

Shenzhen HB Electronic Co Ltd

RF TEST REPORT

Report Type:

FCC Part 15.225 & ISED RSS-210 RF report

MODEL:

HBE-AC32A02ST-U, HBE-AC40A02ST-U,
HBE-AC48A02ST-U

REPORT NUMBER:

2307A0345SHA-002

ISSUE DATE:

June 24, 2024

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FCC ID: 2BF82-HBE02ST

IC: 32422-HBE02ST

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR Part 15 (2023): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2020): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-210 Issue 10 (December 2019): Licence-Exempt Radio Apparatus: Category I Equipment

RSS-Gen Issue 5, Amendment 1 (March 2019): General Requirements for Compliance of Radio Apparatus

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Revision History

Report No.	Version	Description	Issued Date
2307A0345SHA-002	Rev. 01	Initial issue of report	June 24, 2024

Measurement result summary

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Fundamental emission	15.225(a) (b) (c)	RSS 210 B.6	Pass
Spurious emission	15.225(d)	RSS 210 B.6	Pass
Frequency stability	15.225(e)	RSS 210 B.6	Pass
Conducted emissions	15.207	RSS-Gen Issue 5 Clause 8.8	Pass
99% and 20dB Bandwidth	15.215(c)	RSS-Gen Issue 5 Clause 6.6	Pass
Antenna requirement	15.203	RSS-GEN 6.8	Pass

Notes: 1: NA =Not Applicable

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

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Electric Vehicle AC Charger
Type/Model:	HBE-AC32A02ST-U, HBE-AC40A02ST-U, HBE-AC48A02ST-U
Description of EUT:	The EUT is an electric vehicle AC charger. All models are electrically identical except the rated power. EUT contains a certified wireless module, the FCC ID is 2AC7Z-ESP32WROOM32E, the IC is 21098-ESPWROOM32E. We test HBE-AC48A02ST-U as representative and list the results in the report.
Rating:	HBE-AC32A02ST-U: 200-240VAC, 50/60Hz, 32A Max HBE-AC40A02ST-U: 200-240VAC, 50/60Hz, 40A Max HBE-AC48A02ST-U: 200-240VAC, 50/60Hz, 48A Max
Category of EUT:	Class A
EUT type:	<input type="checkbox"/> Table top <input checked="" type="checkbox"/> Floor standing
Software Version:	-
Hardware Version:	-
Serial numbers:	A240424-36
Sample received date:	April 24, 2024
Date of test:	May 8, 2024 ~ May 14, 2024

1.2 Technical Specification

Frequency Range:	13.56 MHz ~ 13.56 MHz
Modulation:	ASK
Antenna:	PCB antenna

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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

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2023)
 ANSI C63.10 (2020)
 RSS-210 Issue 10 (December 2019)
 RSS-Gen Issue 5, Amendment 1 (March 2019)

2.2 Mode of operation during the test

While testing, the internal modulation and continuously transmission was applied.

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	SKET Auto EMC Test Software	Keleto	V3.0
Radiated emission	SKET Auto EMC Test Software	Keleto	V3.0

2.4 Test peripherals list

Item No	Description	Band and Model	S/No

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	26°C	53% RH
Power line conducted emission	27°C	53% RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESR7	EC 6194	2025-02-27
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2024-11-19
<input checked="" type="checkbox"/>	Shielded room	Zhongyu	-	EC 2838	2025-01-11
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2024-08-22
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112B	EC 6411	2024-09-12
<input checked="" type="checkbox"/>	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2024-07-16
<input checked="" type="checkbox"/>	Semi-anechoic chamber	Albatross project	-	EC 3048	2024-07-08
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030B	EC 6078	2025-06-14
<input checked="" type="checkbox"/>	Climate chamber	GWS	MT3065	EC 6021	2025-03-06
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Thermo-Hygrograph	Testo	175h1	EC 6640	2024-08-28
<input checked="" type="checkbox"/>	Thermo-Hygrograph	Testo	175h1	EC6642	2024-08-28

TEST REPORT

2.7 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	3.52 dB
	150kHz ~ 30MHz	3.19 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.06 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.02 dB
	6GHz ~ 18GHz	5.28 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

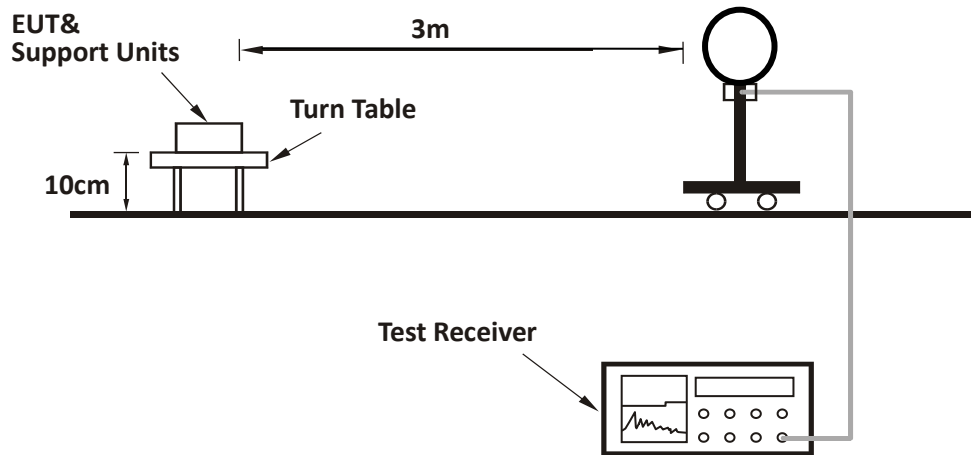
3.2 Measurement Procedure

- a) The EUT was placed on a 0.1m 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:

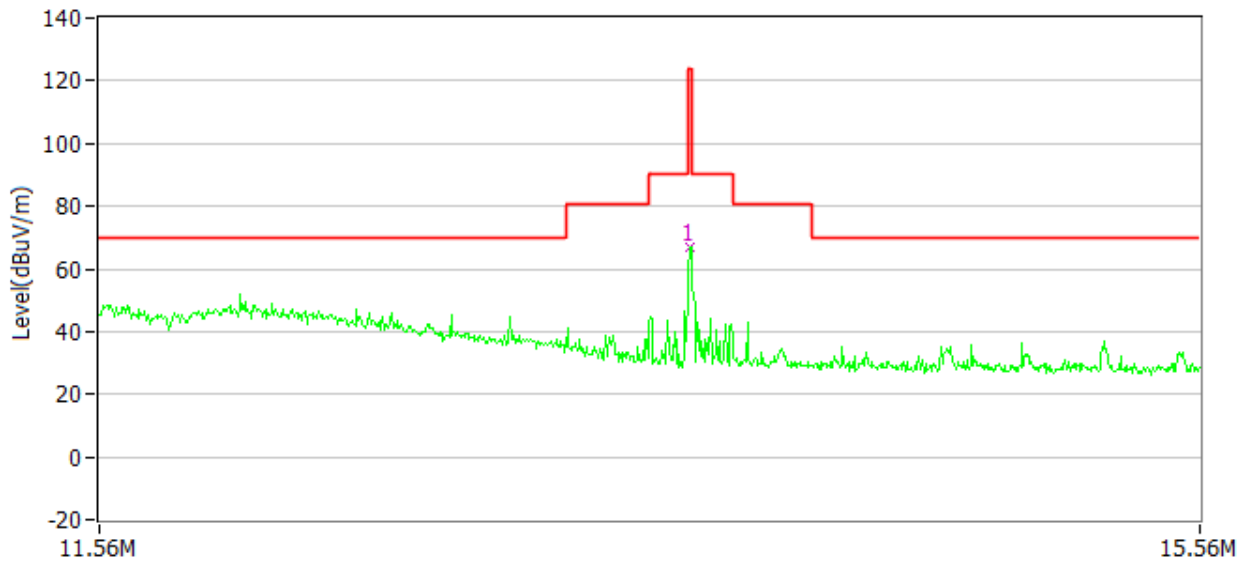
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

3.3 Test Configuration



TEST REPORT

3.4 Test Results of Fundamental Emissions



Antenna Polarization	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin	Detector
X	13.56	61.3	124.00	62.7	PK
Y	13.56	67.1	124.00	56.9	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 = Limit - Corrected Reading

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 = 40.00dBuV/m - 10.20dBuV/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 0.1m 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 0.1m 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

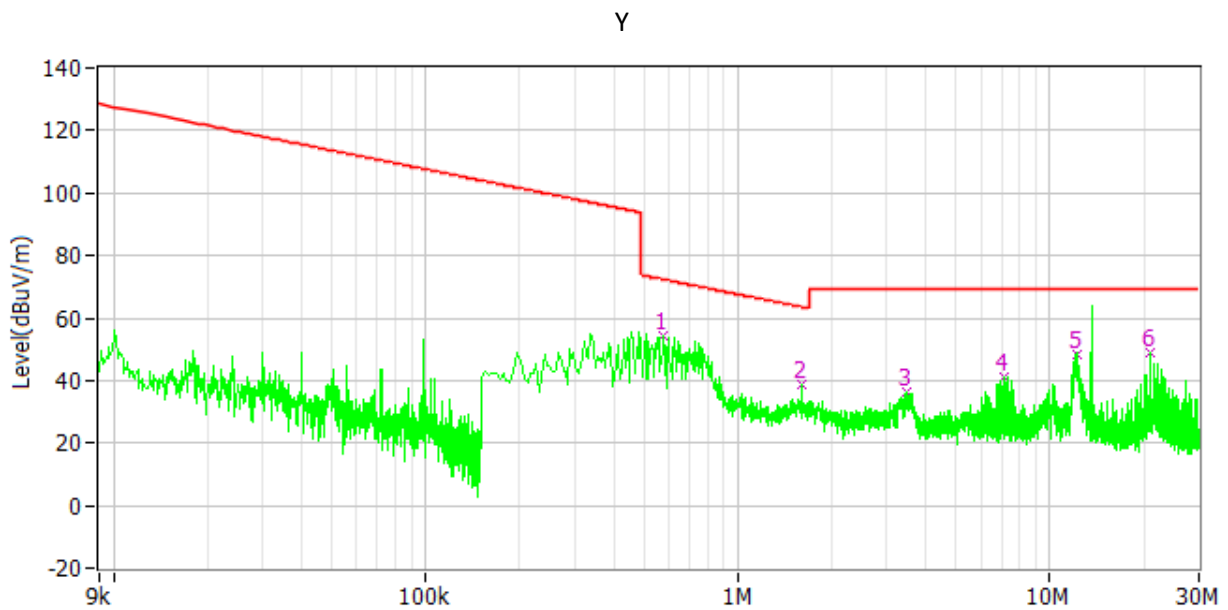
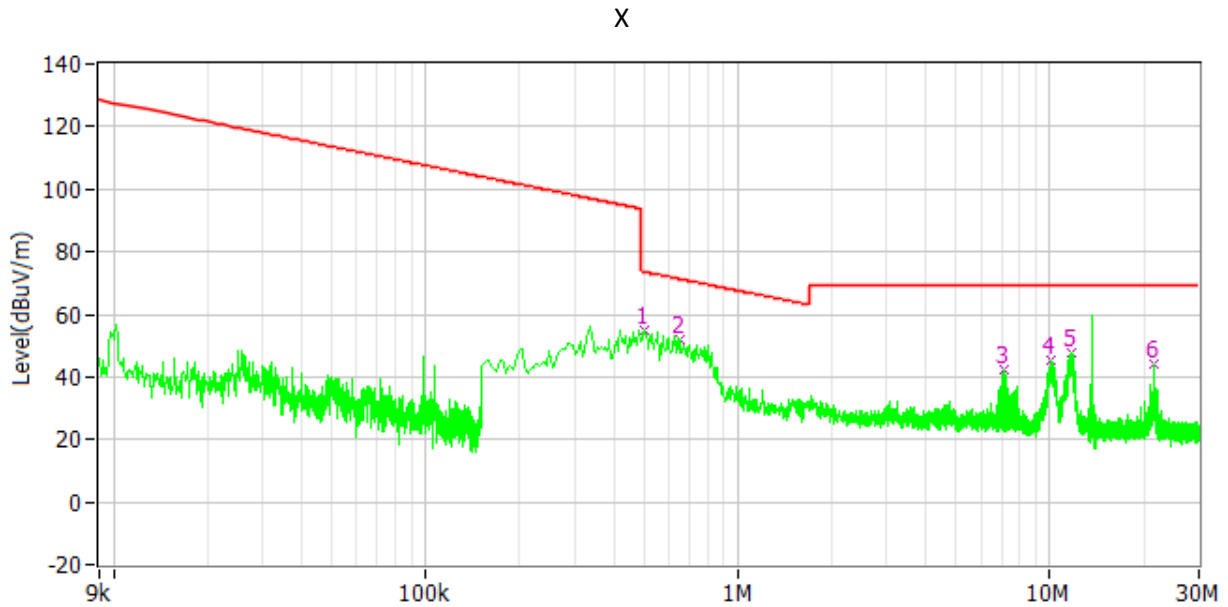
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function 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

TEST REPORT

4.3 Test Results of Radiated Emissions



TEST REPORT

Test data below 30MHz:

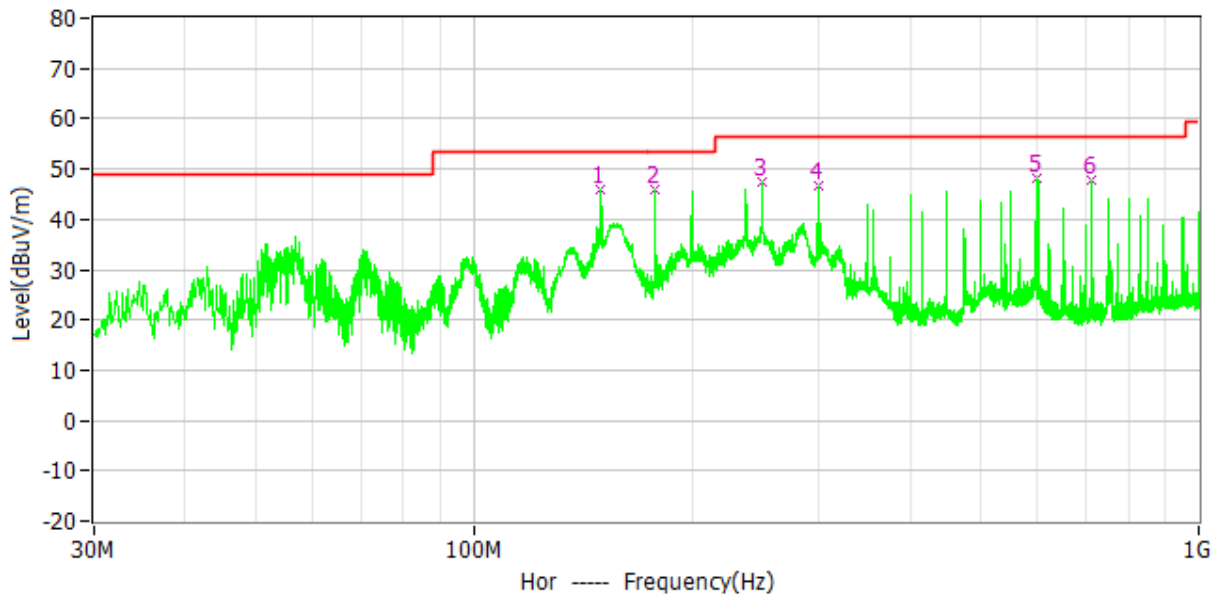
Frequency	Limit (dBuV/m)	Level (dBuV/m)	Delta (dB)	Detector	Polarity
501.000kHz	73.6	54.8	-18.8	PK	X
649.500kHz	71.4	51.7	-19.7	PK	X
7.152MHz	69.5	42.4	-27.1	PK	X
10.118MHz	69.5	45.2	-24.3	PK	X
11.693MHz	69.5	47.9	-21.6	PK	X
21.462MHz	69.5	44.2	-25.3	PK	X
577.500kHz	72.4	54.3	-18.1	PK	Y
1.599MHz	63.6	38.8	-24.8	PK	Y
3.494MHz	69.5	36.1	-33.4	PK	Y
7.161MHz	69.5	41.3	-28.2	PK	Y
12.215MHz	69.5	48.6	-20.9	PK	Y
20.873MHz	69.5	48.9	-20.6	PK	Y

- 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. Level = Original Receiver Reading + Correct Factor
 3. Delta = Level - Limit

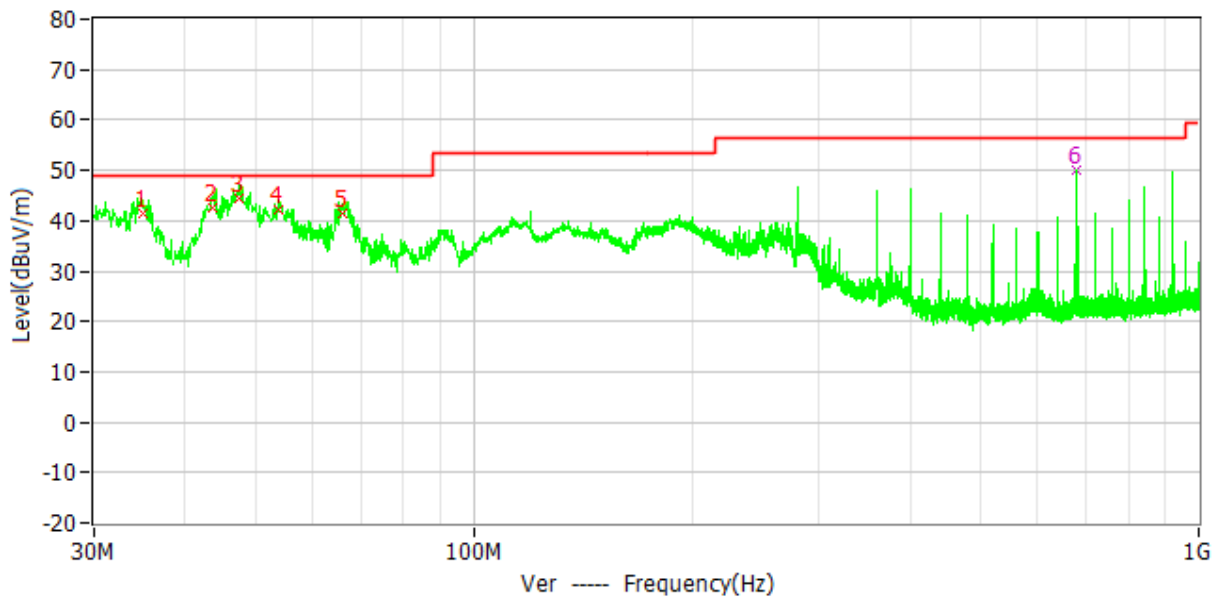
Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
 Limit = 40.00dBuV/m.
 Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
 Level = 10dBuV + 0.20dB/m = 10.20dBuV/m;
 Delta = 10.20dBuV/m - 44.00dBuV/m = -29.80dB.

TEST REPORT

H



V



TEST REPORT

Test data from 30MHz to 1000MHz:

Antenna Polarization	Frequency	Limit (dBuV/m)	Level (dBuV/m)	Delta (dB)	Detector
H	149.989MHz	53.5	45.9	-7.6	PK
H	178.216MHz	53.5	45.8	-7.7	PK
H	249.996MHz	56.5	47.4	-9.1	PK
H	299.951MHz	56.5	46.8	-9.7	PK
H	599.972MHz	56.5	48.0	-8.5	PK
H	712.880MHz	56.5	47.9	-8.6	PK
V	35.021MHz	49.0	41.5	-7.5	QP
V	43.805MHz	49.0	42.4	-6.6	QP
V	47.546MHz	49.0	44.4	-4.6	QP
V	53.936MHz	49.0	42.1	-6.9	QP
V	66.024MHz	49.0	41.6	-7.4	QP
V	679.997MHz	56.5	49.9	-6.6	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. Level = Original Receiver Reading + Correct Factor
 3. Delta = Level - 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;
 Level = 10dBuV + 0.20dB/m = 10.20dBuV/m;
 Delta = 10.20dBuV/m - 44.00dBuV/m = -29.80dB.

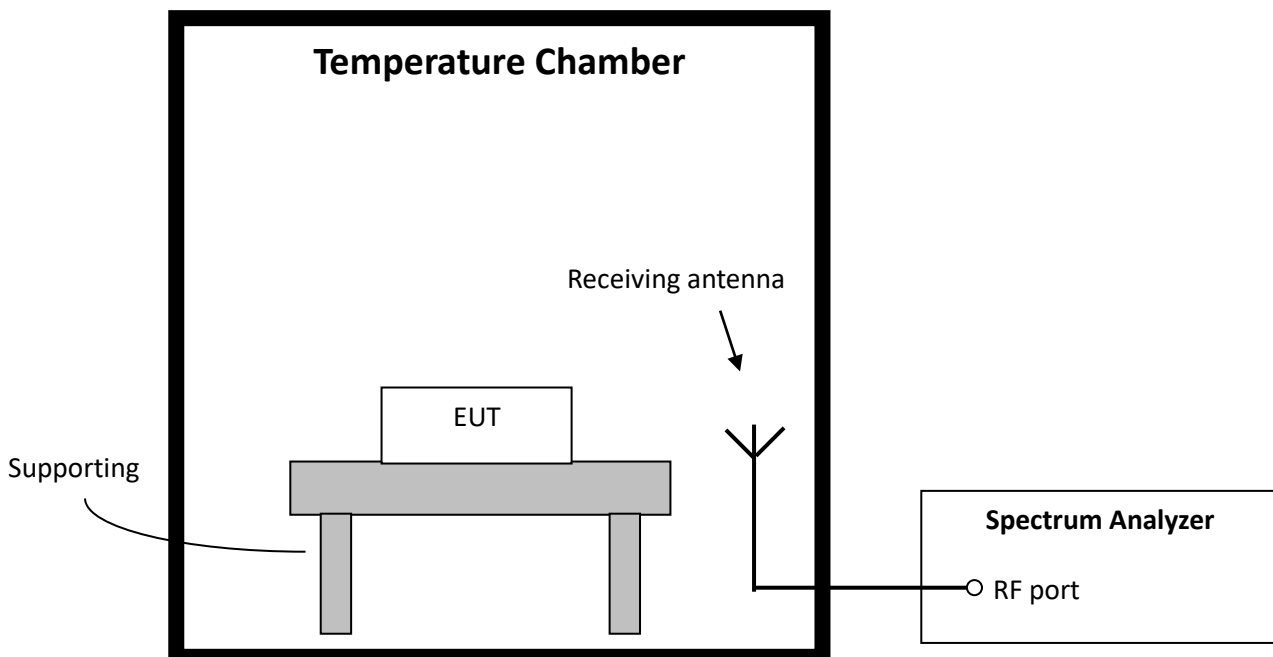
5 Frequency Stability (Temperature Variation)

Test result: PASS

5.1 Test limit

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -30 degrees to $+50$ degrees C at normal supply voltage.

5.2 Test Configuration



TEST REPORT

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 (°C)	Freq measured (MHz)	Freq nominal (MHz)	Tolerance (%)	Limit (%)
240	-30	13.5597	13.56	-0.002	±0.01
	-20	13.5598		-0.001	
	-10	13.5602		0.001	
	0	13.5601		0.0007	
	10	13.5600		0	
	20	13.5601		0.0007	
	30	13.5999		-0.0007	
	40	13.5603		0.002	
	50	13.5598		-0.001	

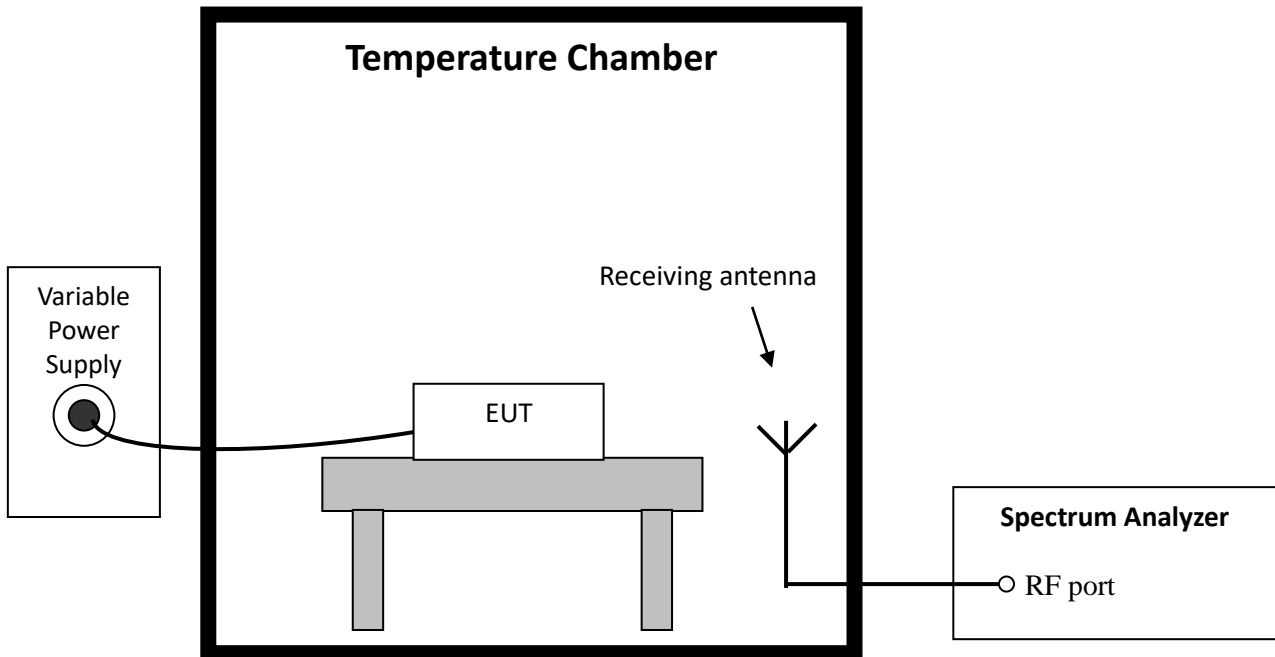
6 Frequency Stability (Voltage Variation)

Test result: PASS

6.1 Test limit

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

TEST REPORT**6.4 Test protocol**

Temp (°C)	Voltage (V)	Freq Measured (MHz)	Freq nominal (MHz)	Tolerance (%)	Limit (%)
20	187	13.5999	13.56	-0.0007	±0.01
	220	13.5600		0	
	253	13.5601		0.0007	

7 Conducted emissions

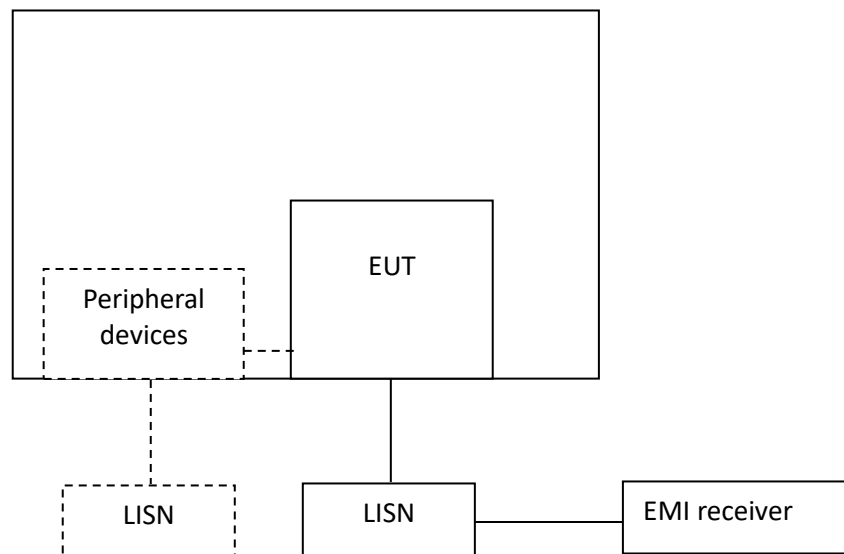
Test result: Pass

7.1 Limit

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0.15 ~ 0.5	79	66
0.5 ~ 30	73	60

Note: If the limit for the measurement with the average detector is met when using a receiver with a quasi-peak detector, the equipment under test shall be deemed to meet both limits and the measurement using the receiver with an average detector need not be carried out.

7.2 Test Configuration



TEST REPORT**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.

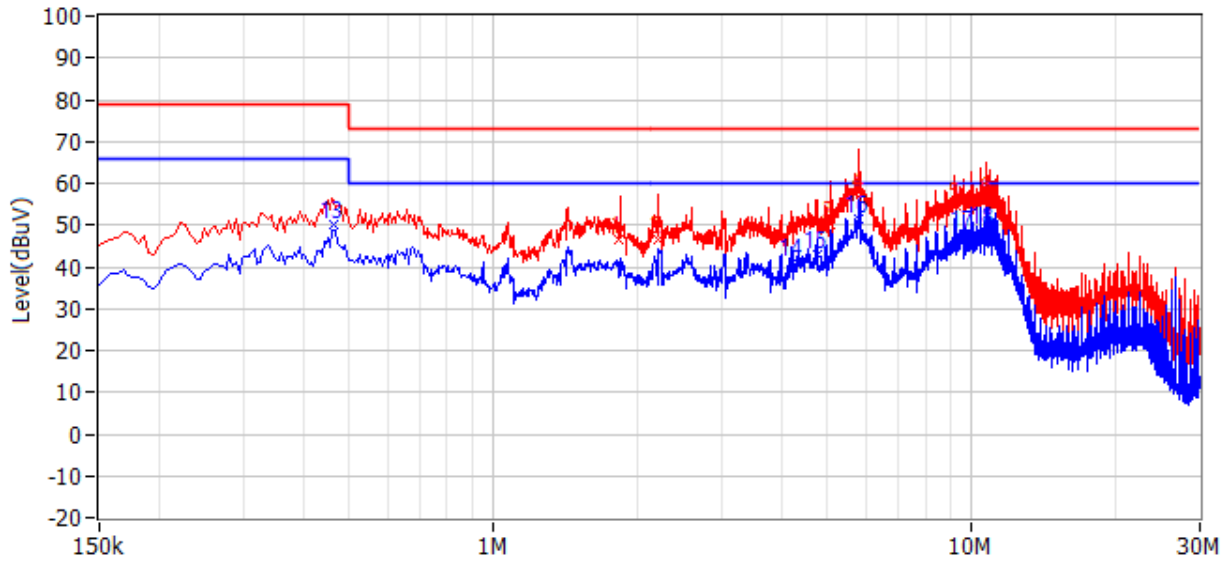
The bandwidth of the test receiver is set at 9 kHz.

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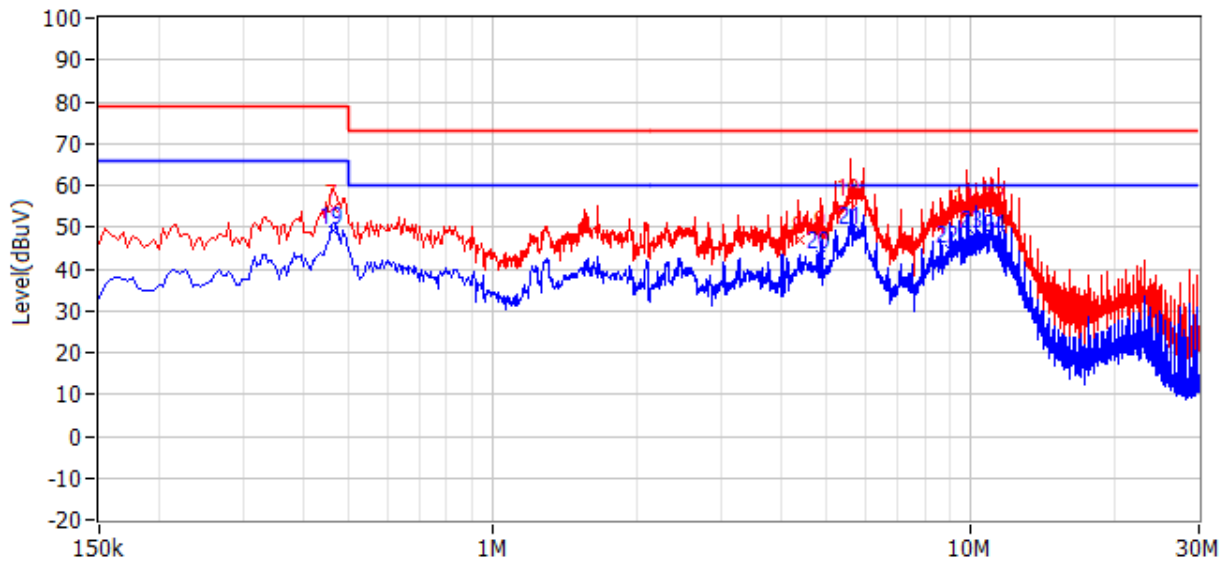
7.4 Test Results of Conducted Emissions

Test Voltage: 240VAC/60Hz

L1 Line



L2 Line



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Test Data:

No.	Frequency	Limit dBuV	Level dBuV	Delta dB	Detector	Phase
1	1.829MHz	73.0	46.7	-26.3	QP	L1
2	2.211MHz	73.0	46.7	-26.3	QP	L1
3	5.073MHz	73.0	50.1	-22.9	QP	L1
4	5.856MHz	73.0	57.4	-15.6	QP	L1
5	9.258MHz	73.0	54.8	-18.2	QP	L1
6	10.865MHz	73.0	56.0	-17.0	QP	L1
7	465.000kHz	79.0	54.6	-24.4	QP	L2
8	4.371MHz	73.0	46.9	-26.1	QP	L2
9	4.898MHz	73.0	48.3	-24.7	QP	L2
10	5.586MHz	73.0	55.9	-17.1	QP	L2
11	9.834MHz	73.0	53.9	-19.1	QP	L2
12	11.310MHz	73.0	54.3	-18.7	QP	L2
13	465.000kHz	66.0	50.0	-16.0	CAV	L1
14	4.241MHz	60.0	41.1	-18.9	CAV	L1
15	4.749MHz	60.0	43.0	-17.0	CAV	L1
16	5.802MHz	60.0	51.3	-8.7	CAV	L1
17	9.650MHz	60.0	47.7	-12.3	CAV	L1
18	10.671MHz	60.0	48.6	-11.4	CAV	L1
19	465.000kHz	66.0	49.3	-16.7	CAV	L2
20	4.866MHz	60.0	43.2	-16.8	CAV	L2
21	5.663MHz	60.0	49.0	-11.0	CAV	L2
22	9.033MHz	60.0	44.5	-15.5	CAV	L2
23	10.176MHz	60.0	48.5	-11.5	CAV	L2
24	11.351MHz	60.0	47.4	-12.6	CAV	L2

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

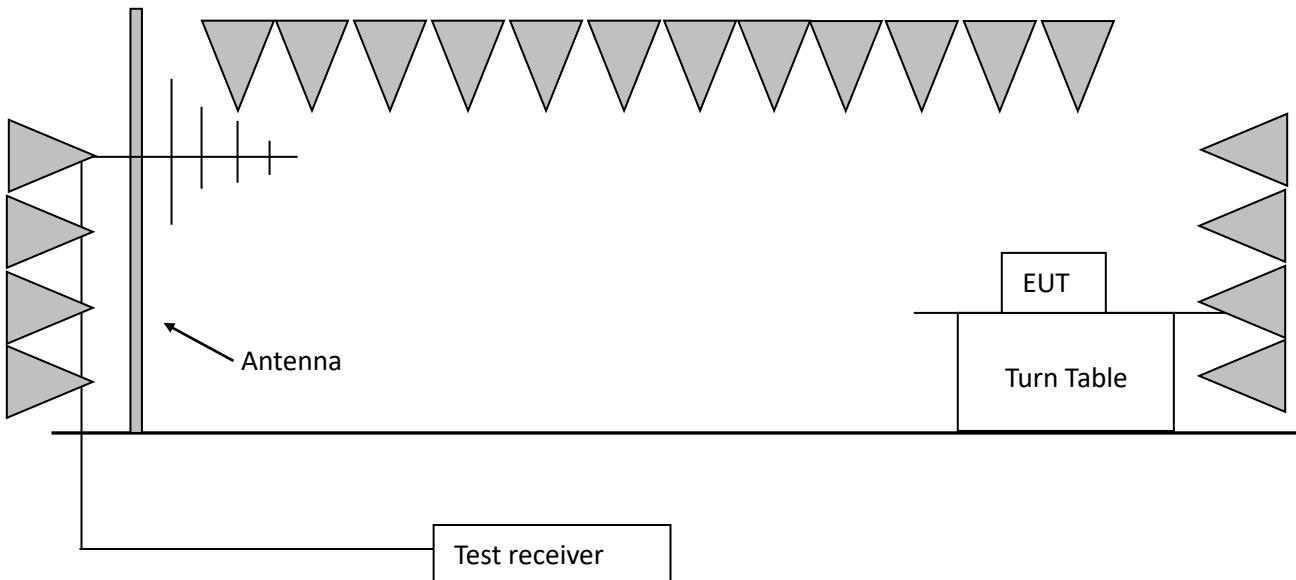
8 20dB Bandwidth

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



TEST REPORT**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 $\geq 3 \cdot$ 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.

TEST REPORT

8.4 Test protocol

	Lower point (MHz)	Higher point (MHz)	Bandwidth (kHz)	Allocated bandwidth (MHz)
20dB Bandwidth	13.560187	13.560668	0.481	13.553 ~ 13.567
Occupied bandwidth	13.559277	13.561556	2.28	13.553 ~ 13.567



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.

***** END *****