

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

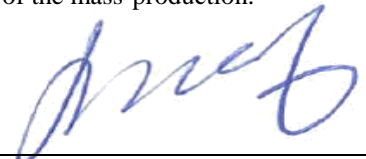
Test Report No. : OT-185-RWD-036
AGR No. : A184A-099
Applicant : Pittasoft Co., Ltd
Address : 7F, BYC HIGH CITY Building A 131, Gasan Digital-ro, Geumcheon-gu, Seoul,
08506, South Korea
Manufacturer : Pittasoft Co., Ltd
Address : 7F, BYC HIGH CITY Building A 131, Gasan Digital-ro, Geumcheon-gu, Seoul,
08506, South Korea
Type of Equipment : Car Dashcam
FCC ID. : YCK-DR900SCH2
Model Name : DR900S-2CH
Multiple Model Name : DR900S-1CH, DR900S-2CH IR, DR900S-2CH Truck, DR900GW-1CH,
DR900GW-2CH, DR900GW-2CH IR, DR900GW-2CH Truck
Serial number : N/A
Total page of Report : 53 pages (including this page)
Date of Incoming : April 19, 2018
Date of issue : May 18, 2018

SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART E Section 15.407*
 This test report only contains the result of a single test of the sample supplied for the examination.
 It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by: 

 Jae-Ho Lee / Chief Engineer
 ONETECH Corp.

Approved by: 

 Keun-Young, Choi / Vice President
 ONETECH Corp.

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REVISION HISTORY

Issued Report No.	Issued Date	Revisions	Effect Section
OT-185-RWD-036	May 18, 2018	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : Pittasoft Co., Ltd
 Address : 7F, BYC HIGH CITY Building A 131, Gasan Digital-ro, Geumcheon-gu, Seoul, 08506, South Korea
 Contact Person : Minho Shin / Senior Research Engineer
 Telephone No. : +82-31-776-6400
 FCC ID : YCK-DR900SCH2
 Model Name : DR900S-2CH
 Brand Name : **BLACKVUE**
 Serial Number : N/A
 Date : May 18, 2018

EQUIPMENT CLASS	Unlicensed National Information Infrastructure(UNII)
E.U.T. DESCRIPTION	Car Dashcam
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART E Section 15.407 KDB 789033 D01 General UNII Test Procedures
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.407(a)	26 dB Bandwidth	PASS
	99 % Occupied Bandwidth	PASS
15.407(a)	Maximum Conducted Output Power	Met the Limit / PASS
15.407(a)	Peak Power Spectral Density	Met the Limit / PASS
15.407(a)	Peak Excursion	Met the Limit / PASS
15.407(g)	Frequency Stability	Met the Limit / PASS
15.407(b)	Undesirable Emissions	Met the Limit / PASS
15.205, 15.407(b)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Met the Limit / PASS
15.207	AC Conducted Emissions 150 kHz-30 MHz	Met the Limit / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART E Section 15.407

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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EMC-003 (Rev.2)

3. GENERAL INFORMATION

3.1 Product Description

The Pittasoft Co., Ltd, Model DR900S-2CH (referred to as the EUT in this report) is a Car Dashcam. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Car Dashcam		
FREQUENCY RANGE	WLAN 2.4 GHz Band	2 422 MHz ~ 2 452 MHz (802.11n(HT40))	
	WLAN 5 GHz Band	5 775 MHz (802.11ac(VHT80))	
MAX. RF OUTPUT POWER	WLAN 2.4 GHz Band	802.11n(HT40) (15.89 dBm)	
	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz Band	802.11ac(HT80) (8.49 dBm)
MODULATION TYPE	WLAN 2.4 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
ANTENNA TYPE	FPCB Antenna		
ANTENNA GAIN	WLAN 2.4 GHz Band	3.0 dBi	
	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz	4.0 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	24 MHz, 26 MHz, 37.125 MHz, 40 MHz		
POWER RE QUIREMENT	DC 12 V / DC 24 V		

3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
DR900S-2CH	Basic Model	<input checked="" type="checkbox"/>
DR900S-1CH	These models are identical to the basic model except for the model name, and have been added at the request of the exporting country buyers.	<input type="checkbox"/>
DR900S-2CH IR		
DR900S-2CH Truck		
DR900GW-1CH		
DR900GW-2CH		
DR900GW-2CH IR		
DR900GW-2CH Truck		

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacture is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
MAIN BOARD	N/A	DR900S-2CH_MAIN(V1.0)	-
SUB BOARD	N/A	N/A	-
CAMERA MODULE	N/A	N/A	-
GPS	N/A	N/A	-
REAR CAM BOARD	N/A	N/A	-

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
G6-1121TV	HP	Notebook PC	EUT, AC/DC Adapter
PPP009C	HP	AC/DC Adapter	Notebook PC

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.

2.4G

Modulation & Channel selected	DATA RATE	OUTPUT POWER[dBm]
HT 40 (Middle Channel)	13.5 Mbps	15.83
	27 Mbps	15.63
	40.5 Mbps	15.38
	54 Mbps	15.16
	81 Mbps	14.99
	108 Mbps	14.66
	121.5 Mbps	14.43
	135 Mbps	14.05

UNII 3

Modulation	DATA RATE	OUTPUT POWER[dBm]
VHT80 (Middle Channel)	29.3 Mbps	6.34
	58.5 Mbps	6.15
	87.8 Mbps	5.84
	117 Mbps	5.70
	175.5 Mbps	5.54
	234 Mbps	5.19
	263.3 Mbps	4.80
	292.5 Mbps	4.69
	351 Mbps	4.45
	390 Mbps	4.20

-. The worse case data rate for each modulation is determined 13.5 Mbps for HT40, 29.3 Mbps for VHT80.

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter open area test site.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The transmitter antenna of the EUT is FPCB Antenna, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7. MINIMUM 26 dB BANDWIDTH

7.1 Operating environment

Temperature : 24 °C

Relative humidity : 44 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 26 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 26 dB.



7.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data for 802.11ac_HT80 WLAN Mode

7.4.1 Test data for DC 12 V

-. Test Date : May 01, 2018

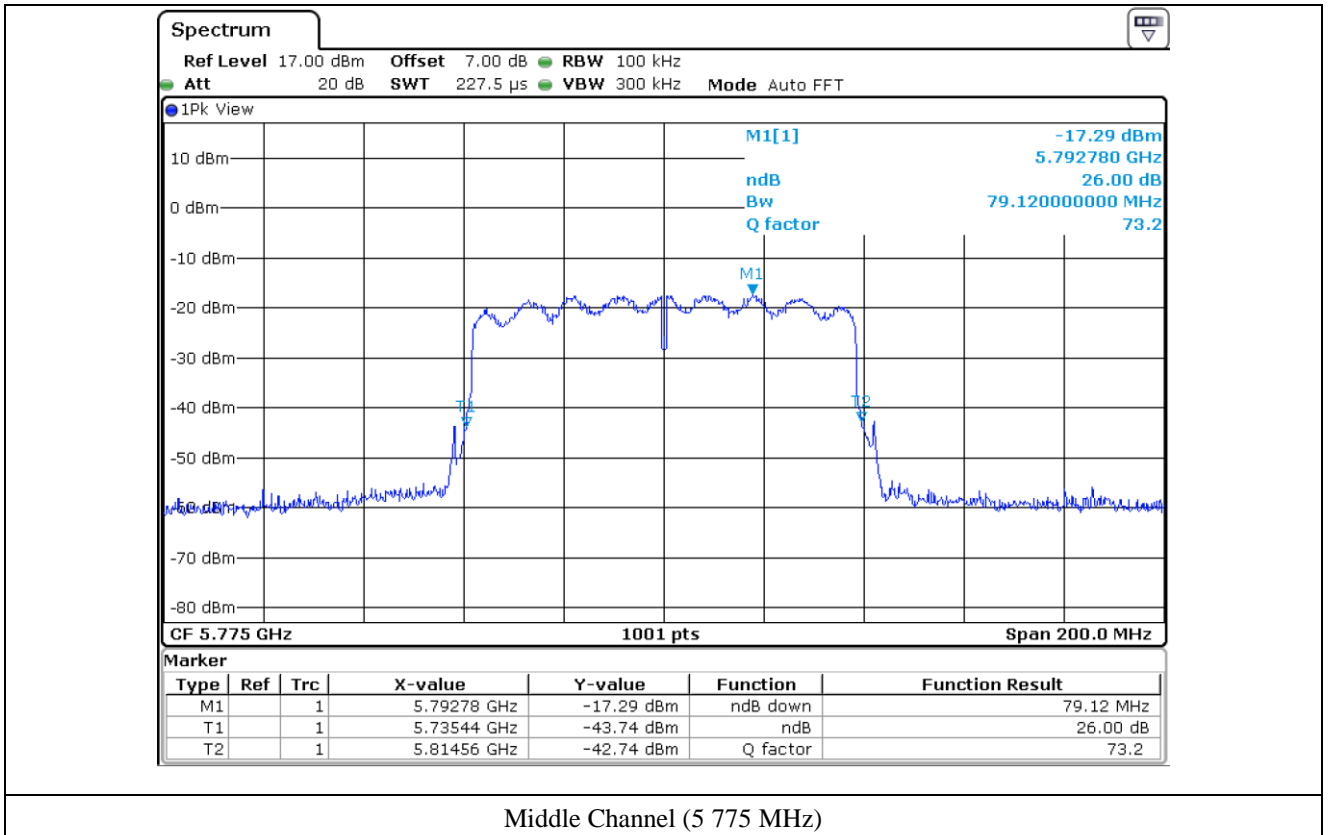
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	79.12

Remark: See next page for measurement data.



Tested by: Min-Gu Ji / Assistant Manager



7.4.2 Test data for DC 24 V

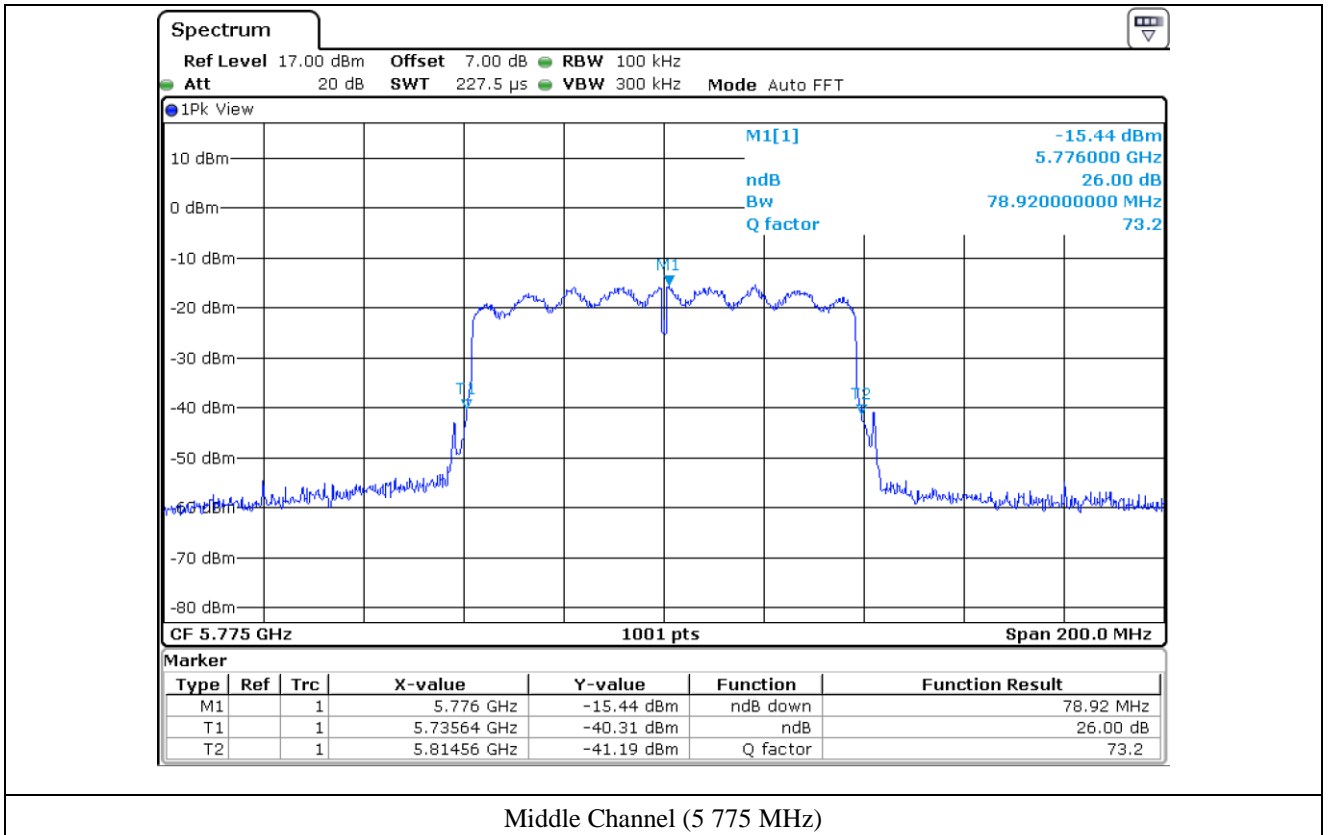
- Test Date : May 01, 2018
 - Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	78.92

Remark: See next page for measurement data.



Tested by: Min-Gu Ji / Assistant Manager



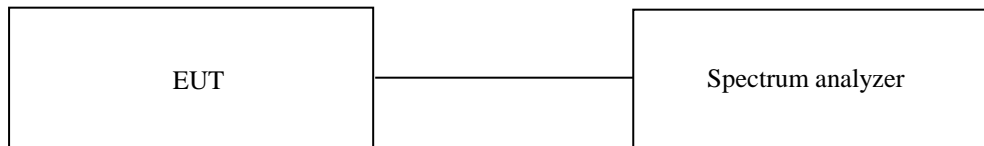
8. 6 dB BANDWIDTH

8.1 Operating environment

Temperature : 24 °C
 Relative humidity : 44 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11ac_HT80 WLAN Mode

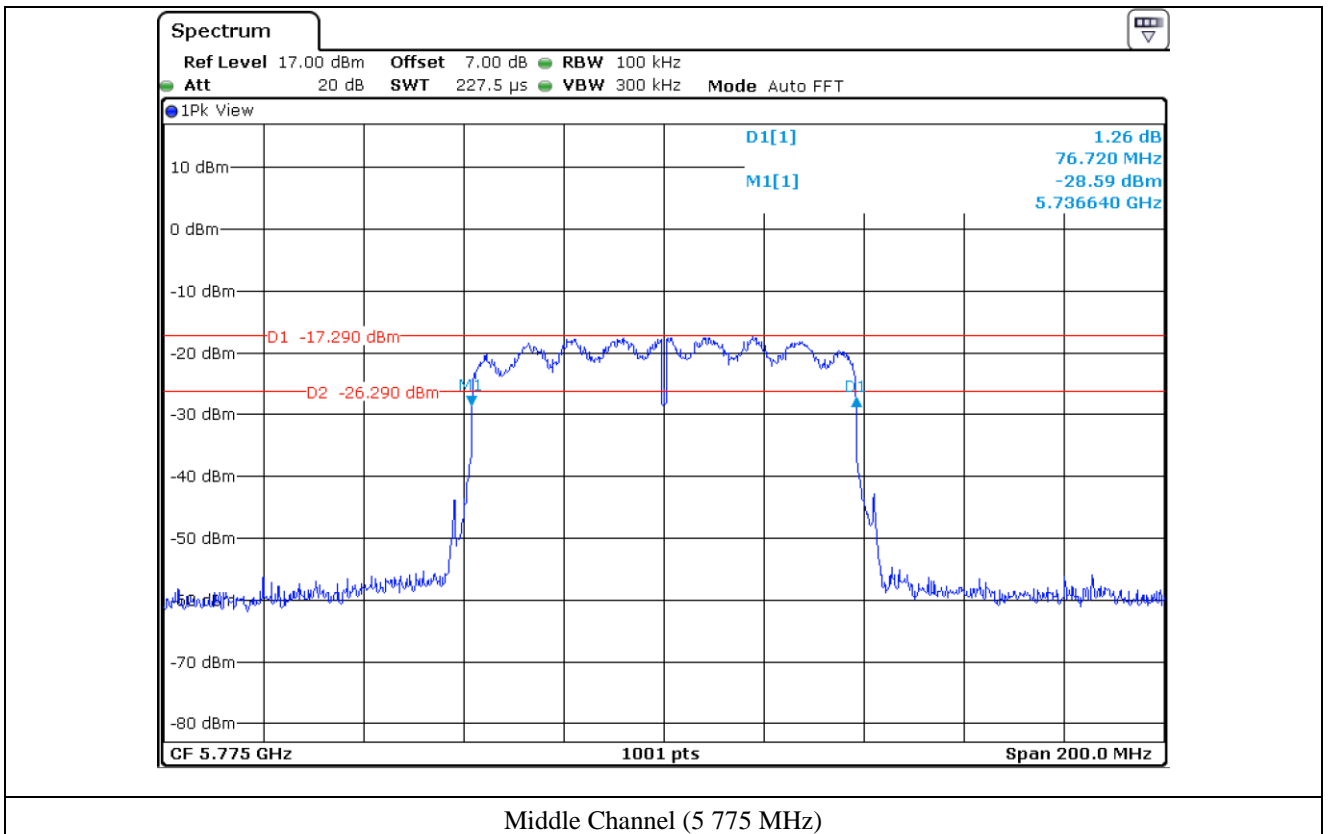
8.4.1 Test data for DC 12 V

- Test Date : May 01, 2018
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	76.72



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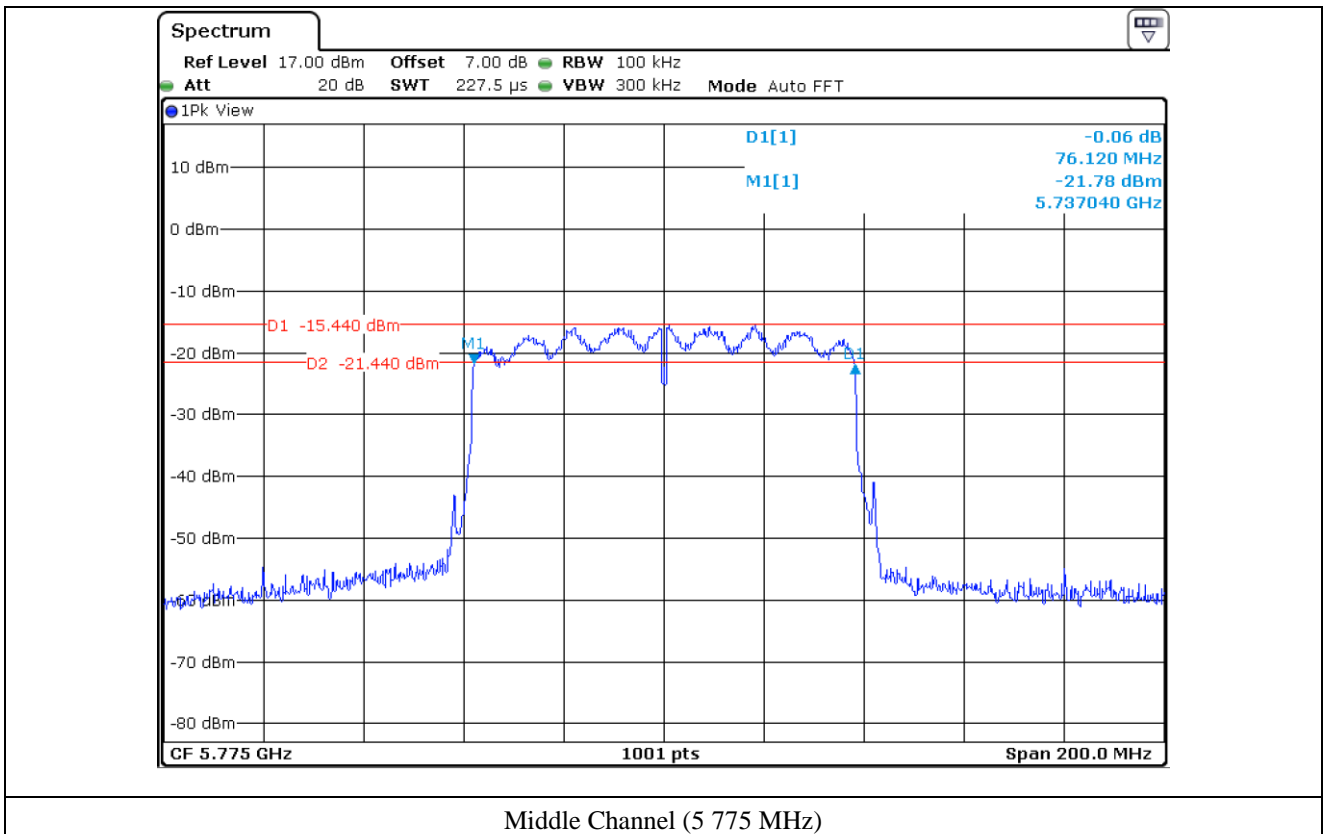


8.4.2 Test data for DC 24 V

- Test Date : May 01, 2018
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	76.12

Tested by: Min-Gu Ji / Assistant Manager



9. MAXIMUM PEAK OUTPUT POWER

9.1 Operating environment

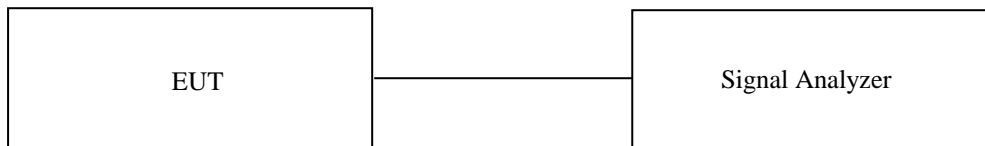
Temperature : 24 °C

Relative humidity : 44 % R.H.

9.2 Test set-up

The maximum peak output power was measured with the Signal Analyzer connected to the antenna output of the EUT. The Signal Analyzer is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section E. 3.(KDB 789033 D02 General UNII Test Procedures New Rules v01r04).

Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



9.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

9.4 Test data for 802.11ac_HT80 WLAN Mode

9.4.1 Test data for DC 12 V

-. Test Date : May 01, 2018

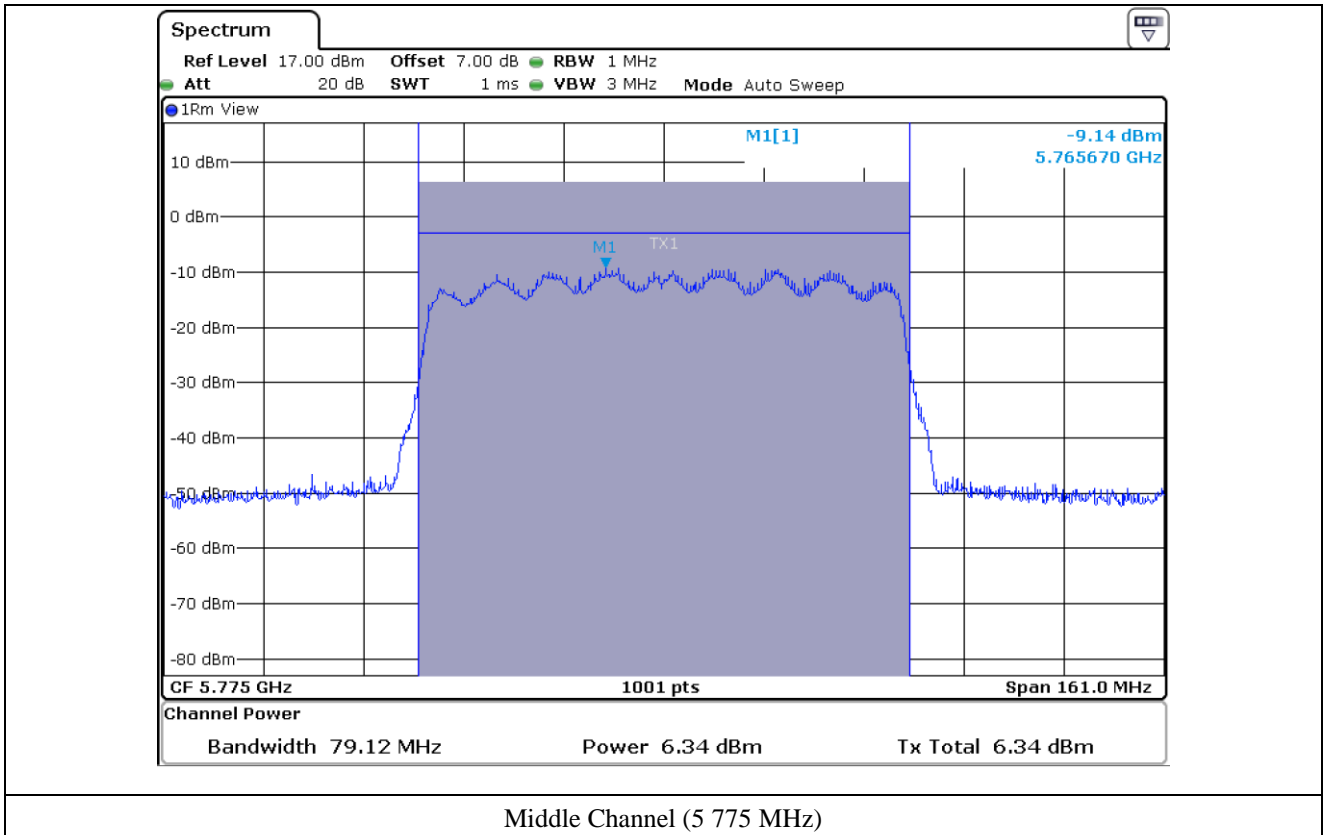
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 725 ~ 5 850	Middle	5 775.00	6.34	30.00	23.66

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



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9.4.2 Test data for DC 24 V

-. Test Date : May 01, 2018

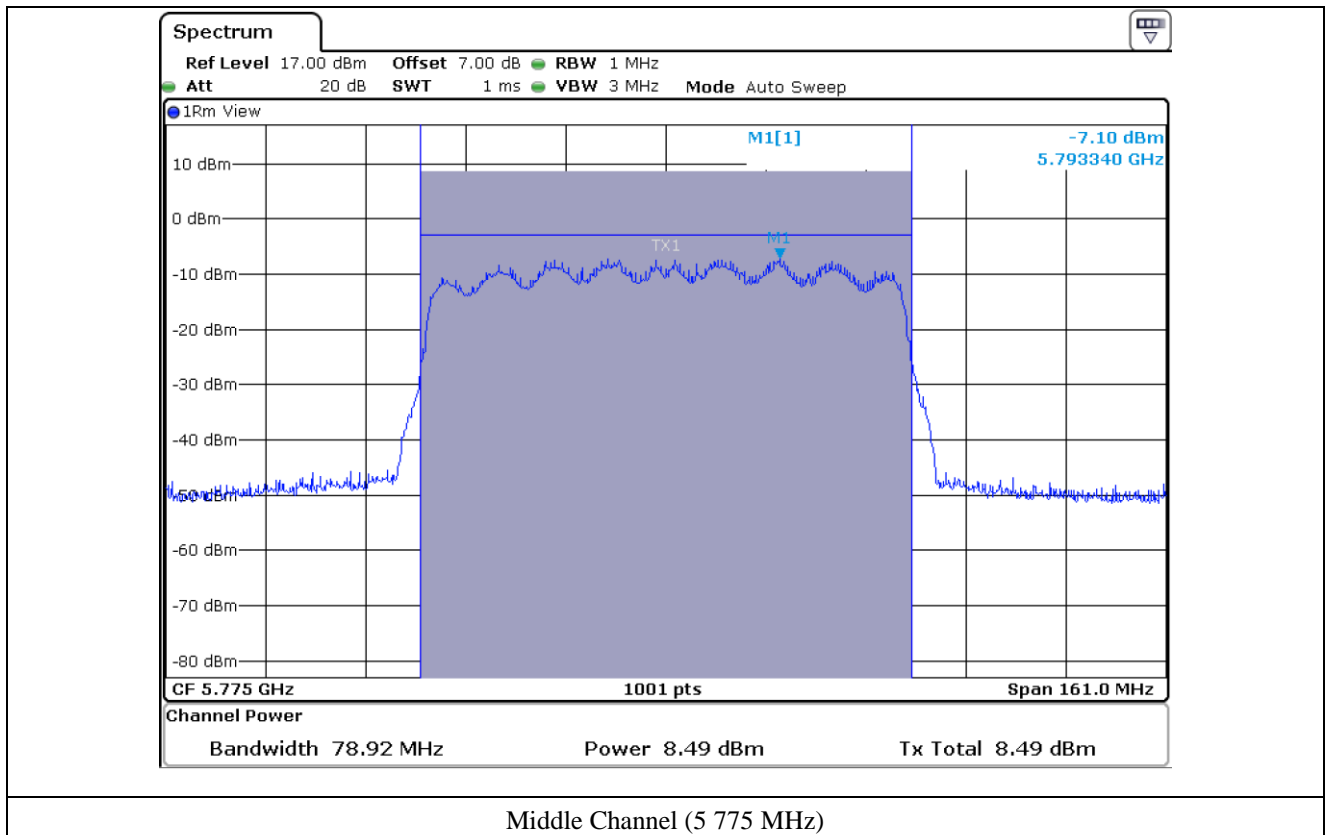
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 725 ~ 5 850	Middle	5 775.00	8.49	30.00	21.51

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



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10. PEAK POWER SPECTRUL DENSITY

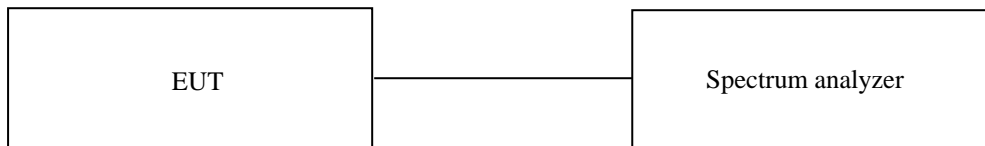
10.1 Operating environment

Temperature : 24 °C

Relative humidity : 44 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 times the resolution bandwidth. The maximum level form the EUT in 1 MHz bandwidth was measured with above condition.



10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data for 802.11ac_HT80 WLAN Mode

10.4.1 Test data for DC 12 V

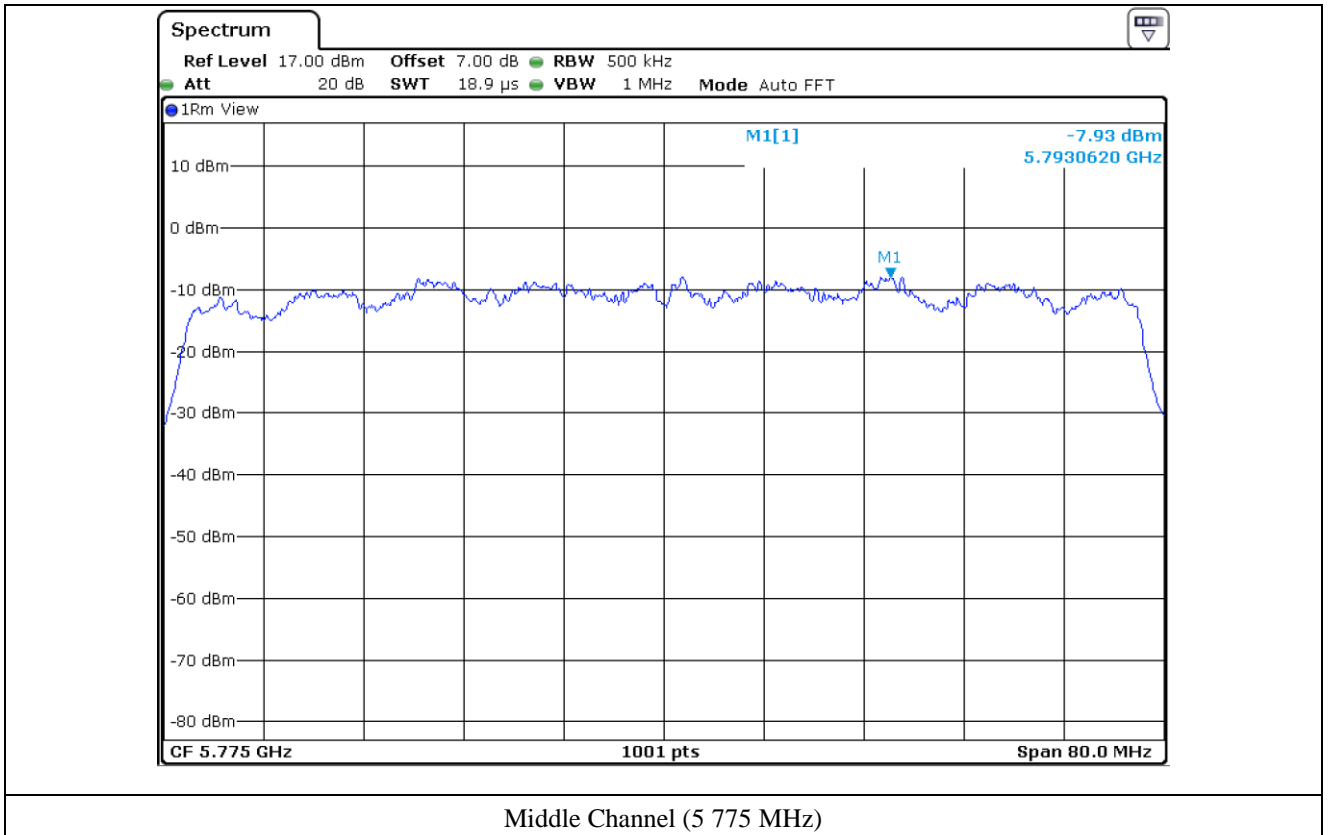
- Test Date : May 01, 2018
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm/500kHz)	MARGIN (dB)
5 725 ~ 5 850	Middle	5 775.00	-7.93	30.00	37.93

Remark: See next page for measurement data.



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10.4.2 Test data for DC 24 V

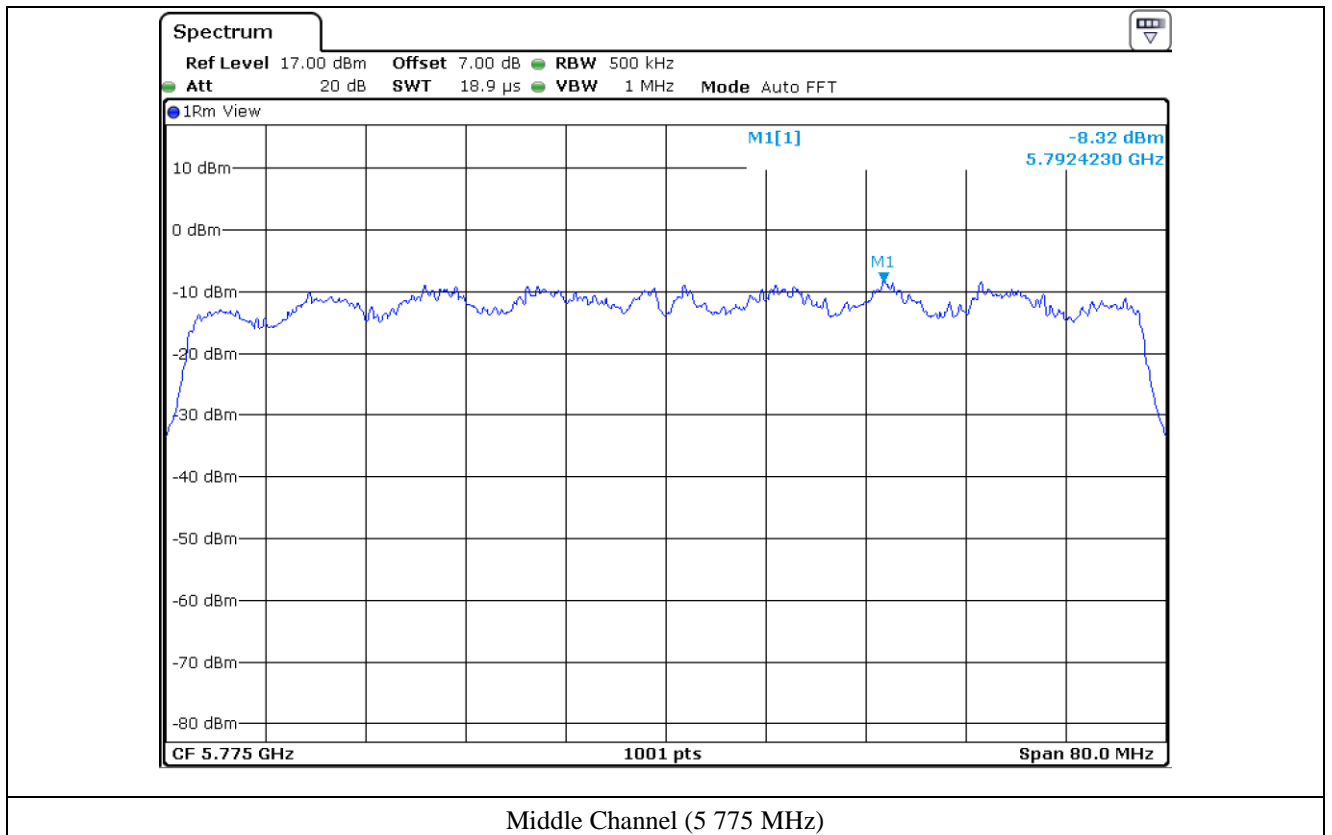
- Test Date : May 01, 2018
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm/500kHz)	MARGIN (dB)
5 725 ~ 5 850	Middle	5 775.00	-8.32	30.00	38.32

Remark: See next page for measurement data.



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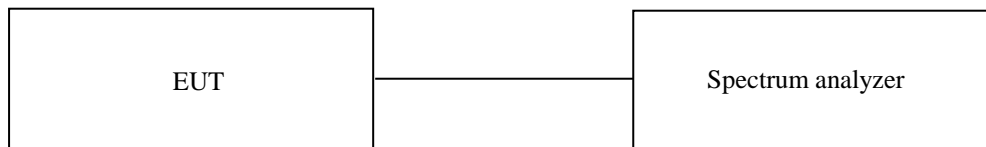
11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION

11.1 Operating environment

Temperature : 24 °C
 Relative humidity : 44 % R.H.

11.2 Test set-up

Turn EUT off and set chamber temperature to -20 °C and then allow sufficient time (approximately 20 min to 30 min after chamber reach the assigned temperature) for EUT to stabilize. Turn on the EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 °C step from -20 °C to +50 °C. Repeat above method for frequency measurements every 10 °C step and then record all measured frequencies on each temperature step.



11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ -	PSL-2KP	ESPEC	Humidity Chamber	14009407	Feb. 23, 2018 (1Y)
■ -	H-3005D	FinePower	DC Power supply	FP09092008	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test Data for DC 12 V

-. Test Date : May 01, 2018

-. Result : Pass

Temperature (°C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Freequency Error (kHz)
-20	5 775 000 000	5 774 967 983	-32.017
-10		5 774 966 950	-33.050
0		5 774 966 340	-33.660
10		5 774 965 874	-34.126
20		5 774965 471	-34.529
30		5 774 965 043	-34.957
40		5 774 964 658	-35.342
50		5 774 964 613	-35.387

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)



Tested by: Min-Gu Ji / Assistant Manager

11.5 Test Data for DC 24 V

-. Test Date : May 01, 2018

-. Result : Pass

Temperature (°C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Freequency Error (kHz)
-20	5 775 000 000	5 774 967 919	-32.081
-10		5 774 966 916	-33.084
0		5 774 964 631	-35.369
10		5 774 965 874	-34.126
20		5 774 964 633	-35.367
30		5 774 965 143	-34.857
40		5 774 964 234	-35.766
50		5 774 964 543	-35.457

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)



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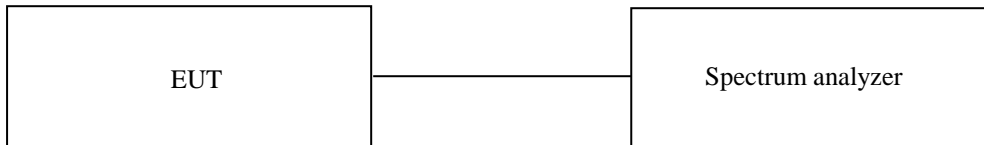
12. FREQUENCY STABILITY WITH VOLTAGE VARIATION

12.1 Operating environment

Temperature : 24 °C
 Relative humidity : 44 % R.H.

12.2 Test set-up

An external DC power supply was connected to the input of the EUT. The voltage of EUT set to 115 % of the nominal value and then was reduced to 85 % of nominal voltage. The output frequency was recorded at each step.



12.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ - H-3005D	FinePower	DC Power supply	FP09092008	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

12.4 Test Data for DC 12 V

-. Test Date : May 01, 2018

-. Result : Pass

Voltage (Vdc)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Freequency Error (kHz)
13.2	5 775 000 000	5 774 976 435	-23.565
12.0		5 774 976 543	-23.457
10.8		5 774 976 846	-23.154

12.5 Test Data for DC 24 V

-. Test Date : May 01, 2018

-. Result : Pass

Voltage (Vdc)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Freequency Error (kHz)
26.4	5 775 000 000	5 774 976 843	-23.157
24.0		5 774 974 354	-25.646
21.6		5 774 976 437	-23.563



Tested by: Min-Gu Ji / Assistant Manager

13. RADIATED SPURIOUS EMISSIONS

13.1 Operating environment

Temperature : 24 °C
 Relative humidity : 52 % R.H.

13.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

13.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
<input type="checkbox"/>	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
<input checked="" type="checkbox"/>	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
<input type="checkbox"/>	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
<input checked="" type="checkbox"/>	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
<input checked="" type="checkbox"/>	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
<input checked="" type="checkbox"/>	BBV 9718 B	Schwarzbeck	Pre-Amplifier	009	Mar. 16, 2018 (1Y)
<input checked="" type="checkbox"/>	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
<input type="checkbox"/>	HD100	HD GmbH	Position Controller	N/A	N/A
<input checked="" type="checkbox"/>	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
<input type="checkbox"/>	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	Jun. 10, 2016 (2Y)
<input checked="" type="checkbox"/>	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 05, 2016 (2Y)
<input checked="" type="checkbox"/>	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
<input checked="" type="checkbox"/>	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
<input checked="" type="checkbox"/>	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

13.4 Test data for DC 12 V

13.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : (45 ~ 46) % R.H. Temperature: (24 ~ 25) °C

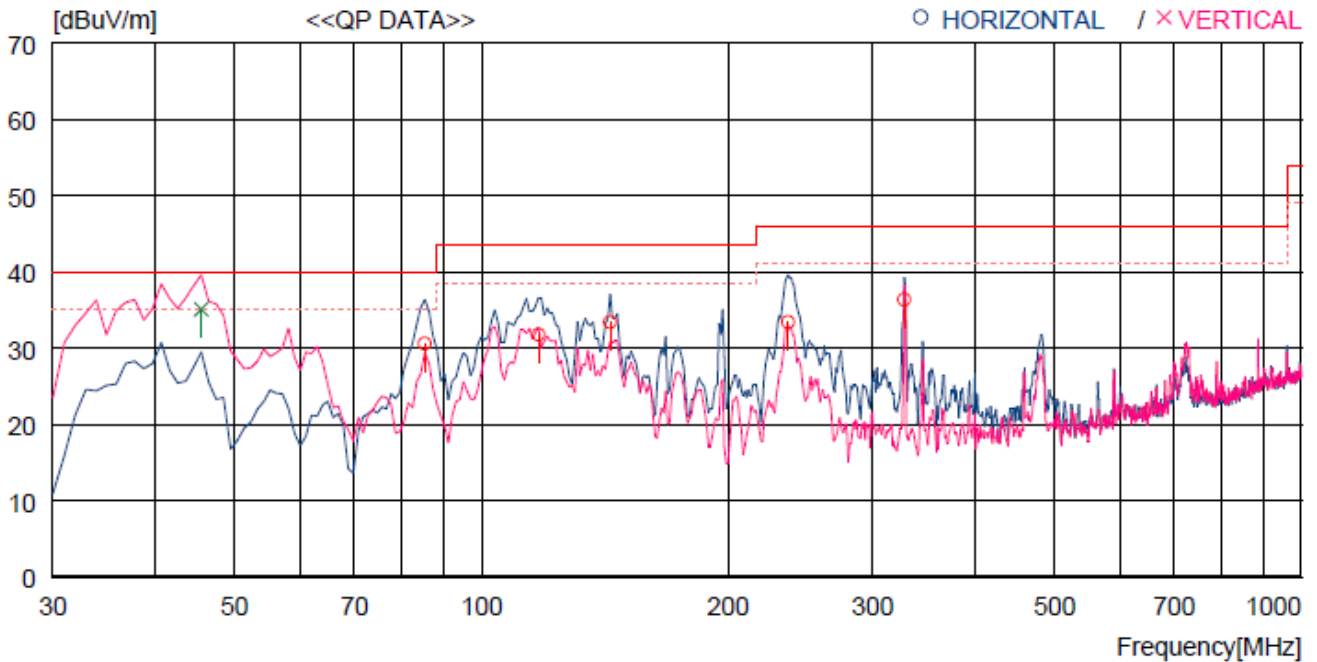
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Date: May 05, 2018

Note : 5 GHz operating mode were tested, (802.11ac WLAN Mode)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	85.290	52.4	8.8	2.4	33.0	30.6	40.0	9.4	300	213
2	117.300	51.4	10.6	2.8	33.0	31.8	43.5	11.7	300	44
3	236.610	50.6	11.9	4.0	33.1	33.4	46.0	12.6	100	359
4	327.790	50.8	14.0	4.7	33.1	36.4	46.0	9.6	100	359
5	143.490	55.3	7.9	3.1	32.9	33.4	43.5	10.1	200	100
----- Vertical -----										
6	45.520	52.6	13.9	1.7	33.1	35.1	40.0	4.9	100	45

[Signature]
Tested by: Min-Gu Ji / Assistant Manager

13.4.3 Test data for Below 30 MHz

- . Test Date : May 05, 2018
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

13.4.3 Test data for above 1 GHz

- . Test Date : May 05, 2018
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 40 GHz
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Middle Channel									
11 550.00	47.55	Peak	H	39.60	7.50	30.96	63.69	73.98	10.29
	36.42	Average	H				52.56	53.98	1.42
	47.05	Peak	V				63.19	73.98	10.79
	36.40	Average	V				52.54	53.98	1.44

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)



Tested by: Min-Gu Ji / Assistant Manager

13.5 Test data for DC 24 V

13.5.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : (45 ~ 46) % R.H.

Temperature: (24 ~ 25) °C

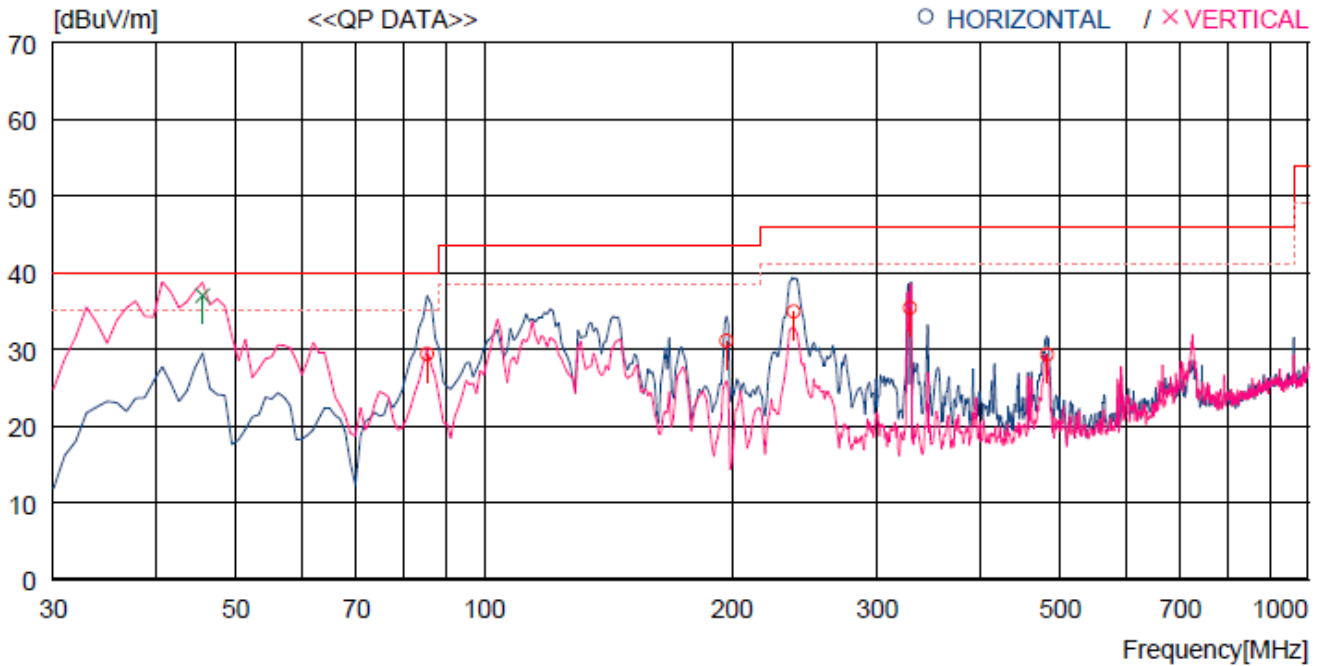
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Date: May 05, 2018

Note : 5 GHz operating mode were tested, (802.11ac WLAN Mode)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	85.290	51.2	8.8	2.4	33.0	29.4	40.0	10.6	300	359
2	237.580	52.1	11.9	4.0	33.1	34.9	46.0	11.1	100	359
3	328.760	49.8	14.0	4.7	33.1	35.4	46.0	10.6	100	359
4	482.021	40.1	16.8	5.7	33.3	29.3	46.0	16.7	200	57
5	196.840	50.1	10.5	3.7	33.2	31.1	43.5	12.4	200	0
---- Vertical ----										
6	45.520	54.5	13.9	1.7	33.1	37.0	40.0	3.0	100	0

DL
Tested by: Min-Gu Ji / Assistant Manager

13.5.3 Test data for Below 30 MHz

- . Test Date : May 05, 2018
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

13.5.3 Test data for above 1 GHz

- . Test Date : May 05, 2018
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 40 GHz
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Middle Channel									
11 550.00	49.05	Peak	H	39.60	7.50	30.96	65.19	73.98	8.79
	36.67	Average	H				52.81	53.98	1.17
	48.64	Peak	V				64.78	73.98	9.20
	36.69	Average	V				52.83	53.98	1.15

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



Tested by: Min-Gu Ji / Assistant Manager

14. RADIATED RESTRICTED BAND EDGE MEASUREMENTS

14.1 Operating environment

Temperature : 24 °C
 Relative humidity : 52 % R.H.

14.2 Test set-up

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
□	- ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
■	- ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
□	- FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
■	- 310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■	- FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■	- BBV 9718 B	Schwarzbeck	Pre-Amplifier	009	Mar. 16, 2018 (1Y)
■	- MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
□	- HD100	HD GmbH	Position Controller	N/A	N/A
■	- DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
□	- FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	Jun. 10, 2016 (2Y)
■	- VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 05, 2016 (2Y)
■	- BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■	- BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■	- SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

14.5 Test data for Restricted Band

14.5.1 Test data for DC 12 V

- . Test Date : May 05, 2018
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
High Channel									
5863.66	40.54	Peak	H	32.80	6.80	32.70	47.44	74.00	26.56
5865.80	29.82	Average	H				36.72	54.00	17.28
5868.15	41.15	Peak	V				48.05	74.00	25.95
5864.96	29.88	Average	V				36.78	54.00	17.22

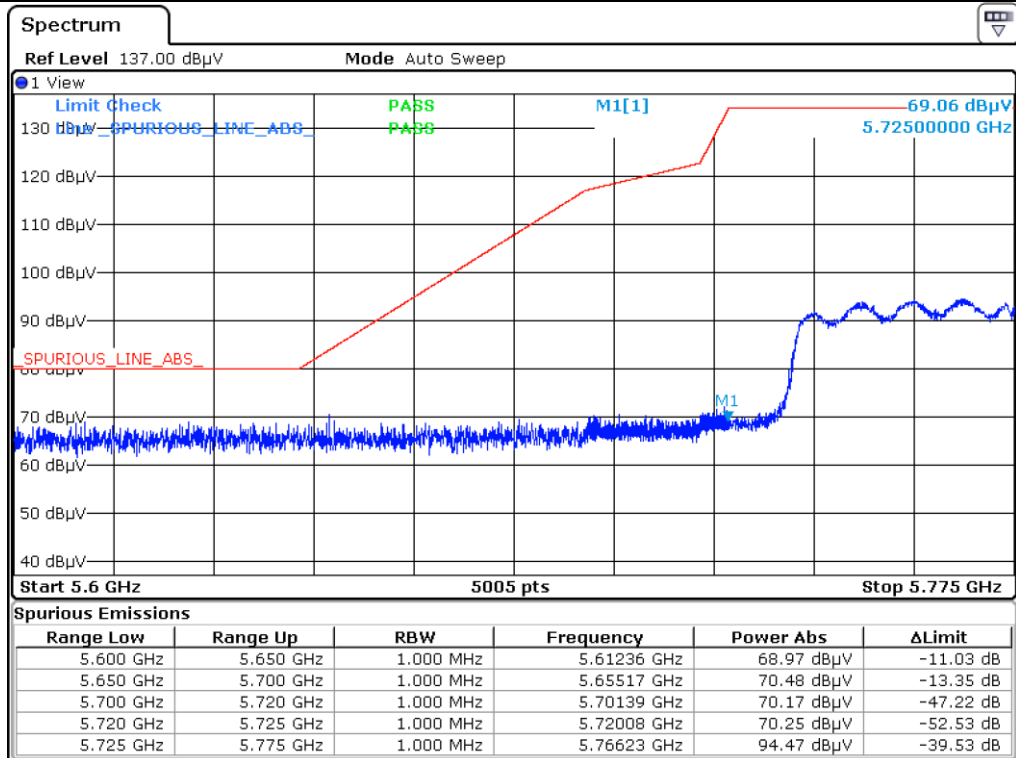
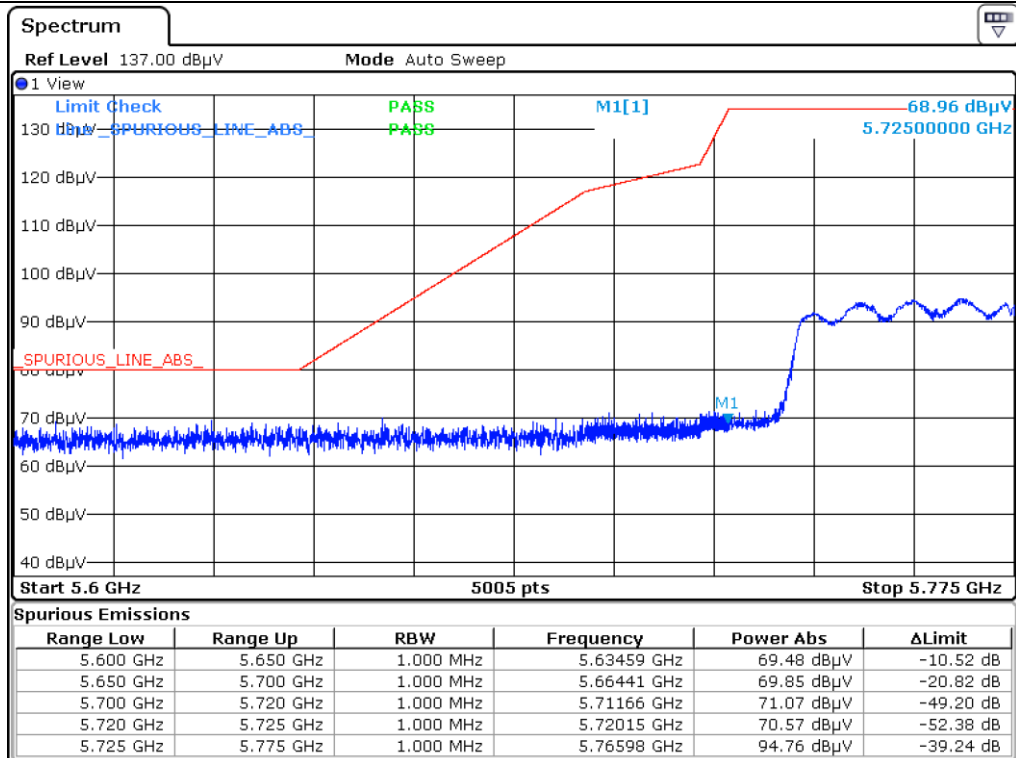
Tabulated test data for Restricted Band

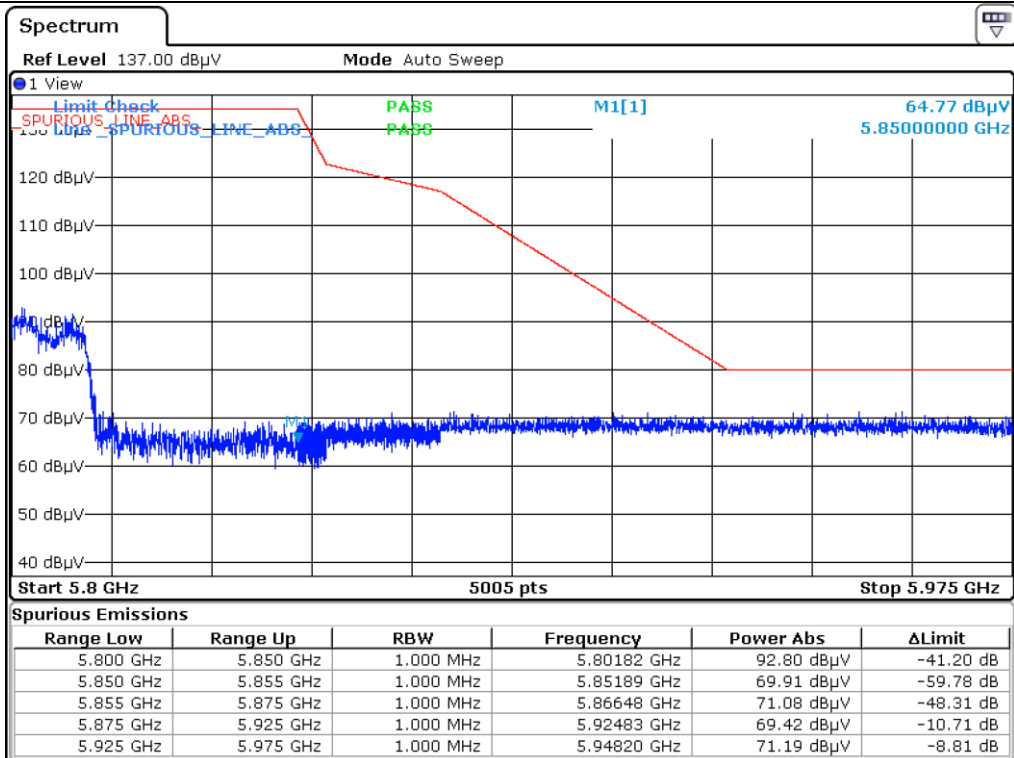
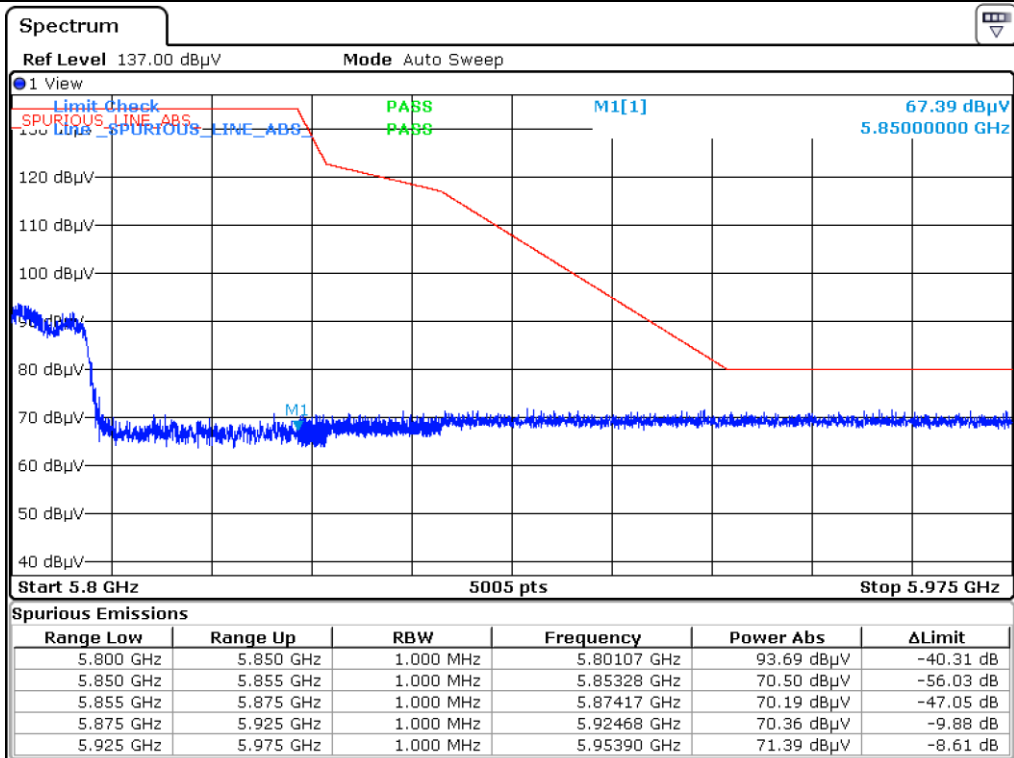
Remark - "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



Tested by: Min-Gu Ji / Assistant Manager





14.5.2 Test data for DC 24 V

- Test Date : May 05, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Detector : Peak Mode(Peak), Average Mode(RMS)
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : Pass

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
High Channel									
5870.45	42.01	Peak	H	32.80	6.80	32.70	48.91	74.00	25.09
5865.50	29.60	Average	H				36.50	54.00	17.50
5862.51	41.41	Peak	V				48.31	74.00	25.69
5865.60	29.81	Average	V				36.71	54.00	17.29

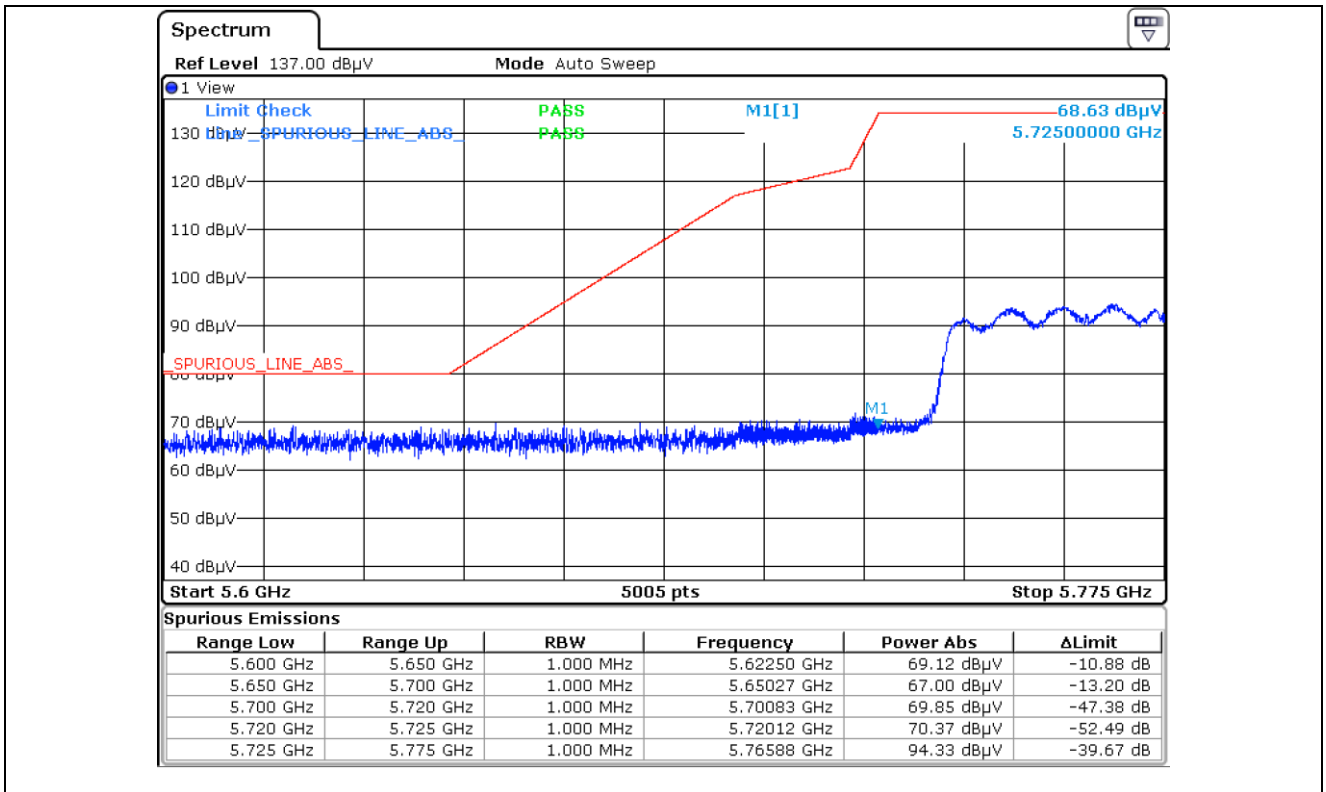
Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

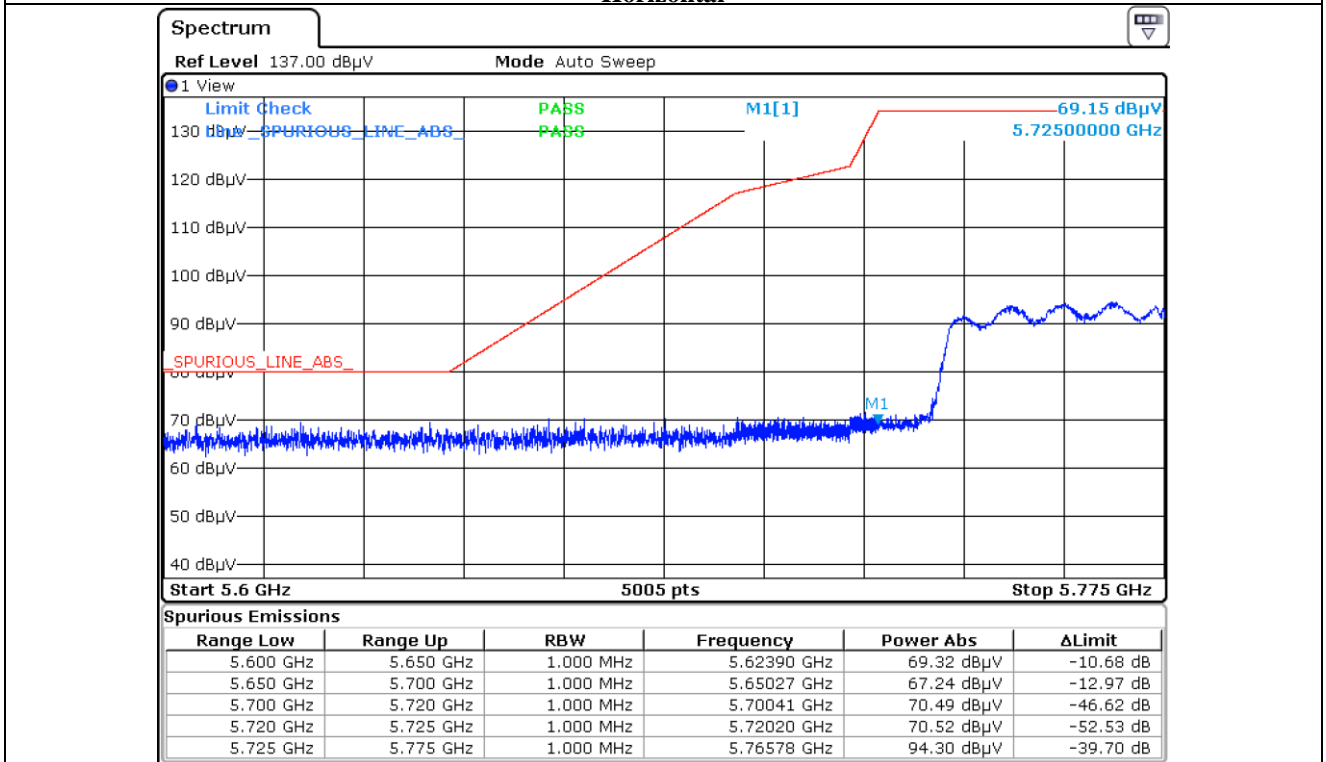
$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



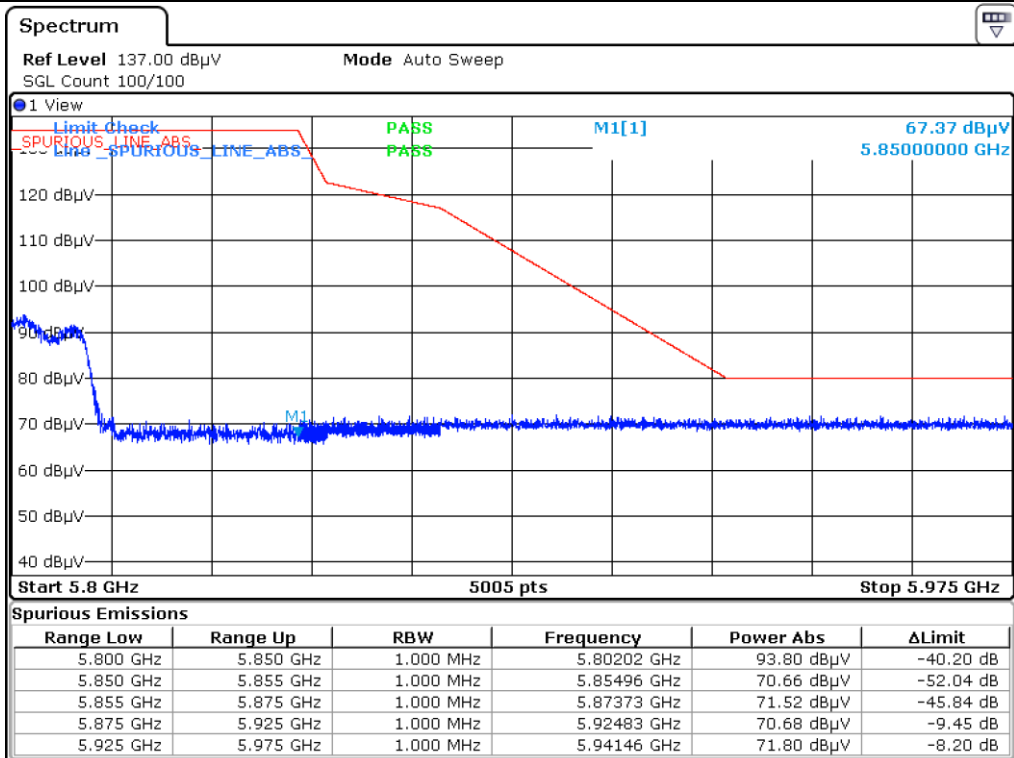
Tested by: Min-Gu Ji / Assistant Manager



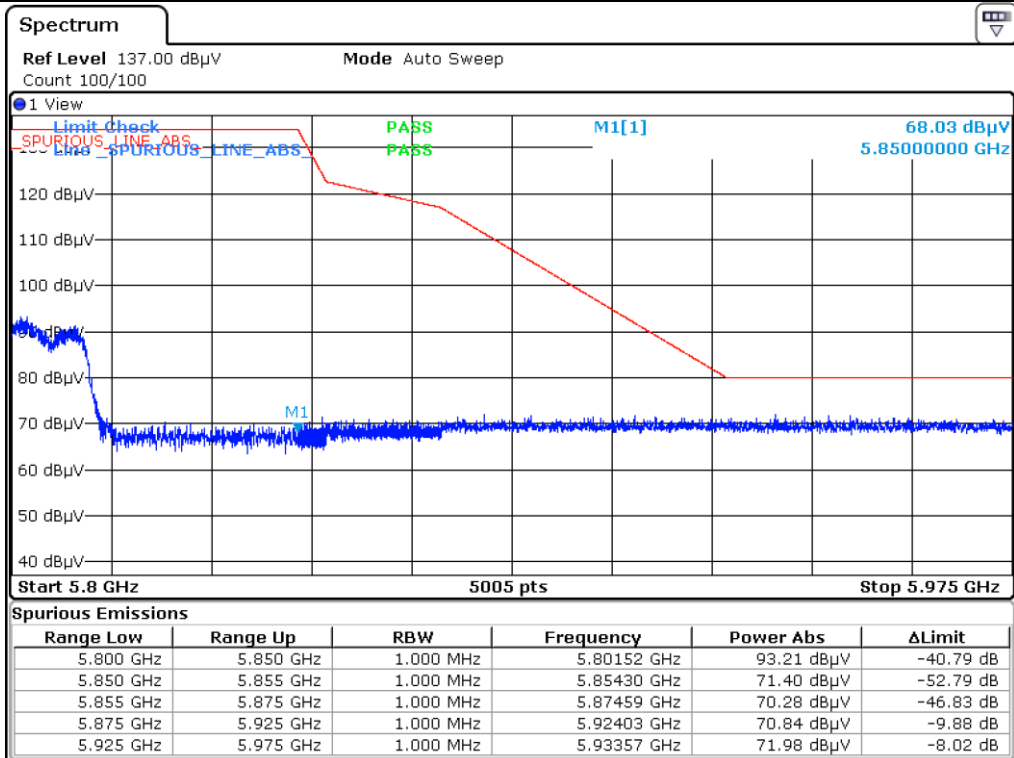
Horizontal



Vertical



Horizontal



Vertical

15. CONDUCTED EMISSION TEST

15.1 Operating environment

Temperature : 23 °C
 Relative humidity : 43 % R.H.

15.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

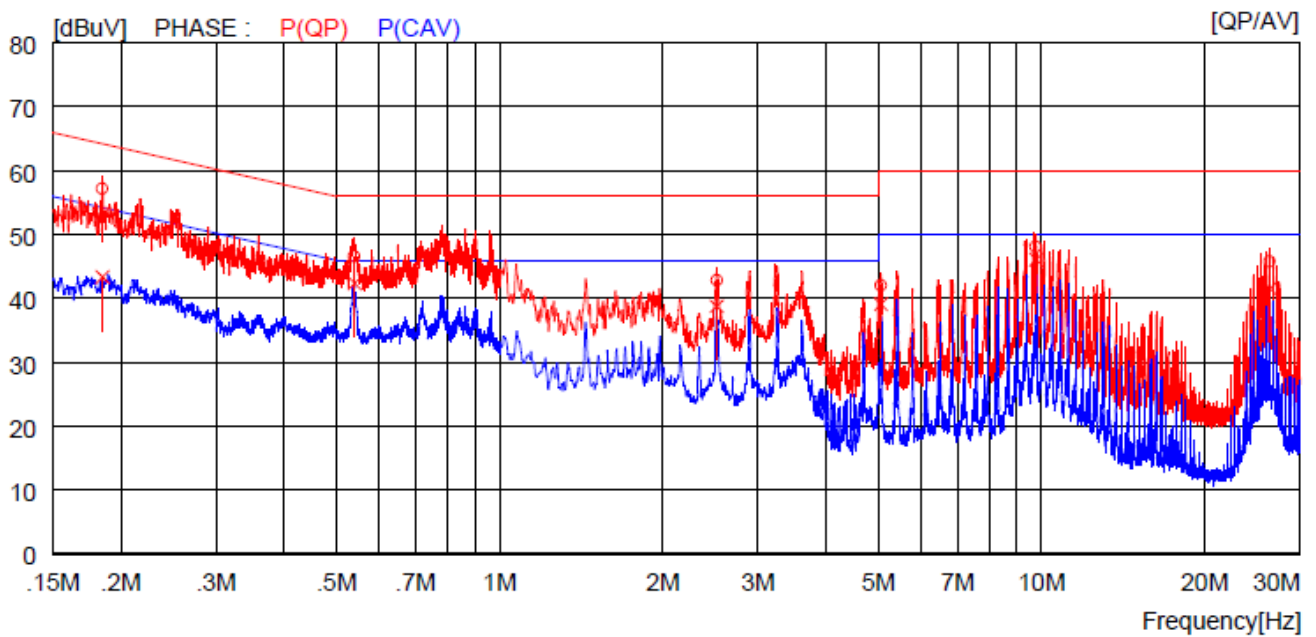
15.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Oct. 27, 2017 (1Y)
□ - ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Apr. 03, 2017 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Mar. 28, 2018 (1Y)
□ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 04, 2018 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-479	Oct. 24, 2017 (1Y)
■ - NNBM 8124	SCHWARZ BECK	V-LISN	05066	Oct. 24, 2017 (1Y)
■ - NNBM 8124	SCHWARZ BECK	V-LISN	05019	Oct. 25, 2017 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 11, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

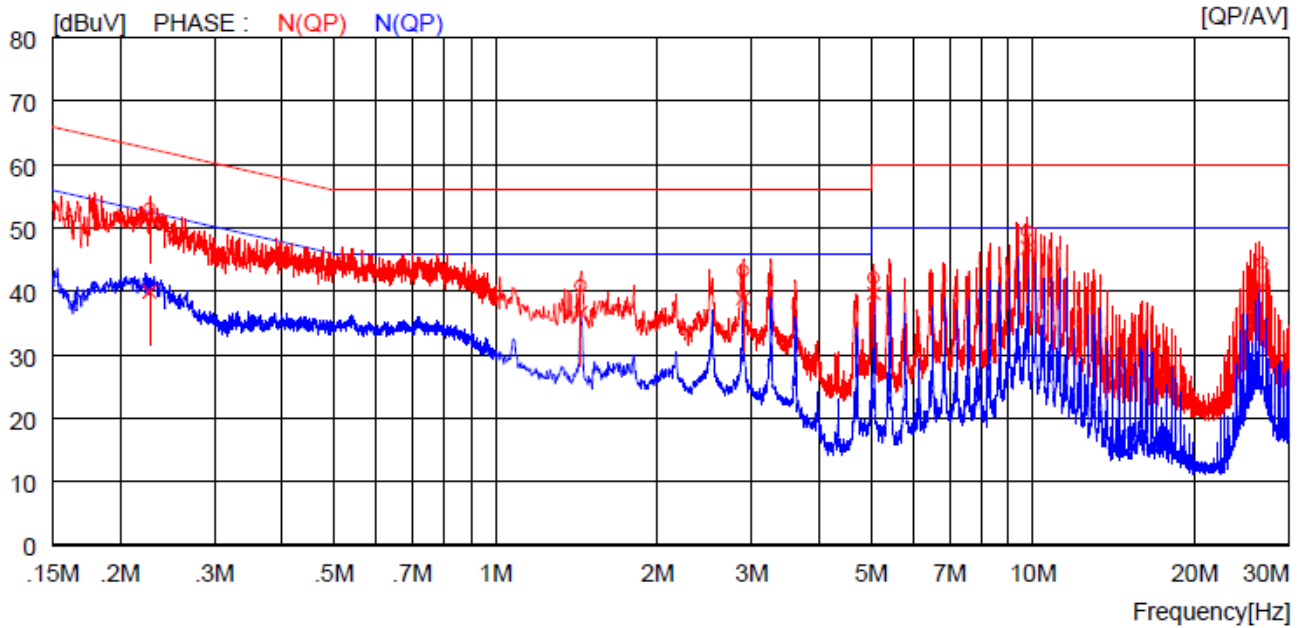
15.4 Test data for DC 12 V

- Test Date : May 05, 2018
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Note : 5 GHz operating mode were tested, but the worst data were recorded.
(802.11a RLAN Mode)
- Tested Line : POSITIVE LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.18500	47.3	----	9.9	57.2	----	64.3	----	7.1	----	P (QP)
2	0.54000	36.7	----	9.9	46.6	----	56.0	----	9.4	----	P (QP)
3	2.51600	32.8	----	10.0	42.8	----	56.0	----	13.2	----	P (QP)
4	5.05500	31.8	----	10.2	42.0	----	60.0	----	18.0	----	P (QP)
5	9.76000	37.7	----	10.4	48.1	----	60.0	----	11.9	----	P (QP)
6	26.39000	35.1	----	10.7	45.8	----	60.0	----	14.2	----	P (QP)
7	0.18500	----	33.5	9.9	----	43.4	----	54.3	----	10.9	P (CAV)
8	0.54000	----	32.5	9.9	----	42.4	----	46.0	----	3.6	P (CAV)
9	2.51600	----	28.8	10.0	----	38.8	----	46.0	----	7.2	P (CAV)
10	5.05500	----	28.9	10.2	----	39.1	----	50.0	----	10.9	P (CAV)
11	9.76000	----	35.7	10.4	----	46.1	----	50.0	----	3.9	P (CAV)
12	26.39000	----	30.9	10.7	----	41.6	----	50.0	----	8.4	P (CAV)

- Tested Line : NEGATIVE LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.22700	43.1	----	9.9	53.0	----	62.6	----	9.6	----	N(QP)
2	1.44000	30.9	----	10.0	40.9	----	56.0	----	15.1	----	N(QP)
3	2.88800	33.1	----	10.1	43.2	----	56.0	----	12.8	----	N(QP)
4	5.05500	31.9	----	10.2	42.1	----	60.0	----	17.9	----	N(QP)
5	9.76000	39.1	----	10.4	49.5	----	60.0	----	10.5	----	N(QP)
6	26.75000	33.9	----	10.7	44.6	----	60.0	----	15.4	----	N(QP)
7	0.22700	----	30.1	9.9	----	40.0	----	52.6	----	12.6	N(CAV)
8	1.44000	----	26.6	10.0	----	36.6	----	46.0	----	9.4	N(CAV)
9	2.88800	----	28.8	10.1	----	38.9	----	46.0	----	7.1	N(CAV)
10	5.05500	----	29.5	10.2	----	39.7	----	50.0	----	10.3	N(CAV)
11	9.76000	----	36.5	10.4	----	46.9	----	50.0	----	3.1	N(CAV)
12	26.75000	----	30.1	10.7	----	40.8	----	50.0	----	9.2	N(CAV)

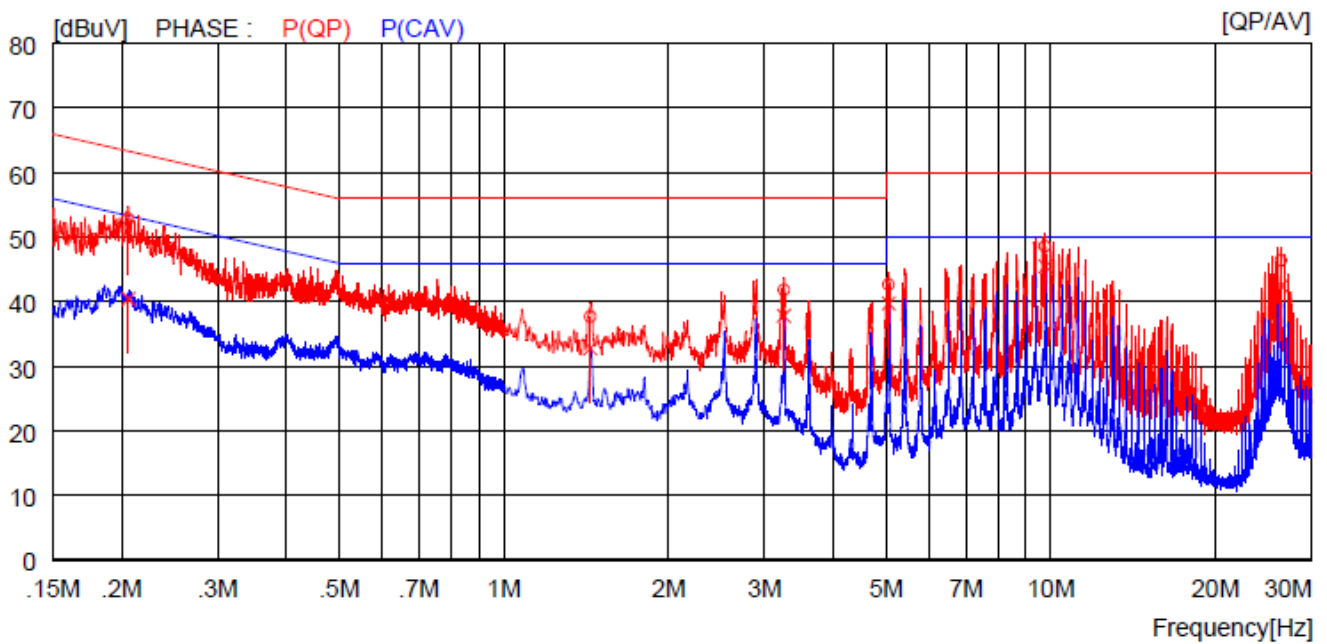
Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: Min-Gu Ji / Assistant Manager

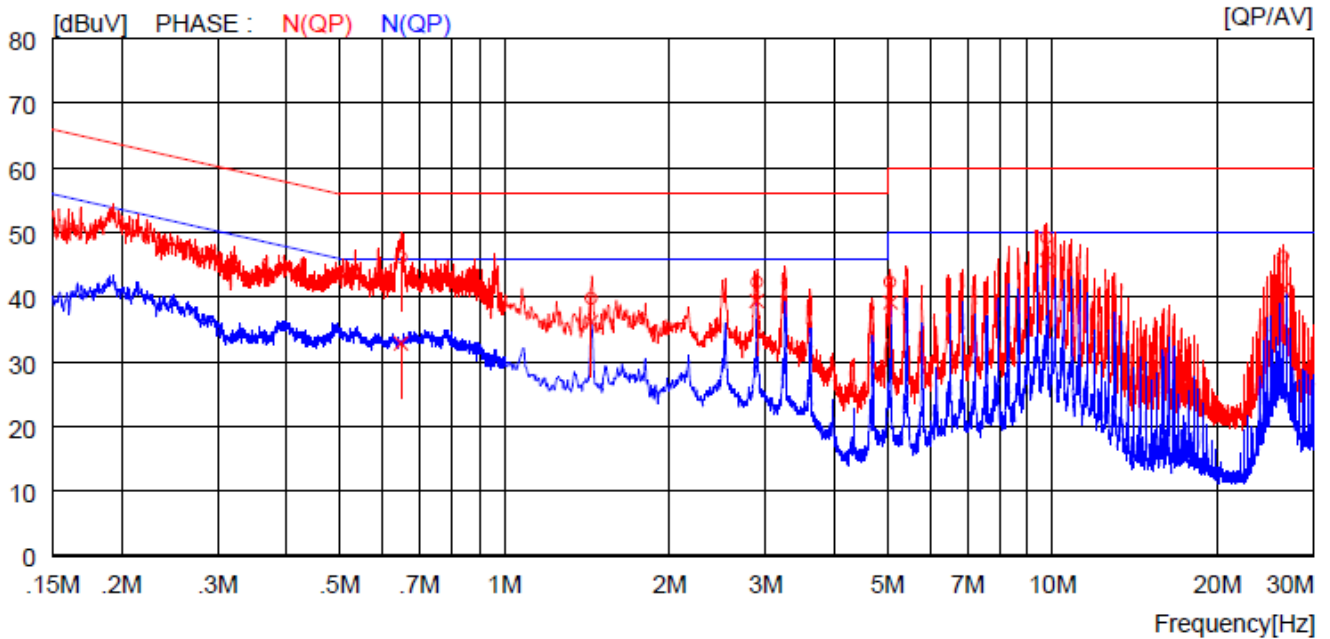
15.5 Test data for DC 24 V

- Test Date : May 05, 2018
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Note : 5 GHz operating mode were tested, but the worst data were recorded.
(802.11a RLAN Mode)
- Tested Line : POSITIVE LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.20600	42.9	----	9.9	52.8	----	63.4	----	10.6	----	P (QP)
2	1.44000	27.7	----	10.0	37.7	----	56.0	----	18.3	----	P (QP)
3	3.25200	31.6	----	10.2	41.8	----	56.0	----	14.2	----	P (QP)
4	5.05500	32.4	----	10.2	42.6	----	60.0	----	17.4	----	P (QP)
5	9.76000	38.2	----	10.4	48.6	----	60.0	----	11.4	----	P (QP)
6	26.39000	35.7	----	10.7	46.4	----	60.0	----	13.6	----	P (QP)
7	0.20600	----	30.6	9.9	----	40.5	----	53.4	----	12.9	P (CAV)
8	1.44000	----	22.8	10.0	----	32.8	----	46.0	----	13.2	P (CAV)
9	3.25200	----	27.6	10.2	----	37.8	----	46.0	----	8.2	P (CAV)
10	5.05500	----	29.6	10.2	----	39.8	----	50.0	----	10.2	P (CAV)
11	9.76000	----	35.1	10.4	----	45.5	----	50.0	----	4.5	P (CAV)
12	26.39000	----	31.8	10.7	----	42.5	----	50.0	----	7.5	P (CAV)

-. Tested Line : NEGATIVE LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.64800	36.2	----	10.0	46.2	----	56.0	----	9.8	----	N(QP)
2	1.44000	29.8	----	10.0	39.8	----	56.0	----	16.2	----	N(QP)
3	2.88800	32.2	----	10.1	42.3	----	56.0	----	13.7	----	N(QP)
4	5.06000	32.1	----	10.2	42.3	----	60.0	----	17.7	----	N(QP)
5	9.76000	38.8	----	10.4	49.2	----	60.0	----	10.8	----	N(QP)
6	26.39000	35.6	----	10.7	46.3	----	60.0	----	13.7	----	N(QP)
7	0.64800	----	22.9	10.0	----	32.9	----	46.0	----	13.1	N(CAV)
8	1.44000	----	26.2	10.0	----	36.2	----	46.0	----	9.8	N(CAV)
9	2.88800	----	29.4	10.1	----	39.5	----	46.0	----	6.5	N(CAV)
10	5.06000	----	29.0	10.2	----	39.2	----	50.0	----	10.8	N(CAV)
11	9.76000	----	35.3	10.4	----	45.7	----	50.0	----	4.3	N(CAV)
12	26.39000	----	30.6	10.7	----	41.3	----	50.0	----	8.7	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: Min-Gu Ji / Assistant Manager