FCC RADIO TEST REPORT

FCC ID	:	2AHL80025368507
Equipment	:	Reverse parking sensors
Brand Name	:	iBEAM
Model Name	:	TE-2PSK
Applicant	:	Metra Electronics 460 Walker St Holly Hill, FL 32117
Manufacturer	:	RoyalTek Company Ltd. 5F, No.188, Wenhua 2nd Rd., Guishan, Taoyuan City 33383, Taiwan, R.O.C
Standard	:	47 CFR FCC Part 95M

The product was received on Jun. 22, 2020, and testing was started from Jun. 26, 2020 and completed on Jul. 06, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Cliff Chang

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR021730-02	01	Initial issue of report	Jul. 28, 2020
FR021730-02	02	Revise the unit of measured Frequency on Frequency stability section.	Jul. 31, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.107	AC Power-line Conducted Emissions	PASS	-
3.2	95.303	Occupied Bandwidth	PASS	-
3.3	95.3367	Radiated E.I.R.P Power / E.I.R.P Power Density	PASS	-
3.4	95.3379	Transmitter Radiated Unwanted Emissions	PASS	-
3.5	95.3379	Frequency Stability	PASS	-
Note: Reference to Sporton Project No.: 021730-01.				

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen
Report Producer: Wendy Pan

1 General Description

1.1 Information

1.1.1 RF General Information

RF General Information			
Frequency Range (GHz)	**Operating Frequency Range (GHz)**	**Test Frequency (GHz)**	**Modulation**
76-81	77 ~ 81	79	FMCW

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	MEDIATEK	MT2706	Array Antenna	N/A	11.6247

Note: The above information was declared by manufacturer.

1.1.3 EUT Operational Condition

EUT Power Type	From DC power supply			
Supply Voltage	☐	AC	State AC voltage	-
Supply Voltage	☒	DC	State DC voltage	12 V

1.1.4 Test Signal Duty Cycle

Test Signal Duty Cycle
☒ Continuous transmission - 91%
☐ Transmissions occur regularly in time - …%

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 95M
- ANSI C63.10 - Testing Unlicensed Wireless Devices
- KDB653005 D01 76-81 GHz Radars v01r01

The following reference test guidance is not within the scope of accreditation of TAF.

- FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location			
☐	HWA YA	ADD :	No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)
		TEL :	886-3-327-3456 FAX : 886-3-327-0973
☒	JHUBEI	ADD :	No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C.
		TEL :	886-3-656-9065 FAX : 886-3-656-9085

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
RF Conducted	TH03-CB	Jay Luo	24.1-25.2°C / 43-46 %	Jun. 30, 2020 ~ Jul. 02, 2020
Radiated<1GHz	03CH05-CB	Stim Sung	24.8-25.9°C / 61-64%	Jun. 26, 2020
Radiated>1GHz	03CH01-CB	Eason Chen	24.5-25.3°C / 42-45%	Jun. 30, 2020 ~ Jul. 01, 2020
AC Conduction	CO01-CB	GN Hou	21~23°C / 61~63%	Jul. 06, 2020

Test site Designation No. TW0006 with FCC.
Test site registered number IC 4086D with Industry Canada.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.0 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.9 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.6 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 60GHz)	3.9 dB	Confidence levels of 95%
Radiated Emission (60GHz ~ 90GHz)	4.5 dB	Confidence levels of 95%
Radiated Emission (90GHz ~ 200GHz)	5.3 dB	Confidence levels of 95%
Radiated Emission (200GHz ~ 280GHz)	5.6 dB	Confidence levels of 95%
Temperature	0.9°C	Confidence levels of 95%

2 Test Configuration of EUT

2.1 Test Channel Frequencies Configuration

Test Channel Frequencies Configuration
Test Channel Frequencies (GHz)
79

2.2 Conformance Tests and Related Test Frequencies

Test Item	Test Frequencies (GHz)
AC Power-line Conducted Emissions	79
Occupied Bandwidth	79
Radiated E.I.R.P Power / E.I.R.P Power Density	79
Transmitter Spurious Emissions (below 1 GHz)	79
Transmitter Spurious Emissions (1 GHz-40 GHz)	79
Transmitter Spurious Emissions (above 40 GHz)	79
Frequency Stability	79

2.3 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral
Operating Mode	Normal Link
1	EUT with Test Assembly 1

The Worst Case Mode for Following Conformance Tests	
Tests Item	Occupied Bandwidth Radiated E.I.R.P Power / E.I.R.P Power Density Frequency Stability
Test Condition	Radiated measurement
Operating Mode	CTX

The Worst Case Mode for Following Conformance Tests	
Tests Item	Transmitter Radiated Unwanted Emissions
Test Condition	Radiated measurement
Operating Mode < 1GHz	Normal Link
1	EUT with Test Assembly 1
2	EUT with Test Assembly 2
For operating mode 1 is the worst case and it was record in this test report.	
Operating Mode > 1GHz	CTX
1	EUT

2.4 EUT Operation during Test

For CTX Mode:
The EUT was programmed to be in continuously transmitting mode.

For Normal Link Mode:
During the test, the EUT operation to normal function.

2.5 Accessories

Main cable for car front radar*1 (Master: Non-shielded, 2.3m / Slave: Non-shielded, 3.7m)
Main cable for car rear radar*1 (Master: Non-shielded, 2.3m / Slave: Non-shielded, 3.7m)
BGC button (Calibration) cable*1: Non-shielded, 2.1m
Function on/off button cable*1: Non-shielded, 1.4m
Buzzer*1: Non-shielded, 1.2m

2.6 Table for Assembly

Set	Main Cable	BGC button (Calibration) cable	Function on/off button cable	Buzzer
1	car front radar	V	V	V
2	car rear radar	V	-	V

2.7 Support Equipment

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
A	Power Supply	Advanced	LPS-305	N/A

2.8 Far Field Boundary Calculations

The far-field boundary is given as:

far field = (2 * L^2) /λ

where:

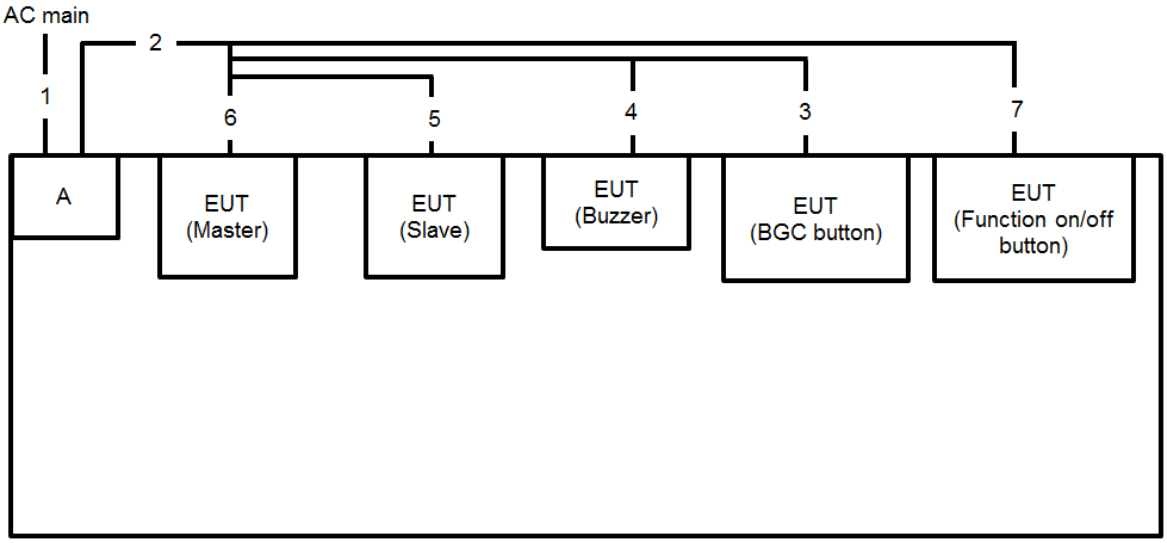
L = Largest Antenna Dimension, including the reflector, in meters

λ= wavelength in meters

Far Field (m)				
Frequency (GHz)	**L (m)**	**Lambda (m)**	**d(Far Field) (m)**	**d(Far Field) (cm)**
79	0.02	0.0037975	0.211	21.07

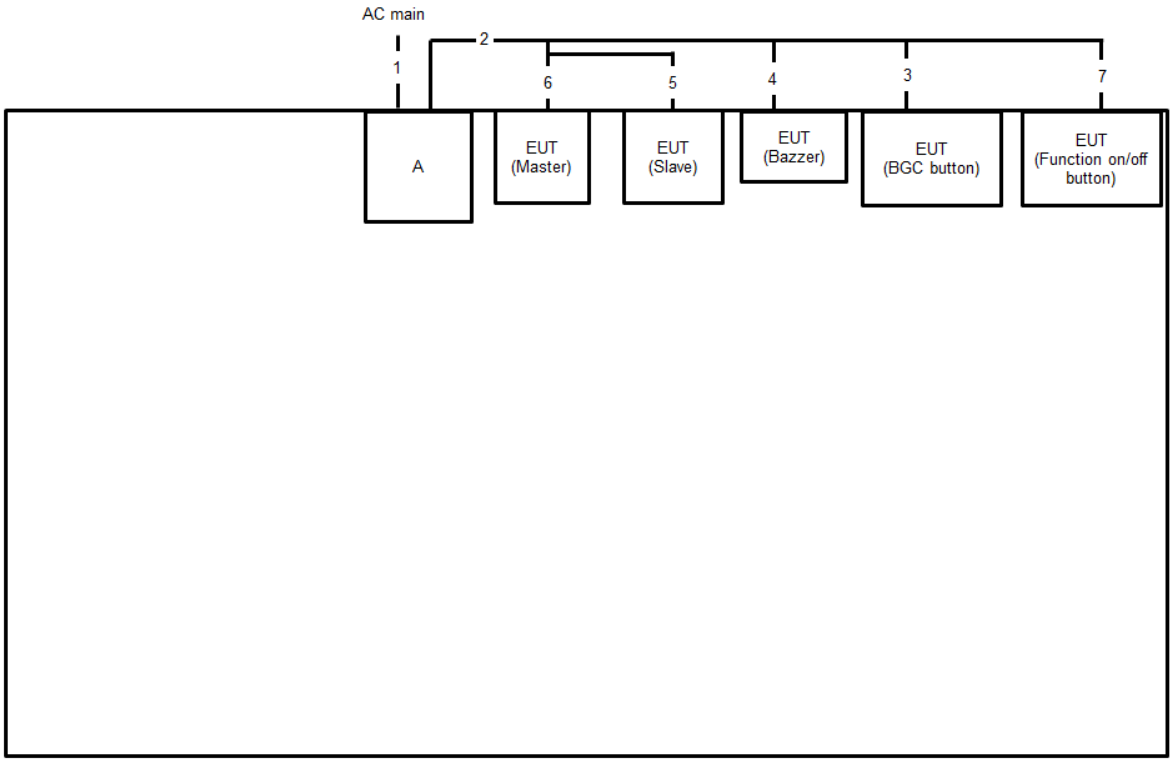
2.9 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



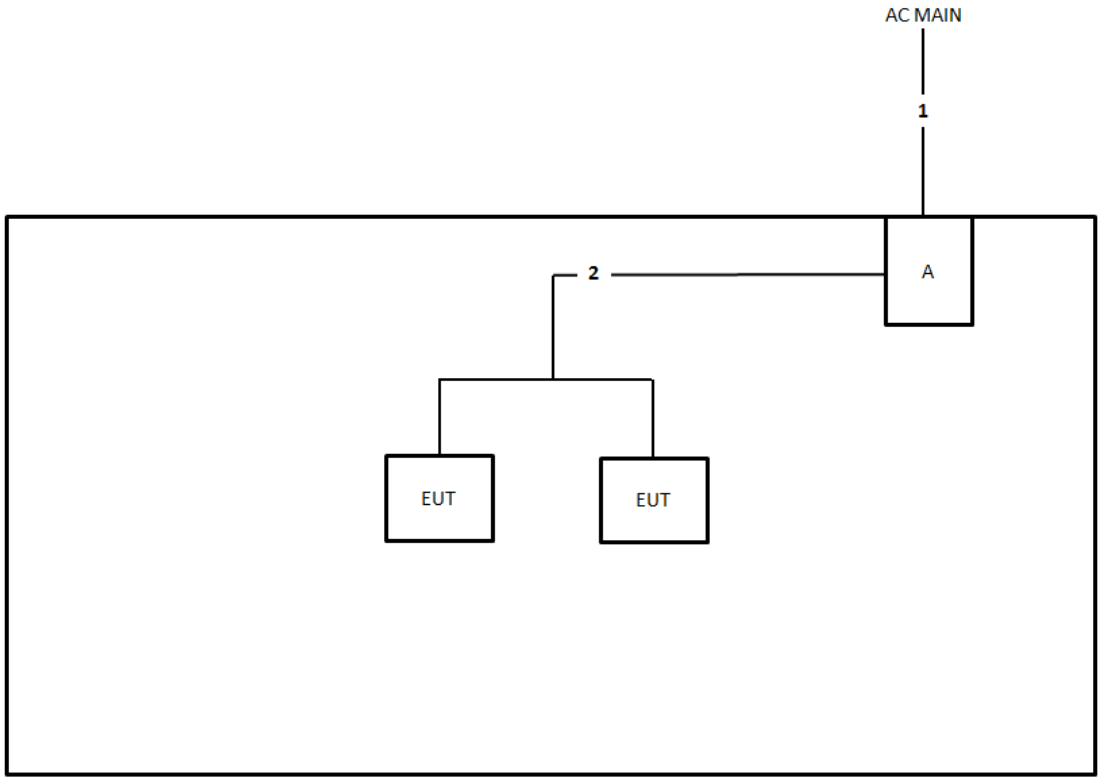
Item	Connection	Shielded	Length
1	Power cable	No	1.8m
2	DC Power cable	No	1m
3	cable	No	2.1m
4	cable	No	1.2m
5	Main cable	No	3.7m
6	Main cable	No	2.3m
7	cable	No	1.4m

Test Setup Diagram - Radiated Test < 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.8m
2	DC Power cable	No	1m
3	cable	No	2.1m
4	cable	No	1.2m
5	Main cable	No	3.7m
6	Main cable	No	2.3m
7	cable	No	1.4m

Test Setup Diagram - Radiated Test > 1GHz



Item	Connection	Shielded	Length
1	Power cable	No	1.8m
2	Power cable	No	5.7m

3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 Limit of AC Power-line Conducted Emissions

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note: * Decreases with the logarithm of the frequency.		

3.1.2 Measuring Instruments

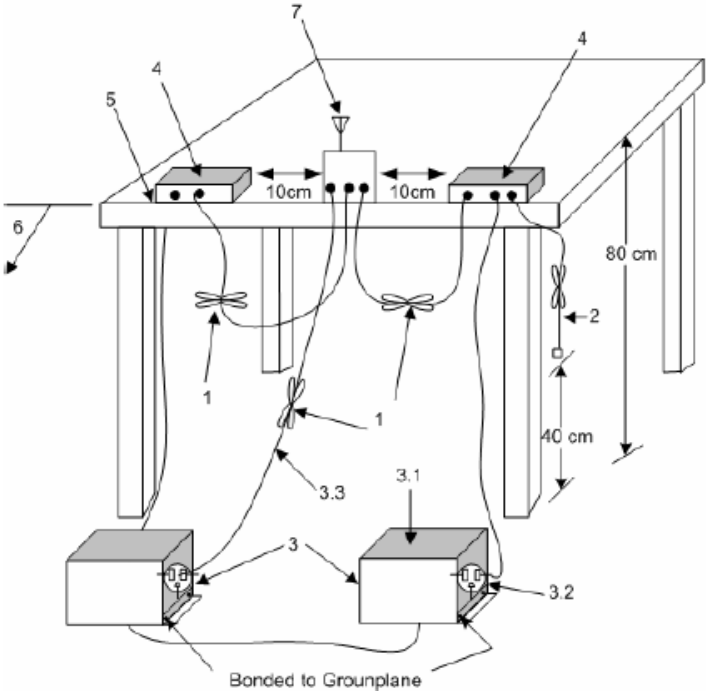
Refer a measuring instruments list in this test report.

3.1.3 Test Procedures

Method of measurement: Refer as ANSI C63.10, clause 6.2.

3.1.4 Test Setup

AC Power-line Conducted Emissions



3.1.5 Measurement Results Calculation

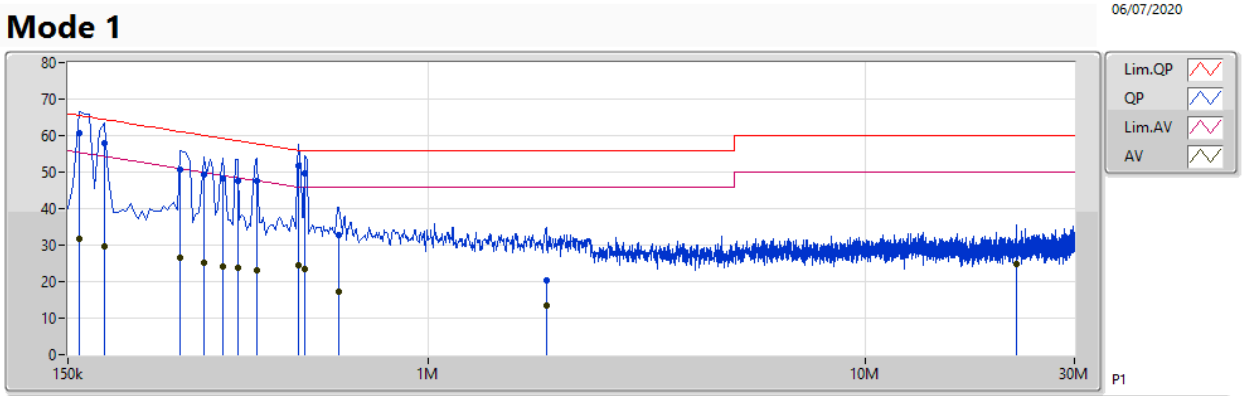
The measured Level is calculated using:

a. Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level

b. Margin = - Limit + (Read Level + LISN Factor + Cable Loss)

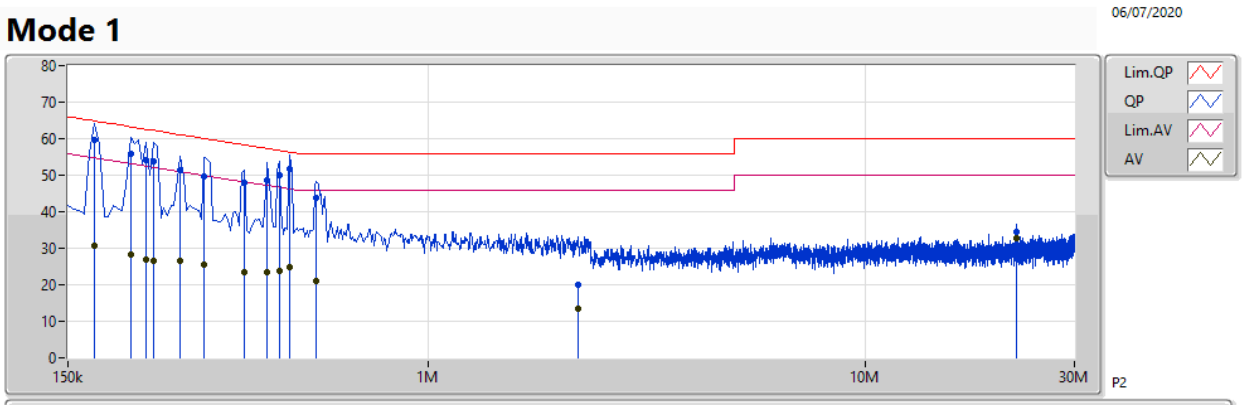
3.1.6 Test Result of AC Power-line Conducted Emissions

Phase: Line



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	AF	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	159k	60.59	65.52	-4.93	9.87	Line	-	50.72	0.05	0.03	9.79
AV	159k	31.60	55.52	-23.92	9.87	Line	-	21.73	0.05	0.03	9.79
QP	181.5k	58.02	64.41	-6.39	9.86	Line	-	48.16	0.04	0.03	9.79
AV	181.5k	29.68	54.41	-24.73	9.86	Line	-	19.82	0.04	0.03	9.79
QP	271.5k	50.86	61.07	-10.21	9.87	Line	-	40.99	0.04	0.03	9.80
AV	271.5k	26.51	51.07	-24.56	9.87	Line	-	16.64	0.04	0.03	9.80
QP	307.5k	49.15	60.03	-10.88	9.87	Line	-	39.28	0.04	0.03	9.80
AV	307.5k	25.26	50.03	-24.77	9.87	Line	-	15.39	0.04	0.03	9.80
QP	339k	48.13	59.23	-11.10	9.88	Line	-	38.25	0.04	0.03	9.81
AV	339k	24.31	49.23	-24.92	9.88	Line	-	14.43	0.04	0.03	9.81
QP	366k	47.67	58.60	-10.93	9.88	Line	-	37.79	0.04	0.03	9.81
AV	366k	23.72	48.60	-24.88	9.88	Line	-	13.84	0.04	0.03	9.81
QP	406.5k	47.54	57.72	-10.18	9.88	Line	-	37.66	0.04	0.03	9.81
AV	406.5k	23.21	47.72	-24.51	9.88	Line	-	13.33	0.04	0.03	9.81
QP	505.5k	51.68	56.00	-4.32	9.88	Line	"Worst"	41.80	0.04	0.03	9.81
AV	505.5k	24.59	46.00	-21.41	9.88	Line	-	14.71	0.04	0.03	9.81
QP	523.5k	49.80	56.00	-6.20	9.88	Line	-	39.92	0.04	0.03	9.81
AV	523.5k	23.53	46.00	-22.47	9.88	Line	-	13.65	0.04	0.03	9.81
QP	622.5k	32.60	56.00	-23.40	9.88	Line	-	22.72	0.04	0.03	9.81
AV	622.5k	17.33	46.00	-28.67	9.88	Line	-	7.45	0.04	0.03	9.81
QP	1.86M	20.27	56.00	-35.73	9.96	Line	-	10.31	0.06	0.07	9.83
AV	1.86M	13.41	46.00	-32.59	9.96	Line	-	3.45	0.06	0.07	9.83
QP	22.124M	27.52	60.00	-32.48	10.58	Line	-	16.94	0.25	0.33	10.00
AV	22.124M	24.75	50.00	-25.25	10.58	Line	-	14.17	0.25	0.33	10.00

Phase: Neutral



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	AF	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	172.5k	59.54	64.83	-5.29	9.86	Neutral	-	49.68	0.04	0.03	9.79
AV	172.5k	30.76	54.83	-24.07	9.86	Neutral	-	20.90	0.04	0.03	9.79
QP	208.5k	55.86	63.27	-7.41	9.86	Neutral	-	46.00	0.04	0.03	9.79
AV	208.5k	28.15	53.27	-25.12	9.86	Neutral	-	18.29	0.04	0.03	9.79
QP	226.5k	54.26	62.58	-8.32	9.86	Neutral	-	44.40	0.04	0.03	9.79
AV	226.5k	27.01	52.58	-25.57	9.86	Neutral	-	17.15	0.04	0.03	9.79
QP	235.5k	53.64	62.25	-8.61	9.86	Neutral	-	43.78	0.04	0.03	9.79
AV	235.5k	26.66	52.25	-25.59	9.86	Neutral	-	16.80	0.04	0.03	9.79
QP	271.5k	51.26	61.07	-9.81	9.87	Neutral	-	41.39	0.04	0.03	9.80
AV	271.5k	26.66	51.07	-24.41	9.87	Neutral	-	16.79	0.04	0.03	9.80
QP	307.5k	49.66	60.03	-10.37	9.87	Neutral	-	39.79	0.04	0.03	9.80
AV	307.5k	25.42	50.03	-24.61	9.87	Neutral	-	15.55	0.04	0.03	9.80
QP	379.5k	47.95	58.29	-10.34	9.88	Neutral	-	38.07	0.04	0.03	9.81
AV	379.5k	23.61	48.29	-24.68	9.88	Neutral	-	13.73	0.04	0.03	9.81
QP	429k	48.60	57.28	-8.68	9.88	Neutral	-	38.72	0.04	0.03	9.81
AV	429k	23.37	47.28	-23.91	9.88	Neutral	-	13.49	0.04	0.03	9.81
QP	456k	49.86	56.76	-6.90	9.88	Neutral	-	39.98	0.04	0.03	9.81
AV	456k	23.77	46.76	-22.99	9.88	Neutral	-	13.89	0.04	0.03	9.81
QP	483k	51.84	56.29	-4.45	9.88	Neutral	"Worst"	41.96	0.04	0.03	9.81
AV	483k	24.85	46.29	-21.44	9.88	Neutral	-	14.97	0.04	0.03	9.81
QP	555k	43.92	56.00	-12.08	9.89	Neutral	-	34.03	0.05	0.03	9.81
AV	555k	20.99	46.00	-25.01	9.89	Neutral	-	11.10	0.05	0.03	9.81
QP	2.193M	20.08	56.00	-35.92	9.98	Neutral	-	10.10	0.07	0.08	9.83
AV	2.193M	13.49	46.00	-32.51	9.98	Neutral	-	3.51	0.07	0.08	9.83
QP	22.119M	34.51	60.00	-25.49	10.57	Neutral	-	23.94	0.24	0.33	10.00
AV	22.119M	32.64	50.00	-17.36	10.57	Neutral	-	22.07	0.24	0.33	10.00

3.2 Occupied Bandwidth

3.2.1 Occupied Bandwidth (OBW) Limit

Occupied Bandwidth (EBW) Limit
Information only

3.2.2 Measuring Instruments

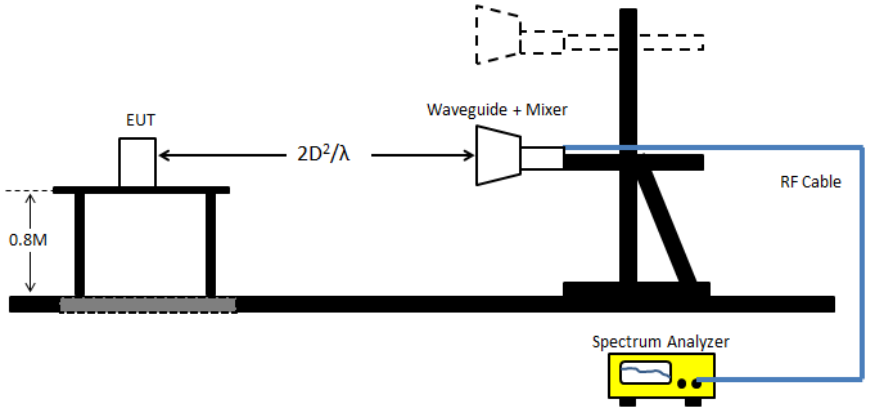
Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
☒	For the Occupied bandwidth shall be measured using one of the options below:
	☒ Refer as ANSI C63.10, clause 7.8.7 for EBW measurement.
	☐ Refer as ANSI C63.10, clause 6.9.2 for occupied bandwidth testing.
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
	☒ Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m

3.2.4 Test Setup

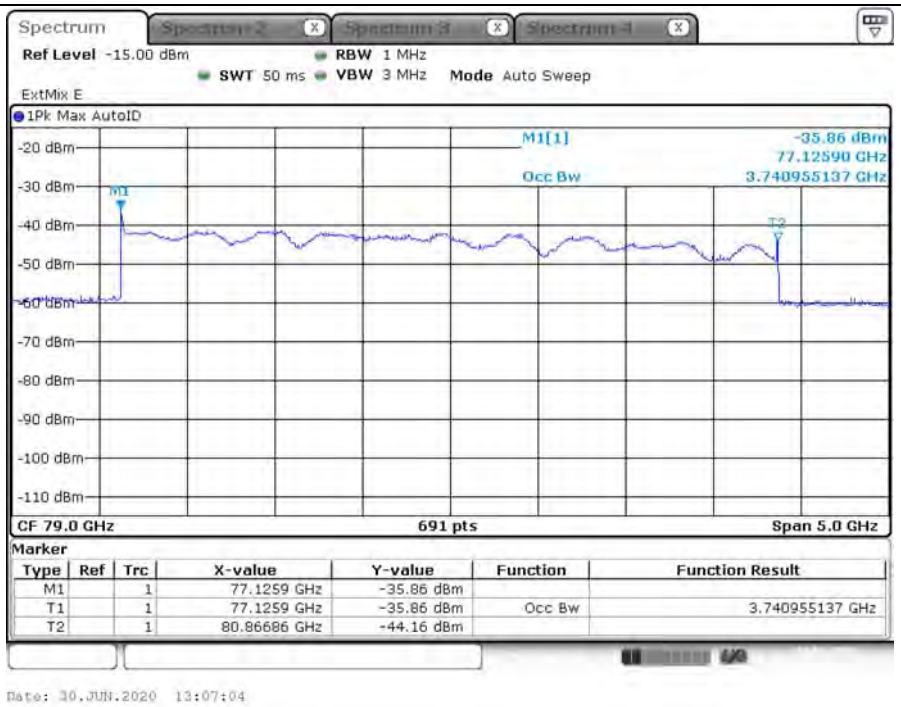
Occupied Bandwidth



3.2.5 Test Result of Occupied Bandwidth

Test Results		
Test Freq. (GHz)	**99% Occupied Bandwidth (MHz)**	**Limit (MHz)**
79	3740.955	N/A

Occupied Bandwidth Plots
Test Frequency: 79 GHz



3.3 Radiated E.I.R.P Power / E.I.R.P Power Density

3.3.1 Radiated E.I.R.P Power / E.I.R.P Power Density Limit

Radiated E.I.R.P Power / E.I.R.P Power Density	
☒	76-81 GHz Band:
	☒ Peak: EIRP 55 dBm [279uW/cm^2 at 3m] Average: EIRP 50 dBm [88uW/cm^2 at 3m]

3.3.2 Measuring Instruments

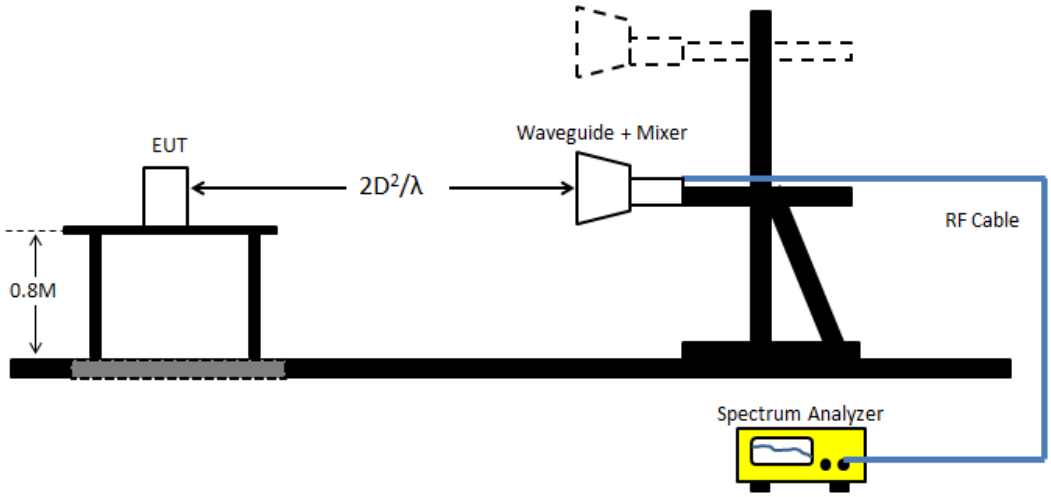
Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method	
☒	For the Occupied bandwidth shall be measured using one of the options below:
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
	☒ Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒ The measured power level is converted to EIRP using the Friis equation: E Meas = 126.8 - 20log(λ) + P – G where E is the field strength of the emission at the measurement distance, in dBμV/m P is the power measured at the output of the test antenna, in dBm λ is the wavelength of the emission under investigation [300/fMHz], in m G is the gain of the test antenna, in dBi EIRP = E Meas + 20 log(d Meas) – 104.7 where EIRP : is the equivalent isotropically radiated power, in dBm. E Meas : is the field strength of the emission at the measurement distance, in dBμV/m. d Meas : is the measurement distance, in m.

3.3.4 Test Setup

Radiated E.I.R.P Power / E.I.R.P Power Density



3.3.5 Measurement Results Calculation

The measured Level is calculated using:
EIRP = Read Level - Rx Gain +20*LOG(4*3.14159* Distance / (300/(Test Freq.*1000))).
Power Density = ((10^(EIRP/10)/1000)/(4*3.14159*(Specification Distance *100)^2))*1000000000000.

3.3.6 Test Result of Radiated E.I.R.P Power / E.I.R.P Power Density

Freq. (GHz)	Rx Gain (dBi)	P-Peak (dBm)	P-Average (dBm)	E-Meas-Peak (dBuV/m)	E-Meas-Average (dBuV/m)	Distance (m)	EIRP-Peak (dBm)	EIRP-Average (dBm)
79	23.0	-8.70	-26.64	143.51	125.57	0.50	32.69	25.15
EIRP Limit							**55**	**50**

3.4 Transmitter Radiated Unwanted Emissions

3.4.1 Transmitter Radiated Unwanted Emissions Limit

Transmitter Radiated Unwanted Emissions Limit (Below 40 GHz)			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960 - 40000	500	54	3

Frequency Range (GHz)	EIRP (dBm)	Power Density (pW/cm^2 @ 3m)
40 - 200	-1.7	600
200 - 231	0.5	1000

3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method – General Information			
☒	For the transmitter unwanted emissions shall be measured using following options below:		
	☒	Refer as ANSI C63.10, clause 6.3 for unwanted emissions into non-restricted bands.	
	☒	For unwanted emissions below 40GHz bands.	
		☒	Radiated emissions below 40 GHz shall not exceed the general limits in LP0002 Section 2.8
		☒	Refer as ANSI C63.10, clause 4.1.4.2.3 (Video Averaging) average measurements using spectrum reduced video bandwidth (VBW≥10Hz) - [duty cycle ≥ 98 or external power trigger].
		☐	Refer as ANSI C63.10, clause 4.1.4.2.4 average value of pulsed emissions.
		☐	Refer as ANSI C63.10, clause 4.1.4.2.2 measurement procedure peak limit.

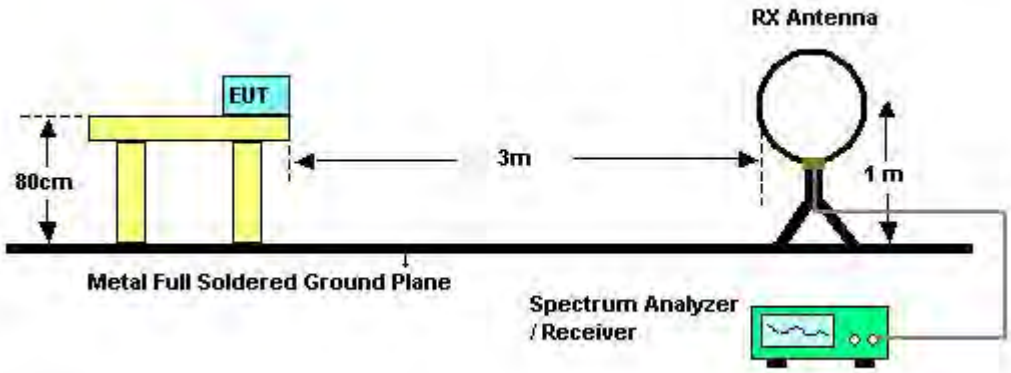
Test Method		
☒	For radiated measurement below 40GHz.	
	☒	Refer as ANSI C63.10, clause 6.3 through 6.6 for radiated emissions from below 40 GHz.
☒	For radiated measurement above 40GHz. Refer as ANSI C63.10, clause 9.12 for radiated measurement.	

Test Method		
	☒	Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒	The measured power level is converted to EIRP using the Friis equation: E Meas = 126.8 - 20log(λ) + P – G where E is the field strength of the emission at the measurement distance, in dBμV/m P is the power measured at the output of the test antenna, in dBm λ is the wavelength of the emission under investigation [300/fMHz], in m G is the gain of the test antenna, in dBi
		EIRP = E Meas + 20 log(d Meas) – 104.7 where EIRP : is the equivalent isotropically radiated power, in dBm. E Meas : is the field strength of the emission at the measurement distance, in dBμV/m. d Meas : is the measurement distance, in m.
		Equations to calculate power density Calculate the power density at the distance specified by the limit from the EIRP in watts using Equation: $PD = \frac{EIRP_{Linear}}{4\pi d^2}$ where PD is the power density at the distance specified by the limit, in W/m2 EIRPLinear is the equivalent isotropically radiated power, in watts d is the distance at which the power density limit is specified, in m.

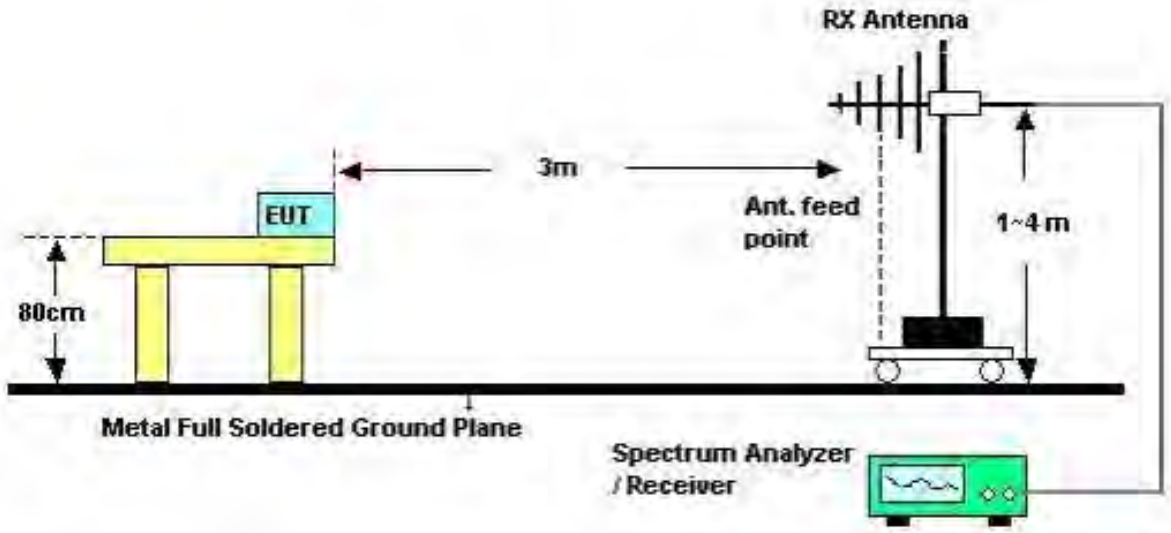
3.4.4 Test Setup

Transmitter Radiated Unwanted Emissions

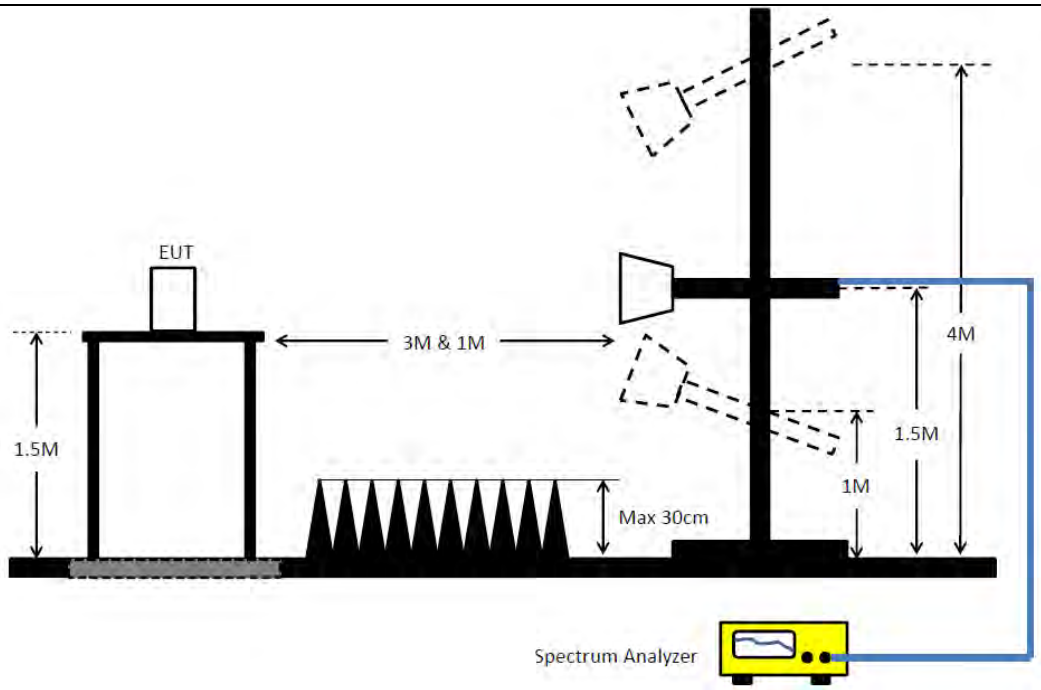
9kHz ~30MHz



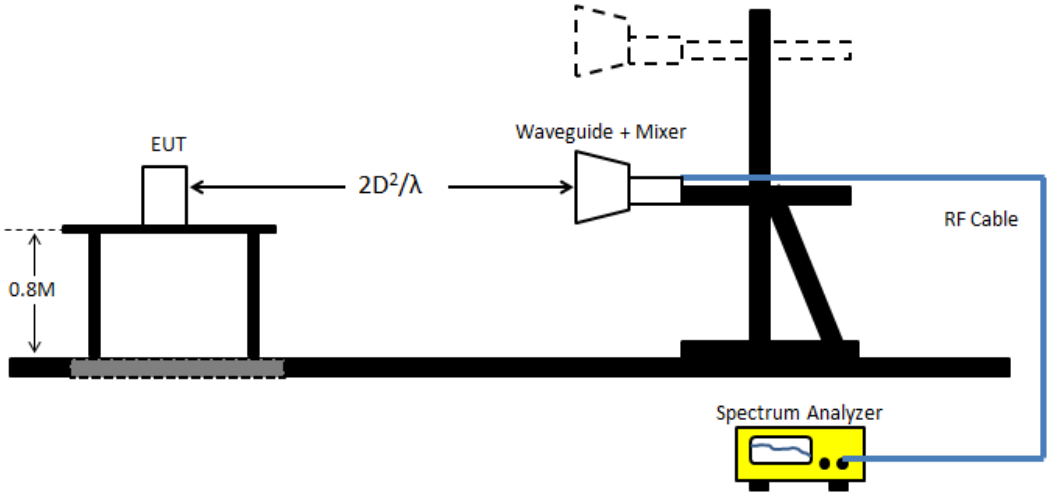
30MHz~1GHz



1GHz ~40GHz



Above 40GHz



3.4.5 Measurement Results Calculation

The measured Level is calculated using:
For below 40GHz
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor (if applicable) = Level.
For above 40GHz
EIRP = Read Level - Rx Gain +20*LOG(4*3.14159* Distance / (300/(Test Freq.*1000))).
Power Density = ((10^(EIRP/10)/1000)/(4*3.14159*(Specification Distance *100)^2))*1000000000000.

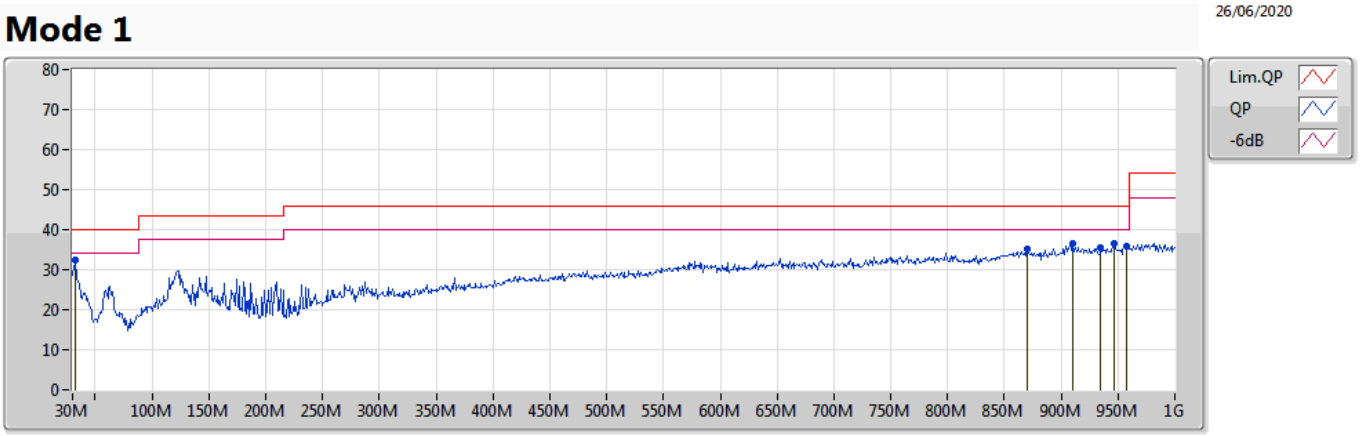
3.4.6 Test Result of Transmitter Radiated Unwanted Emissions (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.
All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.
The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10 harmonic or 40 GHz, whichever is appropriate.

3.4.7 Test Result of Transmitter Radiated Unwanted Emissions (30MHz ~ 1GHz)

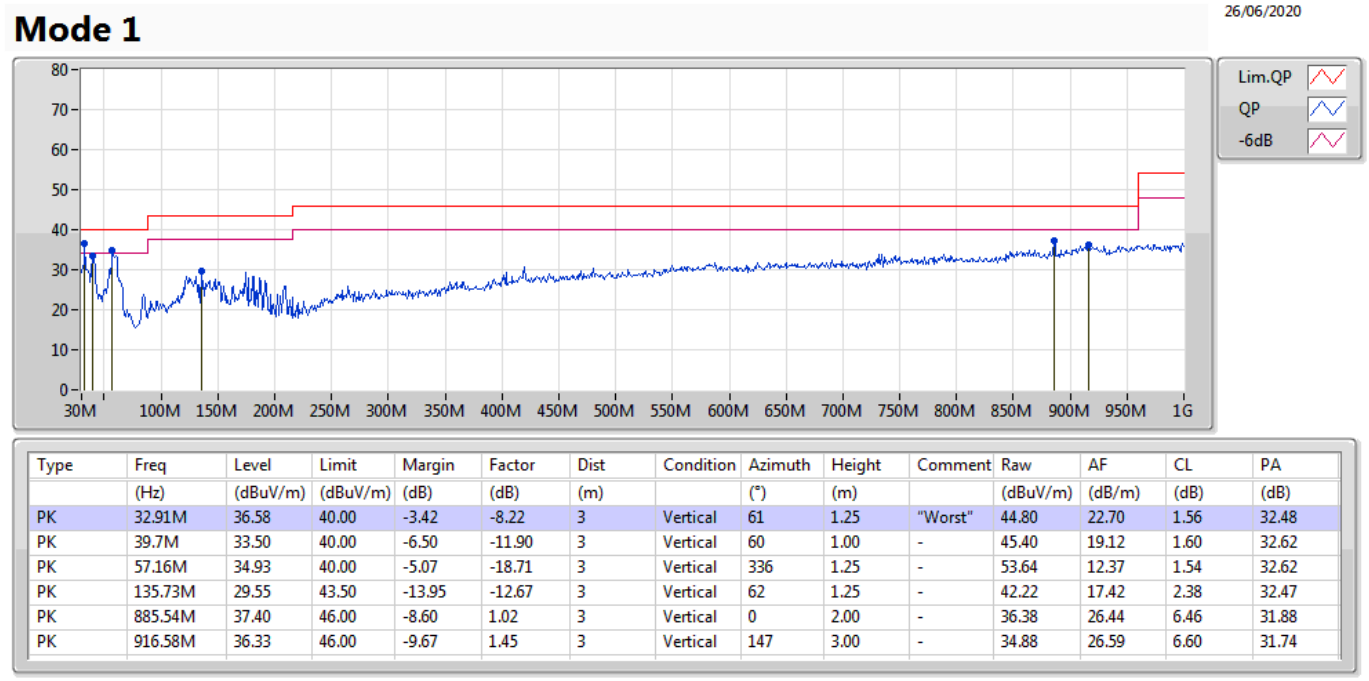
Test Range	30 MHz – 1000 MHz	Test Freq. (GHz)	79
Test Distance	3 m		

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV/m)	(dB/m)	(dB)	(dB)
PK	32.91M	32.33	40.00	-7.67	-8.22	3	Horizontal	5	1.25	"Worst"	40.55	22.70	1.56	32.48
PK	870.02M	35.33	46.00	-10.67	0.75	3	Horizontal	280	1.00	-	34.58	26.34	6.30	31.89
PK	910.76M	36.68	46.00	-9.32	1.51	3	Horizontal	343	1.25	-	35.17	26.69	6.60	31.78
PK	935.01M	35.57	46.00	-10.43	1.61	3	Horizontal	207	2.00	-	33.96	26.59	6.60	31.58
PK	946.65M	36.49	46.00	-9.51	1.85	3	Horizontal	207	1.00	-	34.64	26.73	6.60	31.48
PK	957.32M	35.83	46.00	-10.17	2.11	3	Horizontal	207	1.00	-	33.72	26.89	6.60	31.38

Vertical



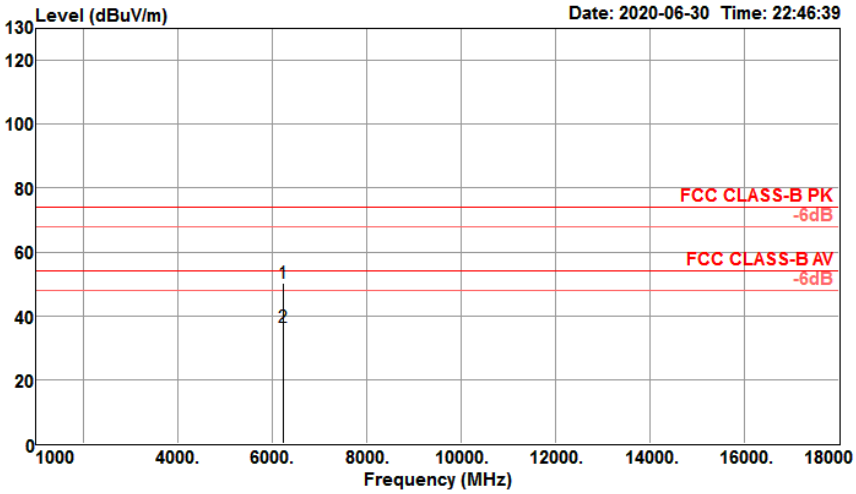
Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV/m)	(dB/m)	(dB)	(dB)
PK	32.91M	36.58	40.00	-3.42	-8.22	3	Vertical	61	1.25	"Worst"	44.80	22.70	1.56	32.48
PK	39.7M	33.50	40.00	-6.50	-11.90	3	Vertical	60	1.00	-	45.40	19.12	1.60	32.62
PK	57.16M	34.93	40.00	-5.07	-18.71	3	Vertical	336	1.25	-	53.64	12.37	1.54	32.62
PK	135.73M	29.55	43.50	-13.95	-12.67	3	Vertical	62	1.25	-	42.22	17.42	2.38	32.47
PK	885.54M	37.40	46.00	-8.60	1.02	3	Vertical	0	2.00	-	36.38	26.44	6.46	31.88
PK	916.58M	36.33	46.00	-9.67	1.45	3	Vertical	147	3.00	-	34.88	26.59	6.60	31.74

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)

3.4.8 Test Result of Transmitter Radiated Unwanted Emissions (1GHz – 40GHz)

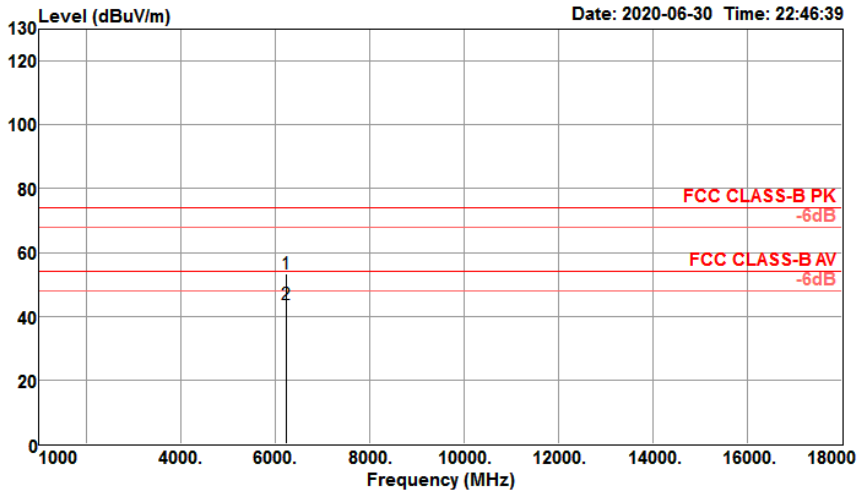
Test Range	1GHz – 18GHz	Test Freq. (GHz)	79
Test Distance	3 m		

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	6239.12	50.36	74.00	-23.64	43.15	6.54	35.27	34.60	220	15	Peak	HORIZONTAL
2	6241.82	36.27	54.00	-17.73	29.12	6.55	35.20	34.60	220	15	Average	HORIZONTAL

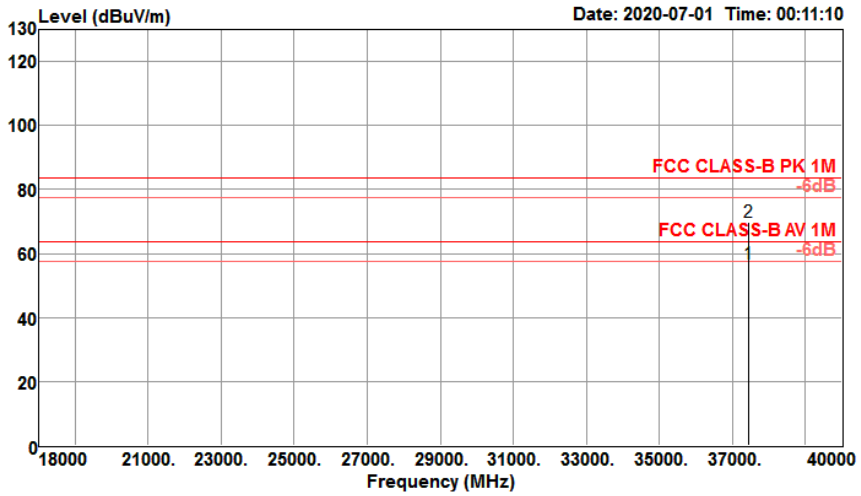
Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	6239.94	53.17	74.00	-20.83	45.96	6.54	35.27	34.60	227	4	Peak	VERTICAL
2	6240.03	43.57	54.00	-10.43	36.36	6.54	35.27	34.60	227	4	Average	VERTICAL

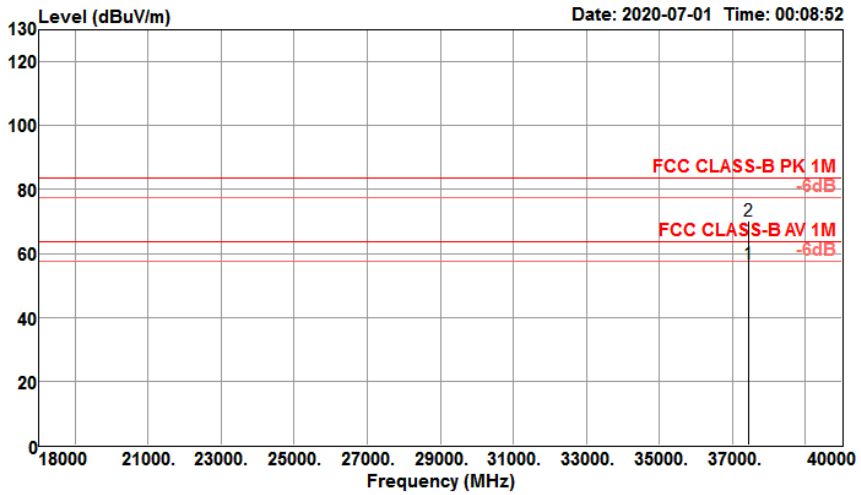
Test Range	18GHz – 40GHz	Test Freq. (GHz)	79
Test Distance	1 m		

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	37438.00	56.77	63.54	-6.77	44.27	20.00	42.76	50.26	150	360	Average	HORIZONTAL
2	37443.42	69.67	83.54	-13.87	57.17	20.00	42.76	50.26	150	360	Peak	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	37439.48	56.77	63.54	-6.77	44.27	20.00	42.76	50.26	150	0	Average	VERTICAL
2	37443.44	70.08	83.54	-13.46	57.58	20.00	42.76	50.26	150	0	Peak	VERTICAL

3.4.9 Test Result of Transmitter Radiated Unwanted Emissions (40GHz – 200GHz)

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79	23.0	0.50	59.41	-63.40	-24.50	3	3.1357	PASS
Limit							**600**	-

3.4.10 Test Result of Transmitter Radiated Unwanted Emissions (200GHz – 231GHz)

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79	23.0	0.50	219.48	-70.69	-20.44	3	7.9883	PASS
Limit							**1000**	-

3.5 Frequency Stability

3.5.1 Frequency Stability Limit

Frequency Stability Limit
Fundamental emissions must be contained within the frequency bands specified in this 76-81GHz band 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.

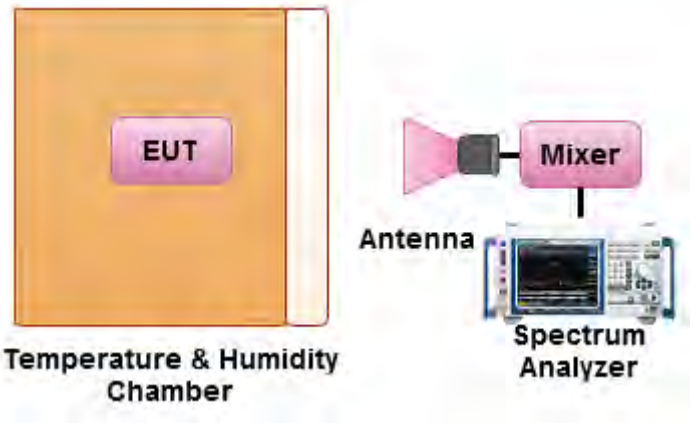
3.5.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method	
☒	For the frequency stability shall be measured using one of the options below:
	☒ Refer as ANSI C63.10, clause 9.14 for frequency stability measurement.
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
	☒ Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒ The mixer may be placed outside the chamber in front of the temperature chamber door, and the chamber door opened for each reading.

3.5.4 Test Setup

Frequency Stability


3.5.5 Test Result of Frequency Stability

Test Freq. (GHz): 79

Test Temperature: (°C)	Measured Frequency (GHz)	Delta Frequency (kHz)	Limit (±kHz)
-40	79.1013	104.92	within band
-30	79.0964	100.02	within band
-20	79.0825	86.12	within band
-10	79.0669	70.52	within band
0	79.0254	29.02	within band
10	79.0132	16.82	within band
20	78.9964	Reference	within band
30	78.9969	0.52	within band
40	78.9924	-3.98	within band
50	78.9964	0.02	within band
60	78.9954	-0.98	within band
70	78.9917	-4.68	within band
80	78.9902	-6.18	within band
85	78.9891	-7.24	within band
Test Voltage: (Vdc)	**Measured Frequency (GHz)**	**Delta Frequency (kHz)**	**Limit (±kHz)**
10.2	78.9964	0	within band
12	78.9964	Reference	within band
13.8	78.9928	-3.62	within band

4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Feb. 26, 2020	Feb. 25, 2021	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 25, 2019	Dec. 24, 2020	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Feb. 25, 2020	Feb. 24, 2021	Conduction (CO01-CB)
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	100430	9kHz ~ 30MHz	Jan. 31, 2020	Jan. 30, 2021	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	May 20, 2020	May 19, 2021	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Apr. 13, 2020	Apr. 12, 2021	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 27, 2020	Mar. 26, 2021	Radiation (03CH05-CB)
Pre-Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	Apr. 28, 2020	Apr. 27, 2021	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Aug. 15, 2019	Aug. 14, 2020	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 13, 2020	May 12, 2021	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	LOW Cable-04+23	30MHz~1GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH05-CB)
Horn Antenna	ETS-LINDGREN	3115	00075790	750MHz ~ 18GHz	Nov. 04, 2019	Nov. 03, 2020	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jun. 27, 2019	Jun. 26, 2020	Radiation (03CH01-CB)
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170507	15GHz ~ 40GHz	Jun. 11, 2020	Jun. 10, 2021	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 08, 2020	Jan. 07, 2021	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jul. 03, 2019	Jul. 02, 2020	Radiation (03CH01-CB)
Amplifier	-	-	TF-130N-R1	18GHz ~ 40GHz	Jun. 19, 2020	Jun. 18, 2021	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Apr. 16, 2020	Apr. 15, 2021	Radiation (03CH01-CB)
RF Cable-high	Woken	RG402	High Cable-16	1 GHz ~ 18 GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH01-CB)
RF Cable-high	Woken	RG402	High Cable-16+17	1 GHz ~ 18 GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH01-CB)
RF Cable-high	Woken	RG402	High Cable-40G#1	18GHz ~ 40 GHz	Jul. 24, 2019	Jul. 23, 2020	Radiation (03CH01-CB)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
RF Cable-high	Woken	RG402	High Cable-40G#2	18GHz ~ 40 GHz	Jul. 24, 2019	Jul. 23, 2020	Radiation (03CH01-CB)
Mixer	OML	M19HWA	U91113-1	40 ~ 60 GHz	Oct. 01 2019	Sep. 30, 2020	Radiation (03CH01-CB)
Mixer	OML	M15HWA	V91113-1	50 ~ 75 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH01-CB)
Mixer	OML	M12HWA	E91113-1	60 ~ 90 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH01-CB)
Mixer	OML	M08HWA	F91113-1	90 ~ 140 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH01-CB)
Mixer	OML	M05HW/A	G91113-1	140 ~ 220 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH01-CB)
Mixer	OML	M03HWD	120320-1	220 ~ 325 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M19RH	U91113-A	40 ~ 60 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M15RH	V91113-A	50 ~ 75 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M12RH	E91113-A	60 ~ 90 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M08RH	F91113-A	90 ~ 140 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M05RH	G91113-A	140 ~ 220 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M03RH	120320-A	220 ~ 325 GHz	N.C.R	N.C.R	Radiation (03CH01-CB)
Temp. and Humidity Chamber	Gaint Force	GTH-408-40-C P-AR	MAA1410-011	-40~100 degree	Sep. 12, 2019	Sep. 11, 2020	Conducted (TH03-CB)

Note: Calibration Interval of instruments listed above is one year.

N.C.R. means Non-Calibration required.