MEASUREMENT REPORT

FCC PART 95 Subpart M

FCC ID:	2ATW7-77GRADARNA
Applicant:	STONKAM CO., LTD
Application Type:	Certification
Product:	Radar Sensor
Model No.:	77GHz 2T4R Sensor
Brand Name:	STONKAM
FCC Classification:	Part 95 Vehicular Radar Systems (VRD)
FCC Rule Part(s):	FCC Part 95, Subpart M
Test Procedure(s):	ANSI C63.10-2013 KDB 653005 D01 76-81 GHz Radars v01r01
Test Date:	December 09, 2020 ~ January 21, 2021

Reviewed By: (Kevin Guo)

Approved By: (Robin Wu)

Revision History

Report No.	Version	Description	Issue Date	Note
2011RSU081-U3	Rev. 01	Initial Report	01-27-2021	Valid

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1. INTRODUCTION

1.1. Applicant

STONKAM CO., LTD
1/F, #6 Building, Huangzhou Industrial Park, Chebei Rd., Tianhe Dist., 510665 Guangzhou, China

1.2. Manufacturer

STONKAM CO., LTD
1/F, #6 Building, Huangzhou Industrial Park, Chebei Rd., Tianhe Dist., 510665 Guangzhou, 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	Radar Sensor
Model No.	77GHz 2T4R Sensor
Brand Name	STONKAM
EUT Identification No.	20201127Sample#06
Radio Specification	77G Radar
Working Voltage Range:	6VDC ~ 32VDC
Working Temperature Range	-20°C ~ 70°C

2.2. Product Specification Subjective to this Report

Frequency Range	76 ~ 77GHz
Type of Modulation	FMCW Fast Chirp, Sawtooth
Sweep Bandwidth	900MHz
Sweep Rate	18MHz/μs
Sweep Time	50μs
Antenna Type:	Integrated antenna

Note: All product information is provided by the manufacturer.

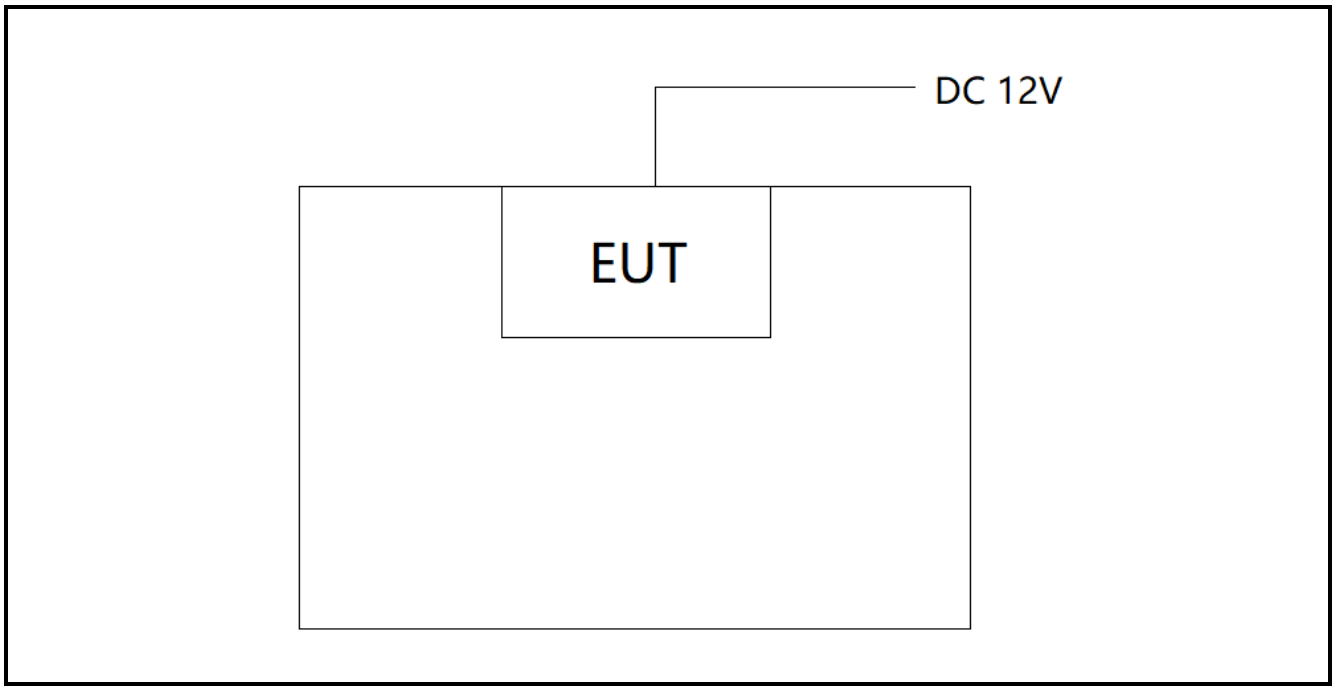
2.3. Test Mode

Test Mode	Transmit

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

2.4. Description of Test Configuration and Software

The device was tested per the guidance ANSI C63.10: 2013 was used to reference the appropriate EUT setup for radiated emissions testing and AC line conducted testing.



2.5. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.6. Labeling Requirements

Per 2.1074; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. TEST EQUIPMENT CALIBRATION DATA

EIRP / Occupied bandwidth / Unwanted Emissions / Frequency stability (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
EXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2021/09/03
Bilog Period Antenna	Schwarzbeck	VULB9168	MRTSUE06646	1 year	2021/12/17
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06648	1 year	2021/12/17
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2021/12/17
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2021/11/15
Preamplifier	EMCI	EMC051845SE	MRTSUE06644	1 year	2021/11/13
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
RF Detector	SAGE	STD-15SF-NI	MRTSUE06466	N/A	N/A
Oscilloscope	Agilent	DSO-X 6002A	MRTSUE06107	1 year	2021/04/14
Thermal Hygrometer	testo	608-H1	MRTSUE06624	1 year	2021/12/29
Anechoic Chamber	RIKEN	SIP-AC2	MRTSUE06781	1 year	2021/12/25

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.

AC Conducted Emission Measurement
Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz~150kHz: 3.74dB 150kHz~30MHz: 3.44dB
Radiated Disturbance
Measurement Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 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 6.4.1		Pass	Section 5.4
95.3379(b)	Frequency stability	Fall within the frequency band 76-81GHz		Pass	Section 5.5

Notes: 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 used

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

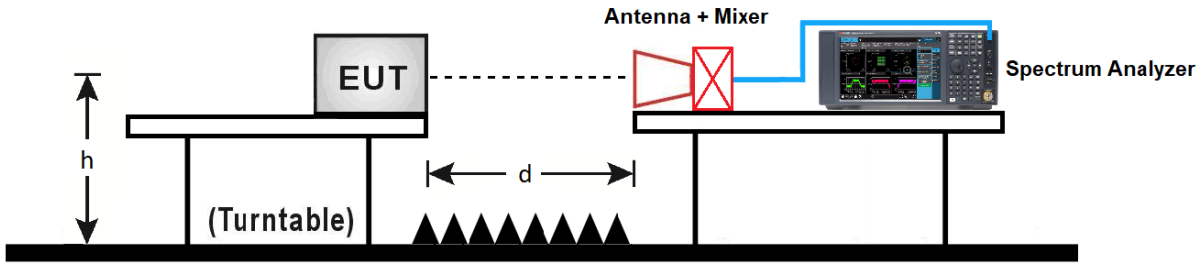
Far-field boundary calculation			
Frequency Range (GHz)	λ (m)	L (m)	$R_{(Far\ Field)}$ (m)
76 ~ 77	0.0039	0.0425	0.98

Our measurement is performed at a minimum distance of 1.00m > $R_{(Far\ Field)}$

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

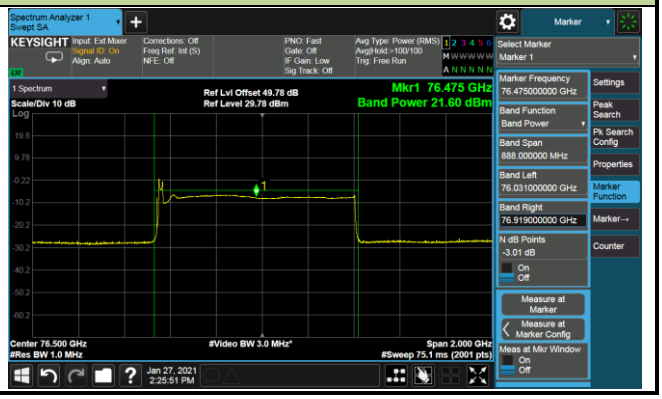


d = Substitution Distance; h = EUT Height

5.2.5. Test Result

Product	Radar Sensor	Temperature	24~26°C
Test Engineer	Ternence Wang	Relative Humidity	54~57%
Test Site	SIP-AC2	Test Date	2020/12/09~2021/01/27

Mode	Peak Power (EIRP) (dBm/MHz)	Average Power (EIRP) (dBm)	Result
77G Radar	18.66	21.60	Pass

Peak Power (EIRP)	Average Power (EIRP)
	

5.3. Occupied bandwidth

5.3.1. Test Limit

N/A

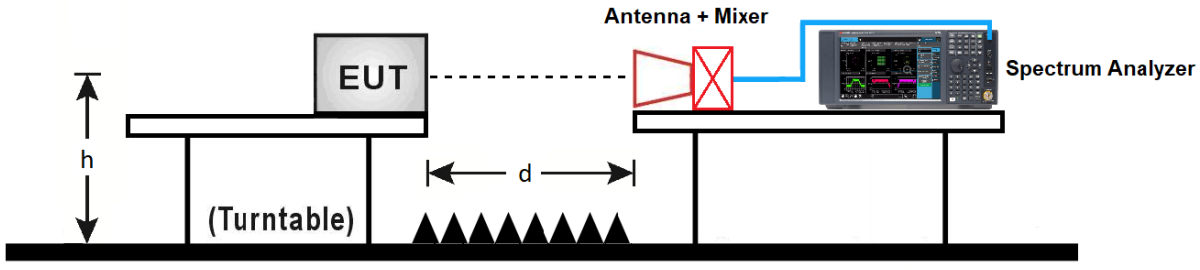
5.3.2. Test Procedure used

ANSI C63.10 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 = 8MHz
3. VBW = 50MHz
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



d = Substitution Distance; h = EUT Height

5.3.5. Test Result

Product	Radar Sensor	Temperature	23°C
Test Engineer	Ternence Wang	Relative Humidity	56%
Test Site	SIP-AC2	Test Date	2021/01/21

99% Bandwidth (GHz)	Lowest Frequency (GHz)	Highest Frequency (GHz)
0.862	76.046	76.907

99% 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 used

ANSI C63.10 Section 9.12 and Section 9.13

5.4.3.Test Procedure

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

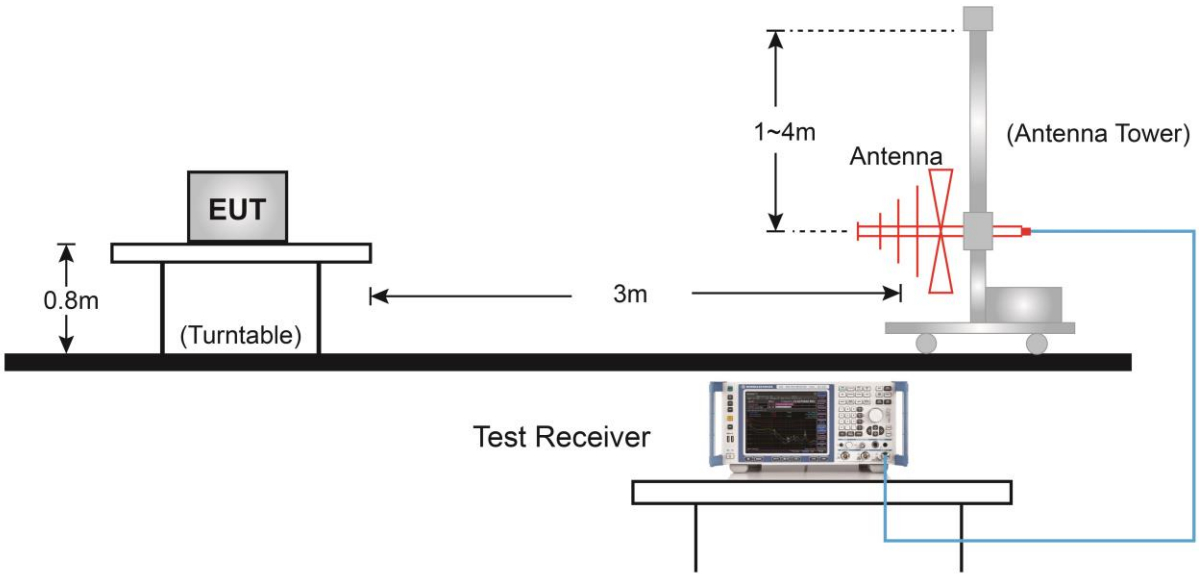
Frequency	RBW
9 ~ 90 kHz	1 MHz
90 ~ 110 kHz	200 Hz
110 ~ 490 kHz	1 MHz
0.49 ~ 30 MHz	9 kHz
30 ~ 1000 MHz	120 kHz
> 1000 MHz	1 MHz

Average Field Strength Measurements

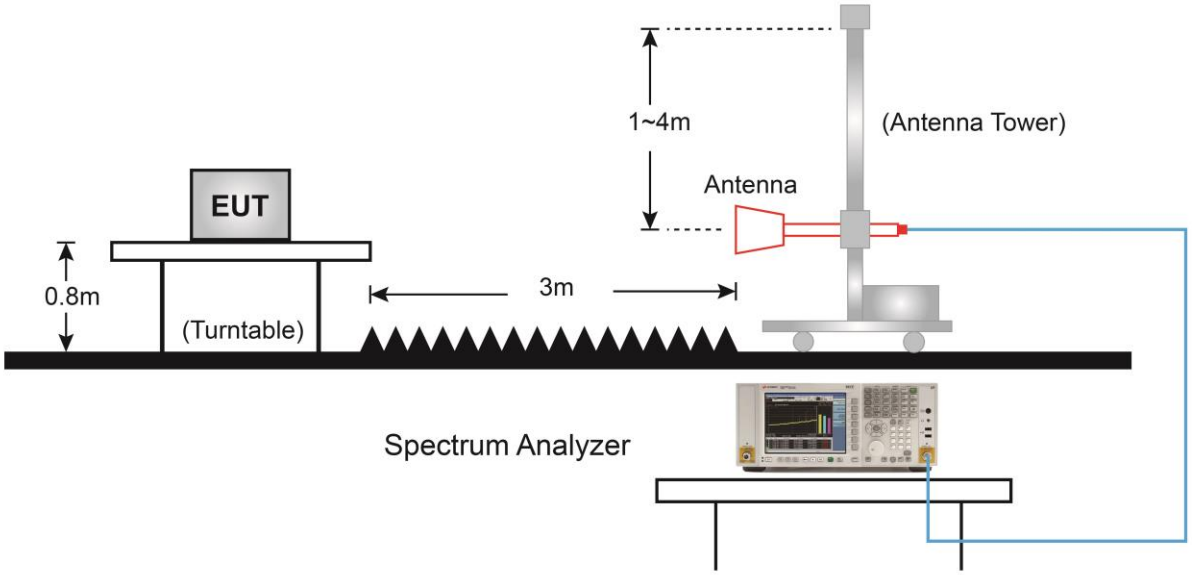
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Average
5. Sweep time = auto
6. Trace mode = max hold
7. Allow max hold to run for at least 50 times (1/duty cycle) traces

5.4.4.Test Setup

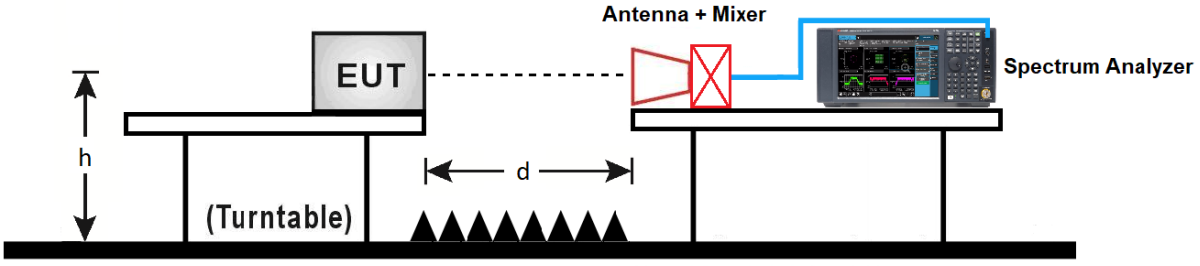
Below 1GHz Test Setup:



1GHz ~ 40GHz Test Setup:



Above 40GHz Test Setup:



d = Substitution Distance; h = EUT Height

5.4.5.Test Result

Product	Radar Sensor	Temperature	23°C
Test Engineer	Messiah Li	Relative Humidity	54%
Test Site	SIP-AC2	Test Date	2020/12/09
Remark	Below 1GHz		

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
131.6	17.2	13.6	30.8	43.5	-12.7	QP	Horizontal
143.9	14.6	14.5	29.1	43.5	-14.4	QP	Horizontal
329.9	14.1	14.6	28.7	46.0	-17.3	QP	Horizontal
525.3	13.4	18.3	31.7	46.0	-14.3	QP	Horizontal
725.4	13.4	21.6	35.0	46.0	-11.0	QP	Horizontal
799.8	13.4	22.4	35.8	46.0	-10.2	QP	Horizontal
30.4	15.5	13.6	29.1	40.0	-10.9	QP	Vertical
58.3	12.6	13.3	25.9	40.0	-14.1	QP	Vertical
143.8	11.2	14.5	25.7	43.5	-17.8	QP	Vertical
495.3	16.1	17.8	33.9	46.0	-12.1	QP	Vertical
525.3	19.2	18.3	37.5	46.0	-8.5	QP	Vertical
701.3	10.5	21.2	31.7	46.0	-14.3	QP	Vertical

Note:

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

Product	Radar Sensor	Temperature	23°C
Test Engineer	Messiah Li	Relative Humidity	54%
Test Site	SIP-AC2	Test Date	2021/01/09
Remark	1 ~ 40GHz		

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
14396.0	47.6	1.5	49.1	74.0	-24.9	Peak	Horizontal
17515.5	44.9	5.6	50.5	74.0	-23.5	Peak	Horizontal
37668.0	58.0	-2.4	55.6	74.0	-18.4	Peak	Horizontal
37668.0	44.6	-2.4	42.2	54.0	-11.8	Average	Horizontal
39637.0	55.0	1.8	56.8	74.0	-17.2	Peak	Horizontal
39637.0	42.3	1.8	44.1	54.0	-9.9	Average	Horizontal
14396.0	47.2	1.5	48.7	74.0	-25.3	Peak	Vertical
16810.0	44.8	5.5	50.3	74.0	-23.7	Peak	Vertical
38394.0	56.3	-0.7	55.6	74.0	-18.4	Peak	Vertical
38394.0	42.6	-0.7	41.9	54.0	-12.1	Average	Vertical
39725.0	55.5	1.1	56.6	74.0	-17.4	Peak	Vertical
39725.0	43.5	1.1	44.6	54.0	-9.4	Average	Vertical

Note:

1. Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)
2. Average measurement was not performed when the peak level lower than average limit

Product	Radar Sensor	Temperature	23°C
Test Engineer	Ternence Wang	Relative Humidity	54%
Test Site	SIP-AC2	Test Date	2020/12/09
Test Range	Above 40GHz		

Frequency (GHz)	Reading Level @1m (dBμV)	Factor (dB)	Measure Level @1m (dBμV/m)	Measure Level @3m (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)	Result
40GHz ~ 231GHz							
49.9	24.8	46.3	71.1	61.6	0.4	600	Pass
60.4	36.3	41.5	77.8	68.3	1.8	600	Pass
98.7	36.1	44.6	80.7	71.2	3.5	600	Pass
135.9	14.1	57.0	71.1	61.6	0.4	600	Pass
166.1	15.0	59.7	74.7	65.2	0.9	600	Pass
220.5	17.5	62.1	79.6	70.1	2.7	1000	Pass

Note:

1. Measure Level @1m = Reading Level @1m + Factor
2. Measure Level @3m = Measure Level @1m + 20 * log(1m / 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.

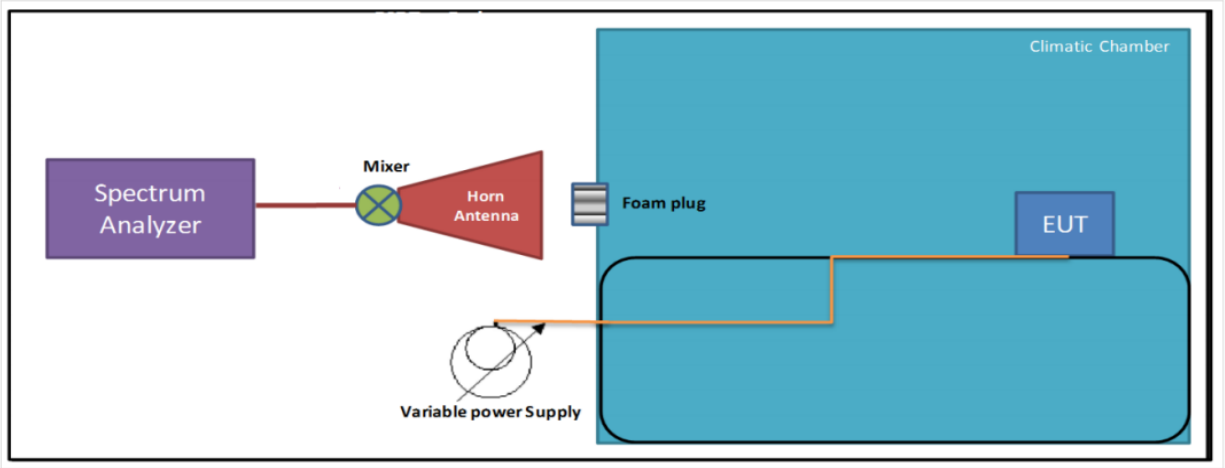
5.5.2.Test Procedure used

ANSI C63.10 Section 9.14

5.5.3.Test Procedure

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 Engineer	Ternence Wang	Temperature	23°C
Test Time	2020/12/09	Relative Humidity	54%RH
Test Mode	Mode 1	Test Site	SIP-AC2

Voltage (%)	Power (VDC)	Temp (℃)	f_L (GHz)	f_H (GHz)	Limit (GHz)	Result
100%	12.0	- 20	76.0436	76.9556	76 ~ 81	Pass
		- 10	76.0436	76.9556	76 ~ 81	Pass
		0	76.0435	76.9556	76 ~ 81	Pass
		+ 10	76.0436	76.9557	76 ~ 81	Pass
		+ 20 (Ref)	76.0436	76.9556	76 ~ 81	Pass
		+ 30	76.0435	76.9554	76 ~ 81	Pass
		+ 40	76.0435	76.9556	76 ~ 81	Pass
		+ 50	76.0435	76.9555	76 ~ 81	Pass
115%	13.8	+ 20	76.0436	76.9556	76 ~ 81	Pass
85%	10.2	+ 20	76.0436	76.9556	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 “2011RSU081-UT” file.

Appendix B - EUT Photograph

Refer to “2011RSU081-UE” file.