FCC Test Report

Report No.:	RFBEIH-WTW-P23060732
FCC ID:	2BBDG-CPSU-TS-A01
Test Model:	CPSU-TS-A01
Received Date:	2023/6/30
Test Date:	2023/7/25 ~ 2023/8/7
Issued Date:	2023/8/11
Applicant:	SNTNL LLC
Address:	1 American Road, Detroit, Michigan, United States
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location (1):	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number (1):	788550 / TW0003
Test Location (2):	No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
FCC Registration / Designation Number (2):	281270 / TW0032

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Release Control Record

Issue No.	Description	Date Issued
RFBEIH-WTW-P23060732	Original release.	2023/8/11

1 Certificate of Conformity

Product:	Pickup Cam
Brand:	CANOPY
Test Model:	CPSU-TS-A01
Sample Status:	Engineering sample
Applicant:	SNTNL LLC
Test Date:	2023/7/25 ~ 2023/8/7
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.255) ANSI C63.10-2013

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 RF characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** 2023/8/11

Polly Chien / Specialist

Approved by : _____ , **Date:** 2023/8/11

Jeremy Lin / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.255)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	N/A	Without AC power port of the EUT
15.255(e)	6dB Bandwidth	-	Reference only.
-	Occupied Bandwidth	-	Reference only.
15.255 (c) (2)(v)	Output Power	Pass	Meet the requirement of limit.
15.255(d) 15.205 15.209	Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -0.1 dB at 54.25 MHz.
15.255(f)	Frequency Stability	Pass	Meet the requirement of limit.

N/A: Not Applicable

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.59 dB
	200MHz ~1000MHz	3.60 dB
	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB
	40GHz ~ 66GHz	4.59 dB
	66GHz ~ 100GHz	5.37 dB
	Above 100GHz	5.40 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Pickup Cam
Brand	CANOPY
Test Model	CPSU-TS-A01
Status of EUT	Engineering sample
Power Supply Method	12/24 Vdc
Modulation Type	BPSK
Modulation Technology	FMCW
Operating Frequency	61 ~ 61.5 GHz
Output Power (EIRP)	61.25 GHz: 9.69dBm (PK)
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	3m shielded USB cable without core

Note:

1. The mode tested is sweep activated and two radars are working via TDD implementation.
2. The antennas type and connector type, please refer to the following table:

Antenna Type	Frequency Range	Antenna Net Gain (dBi)	Connector Type
Chip	60GHz	5	NA

*Only radiated measurements are used to show compliance with FCC limits for fundamental and spurious emissions.

3. 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 EUT.

Channel's Number	1
Frequency (MHz)	61250

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO							DESCRIPTION
	PLC	BW	OBW	OP	FS	RE < 1G	RE ≥ 1G	
-	Note 1	√	√	√	√	√	√	-

Where **PLC:** Power Line Conducted Emission **BW:** 6dB Bandwidth
OBW: Occupied bandwidth **OP:** Output Power
FS: Frequency Stability **RE < 1G:** Radiated Emission below 1GHz
RE ≥ 1G: Radiated Emission above 1GHz

Note:
1. Without AC power port of the EUT.
2. The EUT was positioned on the X-plane during testing.
3. The EUT support low power and active mode. After pretesting, active mode was chosen for final test and presented in the test report.

6dB Bandwidth Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Occupied Bandwidth Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Output Power Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Frequency Stability Test:

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

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

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

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1	1	FMCW	BPSK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
PLC	25 deg. C, 60 %RH	12Vdc	Wade Huang
BW	25 deg. C, 60 %RH	12Vdc	Wade Huang
OBW	25 deg. C, 60 %RH	12Vdc	Wade Huang
OP	25 deg. C, 60 %RH	12Vdc	Wade Huang
FS	25 deg. C, 60 %RH	12Vdc	Wade Huang
RE<1G	18.1 deg. C, 64.7 %RH	120Vac, 60Hz	Edison Lee
RE≥1G	18.1 deg. C, 64.7 %RH	120Vac, 60Hz	Edison Lee

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.

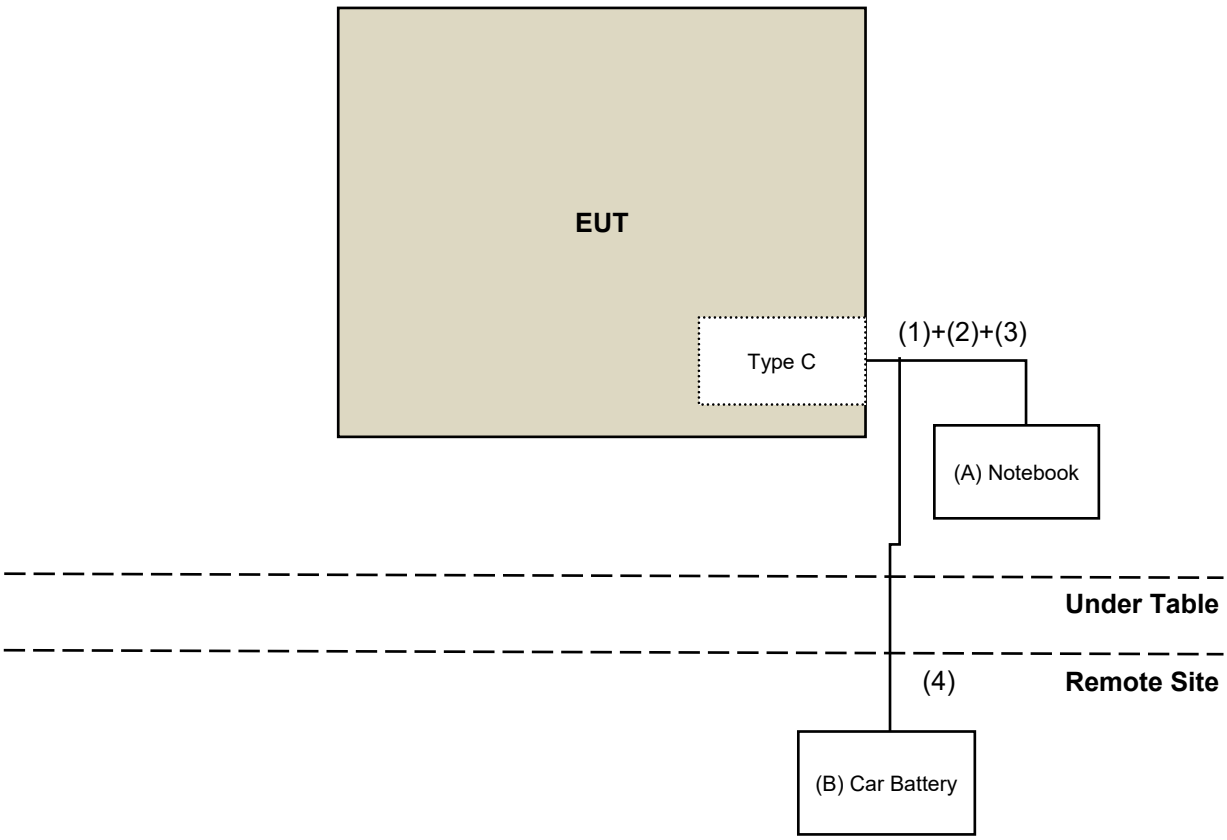
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	HP	15s-du0xxx	NA	NA	Provided by Lab
B.	Car Battery	Global	NX120-7L	NA	NA	Provided by Lab

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.	USB type C Cable	1	0.5	No	0	Supplied by applicant
2.	USB Cable	1	3	Yes	0	Accessory of EUT
3.	USB type C Cable	1	1	No	0	Provided by Lab
4.	DC Cable	1	2	No	0	Provided by Lab

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 15, Subpart C (15.255)
ANSI C63.10-2013

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

4 Test Types and Results

4.1 Radiated Emission Measurement

4.1.1 Limits of Radiated Emission Measurement

Spurious Emission	
Frequency Range	Limitation
Radiated emissions below 40GHz	Part 15.209
Between 40GHz and 200GHz	90pW/cm^2 (at 3 meter)
Note: The levels of the spurious emissions shall not exceed the level of the fundamental emission.	

Emissions radiated outside of the specified bands, shall be according to the general radiated limits in 15.209 as following:

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 lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
4. Section 15.205 restricted bands of operation shall compliance with the limits in Section 15.209.

4.1.2 Test Instruments

For Below 40GHz and Frequency Stability

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	ESR3	102579	Jul. 04, 2023	Jul. 03, 2024
Spectrum Analyzer KEYSIGHT	N9020B	MY60110462	Mar. 07, 2023	Mar. 06, 2024
BILOG Antenna SCHWARZBECK	VULB9168	995	Oct. 20, 2022	Oct. 19, 2023
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-404	Nov. 13, 2022	Nov. 12, 2023
HORN Antenna SCHWARZBECK	BBHA 9170	995	Nov. 13, 2022	Nov. 12, 2023
Loop Antenna EMCI	EM-6879	269	Sep. 19, 2022	Sep. 18, 2023
Preamplifier EMCI	EMC330N	980783	Jan. 16, 2023	Jan. 15, 2024
Preamplifier EMCI	EMC118A45SE	980810	Dec. 29, 2022	Dec. 28, 2023
Preamplifier EMCI	EMC184045SE	980787	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMC104-SM-SM-(9000+2000+1000)	201230+ 201242+ 210101	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMCCFD400-NM-NM-(9000+300+500)	201252+ 201250+ 201245	Jan. 16, 2023	Jan. 15, 2024
RF signal cable EMCI	EMC101G-KM-KM-(5000+3000+2000)	201261+201258+ 201249	Jan. 16, 2023	Jan. 15, 2024
Software BV CPS	ADT_Radiated_V7.6.15.9.5	NA	NA	NA
Turn Table Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208675	NA	NA
Antenna Tower KaiTuo	NA	NA	NA	NA
Antenna Tower Controller KaiTuo	KT-2000	NA	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Temperature & Humidity Chamber Terchy	MHU-225AU	920842	Jun. 17, 2023	Jun. 16, 2024
Digital Storage Oscilloscope Keysight	DSO-X 6004A	MY55190202	Jun. 20, 2023	Jun. 19, 2024

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 test was performed in WM Chamber 7.

For Above 40GHz:

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer Keysight	N9030A	MY55330160	Feb. 07, 2023	Feb. 06, 2024
OXE89 Horn Antenna (33~55GHz) QuinStar	QWH-UCRR00	QWH-QPRR00-2	Apr. 25, 2023	Apr. 24, 2024
Conical Horn Antenna (50~75GHz) Keysight	WR15CH-Conical	RCH015RL-2	Apr. 25, 2023	Apr. 24, 2024
Conical Horn Antenna (75~110GHz) Keysight	WR10CH-Conical	RCH010RL-2	Apr. 25, 2023	Apr. 24, 2024
Conical Horn Antenna (110~170GHz) Keysight	WR6.5CH-Conical	RCH06RL-1	Apr. 25, 2023	Apr. 24, 2024
N9029AV15-DC9 - 50-75 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR15	SAX 381	Apr. 25, 2023	Apr. 24, 2024
N9029AV10-DC9 - 75-110 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR10	SAX 378	Apr. 25, 2023	Apr. 24, 2024
N9029AV06-DC9 - 110-170 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR6.5	SAX 377	Apr. 25, 2023	Apr. 24, 2024
Millimeter-Wave Signal Generator Frequency Extension Module (50~75 GHz) Keysight	E8257DV15	SGX 050	NA	NA
Millimeter-Wave Signal Generator Frequency Extension Module (75~110 GHz) Keysight	E8257DV10	SGX 069	NA	NA
Millimeter-Wave Signal Generator Frequency Extension Module (110~170 GHz) Keysight	E8257DV06-DC9	SGX 223	Apr. 25, 2023	Apr. 24, 2024
Millimeter-Wave Signal Generator Frequency Extension Module (140~220 GHz)	VDIWR5.1SGX	PSGX 007	Apr. 25, 2023	Apr. 24, 2024
PSG analog signal generator Keysight	E8257D	MY53401987	Jan. 11, 2023	Jan. 10, 2024
Antenna Tower & Turn Table CT	NA	NA	NA	NA
*Power Meter VDI	PM5	431V	Apr. 25, 2023	Apr. 24, 2024
*Extension Module_up converter VDI	E8257DV05	SGX644	Feb. 11, 2021	Feb. 10, 2024
*Extension Module_up converter VDI	E8257DV03	SGX643	Feb. 11, 2021	Feb. 10, 2024
*Power Meter VDI	PM5B	571V	Feb. 11, 2021	Feb. 10, 2024

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 36 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in WM Chamber 7.

4.1.3 Test Procedures

For Radiated emission below 30MHz

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. Parallel, perpendicular, and ground-parallel orientations 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 30MHz to 40GHz

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 detects 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 of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1GHz.
3. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission above 40GHz

a. Connect the test antenna covering the appropriate frequency range to a spectrum analyzer via an external mixer to the spectrum analyzer.

b. Set spectrum analyzer RBW = 1 MHz, VBW = 3 MHz, average detector.

c. Calculate the distance to the far field boundary and determine the maximum measurement distance.

d. Perform an exploratory search for emissions and determine the approximate direction at which each observed emission emanates from the EUT.

e. Exploratory measurements be made at a closer distance than the validated maximum measurement distance.

f. Perform a final measurement; begin with the test antenna at the approximate position where the maximum level occurred during the exploratory scan.

g. Slowly scan the test antenna around this position, slowly vary the test antenna polarization by rotating through at least 0° to 180°, and slowly vary the orientation of the test antenna to find the final position, polarization, and orientation at which the maximum level of the emission is observed.

h. Record the measured reading with the test antenna fixed at this maximized position, polarization, and orientation. Record the measurement distance.

i. Calculate the maximum field strength of the emission at the measurement distance and the adjusted/corrected power at the output of the test antenna.

j. Calculate the EIRP from the measured field strength and then convert to the linear.

k. Calculate the power density at the distance specified by the limit from the field strength at the distance specified by the limit.

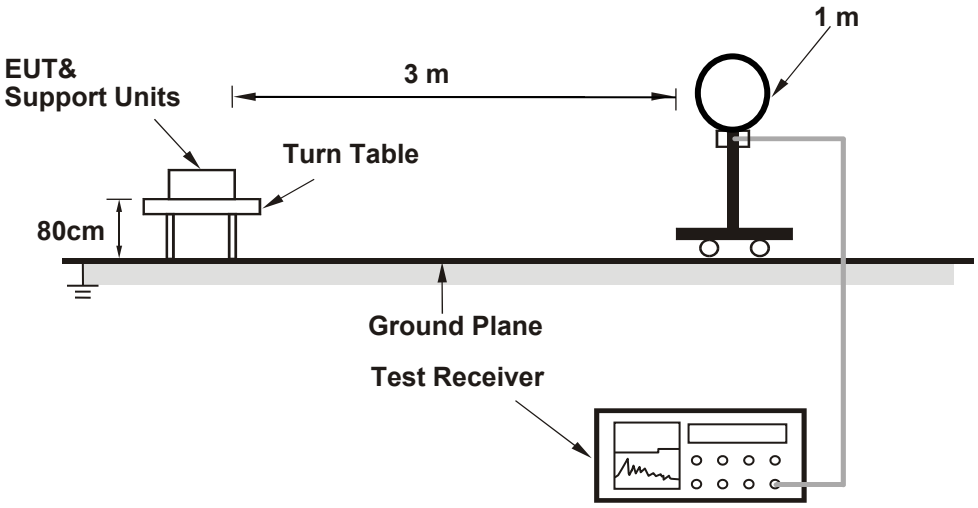
l. Repeat the preceding sequence for every emission observed in the frequency band under investigation.

4.1.4 Deviation from Test Standard

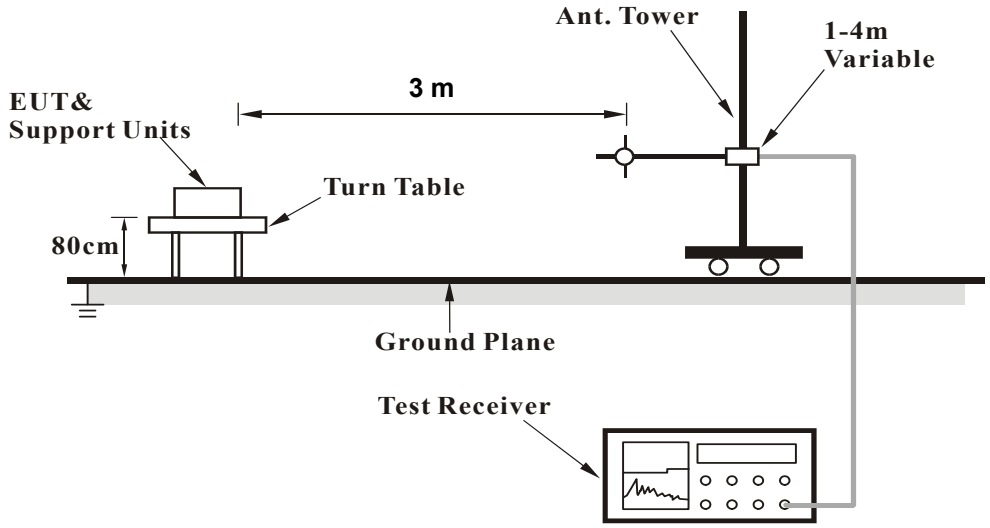
No deviation.

4.1.5 Test Setup

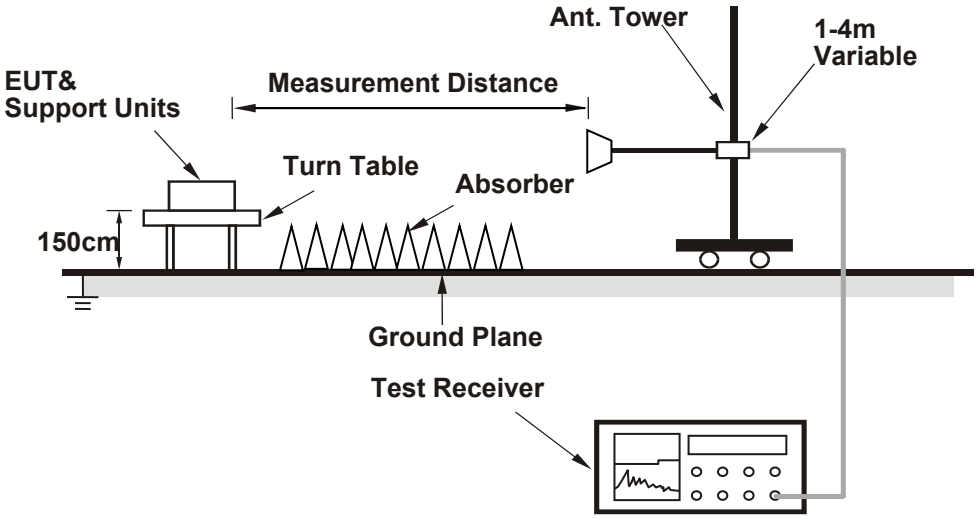
For Radiated emission below 30MHz



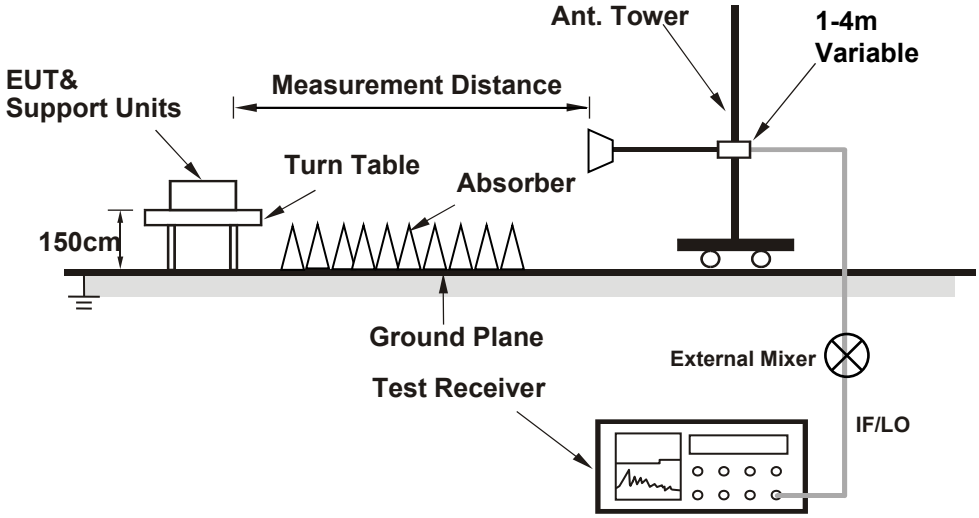
For Radiated emission 30MHz to 1GHz



For Radiated emission 1GHz to 50GHz



For Radiated emission above 50GHz



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

4.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.
b. Controlling software (Python 3.9.13150.1013) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data:

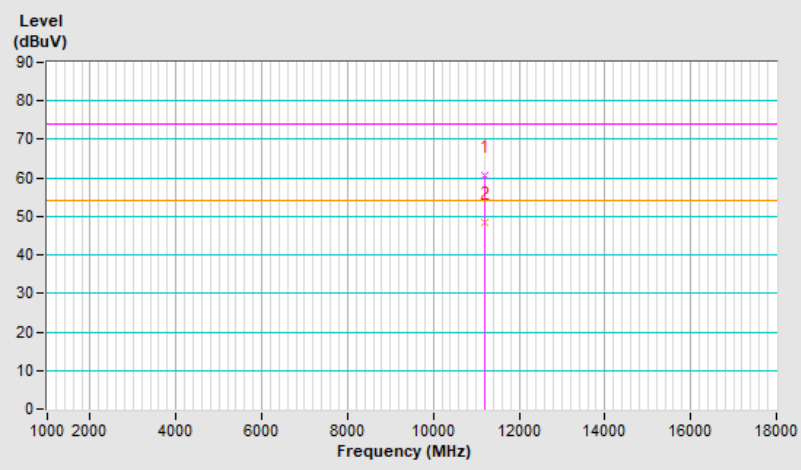
For 1~18 GHz

Channel	CH 1：61.25 GHz		
Frequency Range	1GHz ~ 18GHz	**Detector Function**	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (m)**	**Table Angle (Degree)**	**Raw Value (dBuV)**	**Correction Factor (dB/m)**
1	#11183.00	60.7 PK	74.0	-13.3	2.06 H	179	60.6	0.1
2	#11183.00	48.3 AV	54.0	-5.7	2.06 H	179	48.2	0.1

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.

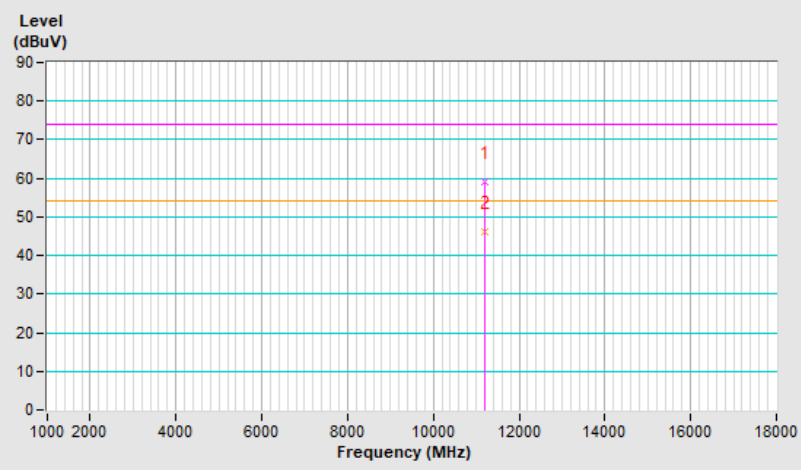


Channel	CH 1：61.25 GHz		
Frequency Range	1GHz ~ 18GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#11183.00	59.1 PK	74.0	-14.9	1.50 V	332	59.0	0.1
2	#11183.00	46.1 AV	54.0	-7.9	1.50 V	332	46.0	0.1

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.



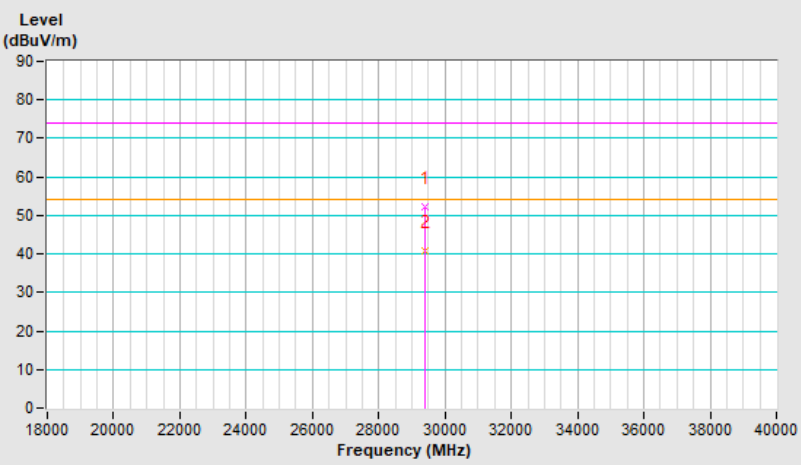
For 18~40 GHz

Channel	CH 1：61.25 GHz		
Frequency Range	18GHz ~ 40GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#29374.00	52.1 PK	74.0	-21.9	2.12 H	58	59.3	-7.2
2	#29374.00	40.8 AV	54.0	-13.2	2.12 H	58	48.0	-7.2

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.

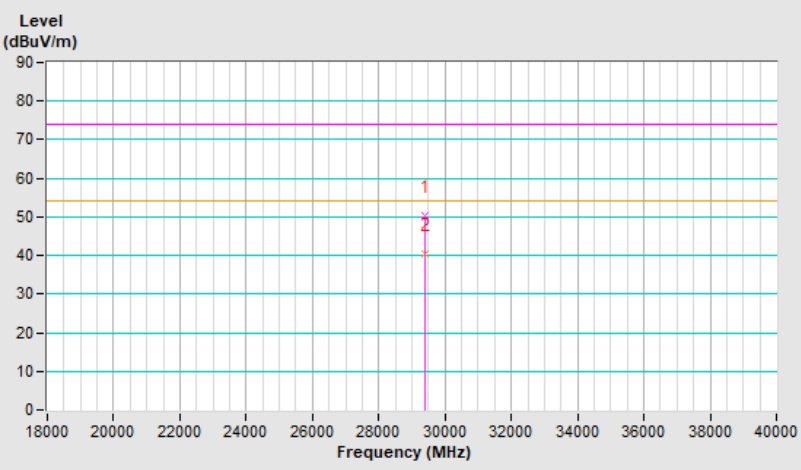


Channel	CH 1：61.25 GHz		
Frequency Range	18GHz ~ 40GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#29374.00	50.4 PK	74.0	-23.6	1.50 V	125	57.6	-7.2
2	#29374.00	40.5 AV	54.0	-13.5	1.50 V	125	47.7	-7.2

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.



For above 40 GHz

Channel	CH 1：61.25 GHz		
Frequency Range	40GHz ~ 200GHz	**Detector Function**	Average (AV)

Antenna Polarity: Horizontal									
No.	Frequency (GHz)	Power (dBm)	Gain of test Antenna (dBi)	EMeas (dBμV/m)	EIRP Level (dBm/MHz)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	Margin (pW/cm^2)	PASS/ FAIL
1	49.59	-97.75	22.50	50.92	-44.24	0.03	90.00	-89.97	PASS
2	52.67	-75.56	21.50	74.63	-20.53	7.83	90.00	-82.17	PASS
3	71.32	-79.03	21.50	73.79	-21.37	6.46	90.00	-83.54	PASS
4	109.97	-87.71	21.60	68.77	-26.38	2.03	90.00	-87.97	PASS
5	167.09	-83.50	22.00	76.22	-18.94	11.28	90.00	-78.72	PASS
6	191.12	-80.79	21.30	80.79	-14.36	32.37	90.00	-57.63	PASS
Antenna Polarity : Vertical									
No.	Frequency (GHz)	Power (dBm)	Gain of test Antenna (dBi)	EMeas (dBμV/m)	EIRP Level (dBm/MHz)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	Margin (pW/cm^2)	PASS/ FAIL
1	49.08	-97.89	22.50	50.69	-44.47	0.03	90.00	-89.97	PASS
2	52.44	-73.50	21.50	76.65	-18.51	12.47	90.00	-77.53	PASS
3	73.39	-78.85	21.50	74.22	-20.94	7.13	90.00	-82.87	PASS
4	109.97	-88.14	21.60	68.34	-26.81	1.84	90.00	-88.16	PASS
5	167.32	-83.55	22.00	76.18	-18.98	11.19	90.00	-78.81	PASS
6	190.90	-80.41	21.30	81.16	-13.99	35.25	90.00	-54.75	PASS

Remarks:

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

Follow ANSI 63.10 section 9.4 Equations to calculate and extrapolate field strength

E_{Meas} (dBμV/m) = 126.8 − 20log(λ) + P −G

where:

E_{Meas} 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

Follow ANSI 63.10 section 9.5 Equations to calculate EIRP

EIRP Level (dBm/MHz) = E_{Meas} (dBμV/m)+20*log(d_{Meas})-104.7

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

Measurements made at 3 meter distance.

2. Power density formula as follows

Follow ANSI 63.10 section 9.6 Equations to calculate power density

$PD=EIRP_{Linear}/4\ \pi\ d^2$

PD is is the power density at the distance specified by the limit, in W/m^2

$EIRP_{Linear}$ is the equivalent isotropically radiated power, in watts

d is the 3m distance.

3. The far-field boundary is given in ANSI 63.10 section 9.1 as:

R far field = (2 * L^2) / λ

L is the Largest Antenna Dimension of measurement antenna, including the reflector

λ is the wavelength

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
40	0.03	0.0075	0.240
50	0.03	0.0060	0.300

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
50	0.025	0.0060	0.208
75	0.025	0.0040	0.313

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
75	0.018	0.0040	0.162
110	0.018	0.0027	0.238

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
110	0.012	0.0027	0.106
170	0.012	0.0018	0.163

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
170	0.008	0.0018	0.073
260	0.008	0.0012	0.111

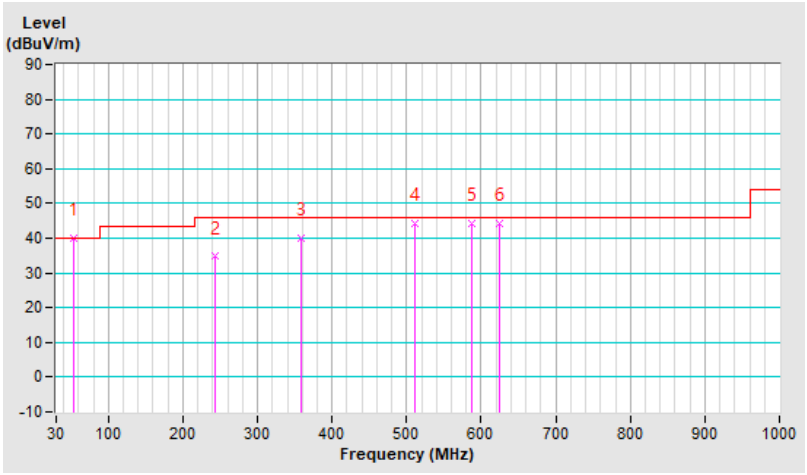
Below 1GHz Data:

Channel	CH 1：61.25 GHz		
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	**54.25**	**39.9 QP**	**40.0**	**-0.1**	**1.00 H**	**68**	**53.0**	**-13.1**
2	242.43	34.7 QP	46.0	-11.3	1.99 H	158	48.9	-14.2
3	357.86	40.0 QP	46.0	-6.0	1.99 H	70	51.1	-11.1
4	511.12	44.1 QP	46.0	-1.9	1.00 H	244	51.5	-7.4
5	586.78	44.4 QP	46.0	-1.6	1.49 H	156	50.0	-5.6
6	624.61	44.2 QP	46.0	-1.8	1.00 H	222	49.2	-5.0

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

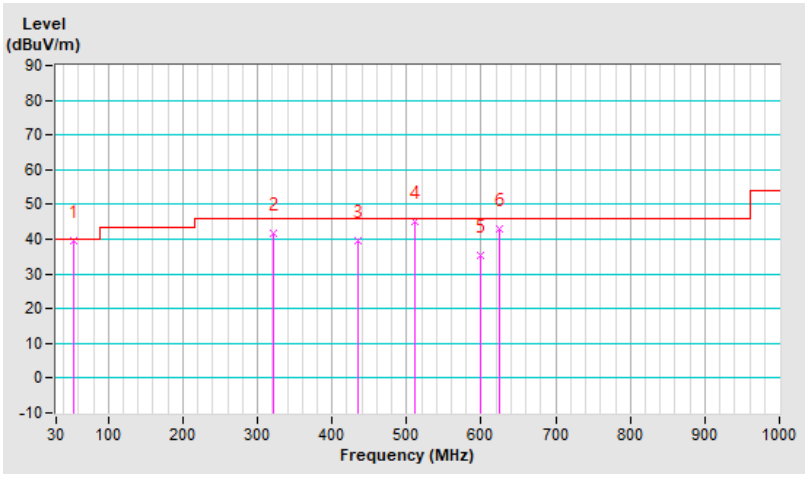


Channel	CH 1：61.25 GHz		
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	54.25	39.4 QP	40.0	-0.6	1.00 V	24	52.5	-13.1
2	321.97	41.5 QP	46.0	-4.5	1.49 V	230	53.1	-11.6
3	435.46	39.4 QP	46.0	-6.6	1.99 V	88	48.1	-8.7
4	511.12	45.1 QP	46.0	-0.9	1.00 V	256	52.5	-7.4
5	598.42	35.2 QP	46.0	-10.8	1.49 V	57	40.5	-5.3
6	624.61	42.8 QP	46.0	-3.2	1.49 V	129	47.8	-5.0

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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

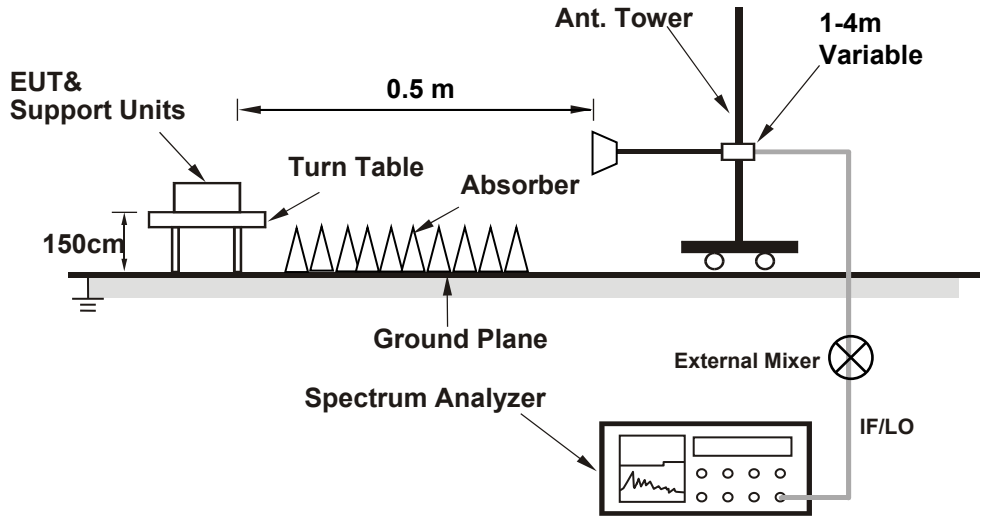


4.2 6dB Bandwidth Measurement

4.2.1 Limits of 6dB Bandwidth Measurement

None: For reporting purposes only.

4.2.2 Test Setup



4.2.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 09, 2022	Dec. 08, 2023
Spectrum Analyzer (50~110GHz) Keysight	V3050A	US60360159	Feb. 07, 2023	Feb. 06, 2024
Conical Horn Antenna (50~75GHz) Keysight	WR15CH-Conical	RCH015RL-2	Apr. 25, 2023	Apr. 24, 2024
DC Power Supply TOPWARD	6306A	727263	NA	NA
Temperature & Humidity Chamber TERCHY	HRM-120RF	931022	Dec. 27, 2022	Dec. 26, 2023

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.2.4 Test Procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.2.5 Deviation from Test Standard

No deviation.

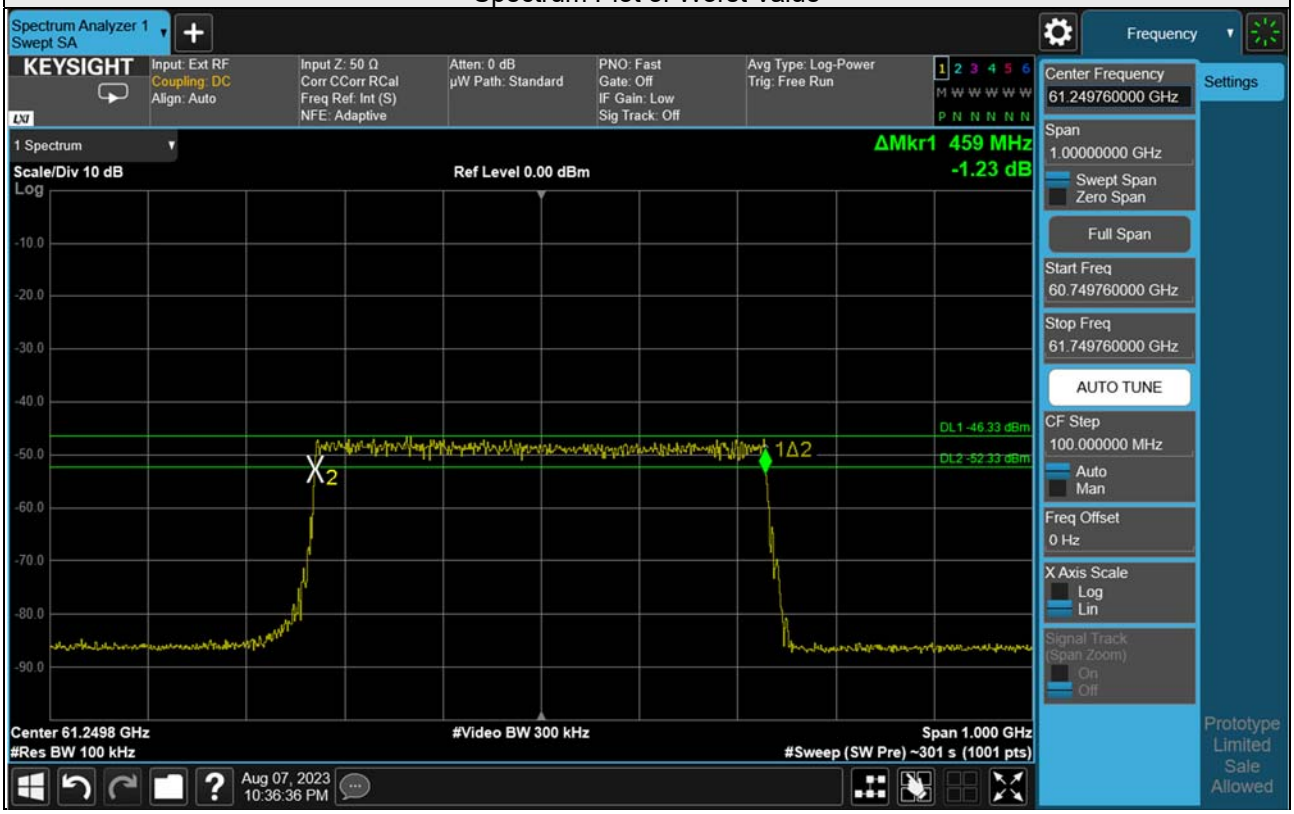
4.2.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 Test Result

Channel	Frequency (GHz)	6dB Bandwidth (MHz)
1	61.25	459

Spectrum Plot of Worst Value

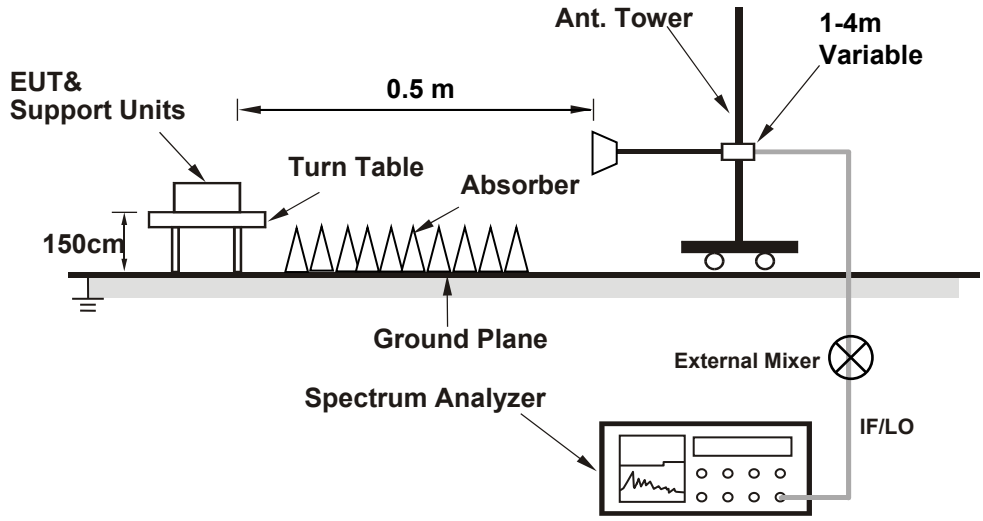


4.3 Occupied Bandwidth Measurement

4.3.1 Limits of Occupied Bandwidth Measurement

None: For reporting purposes only.

4.3.2 Test Setup



4.3.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 09, 2022	Dec. 08, 2023
Spectrum Analyzer (50~110GHz) Keysight	V3050A	US60360159	Feb. 07, 2023	Feb. 06, 2024
Conical Horn Antenna (50~75GHz) Keysight	WR15CH-Conical	RCH015RL-2	Apr. 25, 2023	Apr. 24, 2024
DC Power Supply TOPWARD	6306A	727263	NA	NA
Temperature & Humidity Chamber TERCHY	HRM-120RF	931022	Dec. 27, 2022	Dec. 26, 2023

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.3.4 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.

4.3.5 Deviation from Test Standard

No deviation.

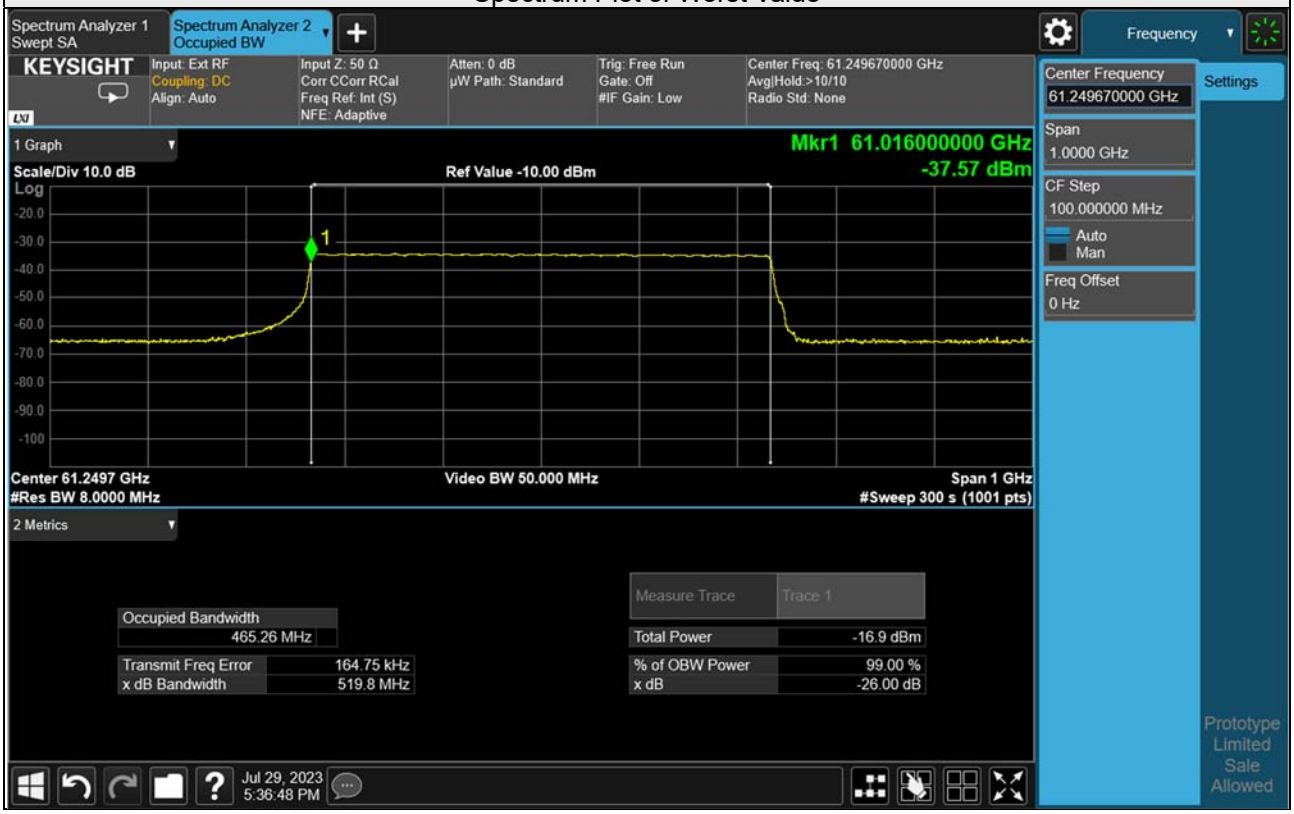
4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Result

Channel	Frequency (GHz)	Occupied Bandwidth (MHz)
1	61.25	465.26

Spectrum Plot of Worst Value

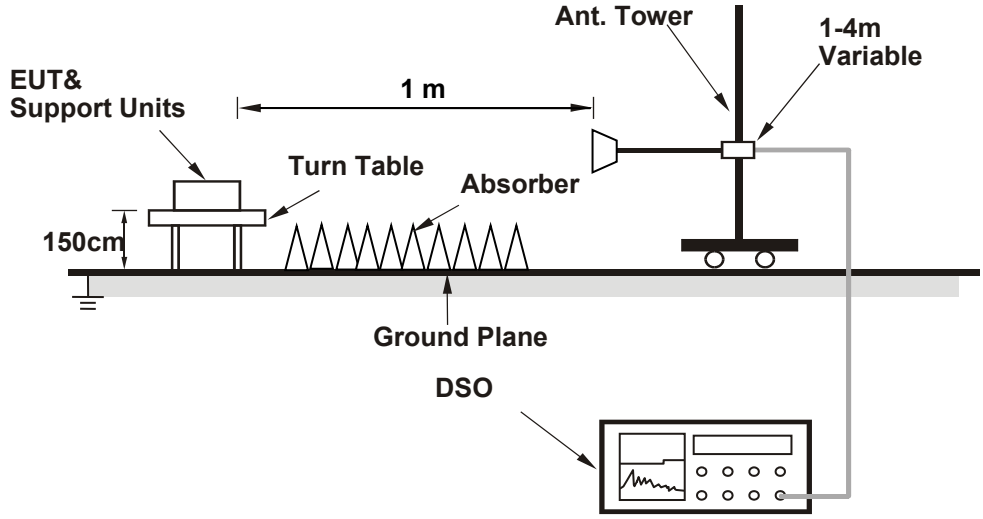


4.4 Output Power Measurement

4.4.1 Limits of Output Power Measurement

15.255 (c)(2)(v)
61.0-61.5 GHz: For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

4.4.2 Test Setup



4.4.3 Test Instruments

Same as Item 4.1.2.

4.4.4 Test Procedures

a. Place the EUT in a continuous transmission mode.
b. For radiated emission measurements, attach a test receive antenna for the fundamental frequency band to the RF input of an RF detector or a downconverter with an RF detector at the output.
c. Connect the video output of the detector to the 50 ohm input of the DSO.
d. Place the test receive antenna in the main beam of the EUT at a distance which will provide a signal within the operating range of the RF detector.
e. Set the sampling rate of the DSO to the required value. Adjust the memory depth, the triggering and the sweep speed to obtain a display which is representative of the signal considering the type of modulation.
f. For radiated emission measurements, calculate the distance to the far field boundary of the fundamental emission using following equation

R far field = (2 * L^2) /λ

Where:

L is the Largest Antenna Dimension of either the EUT antenna or measurement antenna, including the reflector

λ is the wavelength

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
61.252	0.00820061	0.0049	0.027

*Measurements made at 1 meter distance.

g. Perform radiated emission measurements to keep maximize the received signal from the EUT in the far field.
h. Record the average and peak from the DSO and the measurement distance.
i. Disconnect the EUT from the RF input port of the instrumentation system.
j. Connect a mm-wave source to the RF input port of the instrumentation system via a waveguide variable attenuator. The mm-wave source is unmodulated.
k. Using substitution measurement.
l. Measure and note the power.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

Same as Item 4.2.6.

4.4.7 Test Results

For Output Power (EIRP)

Antenna Polarity : Horizontal								
No.	Frequency (GHz)	DSO Value (mV)	Power (dBm)	Gain of Test Antenna (dBi)	E_{Meas} (dBµV/m)	EIRP Level (dBm)	EIRP Limit (dBm)	Pass/Fail
1	61.25	15.01	-47.32	21.50	104.18	-0.52 PK	43.00	PASS
2	61.25	1.62	-76.98	21.50	74.52	-30.18 AV	40.00	PASS
3	60.13	0.43	-76.51	21.50	74.83	-29.87 PK	13.00	PASS
4	60.13	0.41	-87.34	21.50	64.00	-40.7 AV	10.00	PASS
5	70.62	0.42	-77.67	21.50	75.07	-29.63 PK	13.00	PASS
6	70.62	0.40	-87.56	21.50	65.18	-39.52 AV	10.00	PASS
Antenna Polarity : Vertical								
No.	Frequency (GHz)	DSO Value (mV)	Power (dBm)	Gain of Test Antenna (dBi)	E_{Meas} (dBµV/m)	EIRP Level (dBm)	EIRP Limit (dBm)	Pass/Fail
1	61.25	25.10	-37.11	21.50	114.39	9.69 PK	43.00	PASS
2	61.25	2.37	-66.11	21.50	85.39	-19.31 AV	40.00	PASS
3	60.57	0.45	-76.12	21.50	75.28	-29.42 PK	13.00	PASS
4	60.57	0.43	-87.01	21.50	64.39	-40.31 AV	10.00	PASS
5	70.48	0.46	-77.34	21.50	75.38	-29.32 PK	13.00	PASS
6	70.48	0.43	-87.22	21.50	65.50	-39.2 AV	10.00	PASS

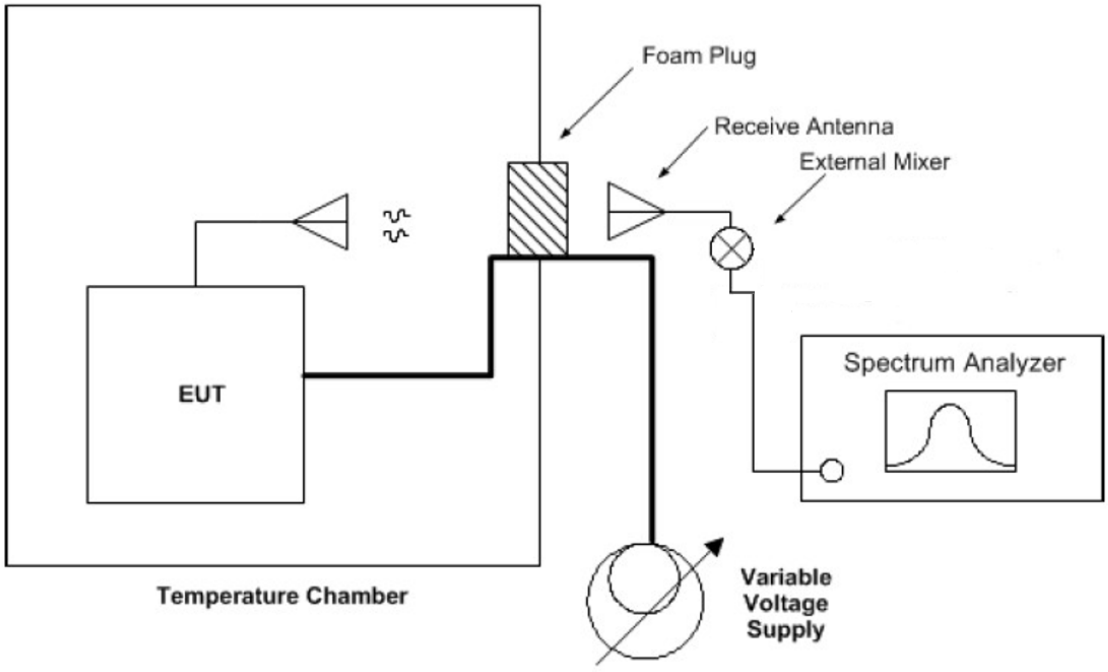
Note:
1. The measured power level is converted to EIRP using the equation:
Follow ANSI 63.10 section 9.4 Equations to calculate and extrapolate field strength
E_{Meas} (dBµV/m) = 126.8 − 20log(λ) + P − G
where:
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
P is 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
Follow ANSI 63.10 section 9.5 Equations to calculate EIRP
EIRP Level (dBm/MHz) = E_{Meas} (dBµV/m)+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
Measurements made at 1 meter distance.

4.5 Frequency Stability Measurement

4.5.1 Limits of Frequency Stability Measurement

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

4.5.2 Test Setup



4.5.3 Test Instruments

Same as Item 4.2.3.

4.5.4 Test Procedure

a. Arrange EUT and test equipment as above setup configuration.
b. With the EUT at ambient temperature and voltage source set to the EUT nominal operating voltage (100%), record the spectrum mask of the EUT emission on the spectrum analyzer.
c. Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask.
d. Set the power supply to 100% nominal setting, and raise EUT operating temperature to 50 °C. Record the frequency excursion of the EUT emission mask.
e. Repeat step d) at each 10 °C increment down to −20 °C

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

Same as Item 4.2.6

4.5.7 Test Results

Frequency Stability Versus Temperature													
Operating Frequency: 61250 MHz													
Temp. (℃)	Power Supply (Vdc)	0 Minute			2 Minutes			5 Minutes			10 Minutes		
		Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result
		FL	FH	Test Result	FL	FH	Test Result	FL	FH	Test Result	FL	FH	Test Result
65	12	61015.87	61481.10	Pass	61015.99	61481.35	Pass	61015.81	61481.45	Pass	61016.14	61481.10	Pass
60	12	61016.18	61481.35	Pass	61016.03	61481.07	Pass	61015.86	61481.34	Pass	61015.99	61481.30	Pass
50	12	61016.04	61481.21	Pass	61016.20	61481.22	Pass	61015.81	61481.35	Pass	61015.80	61481.36	Pass
40	12	61016.00	61481.35	Pass	61015.95	61481.11	Pass	61016.03	61481.43	Pass	61016.04	61481.39	Pass
30	12	61015.85	61481.37	Pass	61016.04	61481.29	Pass	61015.97	61481.30	Pass	61016.20	61481.21	Pass
20	12	61016.00	61481.26	Pass	61015.95	61481.36	Pass	61016.20	61481.16	Pass	61016.19	61481.32	Pass
10	12	61016.20	61481.44	Pass	61016.14	61481.24	Pass	61015.97	61481.18	Pass	61015.97	61481.32	Pass
0	12	61016.11	61481.33	Pass	61016.14	61481.19	Pass	61016.02	61481.25	Pass	61016.15	61481.40	Pass
-10	12	61015.91	61481.09	Pass	61016.14	61481.35	Pass	61016.08	61481.22	Pass	61015.85	61481.13	Pass
-20	12	61015.98	61481.46	Pass	61015.82	61481.20	Pass	61016.19	61481.24	Pass	61015.86	61481.42	Pass

Frequency Stability Versus Voltage													
Operating Frequency: 61250 MHz													
Temp. (℃)	Power Supply (Vdc)	0 Minute			2 Minutes			5 Minutes			10 Minutes		
		Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result	Measured Frequency (MHz)		Test Result
		FL	FH	Test Result	FL	FH	Test Result	FL	FH	Test Result	FL	FH	Test Result
20	13.8	61015.98	61481.44	Pass	61016.14	61481.19	Pass	61016.01	61481.42	Pass	61016.00	61481.30	Pass
	12	61016.00	61481.26	Pass	61015.95	61481.36	Pass	61016.20	61481.16	Pass	61016.19	61481.32	Pass
	10.2	61016.16	61481.44	Pass	61015.91	61481.26	Pass	61016.09	61481.10	Pass	61015.90	61481.26	Pass

5 Pictures of Test Arrangements

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

Appendix – Information of 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:

Lin Kou 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

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Tel: 886-3-3183232
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Email: service.adt@tw.bureauveritas.com
Web Site: http://ee.bureauveritas.com.tw

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

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