeco, 13.56 MHz	NA	NA
4	Laptop	Lenovo,E450	SL10G10780	N/A
5	mouse	DELL, MS111	CN-011D3V-73826-62N-0LK	N/A

2.5 Support Cable list

Item No	Description	**Length (m)**	**Cable Type**
1	Ethernet Cable	1.5	RJ45_Cat 5

2.6 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	22.7°C	59.6% RH
Power line conducted emission	24.4°C	58.2% RH
RF Test	24.8°C	52.4% RH

2.7 Instrument list

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	3m Chamber SAC	ETS-LINDGREN	3m	NA	22-Jan-2021	21-Jan-2024
☒	Receiver	R&S	ESIB26	100114	3-Nov-2022	2-Nov-2023
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 21, 2022	Nov. 20, 2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	13-Dec-2022	12-Dec-2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	13-Dec-2022	12-Dec-2023
☒	Preamplifier	HP	8447F	2805A02960	1-Nov-2022	31-Oct-2023
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 01, 2022	Oct. 31, 2023
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 01, 2022	Oct. 31, 2023
☒	LISN	R&S	ESH2-Z5	860014/024	Nov. 01, 2022	Oct. 31, 2023
☒	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 01, 2022	Oct. 31, 2023
☒	Test Software	Audix	e3	Software Version: 9 20151119i		

Frequency Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 21, 2022	Nov. 20, 2023
☒	DC Source	KIKUSUI	PWR400L	LK003024	Aug. 15, 2022	Aug. 14, 2023
☒	Temp & Humidity chamber	Votisch	VT4002	58566133290020	Apr. 14, 2023	Apr. 13, 2024
☒	Spectrum analyzer	R&S	FSV40-N	101653	Apr. 14, 2023	Apr. 13, 2024

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2.8 Measurement uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2)
Conducted emission at mains ports	9kHz ~ 150kHz	±3.2 dB
	150kHz ~ 30MHz	±2.7 dB
Radiated Emissions	9kHz ~ 30MHz	± 4.7 dB
	30MHz ~ 1GHz	± 4.6 dB
	1GHz ~ 18GHz	± 4.4 dB
	18GHz~26 GHz	± 4.4 dB
	26 GHz~40 GHz	± 4.6 dB

3 Fundamental Emission

Test result: **Pass**

3.1 Limit

Frequencies (MHz)	Limit at 30m (dBuV/m)	Limit at 3m (dBuV/m)
13.110 – 13.410	40.50	80.50
13.410 – 13.553	50.50	90.50
13.553 – 13.567	84.00	124.00
13.567 – 13.710	50.50	90.50
13.710 – 14.010	40.50	80.50

3.2 Measurement Procedure

a) The EUT was placed on a 0.8m plank above the ground at a 3 meter chamber room for test. 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) Both X and Y axes of the antenna are set to make the measurement.
d) For each suspected emission, the EUT was arranged to its worst case 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 PK Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

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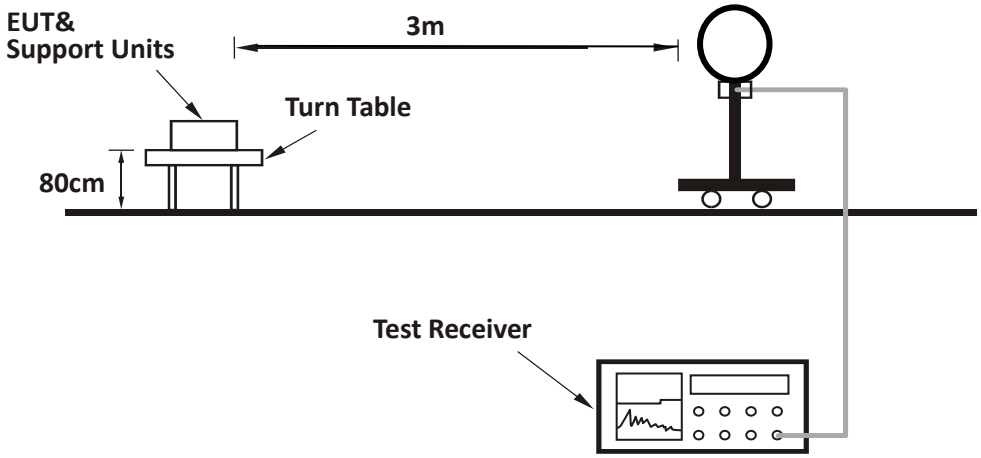
3.3 Test Configuration



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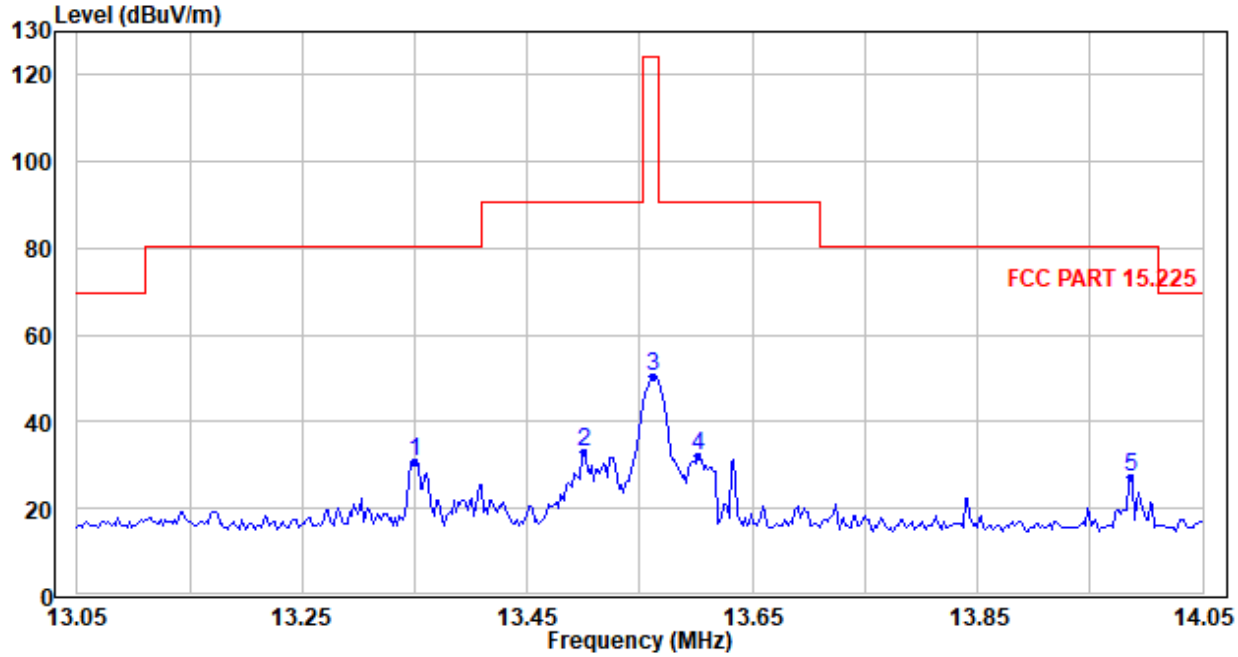
3.4 Test Results of Fundamental Emissions

Test Curve:



Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin	Detector
13.351	30.80	-20.73	80.51	-49.71	PK
13.501	33.09	-20.75	90.47	-57.38	PK
13.561	50.54	-20.76	124.00	-73.46	PK
13.601	32.32	-20.76	90.47	-58.15	PK
13.986	27.25	-20.81	80.51	-53.26	PK

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin =Corrected Reading- Limit

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 10.20dBuV/m -40.00dBuV/m = -29.80dB.

4 Spurious Emission

Test result: **Pass**

4.1 Limit

Frequencies (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

4.2 Measurement Procedure

For Radiated emission below 30MHz:

f) The EUT was placed on a 0.8m plank above the ground at a 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
g) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
h) Both X and Y axes of the antenna are set to make the measurement.
i) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
j) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz:

a) The EUT was placed on a 0.8m plank above the ground at a 3 meter chamber room for test. 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 height of antenna 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.

TEST REPORT

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 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

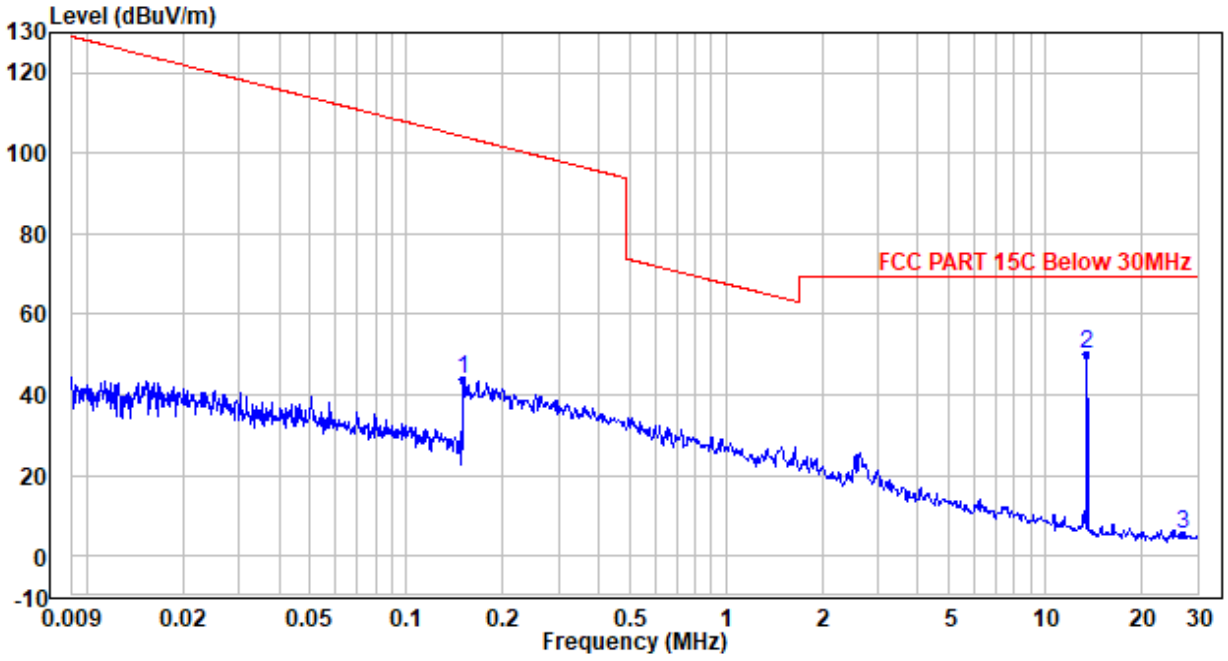
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. All modes of operation were evaluated and the worst-case emissions were reported

4.3 Test Results of Radiated Emissions

The EUT has been tested in all two orthogonal planes, it has the worst case when it is in horizontal position for both below 30MHz & above 30MHz.

Test Curve

Worst case Test Mode 1: X axes



Test data below 30MHz:

Frequency (MHz)	Measured level (dBμV/m)	Factor (dB)	Limits (dBμV/m)	Margin (dB)	Detector
0.151	43.97	-20.24	104.16	-60.19	Peak
13.56	50.15	-20.74	69.50	-19.35	Peak
27.12	5.36	-22.75	69.50	-64.14	Peak

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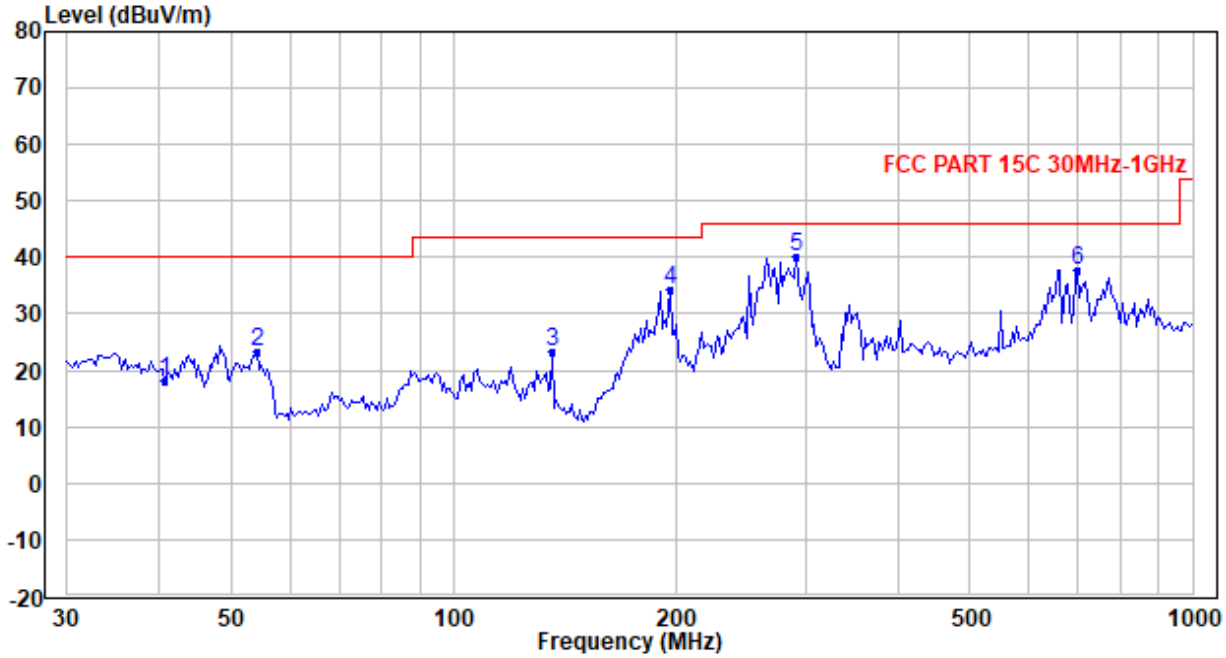
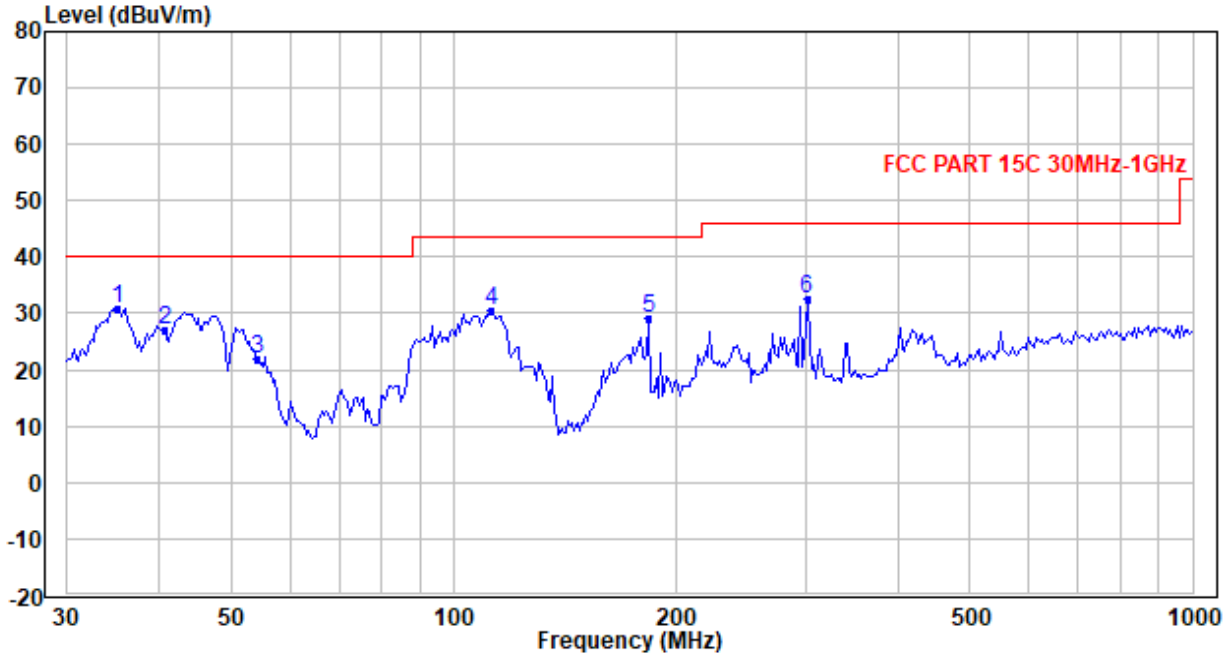
Test Curve

Worst case Test Mode 1

Horizontal



Vertical



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Test data from 30MHz to 1000MHz:

Polarization	Frequency (MHz)	Measured level (dBμV/m)	Factor (dB)	Limits (dBμV/m)	Margin (dB)	Detector
H	40.680	18.26	-8.31	40.00	-21.74	Peak
	54.240	23.13	-16.32	40.00	-16.87	Peak
	135.916	23.20	-15.23	43.50	-20.30	Peak
	195.870	34.23	-10.37	43.50	-9.27	Peak
	290.317	40.19	-7.01	46.00	-5.81	Peak
	698.804	37.89	2.43	46.00	-8.11	Peak
V	35.016	30.94	-5.49	40.00	-9.06	Peak
	40.680	27.09	-8.31	40.00	-12.91	Peak
	54.240	22.07	-16.32	40.00	-17.93	Peak
	112.427	30.45	-15.39	43.50	-13.05	Peak
	183.866	29.04	-10.09	43.50	-14.46	Peak
	300.699	32.56	-6.41	46.00	-13.44	Peak

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Corrected Reading -Limit
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.
5. All possible modes of operation were investigated, only the worst-case emissions reported.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 10.20dBuV/m -40.00dBuV/m = -29.80dB.

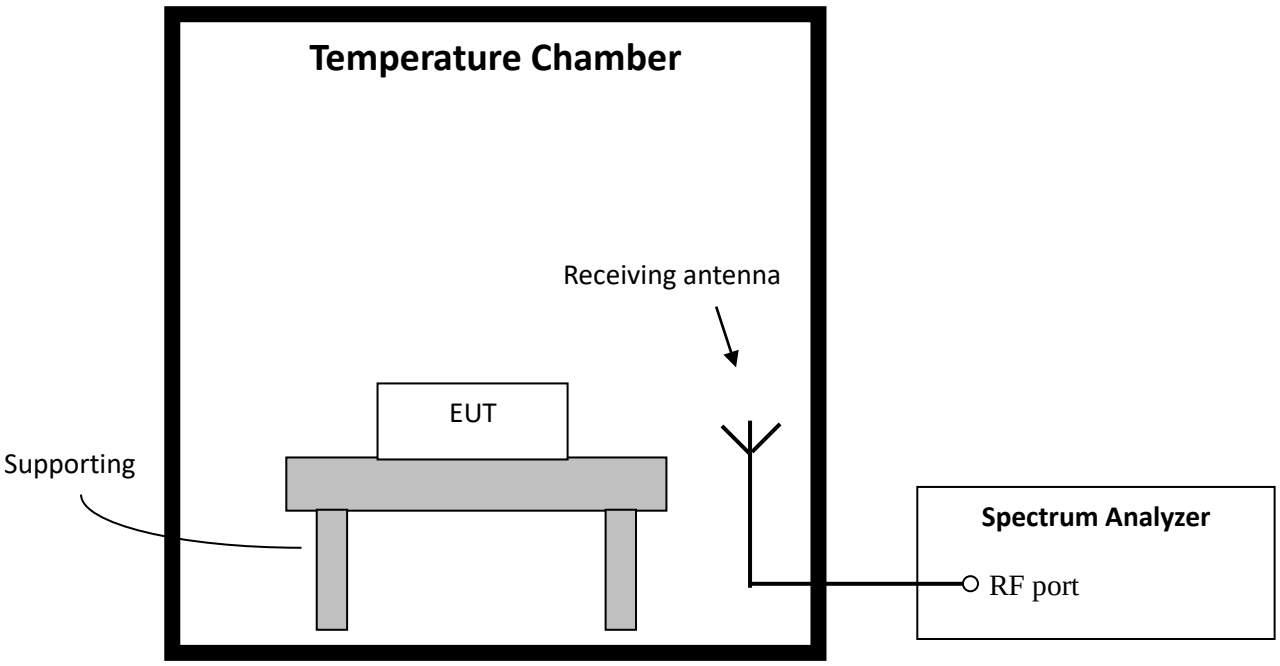
5 Frequency Stability (Temperature Variation)

Test result: PASS

5.1 Test limit

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage.

5.2 Test Configuration



5.3 Test procedure and test setup

Test Procedure as per ANSI 63.10 clause 6.8.1.

5.4 Test protocol

Voltage (V)	Temp (ºC)	Freq measured (MHz)	Freq nominal (MHz)	Tolerance	Limit (%)
12	-20	13.5598	13.56	-0.0015%	±0.01
	-10	13.5602		0.0015%	
	0	13.5598		-0.0015%	
	10	13.5598		-0.0015%	
	20	13.5598		-0.0015%	
	30	13.5598		-0.0015%	
	40	13.5598		-0.0015%	
	50	13.5598		-0.0015%	

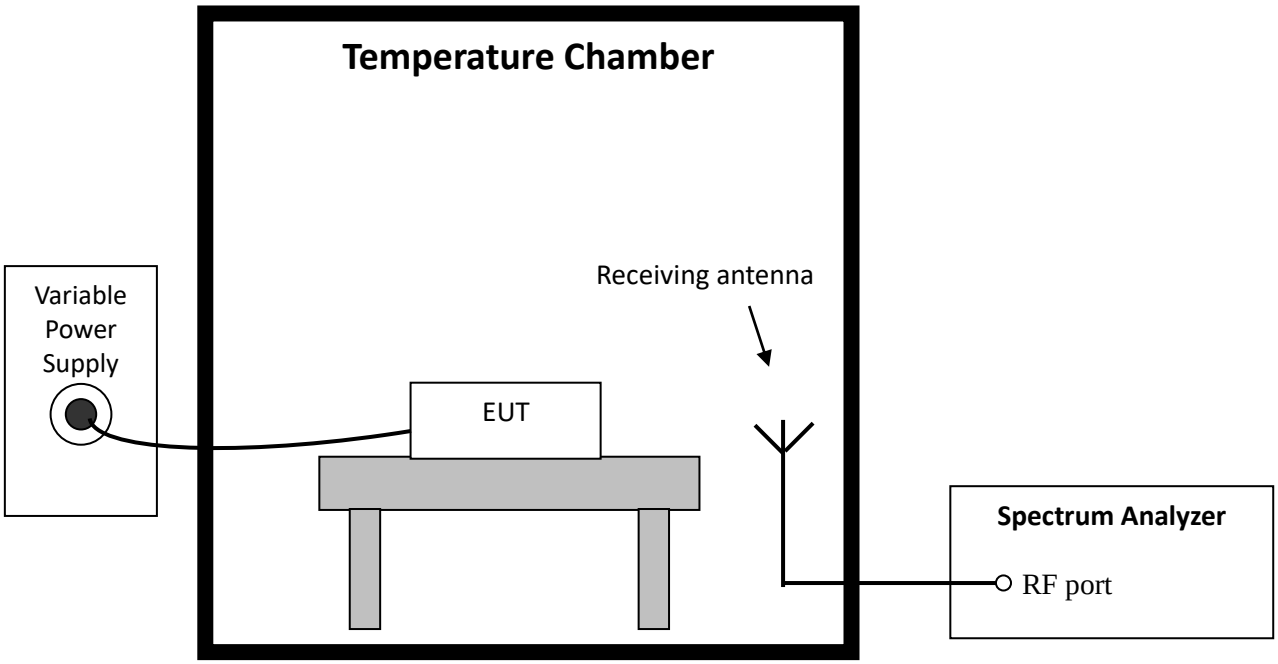
6 Frequency Stability (Voltage Variation)

Test result: PASS

6.1 Test limit

The frequency tolerance of the carrier signal shall be maintained within ±0.01% for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

6.2 Test Configuration



6.3 Test procedure and test setup

Test Procedure as per ANSI 63.10 clause 6.8.2.

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6.4 Test protocol

Temp (ºC)	Voltage (V)	Freq Measured (MHz)	Freq nominal (MHz)	Tolerance	Limit (%)
20	10.2	13.5596	13.56	-0.0029%	±0.01
	12.0	13.5598		-0.0015%	
	13.8	13.5598		-0.0015%	

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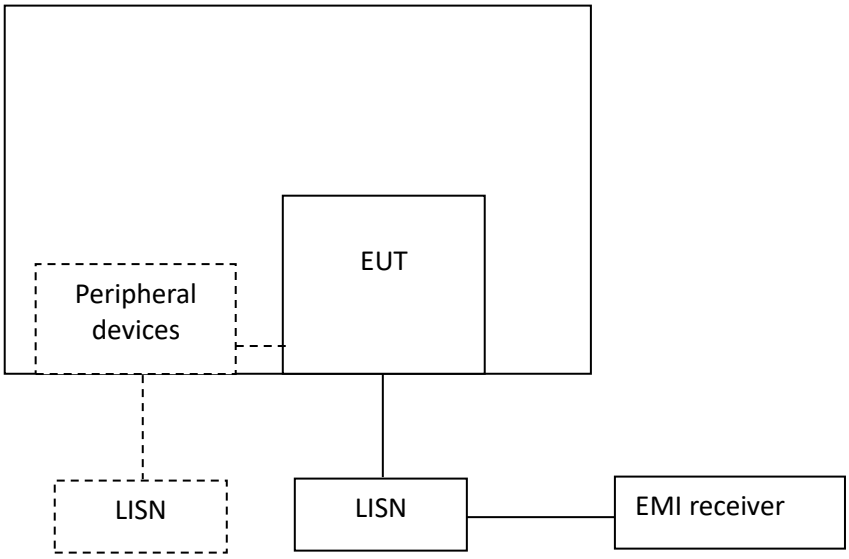
7 Conducted emissions

Test result: **Pass**

7.1 Limit

Frequency of Emission (MHz)	Conducted Emissions Limit (dBuV)	
	QP	AV
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.		

7.2 Test Configuration



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7.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

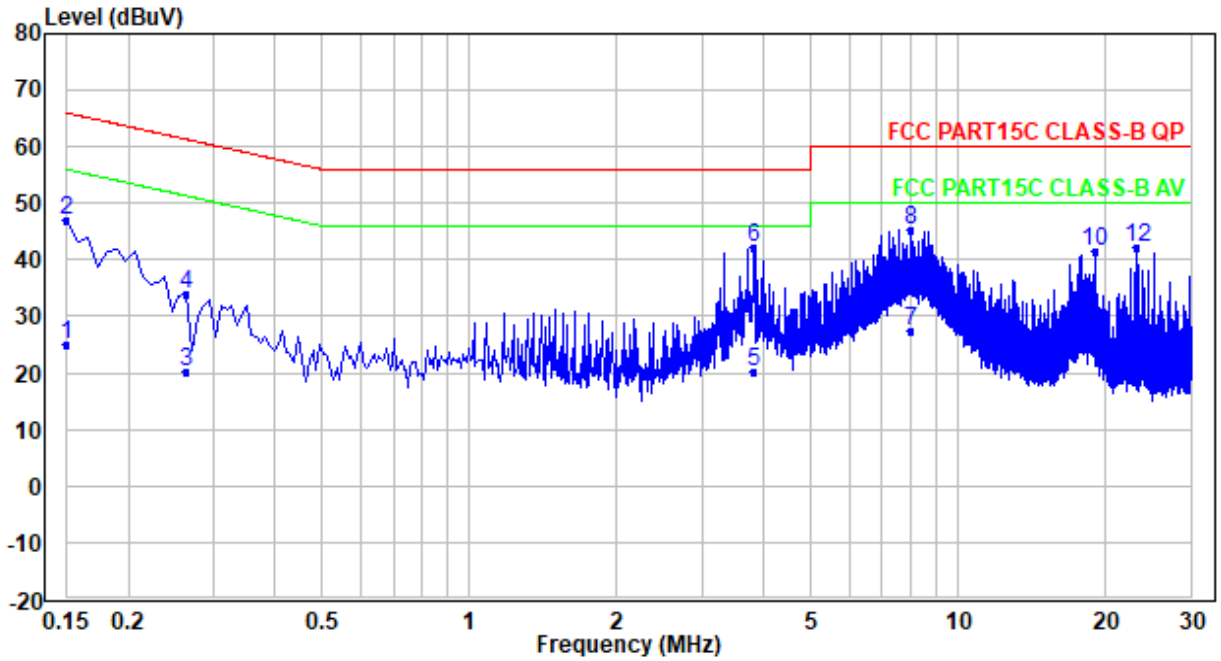
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

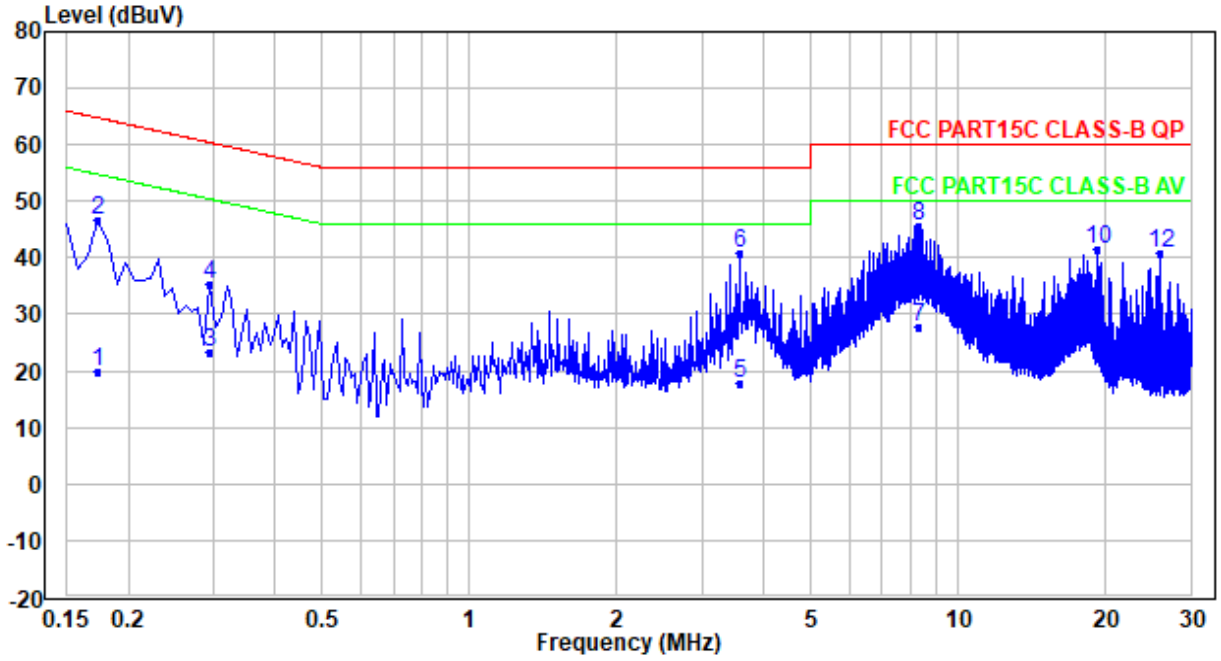
7.4 Test Results of Conducted Emissions

Test Voltage: 120V ~60Hz
Worse Case Test Mode 1
Test Curve:

L Line



N Line



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Frequency [MHz]	QP Level [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Level [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Phase
0.150	47.17	66.00	-18.83	25.17	56.00	-30.83	L
0.262	34.07	61.37	-27.30	20.07	51.37	-31.30	L
3.829	42.29	56.00	-13.71	20.29	46.00	-25.71	L
7.988	45.36	60.00	-14.64	27.36	50.00	-22.64	L
19.050	41.59	60.00	-18.41	23.59	50.00	-26.41	L
23.321	42.22	60.00	-17.78	21.22	50.00	-28.78	L
0.174	46.75	64.77	-18.02	19.75	54.77	-35.02	N
0.294	35.21	60.41	-25.20	23.21	50.41	-27.20	N
3.565	40.90	56.00	-15.10	17.90	46.00	-28.10	N
8.332	45.69	60.00	-14.31	27.69	50.00	-22.31	N
19.354	41.41	60.00	-18.59	23.41	50.00	-26.59	N
26.009	40.79	60.00	-19.21	19.79	50.00	-30.21	N

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Level = Original Receiver Reading + Correct Factor

3. Margin = Level - Limit

4. If the PK Level is lower than AV limit, the AV test can be elided.

5. the emissions of 13.56MHz are the product's RF signal.

6. All possible modes of operation were investigated, only the worst-case emissions reported.

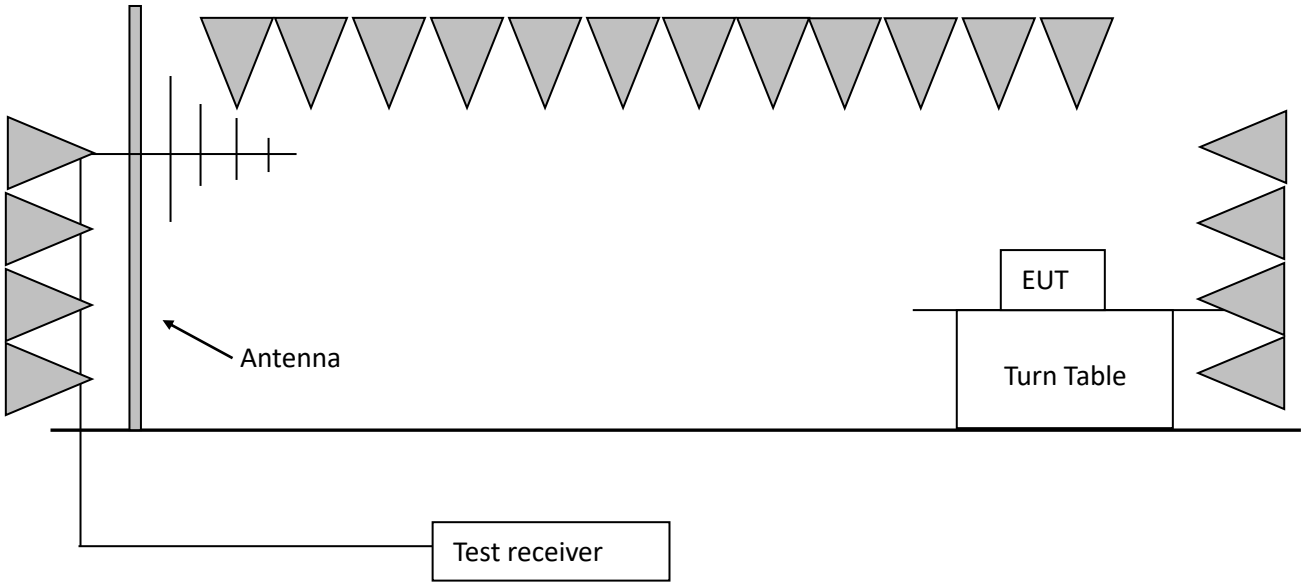
8 20dB Bandwidth

Test result: Pass

8.1 Limit

The 20dB bandwidth should be fallen in the allocated operating frequency range.
No limit for 99% bandwidth.

8.2 Test configuration



8.3 Test procedure and test set up

The measurement was applied in a 3m semi-anechoic chamber.

The center of the loop antenna shall be 1 m above the horizontal metal ground plane.

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set RBW = 1 % to 5 % of the OBW
3. Set VBW ≥ 3 · RBW
4. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
5. Use the 99 % power bandwidth function of the instrument (if available).
6. the 20dB bandwidth is also measured with the same setting.

8.4 Test protocol

Test Frequency (MHz)	Lower point (MHz)	Higher point (MHz)	20dB bandwidth (kHz)	99 % power bandwidth (kHz)	Allocated bandwidth (MHz)
13.56	13.5151	13.5962	81.00	308.2489	13.553 ~ 13.567

Test Curve: 99 % power bandwidth

TEST REPORT

Test Curve: 20dB bandwidth

Date: 31.MAY.2023 10:22:23

TEST REPORT

9 Antenna requirement

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 shall be considered sufficient to comply with the provisions of this section.

Result:
EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

TEST REPORT

Appendix I: Photograph of test setup

See test photos attached in Appendix I for the actual connections between Product and support equipment.

Appendix II: Photograph of equipment under test

Refer to Appendix II for EUT external and internal photos.

********** END **********