

FCC Test Report

Report No.: RF190328C24

FCC ID: M82-EPD-023-053

Test Model: EPD-023, EPD-053

Series Model: EPD023, EPD053 (Refer to item 3.1 for the more details)

Received Date: Mar. 28, 2019

Test Date: Apr. 12 ~ May 25, 2019

Issued Date: May 27, 2019

Applicant: ADVANTECH CO., LTD

Address: No. 1, Alley 20, Lane 26, Rueiguang Rd, Neihu District, Taipei, Taiwan 114

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.)

**FCC Registration /
Designation Number:** 788550 / TW0003



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Release Control Record

Issue No.	Description	Date Issued
RF190328C24	Original release	May 27, 2019

1 Certificate of Conformity

Product: Wireless ePaper Control Board

Brand: Advantech

Test Model: EPD-023, EPD-053

Series Model: EPD023, EPD053 (Refer to item 3.1 for the more details)

Sample Status: Engineering sample

Applicant: ADVANTECH CO., LTD

Test Date: Apr. 12 ~ May 25, 2019

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:** May 27, 2019
Pettie Chen / Senior Specialist

Approved by : Bruce Chen , **Date:** May 27, 2019
Bruce Chen / 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	NA	EUT is powered from battery
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -0.4dB at 2483.50MHz.
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	For Model EPD-023, EPD023: No antenna connector is used For Model EPD-053, EPD053: Antenna connector is IPEX 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	2.94 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	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	Wireless ePaper Control Board
Brand	Advantech
Test Model	EPD-023, EPD-053
Series Model	EPD023, EPD053
Model Difference	Refer to Note for the more details
Status of EUT	Engineering sample
Power Supply Rating	3Vdc from DC power supply
Modulation Type	O-QPSK
Operating Frequency	2405 ~ 2480MHz
Number of Channel	16
Output Power	For Model EPD-023: 3.837mW For Model EPD-053: 3.828 mW
Antenna Type	For Model EPD-023: Chip antenna with -0.25dBi gain For Model EPD-053: PCB dipole antenna with 3.71dBi gain
Antenna Connector	For Model EPD-023: NA For Model EPD-053: IPEX
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. All models are listed as below.

Brand	Product name	Model	Antenna type	Difference
Advantech	Wireless ePaper Control Board	EPD-023	Chip antenna	Marketing purpose
		EPD023		
Advantech	Wireless ePaper Control Board	EPD-053	PCB dipole	
		EPD053		

Model: EPD-023 and EPD023 are electrically identical, different model names are for marketing purpose.

Model: EPD-053 and EPD053 are electrically identical, different model names are for marketing purpose.

Model: EPD-023 and EPD-053 are chosen for the final tests.

2. The EUT is authorized for use in specific End-product. Please refer to below table for more details.

Product Name	Brand	Model No.	Description
2.9" Epd control system device	Advantech	EPD-023B2	For EUT Model: EPD-023, EPD023
5.6" Epd control system device	Advantech	EPD-053R2	For EUT Model: EPD-053, EPD053

3.2 Description of Test Modes

16 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
11	2405	15	2425	19	2445	23	2465
12	2410	16	2430	20	2450	24	2470
13	2415	17	2435	21	2455	25	2475
14	2420	18	2440	22	2460	26	2480

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION	
	RE $\geq$ 1G	RE $<$ 1G	PLC	APCM	EUT Model	Test Condition
A	√	√	Note 2	√	EPD-023	EUT with system
B	√	√	Note 2	√	EPD-053	EUT with system

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 **Y-plane (For Test Mode A), X-plane (For Test Mode B)**.
- No need to concern of PLC due to the EUT is powered from DC.

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, B	11 to 26	11, 18, 26	O-QPSK

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	11 to 26	11	O-QPSK

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, B	11 to 26	11, 18, 26	O-QPSK

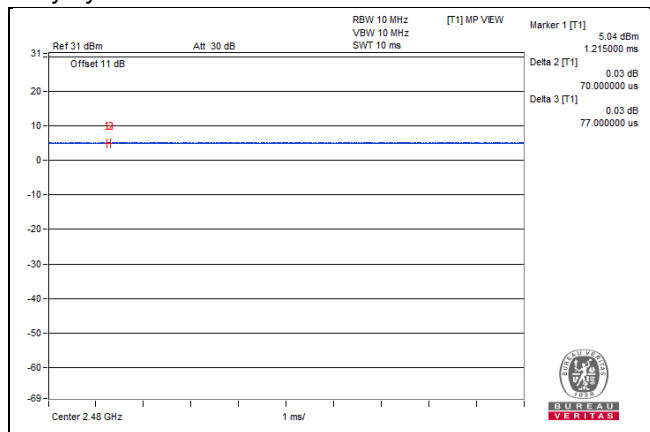
Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	22 deg. C, 66% RH	3Vdc	Han Wu
RE<1G	22 deg. C, 66% RH 25 deg. C, 70% RH	3Vdc	Han Wu Match Tsui
APCM	25 deg. C, 60% RH	3Vdc	Alan Wu

3.1 Duty Cycle of Test Signal

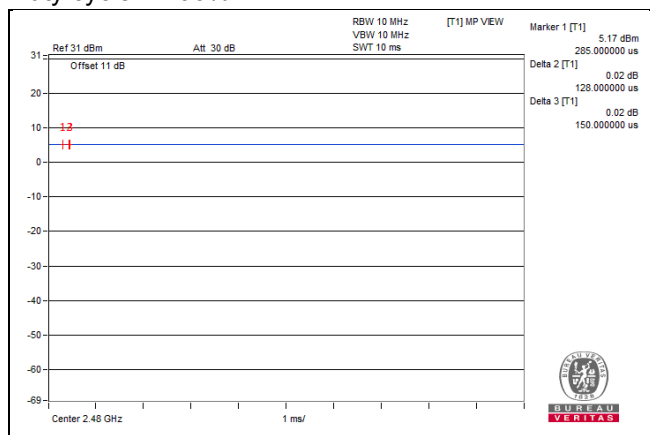
Test Mode A

Duty cycle = 100%



Test Mode B

Duty cycle = 100%



3.2 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.2.1 Configuration of System under Test



3.3 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)

KDB 558074 D01 15.247 Meas Guidance v05r02

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

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.	Date Of Calibration	Due Date Of Calibration
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 15, 2019	Apr. 14, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	May 29, 2018	May 28, 2019
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 21, 2018	Nov. 20, 2019
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 25, 2018	Nov. 24, 2019
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 25, 2018	Nov. 24, 2019
Loop Antenna TESEQ	HLA 6121	45745	Jun. 14, 2018	Jun. 13, 2019
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Aug. 08, 2018	Aug. 07, 2019
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 19, 2019	Feb. 18, 2020
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM80 00	CABLE-CH9-02 (248780+171006)	Jan. 19, 2019	Jan. 18, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(25079 5/4)	Aug. 08, 2018	Aug. 07, 2019
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 31, 2018	Jul. 30, 2019
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	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
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55 190004/MY5519000 7/MY55210005	Jul. 17, 2018	Jul. 16, 2019

- 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 Chamber 9.
3. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
4. The IC Site Registration No. is 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. 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:

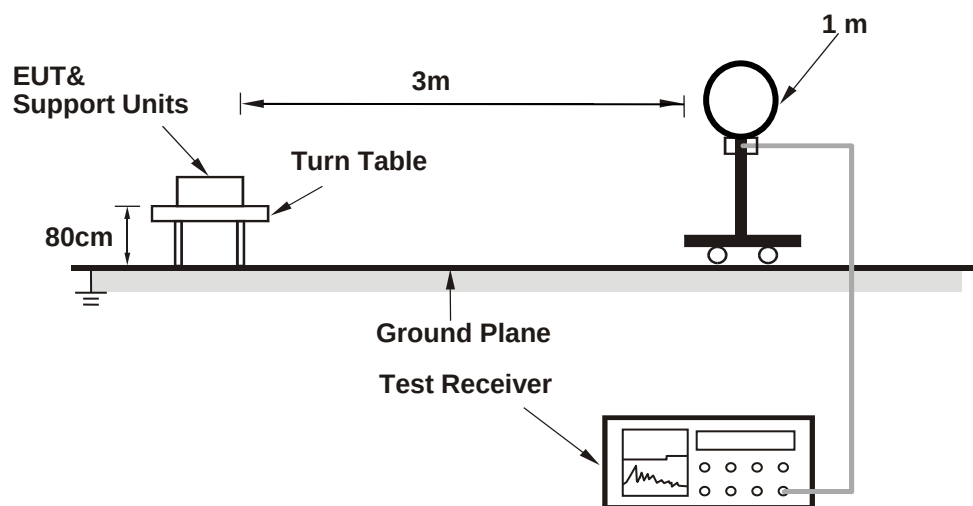
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

4.1.4 Deviation from Test Standard

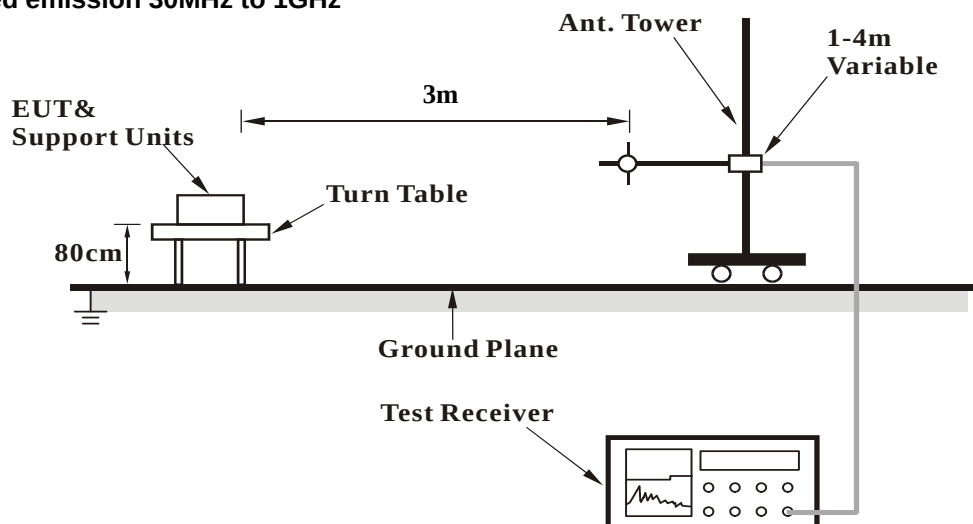
No deviation.

4.1.5 Test Set Up

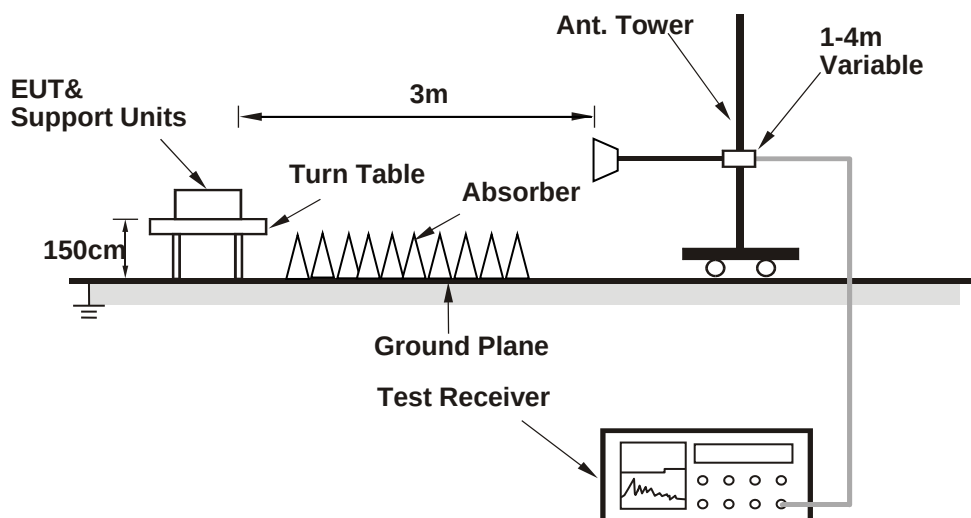
For Radiated emission below 30MHz



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

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

4.1.7 Test Results

Above 1GHz Data

CHANNEL	TX Channel 11	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	2390.00	54.6 PK	74.0	-19.4	1.02 H	157	22.8	31.8
2	2390.00	42.1 AV	54.0	-11.9	1.02 H	157	10.3	31.8
3	*2405.00	87.6 PK			1.04 H	160	55.8	31.8
4	*2405.00	83.6 AV			1.04 H	160	51.8	31.8
5	4810.00	43.8 PK	74.0	-30.2	3.57 H	100	40.1	3.7
6	4810.00	30.8 AV	54.0	-23.2	3.57 H	100	27.1	3.7
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	54.9 PK	74.0	-19.1	1.07 V	187	23.1	31.8
2	2390.00	42.3 AV	54.0	-11.7	1.07 V	187	10.5	31.8
3	*2405.00	98.1 PK			1.00 V	184	66.3	31.8
4	*2405.00	94.2 AV			1.00 V	184	62.4	31.8
5	4810.00	47.5 PK	74.0	-26.5	1.05 V	309	43.8	3.7
6	4810.00	38.0 AV	54.0	-16.0	1.05 V	309	34.3	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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 18	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	*2440.00	87.4 PK			1.03 H	161	55.6	31.8
2	*2440.00	83.2 AV			1.03 H	161	51.4	31.8
3	4880.00	44.1 PK	74.0	-29.9	3.50 H	94	40.6	3.5
4	4880.00	30.0 AV	54.0	-24.0	3.50 H	94	26.5	3.5
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	*2440.00	97.5 PK			1.04 V	181	65.7	31.8
2	*2440.00	93.3 AV			1.04 V	181	61.5	31.8
3	4880.00	47.4 PK	74.0	-26.6	1.10 V	310	43.9	3.5
4	4880.00	37.0 AV	54.0	-17.0	1.10 V	310	33.5	3.5

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.

CHANNEL	TX Channel 26	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	*2480.00	89.4 PK			1.00 H	161	57.6	31.8
2	*2480.00	85.0 AV			1.00 H	161	53.2	31.8
3	2483.50	54.5 PK	74.0	-19.5	1.04 H	157	22.7	31.8
4	2483.50	43.7 AV	54.0	-10.3	1.04 H	157	11.9	31.8
5	4960.00	43.9 PK	74.0	-30.1	3.56 H	97	40.1	3.8
6	4960.00	30.3 AV	54.0	-23.7	3.56 H	97	26.5	3.8
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	*2480.00	99.8 PK			1.04 V	185	68.0	31.8
2	*2480.00	95.5 AV			1.04 V	185	63.7	31.8
3	2483.50	61.9 PK	74.0	-12.1	1.05 V	185	30.1	31.8
4	2483.50	53.6 AV	54.0	-0.4	1.05 V	185	21.8	31.8
5	4960.00	47.8 PK	74.0	-26.2	1.09 V	309	44.0	3.8
6	4960.00	37.9 AV	54.0	-16.1	1.09 V	309	34.1	3.8

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

CHANNEL	TX Channel 11	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	2390.00	56.9 PK	74.0	-17.1	1.22 H	37	25.1	31.8
2	2390.00	44.6 AV	54.0	-9.4	1.22 H	37	12.8	31.8
3	*2405.00	104.3 PK			1.25 H	42	72.5	31.8
4	*2405.00	100.7 AV			1.25 H	42	68.9	31.8
5	4810.00	56.4 PK	74.0	-17.6	1.10 H	93	52.7	3.7
6	4810.00	48.2 AV	54.0	-5.8	1.10 H	93	44.5	3.7
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	55.9 PK	74.0	-18.1	1.38 V	175	24.1	31.8
2	2390.00	44.2 AV	54.0	-9.8	1.38 V	175	12.4	31.8
3	*2405.00	94.0 PK			1.29 V	177	62.2	31.8
4	*2405.00	89.9 AV			1.29 V	177	58.1	31.8
5	4810.00	53.3 PK	74.0	-20.7	1.13 V	219	49.6	3.7
6	4810.00	44.5 AV	54.0	-9.5	1.13 V	219	40.8	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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 18	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	*2440.00	103.3 PK			1.18 H	36	71.5	31.8
2	*2440.00	99.2 AV			1.18 H	36	67.4	31.8
3	4880.00	59.3 PK	74.0	-14.7	1.11 H	99	55.8	3.5
4	4880.00	51.6 AV	54.0	-2.4	1.11 H	99	48.1	3.5
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	*2440.00	92.9 PK			1.35 V	179	61.1	31.8
2	*2440.00	88.9 AV			1.35 V	179	57.1	31.8
3	4880.00	55.0 PK	74.0	-19.0	1.19 V	220	51.5	3.5
4	4880.00	47.0 AV	54.0	-7.0	1.19 V	220	43.5	3.5

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.

CHANNEL	TX Channel 26	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz	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	*2480.00	99.7 PK			1.38 H	40	67.9	31.8
2	*2480.00	95.7 AV			1.38 H	40	63.9	31.8
3	2483.50	62.9 PK	74.0	-11.1	1.28 H	44	31.1	31.8
4	2483.50	53.6 AV	54.0	-0.4	1.28 H	44	21.8	31.8
5	4960.00	52.9 PK	74.0	-21.1	1.15 H	88	49.1	3.8
6	4960.00	44.9 AV	54.0	-9.1	1.15 H	88	41.1	3.8
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	*2480.00	90.5 PK			1.36 V	38	58.7	31.8
2	*2480.00	86.3 AV			1.36 V	38	54.5	31.8
3	2483.50	56.9 PK	74.0	-17.1	1.27 V	43	25.1	31.8
4	2483.50	46.1 AV	54.0	-7.9	1.27 V	43	14.3	31.8
5	4960.00	49.0 PK	74.0	-25.0	1.11 V	88	45.2	3.8
6	4960.00	39.9 AV	54.0	-14.1	1.11 V	88	36.1	3.8

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

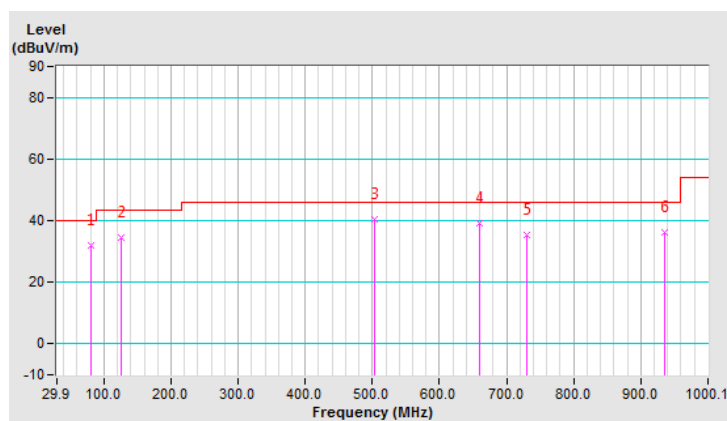
Below 1GHz worst-case data

CHANNEL	TX Channel 11	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	80.35	31.83 QP	40.00	-8.17	1.99 H	339	45.31	-13.48
2	124.98	34.55 QP	43.50	-8.95	1.99 H	343	45.26	-10.71
3	503.36	40.48 QP	46.00	-5.52	1.00 H	30	45.32	-4.84
4	660.53	39.36 QP	46.00	-6.64	1.00 H	152	40.77	-1.41
5	730.38	35.45 QP	46.00	-10.55	1.00 H	51	35.11	0.34
6	936.07	36.17 QP	46.00	-9.83	1.00 H	248	32.22	3.95

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.

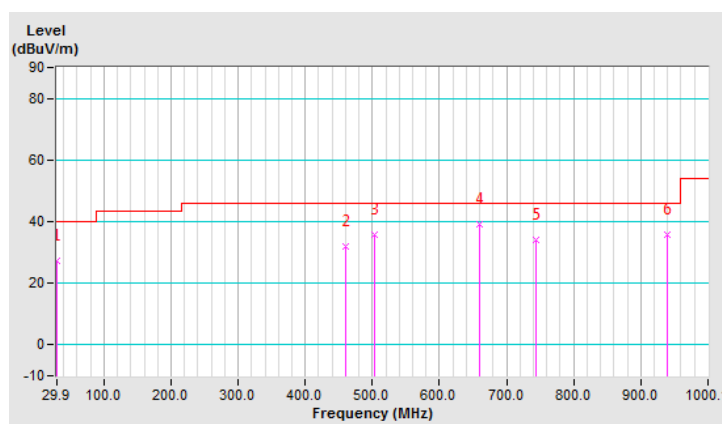


CHANNEL	TX Channel 11	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz	TEST MODE	A

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	29.90	27.24 QP	40.00	-12.76	1.00 V	7	38.36	-11.12
2	460.67	31.88 QP	46.00	-14.12	1.00 V	86	37.42	-5.54
3	503.36	35.93 QP	46.00	-10.07	1.00 V	166	40.77	-4.84
4	660.53	39.18 QP	46.00	-6.82	1.00 V	163	40.59	-1.41
5	743.97	33.94 QP	46.00	-12.06	1.00 V	7	33.11	0.83
6	939.95	35.58 QP	46.00	-10.42	1.00 V	7	31.53	4.05

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.

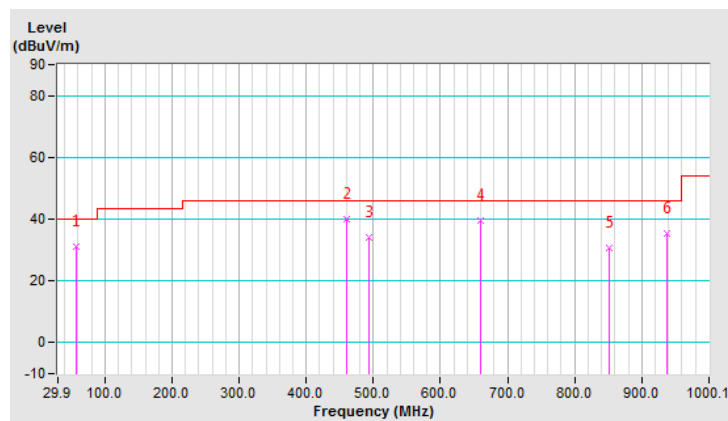


CHANNEL	TX Channel 11	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz	TEST MODE	B

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	57.07	31.18 QP	40.00	-8.82	1.49 H	232	40.74	-9.56
2	460.67	39.99 QP	46.00	-6.01	1.00 H	253	45.53	-5.54
3	493.66	33.93 QP	46.00	-12.07	1.00 H	162	38.99	-5.06
4	660.53	39.55 QP	46.00	-6.45	1.00 H	155	40.96	-1.41
5	850.69	30.57 QP	46.00	-15.43	2.00 H	7	28.06	2.51
6	938.01	35.18 QP	46.00	-10.82	1.49 H	334	31.18	4.00

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.

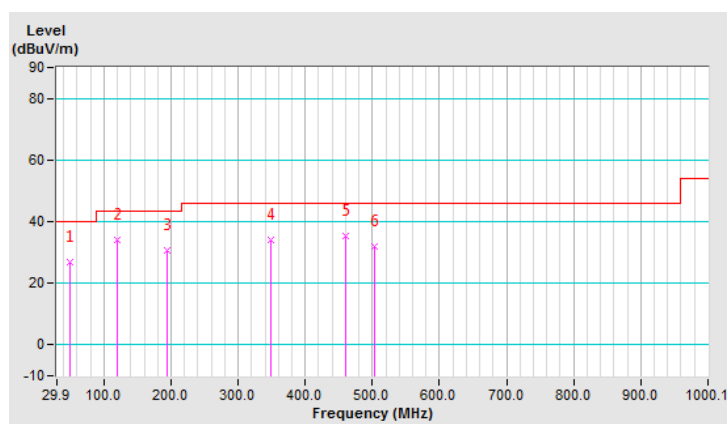


CHANNEL	TX Channel 11	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz	TEST MODE	B

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	49.30	26.81 QP	40.00	-13.19	1.00 V	58	35.80	-8.99
2	119.16	34.09 QP	43.50	-9.41	1.50 V	214	45.37	-11.28
3	194.83	30.80 QP	43.50	-12.70	1.00 V	210	42.08	-11.28
4	348.13	33.94 QP	46.00	-12.06	1.00 V	76	41.37	-7.43
5	460.67	35.21 QP	46.00	-10.79	1.50 V	34	40.75	-5.54
6	503.36	31.86 QP	46.00	-14.14	1.00 V	160	36.70	-4.84

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.

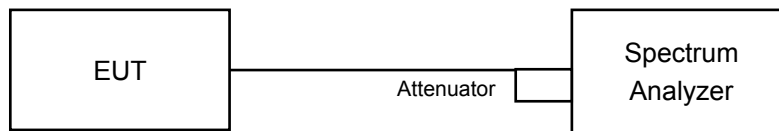


4.2 6dB Bandwidth Measurement

4.2.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 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

4.2.5 Deviation from Test Standard

No deviation.

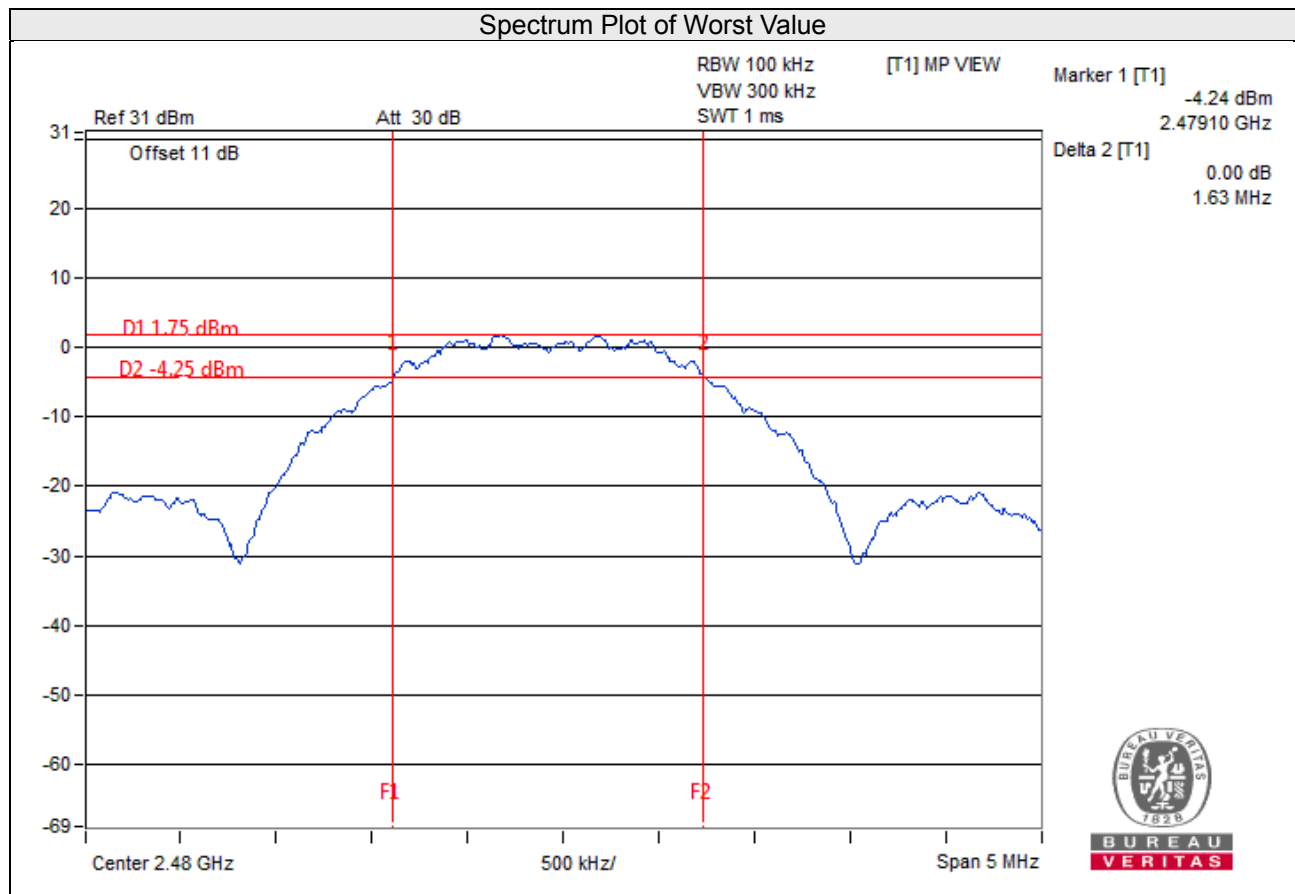
4.2.6 EUT Operating Conditions

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

4.2.7 Test Result

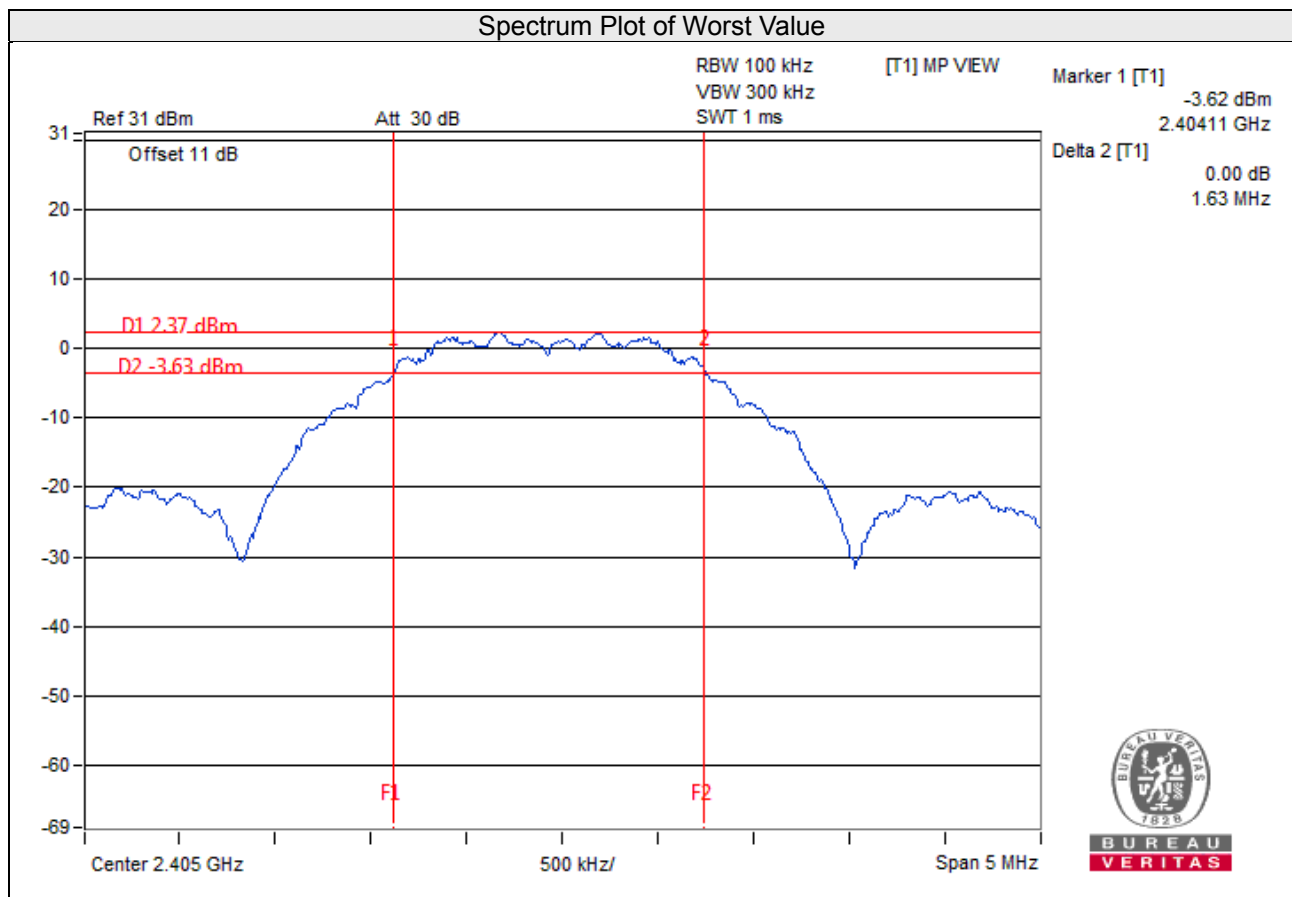
Test Mode A

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
11	2405	1.65	0.5	Pass
18	2440	1.63	0.5	Pass
26	2480	1.63	0.5	Pass



Test Mode B

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
11	2405	1.63	0.5	Pass
18	2440	1.63	0.5	Pass
26	2480	1.65	0.5	Pass

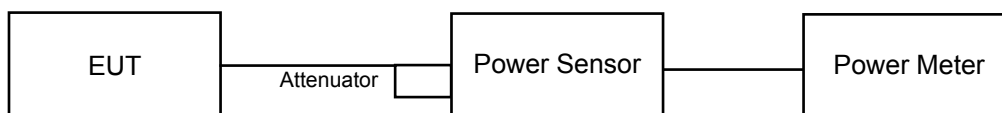


4.3 Conducted Output Power Measurement

4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

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 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.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

Same as Item 4.2.6.

4.3.7 Test Results

Test Mode A

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
11	2405	3.837	5.84	30	Pass
18	2440	3.648	5.62	30	Pass
26	2480	3.573	5.53	30	Pass

Test Mode B

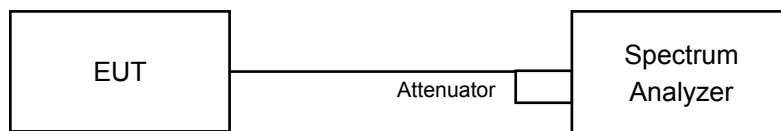
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
11	2405	3.828	5.83	30	Pass
18	2440	3.758	5.75	30	Pass
26	2480	2.286	3.59	30	Pass

4.4 Power Spectral Density Measurement

4.4.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm.

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 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.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Condition

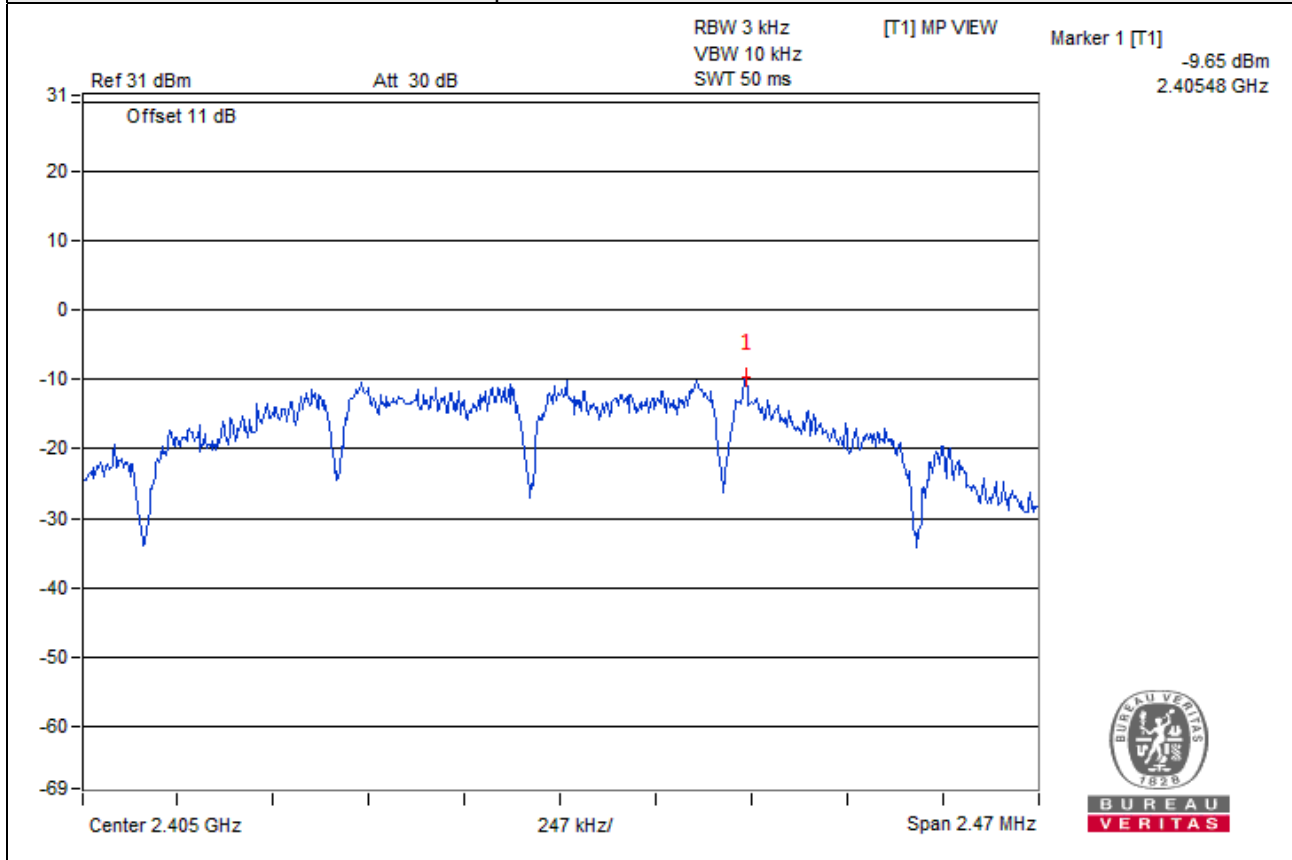
Same as Item 4.2.6

4.4.7 Test Results

Test Mode A

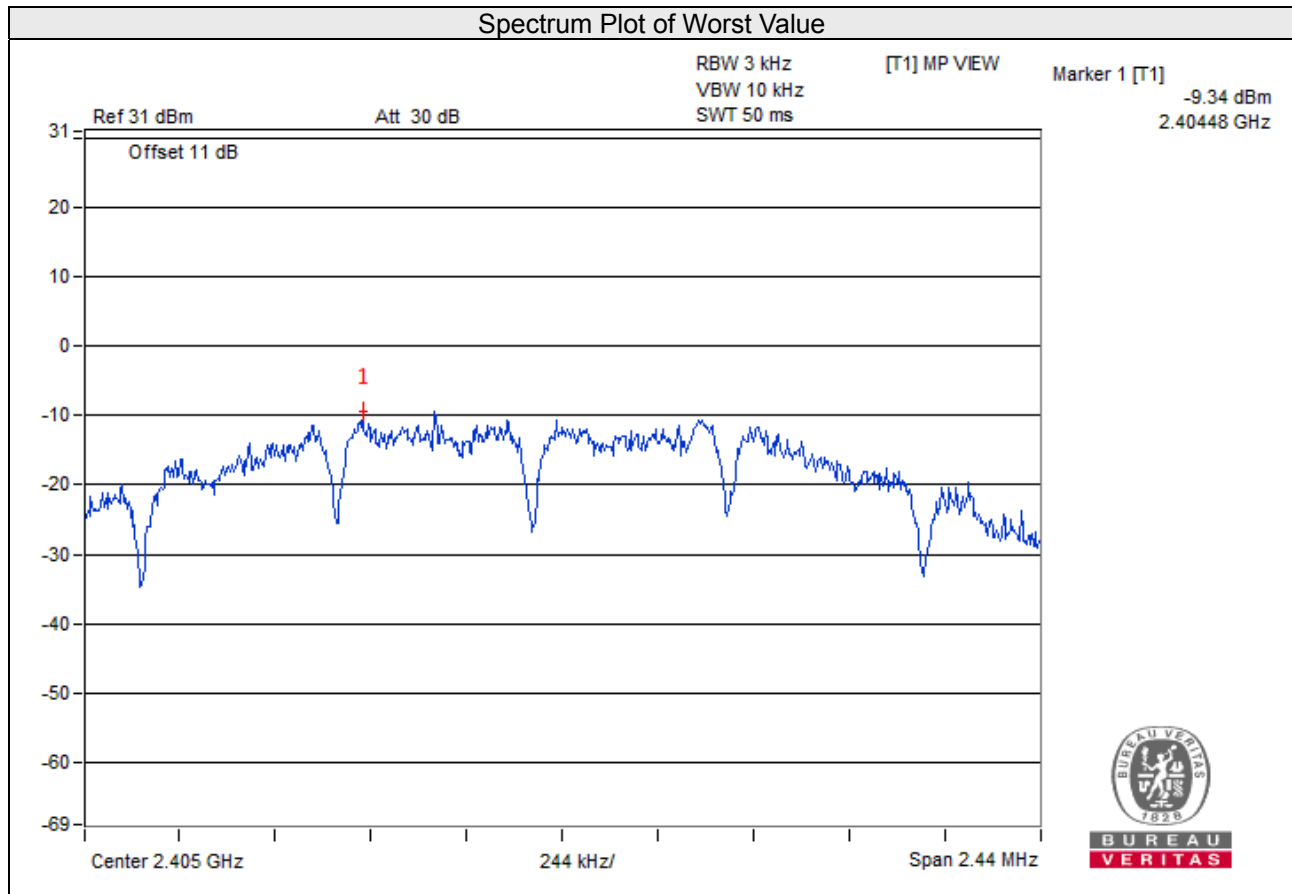
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
11	2405	-9.65	8.00	Pass
18	2440	-9.72	8.00	Pass
26	2480	-9.77	8.00	Pass

Spectrum Plot of Worst Value



Test Mode B

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
11	2405	-9.34	8.00	Pass
18	2440	-9.64	8.00	Pass
26	2480	-9.71	8.00	Pass

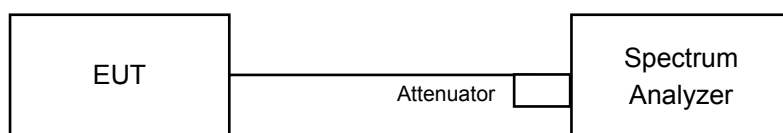


4.5 Conducted Out of Band Emission Measurement

4.5.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

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

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.

4.5.5 Deviation from Test Standard

No deviation.

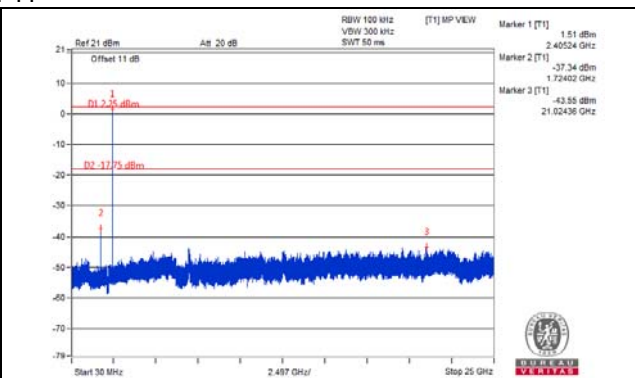
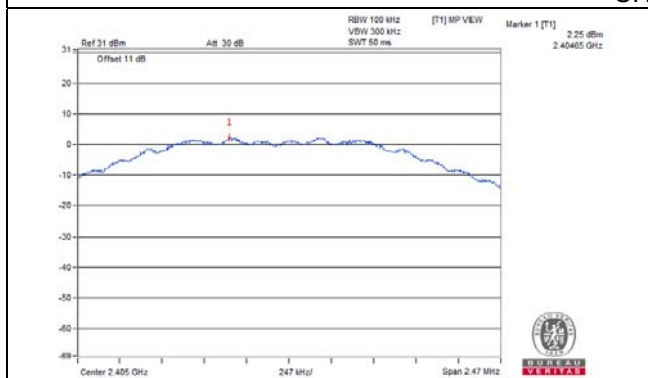
4.5.6 EUT Operating Condition

Same as Item 4.2.6

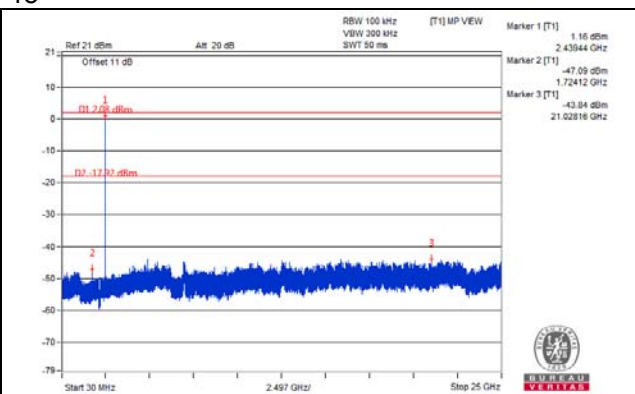
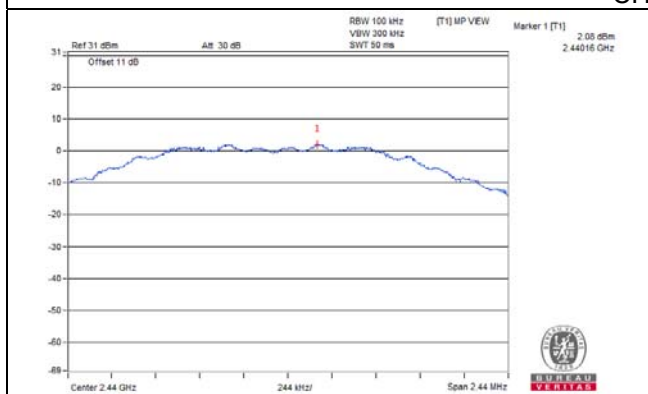
4.5.7 Test Results

Test Mode A

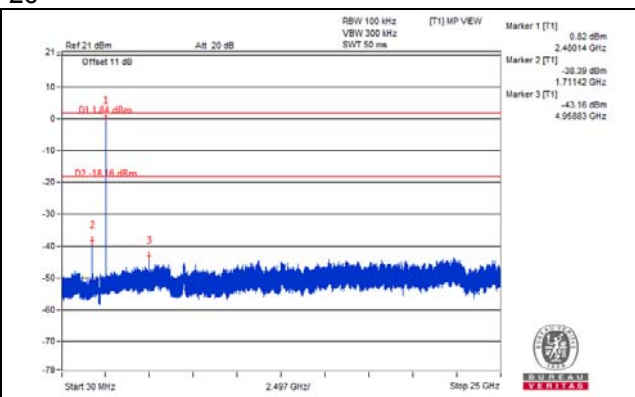
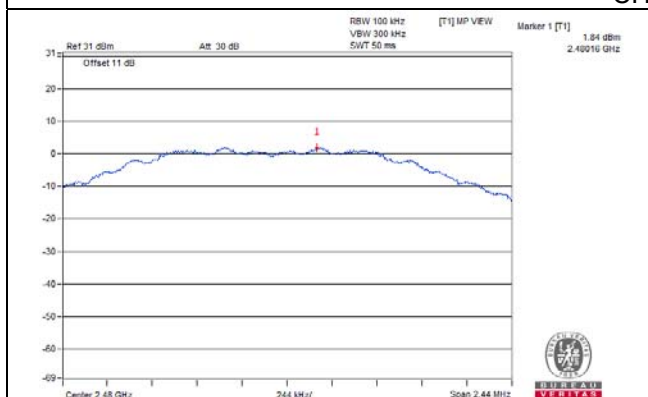
CH 11



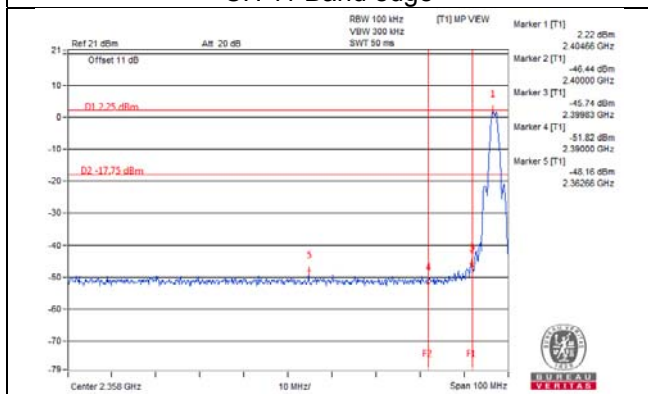
CH 18



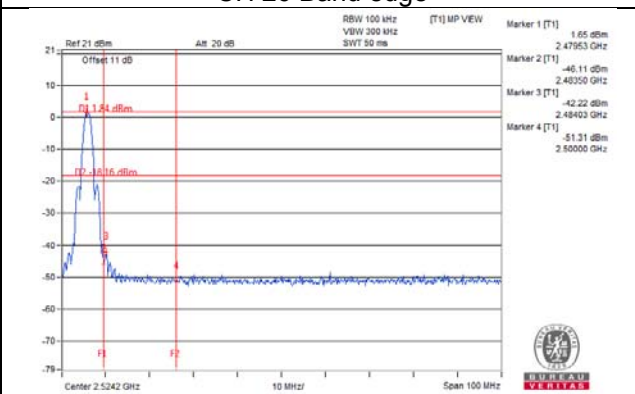
CH 26



CH 11 Band edge

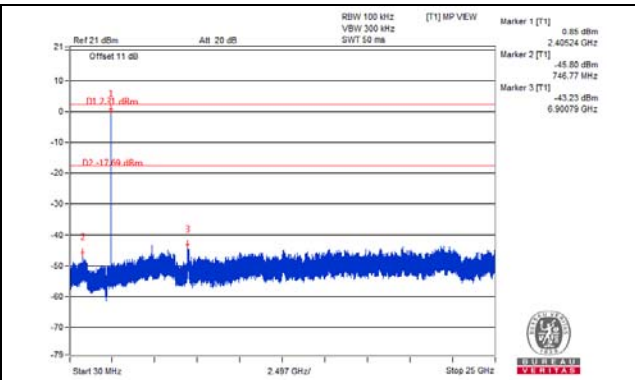
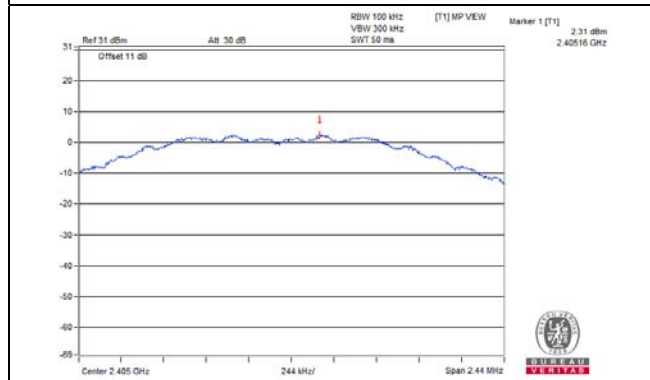


CH 26 Band edge

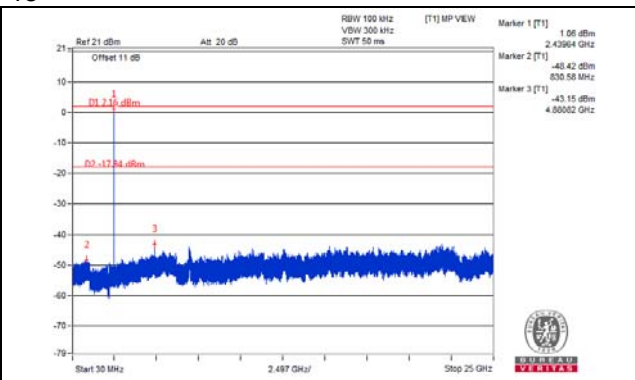
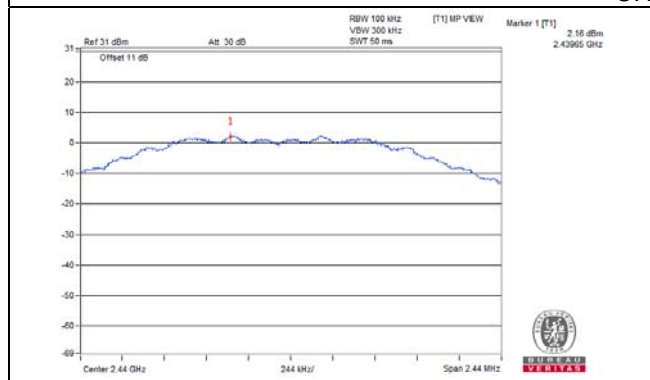


Test Mode B

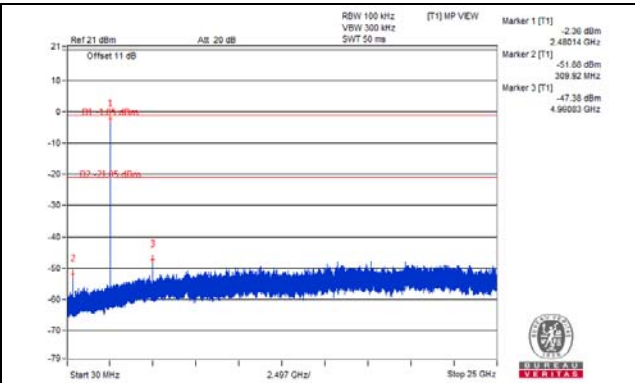
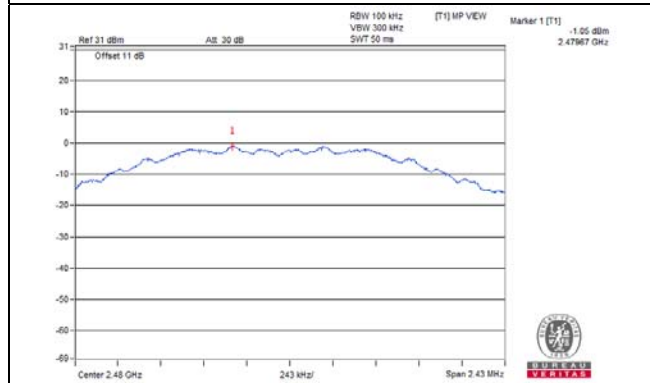
CH 11



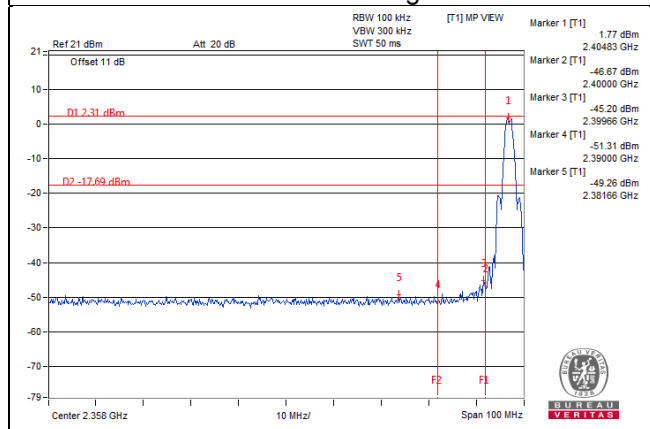
CH 18



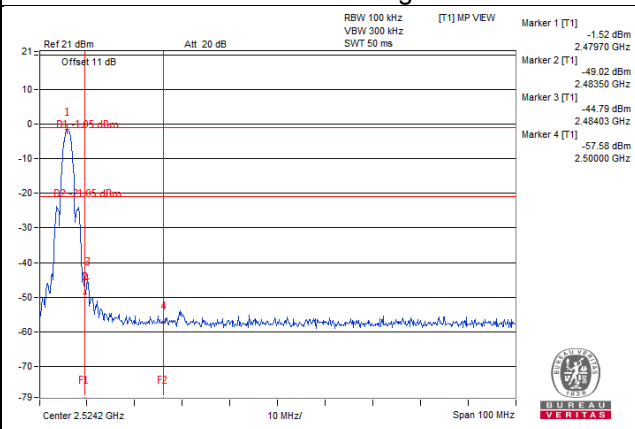
CH 26



CH 11 Band edge



CH 26 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 accredited and approved 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: 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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