

FCC Test Report

Report No.: RFCEPG-WTW-P24080312

FCC ID: VECHB192

Test Model: HB192

Received Date: 2024/8/14

Test Date: 2024/8/29 ~ 2024/9/6

Issued Date: 2024/9/30

Applicant: ST Electronics (Satcom & Sensor Systems) Pte Ltd

Address: 1 Ang Mo Kio Electronics Park Road #06-02 ST Engineering Hub,
Singapore 567710

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

Test Location (2): No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)

FCC Registration / 788550 / TW0003
Designation Number (1):

FCC Registration / 281270 / TW0032
Designation Number (2):



This report is governed by, and incorporates by reference, the Conditions of Testing as posted at the date of issuance of this report at <http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions/> and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurement uncertainty is only provided upon request for accredited tests. Statements of conformity are based on simple acceptance criteria without taking measurement uncertainty into account, unless otherwise requested in writing. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.

Table of Contents

Release Control Record	3
1 Certificate of Conformity.....	4
2 Summary of Test Results	5
2.1 Measurement Uncertainty	5
2.2 Modification Record	5
3 General Information.....	6
3.1 General Description of EUT	6
3.2 Description of Test Modes	7
3.2.1 Test Mode Applicability and Tested Channel Detail.....	8
3.3 Description of Support Units	9
3.3.1 Configuration of System under Test	9
3.4 General Description of Applied Standards	9
4 Test Types and Results	10
4.1 Radiated Emission and Bandedge Measurement.....	10
4.1.1 Limits of Radiated Emission and Bandedge Measurement	10
4.1.2 Test Instruments	11
4.1.3 Test Procedures.....	13
4.1.4 Deviation from Test Standard	14
4.1.5 Test Setup.....	14
4.1.6 EUT Operating Conditions.....	15
4.1.7 Test Results	16
4.2 Conducted Emission Measurement	24
4.2.1 Limits of Conducted Emission Measurement	24
4.2.2 Test Instruments	24
4.2.3 Test Procedures.....	25
4.2.4 Deviation from Test Standard	25
4.2.5 Test Setup.....	25
4.2.6 EUT Operating Conditions.....	25
4.2.7 Test Results	26
4.3 20dB Bandwidth Measurement	28
4.3.1 Limits of 20dB bandwidth Measurement	28
4.3.2 Test Instruments	28
4.3.3 Test Procedures.....	28
4.3.4 Deviation from Test Standard	28
4.3.5 Test Setup.....	28
4.3.6 EUT Operating Conditions.....	28
4.3.7 Test Results	29
5 Pictures of Test Arrangements.....	30
Appendix – Information of the Testing Laboratories	31

Release Control Record

Issue No.	Description	Date Issued
RFCEPG-WTW-P24080312	Original release.	2024/9/30

1 Certificate of Conformity

Product: X-band Microwave Sensor Module

Brand: ST Engineering Urban Solutions Ltd.

Test Model: HB192

Sample Status: Engineering sample

Applicant: ST Electronics (Satcom & Sensor Systems) Pte Ltd

Test Date: 2024/8/29 ~ 2024/9/6

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.245)
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 : Celine Chou , **Date:** 2024/9/30
Celine Chou / Senior Specialist

Approved by : Jeremy Lin , **Date:** 2024/9/30
Jeremy Lin / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.245)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -15.5 dB at 759.44 MHz.
15.245	Radiated Emission Test	Pass	Meet the requirement of limit Minimum passing margin is -6.1 dB at 31563.42 MHz.
15.215 (c)	20dB Bandwidth	Pass	Meet the requirement.
15.203	Antenna Requirement	Pass	No antenna connector is used.

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) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.90 dB
Radiated Emissions	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 1GHz	2.29 dB
	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB
	40GHz ~ 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	X-band Microwave Sensor Module
Brand	ST Engineering Urban Solutions Ltd.
Test Model	HB192
Status of EUT	Engineering sample
Power Supply Rating	5 Vdc
Modulation Type	CW
Operating Frequency	10.521GHz
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note: The antenna information is listed as below.

Antenna Gain (dBi)	Frequency Range (GHz)	Antenna Type	Connector Type
5	10.5~10.6	Patch antenna	N/A

* Due to radiated measurements are made and the antenna gain is already accounted for this device, so provide an antenna datasheet and/or antenna measurement report is not required. The antenna dimensions and pictures (include antenna wire length if have) are stated in EUT photo exhibit.

3.2 Description of Test Modes

1 channel is provided for test:

Channel	Frequency (GHz)
1	10.521

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE $\geq$ 1G	RE<1G	PLC	BW	
-	√	√	√	√	-

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz & Bandedge Measurement **RE<1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **BW**: 20dB Bandwidth Measurement

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

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.

Tested Channel	Modulation Type
1	CW

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.

Tested Channel	Modulation Type
1	CW

Power Line Conducted Emission 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.

Tested Channel	Modulation Type
1	CW

20dB Bandwidth 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.

Tested Channel	Modulation Type
1	CW

Test Condition:

Applicable to	Environmental Conditions	Input Power (System)	Tested by
RE$\geq$1G	22deg. C, 68%RH	120Vac, 60Hz	Wade Huang
RE<1G	23deg. C, 67%RH	120Vac, 60Hz	Wade Huang
PLC	25deg. C, 75%RH	120Vac, 60Hz	Greg Lin
BW	22deg. C, 68%RH	120Vac, 60Hz	Wade Huang

3.3 Description of Support Units

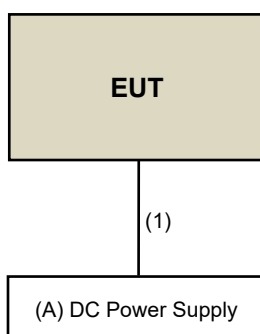
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
1.	DC Power Supply	TECPEL	GPS-3030DD	GEO855738	NA	Provided by Lab

Note: 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	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 (15.245)

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 and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (millivolts/meter)	Field Strength of Fundamental (dBuV/meter)	Field strength of harmonics (millivolts/meter)	Field strength of harmonics (dBuV/meter)
902-928	500	113.9	1.6	64.0
2435-2465	500	113.9	1.6	64.0
5785-5815	500	113.9	1.6	64.0
10500-10550	2500	127.9	25.0	87.9
24075-24175	2500	127.9	25.0	87.9

- (1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in § 15.205, shall not exceed the field strength limits shown in § 15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:
 - (i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.
 - (ii) For all other field disturbance sensors, 7.5 mV/m.
 - (iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in § 15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).
- (2) Field strength limits are specified at a distance of 3 meters.
- (3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

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. 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.

4.1.2 Test Instruments

For Radiated Emission test: (Below 40GHz)

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower KaiTuo	NA	NA	NA	NA
Antenna Tower Controller KaiTuo	KT-2000	NA	NA	NA
Turn Table Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208675	NA	NA
Test Receiver Agilent	N9038A	MY52260177	Sep. 15, 2023	Sep. 14, 2024
PXA Signal Analyzer Keysight	N9030B	MY57140488	Mar. 06, 2024	Mar. 05, 2025
Preamplifier EMCI	EMC330N	980783	Jan. 15, 2024	Jan. 14, 2025
Bi_Log Antenna Schwarzbeck	VULB 9168	9168-995	Oct. 16, 2023	Oct. 15, 2024
RF Coaxial Cable EMCI	EMCCFD400-NM-N M-9000	201252(with PAD)	Jan. 15, 2024	Jan. 14, 2025
RF Coaxial Cable EMCI	EMCCFD400-NM-N M-3000	201250	Jan. 15, 2024	Jan. 14, 2025
RF Coaxial Cable EMCI	EMCCFD400-NM-N M-500	201245	Jan. 15, 2024	Jan. 14, 2025
Preamplifier EMCI	EMC184045SE	980787	Jan. 15, 2024	Jan. 14, 2025
Horn Antenna Schwarzbeck	BBHA 9170	9170-1048	Nov. 12, 2023	Nov. 11, 2024
RF Coaxial Cable EMCI	EMC101G-KM-KM-5 000	201261	Jan. 15, 2024	Jan. 14, 2025
RF Coaxial Cable EMCI	EMC101G-KM-KM-3 000	201258	Jan. 15, 2024	Jan. 14, 2025
RF Coaxial Cable EMCI	EMC101G-KM-KM-2 000	201253	Jan. 15, 2024	Jan. 14, 2025

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 - 966 Chamber 7.

For Radiated Emission test: (Above 40GHz)

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 14, 2023	Dec. 13, 2024
Spectrum Analyzer (50~110GHz) Keysight	V3050A	US60360159	Apr. 16, 2024	Apr. 15, 2025
4CH Infiniivision Oscilloscope Keysight	DSOX6004A	MY55190202	Jun. 17, 2024	Jun. 16, 2025
*OXE89 Horn Antenna (33~55GHz) QuinStar	QWH-UCRR00	QWH-QPRR00-1	Apr. 09, 2024	Apr. 08, 2025
*Conical Horn Antenna (50~75GHz) Keysight	WR15CH-Conical	RCHO15RL-1	Apr. 09, 2024	Apr. 08, 2025
*Conical Horn Antenna (75~110GHz) Keysight	WR10CH-Conical	RCHO10RL-1	Apr. 09, 2024	Apr. 08, 2025
*Conical Horn Antenna (110~170GHz) Keysight	WR6.5CH-Conical	RCHO10RL-1	Apr. 09, 2024	Apr. 08, 2025
*Conical Horn Antenna (140~220GHz) Keysight	WR5.1CH-Conical	RCHO5RL-1	Apr. 09, 2024	Apr. 08, 2025
N9029AV06-DC9 - 110-170 GHz VDI Standard Downconverter Keysight	N9029AV06	SAX723	Apr. 16, 2024	Apr. 15, 2025
*N9029AV05-DC9 - 140-220 GHz VDI Standard Downconverte Keysight	N9029AV05	SAX722	Apr. 16, 2024	Apr. 15, 2025
USB Thermocouple Power Sensors (10MHz-120GHz) Keysight	U8489A	US59290180	Mar. 08, 2024	Mar. 07, 2025
*Power Meter (above 110GHz) VDI	PM5B	571V	Apr. 16, 2024	Apr. 15, 2025

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 - 966 Chamber 7.

For other test items:

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Signal & Spectrum Analyzer R&S	FSW43	101582	Apr. 12, 2024	Apr. 11, 2025
Software BV	ADT_RF Test Software V7.6.5.4	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 test was performed in HW Oven room.

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 ~ 55GHz

- 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 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. 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.
- f. 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.
- g. 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.
- h. 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:

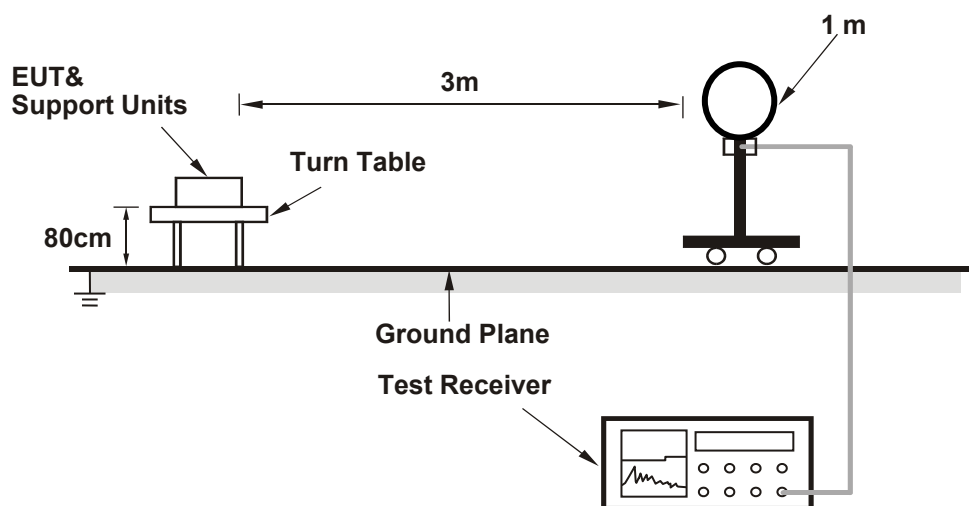
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection (PK) at frequency above 1GHz.
3. The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

4.1.4 Deviation from Test Standard

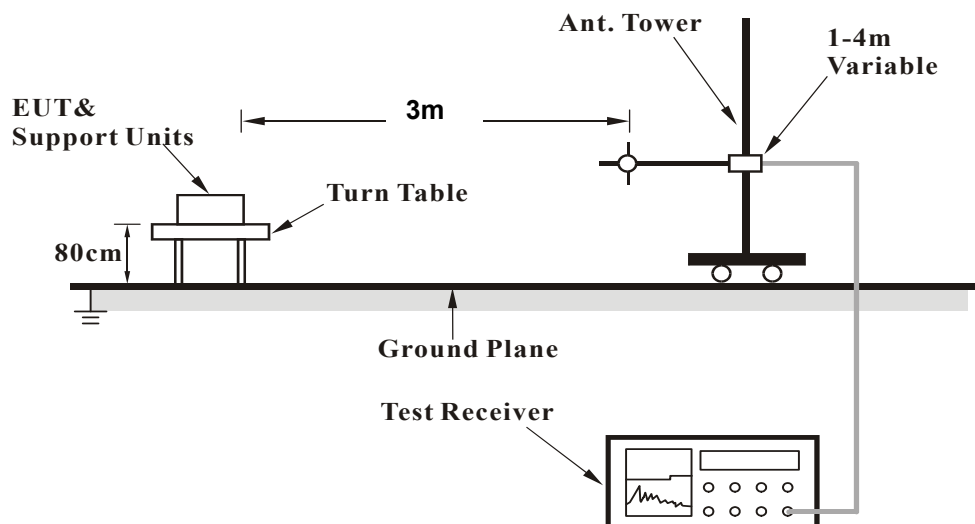
No deviation.

4.1.5 Test Setup

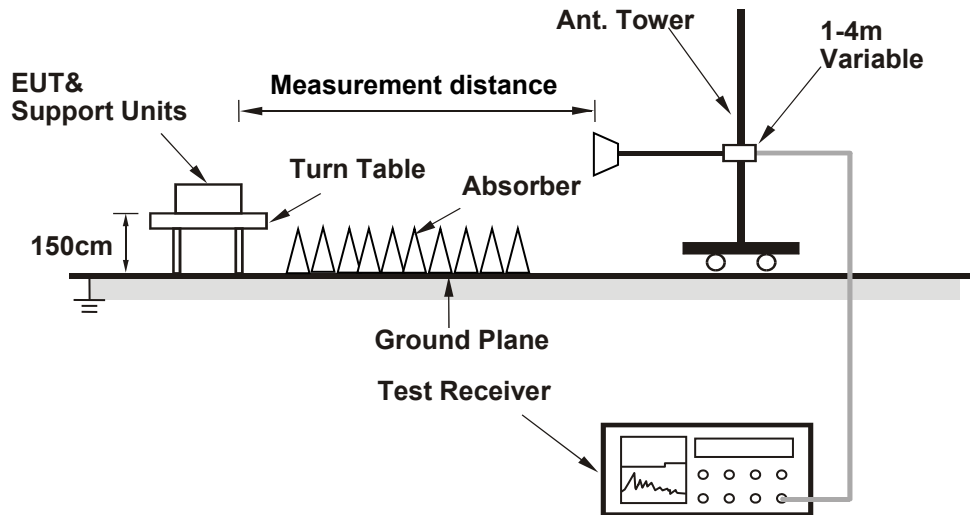
For Radiated emission below 30MHz



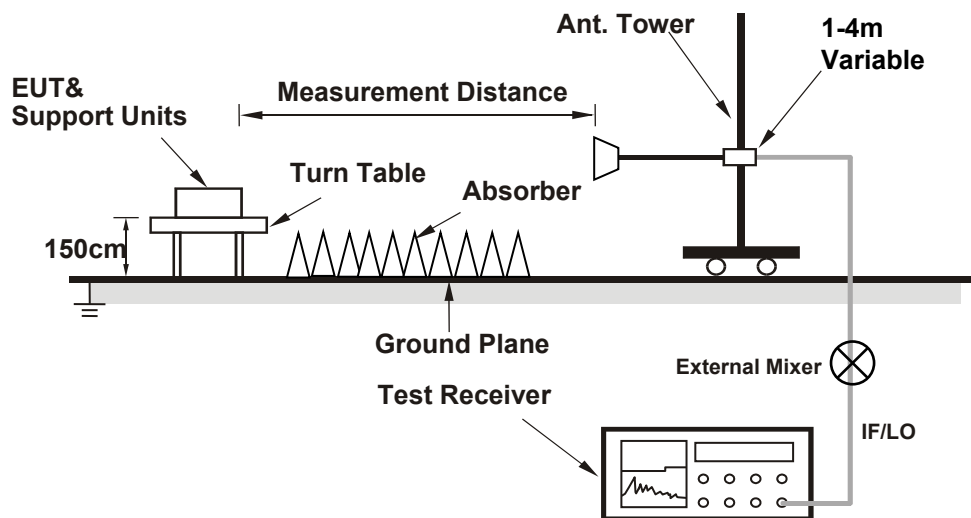
For Radiated emission 30MHz to 1GHz



For Radiated emission 1GHz ~ 40GHz



For Radiated emission above 40GHz



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

4.1.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data:

RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	10.3GHz ~ 10.75GHz	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	*10521.14	103.7 PK	147.9	-44.2	1.60 H	337	64.4	39.3
2	*10521.14	103.6 AV	127.9	-24.3	1.60 H	337	64.3	39.3
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	*10521.14	106.3 PK	147.9	-41.6	1.47 V	12	67.0	39.3
2	*10521.14	106.2 AV	127.9	-21.7	1.47 V	12	66.9	39.3

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) + Distance Factor.
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. “ * ” : Fundamental frequency.
6. Field strength limits are specified at a distance of 3 meters
The measurements made at 1 meter distance. 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 (1/3)(dB) = Test value at 1 meter distance(dBuV) - 9.5(dB).

RF Mode	TX	Channel	CH 1 : 10.521GHz
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	#17648.17	51.8 PK	74.0	-22.2	1.52 H	341	52.1	-0.3
2	#17648.17	40.9 AV	54.0	-13.1	1.52 H	341	41.2	-0.3
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	#17648.17	52.1 PK	74.0	-21.9	1.45 V	25	52.4	-0.3
2	#17648.17	41.2 AV	54.0	-12.8	1.45 V	25	41.5	-0.3

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) + Distance Factor.
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.
6. Field strength limits are specified at a distance of 3 meters
 The measurements made at 1 meter distance. 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 (1/3)(dB) = Test value at 1 meter distance(dBuV) - 9.5(dB).

RF Mode	TX	Channel	CH 1 : 10.521GHz
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	21042.28	53.2 PK	97.5	-44.3	1.32 H	57	69.0	-15.8
2	21042.28	53.1 AV	77.5	-24.4	1.32 H	57	68.9	-15.8
3	31563.42	69.9 PK	97.5	-27.6	1.46 H	353	87.8	-17.9
4	31563.42	69.8 AV	77.5	-7.7	1.46 H	353	87.7	-17.9
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	21042.28	51.2 PK	97.5	-46.3	1.87 V	35	67.0	-15.8
2	21042.28	51.1 AV	77.5	-26.4	1.87 V	35	66.9	-15.8
3	31563.42	71.5 PK	97.5	-26.0	1.38 V	348	89.4	-17.9
4	31563.42	71.4 AV	77.5	-6.1	1.38 V	348	89.3	-17.9

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) + Distance Factor.
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. Field strength limits are specified at a distance of 3 meters

The measurements made at 1 meter distance. 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 (1/3)(dB) = Test value at 1 meter distance(dBuV) - 9.5(dB).

RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	40GHz ~ 50GHz	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	#42084.56	53.0 PK	107.9	-54.9	1.52 H	57	57.7	-4.7
2	#42084.56	52.9 AV	87.9	-35.0	1.52 H	57	57.6	-4.7
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	#42084.56	56.8 PK	107.9	-51.1	1.49 V	333	61.5	-4.7
2	#42084.56	56.7 AV	87.9	-31.2	1.49 V	333	61.4	-4.7

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) + Distance Factor.
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.
6. Field strength limits are specified at a distance of 3 meters

The measurements made at 1 meter distance. 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 (1/3)(dB) = Test value at 1 meter distance(dBuV) - 9.5(dB).

RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	50GHz ~ 55GHz	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	#52605.70	61.9 PK	107.9	-46.0	1.33 H	316	81.2	-19.3
2	#52605.70	61.8 AV	87.9	-26.1	1.33 H	316	81.1	-19.3
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	#52605.70	57.2 PK	107.9	-50.7	1.40 V	1	76.5	-19.3
2	#52605.70	57.1 AV	87.9	-30.8	1.40 V	1	76.4	-19.3

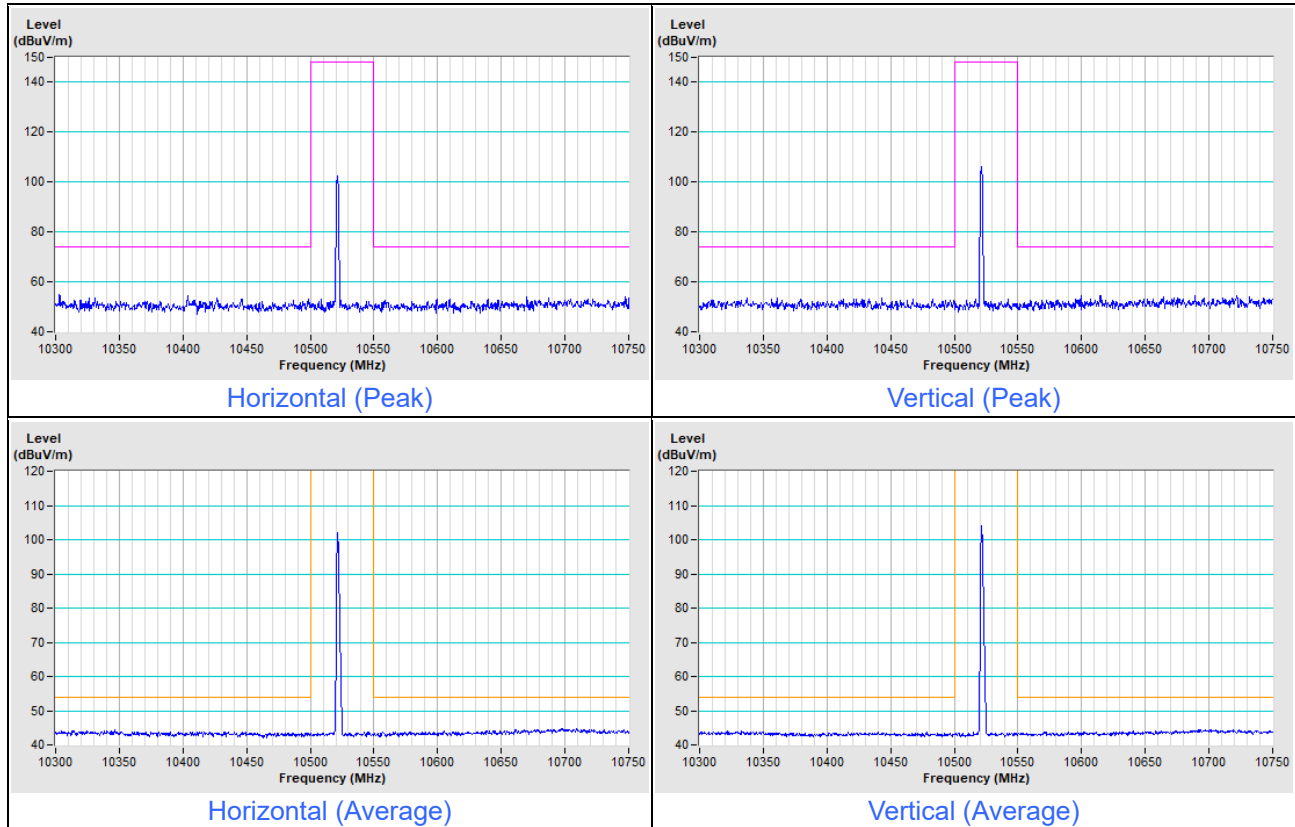
Remarks:

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) + Distance Factor.
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.
6. Field strength limits are specified at a distance of 3 meters

The measurements made at 1 meter distance. 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 (1/3)(dB) = Test value at 1 meter distance(dBuV) - 9.5(dB).

Plot of Band Edge

Frequency Range	10.3GHz ~ 10.75GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=3 MHz, DET=RMS
-----------------	--------------------	-------------------------------	---



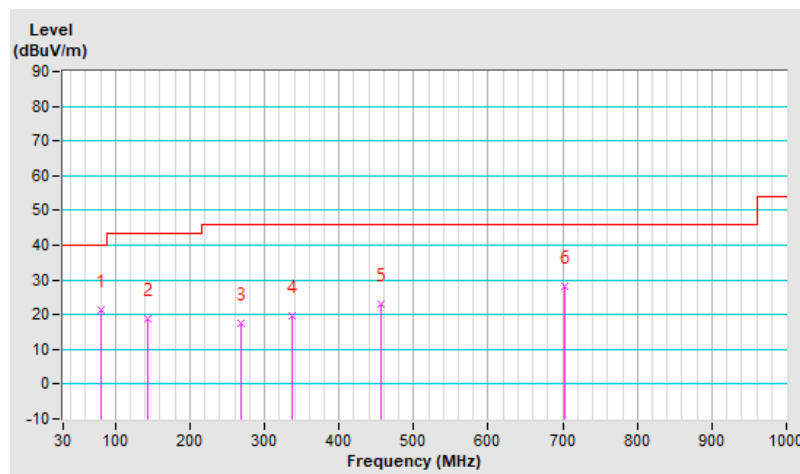
Below 1GHz Data:

RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	30kHz ~ 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	81.41	21.4 QP	40.0	-18.6	1.88 H	126	39.7	-18.3
2	143.49	18.9 QP	43.5	-24.6	1.98 H	128	32.0	-13.1
3	267.65	17.4 QP	46.0	-28.6	1.16 H	201	31.0	-13.6
4	336.52	19.7 QP	46.0	-26.3	2.39 H	152	31.1	-11.4
5	456.80	23.2 QP	46.0	-22.8	2.89 H	154	31.3	-8.1
6	703.18	28.0 QP	46.0	-18.0	1.77 H	151	31.7	-3.7

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.

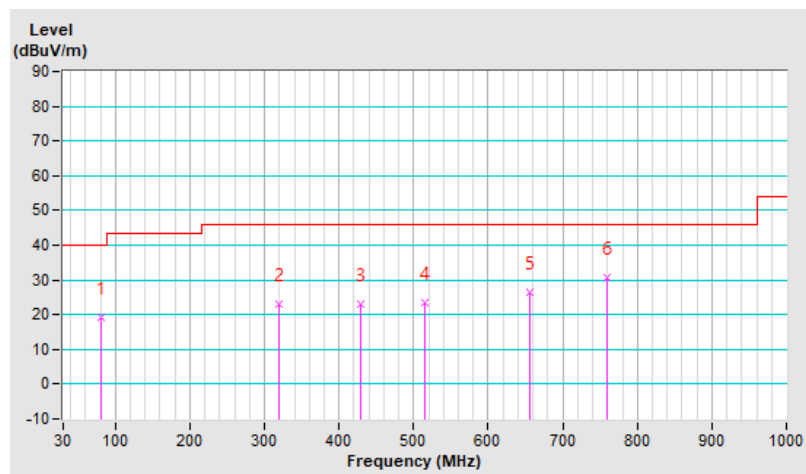


RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	30kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

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	80.44	19.3 QP	40.0	-20.7	1.39 V	293	37.4	-18.1
2	320.03	23.2 QP	46.0	-22.8	1.82 V	154	35.0	-11.8
3	428.67	22.9 QP	46.0	-23.1	2.06 V	284	32.0	-9.1
4	514.03	23.6 QP	46.0	-22.4	1.55 V	121	31.0	-7.4
5	655.65	26.3 QP	46.0	-19.7	1.63 V	238	30.7	-4.4
6	759.44	30.5 QP	46.0	-15.5	1.71 V	220	32.9	-2.4

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. 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 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
EMI Test Receiver R&S	ESR3	102783	Dec. 13, 2023	Dec. 12, 2024
RF Coaxial Cable Woken	5D-FB	Cable-cond2-01	Aug. 25, 2024	Aug. 24, 2025
LISN R&S	ESH2-Z5	100100	Mar. 06, 2024	Mar. 05, 2025
LISN R&S	ESH3-Z5	100116	Feb. 21, 2024	Feb. 20, 2025
Software BVADT	BVADT_Conc_ V7.4.1.0	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 test was performed in HwaYa Shielded Room 2.

3. The VCCI Site Registration No. is C-2047.

4.2.3 Test Procedures

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

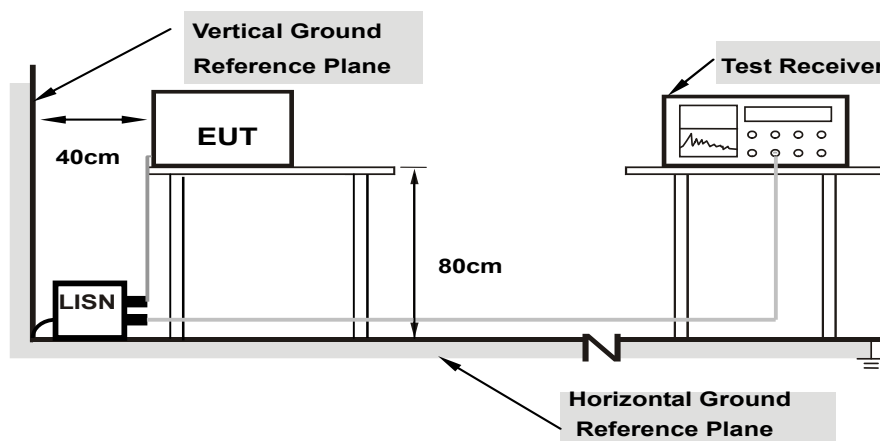
Note:

- The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

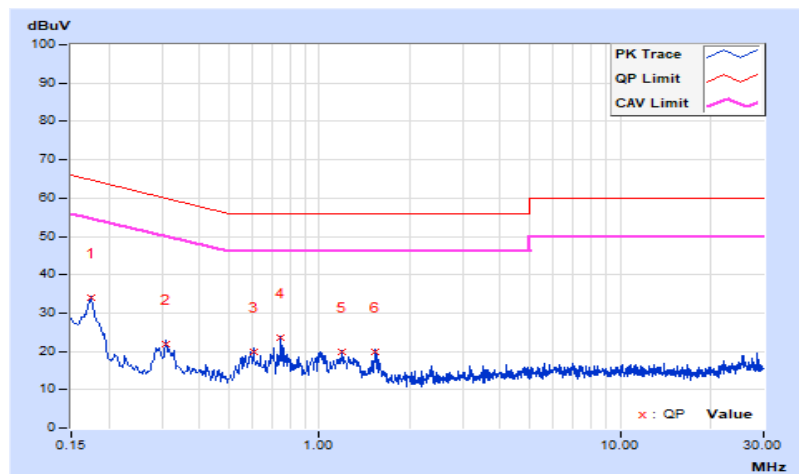
4.2.7 Test Results

RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17400	10.10	24.03	17.53	34.13	27.63	64.77	54.77	-30.64	-27.14
2	0.31000	10.11	11.82	6.07	21.93	16.18	59.97	49.97	-38.04	-33.79
3	0.60600	10.12	9.79	3.16	19.91	13.28	56.00	46.00	-36.09	-32.72
4	0.74600	10.13	13.37	8.37	23.50	18.50	56.00	46.00	-32.50	-27.50
5	1.19000	10.15	9.63	2.28	19.78	12.43	56.00	46.00	-36.22	-33.57
6	1.53800	10.17	9.60	4.78	19.77	14.95	56.00	46.00	-36.23	-31.05

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

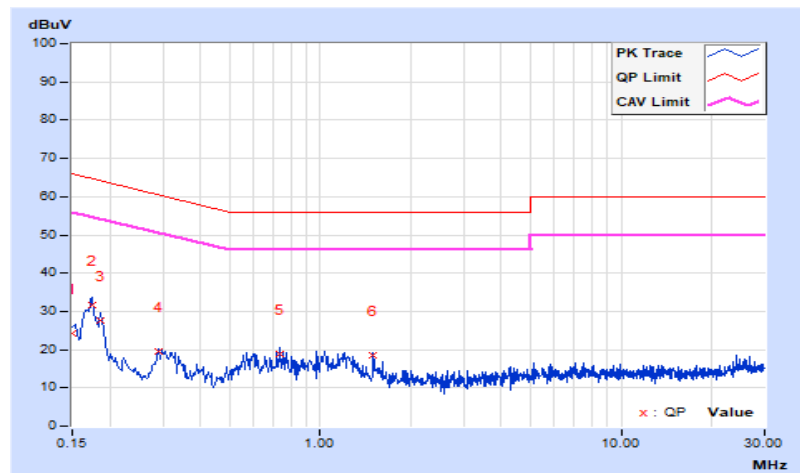


RF Mode	TX	Channel	CH 1 : 10.521GHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.13	14.03	8.12	24.16	18.25	66.00	56.00	-41.84	-37.75
2	0.17384	10.13	21.43	14.67	31.56	24.80	64.77	54.77	-33.21	-29.97
3	0.18600	10.14	17.56	10.22	27.70	20.36	64.21	54.21	-36.51	-33.85
4	0.28982	10.14	9.27	5.98	19.41	16.12	60.53	50.53	-41.12	-34.41
5	0.73800	10.16	8.79	4.82	18.95	14.98	56.00	46.00	-37.05	-31.02
6	1.49800	10.19	8.23	3.86	18.42	14.05	56.00	46.00	-37.58	-31.95

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



4.3 20dB Bandwidth Measurement

4.3.1 Limits of 20dB bandwidth Measurement

According to 15.215(c), the requirement is to ensure the 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified, is contained within the frequency band designated in the rule section under which the equipment is operated.

4.3.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

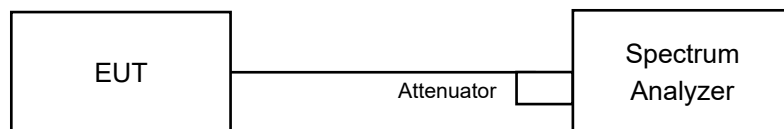
4.3.3 Test Procedures

- Set resolution bandwidth (RBW) = 1% to 5% of the OBW.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- 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 20 dB relative to the maximum level measured in the fundamental emission.

4.3.4 Deviation from Test Standard

No deviation

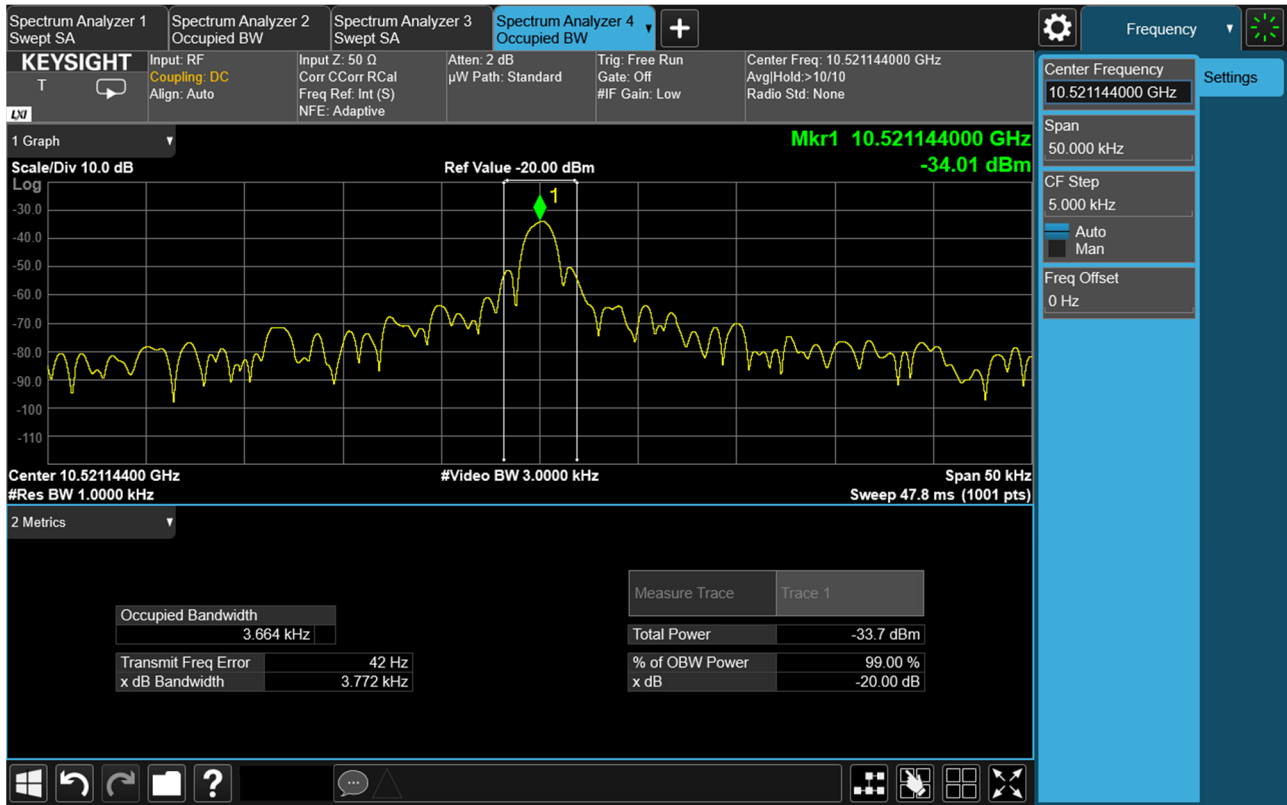
4.3.5 Test Setup



4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously.

4.3.7 Test Results



Note: The signal is CW signal, so RBW can't be match 1~5 % OBW.

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

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

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.

--- END ---