FCC Test Report

Report No.:	RF171129E01
FCC ID:	2AN3BVS93G001
Test Model:	VS-93G001
Received Date:	Nov. 29, 2017
Test Date:	Dec. 04 to 07, 2017
Issued Date:	Dec. 13, 2017
Applicant:	CUBTEK INC.
Address:	Rm. 7, 6F., No.38, Taiyuan St., Zhubei City, Hsinchu County 30265, Taiwan (R.O.C.)
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
FCC Registration / Designation Number:	723255 / TW2022

Testing Laboratory
2022

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Release Control Record

Issue No.	Description	Date Issued
RF171129E01	Original release.	Dec. 13, 2017

1 Certificate of Conformity

Product:	77GHz Radar
Brand:	CUBTEK
Test Model:	VS-93G001
Sample Status:	ENGINEERING SAMPLE
Applicant:	CUBTEK INC.
Test Date:	Dec. 04 to 07, 2017
Standards:	47 CFR FCC Part 95, Subpart M

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Mary Ko , **Date:** Dec. 13, 2017

Mary Ko / Specialist

Approved by : , **Date:** Dec. 13, 2017

May Chen / Manager

2 Summary of Test Results

47 CFR FCC Part 95, Subpart M			
FCC Clause	Test Item	Result	Remarks
95.3367 95.3379(a)	Radiated Power Test Unwanted Emission Test	PASS	Meet the requirement of limit.
95.3379(b)	Frequency Stability Test	PASS	Meet the requirement of limit.
-	Occupied Bandwidth Measurement	PASS	Meet the requirement of limit.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.32 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.14 dB
	6GHz ~ 18GHz	5.04 dB
	18GHz ~ 40GHz	5.25 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	77GHz Radar
Brand	CUBTEK
Test Model	VS-93G001
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	12Vdc
Modulation Type	FMCW
Operating Frequency	76 ~ 77GHz
Emission designator	F1N
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The antenna provided to the EUT, please refer to the following table:

Antenna Net Gain (dBi)	Antenna Type	Connector Type	Frequency range (GHz)
13.6	Printed Antenna	none	76 ~ 77

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

1 channel is provided for test:

Channel	Frequency
1	76.47 GHz

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	FS	OB	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz & Bandedge Measurement **RE<1G:** Radiated Emission below 1GHz

FS: Frequency Stability **OB:** Occupied Bandwidth measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.

Radiated Emission Test (Above 1GHz):

☒ Following channel(s) was (were) selected for the final test as listed below.

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Radiated Emission Test (Below 1GHz):

☒ Following channel(s) was (were) selected for the final test as listed below.

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Frequency Stability Test:

☒ Following channel(s) was (were) selected for the final test as listed below.

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Occupied Bandwidth:

☒ Following channel(s) was (were) selected for the final test as listed below.

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (sysem)	TESTED BY
RE≥1G	23deg. C, 67%RH 24deg. C, 69%RH	120Vac, 60Hz	Frank Chuang
RE<1G	24deg. C, 69%RH	120Vac, 60Hz	Frank Chuang
FS	25deg. C, 68%RH	120Vac, 60Hz	Weiwei Lo
OB	25deg. C, 68%RH	120Vac, 60Hz	Weiwei Lo

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

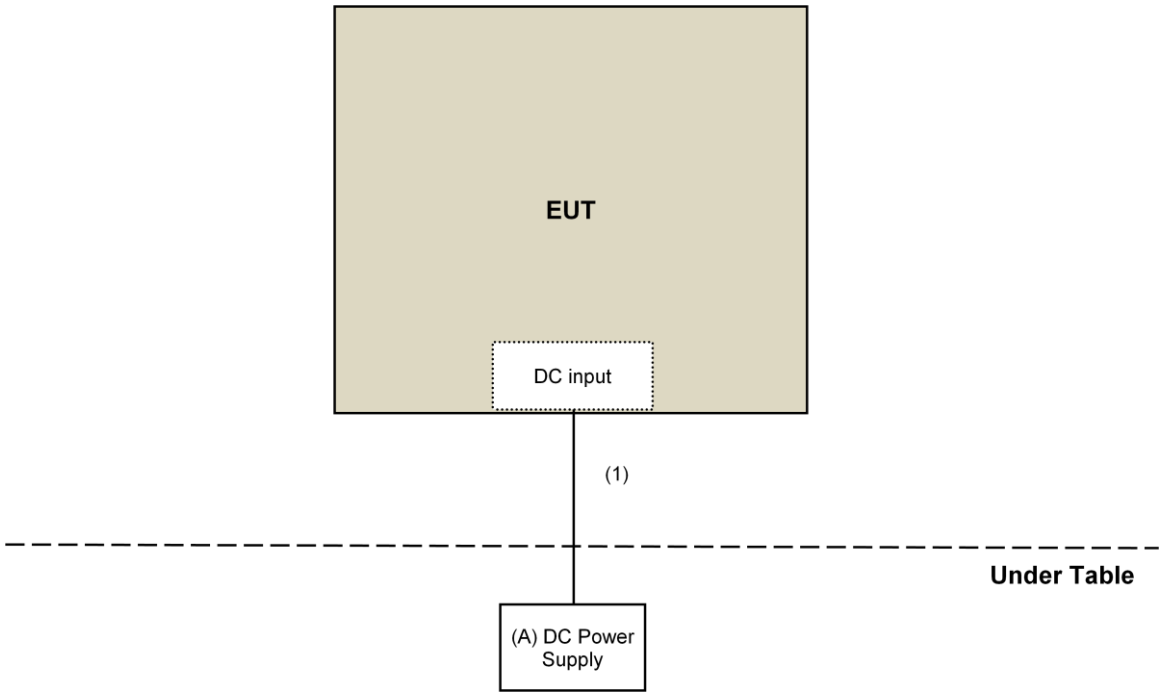
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	DC Power Supply	Topward	6603D	795558	NA	Proivded by Lab

Note:

1. All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC Cable	1	3.6	No	0	Supplied by client

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 95, Subpart M

ANSI 63.26-2015

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Power and Unwanted Emission Measurement

4.1.1 Limits of Radiated Power and Unwanted Emission Measurement

According to 95.3367 the field strength of emissions from intentional radiators operated under these frequencies bands shall not exceed the following:

Fundamental Frequency (GHz)	Equivalent Isotropically Radiated Power (EIRP)	
	Peak	Average
76 ~ 81	55 dBm/MHz	50 dBm/MHz

According to 95.3379 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.

Frequencies (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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

NOTE:

1. The tighter limit applies at the band edges.
2. The limits 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.
3. The emissions limits 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 outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 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 from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 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.

4.1.2 Test Instruments

Below 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	July 12, 2017	July 11, 2018
Pre-Amplifier(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna(*) Electro-Metrics	EM-6879	264	Dec. 16, 2016	Dec. 15, 2018
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 17, 2017	Jan. 16, 2018
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-05	May 06, 2017	May 05, 2018
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Dec. 29, 2016	Dec. 28, 2017
RF Cable	8D	966-3-1 966-3-2 966-3-3	Apr. 01, 2017	Mar. 31, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	Oct. 03, 2017	Oct. 02, 2018
Horn_Antenna SCHWARZBECK	BBHA9120-D	9120D-406	Dec. 28, 2016	Dec. 27, 2017
Pre-Amplifier EMCI	EMC12630SE	980384	Feb. 02, 2017	Feb. 01, 2018
RF Cable	EMC104-SM-SM-1200 EMC104-SM-SM-2000 EMC104-SM-SM-5000	160922 150317 150322	Feb. 02, 2017 Mar. 29, 2017 Mar. 29, 2017	Feb. 01, 2018 Mar. 28, 2018 Mar. 28, 2018
Spectrum Analyzer Keysight	N9030A	MY54490679	July 25, 2017	July 24, 2018
Pre-Amplifier EMCI	EMC184045SE	980386	Feb. 02, 2017	Feb. 01, 2018
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Dec. 15, 2016	Dec. 14, 2017
RF Cable	SUCOFLEX 102	36432/2 36433/2	Jan. 15, 2017	Jan. 14, 2018
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. *The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 3.
4. The CANADA Site Registration No. is 20331-1
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Dec. 04 to 05, 2017

Above 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer Agilent	E4446A	MY48250253	Dec. 21, 2016	Dec. 20, 2017
*Harmonic Mixer (33~55GHz) OML	M22HWD	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna (33~55GHz) OML	M22RH	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Harmonic Mixer (50~75GHz) OML	M15RH	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna (50~75GHz) OML	M15HWD	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Harmonic Mixer (75~110GHz) OML	M10HWD	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna (75~110GHz) OML	M10RH	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Harmonic Mixer (110~170GHz) OML	M06RH	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna(110~170GHz) OML	M06HWD	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Harmonic Mixer (140~220GHz) OML	M05HWD	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna (140~220GHz) OML	M05RH	110215-1	Oct. 17, 2017	Oct. 16, 2019
*Harmonic Mixer (220~325GHz) OML	M03HWA	M03HWA_140505-1	Oct. 17, 2017	Oct. 16, 2019
*Horn Antenna (220~325GHz) OML	M03RH	M03RH_140508-1	Oct. 17, 2017	Oct. 16, 2019
*Diplexer EMCI	DPL26	DPL26_01	Oct. 17, 2017	Oct. 16, 2019
*Diplexer EMCI	DPL26	DPL26_02	Oct. 17, 2017	Oct. 16, 2019
*Precision 30dB Attenuator Keysight	11708A	MY55260015	Oct. 17, 2017	Oct. 16, 2019
*Zero-Bias Detector (50~75GHz) Vdi	WR15ZBD	WR15R5 1-30	Oct. 17, 2017	Oct. 16, 2019
4CH Infiniivision Oscilloscope Keysight	DSOX6004A	MY55190202	Dec. 09, 2016	Dec. 08, 2017
*WR15CH Conical Horn Keysight	WR15CH	WR15CH-01	Oct. 17, 2017	Oct. 16, 2019
*WR10CH Conical Horn Keysight	WR10CH	WR10CH-01	Oct. 17, 2017	Oct. 16, 2019
*Millimeter-Wave Signal Generator Frequency Extension Module (50~75 GHz) Keysight	E8257DV15	US54250106	Oct. 17, 2017	Oct. 16, 2019
*Millimeter-Wave Signal Generator Frequency Extension Module (75~110 GHz) Keysight	E8257DV10	US53250009	Oct. 17, 2017	Oct. 16, 2019
Antenna Tower & Turn Table CT	NA	NA	NA	NA

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. *The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 3
4. The CANADA Site Registration No. is IC 7450H-2.
5. Test Date: Dec. 06 , 2017

4.1.3 Test Procedures

For Radiated emission: Below 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Both X and Y axes of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission: 30 MHz ~ 18 GHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection (PK) at frequency from 1GHz to 40GHz.
3. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Average detection (AV) at frequency from 1GHz to 40GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission: Above 18GHz

External harmonic mixers are utilized.

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The distance at which limits are typically specified is 3 meter; however, closer measurement distances may be utilized.

c. Begin handheld measurements with the test antenna (horn) at a distance of 1 meter from the EUT, in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 meter from the EUT.

d. Repeat (b) with the horn in a vertically polarized position.

e. If the emission cannot be detected at 1 meter, reduce the RBW in order to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

f. Note the maximum level indicated on the Spectrum Analyzer.

g. Based on the distance at which the measurement was made and the calculated distance to the edge of the far field, determine the appropriate distance attenuation factor. Apply this factor to the calculated field strength in order to determine the equivalent field strength at the distance at which the regulatory limit is specified. Compare to the appropriate limits

h. Repeat (a) - (f) for every emission that must be measured, up through the required frequency range of investigation

NOTE:

1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 50MHz for Peak and Average detection at frequency above 40GHz.
2. Shorter measurement distances may be used to improve the measurement system's noise floor. As ANSI C63.26 description is based on the measurement in distance of 3 meters, the data obtained at 1-meter distance was extrapolate results to the 3-m distance:

   Test value at 3-meter distance (dBuV)

   = Test value at 1 meter distance (dBuV) - 20log(3/1)(dB)

   = Test value at 1 meter distance (dBuV) - 9.5(dB).

* Measurements made at 1 meter distance. Test value converted to account for 3-meter measurement distance.

Far Field Boundary Calculations

The far-field boundary is given as:
R far field = (2 * L^2) /λ
where: L = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

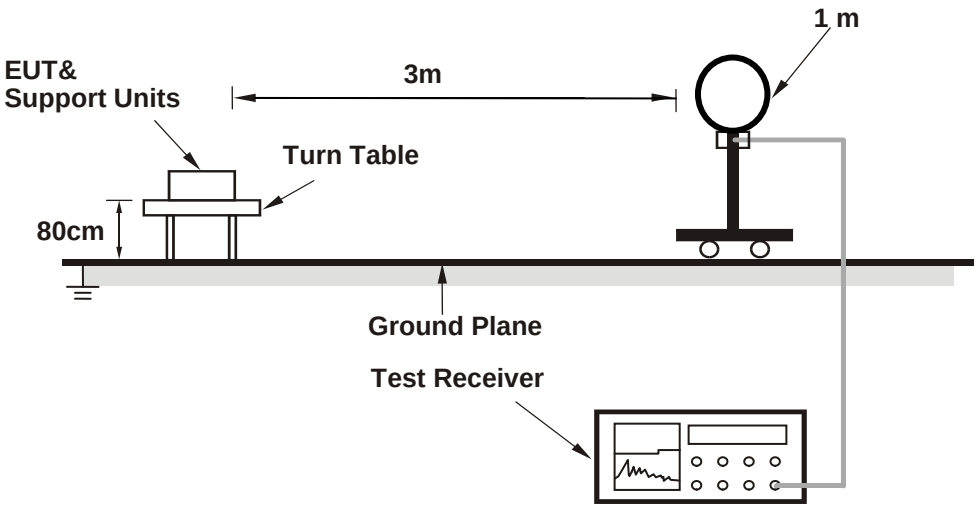
FREQUENCY (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
76.47	0.042	0.00392	0.9

4.1.4 Deviation from Test Standard

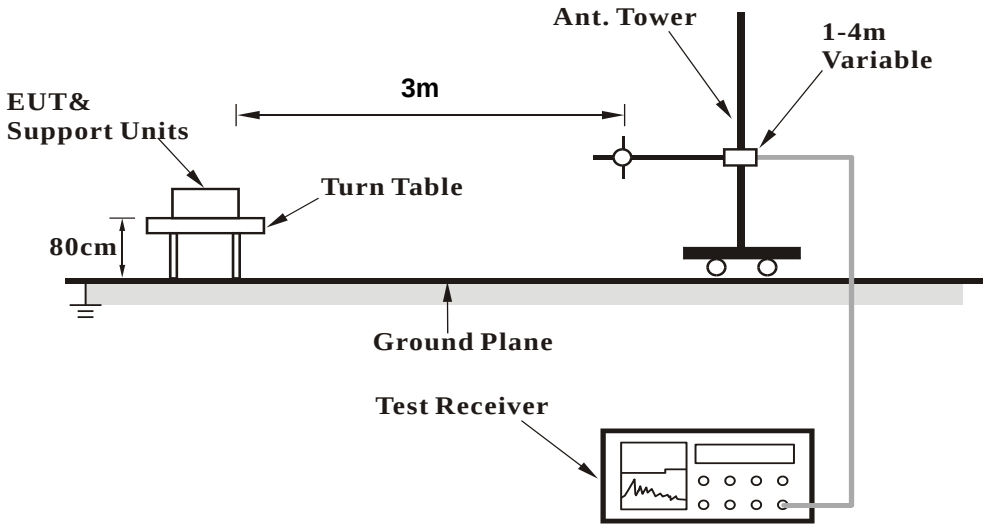
No deviation.

4.1.5 Test Setup

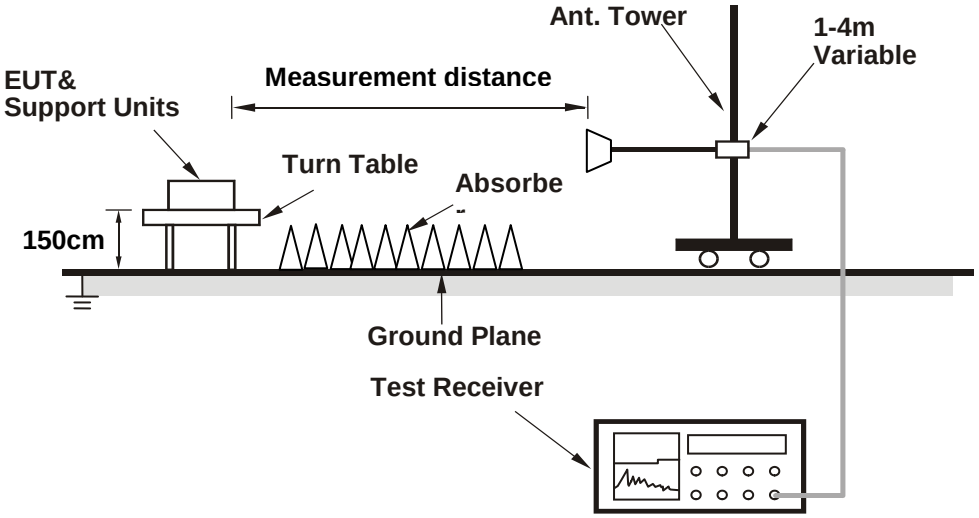
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 18GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1240.00	50.3 PK	74.0	-23.7	1.47 H	328	55.7	-5.4
2	1240.00	48.1 AV	54.0	-5.9	1.47 H	328	53.5	-5.4
3	2159.00	38.7 PK	74.0	-35.3	1.00 H	0	41.1	-2.4
4	2159.00	34.1 AV	54.0	-19.9	1.00 H	0	36.5	-2.4
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	1240.00	53.1 PK	74.0	-20.9	3.07 V	350	58.5	-5.4
2	1240.00	51.3 AV	54.0	-2.7	3.07 V	350	56.7	-5.4
3	3599.00	37.5 PK	74.0	-36.5	1.05 V	12	36.7	0.8
4	3599.00	33.4 AV	54.0	-20.6	1.05 V	12	32.6	0.8

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	18GHz ~ 40GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	25461.36	61.3 PK	74.0	-12.7	1.78 H	360	76.1	-14.8
2	25461.36	48.6 AV	54.0	-5.4	1.78 H	360	63.4	-14.8
3	34528.87	44.6 PK	74.0	-29.4	1.50 H	131	54.7	-10.1
4	34528.87	40.9 AV	54.0	-13.1	1.50 H	131	51.0	-10.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	25461.36	62.0 PK	74.0	-12.0	1.66 V	22	76.8	-14.8
2	25461.36	46.5 AV	54.0	-7.5	1.66 V	22	61.3	-14.8
3	34619.70	40.0 PK	74.0	-34.0	1.50 V	58	50.2	-10.2
4	34619.70	39.8 AV	54.0	-14.2	1.50 V	58	50.0	-10.2

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

CHANNEL	TX Channel 1	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
FREQUENCY RANGE	40GHz ~ 100GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL						
NO.	**FREQ. (GHz)**	**Raw Value (dBm)**	**Receiver Antenna Gain (dBi)**	**EIRP Level (dBm)**	**EIRP Limit (dBm)**	**PASS/FAIL**
1	76.47	-7.6	23.6	38.9 PK	55	PASS
2	76.47	-14.6	23.6	31.9 AV	50	PASS
ANTENNA POLARITY & TEST DISTANCE: VERTICAL						
NO.	**FREQ. (GHz)**	**Raw Value (dBm)**	**Receiver Antenna Gain (dBi)**	**EIRP Level (dBm)**	**EIRP Limit (dBm)**	**PASS/FAIL**
1	76.47	-9.8	23.6	36.7 PK	55	PASS
2	76.47	-16.2	23.6	30.3 AV	50	PASS

REMARKS:

1.The measured power level is converted to EIRP using the Friis equation:

EIRP = PT * GT = (PR / GR) * (4 * Pi * D/ λ)^ 2

where:

PR is the power of the receive measurement

GR is the gain of the receive measurement antenna

D is the measurement distance

λ is the wavelength

*Measurements made at 1 meter distance.

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	100GHz ~ 231GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL							
NO.	FREQ. (GHz)	Raw Value (dBm)	Receiver Antenna Gain (dBi)	EIRP Level (dBm)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	PASS/FAIL
1	152.94	-60.9	23.6	-8.4	127.809 PK	600	PASS
2	229.41	-56.0	23.6	0.1	904.816 PK	1000	PASS
ANTENNA POLARITY & TEST DISTANCE: VERTICAL							
NO.	FREQ. (GHz)	Raw Value (dBm)	Receiver Antenna Gain (dBi)	EIRP Level (dBm)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	PASS/FAIL
1	152.94	-61.3	23.6	-8.8	116.563 PK	600	PASS
2	229.41	-57.8	23.6	-1.7	597.806 PK	1000	PASS

REMARKS:

1.The measured power level is converted to EIRP using the Friis equation:

EIRP = PT * GT = (PR / GR) * (4 * Pi * D/ λ)^ 2

where:

PR is the power of the receive measurement

GR is the gain of the receive measurement antenna

D is the measurement distance

λ is the wavelength

*Measurements made at 1 meter distance.

Below 1GHz Data

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

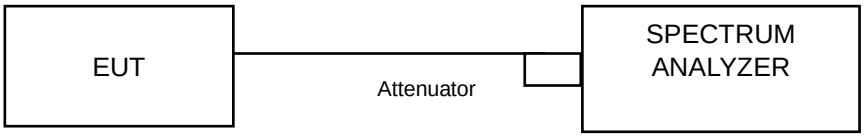
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	440.02	41.5 QP	46.0	-4.5	1.00 H	305	45.3	-3.8
2	592.50	40.4 QP	46.0	-5.6	1.50 H	316	41.4	-1.0
3	680.00	43.6 QP	46.0	-2.4	1.50 H	26	43.4	0.2
4	719.98	45.8 QP	46.0	-0.2	1.00 H	326	45.4	0.4
5	760.00	43.6 QP	46.0	-2.4	1.00 H	28	41.9	1.7
6	840.00	43.6 QP	46.0	-2.4	1.00 H	360	41.3	2.3
7	919.97	45.7 QP	46.0	-0.3	1.66 H	360	42.3	3.4
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	439.99	44.8 QP	46.0	-1.2	1.00 V	329	48.6	-3.8
2	480.01	41.0 QP	46.0	-5.0	1.00 V	328	44.4	-3.4
3	637.49	42.1 QP	46.0	-3.9	1.50 V	2	42.3	-0.2
4	719.99	44.6 QP	46.0	-1.4	1.00 V	4	44.2	0.4
5	840.00	43.3 QP	46.0	-2.7	1.50 V	0	41.0	2.3
6	919.98	45.9 QP	46.0	-0.1	1.50 V	335	42.5	3.4

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

4.2 Occupied Bandwidth Measurement

4.2.1 Test Setup



4.2.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

4.2.4 Deviation from Test Standard

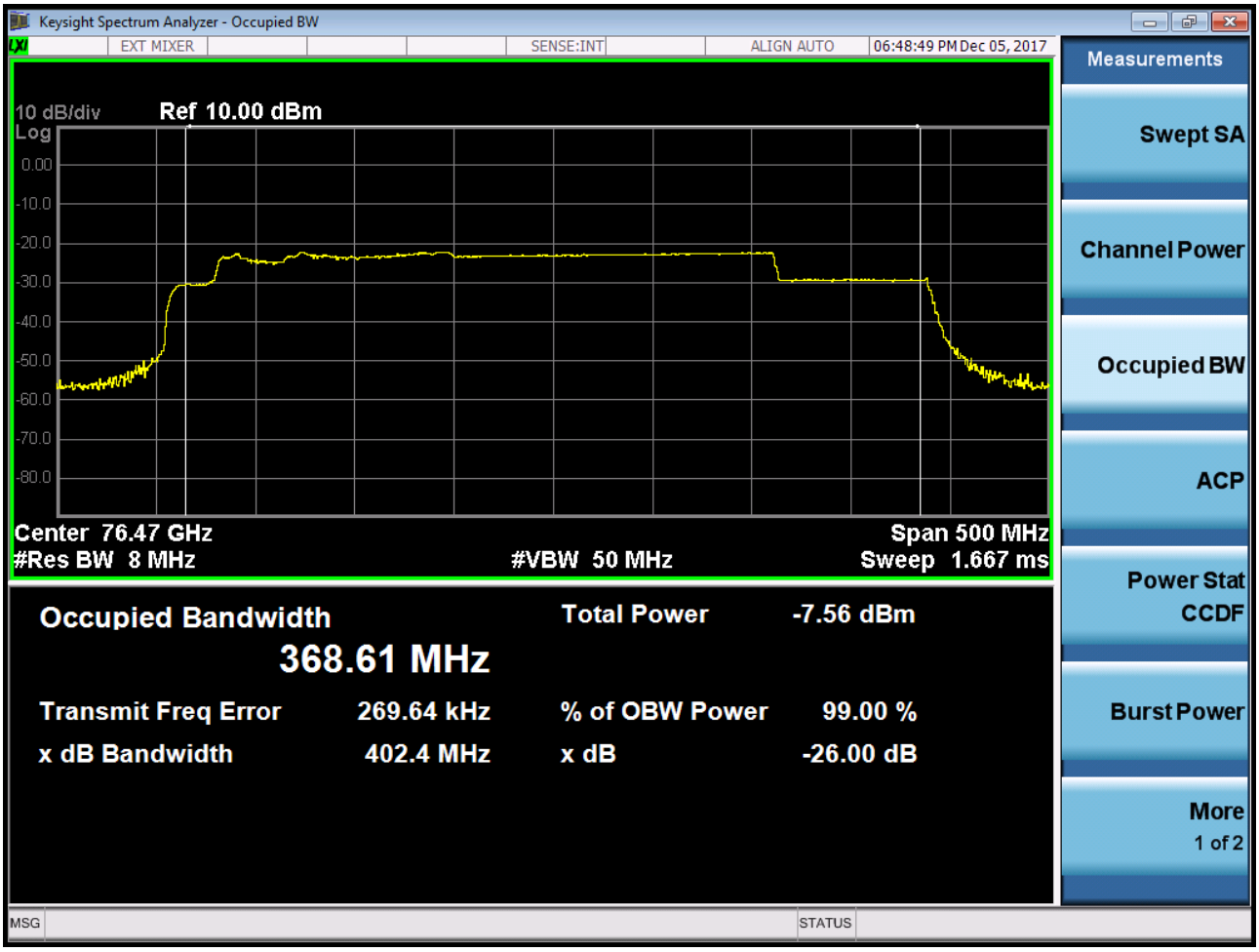
No deviation.

4.2.5 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.2.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
1	76.47	368.61



4.3 Frequency Stability Measurement

4.3.1 Limits of Conducted Emission Measurement

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation.

4.3.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Digital Multimeter FLUKE	325	31130711WS	May 29, 2017	May 28, 2018
Temperature & Humidity Chamber TERCHY	MHU-225AU	911033	Dec. 01, 2017	Nov. 30, 2018
DC Power Supply GOOD WILL INSTRUMENT CO., LTD.	GPC - 3030D	7700087	NA	NA
Spectrum Analyzer Agilent	E4446A	MY48250253	Dec. 21, 2016	Dec. 20, 2017

NOTE: 1. The test was performed in Oven room 1.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: Dec. 07, 2017

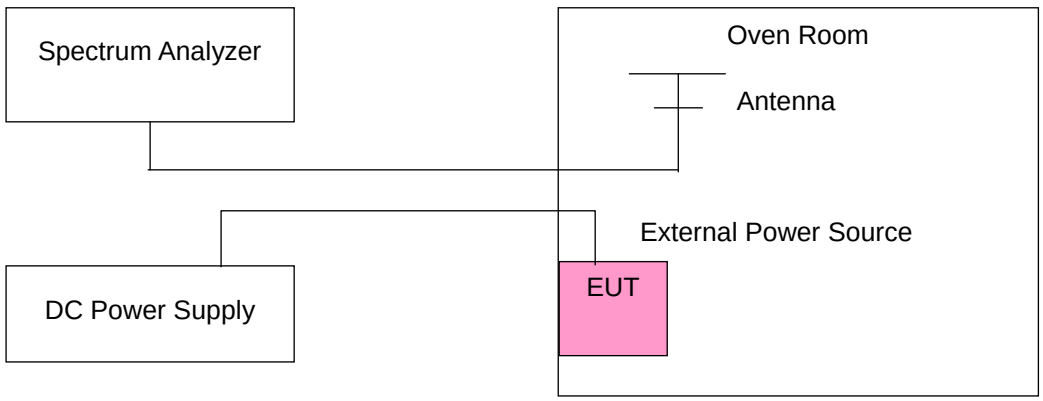
4.3.3 Test Procedure

a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5 ℃ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

4.3.4 Test Setup



4.3.5 Test Results

Frequency Stability Versus Temp.									
Operating Frequency: 76470 MHz									
TEMP. (℃)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail
50	12	76470.0906	PASS	76470.038	PASS	76470.0981	PASS	76470.0339	PASS
40	12	76470.3258	PASS	76470.3539	PASS	76470.3208	PASS	76470.3383	PASS
30	12	76469.7108	PASS	76469.7526	PASS	76469.7151	PASS	76469.7312	PASS
20	12	76469.7038	PASS	76469.693	PASS	76469.7118	PASS	76469.7296	PASS
10	12	76470.244	PASS	76470.2694	PASS	76470.2906	PASS	76470.2935	PASS
0	12	76469.6761	PASS	76469.6972	PASS	76469.6389	PASS	76469.641	PASS
-10	12	76469.6693	PASS	76469.6359	PASS	76469.6264	PASS	76469.6159	PASS
-20	12	76470.0255	PASS	76470.0694	PASS	76470.0519	PASS	76470.0247	PASS

Frequency Stability Versus Voltage									
Operating Frequency: 76470 MHz									
TEMP. (℃)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail	Measured Frequency (MHz)	Pass/Fail
20	13.8	76469.6915	PASS	76469.6824	PASS	76469.7253	PASS	76469.7437	PASS
	12	76469.7038	PASS	76469.693	PASS	76469.7118	PASS	76469.7296	PASS
	10.2	76469.7171	PASS	76469.7003	PASS	76469.709	PASS	76469.7413	PASS

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linkou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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