



FCC PART 15.225

TEST REPORT

For

Zhejiang Okai Vehicle Co., Ltd

No.9, Xinxing Road, Xinbi Town, Jinyun County, Zhejiang, China

FCC ID: 2AYF8-YBES20

Report Type:		Product Type:
Original Report		Meter
Project Engineer:	Miller Xie	Miller xie
Report Number:	RSHA21072202	23-00B
Report Date:	2021-08-19	,
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Zhejiang Okai Vehicle Co., Ltd
Tested Model	ES20
Product Type	Meter
Power Supply	DC 12V by DC Source
RF Function	RFID
Operating Band/Frequency	13.56 MHz
Antenna Type	PCB antenna
*Antenna Gain	0.0 dBi

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Objective

This Type approval report is prepared on behalf of *Zhejiang Okai Vehicle Co., Ltd* in accordance with Part 2- Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission's rules.

The objective is to determine the Compliance of the EUT with FCC rules, sec 15.203, 15.205, 15.207, 15.209, 15.225, 15.215.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS Submittal with FCC ID: 2AYF8-YBES20

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

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^{*}Note: The antenna gain is provided by the applicant.

^{*}All measurement and test data in this report was gathered from production sample serial number: RSHA210722023-1.(Assigned by the BACL. The EUT supplied by the applicant was received on 2021-07-22)

Measurement Uncertainty

Item		Uncertainty	
AC Power Lines Conducted Emissions		3.19 dB	
RF conducte	ed test with spectrum	0.9dB	
Radiated emission	9kHz~30MHz	6.07dB	
Radiated emission	30MHz~1GHz	6.11dB	
Occup	ied Bandwidth	0.5kHz	
Temperature		1.0°C	
I	Humidity	6%	

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Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01), the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

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SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in a typical mode (as normally used by a typical user).

EUT Exercise Software

The EUT was tested in the engineering mode.

Equipment Modifications

No modification on the EUT.

Support Equipment List and Details

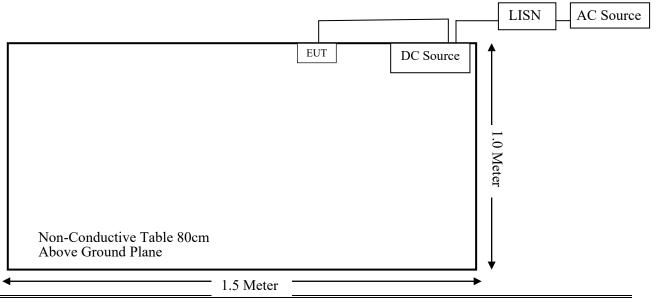
Manufacturer	Description	Model	Serial Number	
ZHAOXIN	DC Power Supply	RXN-605D	DC002	

External I/O Cable

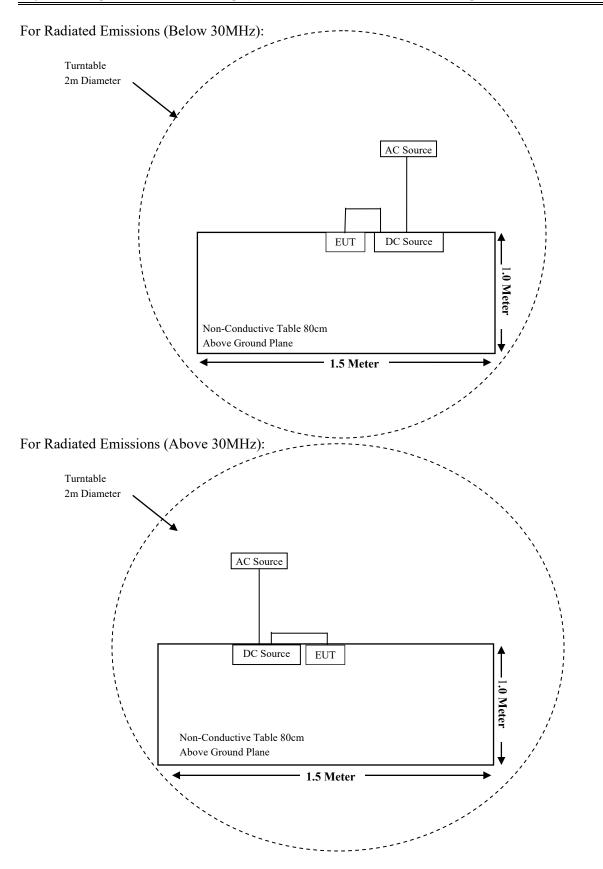
Cable Description	Length (m)	From Port	То
Power cable 1	1.0	EUT	DC Source
Power cable 2	1.0	DC Source	LISN/AC Source

Block Diagram of Test Setup

For Conducted Emissions:



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SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.225 §15.209 §15.205	Radiated Emission Test	Compliant
§15.225(e)	Frequency Stability	Compliant
§15.215(c)	20dB Emission Bandwidth Testing	Compliant

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TEST EQUIPMENT LIST

Manufacturer	Description	Model Serial Number		Calibration Date	Calibration Due Date			
Radiated Emission Test								
Rohde & Schwarz	rz EMI Test Receiver ESCI 100195 2020-12-14							
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2020-12-26	2021-12-25			
Sonoma Instrunent	Pre-amplifier	310N	171205	2020-08-14	2021-08-13			
ETS-LINDGREN	Loop Antenna	6512	00108100	2019-04-25	2022-04-24			
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/			
MICRO-COAX	Coaxial Cable	Cable-8	008	2020-08-15	2021-08-14			
MICRO-COAX	Coaxial Cable	Cable-9	009	2020-08-15	2021-08-14			
MICRO-COAX	Coaxial Cable	Cable-10	010	2020-08-15	2021-08-14			
BACL	Temperature & Humidity Chamber	BTH-150	30023	2020-12-20	2021-12-19			
	Cond	lucted Emission T	est					
Rohde & Schwarz	EMI Test Receiver	ESR	ESR 1316.3003K03- 101746-zn 2021-0		2022-08-04			
Rohde & Schwarz	LISN	ENV216	101115 2020-12-14		2021-12-13			
Audix	Test Software	e3	V9	/	/			
Rohde & Schwarz	Pulse limiter	ESH3-Z2 100552		2021-03-01	2022-02-28			
MICRO-COAX	Coaxial Cable	Cable-15	015	2020-08-15	2021-08-14			

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^{*} Statement of Traceability: Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

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Antenna Connected Construction

The EUT has a PCB antenna and antenna gain is 0 dBi, the antenna was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

Result: Compliant.

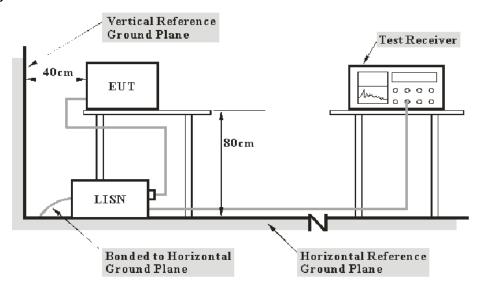
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FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



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Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the DC source was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

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Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

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Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

The "Over Limit" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over Limit of 7 dB means the emission is 7 dB above the limit. The equation for over limit calculation is as follows:

Over Limit (dB) = Read level (dB μ V) + Factor (dB) - Limit (dB μ V)

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

Environmental Conditions

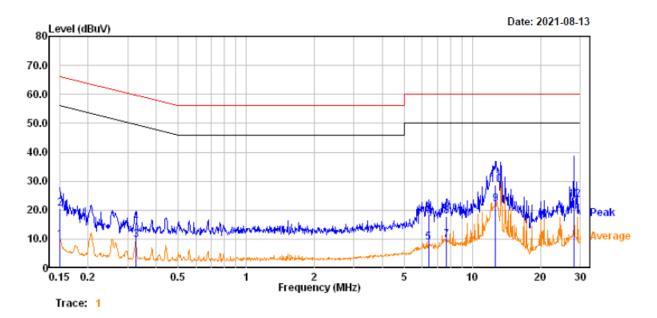
Temperature:	24.5 ℃
Relative Humidity:	48 %
ATM Pressure:	101.3 kPa

The testing was performed by Jack Jiang on 2021-08-13.

EUT operation mode: Transmitting

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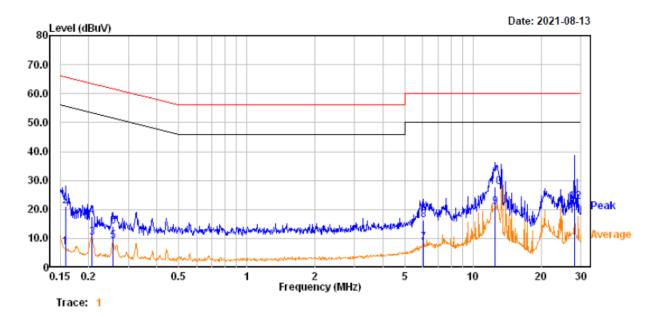
Line:



		Read			Limit	0ver	
	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	——dB	
1	0.151	-10.19	19.82	9.63	55.96	-46.33	Average
2	0.151	0.70	19.82	20.52	65.96	-45.44	QP
3	0.325	-10.31	19.82	9.51	49.58	-40.07	Average
4	0.325	-4.20	19.82	15.62	59.58	-43.96	QP
5	6.398	-10.89	19.51	8.62	50.00	-41.38	Average
6	6.398	-0.70	19.51	18.81	60.00	-41.19	QP
7	7.694	-9.71	19.52	9.81	50.00	-40.19	Average
8	7.694	-1.59	19.52	17.93	60.00	-42.07	QP
9	12.666	2.34	19.60	21.94	50.00	-28.06	Average
10	12.666	9.10	19.60	28.70	60.00	-31.30	QP
11	28.118	-2.07	19.75	17.68	50.00	-32.32	Average
12	28.118	3.70	19.75	23.45	60.00	-36.55	QP

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Neutral:



		Read			Limit	0ver	
	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.158	-12.87	19.82	6.95	55.59	-48.64	Average
2	0.158	1.20	19.82	21.02	65.59	-44.57	QP
3	0.206	-9.54	19.82	10.28	53.35	-43.07	Average
4	0.206	-2.40	19.82	17.42	63.35	-45.93	QP
5	0.256	-10.89	19.82	8.93	51.57	-42.64	Average
6	0.256	-5.70	19.82	14.12	61.57	-47.45	QP
7	6.057	-11.04	19.51	8.47	50.00	-41.53	Average
8	6.057	-3.10	19.51	16.41	60.00	-43.59	QP
9	12.540	1.19	19.60	20.79	50.00	-29.21	Average
10	12.540	8.09	19.60	27.69	60.00	-32.31	QP
11	28.118	-1.98	19.75	17.77	50.00	-32.23	Average
12	28.118	3.00	19.75	22.75	60.00	-37.25	QP

Note:

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¹⁾ Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB) 2) Over Limit (dB) = Read level (dB μ V) + Factor (dB) - Limit (dB μ V)

FCC§15.225, §15.205 & §15.209 - RADIATED EMISSIONS TEST

Applicable Standard

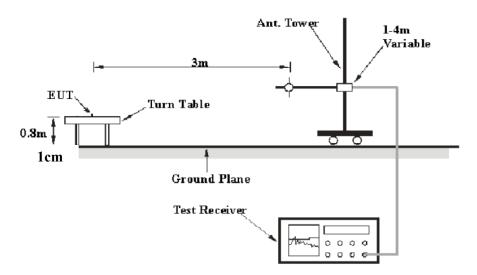
As per FCC Part 15.225

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

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- (b) 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.
- (c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

EUT Setup



The radiated emission tests were performed in the 3-meter chamber a test site, using the setup accordance with the ANSI C63.10. The specification used was the FCC Part Subpart C limits.

The spacing between the peripherals was 10 cm.

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EMI Test Receiver Setup

According to FCC Rules, 47 CFR 15.33, the EUT emissions were investigated up to 1000 MHz.

During the radiated emission test, the EMI test Receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	Detector
9 kHz – 150 kHz	200 Hz	1 kHz	QP/Average
150 kHz –30 MHz	9 kHz	30 kHz	QP/Average
30 MHz – 1000 MHz	120 kHz	300 kHz	QP

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Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Factor = Antenna Factor + Cable Loss- Amplifier Gain Corrected Amplitude = Meter Reading + Corrected Factor

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209, 15.205, 15.225.

Test Data

Environmental Conditions

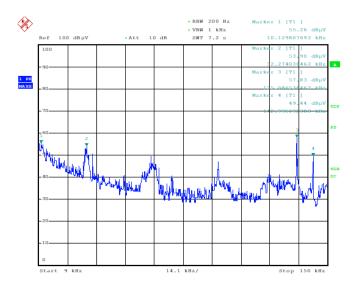
Temperature:	24.2~25.0 ℃
Relative Humidity:	48~49 %
ATM Pressure:	101.1 ∼101.3 kPa

The testing was performed by Jack Jiang from 2021-08-06 to 2021-08-10.

Test mode: Transmitting

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1) Spurious Emissions (9 kHz~150 kHz):



Date: 10.AUG.2021 16:04:21

E	Corrected	Dotootou	Commented Footon	FCC Part 15.225/15.209		
Frequency (MHz)	Amplitude (dBµV/m)@3m	Detector PK/QP/AV	Corrected Factor (dB/m)	Limit (dBµV/m) @3m	Margin (dB)	
0.01013	55.26	PK	56.28	127.49	72.23	
0.03227	53.90	PK	46.61	117.43	63.53	
0.13509	57.83	PK	50.69	104.99	47.16	
0.143	49.44	PK	50.80	104.50	55.06	

Note: The average emissions which fall into frequencies 9-90 kHz, 110-490 kHz was not recorded, because the peak emissions are below the average limit.

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2) Spurious Emissions (150 kHz~30 MHz):



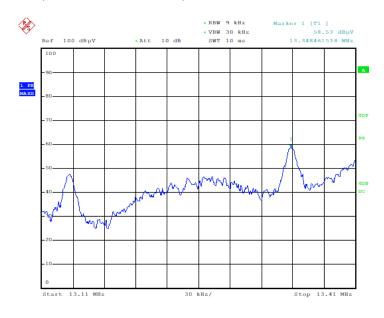
Date: 10.AUG.2021 16:00:24

E.	Corrected	D . ()	G / IF /	FCC Part 15.225/15.209	
Frequency (MHz)	Amplitude (dBµV/m)@3m	Detector PK/QP/Ave.	Corrected Factor (dB/m)	Limit (dBµV/m) @3m	Margin (dB)
0.77	61.59	PK	19.88	69.87	8.28
2.21	62.03	PK	13.52	69.54	7.51
13.56	82.06	PK	6.12	124.00	41.94
25.07	31.90	PK	5.49	69.54	37.64

Note: The average emissions which fall into frequencies 9-90 kHz, 110-490 kHz was not recorded, because the peak emissions are below the average limit.

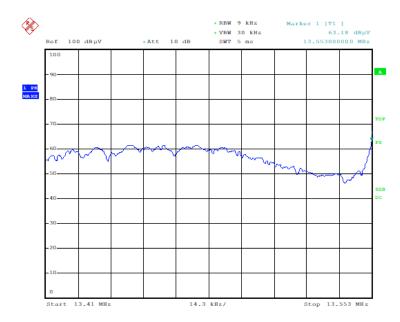
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3) Spurious Emissions (13.11MHz~13.41 MHz):



Date: 10.AUG.2021 17:31:32

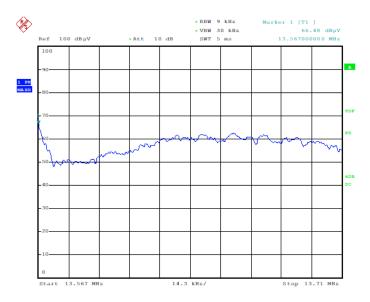
Spurious Emissions (13.41MHz~13.553 MHz):



Date: 10.AUG.2021 17:34:29

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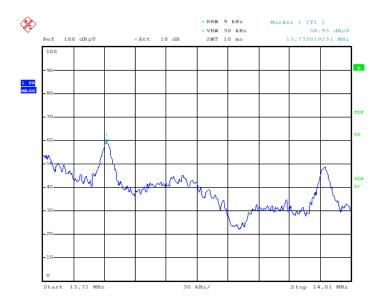
Spurious Emissions (13.567MHz~13.710 MHz):



Date: 10.AUG.2021 17:39:40

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Spurious Emissions (13.710MHz~14.010 MHz):

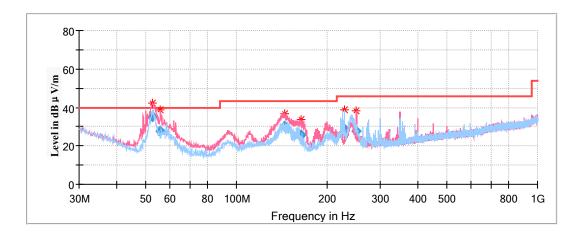


Date: 10.AUG.2021 17:37:06

T.	Corrected	D ()	Detector Commented France		FCC Part 15.225/15.209		
Frequency (MHz)	Amplitude (dBμV/m)@3m	Detector PK/QP/Ave.	Corrected Factor (dB/m)	Limit (dBµV/m) @3m	Margin (dB)		
13.35	58.53	PK	6.13	80.5	21.97		
13.55	63.18	PK	6.11	90.5	27.32		
13.57	66.48	PK	6.11	90.5	24.02		
13.77	58.95	PK	6.10	80.5	21.55		

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4) Spurious Emissions (30 MHz ~1 GHz):



Frequency	Corrected Amplitude	Rx A	ntenna	Turntable	Corrected	Limit	Margin
(MHz)	QuasiPeak (dBμV/m)	Height (cm)	Polar (H/V)	Degree	Factor (dB/m)	(dBµV/m)	(dB)
52.676650	35.01	100.0	V	181.0	-16.5	40.00	4.99
55.946500	27.82	100.0	V	268.0	-15.5	40.00	12.18
144.279950	30.13	100.0	V	341.0	-11.9	43.50	13.37
164.114200	25.68	100.0	V	55.0	-14.0	43.50	17.82
228.678700	28.85	100.0	Н	77.0	-12.0	46.00	17.15
248.910150	27.45	100.0	V	358.0	-11.9	46.00	18.55

Note

1) Factor (dB) = Antenna Factor (dB/m) + Cable Loss (dB) + Amplifier Gain (dB)

2) Over Limit (dB) = Read level (dB μ V) + Factor (dB) - Limit (dB μ V)

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FCC§15.225(e) - FREQUENCY STABILITY

Applicable Standard

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.

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Test Procedure

- a) Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.
- b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.

 NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or
- NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory agency is the recommended measuring instrument.
- c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).
- d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.
- e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.
- f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.
- g) Measure the frequency at each of frequencies specified in 5.6.
- h) Switch OFF the EUT but do not switch OFF the oscillator heater.
- i) Lower the chamber temperature by not more that 10 °C, and allow the temperature inside the chamber to stabilize.
- j) Repeat step f) through step i) down to the lowest specified temperature.

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Test Data

Environmental Conditions

Temperature:	24.2 ℃
Relative Humidity:	48 %
ATM Pressure:	101.7 kPa

The testing was performed by Jack Jaing on 2021-08-06.

Test Mode: Transmitting.

Test Result: Compliant

		$F_0 = 13.56 MHz$		
Power Supply(V _{DC})	Temperature (°C)	Measured Frequency (MHz)	Frequency Error (%)	Part 15.225 Limit
	-20	13.55994877	-0.00038	±0.01%
	-10	13.55995865	-0.00030	±0.01%
	0	13.55995847	-0.00031	±0.01%
12	10	13.55994391	-0.00041	±0.01%
	20	13.55994568	-0.00040	±0.01%
	30	13.55997874	-0.00016	±0.01%
	40	13.55994789	-0.00038	±0.01%
	50	13.55996844	-0.00023	±0.01%
10.2	20	13.55995144	-0.00036	±0.01%
13.8	20	13.55995854	-0.00031	±0.01%

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§15.215(c) - 20dB EMISSION BANDWIDTH TESTING

Requirement

Per 15.215 (c) 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 the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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Test Procedure

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target "-xx dB down" requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- h) Determine the "-xx dB down amplitude" using [(reference value) -xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
- j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-xx dB down amplitude" determined in step h). If a marker is below this "-xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "-xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.
- k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

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Environmental Conditions

Temperature:	24.2 ℃
Relative Humidity:	48 %
ATM Pressure:	103.7 kPa

The testing was performed by Jack Jiang on 2021-08-10.

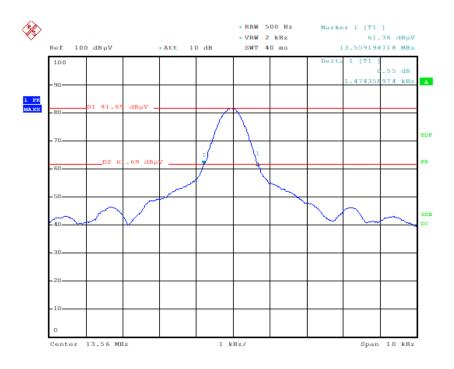
Test Mode: Transmitting

Test Result: Compliant

Frequency	20 dB Bandwidth
(MHz)	(kHz)
13.56	1.474

Report No.: RSHA210722023-00B

20 dB Emission Bandwidth



Date: 10.AUG.2021 17:46:54

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Declarations

Report No.: RSHA210722023-00B

- 1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.
- 2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
- 3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.
- 4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.
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***** END OF REPORT *****

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