

FCC Test Report

Report No.: RF170620C22-2

FCC ID: Y6S-IOTADV

Test Model: IoT Platform Advance

Series Model: 72201R Lumewave IoT Platform

Received Date: Apr. 26, 2017

Test Date: Apr. 27 ~ Aug. 31, 2017

Issued Date: Sep. 07, 2017

Applicant: Ionics EMS, Inc.

Address: 14 Mountain Drive, Light Industry and Science Park II, Brgy. La Mesa,
Calamba, Laguna 4027, Philippines

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

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan,
R.O.C.

Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City
33383, TAIWAN (R.O.C.)



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Release Control Record

Issue No.	Description	Date Issued
RF170620C22-2	Original release.	Sep. 07, 2017

1 Certificate of Conformity

Product: IOT PLATFORM

Brand: Ionics, Lumewave

Test Model: IoT Platform Advance

Series Model: 72201R Lumewave IoT Platform

Sample Status: Engineering sample

Applicant: Ionics EMS, Inc.

Test Date: Apr. 27 ~ Aug. 31, 2017

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 EMC characteristics under the conditions specified in this report.

Prepared by :


Pettie Chen / Senior Specialist

Date:

Sep. 07, 2017

Approved by :



Ken Liu / Senior Manager

Date:

Sep. 07, 2017

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 -8.26dB at 0.37304MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -2.4dB at 30.00MHz.
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	No antenna connector is used.

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) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.94 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.59 dB
	200MHz ~ 1000MHz	3.60 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	IOT PLATFORM
Brand	Ionics, Lumewave
Test Model	IoT Platform Advance
Series Model	72201R Lumewave IoT Platform
Model Difference	Refer to Note
Status of EUT	Engineering sample
Power Supply Rating	9Vdc or 12Vdc (adapter)
Modulation Type	GFSK
Transfer Rate	1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Channel Spacing	2MHz
Output Power	7.096mW
Antenna Type	PCB printed antenna with -0.06dBi gain
Antenna Connector	NA
Accessory Device	Adapter
Data Cable Supplied	NA

Note:

1. All models are listed as below.

Description	Sample 1	Sample 2
Brand	Ionics	Lumewave
Model	IoT Platform Advance	72201R Lumewave IoT Platform
Processor	NXP I.MX6 Dual Lite	NXP I.MX6 Dual Lite
Memory	2GB DDR3L SDRAM, 400 MHz	2GB DDR3L SDRAM, 400 MHz
Internal Storage	8GB eMMC	8GB eMMC
LAN	2 x Gigabit Ethernet	2 x Gigabit Ethernet
Button	1 x Hardware Reset Button	1 x Hardware Reset Button
	1 x Software Reset Button	1 x Software Reset Button
USB	2 x USB2.0 Port	2 x USB 2.0 Port
MicroSD	2 x microSD Card Port	2 x microSD Card Port
Audio	-	-
Debug	1 x Debug Console Port	1 x Debug Console Port
Debug LED	1 x Programming Port	1 x Programming Port
	6 x Status LED	6 x Status LED
Wi-Fi/BT	1 x 802.11 b/g/n 2.4 GHz / BT 2.1 +EDR, BT 4.0	1 x 802.11 b/g/n 2.4 GHz / BT 2.1 +EDR, BT 4.0
IEEE 802.15.4 Sub GHz	1 x 908 MHz Module	1 x 908 MHz Module
RFM900	1 x 915 MHz RFM900 Module	1 x 915 MHz RFM900 Module
Power Supply	Flypower PS30D120K2000UD	XP-Power ECL25US09-S
	12.0V, 2.0 A	9.0 V, 2.8A
	Tma= 40°C	Tma=70°C

2. The EUT consumes power from the following adapters

Adapter 1	
Brand	FLYPOWER
Model	PS30D120K2000UD
Input Power	100-240Vac~50/60Hz 800mA
Output Power	12.0Vdc / 2000mA
Power Line	1.5m power cable with one core

Adapter 2	
Brand	XP Power
Model	ECL25US09-S
Input Power	100-240Vac~0.8A 50/60Hz
Output Power	9Vdc / 2.8A
Power Line	AC: 0.7m non-shielded power cable without core DC: 0.25m non-shielded power cable without core

3. WLAN, RFID and BT technologies can transmit at same time.

3.2 Description of Test Modes

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

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:

1. The antenna had been pre-tested on the positioned of each 3 axis. The worst cases were found when positioned on X-plane.
2. "-": Means no effect.

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	DATA RATE (Mbps)
A	0 to 39	0, 19, 39	GFSK	1

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	DATA RATE (Mbps)
A, B	0 to 39	19	GFSK	1

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	DATA RATE (Mbps)
A, B	0 to 39	19	GFSK	1

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	DATA RATE (Mbps)
A	0 to 39	0, 19, 39	GFSK	1

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE $\geq$ 1G	20 deg. C, 69% RH 25 deg. C, 69% RH	120Vac, 60Hz	Bayu Chen Bond Tseng
RE<1G	25 deg. C, 66% RH	120Vac, 60Hz	James Yang
PLC	25 deg. C, 75% RH	120Vac, 60Hz	Luis Lee
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Cedric Wu

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.	Notebook	DELL	D531	CN-0XM006-48643-81U-2610	QDS-BRCM1020	-
B.	Jig	NA	NA	NA	NA	-

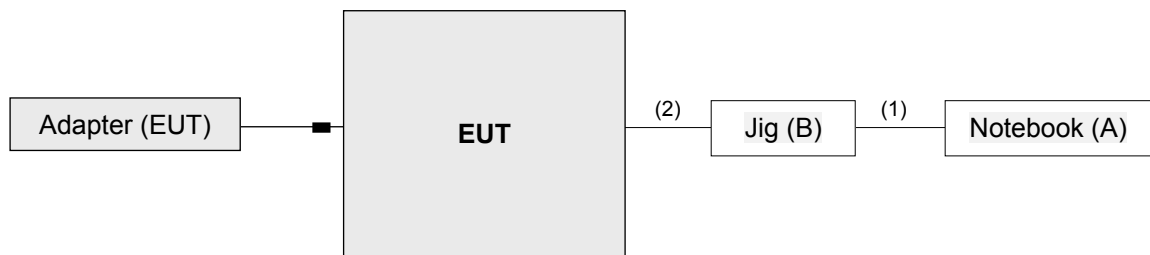
Note:

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

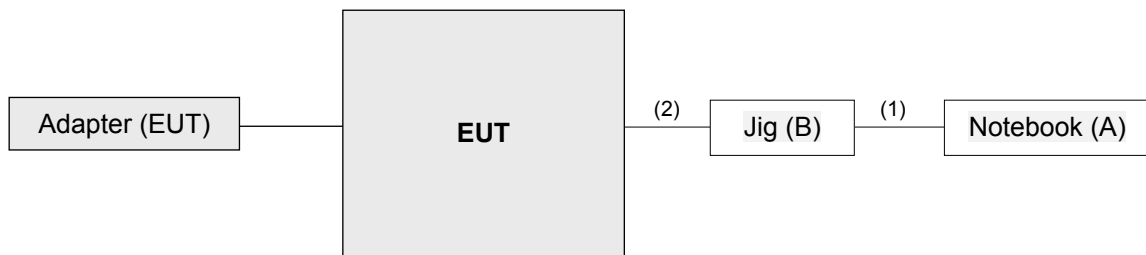
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Micro USB	1	0.6	Y	0	Provided by manufacturer
2.	Flat cable	1	0.2	N	0	Provided by manufacturer

3.3.1 Configuration of System under Test

Test Mode A

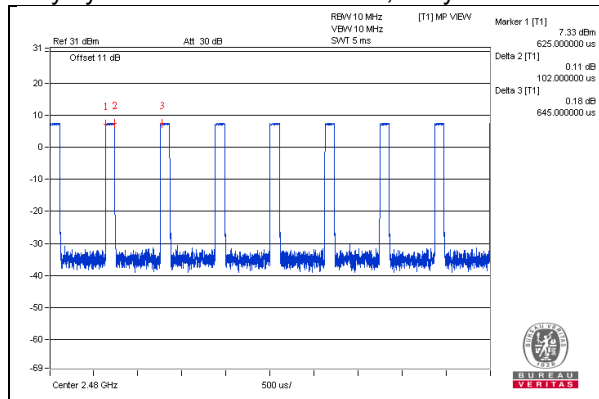


Test Mode B



3.4 Duty Cycle of Test Signal

Duty cycle = $0.102/0.645=0.158$, Duty factor = $10 * \log(1/0.158) = 8.01$



3.5 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 (15.247)

558074 D01 DTS Meas Guidance v04

ANSI C63.10-2013

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

NOTE: The EUT is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use. It has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

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 20dB 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.	Cal. Date	Cal. Due
Test Receiver KEYSIGHT	N9038A	MY55420137	Mar. 27, 2017	Mar. 26, 2018
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100041	Nov. 16, 2016	Nov. 15, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-148	Dec. 28, 2016	Dec. 27, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Dec. 27, 2016	Dec. 26, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Dec. 14, 2016	Dec. 13, 2017
Loop Antenna ETS-LINDGREN	3127-1880	00099260	Sep. 26, 2015	Sep. 27, 2017
Preamplifier Agilent	8449B	3008A01638	Feb. 22, 2017	Feb. 21, 2018
Preamplifier Agilent	8447D	2944A10638	Aug. 09, 2016 Aug. 08, 2017	Aug. 08, 2017 Aug. 07, 2018
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-02 (248780+MY13377)	Aug. 09, 2016 Aug. 08, 2017	Aug. 08, 2017 Aug. 07, 2018
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Aug. 09, 2016 Aug. 08, 2017	Aug. 08, 2017 Aug. 07, 2018
RF signal cable Woken	8D-FB	Cable-CH9-01	Aug. 09, 2016 Aug. 01, 2017	Aug. 08, 2017 Jul. 31, 2018
Software BV ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	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
High Speed Peak Power Meter	ML2495A	1145013	Mar. 07, 2017	Mar. 06, 2018
Power Sensor	MA2411B	1126085	Mar. 07, 2017	Mar. 06, 2018

- Note:
1. The calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Chamber 9.
 3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
 4. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
 5. The IC Site Registration No. is IC 7450F-9.

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. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

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

For Radiated emission 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:

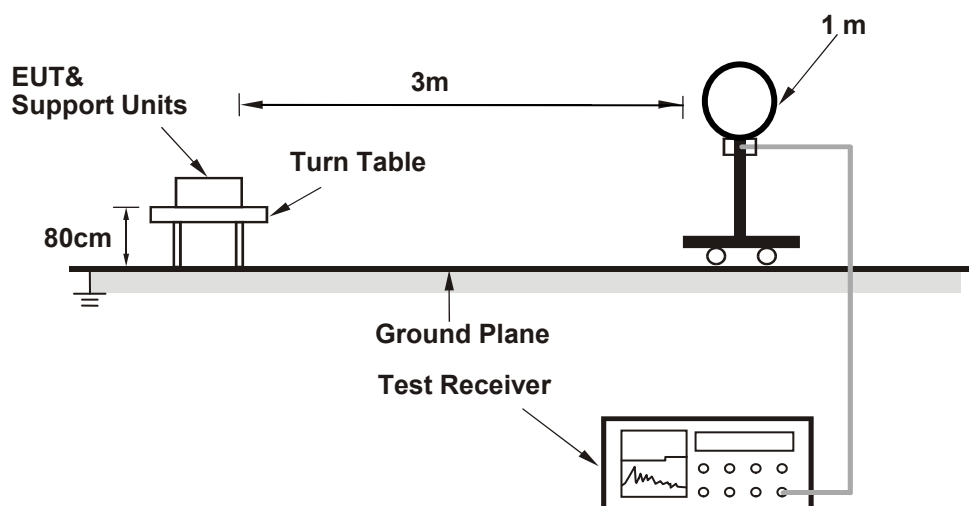
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

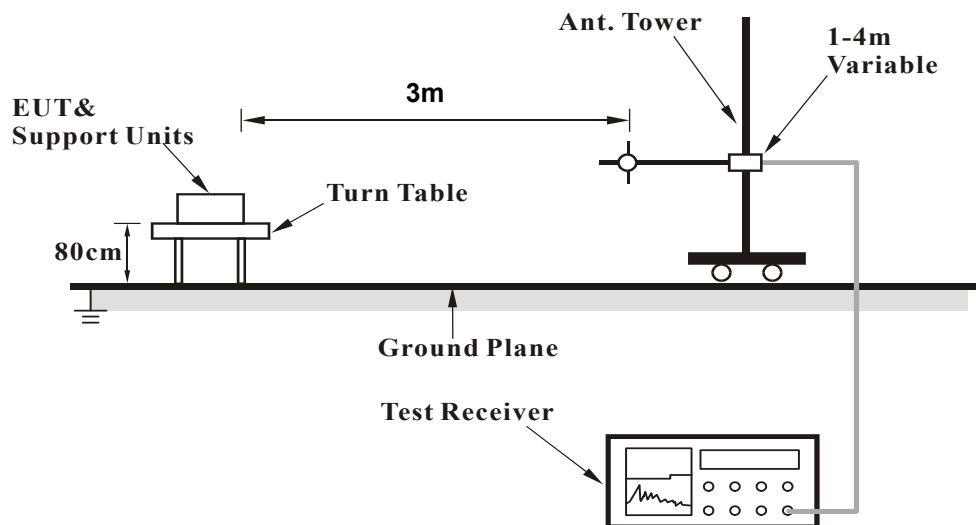
No deviation.

4.1.5 Test Set Up

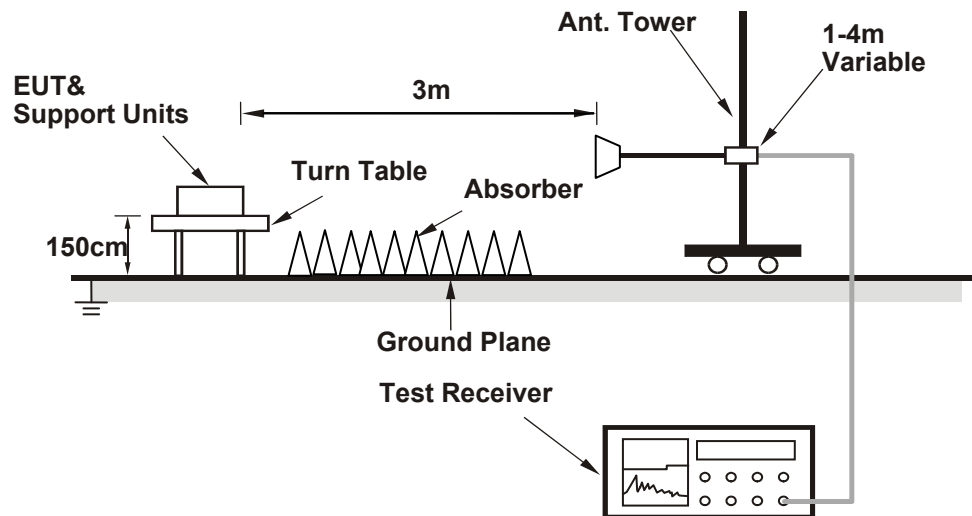
For Radiated emission below 30MHz



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

- Connected the EUT with the notebook and placed them on the testing table.
- The notebook ran a test program to enable EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Worst-Case Data

CHANNEL	TX Channel 0	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	2390.00	59.7 PK	74.0	-14.3	1.26 H	207	27.5	32.2
2	2390.00	47.2 AV	54.0	-6.8	1.26 H	207	15.0	32.2
3	*2402.00	102.3 PK			1.26 H	207	70.0	32.3
4	*2402.00	100.8 AV			1.26 H	207	68.5	32.3
5	4804.00	49.6 PK	74.0	-24.4	1.26 H	254	47.5	2.1
6	4804.00	42.6 AV	54.0	-11.4	1.26 H	254	40.5	2.1
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	2390.00	58.6 PK	74.0	-15.4	3.86 V	186	26.4	32.2
2	2390.00	46.4 AV	54.0	-7.6	3.86 V	186	14.2	32.2
3	*2402.00	99.8 PK			3.86 V	186	67.5	32.3
4	*2402.00	97.7 AV			3.86 V	186	65.4	32.3
5	4804.00	48.7 PK	74.0	-25.3	2.89 V	78	46.6	2.1
6	4804.00	41.3 AV	54.0	-12.7	2.89 V	78	39.2	2.1

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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	Average (AV)

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	*2440.00	103.1 PK			1.30 H	208	70.6	32.5
2	*2440.00	101.7 AV			1.30 H	208	69.2	32.5
3	4880.00	50.0 PK	74.0	-24.0	1.06 H	243	47.8	2.2
4	4880.00	43.4 AV	54.0	-10.6	1.06 H	243	41.2	2.2
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	*2440.00	100.0 PK			3.76 V	173	67.5	32.5
2	*2440.00	98.3 AV			3.76 V	173	65.8	32.5
3	4880.00	48.5 PK	74.0	-25.5	2.74 V	81	46.3	2.2
4	4880.00	40.8 AV	54.0	-13.2	2.74 V	81	38.6	2.2

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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

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	*2480.00	103.5 PK			1.26 H	210	70.8	32.7
2	*2480.00	101.6 AV			1.26 H	210	68.9	32.7
3	2483.50	60.9 PK	74.0	-13.1	1.26 H	210	28.2	32.7
4	2483.50	48.2 AV	54.0	-5.8	1.26 H	210	15.5	32.7
5	4960.00	50.4 PK	74.0	-23.6	1.00 H	254	47.9	2.5
6	4960.00	44.0 AV	54.0	-10.0	1.00 H	254	41.5	2.5
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	*2480.00	101.2 PK			3.62 V	194	68.5	32.7
2	*2480.00	100.4 AV			3.62 V	194	67.7	32.7
3	2483.50	59.5 PK	74.0	-14.5	3.62 V	194	26.8	32.7
4	2483.50	47.4 AV	54.0	-6.6	3.62 V	194	14.7	32.7
5	4960.00	49.0 PK	74.0	-25.0	2.80 V	97	46.5	2.5
6	4960.00	42.8 AV	54.0	-11.2	2.80 V	97	40.3	2.5

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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

Below 1GHz worst-case data

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 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	88.20	37.7 QP	43.5	-5.8	1.50 H	65	56.9	-19.2
2	181.32	37.4 QP	43.5	-6.1	1.50 H	155	52.3	-14.9
3	239.52	39.5 QP	46.0	-6.5	1.01 H	129	54.2	-14.7
4	264.74	39.1 QP	46.0	-6.9	1.01 H	185	52.6	-13.5
5	288.02	37.8 QP	46.0	-8.2	1.01 H	177	50.3	-12.5
6	648.86	41.9 QP	46.0	-4.1	1.50 H	216	48.7	-6.8
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	37.6 QP	40.0	-2.4	1.00 V	182	53.1	-15.5
2	92.08	38.9 QP	43.5	-4.6	1.00 V	110	57.9	-19.0
3	152.22	37.1 QP	43.5	-6.4	1.00 V	178	50.5	-13.4
4	600.36	38.0 QP	46.0	-8.0	1.49 V	184	45.5	-7.5
5	648.86	38.3 QP	46.0	-7.7	1.49 V	182	45.1	-6.8
6	769.14	39.7 QP	46.0	-6.3	1.00 V	180	44.2	-4.5

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 emission levels were very low against the limit of frequency range 9kHz ~ 30MHz.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 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	95.96	38.0 QP	43.5	-5.5	1.49 H	94	56.5	-18.5
2	249.22	42.6 QP	46.0	-3.4	1.00 H	259	56.9	-14.3
3	288.02	39.3 QP	46.0	-6.7	1.00 H	182	51.8	-12.5
4	499.48	37.7 QP	46.0	-8.3	1.49 H	15	47.1	-9.4
5	648.86	42.8 QP	46.0	-3.2	1.00 H	216	49.6	-6.8
6	769.14	43.4 QP	46.0	-2.6	1.00 H	196	47.9	-4.5
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	31.30	34.7 QP	40.0	-5.3	1.00 V	193	50.2	-15.5
2	50.87	35.3 QP	40.0	-4.7	1.00 V	51	48.9	-13.6
3	66.56	34.4 QP	40.0	-5.6	1.00 V	312	49.5	-15.1
4	95.96	40.6 QP	43.5	-2.9	1.00 V	198	59.1	-18.5
5	154.16	39.5 QP	43.5	-4.0	1.00 V	198	52.8	-13.3
6	648.86	38.6 QP	46.0	-7.4	1.49 V	176	45.4	-6.8

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
– Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz.

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.	Date Of Calibration	Due Date Of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 21, 2016	Nov. 20, 2017
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Dec. 22, 2016	Dec. 21, 2017
LISN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Mar. 10, 2017	Mar. 09, 2018
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100220	Nov. 08, 2016	Nov. 07, 2017
Software ADT	BV ADT_Cond_ V7.3.7.3	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 1.

3. The VCCI Site Registration No. is C-2040.

4.2.3 Test Procedures

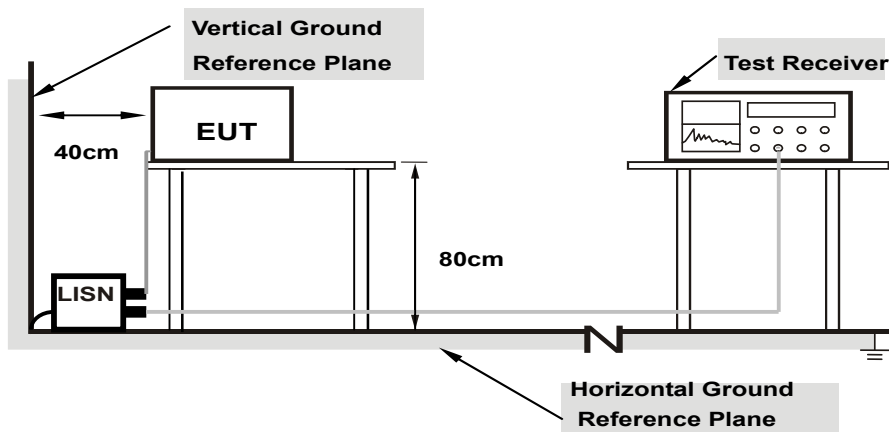
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

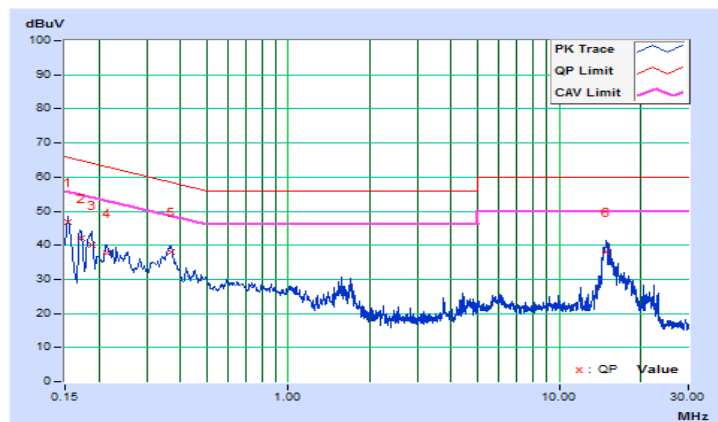
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 19	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	0.15391	10.41	36.24	22.10	46.65	32.51	65.79	55.79	-19.14	-23.28
2	0.17346	10.42	31.74	18.87	42.16	29.29	64.79	54.79	-22.63	-25.50
3	0.18754	10.42	29.70	17.40	40.12	27.82	64.14	54.14	-24.02	-26.32
4	0.21282	10.44	27.12	19.09	37.56	29.53	63.09	53.09	-25.53	-23.56
5	0.36896	10.50	27.61	20.76	38.11	31.26	58.52	48.52	-20.41	-17.26
6	14.88197	11.15	26.74	15.38	37.89	26.53	60.00	50.00	-22.11	-23.47

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.

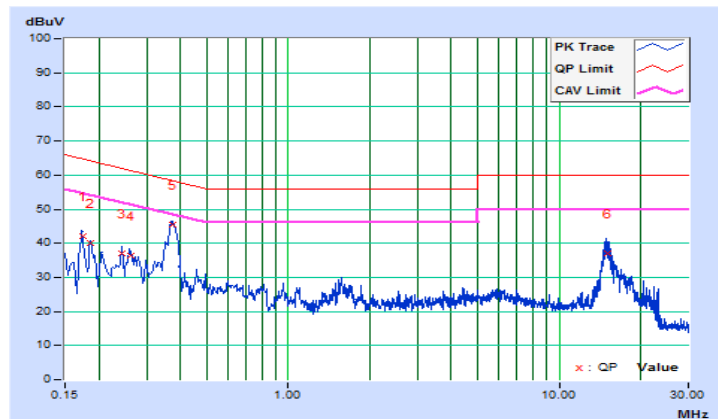


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 19	Test Mode	A

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	0.17374	10.18	31.87	18.79	42.05	28.97	64.78	54.78	-22.73	-25.81
2	0.18508	10.19	29.75	15.58	39.94	25.77	64.25	54.25	-24.31	-28.48
3	0.24215	10.21	26.72	16.77	36.93	26.98	62.02	52.02	-25.09	-25.04
4	0.26339	10.21	26.03	17.29	36.24	27.50	61.32	51.32	-25.08	-23.82
5	0.37304	10.23	35.25	29.94	45.48	40.17	58.43	48.43	-12.95	-8.26
6	15.05101	10.84	26.29	14.20	37.13	25.04	60.00	50.00	-22.87	-24.96

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.

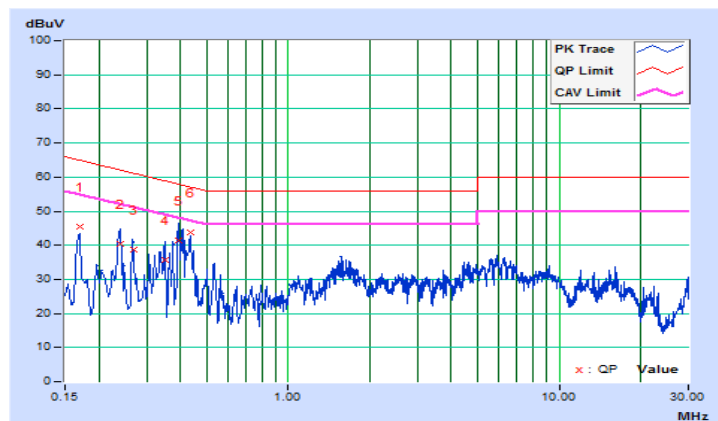


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 19	Test Mode	B

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	0.16967	10.41	35.08	23.21	45.49	33.62	64.98	54.98	-19.49	-21.36
2	0.23898	10.45	30.04	17.29	40.49	27.74	62.13	52.13	-21.64	-24.39
3	0.26765	10.46	28.38	20.42	38.84	30.88	61.19	51.19	-22.35	-20.31
4	0.34926	10.49	25.19	13.52	35.68	24.01	58.98	48.98	-23.30	-24.97
5	0.39219	10.51	30.94	18.62	41.45	29.13	58.02	48.02	-16.57	-18.89
6	0.43350	10.51	33.36	27.12	43.87	37.63	57.19	47.19	-13.32	-9.56

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.

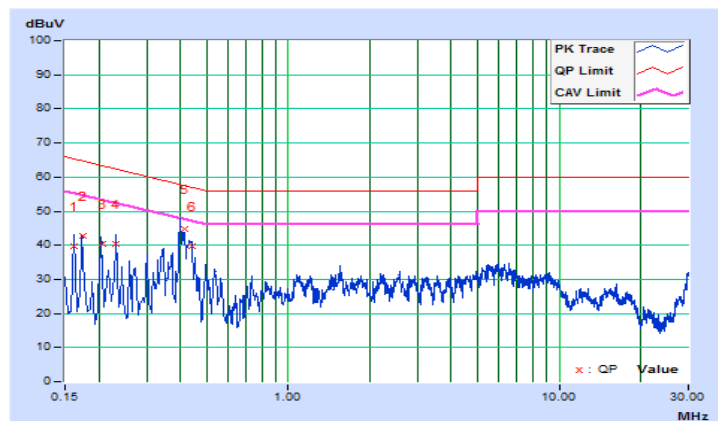


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 19	Test Mode	B

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	0.16096	10.16	29.56	15.42	39.72	25.58	65.41	55.41	-25.69	-29.83
2	0.17374	10.18	32.48	16.93	42.66	27.11	64.78	54.78	-22.12	-27.67
3	0.20511	10.20	30.17	16.65	40.37	26.85	63.40	53.40	-23.03	-26.55
4	0.22972	10.20	30.27	17.58	40.47	27.78	62.46	52.46	-21.99	-24.68
5	0.41197	10.23	34.48	18.53	44.71	28.76	57.61	47.61	-12.90	-18.85
6	0.43924	10.23	29.55	20.96	39.78	31.19	57.08	47.08	-17.30	-15.89

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.

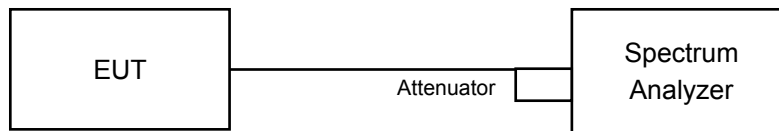


4.3 6dB Bandwidth Measurement

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

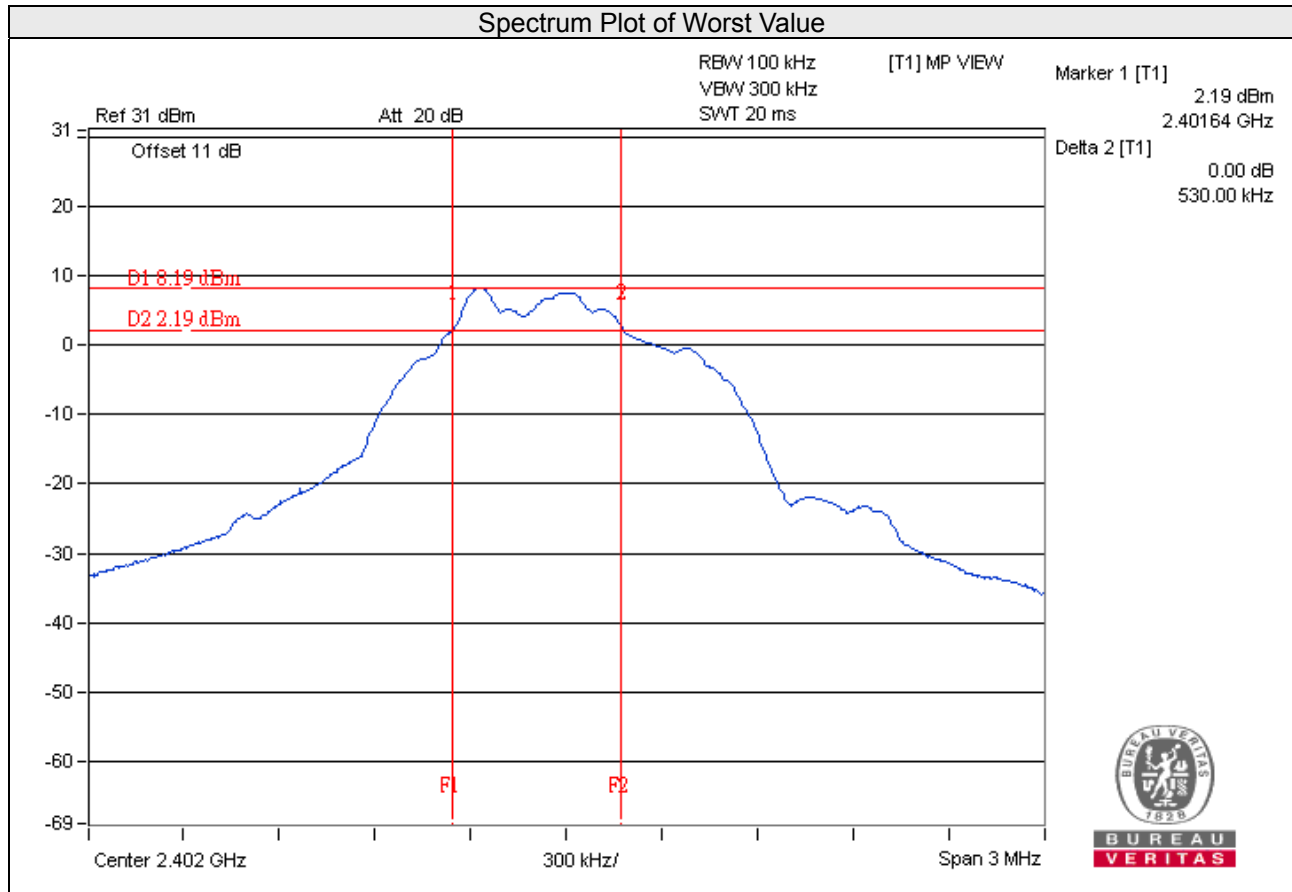
No deviation.

4.3.6 EUT Operating Conditions

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

4.3.7 Test Result

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.53	0.5	Pass
19	2440	0.53	0.5	Pass
39	2480	0.53	0.5	Pass

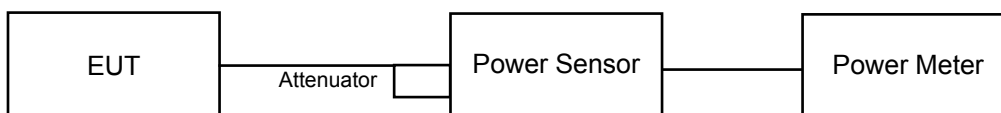


4.4 Conducted Output Power Measurement

4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 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

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

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

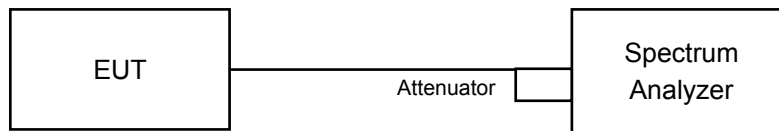
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	7.096	8.51	30	Pass
19	2440	6.622	8.21	30	Pass
39	2480	5.662	7.53	30	Pass

4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

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

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 analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.5 Deviation from Test Standard

No deviation.

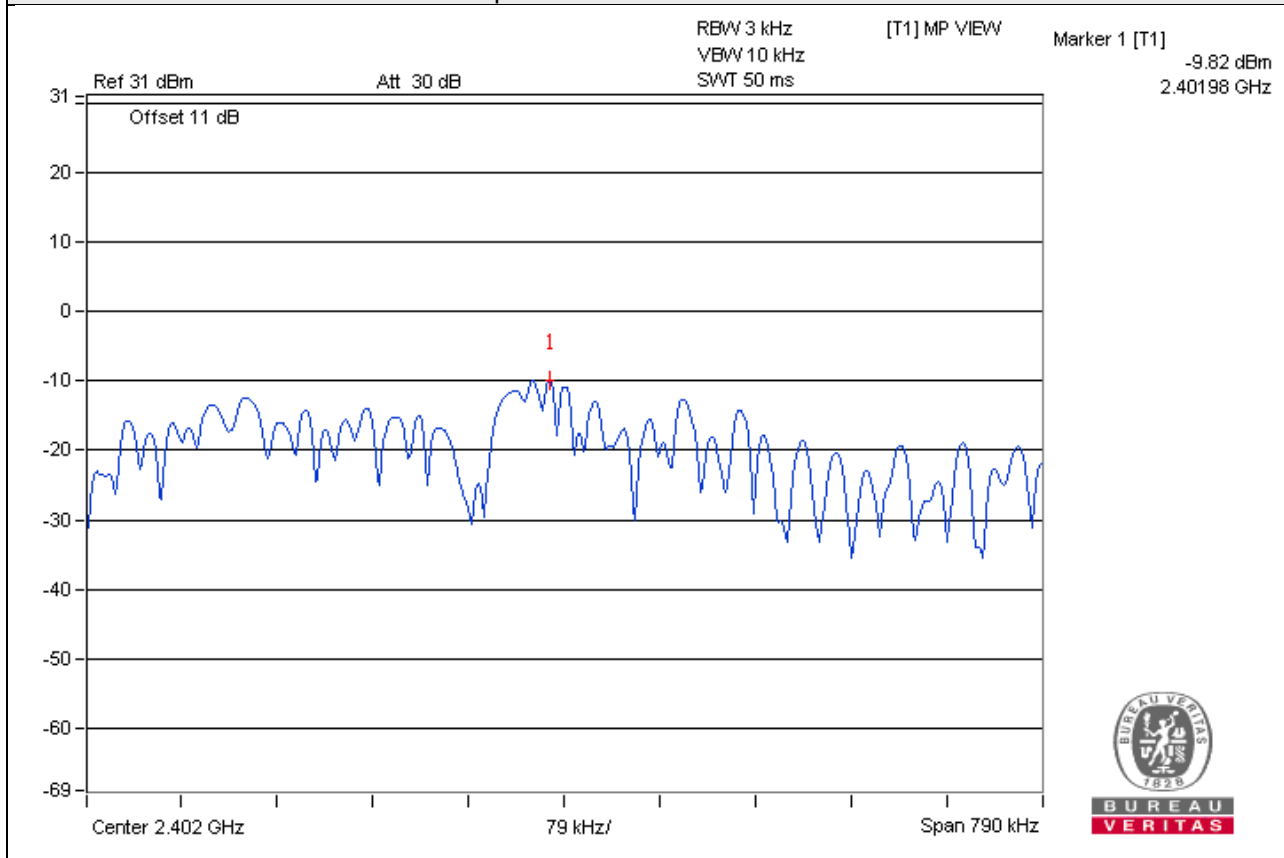
4.5.6 EUT Operating Condition

Same as Item 4.3.6

4.5.7 Test Results

Channel	Freq. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass /Fail
0	2402	-9.82	8	Pass
19	2440	-10.14	8	Pass
39	2480	-10.93	8	Pass

Spectrum Plot of Worst Value

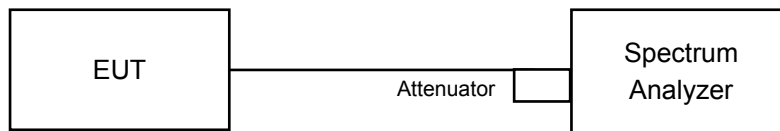


4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB 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.

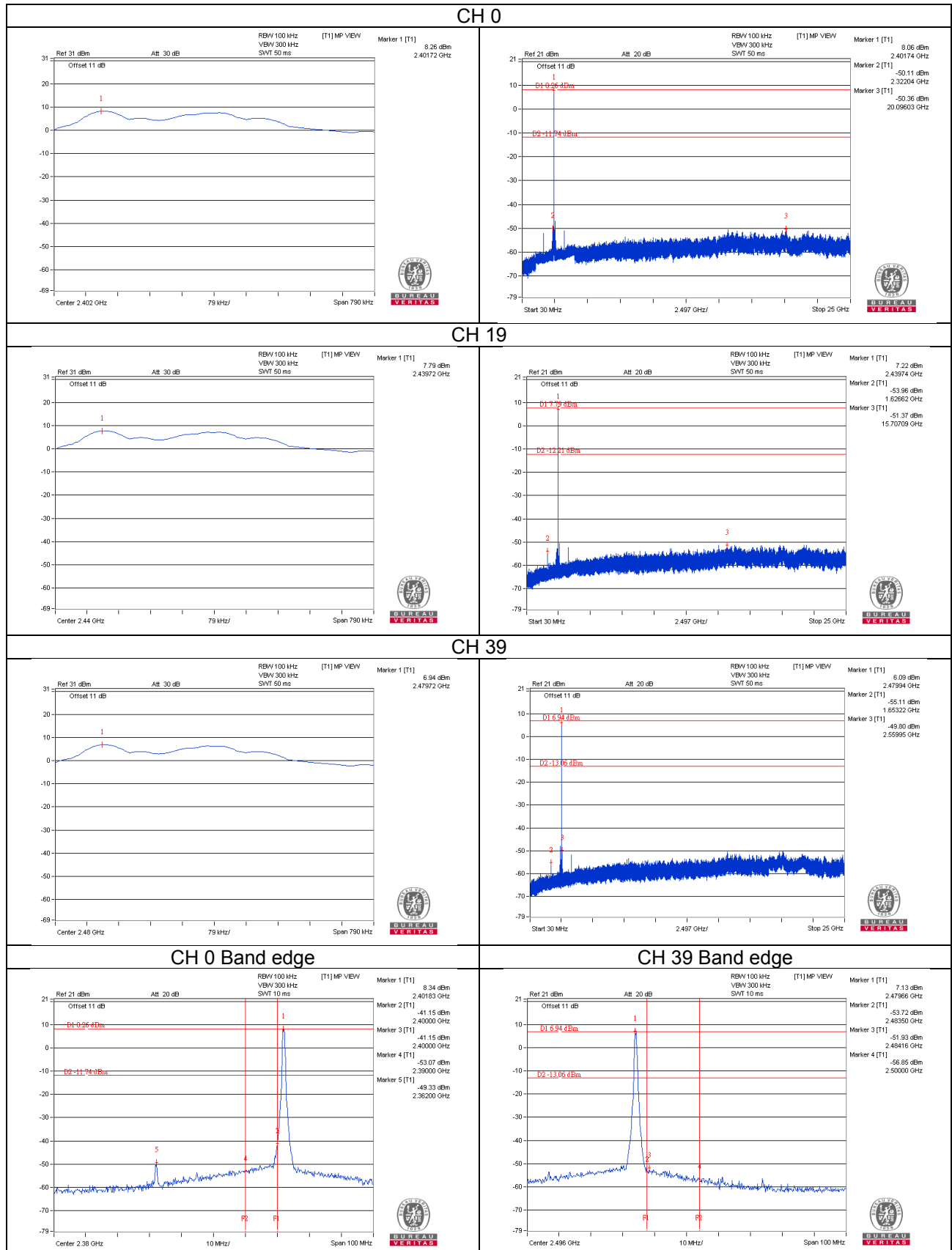
4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

Same as Item 4.3.6

4.6.7 Test Results



5 Pictures of Test Arrangements

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

Appendix – Information on the Testing Laboratories

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

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

Linko EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

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