



TEST REPORT

Product Name: Card Reader
FCC ID: 2AHCR-ACRCRM11
Trademark: **Akuvox**
Model Number: ACR-CRM11
Prepared For: AKUVOX (XIAMEN) NETWORKS CO., LTD.
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Manufacturer: AKUVOX (XIAMEN) NETWORKS CO., LTD.
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Sample Received Date: Nov. 14, 2024
Sample tested Date: Nov. 14, 2024 to Nov. 21, 2024
Issue Date: Nov. 21, 2024
Report No.: CTB24111401803RF01
Test Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.225
ANSI C63.10:2013
Test Results: PASS
Remark: This is 13.56MHz radio test report.

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Note: If there is any objection to the inspection results in this report, please submit a written report to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client. "*" indicates the testing items were fulfilled by subcontracted lab. "#" indicates the items are not in CNAS accreditation scope.

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(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB24111401803RF01	Nov. 21, 2024	Original	Valid

2. TESTSUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	N/A
Radiated Emission	47 CFR Part 15 Subpart C Section 15.209; 15.225(a)(b)(c)(d)	ANSI C63.10-2013	PASS
Frequency Tolerance	47 CFR Part 15 Subpart C Section 15.225(e)	ANSI C63.10-2013	PASS
Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.215	ANSI C63.10-2013	PASS
Antenna requirement	47 CFR Part 15 Subpart C Section 15.203	ANSI C63.10-2013	PASS

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Occupancy bandwidth	$U=\pm 54.3\text{Hz}$
Conducted output power Above 1G	$U=\pm 1.0\text{dB}$
Conducted output power below 1G	$U=\pm 0.9\text{dB}$
Power Spectral Density , Conduction	$U=\pm 1.0\text{dB}$
Conduction spurious emissions	$U=\pm 2.8\text{dB}$
Out of band emission	$U=\pm 54\text{Hz}$
3m chamber Radiated spurious emission(30MHz-1GHz)	$U=\pm 4.3\text{dB}$
3m chamber Radiated spurious emission(1GHz-18GHz)	$U=\pm 4.5\text{dB}$
humidity uncertainty	$U=\pm 5.3\%$
Temperature uncertainty	$U=\pm 0.59^{\circ}\text{C}$
Supply voltages	$U=\pm 3\%$
Time	$U=\pm 5\%$

4. PRODUCT INFORMATION AND TESTSETUP

4.1 Product Information

Model(s): ACR-CRM11
Model Description: N/A
Hardware Version: V1.00
Software Version: V1.05

Operation Frequency: 13.56MHz
Type of Modulation: ASK
Antenna installation: PCB antenna
Antenna Gain: 1.0dBi
Ratings: DC 12V

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

No.	Device Type	Brand	Model	Series No.	Note
1.	DC power	LONGWEI	TPR-12002D	N/A	AE

Notes:

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.

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode
Keep the EUT in transmitting mode (NFC mode) with modulation.
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.

4.5 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(DC):	12V
Normal Temperature(°C)	23

5. TEST FACILITY AND TEST INSTRUMENTUSED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at 1&2F., Building A, No. 26, Xinhe Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test InstrumentUsed

No.	Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	A.14.16	2025/6/28
2	Power Sensor	Agilent	U2021XA	MY56120032	/	2025/6/28
3	Power Sensor	Agilent	U2021XA	MY56120034	/	2025/6/28
4	Communication test set	R&S	CMW500	108058	V3.5.80	2025/6/28
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2025/6/28
6	Signal Generator	Agilent	N5181A	MY50140365	A.01.60	2025/6/28
7	Vector signal generator	Agilent	N5182A	MY47420195	A.01.87	2025/6/28
8	Communication test set	Agilent	E5515C	MY50102567	B.19.07 (E1962B)	2025/6/28
9	2.4 GHz Filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	/	2025/6/30
10	5 GHz Filter	Shenxiang	MSF5150-5850MS-1155	20181015001	/	2025/6/30
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	/	2025/6/30
12	BT&WI-FI Automatic test software	Microwave	MTS8310	Ver. 2.0.0.0	/	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	/	2025/6/28
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	/	2025/6/28
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/	/
16	966 chamber	C.R.T.	966	/	/	2027/6/21
17	Receiver	R&S	ESPI	100362	RF_ATTEN_7 (104489/003)	2025/6/28
18	Amplifier	HP	8447E	2945A02747	/	2025/6/28
19	Amplifier	Agilent	8449B	3008A01838	/	2025/6/28
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	/	2025/6/28
21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	/	2025/6/28

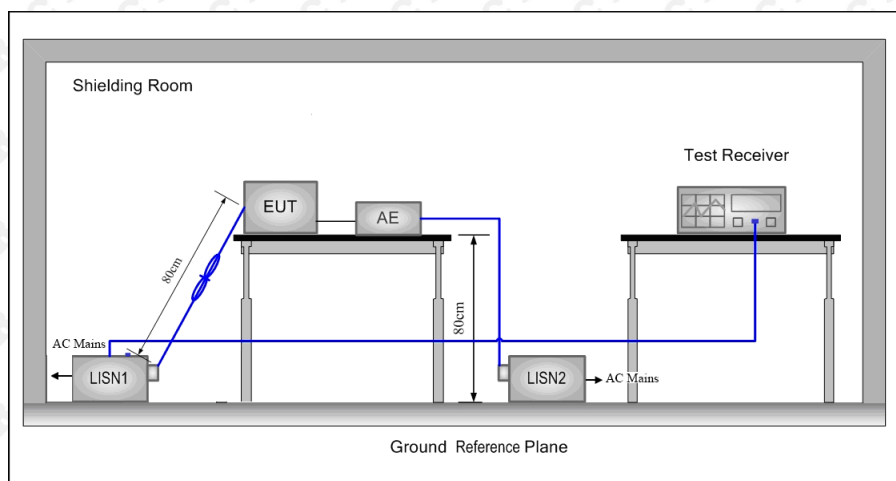
22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2025/6/28
24	loop antenna	ZHINAN	ZN30900A	GTS534	/	/
25	40G Horn antenna	A/H/System	SAS-574	588	/	2025/6/28
26	Amplifier	AEROFLEX	Aeroflex	097	/	2025/6/28
27	Power Metter	KEYSIGHT	N1912AP	N/A	A.05.00	2025/6/28

Radiated emission(No.2 Chamber)

No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated until
1	966 Chamber	C/ R/ T	966	/	/	2026/11/14
2	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	/	2026/7/07
3	Broadband Antenna	Schwarzbeck	VULB 9168	1471	/	2025/7/06
4	Amplifier	Agilent	8449B	3008A01838	/	2025/6/30
5	Preamplifier	Schwarzbeck	BBV 9743 B	00500	/	2025/5/23
6	EMI TEST RECEIVER	R&S	ESCI7	100861	/	2024/11/27
7	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2025/6/28
8	EMI test software	Farad	EZ-EMC	/	Ver. FARAD-3A1+	/
9	Coaxial cable	Rosenberg	8m	/	/	2024/11/27
10	Coaxial cable	Times	2m	/	/	2024/11/27
11	Coaxial cable	Times	2m	/	/	2024/11/27
12	Coaxial cable	Times	1m	/	/	2024/11/27
13	loop antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2025/6/29
14	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2025/6/28
15	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2025/6/28

6. AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

* Decreasing linearly with the logarithm of the frequency

Frequency (MHz)	Maximum RF Line Voltage (dB μ V)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

6.3 Test procedure

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was

between the closest point of the LISN1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN2. the

- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

6.4 Test Result

N/A

NOTE: This EUT is powered by DC power only, this test item is not applicable.

7. RADIATEDEMISSION

7.1 Block Diagram Of Test Setup

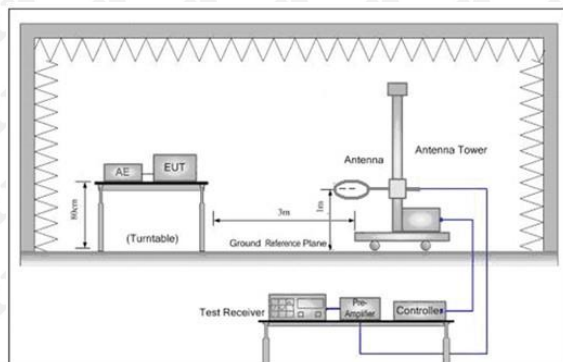


Figure 1. Below 30 MHz

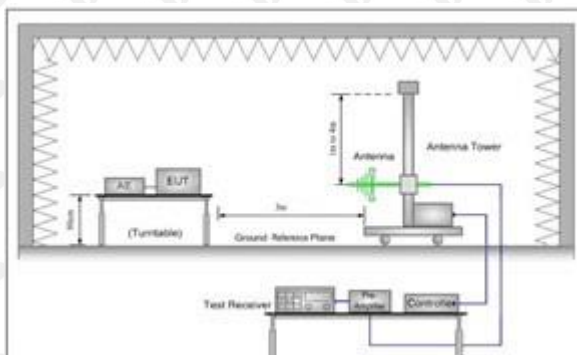


Figure 2. 30 MHz to 1 GHz

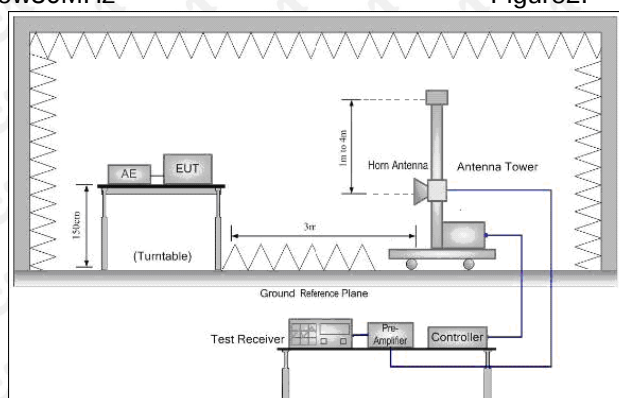


Figure 3. Above 1 GHz

7.2 Limit

Spurious Emissions:

Frequency	Field strength (dB μ V/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	$20\log 2400/F \text{ (kHz)} + 80$	Quasi-peak	3
0.490 MHz-1.705 MHz	$20\log 24000/F \text{ (kHz)} + 40$	Quasi-peak	3
1.705 MHz-30 MHz	$20\log 30 + 40$	Quasi-peak	3
30 MHz-88 MHz	40.0	Quasi-peak	3
88 MHz-216 MHz	43.5	Quasi-peak	3
216 MHz-960 MHz	46.0	Quasi-peak	3
960 MHz-1 GHz	54.0	Quasi-peak	3
Above 1 GHz	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Field Strength of Fundamental Limit:

- The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters. 15,848 microvolts/meter at 3 meters=124 dB μ V/m.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters. 334 microvolts/meter at 3 meters=94.47 dB μ V/m.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not

exceed 334 microvolts/meter at 30 meters.

7.3 Test procedure

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antennatower.
- 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.
- 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 rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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 datasheet.

Above 1GHz test procedure as below:

- Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
- Test the EUT in the lowest channel ,the middle channel ,the Highest channel
- Repeat above procedures until all frequencies measured was complete.

Receiver set:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30KHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	120 kHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

7.4 Test Result

Field Strength of Fundamental

Frequency (MHz)	Reading (dBuV/m)	Correction Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar (H/V)	Detector
13.34	47.48	15.82	63.30	80.51	-17.21	H	QP
13.36	45.72	15.82	61.54	80.51	-18.97	V	QP
13.95	46.32	15.82	62.14	80.51	-18.37	H	QP
13.93	49.21	15.82	65.03	80.51	-15.48	V	QP
13.58	57.52	15.61	73.13	90.47	-17.34	H	QP
13.58	58.58	15.61	74.19	90.47	-16.28	V	QP
13.56	88.76	12.33	101.09	124.00	-22.91	H	Peak
13.56	85.41	12.33	97.74	124.00	-26.26	V	Peak
13.57	56.84	12.33	69.17	90.47	-21.30	H	QP
13.59	57.24	12.33	69.57	90.47	-20.90	V	QP
13.43	46.75	15.82	62.57	80.50	-17.93	H	QP
13.44	44.86	15.82	60.68	80.50	-19.82	V	QP
13.73	43.36	15.82	59.18	80.50	-21.32	H	QP
13.73	45.40	15.82	61.22	80.50	-19.28	V	QP
13.48	53.91	15.82	69.73	90.47	-20.74	H	QP
13.49	52.32	15.82	68.14	90.47	-22.33	V	QP
13.71	51.31	15.82	67.13	90.47	-23.34	H	QP
13.68	49.13	15.82	64.95	90.47	-25.52	V	QP

Harmonics and Spurious Emissions

Frequency Range (9 kHz-30MHz)

Temperature:	23°C	Relative Humidity:	54%
Pressure:	1010 hPa	Polarization :	Horizontal
Test Voltage:	DC 12V	Test Mode :	NFC

Freq. (MHz)	Reading (dBuV)	Factor (dB)	ActualFS (dBuV/m)	Limits3m (dBuV/m)	Margin (dBuV/m)	Detector Mode (PK/QP/AV)	loop antenna Azimuth (deg.)
0.136	50.16	20.47	70.63	105.67	-35.04	PEAK	0
0.381	44.26	20.23	64.49	96.97	-32.48	PEAK	0
0.526	23.21	20.01	43.22	72.32	-29.1	PEAK	0
0.868	23.08	19.95	43.03	69.47	-26.44	PEAK	0
1.179	21.67	19.87	41.54	66.53	-24.99	PEAK	0
2.593	17.22	19.78	37.00	60.18	-23.18	PEAK	0

Note:

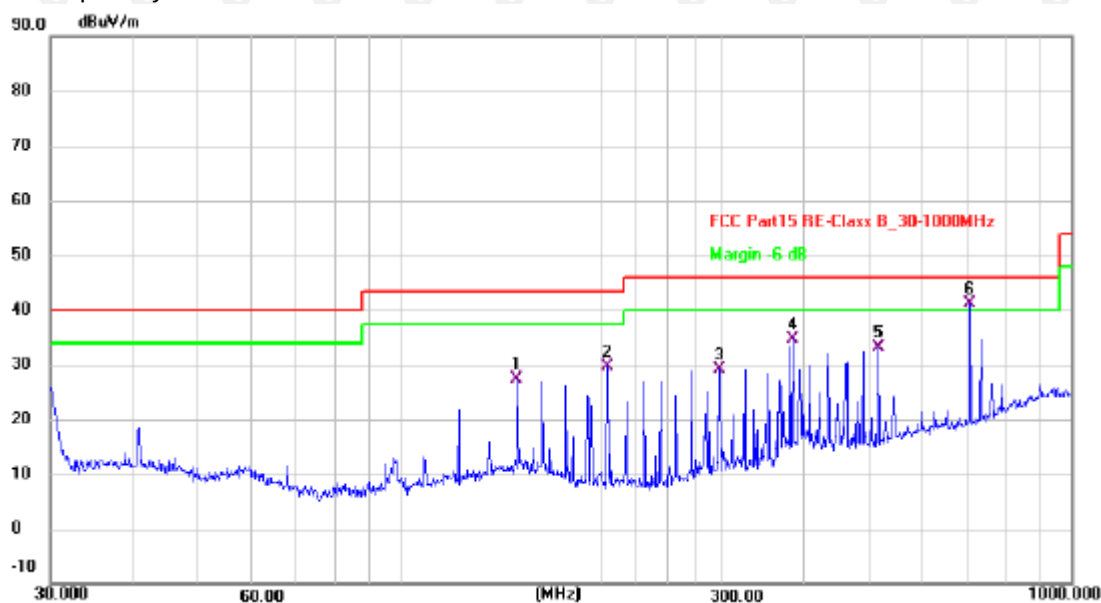
Pre-scan in the all of mode, the worst case in of was recorded.

Factor = antenna factor + cable loss – pre-amplifier.

Margin = Limit - Emission Level.

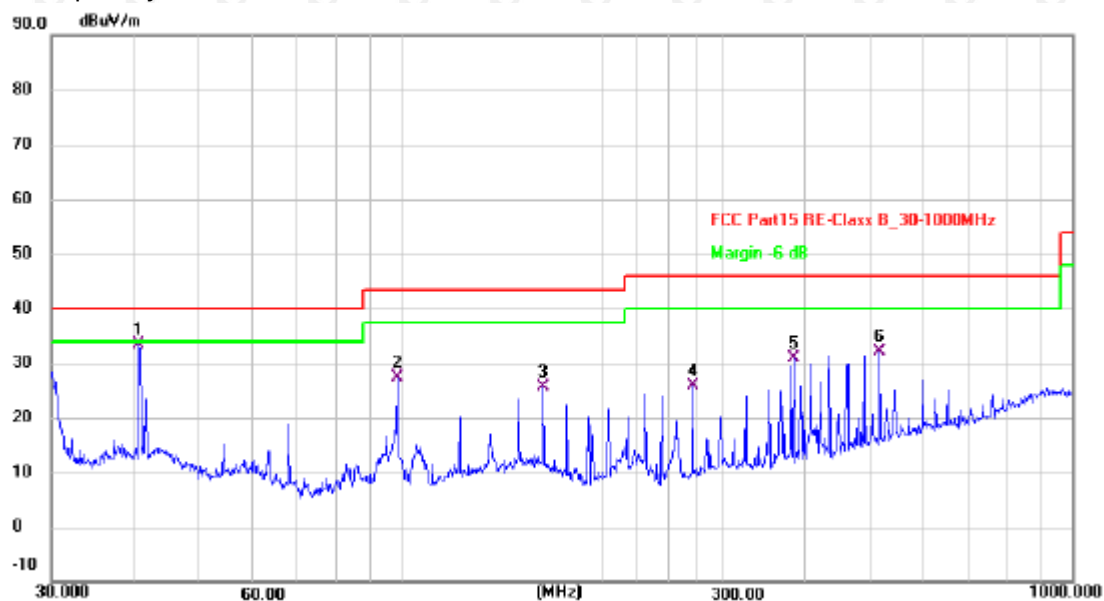
About 30MHz-1GHz Test Results:

Antenna polarity: H



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	148.9625	40.53	-13.25	27.28	43.50	-16.22	QP
2	203.5228	46.62	-17.01	29.61	43.50	-13.89	QP
3	298.2681	43.11	-13.87	29.24	46.00	-16.76	QP
4	383.9318	47.36	-12.63	34.73	46.00	-11.27	QP
5	515.4374	41.86	-8.84	33.02	46.00	-12.98	QP
6 *	706.6999	46.47	-5.24	41.23	46.00	-4.77	QP

Antenna polarity: V

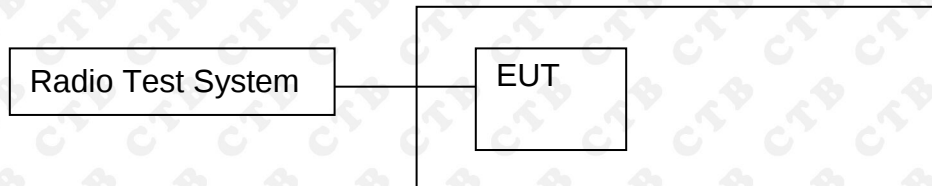


No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	40.5591	46.07	-12.71	33.36	40.00	-6.64	QP
2	98.4866	45.53	-18.10	27.43	43.50	-16.07	QP
3	162.6106	39.16	-13.57	25.59	43.50	-17.91	QP
4	271.3246	41.25	-15.29	25.96	46.00	-20.04	QP
5	383.9318	43.59	-12.63	30.96	46.00	-15.04	QP
6	515.4374	41.06	-8.84	32.22	46.00	-13.78	QP

Remark: 1. Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Limit – Level
2. This EUT was tested in 3 axis and the worst case position data was reported.

8. FREQUENCY TOLERANCE

8.1 Block Diagram Of Test Setup



8.2 Limit

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and 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.

Limit: $\pm 0.01\%$ of 13.56MHz = ± 1356 Hz

8.3 Test procedure

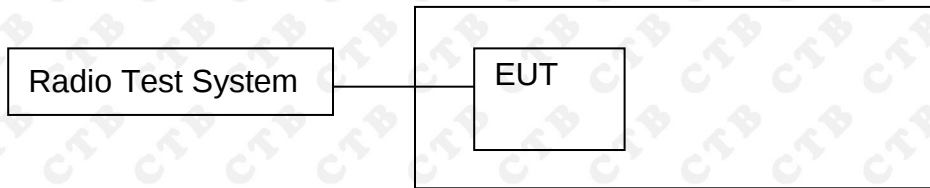
1. Set RBW = 10kHz.
2. Set the video bandwidth (VBW) $\geq$ RBW.
3. Detector = Peak.
4. Trace mode = maxhold.
5. Sweep = autocouple.
6. Allow the trace to stabilize.
7. The transmitter output (antenna port) was connected to the spectrum analyzer.

8.4 Test Result

Test Conditions			Frequency Deviation		Limit
Frequency MHz	Power(Vdc)	Temperature (°C)	Measured Freq. (MHz)	Deviation (%)	
13.56	Normal	-20	13.5603	0.0020	±0.01%
	Normal	-10	13.5604	0.0028	
	Normal	0	13.5602	0.0016	
	Normal	10	13.5606	0.0042	
	Normal	20	13.5602	0.0018	
	Normal	30	13.5604	0.0031	
	Normal	40	13.5602	0.0016	
	Normal	50	13.5604	0.0029	
	Normal*85%	20	13.5602	0.0018	
	Normal *115%	20	13.5604	0.0029	

9. OCCUPIED BANDWIDTH

9.1 Block Diagram Of Test Setup



9.2 Limit

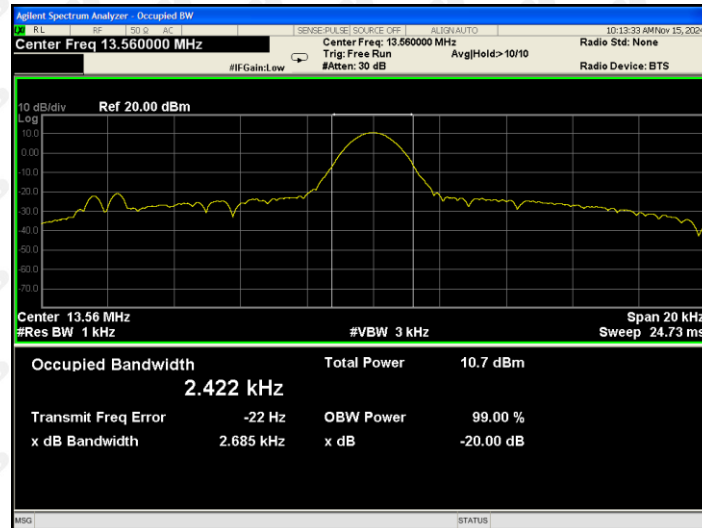
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment complies with the 20dB attenuation specification may be based on measurement at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

9.3 Test procedure

1. Set RBW = 1kHz.
2. Set the video bandwidth (VBW) ≥ RBW.
3. Detector = Peak.
4. Trace mode = maxhold.
5. Sweep = autocouple.
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 20 dB relative to the maximum level measured in the fundamental emission.

9.4 Test Result

Test Channel (MHz)	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Conclusion
13.56	2.685	N/A	PASS



10. ANTENNA REQUIREMENT

15.203 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.

EUT Antenna:

The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 1.0dBi.

11. EUT TEST SETUPPHOTOGRAPHS

Radiated Emission

30M-1GHz



9KHz-30MHz



***** END OF REPORT *****