FCC Test Report

Report No.:	RF170808E02
FCC ID:	2AM57WDR210
Test Model:	WDR210
Received Date:	Aug. 04, 2017
Test Date:	Aug. 17 to 30, 2017
Issued Date:	Sep. 21, 2017
Applicant:	WOORIRO Co., Ltd.
Address:	102-22, Pyeongdongsandan 6beon-ro, Gwangsan-gu, Gwangju, South Korea
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location :	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RF170808E02	Original release.	Sep. 21, 2017

1 Certificate of Conformity

Product:	24GHz Smart Radar
Brand:	WooriRadar
Test Model:	WDR210
Sample Status:	ENGINEERING SAMPLE
Applicant:	WOORIRO Co., Ltd.
Test Date:	Aug. 17 to 30, 2017
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.249) 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 : _____ , **Date:** Sep. 21, 2017

Wendy Wu / Specialist

Approved by : _____ , **Date:** Sep. 21, 2017

May Chen / Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.249)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -12.43dB at 17.26953MHz.
15.209 15.249 15.249 (d)	Radiated Emission Test Band Edge Measurement Limit: 50dB less than the peak value of fundamental frequency or meet radiated emission limit in section 15.209	PASS	Meet the requirement of limit. Minimum passing margin is -3.1dB at 131.97MHz.

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	1.84 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.30 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.16 dB
	6GHz ~ 18GHz	4.91 dB
	18GHz ~ 40GHz	5.30 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	24GHz Smart Radar
Brand	WooriRadar
Test Model	WDR210
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	DC 12V
Modulation Type	FMCW
Operating Frequency	24.05~24.25GHz
Number of Channel	1
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The antennas provided to the EUT, please refer to the following table:

Antenna Set.	Chain No.	Brand	Model	Antenna Gain (dBi)	Frequency range(GHz)	Antenna Type	Connecter Type
1	Chain 0	Wooriro	1x8 ANT	10.58	24.05~24.25	Patch	Fixed
	Chain 1			10.58			
	Chain 2			10.58			
2	Chain 0	Wooriro	1x3 ANT	8.25	24.05~24.25	Patch	Fixed
	Chain 1			8.25			
	Chain 2			8.25			

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

1 channel is provided in EUT for test:

Channel	Frequency
1	24.152GHz

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	PLC	EB	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz & Bandedge Measurement **RE<1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

Radiated Emission Test (Above 1GHz):

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

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

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Radiated Emission Test (Below 1GHz):

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

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

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Power Line Conducted Emission Test:

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

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

TESTED CHANNEL	MODULATION TYPE
1	FMCW

20dB Bandwidth:

☒ 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.

TESTED CHANNEL	MODULATION TYPE
1	FMCW

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE≥1G	22deg. C, 66%RH	DC 12V	Rey Chen
RE<1G	22deg. C, 66%RH	DC 12V	Rey Chen
PLC	25deg. C, 75%RH	120Vac, 60Hz (system)	Andy Ho
EB	25deg. C, 60%RH	DC 12V	Andrrson Chen

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	DC Power Supply	NA	NA	NA	NA	Provided by Lab

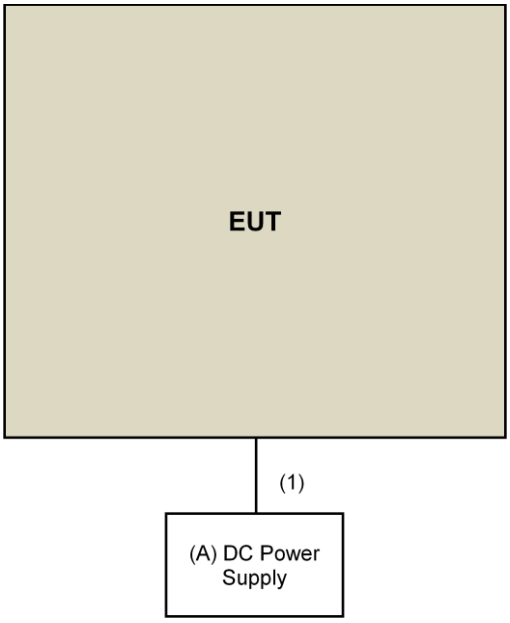
Note:

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

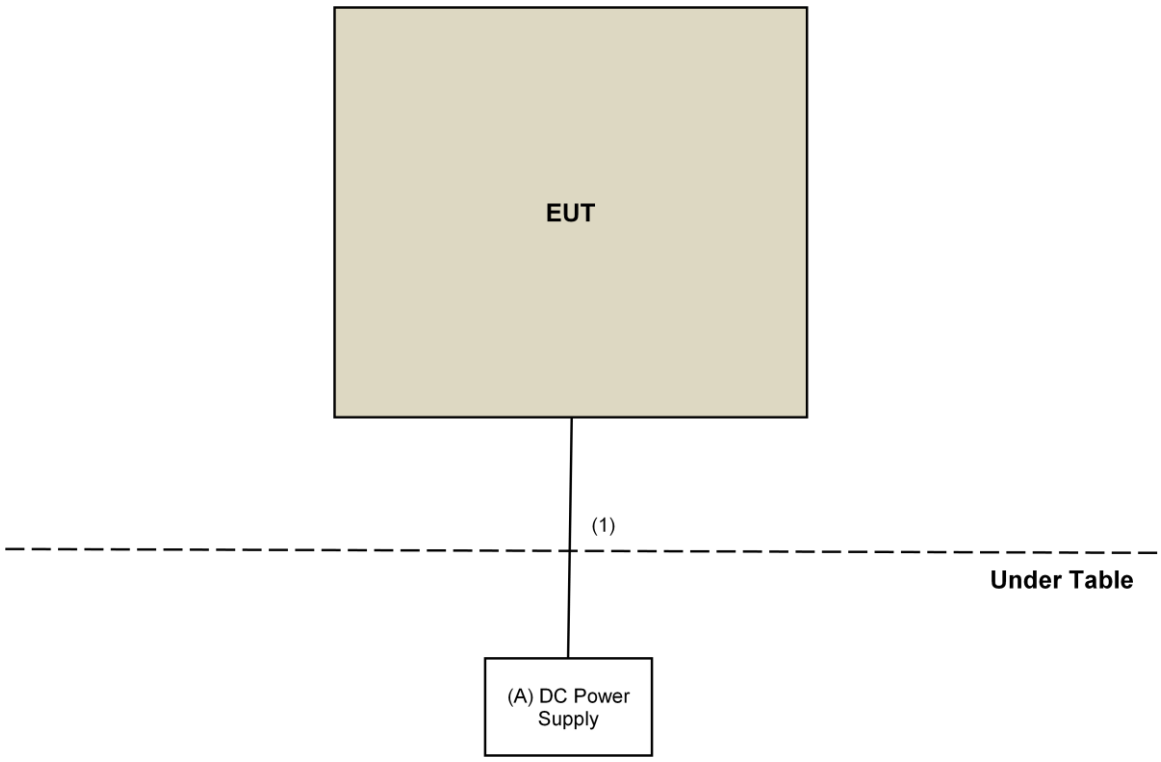
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	DC cable	1	5.05	No	0	Supplied by client

3.3.1 Configuration of System under Test

For conducted emission



For radiated emission



3.4 General Description of Applied Standards

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

FCC Part 15, Subpart C (15.249)
ANSI C63.10-2013

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

Fundamental Frequency	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (microvolts/meter)
902 ~ 928 MHz	50	500
2400 ~ 2483.5 MHz	50	500
5725 ~ 5875 MHz	50	500
24 ~ 24.25 GHz	250	2500

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits as below table, whichever is the lesser attenuation

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

Below 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 08, 2017	July 07, 2018
Pre-Amplifier(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna(*) Electro-Metrics	EM-6879	264	Dec. 16, 2016	Dec. 15, 2018
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 17, 2017	Jan. 16, 2018
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-01	Nov. 10, 2016	Nov. 09, 2017
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Dec. 13, 2016	Dec. 12, 2017
RF Cable	8D	966-4-1 966-4-2 966-4-3	Apr. 01, 2017	Mar. 31, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-4-01	Oct. 05, 2016	Oct. 04, 2017
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-783	Dec. 27, 2016	Dec. 26, 2017
Pre-Amplifier EMCI	EMC12630SE	980385	Feb. 02, 2017	Feb. 01, 2018
RF Cable	EMC104-SM-SM-1200 EMC104-SM-SM-2000 EMC104-SM-SM-5000	160923 150318 150321	Feb. 02, 2017 Mar. 29, 2017 Mar. 29, 2017	Feb. 01, 2018 Mar. 28, 2018 Mar. 28, 2018
Pre-Amplifier EMCI	EMC184045SE	980387	Feb. 02, 2017	Feb. 01, 2018
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Dec. 15, 2016	Dec. 14, 2017
RF Cable	SUCOFLEX 102	36432/2 36433/2	Jan. 15, 2017	Jan. 14, 2018
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208410	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP02	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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Loop antenna was used for all emissions below 30 MHz.
4. The test was performed in 966 Chamber No. 4.
5 The CANADA Site Registration No. is 20331-2
6. Tested Date: Aug. 17, 2017

Above 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer Agilent	E4446A	MY48250253	Dec. 21, 2016	Dec. 20, 2017
*Harmonic Mixer (33~55GHz) OML	M22HWD	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Horn Antenna (33~55GHz) OML	M22RH	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Harmonic Mixer (50~75GHz) OML	M15RH	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Horn Antenna (50~75GHz) OML	M15HWD	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Harmonic Mixer (75~110GHz) OML	M10HWD	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Horn Antenna (75~110GHz) OML	M10RH	110215-1	Apr. 12, 2017	Apr. 11, 2019
*Diplexer EMCI	DPL26	DPL26_01	Apr. 12, 2017	Apr. 11, 2019
*Diplexer EMCI	DPL26	DPL26_02	Apr. 12, 2017	Apr. 11, 2019
4CH Infiniivision Oscilloscope Keysight	DSOX6004A	MY55190202	Dec. 09, 2016	Dec. 08, 2017
*WR15CH Conical Horn Keysight	WR15CH	WR15CH-01	Sep. 08, 2015	Sep. 07, 2017
*WR10CH Conical Horn Keysight	WR10CH	WR10CH-01	Sep. 08, 2015	Sep. 07, 2017
*Millimeter-Wave Signal Generator Frequency Extension Module (50~75 GHz) Keysight	E8257DV15	US54250106	Dec. 22, 2015	Dec. 21, 2017
*Millimeter-Wave Signal Generator Frequency Extension Module (75~110 GHz) Keysight	E8257DV10	US53250009	Dec. 22, 2015	Dec. 21, 2017
Antenna Tower & Turn Table CT	NA	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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 4.
4. The CANADA Site Registration No. is 20331-2
5. Tested Date:Aug. 17, 2017

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: 30MHz ~ 18GHz

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 is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection (PK) at frequency from 1GHz to 40GHz.
3. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 10Hz for Average detection (AV) at frequency from 1GHz to 40GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission: Above 18GHz

External harmonic mixers are utilized.

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The distance at which limits are typically specified is 3 meter; however, closer measurement distances may be utilized.

c. Begin handheld measurements with the test antenna (horn) at a distance of 1 meter from the EUT, in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 meter from the EUT.

d. Repeat (b) with the horn in a vertically polarized position.

e. If the emission cannot be detected at 1 meter, reduce the RBW in order to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

f. Note the maximum level indicated on the Spectrum Analyzer.

g. Based on the distance at which the measurement was made and the calculated distance to the edge of the far field, determine the appropriate distance attenuation factor. Apply this factor to the calculated field strength in order to determine the equivalent field strength at the distance at which the regulatory limit is specified. Compare to the appropriate limits

h. Repeat (a) - (f) for every emission that must be measured, up through the required frequency range of investigation

NOTE:

1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 50MHz for Peak and Average detection at frequency above 40GHz.
2. Shorter measurement distances may be used to improve the measurement system's noise floor. As ANSI C63.10 description is based on the measurement in distance of 3 meters, the data obtained at 0.8-meter distance was extrapolate results to the 3-m distance:

   Test value at 3-meter distance (dBuV)

   = Test value at 0.8 meter distance (dBuV) -20log(3/0.8)(dB)

   = Test value at 0.8 meter distance (dBuV) -11.5(dB).

* Measurements made at 0.8 meter distance. Test value converted to account for 3-meter measurement distance.

FAR FIELD BOUNDARY CALCULATIONS
The far-field boundary is given as:
R far field = (2 * L^2) /λ
where: L = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

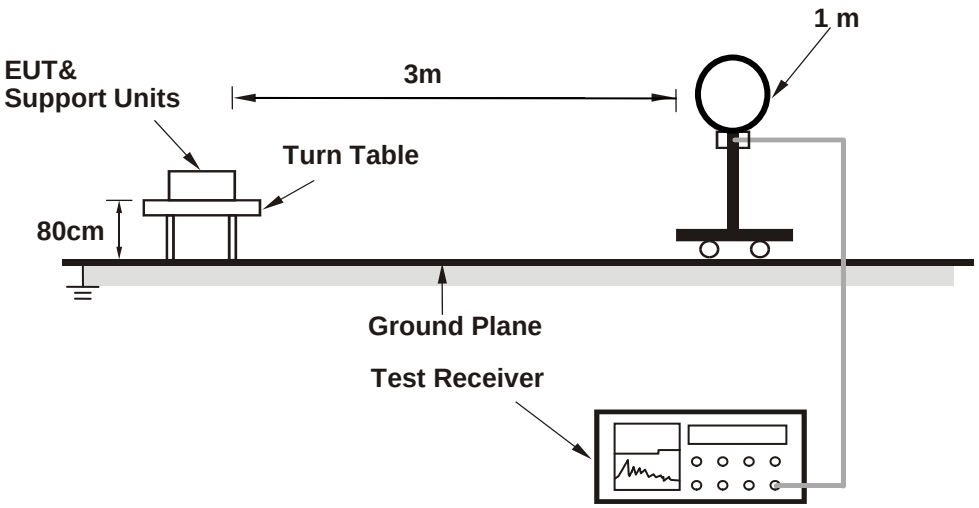
FREQUENCY (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
24.152	0.065	0.0124	0.6815

4.1.4 Deviation from Test Standard

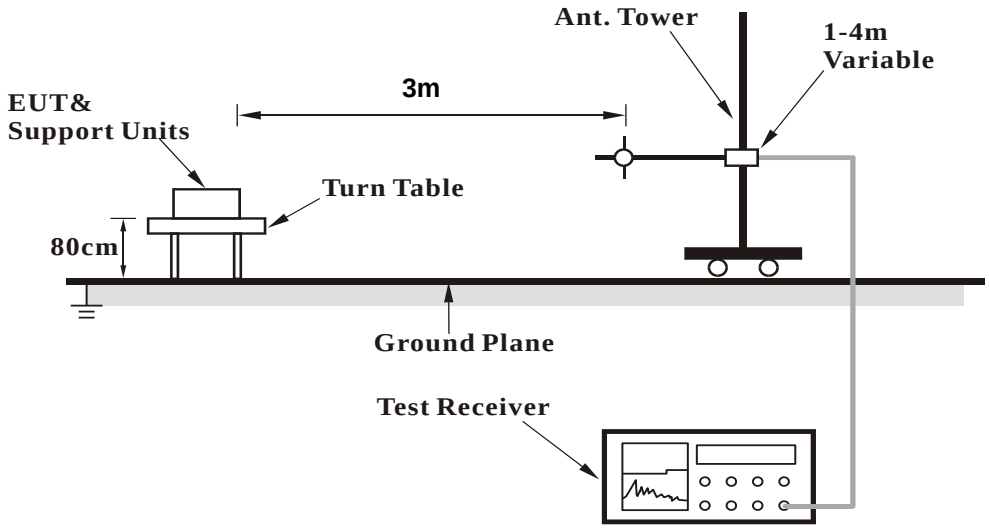
No deviation.

4.1.5 Test Setup

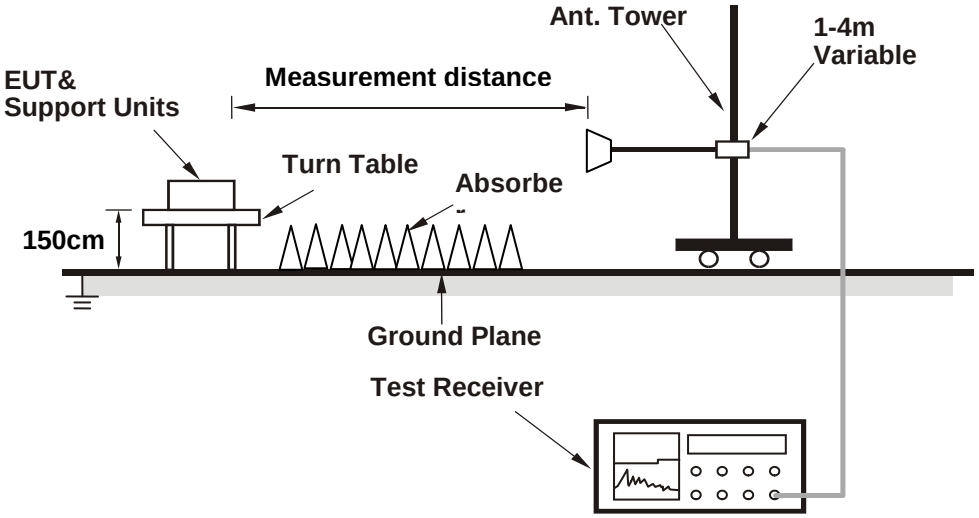
For Radiated emission below 30MHz



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

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

4.1.7 Test Results

Above 1GHz Data

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 18GHz		

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	2421.35	42.4 PK	74.0	-31.6	1.58 H	256	43.7	-1.3
2	2421.35	34.1 AV	54.0	-19.9	1.58 H	256	35.4	-1.3
3	10106.35	48.5 PK	74.0	-25.5	1.49 H	155	35.0	13.5
4	10106.35	35.7 AV	54.0	-18.3	1.49 H	155	22.2	13.5
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	4529.28	48.5 PK	74.0	-25.5	1.62 V	174	46.1	2.4
2	4529.28	36.8 AV	54.0	-17.2	1.62 V	174	34.4	2.4
3	10555.73	52.4 PK	74.0	-21.6	1.55 V	203	38.6	13.8
4	10555.73	42.1 AV	54.0	-11.9	1.55 V	203	28.3	13.8

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.
4. Margin value = Emission Level – Limit value

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	18GHz ~ 40GHz		

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	24000.00	56.1 PK	74.0	-17.9	1.59 H	360	73.7	-17.6
2	24000.00	46.0 AV	54.0	-8.0	1.59 H	360	63.6	-17.6
3	24152.00	101.1 PK	127.9	-26.8	1.59 H	360	118.5	-17.4
4	24152.00	67.7 AV	107.9	-40.2	1.59 H	360	85.1	-17.4
5	24250.00	58.3 PK	74.0	-15.7	1.59 H	360	75.4	-17.1
6	24250.00	47.7 AV	54.0	-6.3	1.59 H	360	64.8	-17.1
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	24000.00	58.7 PK	74.0	-15.3	1.57 V	357	76.3	-17.6
2	24000.00	47.9 AV	54.0	-6.1	1.57 V	357	65.5	-17.6
3	24152.00	107.8 PK	127.9	-20.1	1.57 V	357	125.2	-17.4
4	24152.00	73.2 AV	107.9	-34.7	1.57 V	357	90.6	-17.4
5	24250.00	59.1 PK	74.0	-14.9	1.57 V	357	76.2	-17.1
6	24250.00	48.1 AV	54.0	-5.9	1.57 V	357	65.2	-17.1

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

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	40GHz ~ 100GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M							
NO.	FREQ. (GHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	EIRP Level (dBm)	Measured Power (dBm)	Receiver Antenna Gain (dBi)
1	48.304	75.2 PK	87.9	-12.7	-20.0	-60.3	23.9
2	48.304	63 AV	67.9	-4.9	-32.2	-72.5	23.9
3	72.456	77.7 PK	87.9	-10.2	-17.5	-61.3	23.9
4	72.456	62.8 AV	67.9	-5.1	-32.4	-76.2	23.9
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M							
NO.	FREQ. (GHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	EIRP Level (dBm)	Measured Power (dBm)	Receiver Antenna Gain (dBi)
1	48.304	73.9 PK	87.9	-14.0	-21.3	-61.6	23.9
2	48.304	61.3 AV	67.9	-6.6	-33.9	-74.2	23.9
3	72.456	75.6 PK	87.9	-12.3	-19.6	-63.4	23.9
4	72.456	60.8 AV	67.9	-7.1	-34.4	-78.2	23.9

REMARKS:

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

EIRP = PT * GT = (PR / GR) * (4 * Pi * D/ λ)^ 2

where:

PR is the power of the receive measurement

GR is the gain of the receive measurement antenna

D is the measurement distance

λ is the wavelength

2. Field strength is then converted to EIRP as follows:

EIRP = ((E*D)^2) / 30

Working in dB units, the above equation is equivalent to:

EIRP[dBm] = E[dBμV/m] + 20 log(D[meters]) - 104.8

E = EIRP – 20 * log(D) + 104.8

3. " - ": The emission levels were too low to be detected.

4. Shorter measurement distances may be used to improve the measurement system's noise floor. As ANSI C63.10 description is based on the measurement in distance of 3 meters, the data obtained at 0.8-meter distance was extrapolate results to the 3-m distance:

Test value at 3-meter distance (dBuV)

= Test value at 0.8 meter distance (dBuV) -20log(3/0.8)(dB)

= Test value at 0.8 meter distance (dBuV) -11.5(dB).

*Measurements made at 0.8 meter distance. Test value converted to account for 3-meter measurement distance.

Below 1GHz Data

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

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	87.76	36.5 QP	40.0	-3.5	2.00 H	265	50.7	-14.2
2	**131.97**	**40.4 QP**	**43.5**	**-3.1**	**3.00 H**	**251**	**49.4**	**-9.0**
3	187.75	37.4 QP	43.5	-6.1	3.00 H	100	48.0	-10.6
4	244.27	30.7 QP	46.0	-15.3	2.00 H	277	40.4	-9.7
5	327.89	29.8 QP	46.0	-16.2	2.00 H	331	36.6	-6.8
6	601.77	29.4 QP	46.0	-16.6	3.00 H	207	29.7	-0.3
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	47.27	36.0 QP	40.0	-4.0	1.00 V	347	43.8	-7.8
2	87.72	36.8 QP	40.0	-3.2	1.50 V	225	51.0	-14.2
3	144.68	40.0 QP	43.5	-3.5	1.50 V	188	48.1	-8.1
4	188.30	40.2 QP	43.5	-3.3	1.00 V	321	50.9	-10.7
5	287.56	33.3 QP	46.0	-12.7	1.50 V	34	41.2	-7.9
6	616.90	32.3 QP	46.0	-13.7	1.00 V	54	32.5	-0.2

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

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.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	847124/029	Oct. 24, 2016	Oct. 23, 2017
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Oct. 26, 2016	Oct. 25, 2017
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV216	100072	June 03, 2017	June 02, 2018
50 ohms Terminator	N/A	EMC-02	Sep. 29, 2016	Sep. 28, 2017
RF Cable	5D-FB	COCCAB-001	Sep. 30, 2016	Sep. 29, 2017
10 dB PAD Mini-Circuits	HAT-10+	CONATT-004	June 18, 2017	June 17, 2018
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

Note:
1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Shielded Room No. 1.
3 Tested Date: Aug. 19, 2017

4.2.3 Test Procedures

a. 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.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

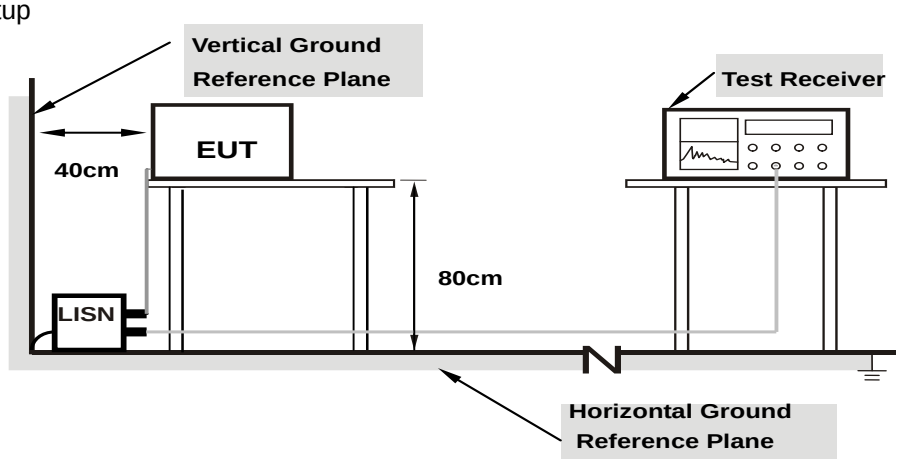
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

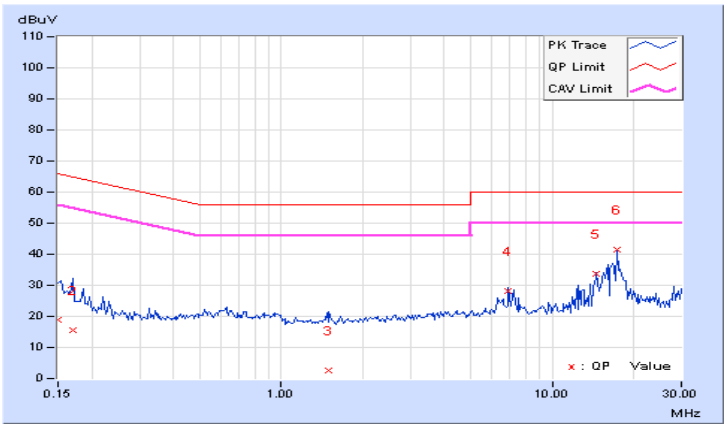
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.07	8.83	-4.98	18.90	5.09	66.00	56.00	-47.10	-50.91
2	0.16953	10.07	5.60	-7.70	15.67	2.37	64.98	54.98	-49.31	-52.61
3	1.50391	10.14	-7.73	-8.92	2.41	1.22	56.00	46.00	-53.59	-44.78
4	6.91016	10.45	17.79	16.80	28.24	27.25	60.00	50.00	-31.76	-22.75
5	14.53516	10.93	22.87	20.34	33.80	31.27	60.00	50.00	-26.20	-18.73
6	**17.26953**	**11.11**	**30.46**	**26.46**	**41.57**	**37.57**	**60.00**	**50.00**	**-18.43**	**-12.43**

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

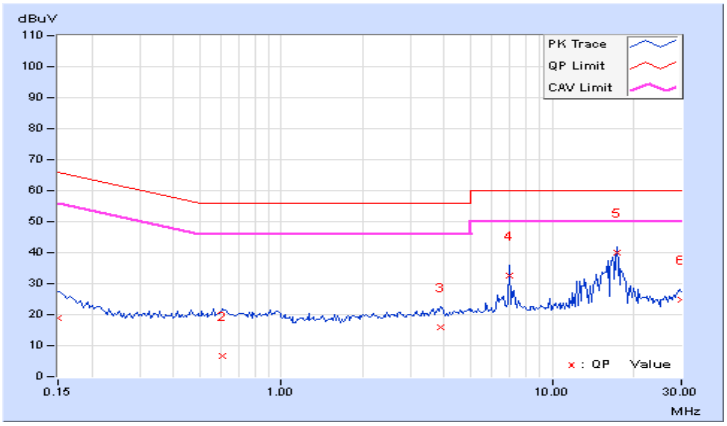


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.06	8.81	-4.77	18.87	5.29	66.00	56.00	-47.13	-50.71
2	0.60313	10.10	-3.42	-8.50	6.68	1.60	56.00	46.00	-49.32	-44.40
3	3.86328	10.22	5.81	2.04	16.03	12.26	56.00	46.00	-39.97	-33.74
4	6.91797	10.38	22.37	3.05	32.75	13.43	60.00	50.00	-27.25	-36.57
5	17.27344	10.89	29.23	25.55	40.12	36.44	60.00	50.00	-19.88	-13.56
6	29.83594	10.96	13.86	10.20	24.82	21.16	60.00	50.00	-35.18	-28.84

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

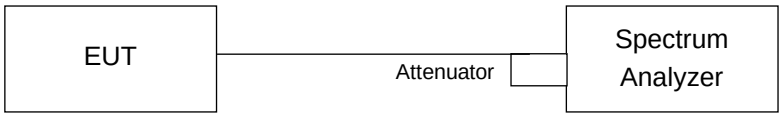


4.3 20dB bandwidth

4.3.1 Limits Of 20dB BANDWIDTH Measurement

The 20dB bandwidth shall be specified in operating frequency band.

4.3.2 Test Setup



4.3.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer R&S	FSV40	100964	July 1, 2017	June 30, 2018

NOTE:
1. The test was performed in Oven room 2.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: Aug. 29, 2017

4.3.4 Test Procedures

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3MHz RBW and 10MHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

4.3.5 Deviation from Test Standard

No deviation.

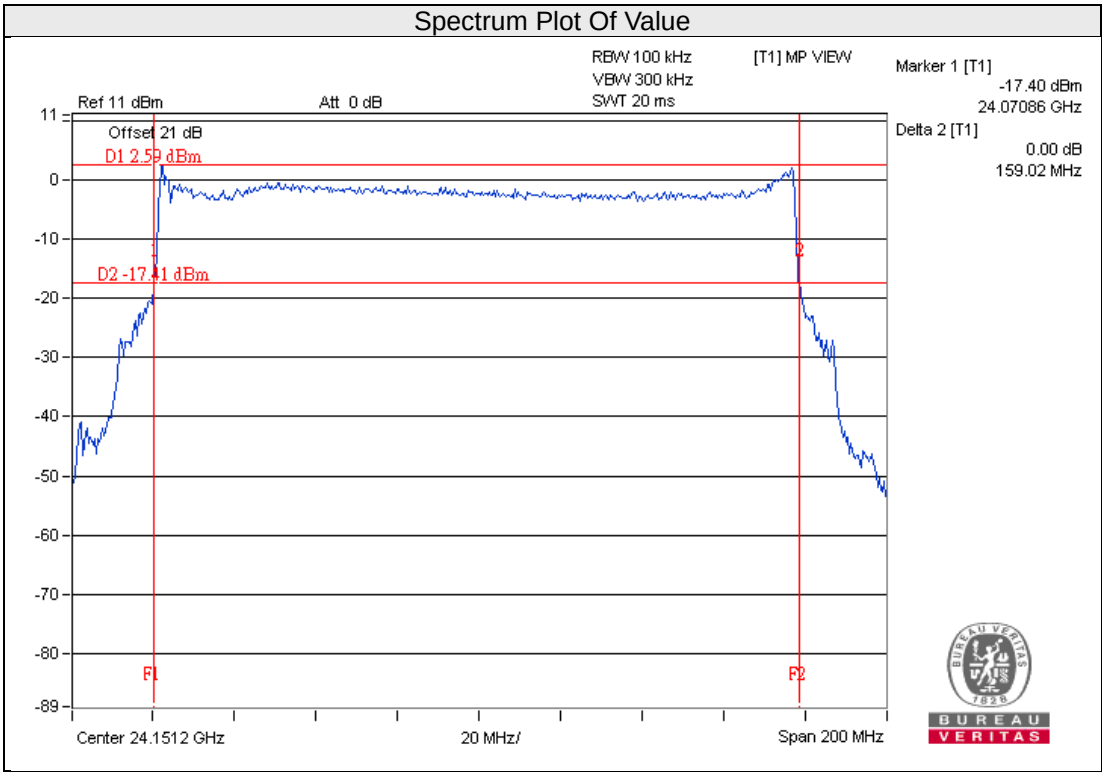
4.3.6 EUT Operating Conditions

Same as Item 4.1.6.

4.3.7 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
1	24152	159.02

Spectrum Plot Of Value



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 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.

--- END ---