

FCC Test Report

Report No.: RFBDYS-WTW-P24060725

FCC ID: 2AWUU60B0801

Test Model: BE32-HW

Received Date: 2024/6/29

Test Date: 2024/7/12 ~ 2024/7/16

Issued Date: 2024/9/25

Applicant: Verkada Inc.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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FCC Registration /

Designation Number: 788550 / TW0003



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Release Control Record

Issue No.	Description	Date Issued
RFBDYS-WTW-P24060725	Original release	2024/9/25

1 Certificate of Conformity

Product: 8-Zone Alarm Expander

Brand: Verkada

Test Model: BE32-HW

Sample Status: Engineering sample

Applicant: Verkada Inc.

Test Date: 2024/7/12 ~ 2024/7/16

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
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 : Pettie Chen , **Date:** 2024/9/25
Pettie Chen / Senior Specialist

Approved by : Jeremy Lin , **Date:** 2024/9/25
Jeremy Lin / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -14.06dB at 0.29400MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -2.5dB at 125.06MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	Pass	Meet the requirement of limit.
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	Antenna connector is ipex(MHF) not a standard connector.

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	2.79 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~ 1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	8-Zone Alarm Expander
Brand	Verkada
Test Model	BE32-HW
Sample Status	Engineering sample
Power Supply Rating	10-36 Vdc, 45W maximum (Refer to note)
Modulation Type	OQPSK
Operating Frequency	915 ~ 915.7MHz
Number of Channel	21
Channel Spacing	35kHz
Output Power	119.399mW (20.77dBm)
Antenna Type	Refer to note
Antenna Connector	Refer to note
Accessory Device	Refer to note
Cable Supplied	NA

Note:

1. The EUT uses following support unit.

AC Adapter 1 (Support Unit)		
Brand	Model	Specification
Verkada	PSAC30U-120L6	AC Input : 100-240Vac, 0.8A, 50-60Hz DC Output : 12Vdc, 2.5A, 30W
AC Adapter 2 (Support Unit)		
Brand	Model	Specification
Channel Well Technology	KPL-060A-VI	AC Input : 100-240Vac, 50/60Hz, 1.7A DC Output : 36Vdc, 1.67A, 60W

* After pretesting, Adapter 1 was the worst for the final tests.

2. The antenna information is listed as below.

Antenna Type	Connector Type	Gain (dBi)
Monopole	ipex(MHF)	2.65

*Detail antenna specification please refer to antenna photos/or drawings, including antenna dimensions.

3.2 Description of Test Modes

21 channels are provided to this EUT:

Channel	Freq. (MHz)
0	915.000
1	915.035
2	915.070
3	915.105
4	915.140
5	915.175
6	915.210
7	915.245
8	915.280
9	915.315
10	915.350
11	915.385
12	915.420
13	915.455
14	915.490
15	915.525
16	915.560
17	915.595
18	915.630
19	915.665
20	915.700

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE \geq 1G	RE<1G	PLC	APCM	
A	√	√	√	√	Power from adapter 1
B	-	√	√	-	Power from adapter 2

Where RE \geq 1G: Radiated Emission above 1GHz & Bandedge Measurement
 RE<1G: Radiated Emission below 1GHz
 PLC: Power Line Conducted Emission
 APCM: Antenna Port Conducted 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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A	0 to 20	10	OQPSK

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A, B	0 to 20	10	OQPSK

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A, B	0 to 20	10	OQPSK

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ 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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type
A	0 to 20	10	OQPSK

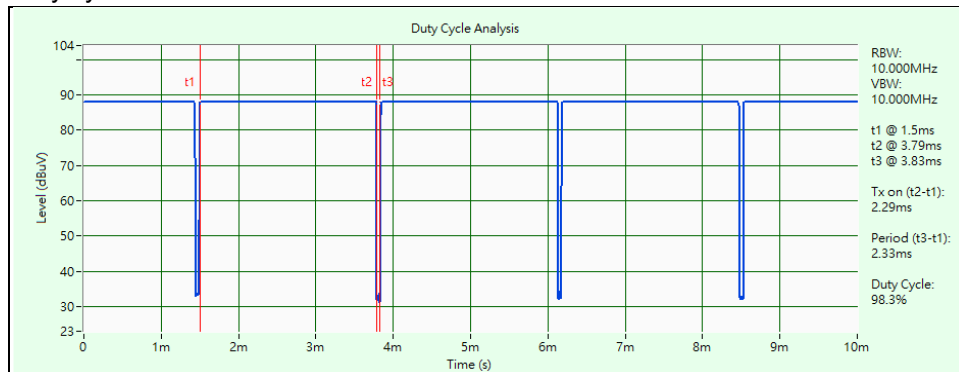
Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE \geq 1G	22 deg. C, 76.3 % RH	120 Vac, 60 Hz	Rex Wang
RE<1G	22 deg. C, 76.3 % RH	120 Vac, 60 Hz	Rex Wang
PLC	25 deg. C, 75% RH	120 Vac, 60 Hz	Rex Wang
APCM	25 deg. C, 60% RH	120 Vac, 60 Hz	Chris Lin

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is > 98%, duty factor is not required.

Duty cycle = $2.29/2.33 = 0.983$

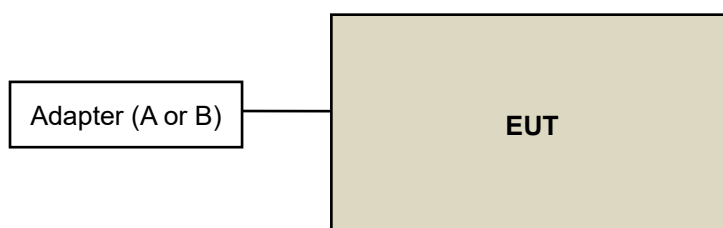


3.4 Description of Support Units

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	Adapter	Verkada	PSAC30U-120L6	N/A	N/A	Supplied by applicant
B	Adapter	Channel Well Technology	KPL-060A-VI	N/A	N/A	Supplied by applicant

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards and References

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

Test standard:

FCC Part 15, Subpart C (15.247)

ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 15.247 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 30dB below the highest level of the desired power:

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

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower & Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
MXE EMI Receiver Keysight	N9038B	MY60180018	2024/3/13	2025/3/12
Signal & Spectrum Analyzer R&S	FSW43	101867	2023/12/29	2024/12/28
Loop Antenna TESEQ	HLA 6121	45745	2023/8/8	2024/8/7
Loop Antenna Electro-Metrics	EM-6879	269	2023/9/23	2024/9/22
Preamplifier EMCI	EMC001340	980201	2023/9/27	2024/9/26
Preamplifier Agilent	8447D	2944A10638	2024/5/1	2025/4/30
Bi_Log Antenna Schwarzbeck	VULB 9168	9168-160	2023/10/17	2024/10/16
RF Coaxial Cable Woken	8D-FB	Cable-CH9-01	2024/5/1	2025/4/30
Horn Antenna Schwarzbeck	BBHA 9120D	9120D-1169	2023/11/12	2024/11/11
Preamplifier Agilent	8449B	3008A02367	2024/1/6	2025/1/5
RF Coaxial Cable HUBER+SUHNER&EMCI	SUCOFLEX 104& EMC104-SM-SM8000	CABLE-CH9-02 (248780+171006)	2024/1/6	2025/1/5
RF Coaxial Cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9- (250795/4)	2024/1/6	2025/1/5
Boresight antenna tower fixture BV	BAF-02	5	NA	NA

Notes:

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 RF Chamber 4.

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 above 30MHz

- 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:

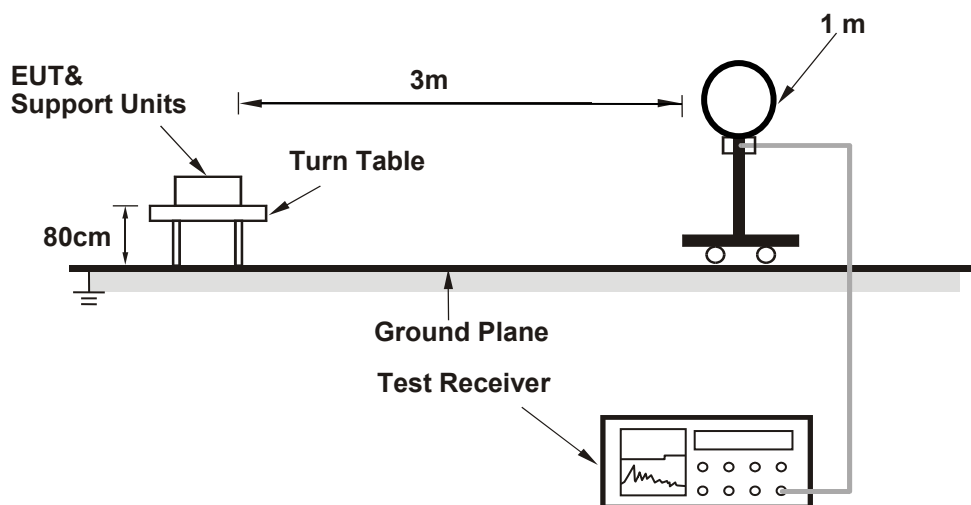
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.

4.1.4 Deviation from Test Standard

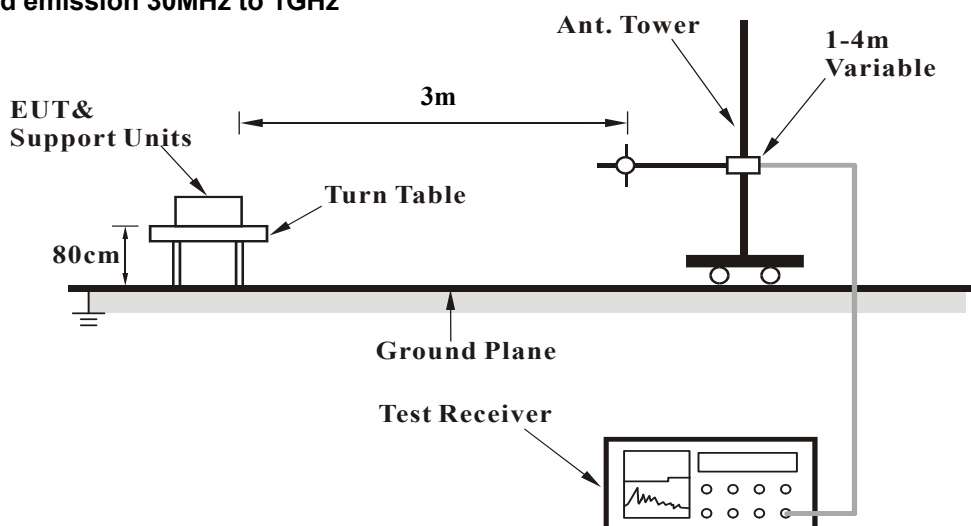
No deviation.

4.1.5 Test Setup

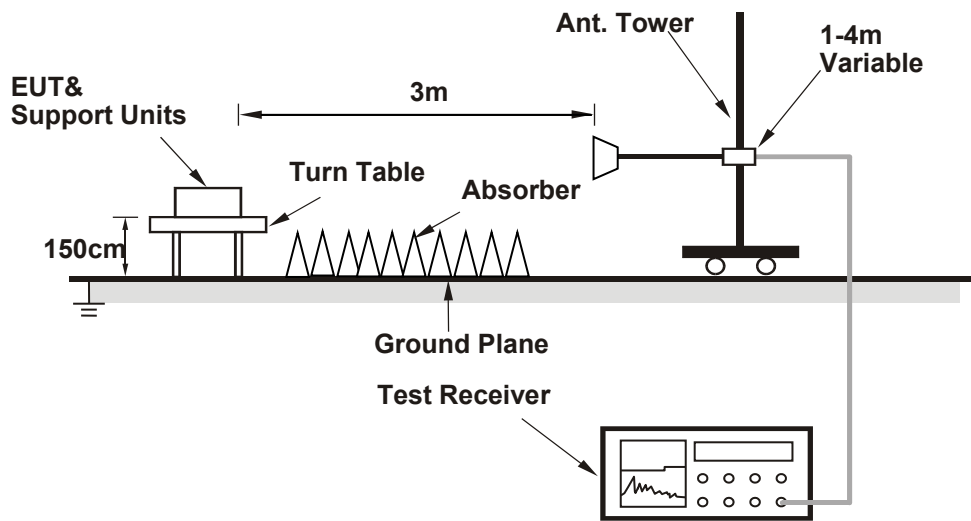
For Radiated emission below 30MHz



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

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

4.1.7 Test Results

CHANNEL	TX Channel 10	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	915.35MHz		

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	902.00	56.7 QP	87.2	-30.5	1.34 H	0	24.0	32.7
2	915.35	117.2 QP			1.34 H	0	84.2	33.0
3	928.00	57.2 QP	87.2	-30.0	1.34 H	0	24.1	33.1
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	902.00	56.6 QP	86.1	-29.5	1.00 V	300	23.9	32.7
2	915.35	116.1 QP			1.00 V	300	83.1	33.0
3	928.00	57.0 QP	86.1	-29.1	1.00 V	300	23.9	33.1

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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value.

Above 1GHz Data

CHANNEL	TX Channel 10	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 10GHz		

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	2746.05	57.5 PK	74.0	-16.5	1.91 H	11	58.6	-1.1
2	2746.05	50.8 AV	54.0	-3.2	1.91 H	11	51.9	-1.1
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	2746.05	53.3 PK	74.0	-20.7	1.98 V	338	54.4	-1.1
2	2746.05	46.2 AV	54.0	-7.8	1.98 V	338	47.3	-1.1

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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value.

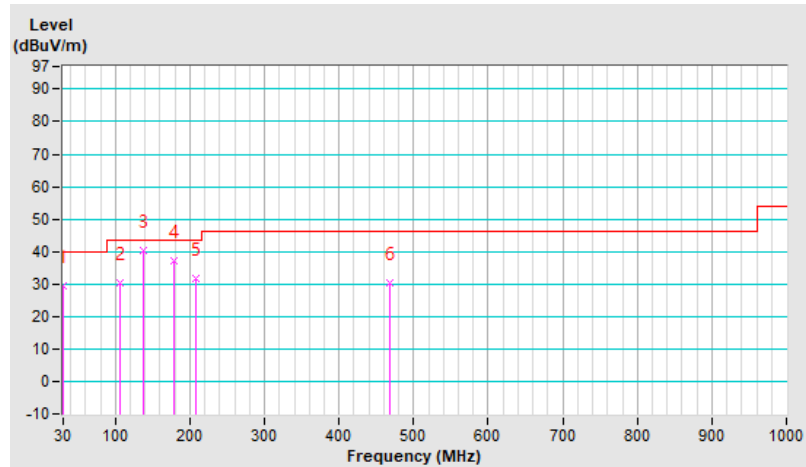
Below 1GHz worst-case data:

CHANNEL	TX Channel 10	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz	TEST MODE	A

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	30.00	29.6 QP	40.0	-10.4	1.01 H	31	40.1	-10.5
2	106.63	30.4 QP	43.5	-13.1	1.50 H	201	42.6	-12.2
3	137.67	40.5 QP	43.5	-3.0	2.00 H	252	49.6	-9.1
4	179.38	37.0 QP	43.5	-6.5	1.50 H	61	46.6	-9.6
5	207.51	31.8 QP	43.5	-11.7	1.01 H	192	42.9	-11.1
6	467.47	30.2 QP	46.0	-15.8	1.01 H	14	33.6	-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 of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
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.

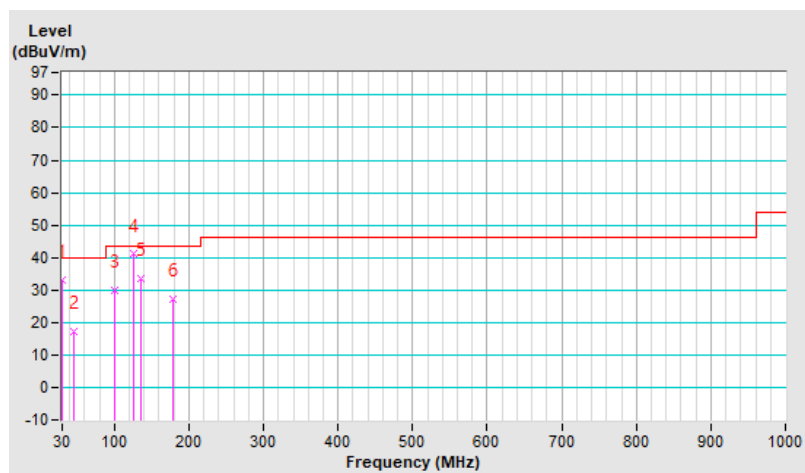


CHANNEL	TX Channel 10	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz	TEST MODE	A

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	30.00	33.2 QP	40.0	-6.8	1.49 V	304	43.7	-10.5
2	46.49	17.1 QP	40.0	-22.9	1.00 V	210	26.3	-9.2
3	100.81	29.9 QP	43.5	-13.6	1.00 V	215	42.9	-13.0
4	125.06	41.0 QP	43.5	-2.5	1.99 V	136	51.3	-10.3
5	135.73	33.6 QP	43.5	-9.9	1.00 V	199	42.9	-9.3
6	179.38	27.4 QP	43.5	-16.1	1.00 V	178	37.0	-9.6

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 of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
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.

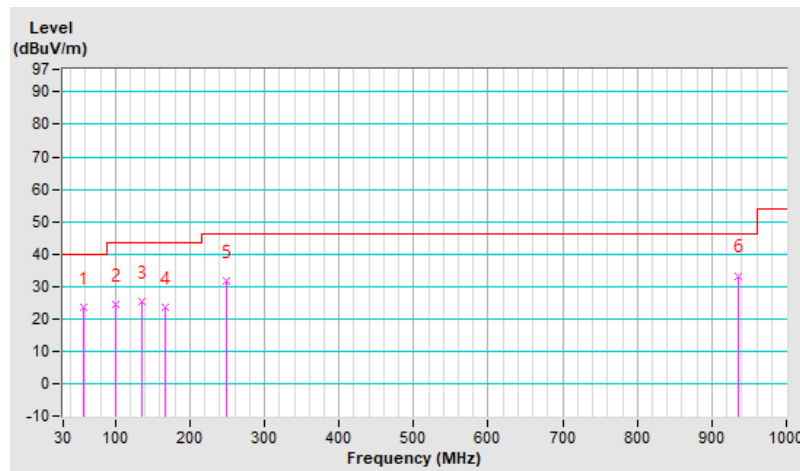


CHANNEL	TX Channel 10	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz	TEST MODE	B

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	57.16	23.4 QP	40.0	-16.6	1.50 H	44	32.8	-9.4
2	100.81	24.6 QP	43.5	-18.9	1.00 H	4	37.6	-13.0
3	135.73	25.3 QP	43.5	-18.2	1.00 H	95	34.6	-9.3
4	167.74	23.5 QP	43.5	-20.0	1.50 H	129	32.0	-8.5
5	248.25	31.8 QP	46.0	-14.2	1.00 H	324	40.6	-8.8
6	935.98	33.3 QP	46.0	-12.7	1.00 H	187	28.0	5.3

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).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
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.

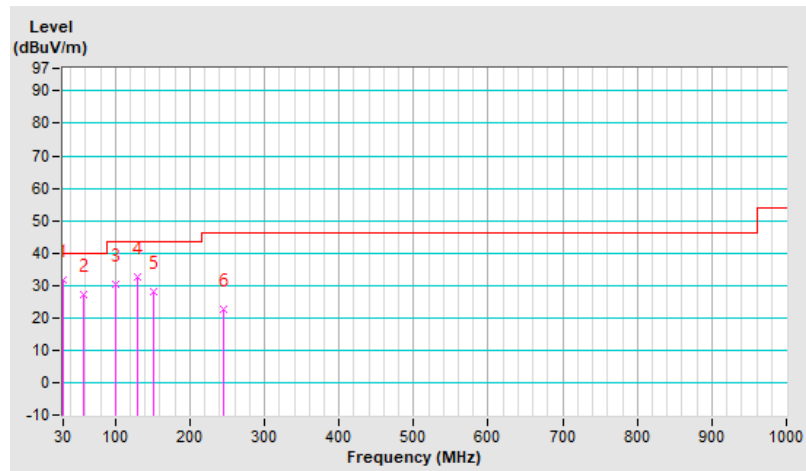


CHANNEL	TX Channel 10	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz	TEST MODE	B

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	30.00	31.6 QP	40.0	-8.4	1.00 V	352	42.1	-10.5
2	57.16	27.4 QP	40.0	-12.6	1.00 V	233	36.8	-9.4
3	100.81	30.5 QP	43.5	-13.0	1.00 V	50	43.5	-13.0
4	129.91	32.6 QP	43.5	-10.9	1.00 V	3	42.5	-9.9
5	151.25	27.9 QP	43.5	-15.6	1.00 V	161	36.2	-8.3
6	245.34	22.5 QP	46.0	-23.5	1.00 V	85	31.4	-8.9

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).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
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	2023/12/13	2024/12/12
RF Coaxial Cable Woken	5D-FB	Cable-cond2-01	2023/9/2	2024/9/1
Fixed Attenuator SGH	BNC10W10dB	PAD-COND2-01	2023/9/2	2024/9/1
LISN R&S	ESH2-Z5	100100	2024/3/6	2025/3/5
LISN R&S	ESH3-Z5	100312	2023/9/12	2024/9/11
Software BVADT	BVADT_Cond_ 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 (Conduction 2).

3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

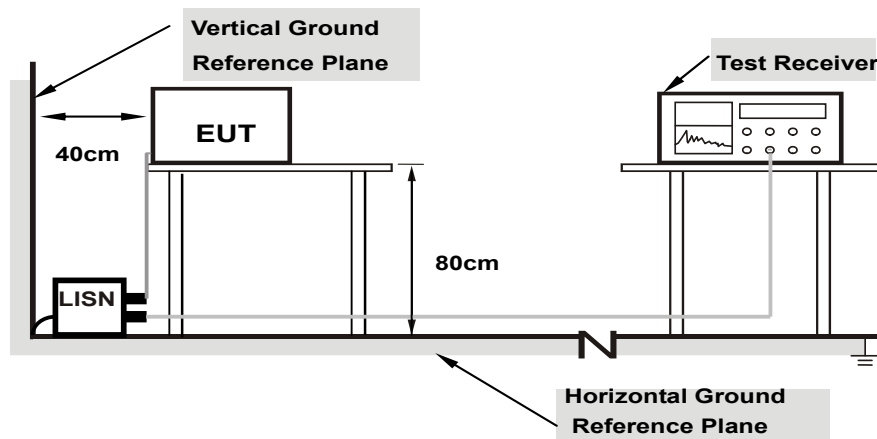
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance 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.

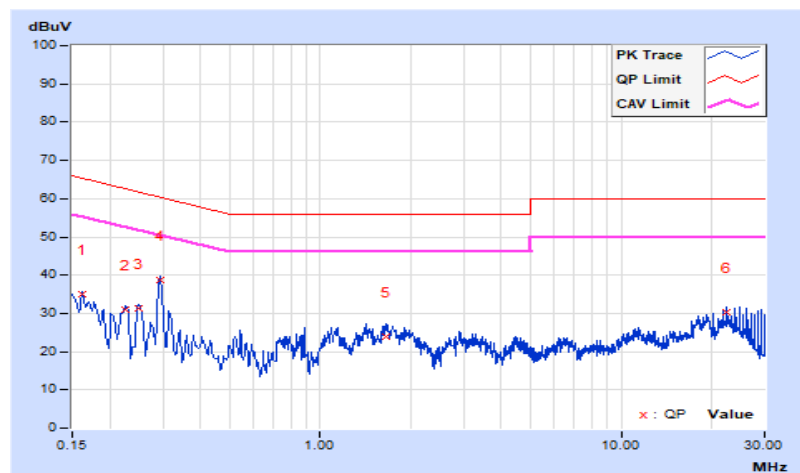
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 10	Test Mode	A

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16190	10.32	24.66	13.79	34.98	24.11	65.37	55.37	-30.39	-31.26
2	0.22600	10.35	20.72	15.58	31.07	25.93	62.60	52.60	-31.53	-26.67
3	0.24875	10.36	21.00	16.30	31.36	26.66	61.80	51.80	-30.44	-25.14
4	0.29400	10.38	28.28	25.97	38.66	36.35	60.41	50.41	-21.75	-14.06
5	1.64925	10.42	13.61	8.14	24.03	18.56	56.00	46.00	-31.97	-27.44
6	22.47800	10.66	19.81	16.28	30.47	26.94	60.00	50.00	-29.53	-23.06

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.

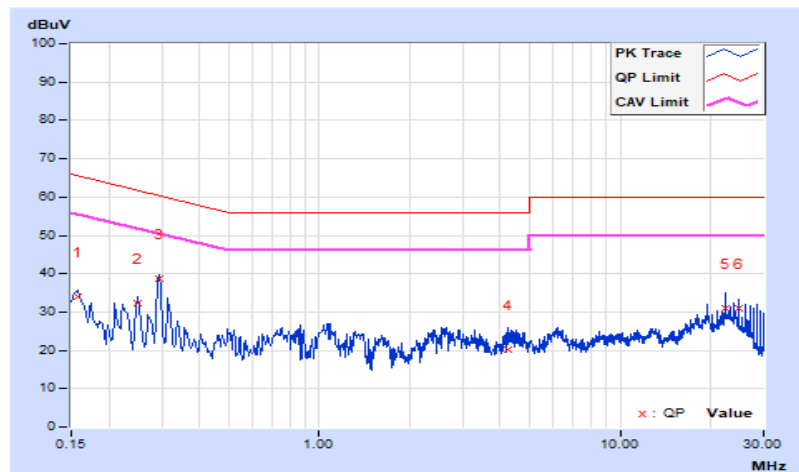


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 10	Test Mode	A

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15687	10.33	23.62	14.11	33.95	24.44	65.63	55.63	-31.68	-31.19
2	0.25000	10.38	21.92	17.86	32.30	28.24	61.76	51.76	-29.46	-23.52
3	0.29400	10.40	28.23	25.84	38.63	36.24	60.41	50.41	-21.78	-14.17
4	4.25800	10.55	9.70	2.09	20.25	12.64	56.00	46.00	-35.75	-33.36
5	22.47800	10.83	20.29	16.67	31.12	27.50	60.00	50.00	-28.88	-22.50
6	24.72600	10.75	20.13	17.41	30.88	28.16	60.00	50.00	-29.12	-21.84

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.

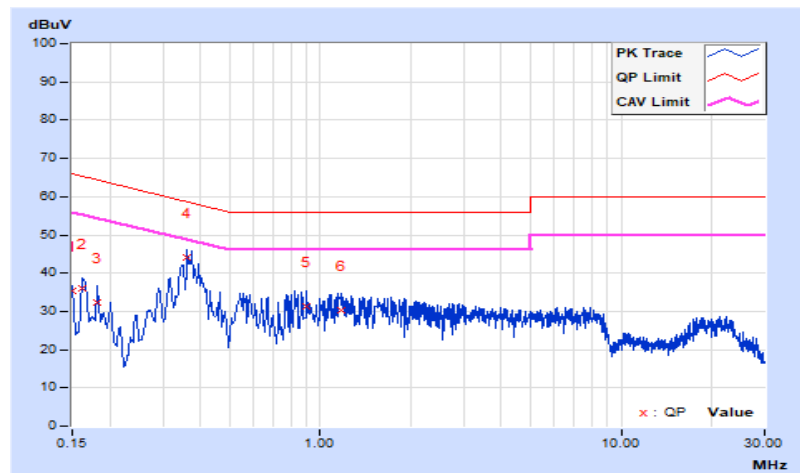


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 10	Test Mode	B

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.32	25.13	7.47	35.45	17.79	66.00	56.00	-30.55	-38.21
2	0.16200	10.32	25.83	9.83	36.15	20.15	65.36	55.36	-29.21	-35.21
3	0.18200	10.33	21.92	5.77	32.25	16.10	64.39	54.39	-32.14	-38.29
4	0.36200	10.40	33.63	16.41	44.03	26.81	58.68	48.68	-14.65	-21.87
5	0.90200	10.43	20.92	5.16	31.35	15.59	56.00	46.00	-24.65	-30.41
6	1.17000	10.43	20.04	4.89	30.47	15.32	56.00	46.00	-25.53	-30.68

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.

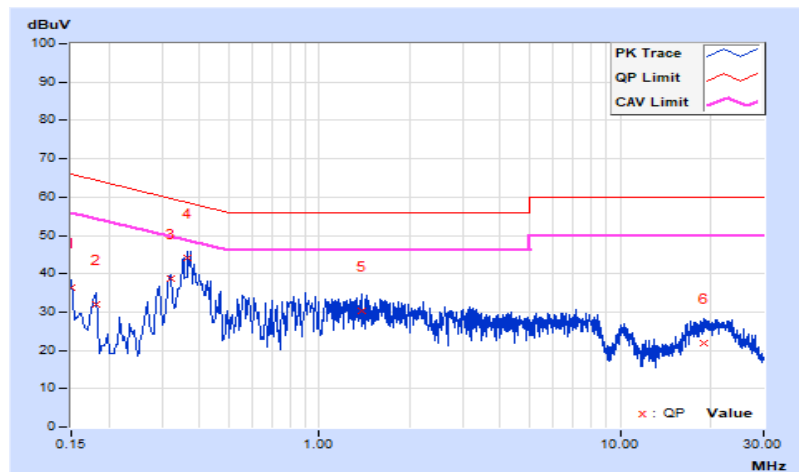


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 10	Test Mode	B

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.33	25.95	7.15	36.28	17.48	66.00	56.00	-29.72	-38.52
2	0.18180	10.35	21.54	5.32	31.89	15.67	64.40	54.40	-32.51	-38.73
3	0.32033	10.41	28.34	13.57	38.75	23.98	59.70	49.70	-20.95	-25.72
4	0.36600	10.43	33.58	17.84	44.01	28.27	58.59	48.59	-14.58	-20.32
5	1.39400	10.45	19.88	2.94	30.33	13.39	56.00	46.00	-25.67	-32.61
6	18.91000	10.89	10.86	2.51	21.75	13.40	60.00	50.00	-38.25	-36.60

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.

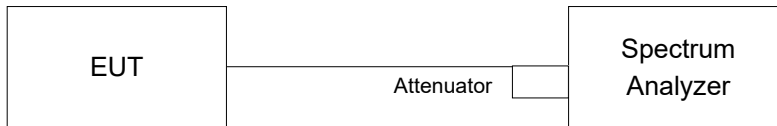


4.3 6dB Bandwidth Measurement

4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

- Set resolution bandwidth (RBW) = 100kHz.
- 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 6 dB relative to the maximum level measured in the fundamental emission.

4.3.5 Deviation from Test Standard

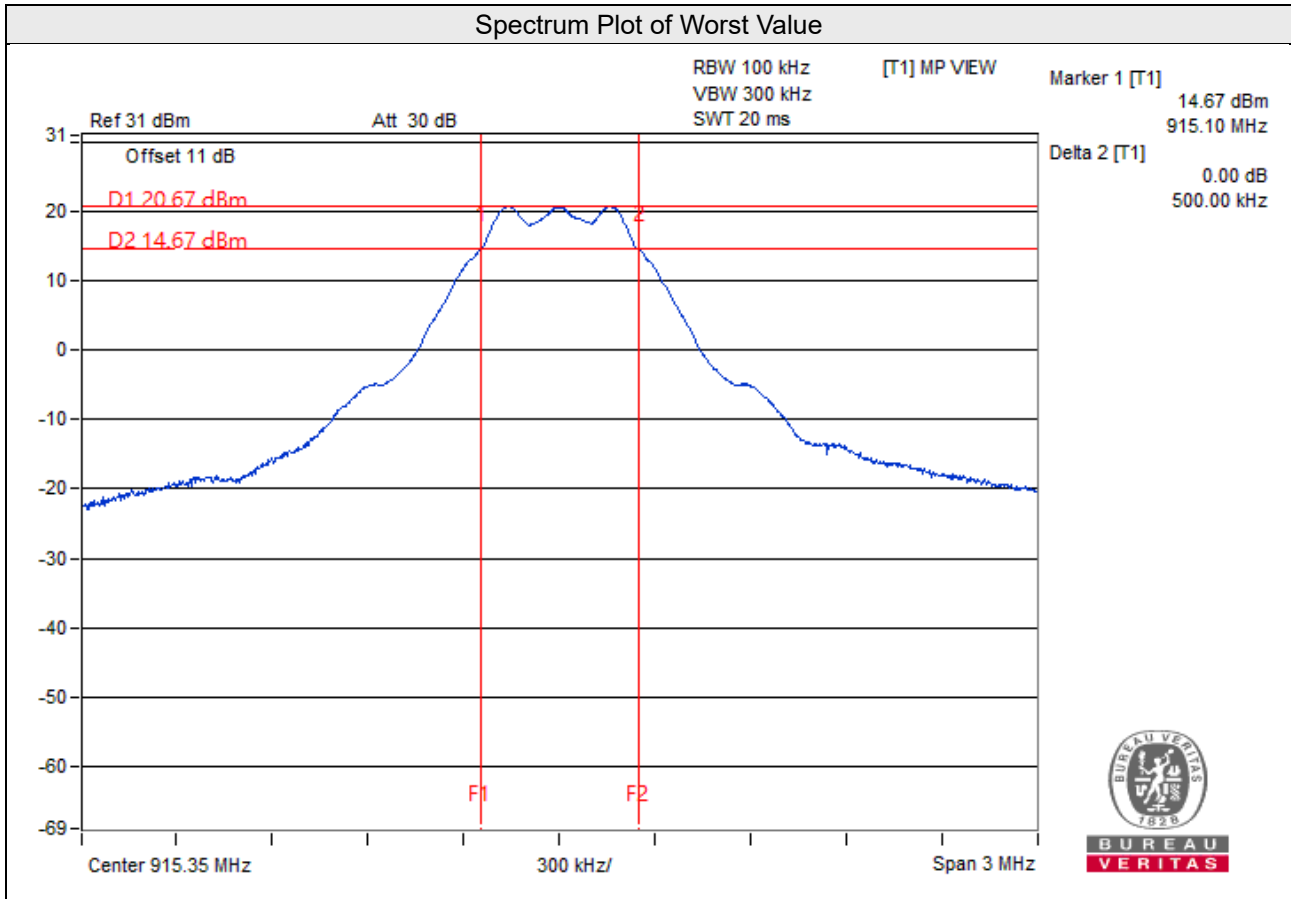
No deviation.

4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at the channel frequencies individually.

4.3.7 Test Result

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
10	915.35	0.5	0.5	Pass

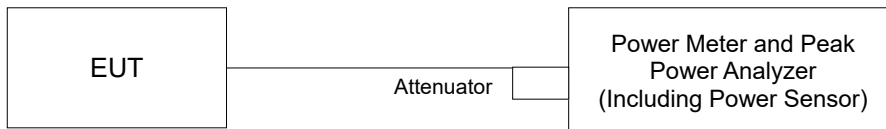


4.4 Conducted Output Power Measurement

4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 902 ~ 928 MHz bands: 1 Watt (30dBm)

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

For Average Power

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

Same as item 4.3.6.

4.4.7 Test Results

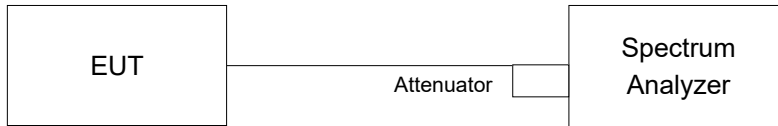
Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
10	915.35	119.399	20.77	30.00	Pass

4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set VBW $\geq 3 \times \text{RBW}$.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- Sweep time = auto couple.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.

4.5.5 Deviation from Test Standard

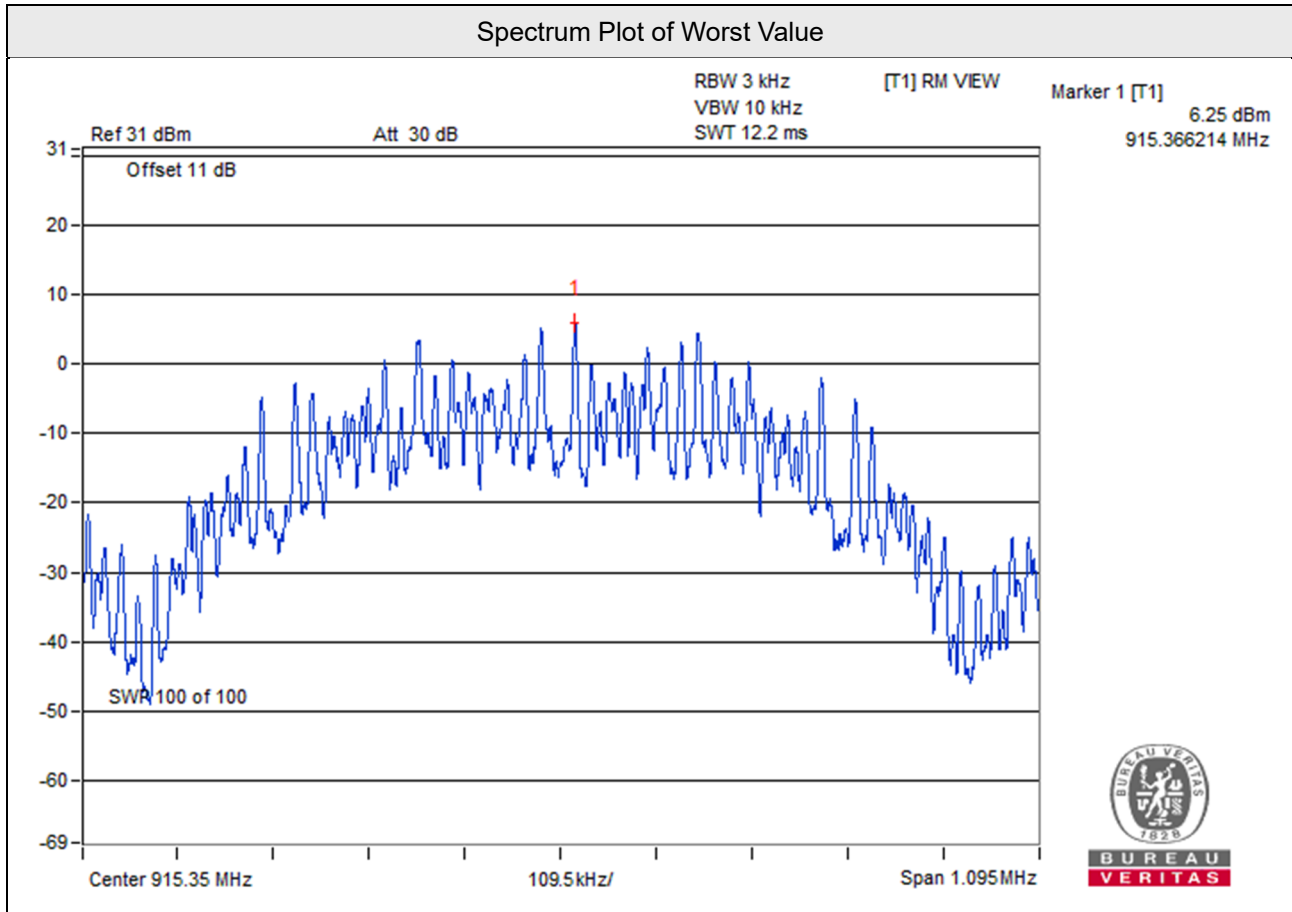
No deviation.

4.5.6 EUT Operating Condition

Same as item 4.3.6

4.5.7 Test Results

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
10	915.35	6.25	8.00	Pass

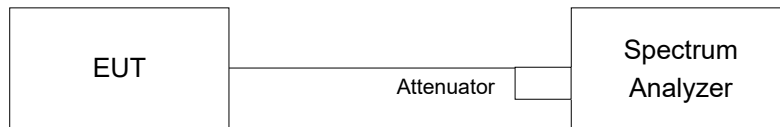


4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

Below 30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

MEASUREMENT PROCEDURE REF

- Set the RBW = 100 kHz.
- Set the VBW \geq 300 kHz.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

- Set RBW = 100 kHz.
- Set VBW \geq 300 kHz.
- Detector = peak.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

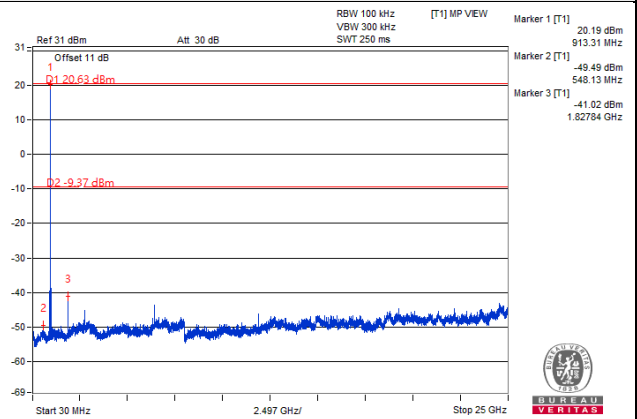
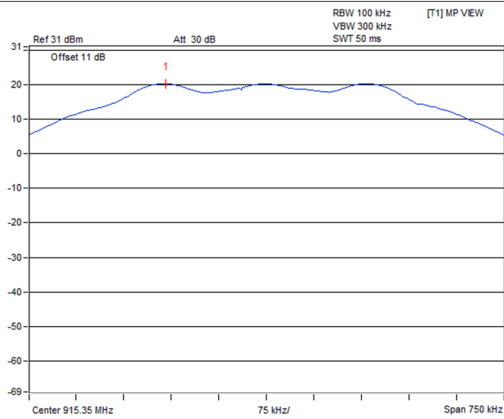
Same as item 4.3.6

4.6.7 Test Results

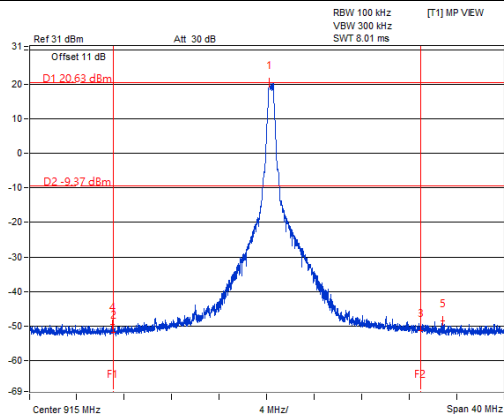
The conducted emission test is performed on each TX port of operating mode without summing or adding 10log (N) since the limit is relative emission limit.

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

CH 10



Band edge



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 and approved according to ISO/IEC 17025.

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

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Email: service.adt@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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