MEASUREMENT REPORT

FCC PART95 Subpart M

FCC ID:	2AZN4-CAEASRR400
Applicant:	Changjiang Automobile Electronic System Co., Ltd.
Application Type:	Certification
Product:	SRR
Model No.:	CAEA-SRR-400
Serial Model No.:	SRR400
Brand Name:	CAEA
FCC Classification:	Part 95 Vehicular Radar Systems
FCC Rule Part(s):	FCC Part 95, Subpart M
Test Procedure(s):	ANSI C63.10-2013
Test Date:	April 24 ~ June 10, 2021

Reviewed By: Vincent Yu

Approved By: Robin Wu

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date	Note
2104RSU051-U1	Rev. 01	Initial Report	06-26-2021	Valid

CONTENTS

1. GENERAL INFORMATION

1.1. Applicant

Changjiang Automobile Electronic System Co., Ltd.

No.289, Road12, Avenue2, Binhai Industrial Zone, Wenzhou, Zhejiang 325024, P.R.China

1.2. Manufacturer

Changjiang Automobile Electronic System Co., Ltd.

No.289, Road12, Avenue2, Binhai Industrial Zone, Wenzhou, Zhejiang 325024, P.R.China

1.3. Testing Facility

☒	**Test Site – MRT Suzhou Laboratory**	
	Laboratory Location (Suzhou - Wuzhong)	
	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China	
	Laboratory Location (Suzhou - SIP)	
	4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China	
	Laboratory Accreditations	
	A2LA: 3628.01	CNAS: L10551
	FCC: CN1166	ISED: CN0001
	VCCI: R-20025, G-20034, C-20020, T-20020	
☐	**Test Site – MRT Shenzhen Laboratory**	
	Laboratory Location (Shenzhen)	
	1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China	
	Laboratory Accreditations	
	A2LA: 3628.02	CNAS: L10551
	FCC: CN1284	ISED: CN0105
☐	**Test Site – MRT Taiwan Laboratory**	
	Laboratory Location (Taiwan)	
	No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)	
	Laboratory Accreditations	
	TAF: L3261-190725	
	FCC: 291082, TW3261	ISED: TW3261

2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	SRR
Model No.	CAEA-SRR-400
Serial Model No.	SRR400
Working Frequency Range	76 ~ 77GHz
Type of Modulation	FMCW
Emission Designator	518MN0N
Working Voltage	12VDC
Antenna Type	Integrated antenna
Remark: The different of models only for marketing different client. The PCB layout, circuit schematic, and RF performance of each model are the same.	

2.2. Test Mode

Test Mode:	Transmit

Note: The engineer test sample was provided by the manufacturer, it was configured into continuous TX status after power on.

2.3. Test Environment Condition

Ambient Temp.	15°C ~ 35°C
Relative Humidity	20%RH ~75%RH

3. TEST EQUIPMENT CALIBRATION DATA

Radiated Emission (SIP-AC2)

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTSUE06613	1 year	2021/07/02
PXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2021/08/30
Bilog Period Antenna	Schwarzbeck	VULB9168	MRTSUE06647	1 year	2021/08/08
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06648	1 year	2021/11/26
Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06599	1 year	2021/11/26
Preamplifier	EMCI	EMC051845SE	MRTSUE06644	1 year	2021/11/09
Preamplifier	EMCI	EMC184045SE	MRTSUE06602	1 year	2021/10/12
Micro-Wave Antenna	MI-WWAVE	261U-25	MRTSUE06273	N/A	N/A
Micro-Wave Antenna	MI-WWAVE	261E-25	MRTSUE06276	N/A	N/A
Micro-Wave Antenna	MI-WWAVE	261F-25	MRTSUE06275	N/A	N/A
Micro-Wave Antenna	MI-WWAVE	261G	MRTSUE06274	N/A	N/A
Standard Gain Horn Antenna	A-INFOMW	LB-10-25-A	MRTSUE06410	N/A	N/A
Standard Gain Horn Antenna	A-INFOMW	LB-15-25-A	MRTSUE06409	N/A	N/A
Waveguide Harmonic Mixer	Keysight	M1970V	MRTSUE06271	N/A	N/A
Waveguide Harmonic Mixer	Keysight	M1970W	MRTSUE06272	N/A	N/A
RF Signal Generator	Keysight	E8257D	MRTSUE06453	N/A	N/A
SA Extension Module	Keysight	N9029AV06	MRTSUE06368	N/A	N/A
SA Extension Module	Keysight	N9029AV05	MRTSUE06367	N/A	N/A
SA Extension Module	Keysight	N9029AV03	MRTSUE06366	N/A	N/A
Millimeter wave signal source frequency expander	Keysight	E8257DV15	MRTSUE06456	N/A	N/A
Thermal Hygrometer	testo	608-H1	MRTSUE06624	1 year	2021/12/03
Anechoic Chamber	RIKEN	SIP-AC2	MRTSUE06781	1 year	2021/12/24

Frequency Stability (SIP-TR1)

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
PXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2021/08/30
Waveguide Harmonic Mixer	Keysight	M1970W	MRTSUE06272	N/A	N/A
Standard Gain Horn Antenna	A-INFOMW	LB-10-25-A	MRTSUE06410	N/A	N/A
Temperature Chamber	BAOYT	BYG-408CS	MRTSUE06847	1 year	2022/02/23
Thermal Hygrometer	testo	608-H1	MRTSUE11022	1 year	2021/11/25

Software	Version	Function
EMI Software	V3	EMI Test Software

4. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT 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.

Radiated Emission Measurement
The maximum measurement uncertainty is evaluated as: Horizontal: 30MHz~300MHz: 5.04dB 300MHz~1GHz: 4.95dB 1GHz~40GHz: 6.40dB Vertical: 30MHz~300MHz: 5.24dB 300MHz~1GHz: 6.03dB 1GHz~40GHz: 6.40dB

5. TEST RESULT

5.1. Summary

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
95.3367	EIRP	Peak EIRP < 55dBm/MHz Average EIRP < 50dBm/MHz	Radiated	Pass	Section 5.2
2.1049	Occupied bandwidth	N/A		Pass	Section 5.3
95.3379(a)	Unwanted Emissions	Refer to Section 5.4.1		Pass	Section 5.4
95.3379(b)	Frequency stability	Fall within the frequency band 76-81GHz		Pass	Section 5.5

Note: The radiation measurements are performed in X, Y, Z axis positioning. Only the worst-case data is shown in the report.

5.2. EIRP

5.2.1. Test Limit

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

5.2.2. Test Procedure

ANSI C63.10-2013 Section 9.10

Note: Far-field boundary calculation as below.

According to ANSI C63.10-2013, Clause 9, for mm-wave measurements, L >> λ and a more suitable formula for the far-field boundary distance: $R_{(Far\ Field)} = 2L^2/\lambda$

- L is the largest antenna dimension of the transmit antenna in m
- λ is the wavelength in m

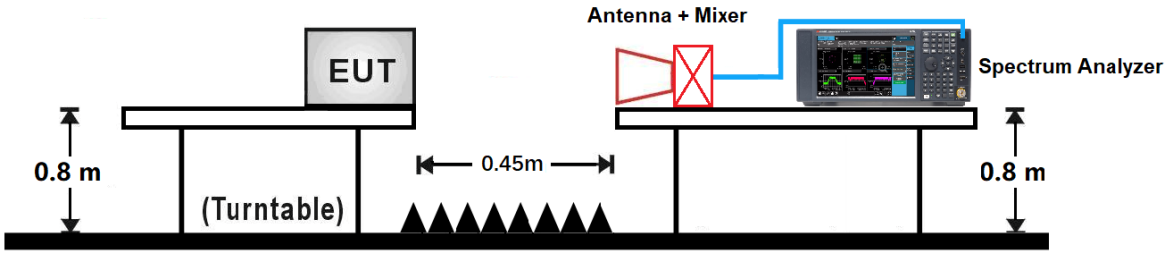
Far-field boundary calculation			
Frequency Range (GHz)	λ (m)	L (m)	$R_{(Far\ Field)}$ (m)
76 ~ 77	0.0039	0.0267	0.37

Our measurement is performed at a minimum distance (d) of 0.45m > $R_{(Far\ Field)}$

5.2.3. Test Setting

1. Span = approximately two times to three times the EBW, centered on the carrier frequency
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector function = Peak for peak EIRP, Average for average EIRP.
5. Sweep time = auto
6. Trace mode = max hold.
7. Allow the trace to stabilize.
8. Use the peak search function to mark the max of the emission.

5.2.4. Test Setup

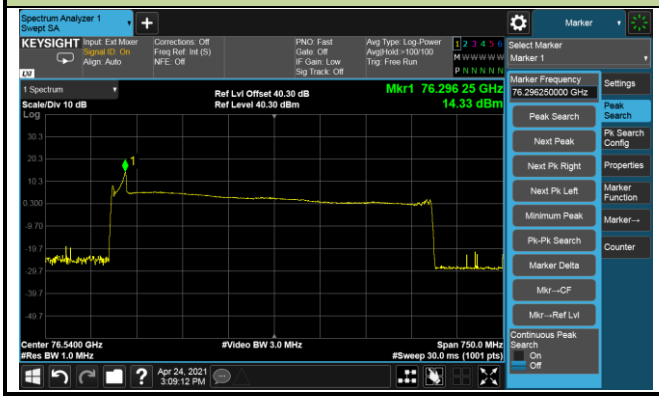


5.2.5. Test Result

Test Site	SIP-AC2	Test Engineer	Andy Zhu
Test Date	2021/04/24		

EIRP (dBm)		EIRP Limit (dBm)		Result
Peak	Average	Peak	Average	
14.33	N/A (Note)	≤ 55	≤ 50	Pass

Note: Average EIRP measurement was not performed when the Peak EIRP level lower than average limit.

Peak EIRP	
	

5.3. Occupied Bandwidth

5.3.1. Test Limit

N/A

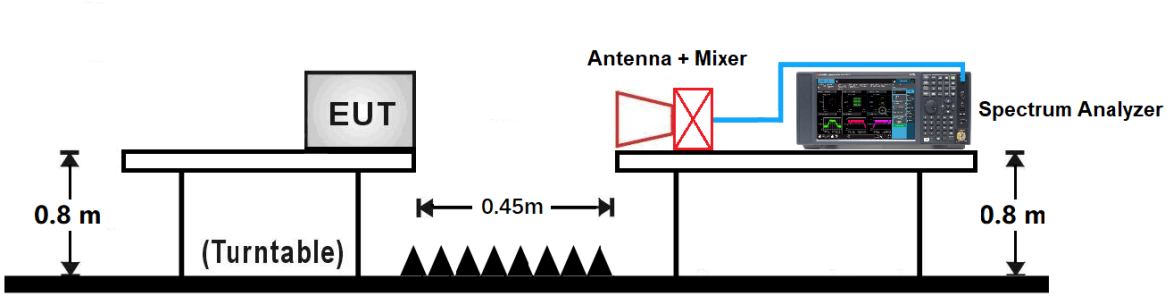
5.3.2. Test Procedure

ANSI C63.10-2013 Section 6.9.3

5.3.3. Test Setting

1. Span = approximately 1.5 times to 5 times the OBW, centered on the carrier frequency
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector function = Peak
5. Sweep time = auto
6. Trace mode = max hold.
7. The EUT shall be transmitting at its maximum data rate. Allow the trace to stabilize.
8. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

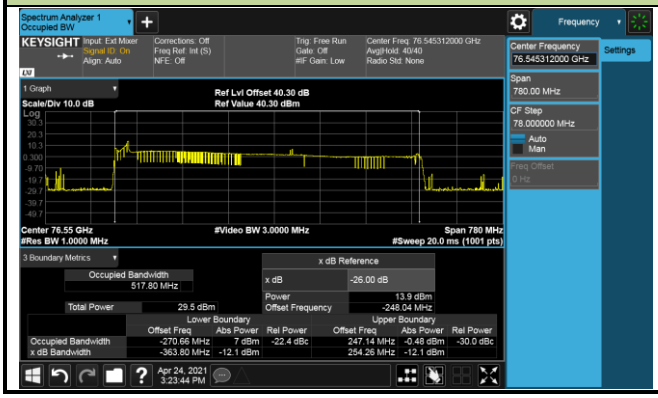
5.3.4. Test Setup



5.3.5. Test Result

Test Site	SIP-AC2	Test Engineer	Andy Zhu
Test Date	2021/04/24		

99% Bandwidth (MHz)	26dB Bandwidth (MHz)	Result
517.80	618.06	Pass

99% & 26dB Occupied Bandwidth	
	

5.4. Unwanted Emissions

5.4.1.Test Limit

The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
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

(i) The tighter limit applies at the band edges.

(ii) The limits in the table are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions between 40 GHz and 200 GHz: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz: 1000 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

5.4.2.Test Procedure

ANSI C63.10-2013 Section 9.12 and Section 9.13

5.4.3.Test Setting

Measurement of harmonic and spurious emissions above 40 GHz

1. Connect the test antenna covering the appropriate frequency range to a spectrum analyzer via an external mixer.
2. Set spectrum analyzer RBW = 1MHz, VBW = 3MHz, average detector.
3. Maximize all observed emissions. Note the maximum power indicated on the spectrum analyzer. Adjust this reading, if necessary, by the conversion loss of the external mixer used at the frequency under investigation and the external mixer IF cable loss.
4. Calculate the maximum field strength of the emission at the measurement distance.
5. Calculate the power density at the distance specified by the limit from the field strength at the distance specified by the limit.
6. Repeat the preceding sequence for every emission observed in the frequency band under investigation.

Measurement of harmonic and spurious emissions below 40 GHz

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3 x RBW
4. Detector = Peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Table 1 – RBW

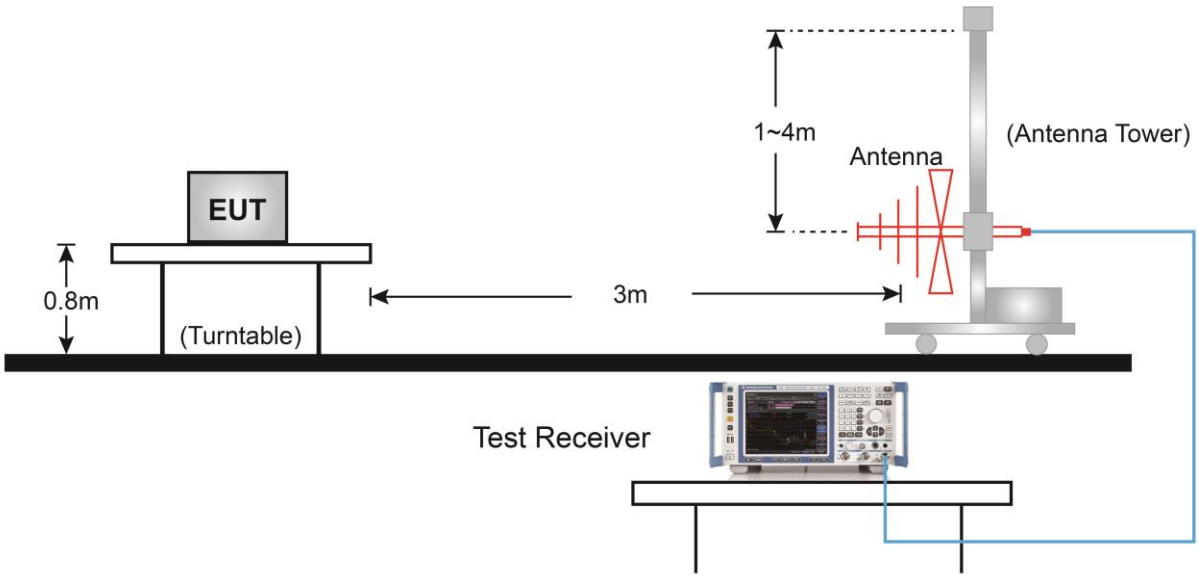
Frequency	RBW
9 ~ 90 kHz	1 MHz
90 ~ 110 kHz	200 Hz
110 ~ 490 kHz	1 MHz
0.49 ~ 30 MHz	9 kHz
30 ~ 1000 MHz	120 kHz
> 1000 MHz	1 MHz

Average Field Strength Measurements

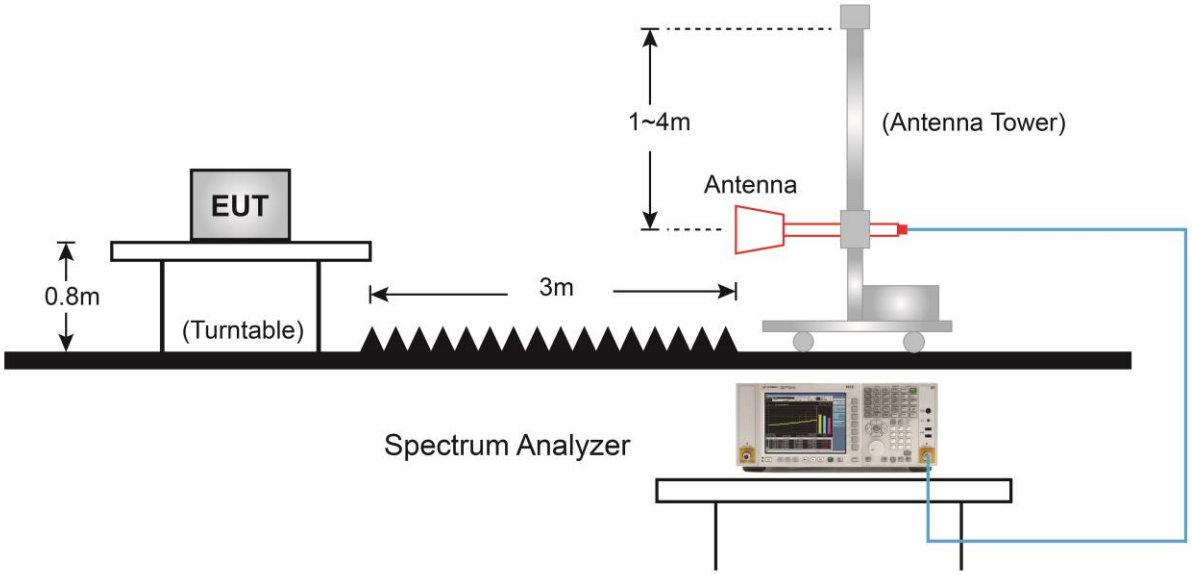
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW ≥ 1/T
4. As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

5.4.4.Test Setup

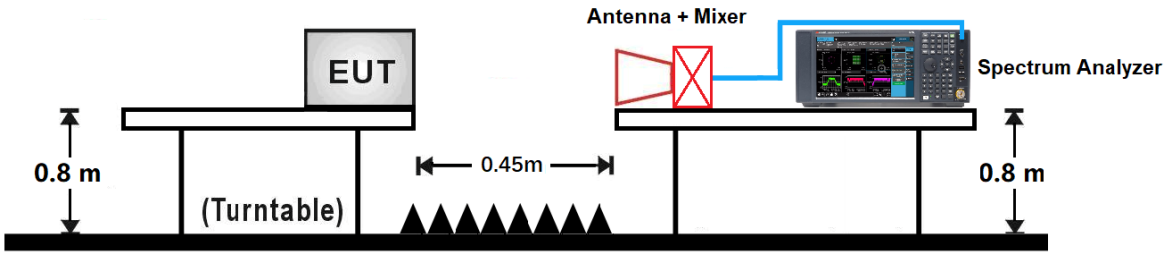
Below 1GHz Test Setup:



1GHz ~ 40GHz Test Setup:



Above 40GHz Test Setup:



5.4.5.Test Result

Test Site	SIP-AC2	Test Engineer	Allen Zou
Test Date	2021/06/10		
Remark	Below 1GHz		

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
41.6	-7.2	17.6	10.4	40.0	-29.6	QP	Horizontal
94.5	-3.2	12.3	9.1	43.5	-34.4	QP	Horizontal
144.5	-2.1	17.8	15.7	43.5	-27.8	QP	Horizontal
292.4	-7.1	18.1	11.0	46.0	-35.0	QP	Horizontal
400.1	-6.0	20.6	14.6	46.0	-31.4	QP	Horizontal
740.5	-8.1	27.4	19.3	46.0	-26.7	QP	Horizontal
31.5	4.3	16.7	21.0	40.0	-19.0	QP	Vertical
51.3	7.0	17.6	24.6	40.0	-15.4	QP	Vertical
60.6	4.9	16.9	21.8	40.0	-18.2	QP	Vertical
65.9	5.2	16.2	21.4	40.0	-18.6	QP	Vertical
94.0	4.2	12.2	16.5	43.5	-27.1	QP	Vertical
135.2	9.0	17.0	25.9	43.5	-17.6	QP	Vertical

Note:

1. Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

   Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

2. The amplitude of radiated emissions (frequency range from 9kHz to 30MHz) is that proximity to ambient noise, which also are attenuated more than 20 dB below the permissible value. Therefore, the data is not presented in the report.

Test Site	SIP-AC2	Test Engineer	Allen Zou
Test Date	2021/06/10		
Remark	1 ~ 40GHz		

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
8769.0	47.3	0.6	47.9	74.0	-26.1	Peak	Horizontal
9772.0	47.9	2.7	50.6	74.0	-23.4	Peak	Horizontal
10843.0	46.1	4.5	50.6	74.0	-23.4	Peak	Horizontal
19078.0	63.5	-10.6	52.9	74.0	-21.1	Peak	Horizontal
19078.0	60.2	-10.6	49.6	54.0	-4.4	Average	Horizontal
29110.0	58.7	-9.2	49.5	74.0	-24.5	Peak	Horizontal
39670.0	54.6	1.1	55.7	74.0	-18.3	Peak	Horizontal
39670.0	40.2	1.1	41.3	54.0	-12.7	Average	Horizontal
8080.5	47.6	0.1	47.7	74.0	-26.3	Peak	Vertical
9228.0	46.8	2.0	48.8	74.0	-25.2	Peak	Vertical
10401.0	46.8	3.7	50.5	74.0	-23.5	Peak	Vertical
19078.0	61.2	-10.6	50.6	74.0	-23.4	Peak	Vertical
19078.0	58.6	-10.6	48.0	54.0	-6.0	Average	Vertical
31167.0	59.5	-8.7	50.8	74.0	-23.2	Peak	Vertical
39483.0	55.2	0.4	55.6	74.0	-18.4	Peak	Vertical
39483.0	41.5	0.4	41.9	54.0	-12.1	Average	Vertical

Note:

1. Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

   Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

2. Average measurement was not performed when the peak level lower than average limit

Test Site	SIP-AC2	Test Engineer	Allen Zou
Test Date	2021/06/10		
Remark	Above 40GHz		

Frequency (GHz)	Reading Level @0.45m (dBμV)	Factor (dB)	Measure Level @0.45m (dBμV/m)	Measure Level @3m (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)	Result
48.65	42.33	45.66	87.99	71.51	3.76	600	Pass
56.80	37.61	41.34	78.95	62.47	0.47	600	Pass
85.82	40.72	44.28	85.00	68.52	1.89	600	Pass
122.09	16.75	57.44	74.19	57.71	0.16	600	Pass
154.40	17.42	60.69	78.11	61.63	0.39	600	Pass

Note:

1. Measure Level @0.45m = Reading Level @0.45m + Factor

   Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) + Mixer Conversion Loss (dB)

2. Measure Level @3m = Measure Level @0.45m + 20 * log(0.45m / 3m)

3. Power Density = $(10^8 / 377) * \{10^{[(\text{Measure Level @3m } -120) / 20]}\}^2$

5.5. Frequency Stability

5.5.1.Test Limit

Fundamental emissions must be contained within the frequency bands 76 - 81GHz during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

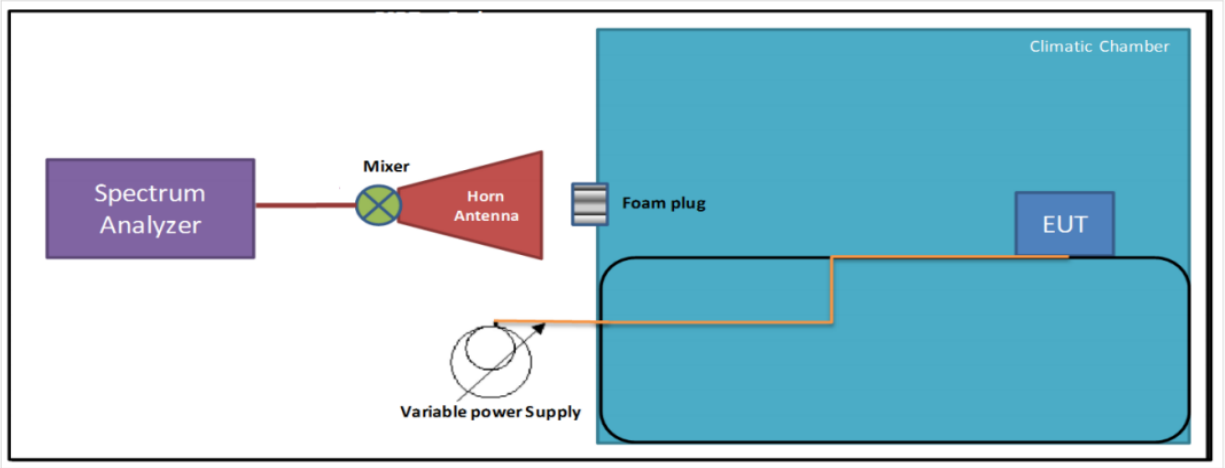
5.5.2.Test Procedure

ANSI C63.10-2013 Section 9.14

5.5.3.Test Setting

1. Arrange EUT and test equipment according Section 6.5.4.
2. With the EUT at ambient temperature (20 °C) and voltage source set to the EUT nominal operating voltage (12VDC, 100%)
3. RBW = 1MHz, VBW = 3MHz
4. Detector = Peak
5. Trace Mode = Max Hold
6. Record the Low and high frequencies (f_L and f_H) of the fundamental frequency emission. The applicable spurious emissions limit 600pW/cm^2 (-1.61dBm) was used to define f_L and f_H.
7. Vary EUT power supply between 85% (10.2VDC) and 115% (13.8VDC) of nominal, record the f_L and f_H.
8. Set the power supply to 100% nominal setting, and raise EUT operating temperature to 50 °C.
9. Record the f_L and f_H of the fundamental frequency emission.
10. Repeat step 9 at each 10°C increment down to -20 °C.

5.5.4.Test Setup



5.5.5.Test Result

Test Site	SIP-TR1	Test Engineer	Andy Zhu
Test Date	2021/04/24		

Voltage (%)	Power (VDC)	Temp (℃)	f_L (GHz)	f_H (GHz)	Limit (GHz)	Result
100%	12.0	- 20	76.273500	76.797000	76 ~ 81	Pass
		- 10	76.274250	76.795875	76 ~ 81	Pass
		0	76.273875	76.796250	76 ~ 81	Pass
		+ 10	76.274250	76.796250	76 ~ 81	Pass
		+ 20 (Ref)	76.274250	76.792500	76 ~ 81	Pass
		+ 30	76.273875	76.795875	76 ~ 81	Pass
		+ 40	76.274250	76.795875	76 ~ 81	Pass
		+ 50	76.274250	76.796625	76 ~ 81	Pass
115%	13.8	+ 20	76.273500	76.796625	76 ~ 81	Pass
85%	10.2	+ 20	76.274625	76.796625	76 ~ 81	Pass

6. CONCLUSION

The data collected relate only the item(s) tested and show that this device is in compliance with Part 95M of the FCC Rules.

The End

Appendix A - Test Setup Photograph

Refer to “2104RSU051-UT” file.

Appendix B - EUT Photograph

Refer to “2104RSU051-UE” file.