

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

Test Report No. : OT-185-RWD-035

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-DR900S-2CH

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 : 55 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 C Section 15.247*

This test report only contains the result of a single test of the sample supplied for the examination.

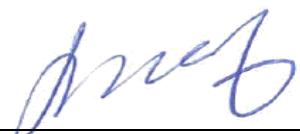
It is not a generally valid assessment of the features of the respective products of the mass-production.

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-035	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. : +82-2-6947-4670  
FCC ID. : YCK-DR900S-2CH  
Model Name : DR900S-2CH  
Serial Number : N/A  
Date : May 18, 2018

EQUIPMENT CLASS	DTS-Digital Transmission System
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 C Section 15.247
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
15.247 (a) (2)	6 dB bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / 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 C Section 15.247

### 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

### 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 REQUIREMENT		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/manufacturer 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

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

The worse case data rate for each modulation is determined 13.5 Mbps for HT40.

## 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

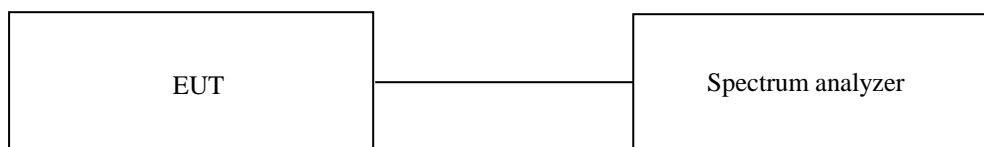
## 7. MINIMUM 6 dB BANDWIDTH & 99 % OCCUPIED BANDWIDTH

### 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 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 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 802.11n\_HT40 WLAN Mode

### 7.4.1 Test data for DC 12 V

-. Test Date : May 01, 2018

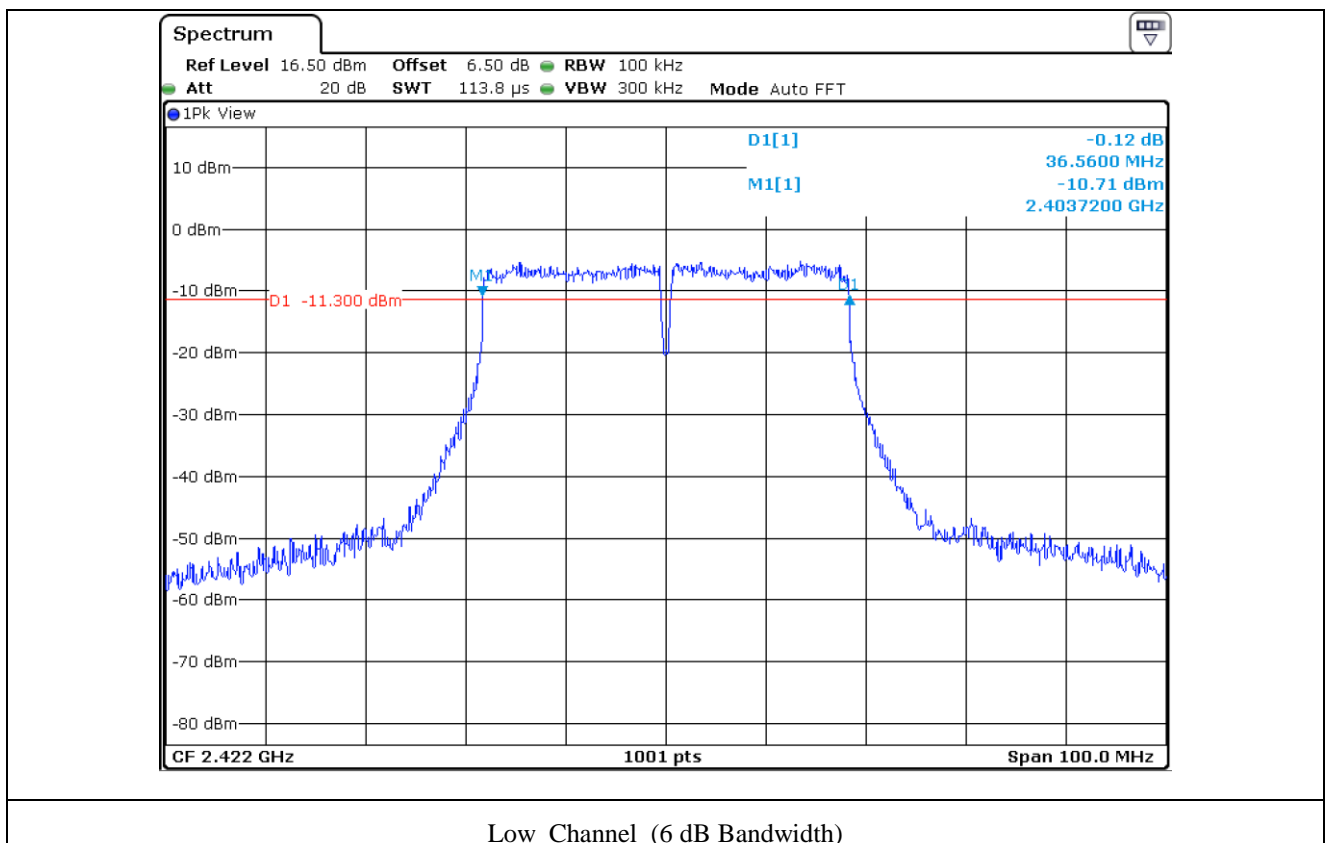
-. Test Result : Pass

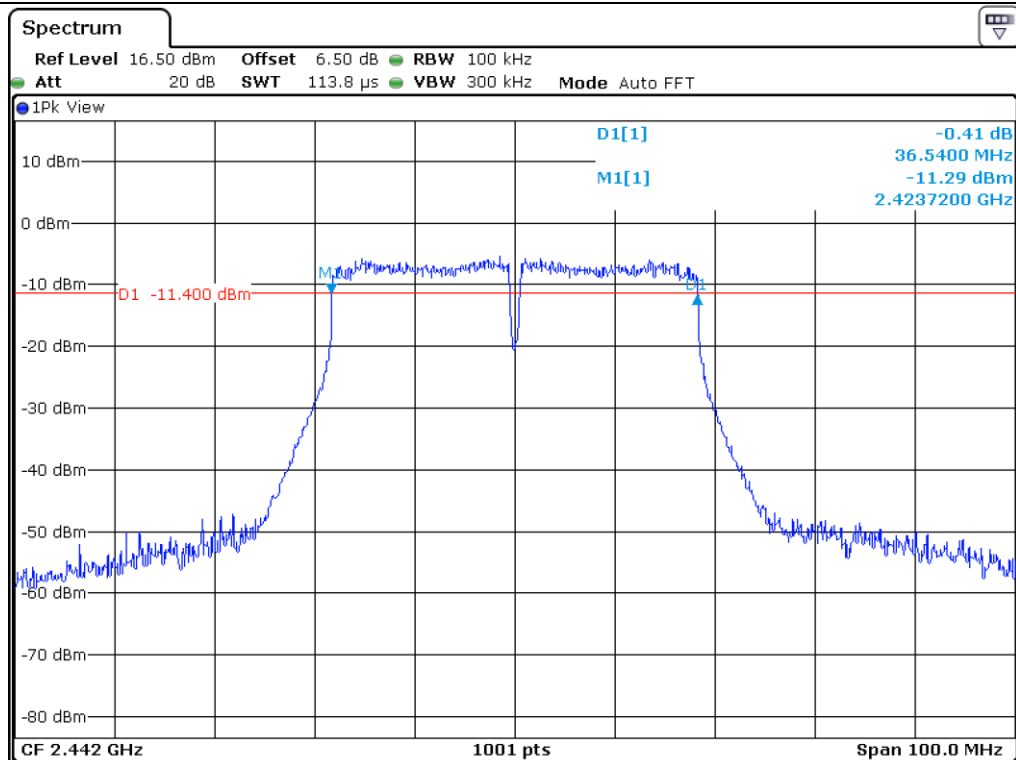
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 422	36.56	36.16	0.5	36.16	35.66
Middle	2 442	36.54	36.16	0.5	36.04	35.66
High	2 452	36.53	36.26	0.5	36.03	35.76

Remark. Margin = Measured Value - Limit

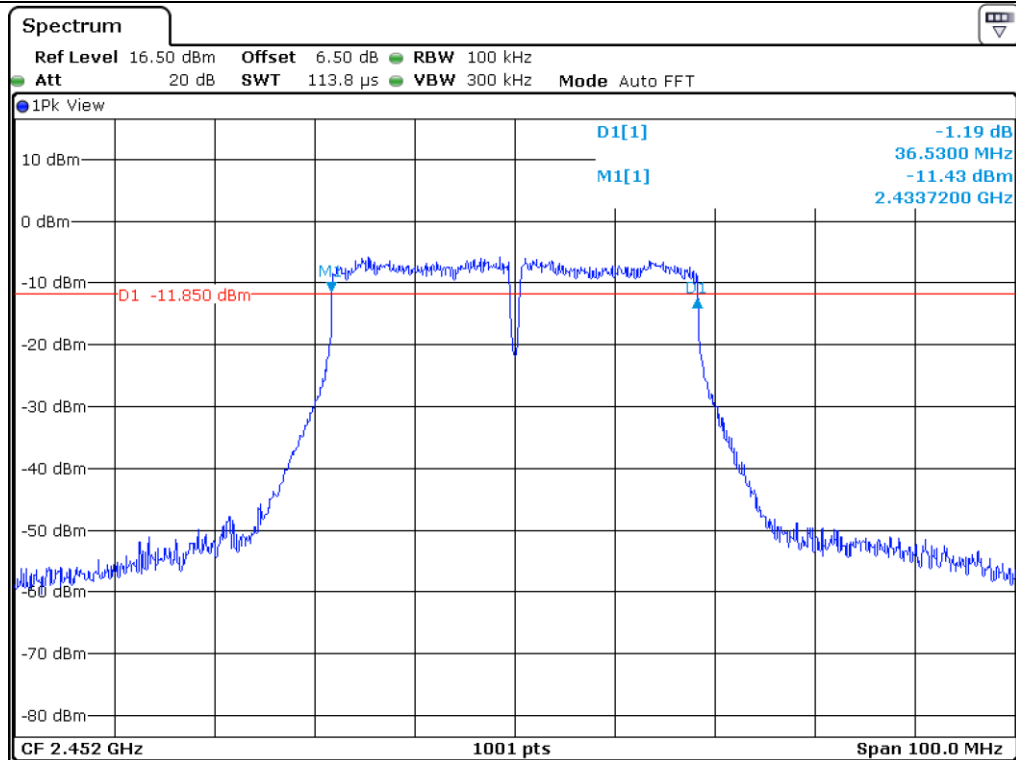


Tested by: Min-Gu Ji / Assistant Manager

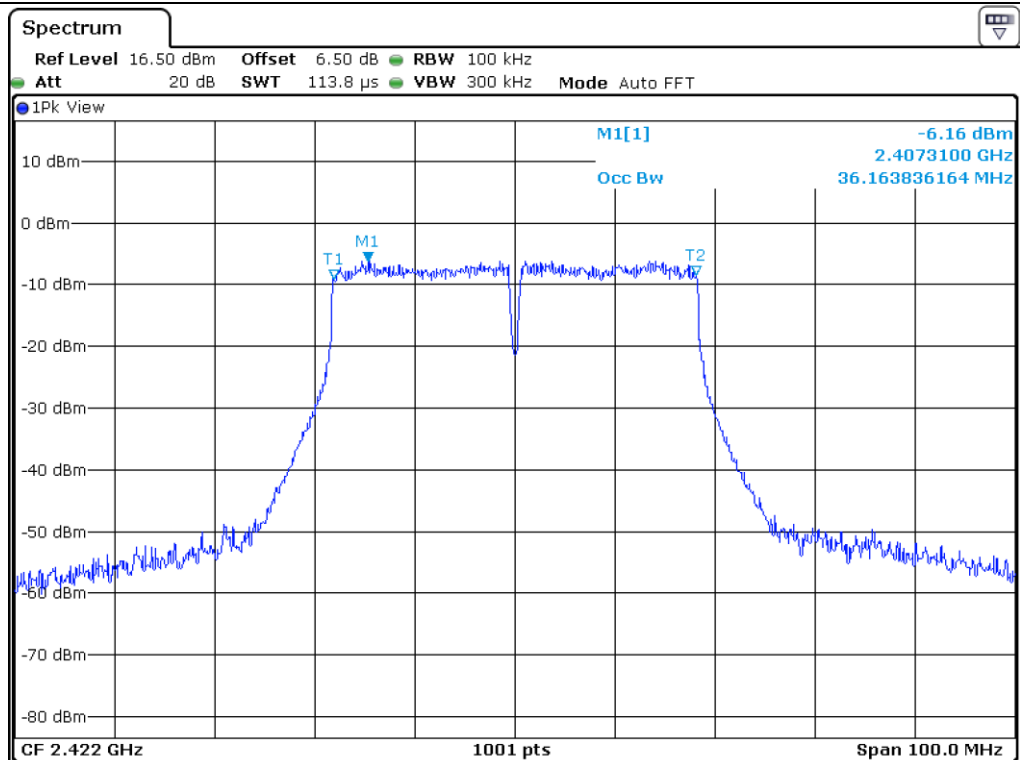




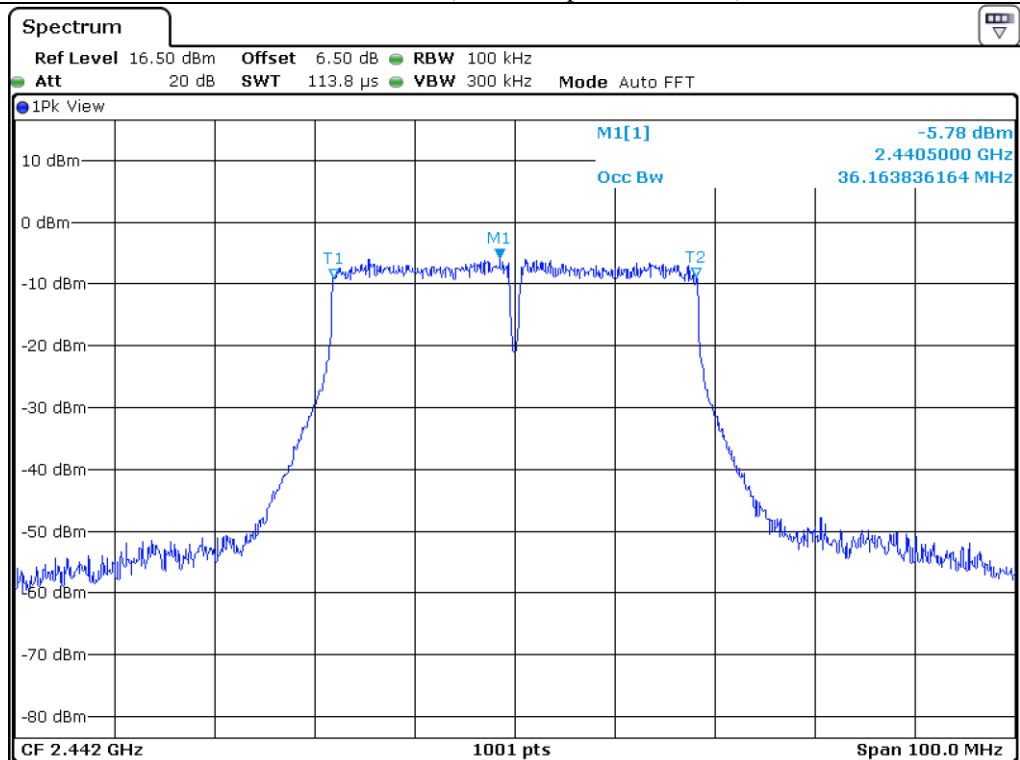
Middle Channel (6 dB Bandwidth)



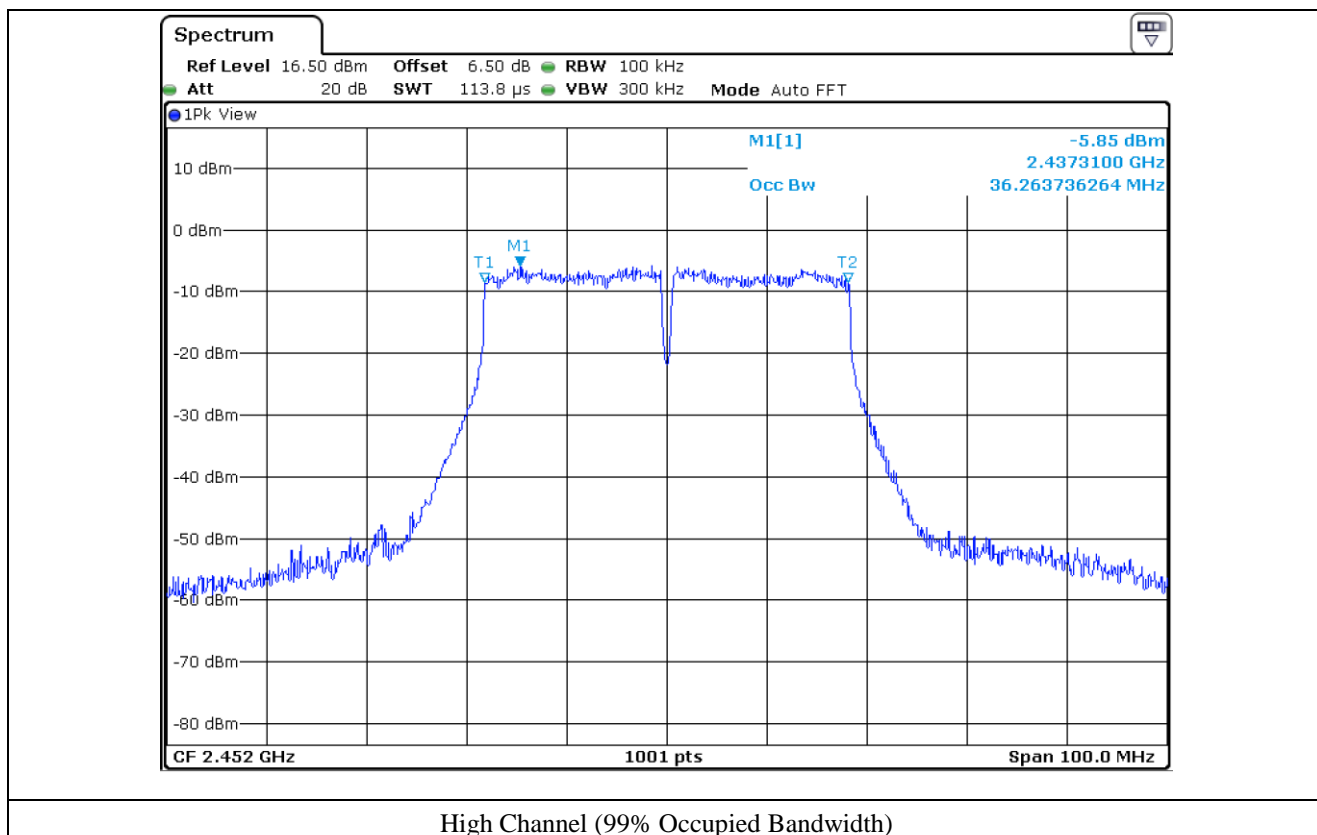
High Channel (6 dB Bandwidth)



Low Channel (99% Occupied Bandwidth)



Middle Channel (99% Occupied Bandwidth)





## 7.4.2 Test data for DC 24 V

-. Test Date : May 01, 2018

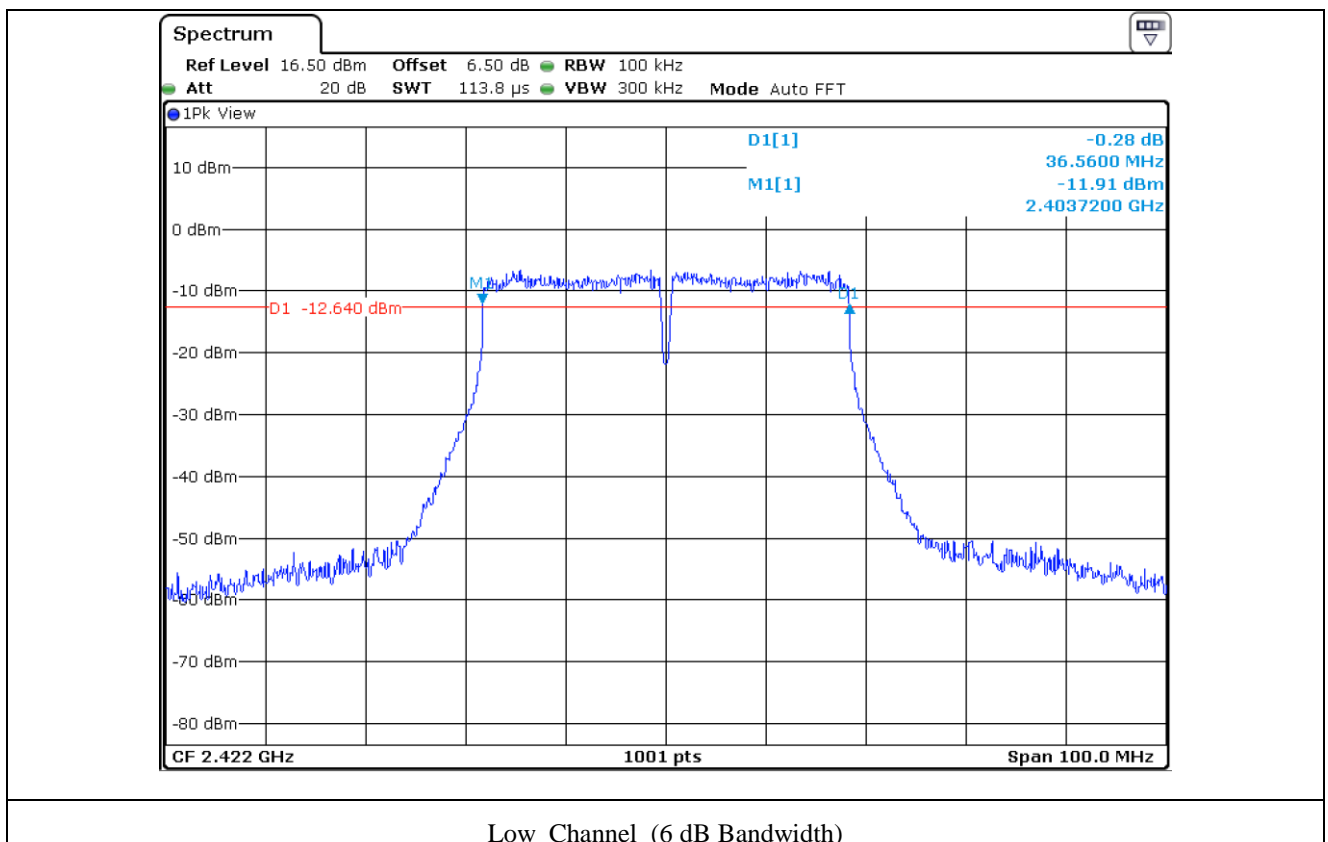
-. Test Result : Pass

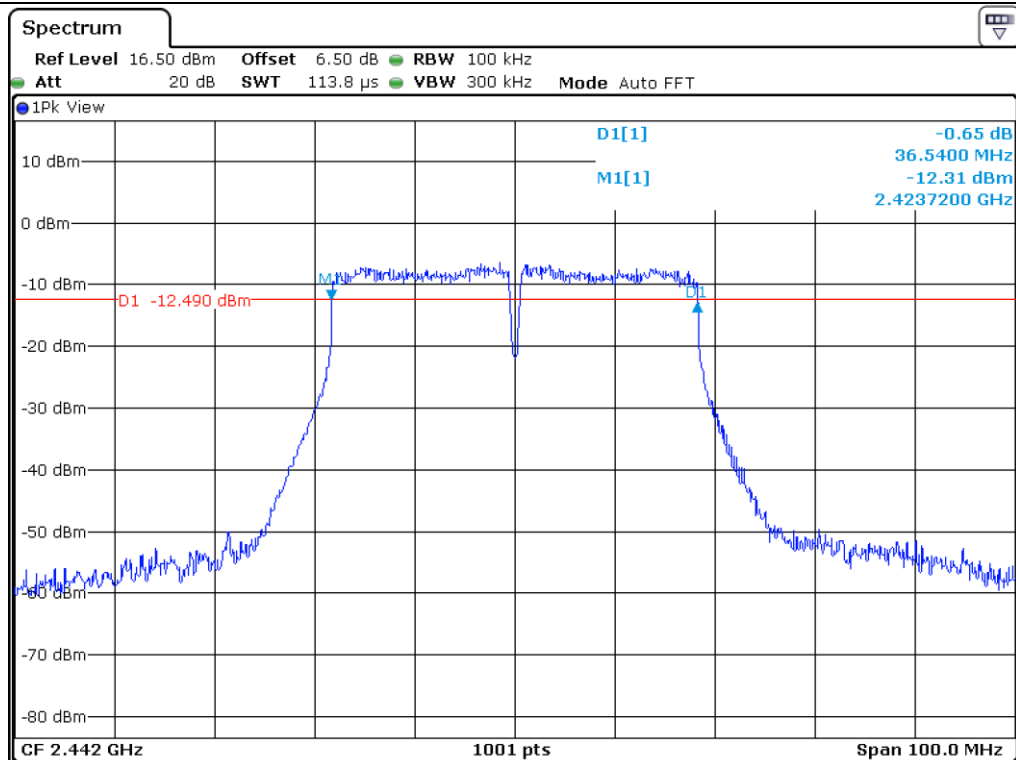
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412	36.56	36.16	0.5	36.06	35.66
Middle	2 442	36.54	36.16	0.5	36.04	35.66
High	2 452	36.56	36.16	0.5	36.06	35.66

Remark. Margin = Measured Value - Limit

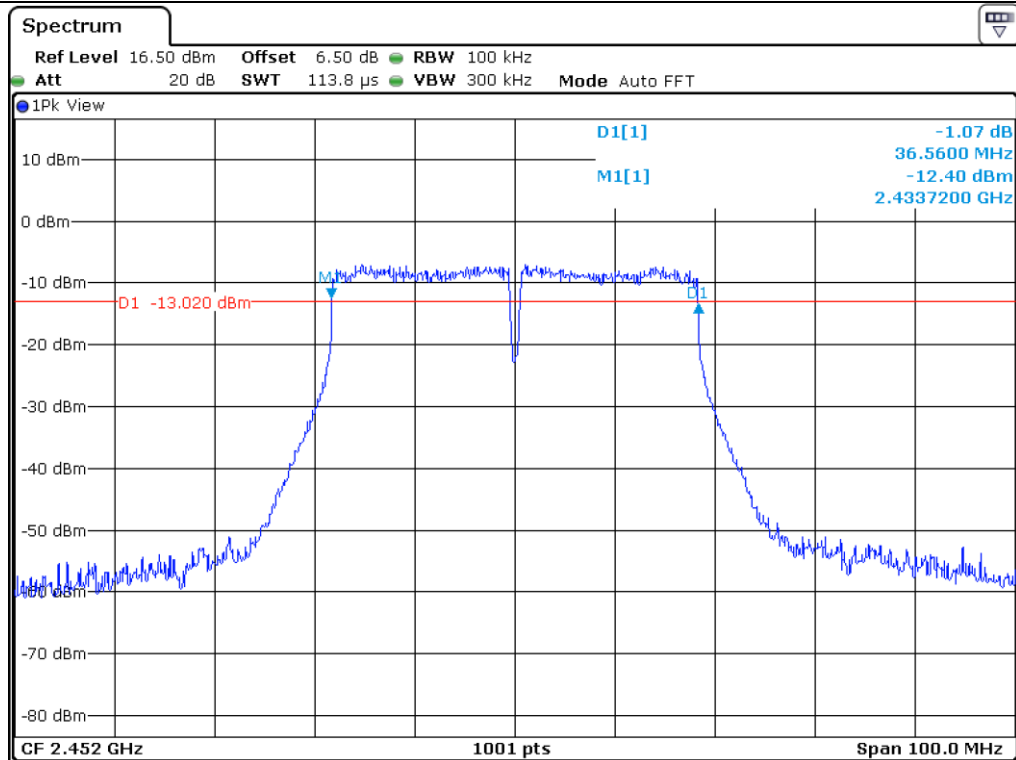
*DL*

Tested by: Min-Gu Ji / Assistant Manager

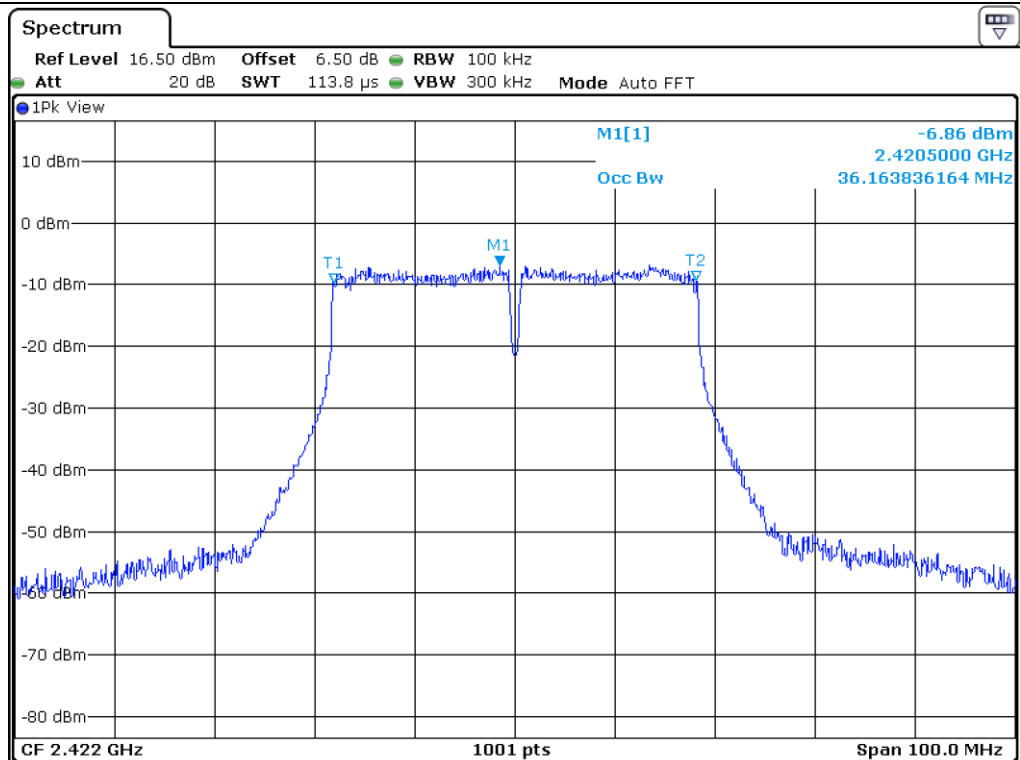




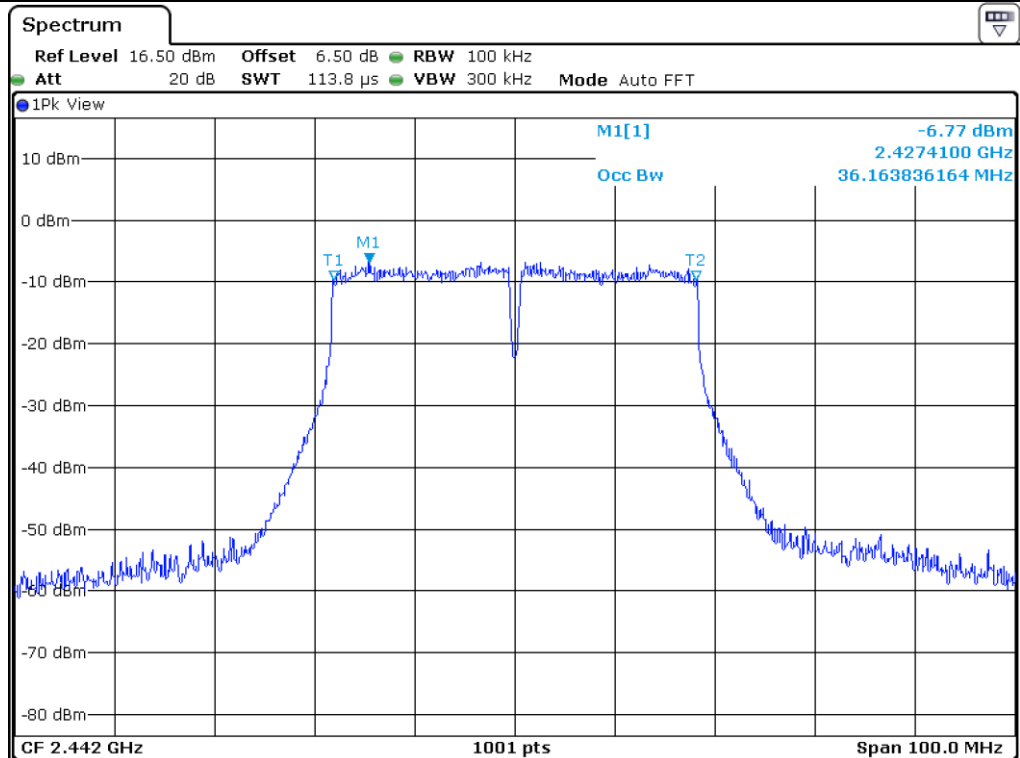
Middle Channel (6 dB Bandwidth)



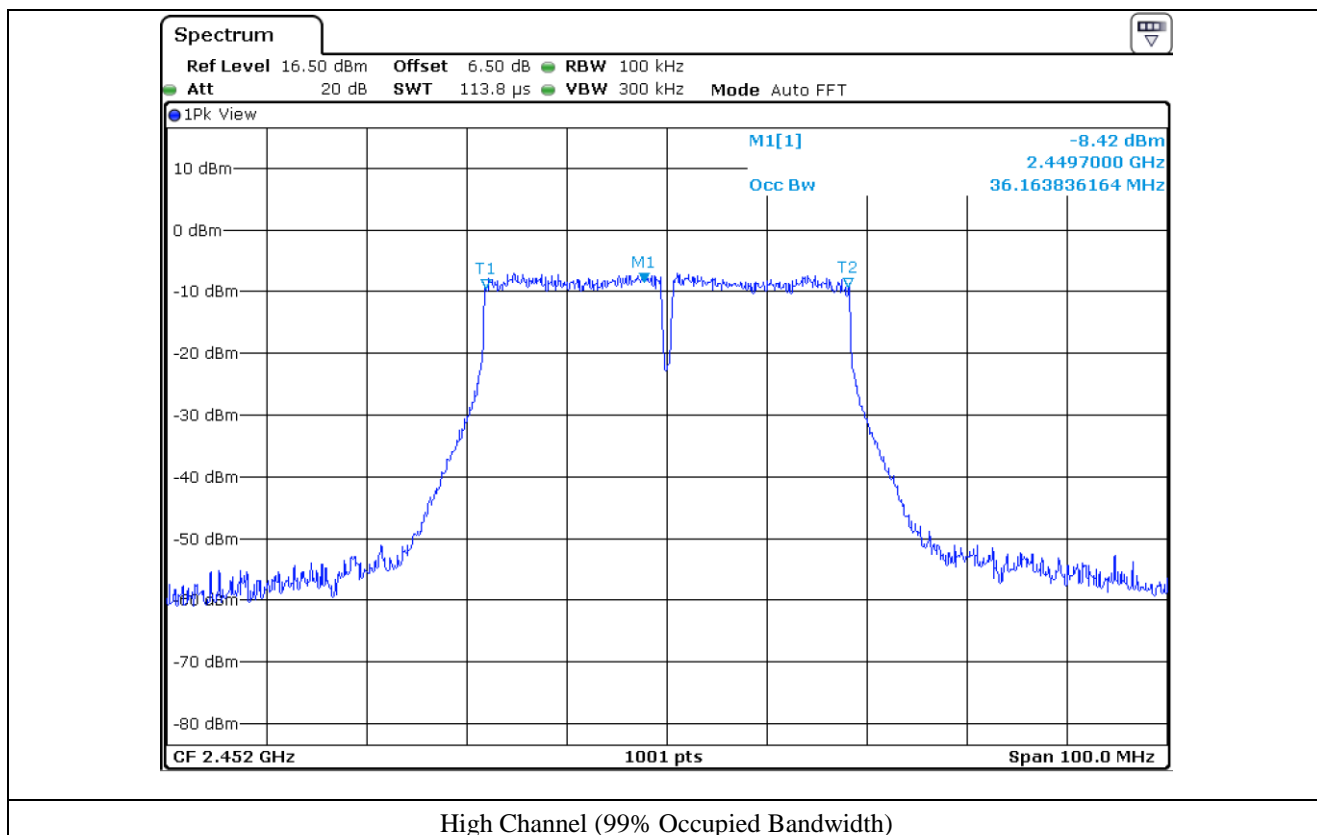
High Channel (6 dB Bandwidth)



Low Channel (99% Occupied Bandwidth)



Middle Channel (99% Occupied Bandwidth)



## 8. MAXIMUM PEAK OUTPUT POWER

### 8.1 Operating environment

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

### 8.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



### 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 802.11n\_HT40 WLAN Mode

### 8.4.1 Test data for DC 12 V

-. Test Date : May 01, 2018

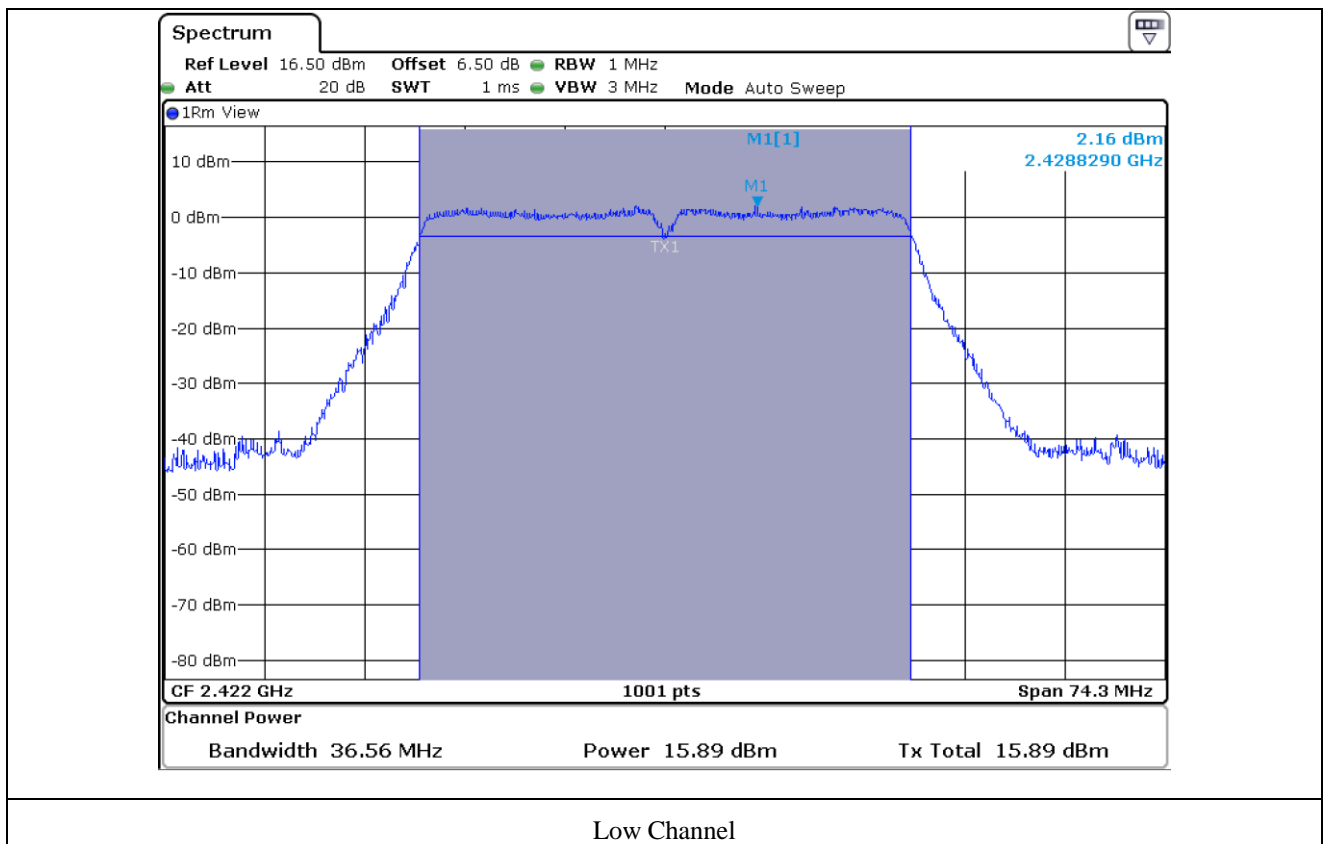
-. Test Result : Pass

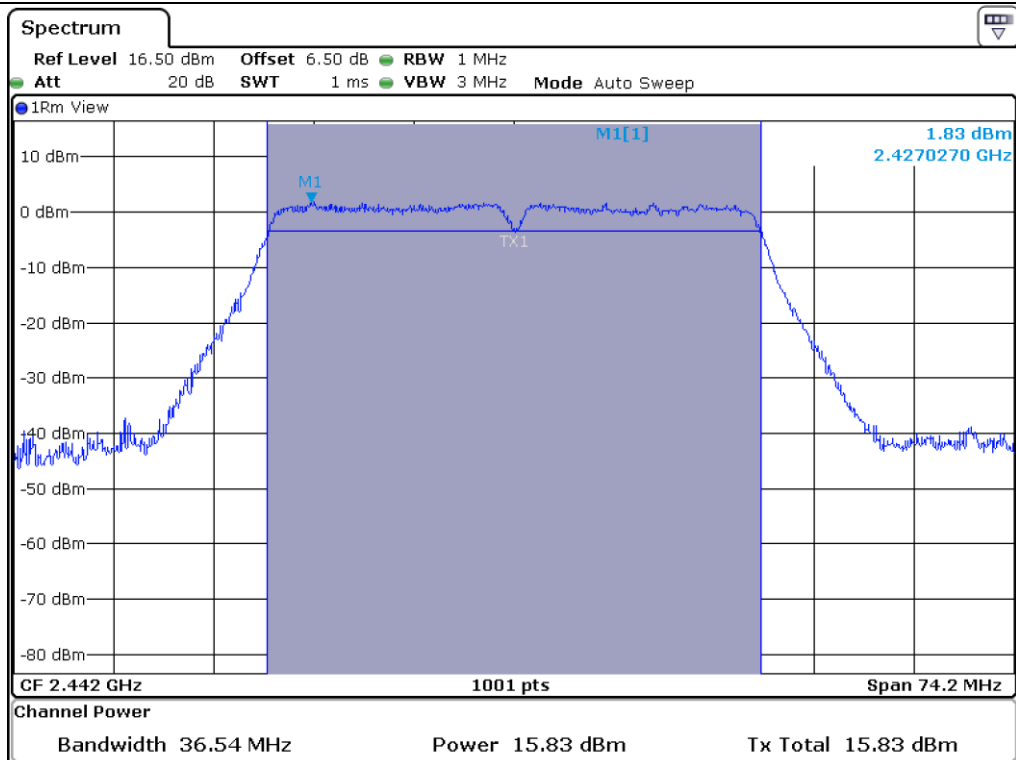
CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422	36.56	15.89	30.00	14.11
MIDDLE	2 442	36.54	15.83	30.00	14.17
HIGH	2 452	36.53	15.65	30.00	14.35

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

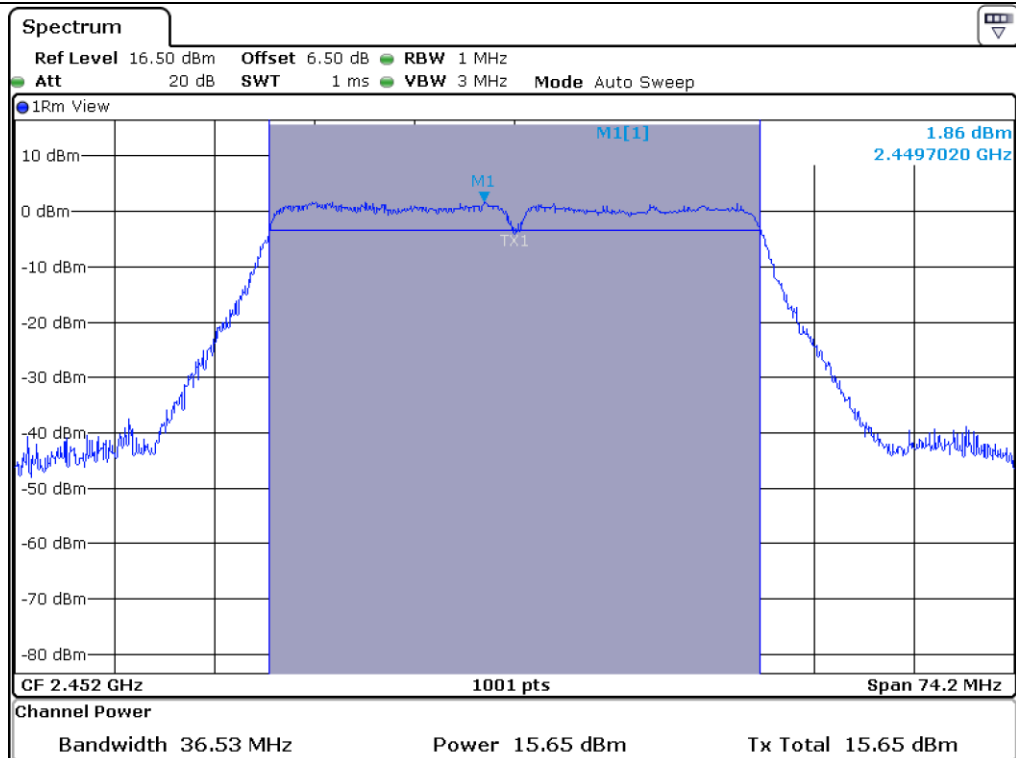


Tested by: Min-Gu Ji / Assistant Manager





Middle Channel



High Channel

## 8.4.2 Test data for DC 24 V

-. Test Date : May 01, 2018

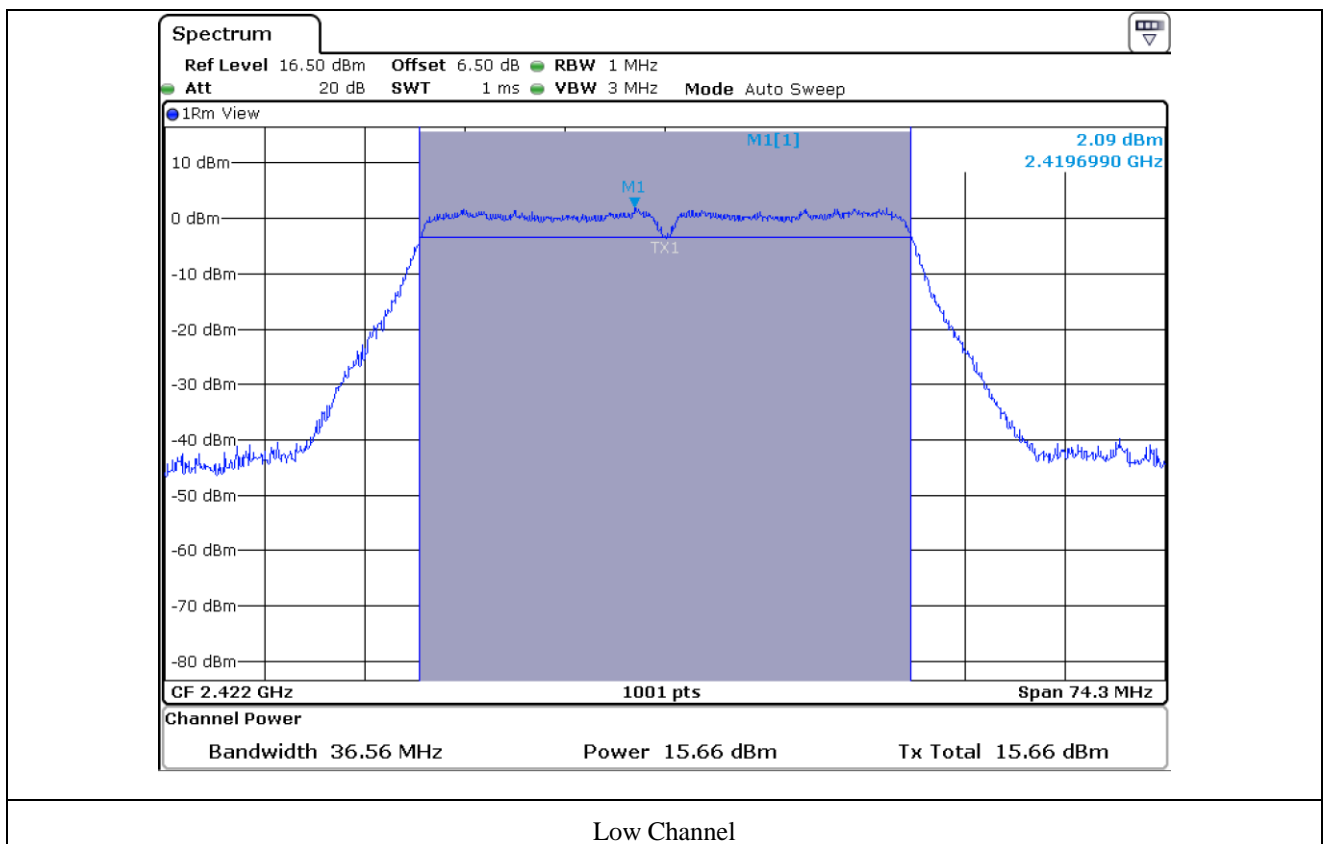
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422	36.56	15.66	30.00	14.34
MIDDLE	2 442	36.54	15.61	30.00	14.39
HIGH	2 452	36.56	15.36	30.00	14.64

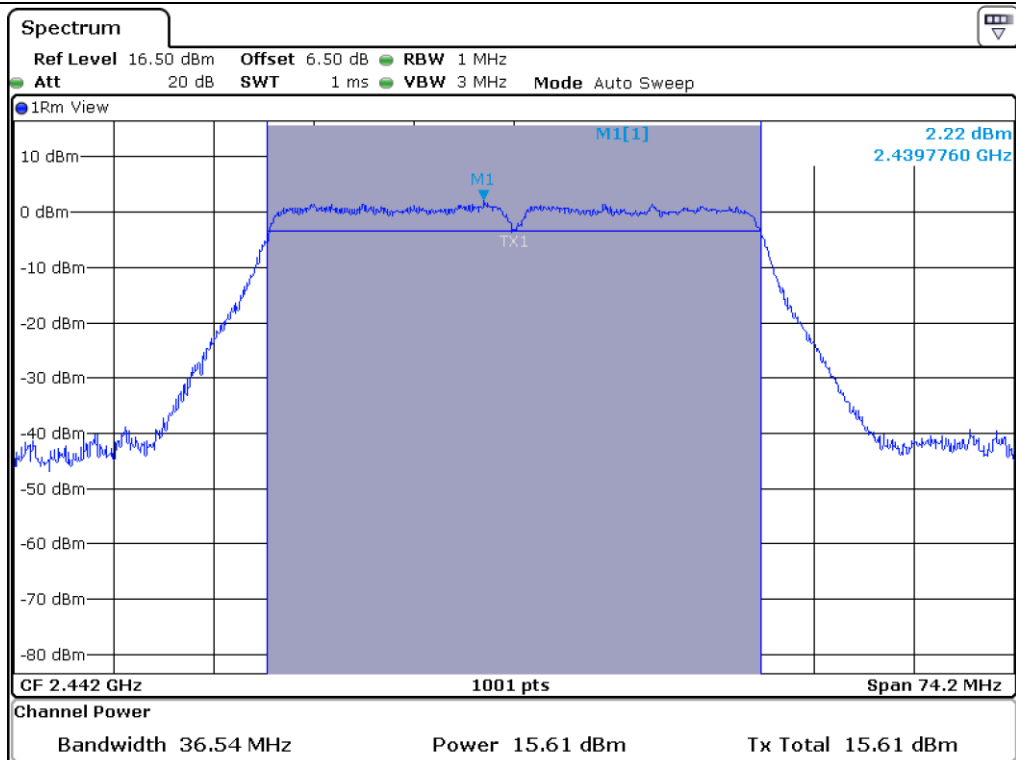
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



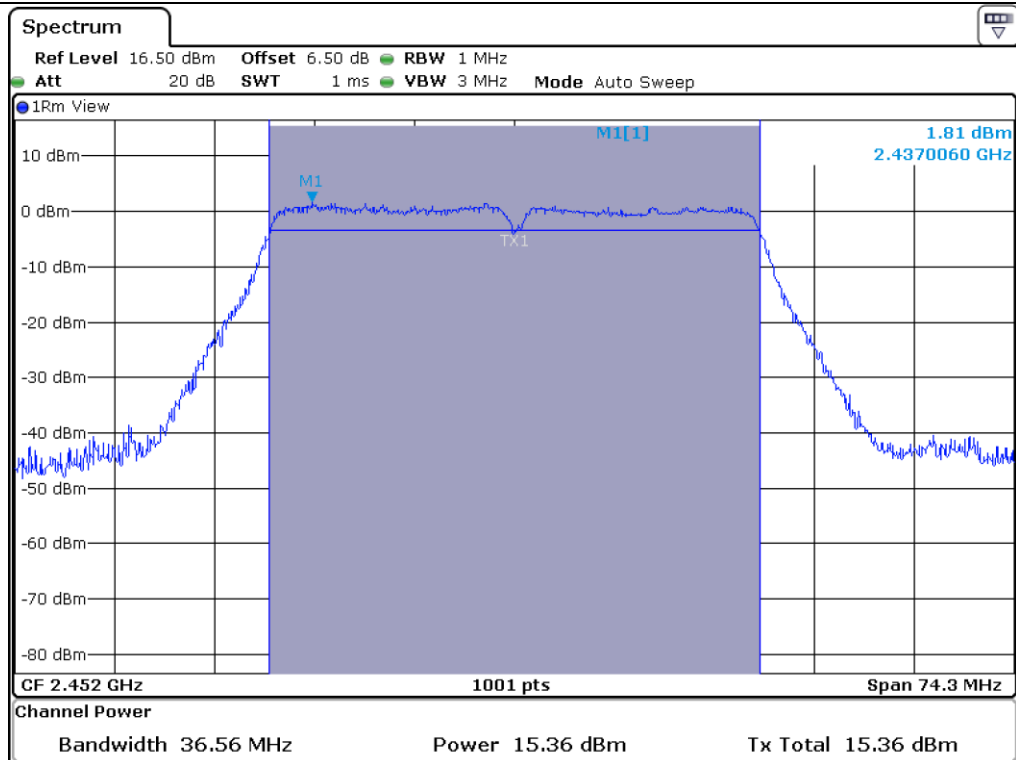
Tested by: Min-Gu Ji / Assistant Manager







Middle Channel



High Channel

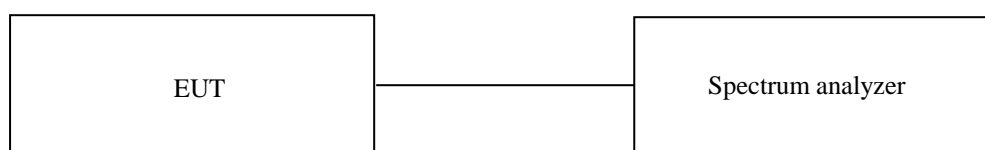
## 9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 9.1 Operating environment

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

### 9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



### 9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 30 MHz to 40 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.

### 9.4 Test equipment used

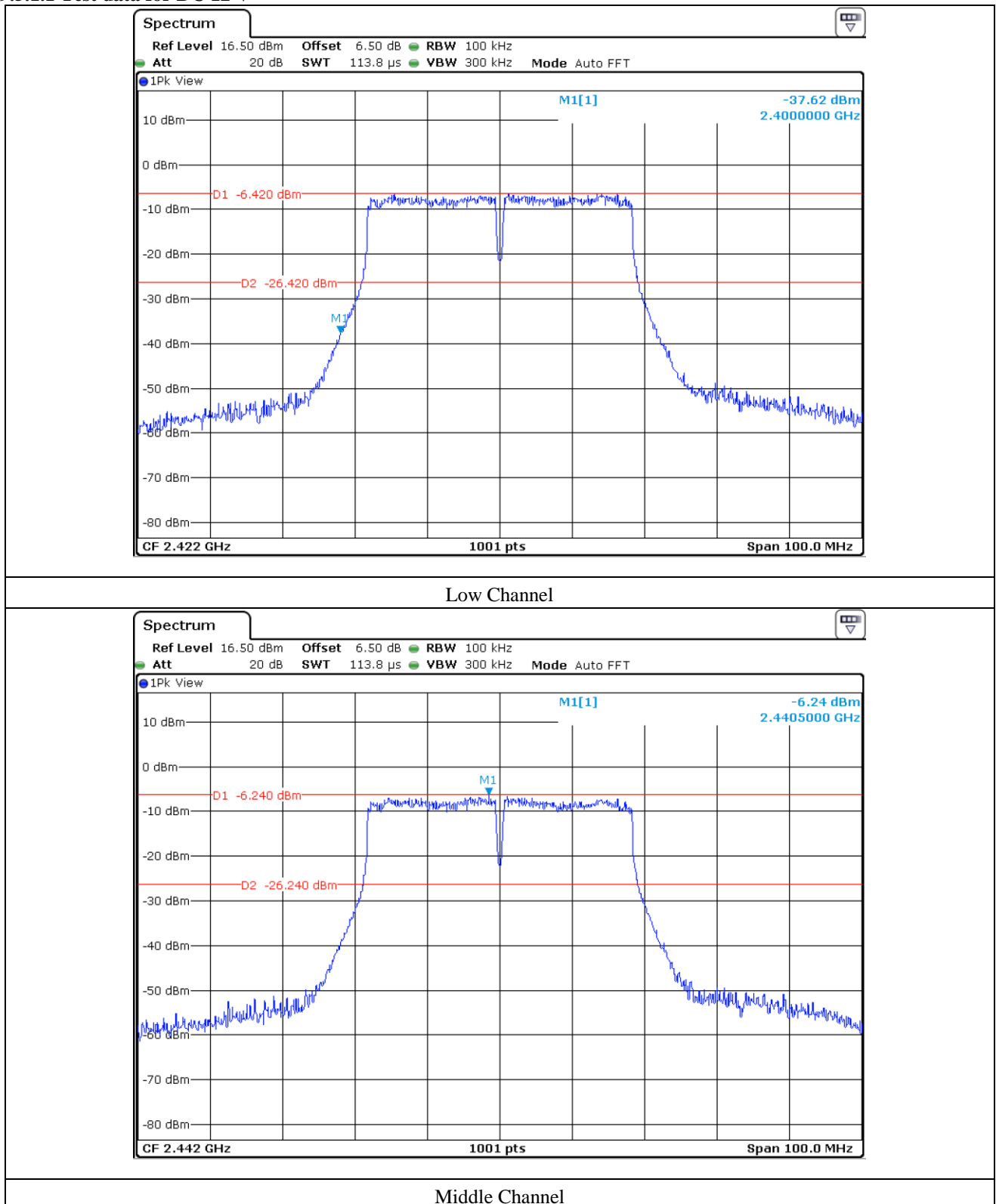
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102346	Oct. 24, 2017 (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)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 16, 2018(1Y)

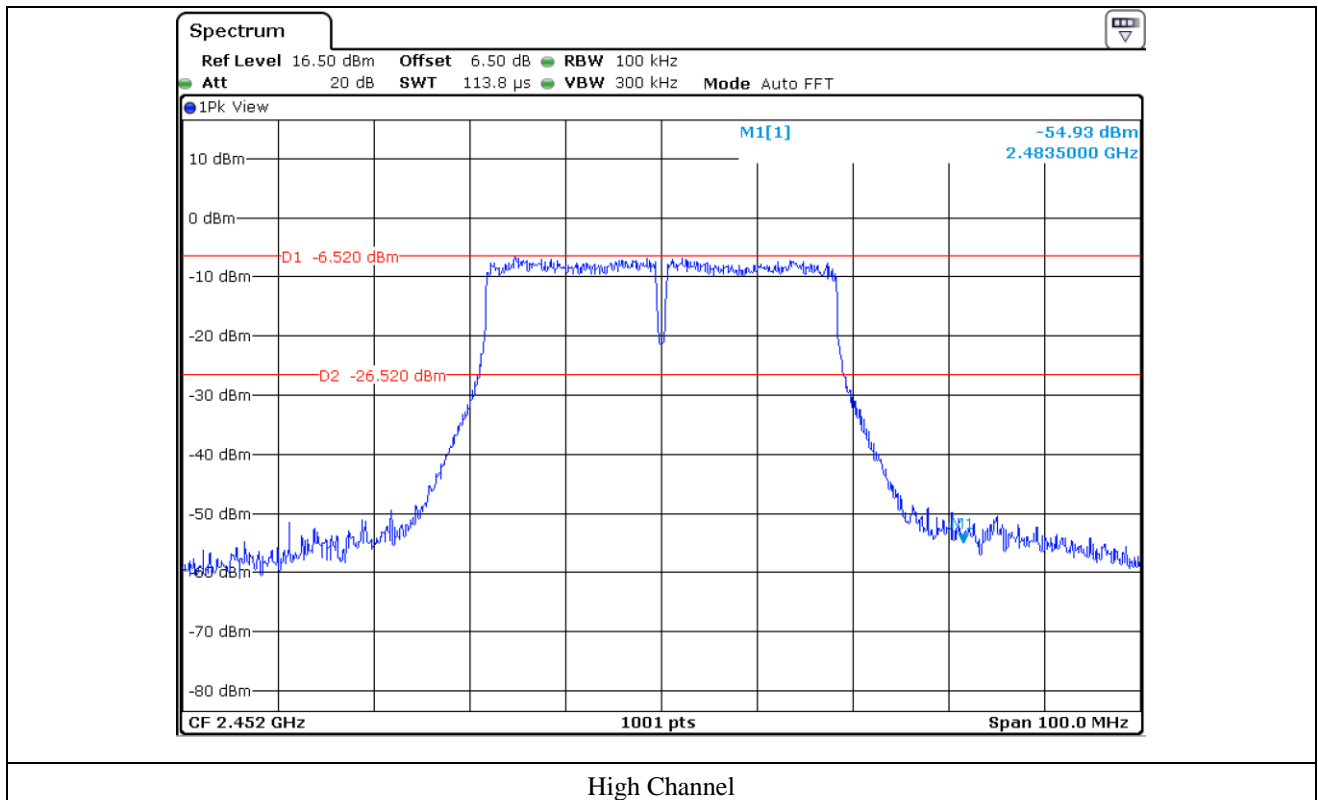
All test equipment used is calibrated on a regular basis.

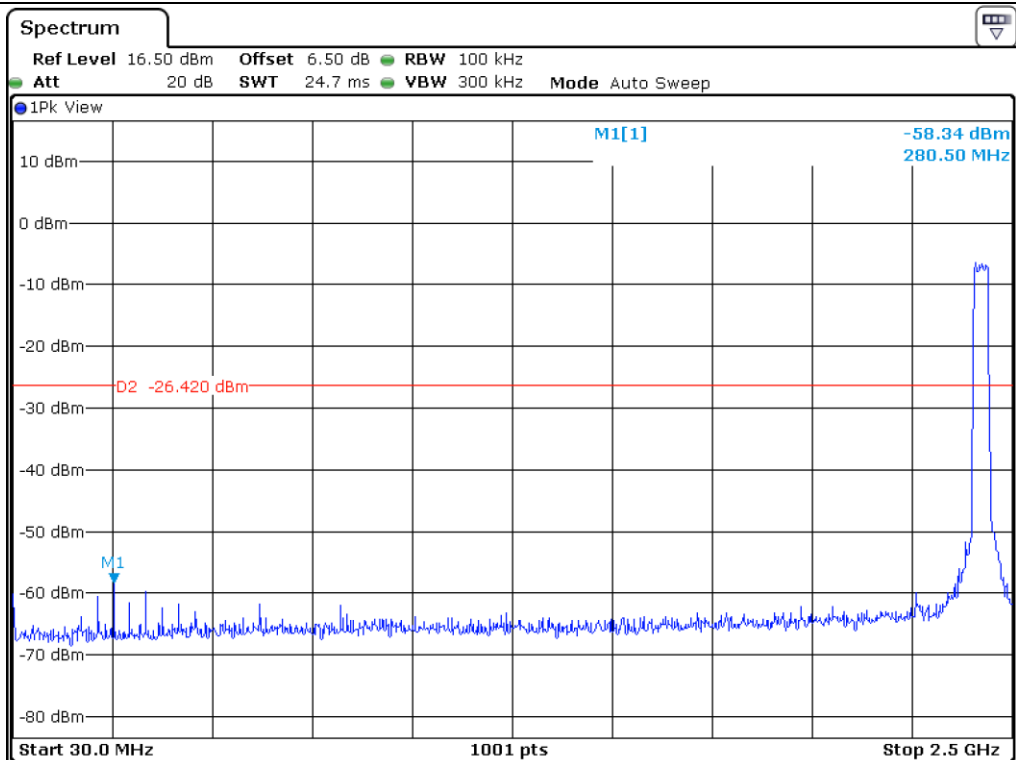
## 9.5 Test data for conducted emission

### 9.5.1 Test data for 802.11n\_HT40 WLAN Mode

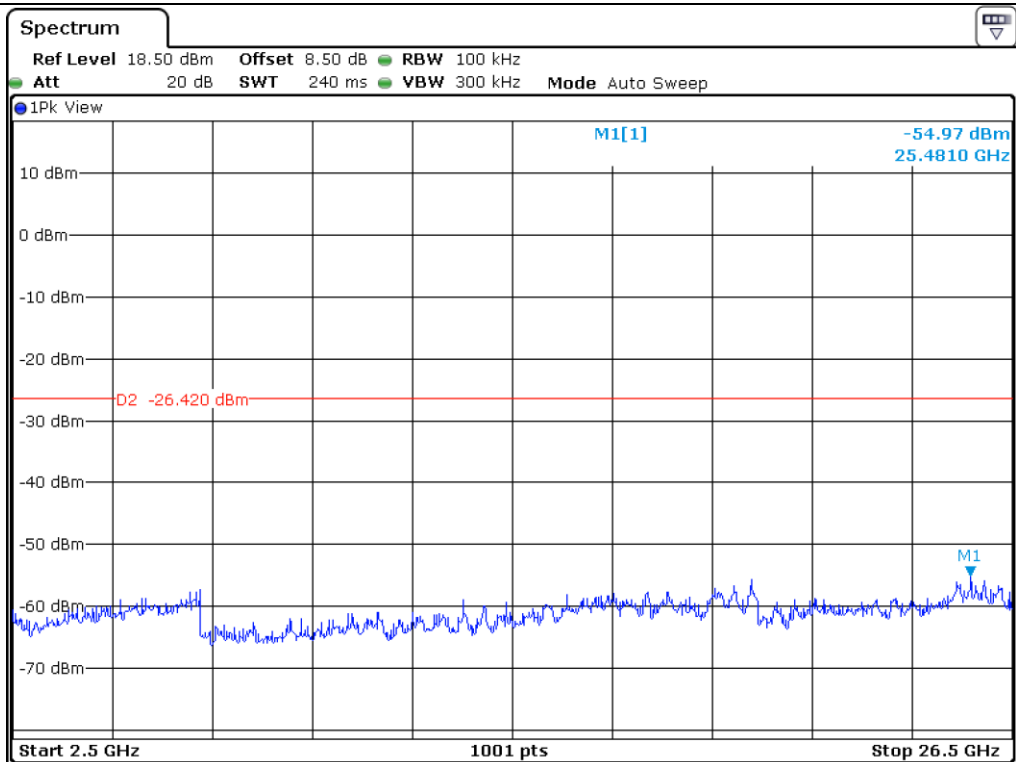
#### 9.5.1.1 Test data for DC 12 V



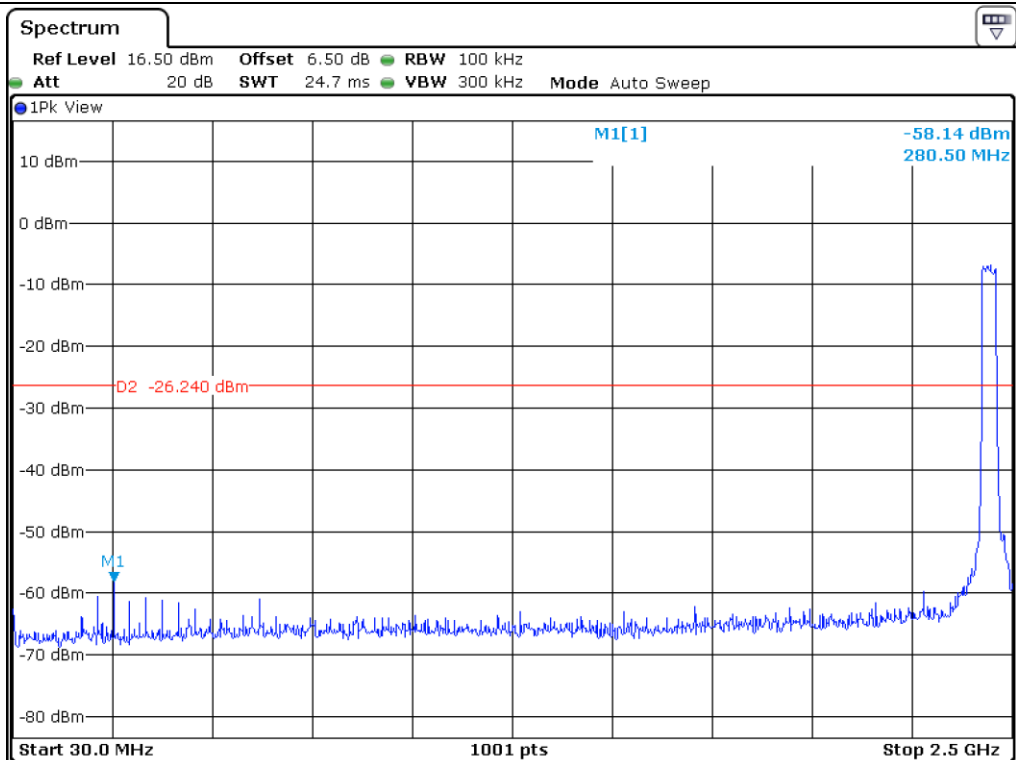




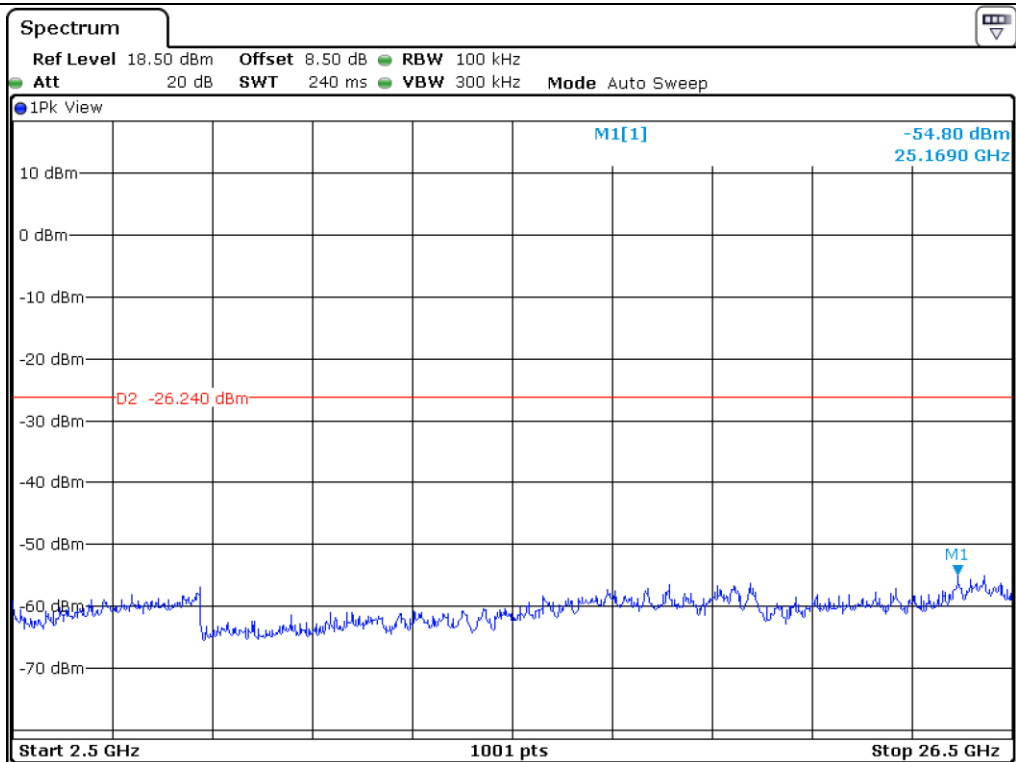
Low Channel



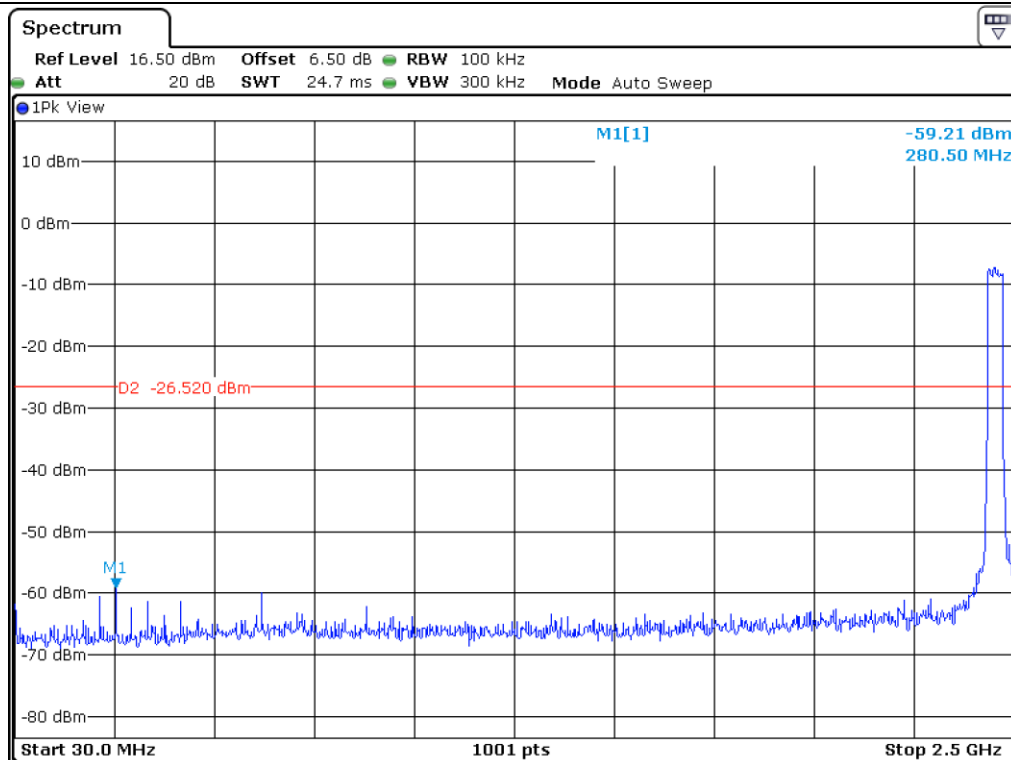
Low Channel



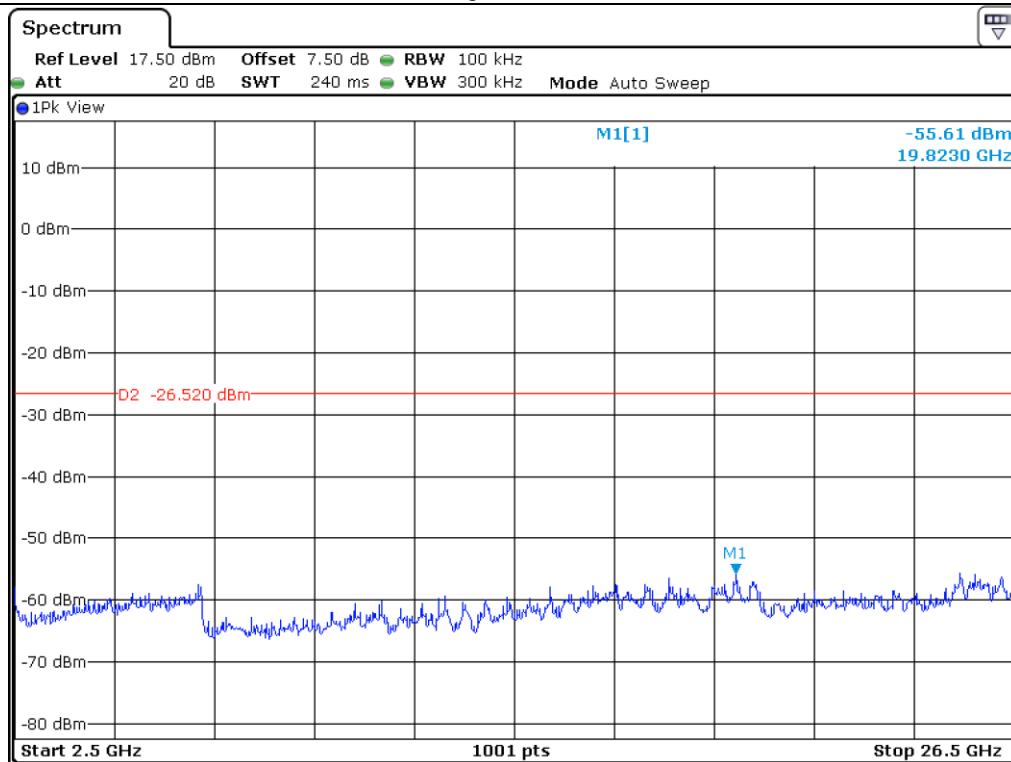
Middle Channel



Middle Channel

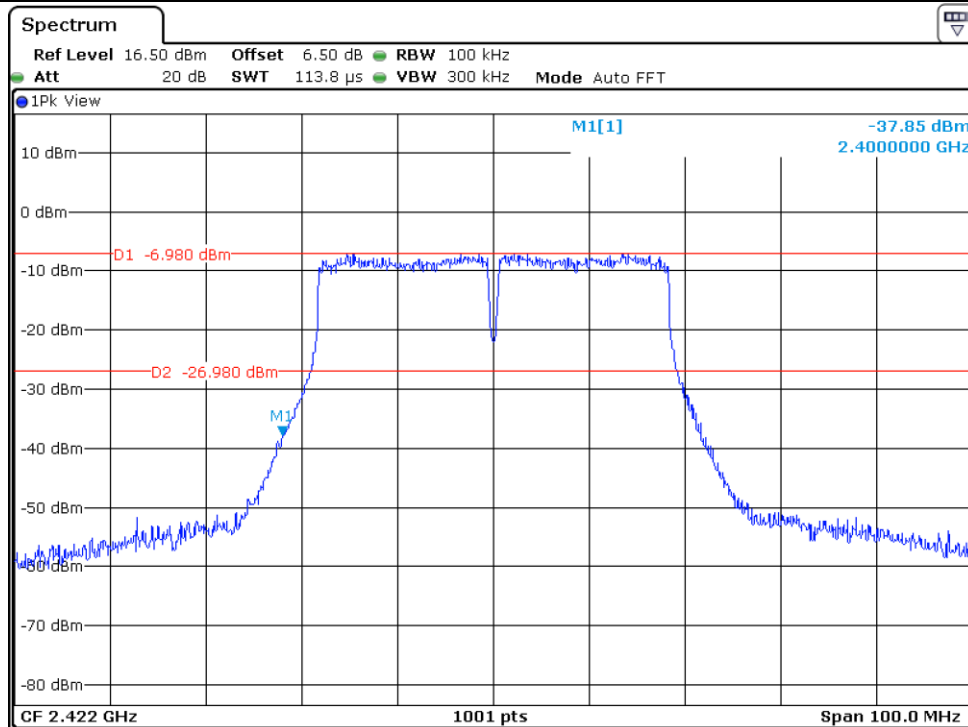


High Channel

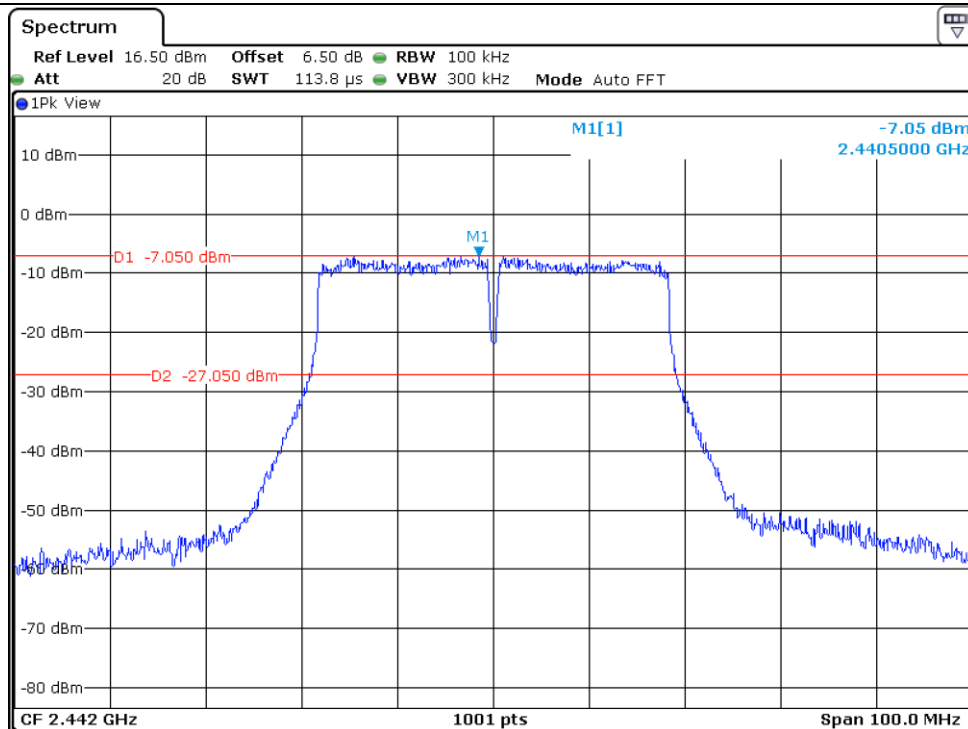


High Channel

### 9.5.1.2 Test data for DC 24 V

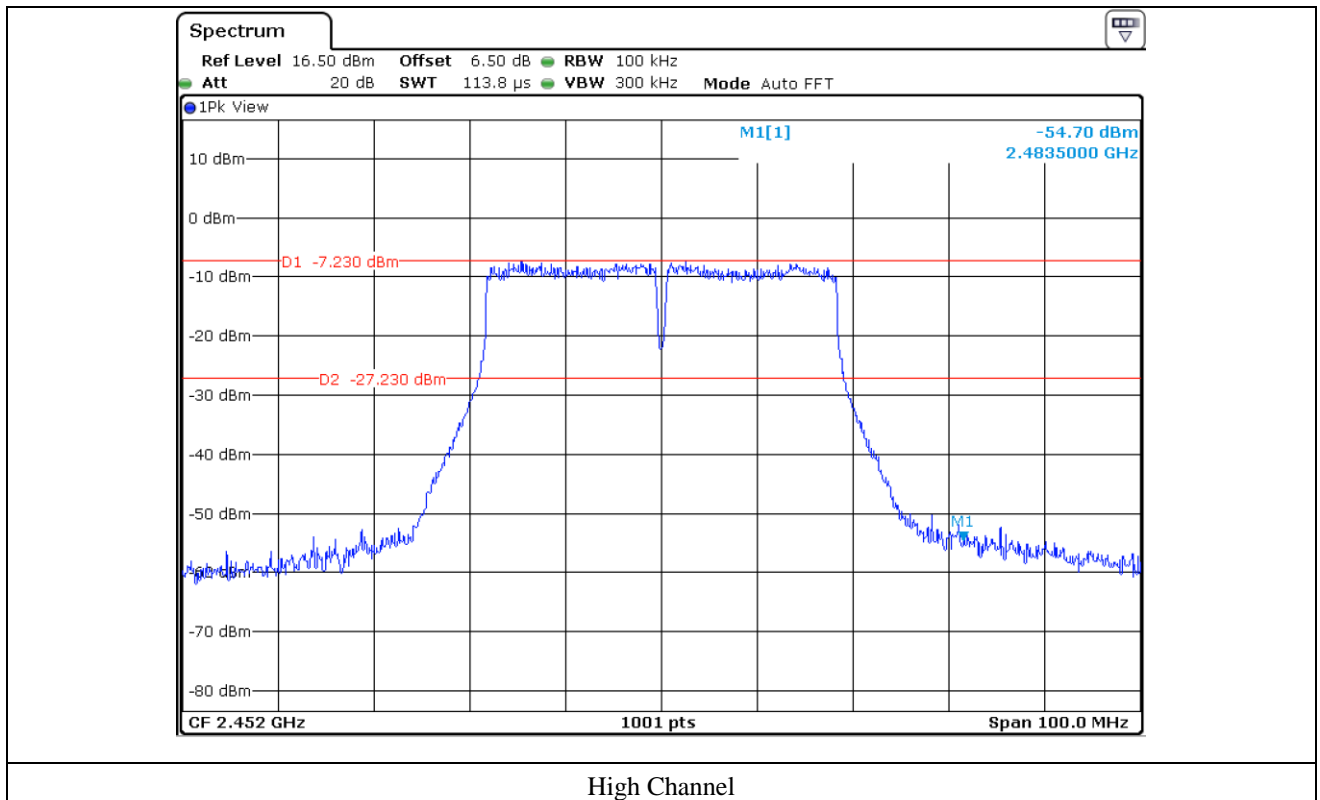


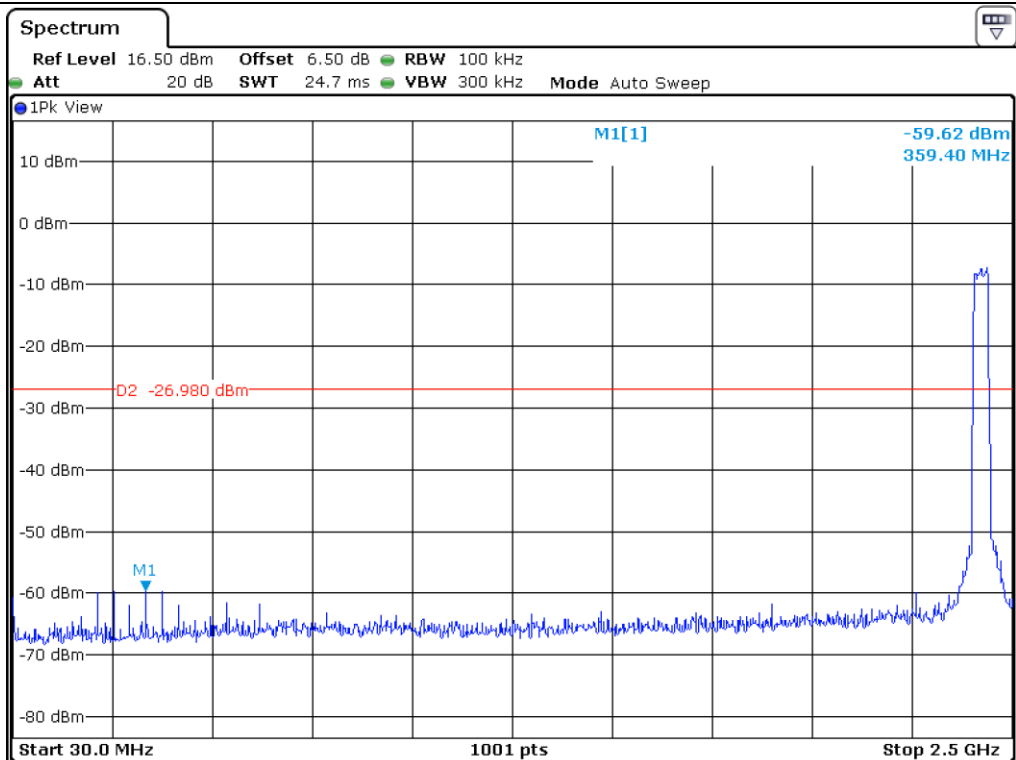
Low Channel



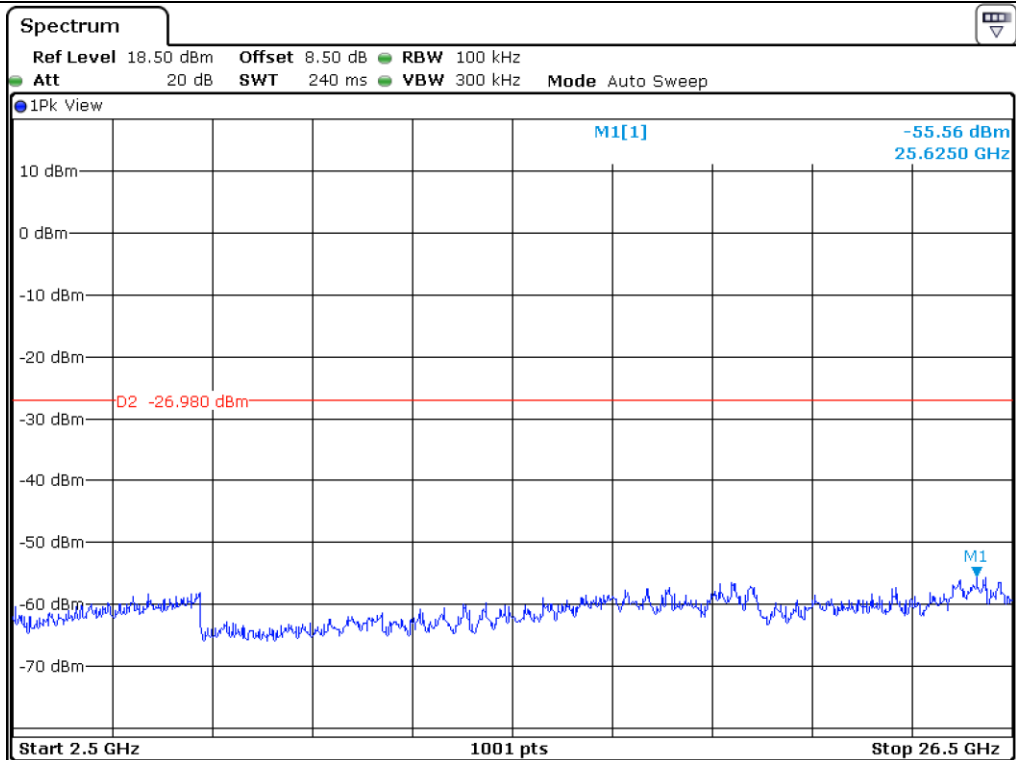
Middle Channel



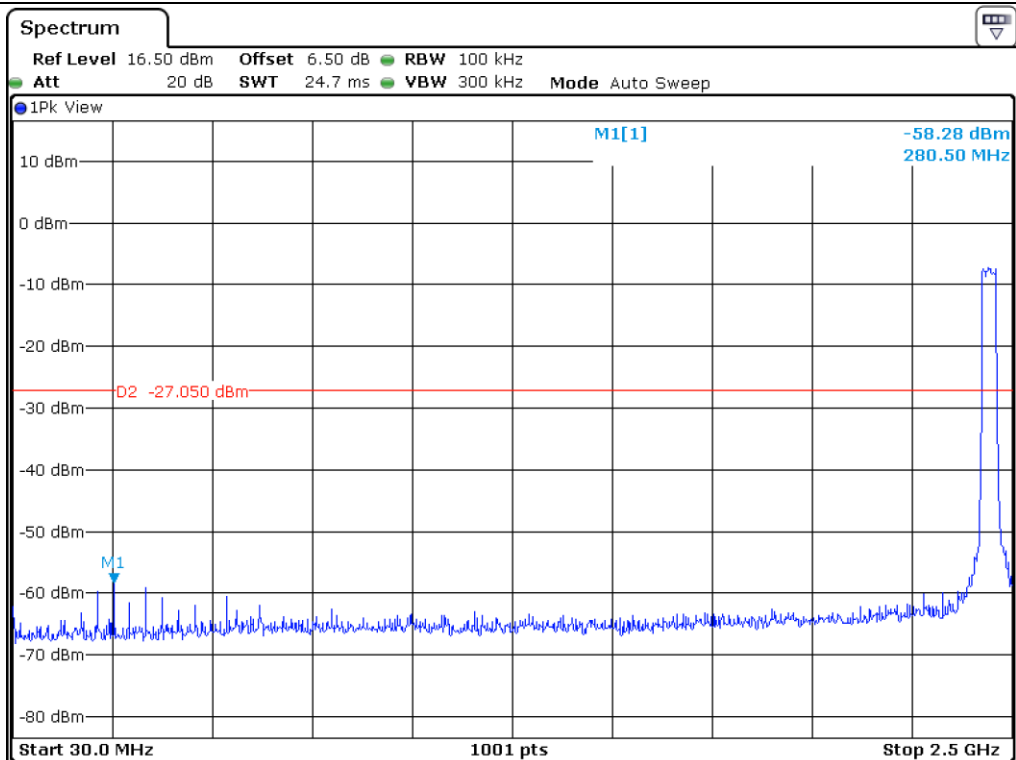




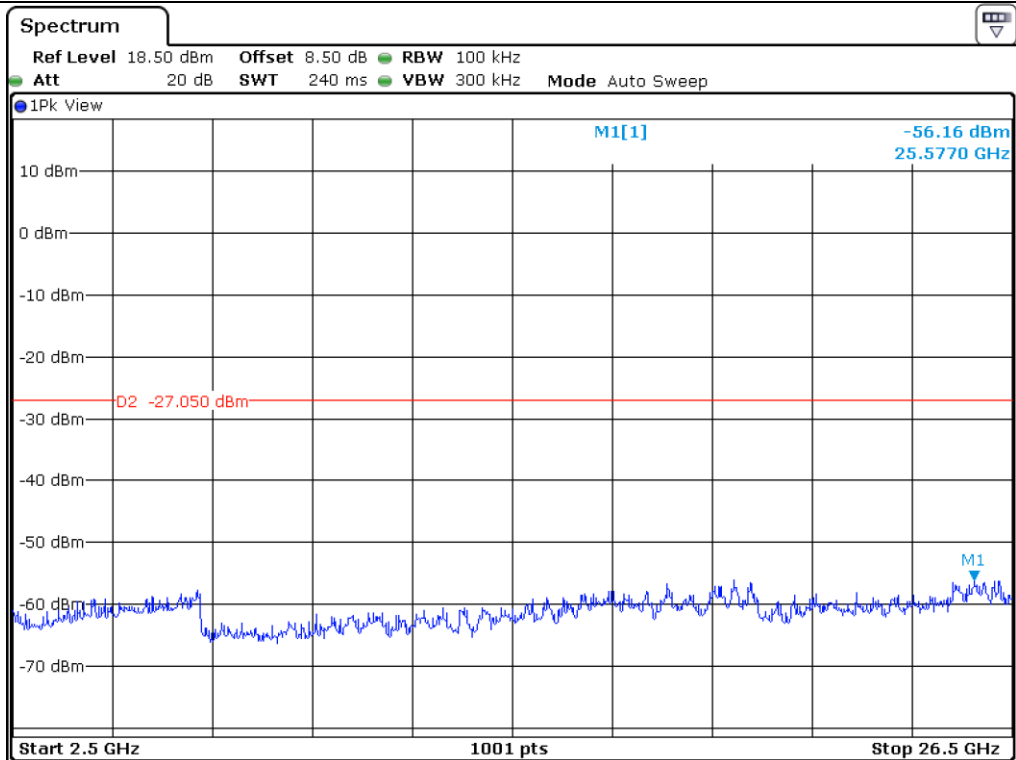
Low Channel



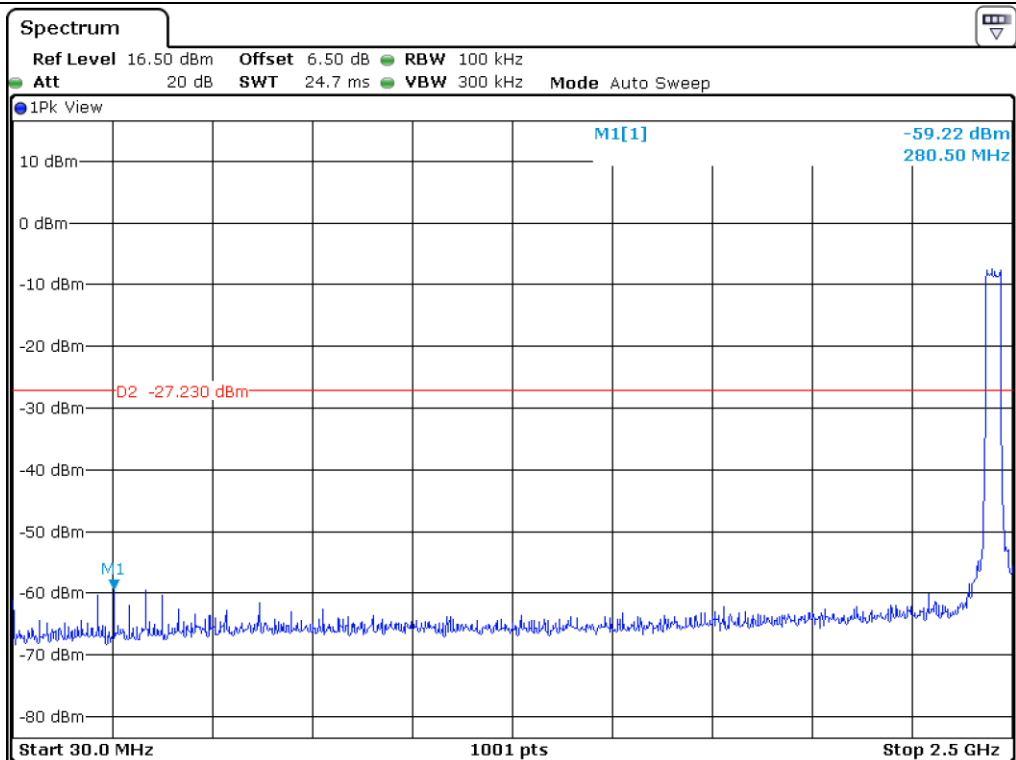
Low Channel



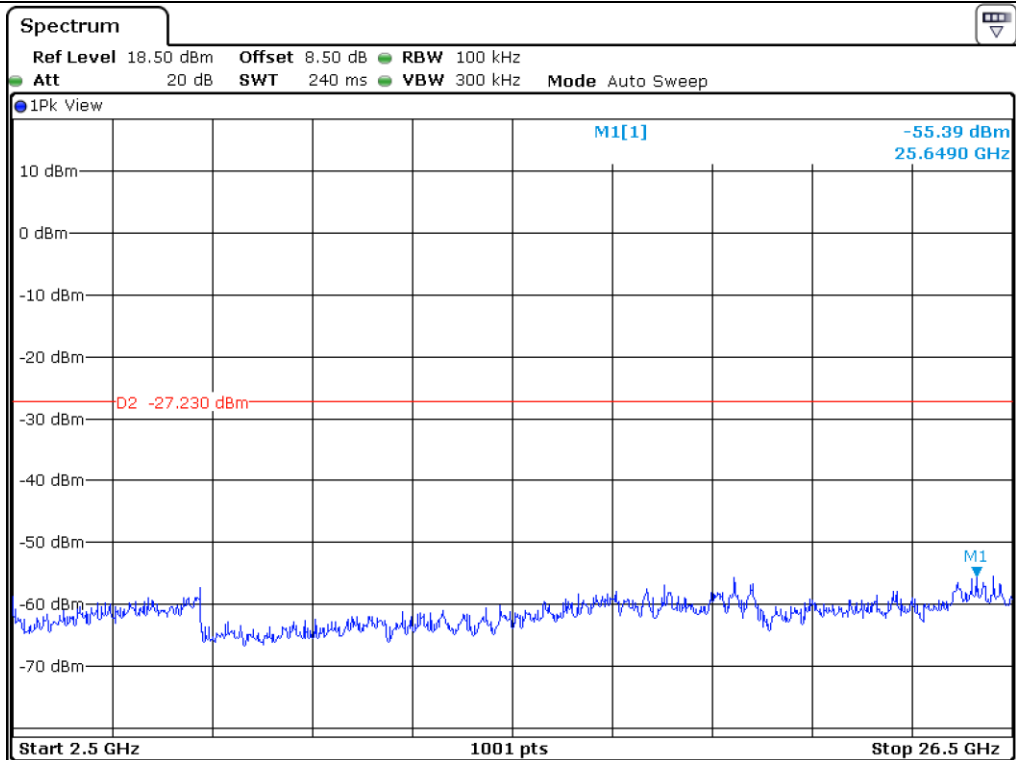
Middle Channel



Middle Channel



High Channel



High Channel

## 9.6 Test data for radiated emission

### 9.6.1 Radiated Emission which fall in the Restricted Band

#### 9.6.1.1 Test data for 802.11n\_HT40 WLAN Mode

##### 9.6.1.1.1 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)
- . Frequency range : 30 MHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2341.44	40.02	Peak	H	27.60	11.40	33.60	45.42	74.00	28.58
2339.85	28.15	Average	H				33.55	54.00	20.45
2382.36	40.12	Peak	V				45.52	74.00	28.48
2336.73	27.94	Average	V				33.34	54.00	20.66
Test Data for High Channel									
2493.41	41.01	Peak	H	27.80	11.40	33.60	46.61	74.00	27.39
2498.34	27.42	Average	H				33.02	54.00	20.98
2491.88	39.89	Peak	V				45.49	74.00	28.51
2492.29	27.64	Average	V				33.24	54.00	20.76

Tabulated test data for Restricted Band

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

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

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Min-Gu Ji / Assistant Manager

### 9.6.1.1.2 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)
- Frequency range : 30 MHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2344.72	40.80	Peak	H	27.60	11.40	33.60	46.20	74.00	27.80
2344.72	29.00	Average	H				34.40	54.00	19.60
2387.00	40.97	Peak	V				46.37	74.00	27.63
2343.04	28.67	Average	V				34.07	54.00	19.93
Test Data for High Channel									
2489.29	40.96	Peak	H	27.80	11.40	33.60	46.56	74.00	27.44
2486.92	28.17	Average	H				33.77	54.00	20.23
2491.73	40.16	Peak	V				45.76	74.00	28.24
2499.48	28.48	Average	V				34.08	54.00	19.92

Tabulated test data for Restricted Band

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

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

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Min-Gu Ji / Assistant Manager

## 9.6.2 Spurious & Harmonic Radiated Emission

### 9.6.2.1 Test data for 802.11n\_HT40 WLAN Mode

#### 9.6.2.1.1 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)
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 844.00	41.18	Peak	H	31.00	16.10	32.90	55.38	74.00	18.62
	29.17	Average	H				43.37	54.00	10.63
	41.19	Peak	V				55.39	74.00	18.61
	29.44	Average	V				43.64	54.00	10.36
Test Data for Middle Channel									
4 884.00	37.84	Peak	H	31.10	16.10	33.00	52.04	74.00	21.96
	24.83	Average	H				39.03	54.00	14.97
	37.88	Peak	V				52.08	74.00	21.92
	24.97	Average	V				39.17	54.00	14.83
Test Data for High Channel									
4 904.00	38.36	Peak	H	31.20	16.10	33.10	52.56	74.00	21.44
	26.27	Average	H				40.47	54.00	13.53
	38.40	Peak	V				52.60	74.00	21.40
	25.76	Average	V				39.96	54.00	14.04

Tabulated test data for Spurious & Harmonic

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

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

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain



**Tested by: Min-Gu Ji / Assistant Manager**

### 9.6.2.1.2 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)
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 844.00	41.06	Peak	H	31.00	16.10	32.90	55.26	74.00	18.74
	29.82	Average	H				44.02	54.00	9.98
	41.05	Peak	V				55.25	74.00	18.75
	29.62	Average	V				43.82	54.00	10.18
Test Data for Middle Channel									
4 884.00	36.55	Peak	H	31.10	16.10	33.00	50.75	74.00	23.25
	25.33	Average	H				39.53	54.00	14.47
	36.24	Peak	V				50.44	74.00	23.56
	25.55	Average	V				39.75	54.00	14.25
Test Data for High Channel									
4 904.00	37.94	Peak	H	31.20	16.10	33.10	52.14	74.00	21.86
	26.76	Average	H				40.96	54.00	13.04
	37.90	Peak	V				52.10	74.00	21.90
	26.09	Average	V				40.29	54.00	13.71

Tabulated test data for Spurious & Harmonic

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

$$\text{Margin (dB)} = \text{Limits (dBμV/m)} - \text{Total Level (dBμV/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Min-Gu Ji / Assistant Manager



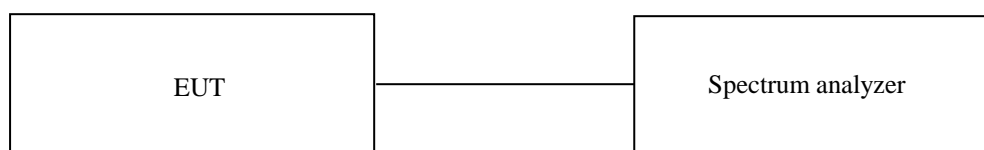
## 10. PEAK POWER SPECTRUL DENSITY

### 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 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.



### 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 802.11n\_HT40 WLAN Mode

### 10.4.1 Test data for DC 12 V

-. Test Date : May 01, 2018

-. Test Result : Pass

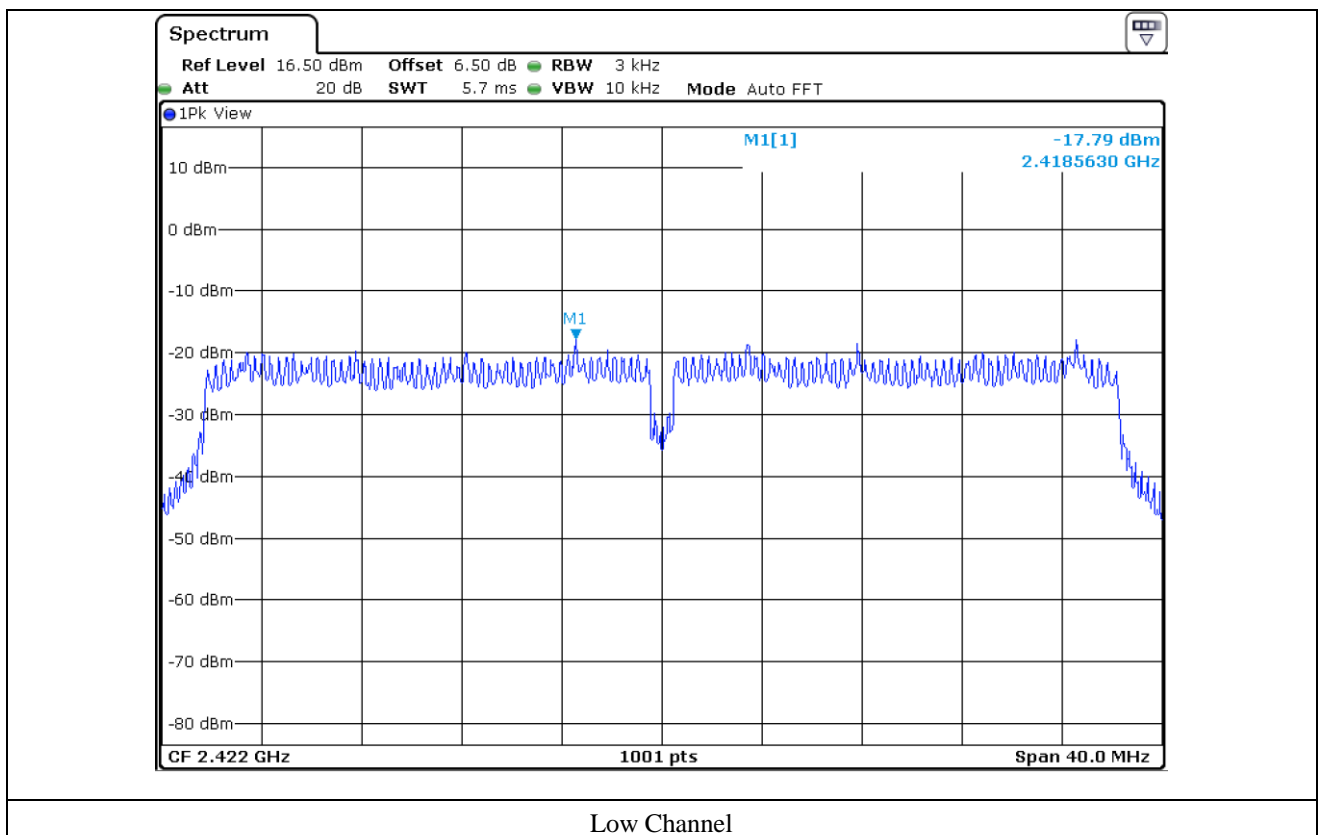
-. Operating Condition : Continuous transmitting mode

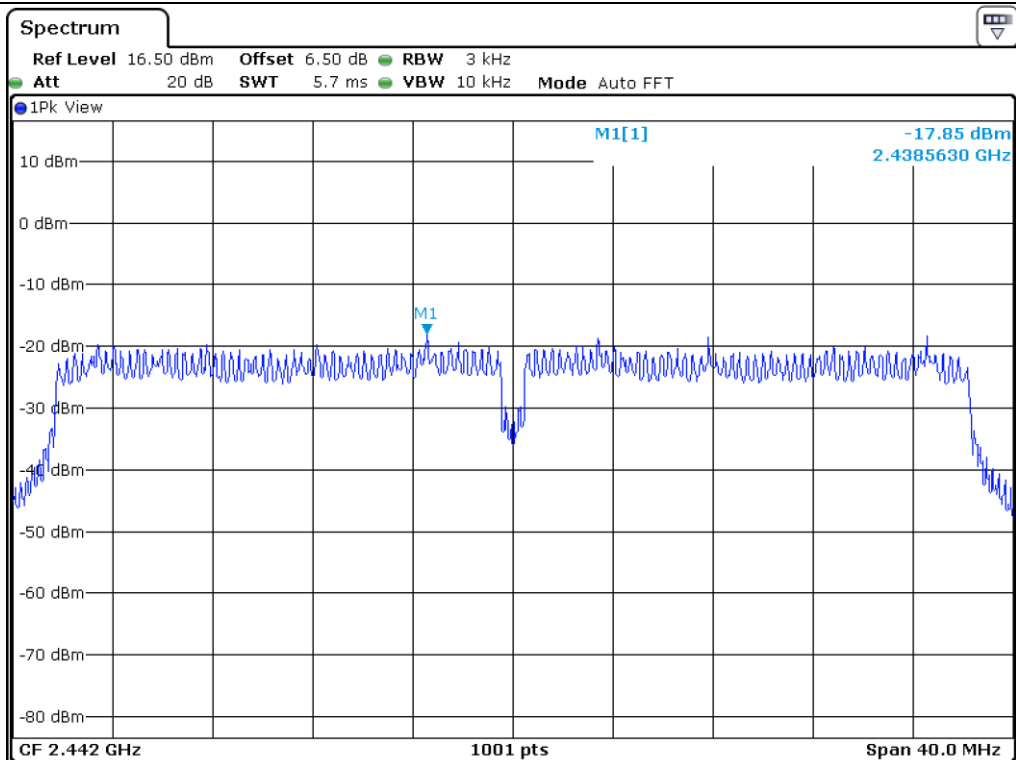
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 422	-17.79	8.00	25.79
Middle	2 442	-17.85	8.00	25.85
High	2 452	-18.25	8.00	26.25

Remark. Margin = Limit – Measured value

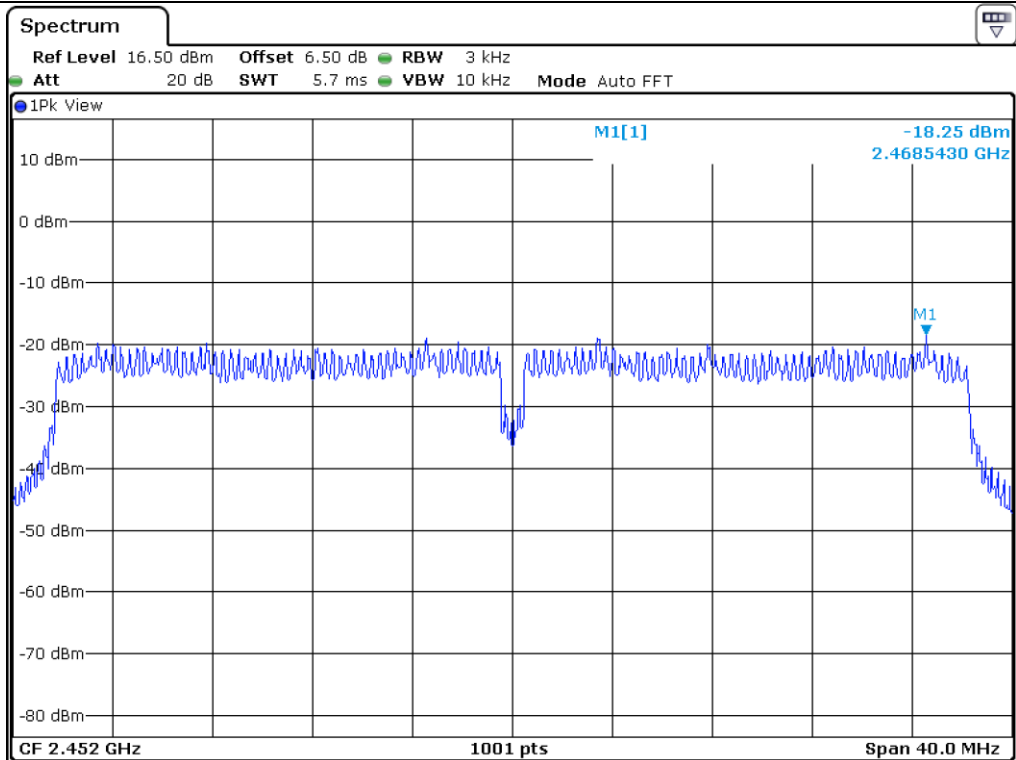


Tested by: Min-Gu Ji / Assistant Manager





Middle Channel



High Channel

#### 10.4.2 Test data for DC 24 V

-. Test Date : May 01, 2018

-. Test Result : Pass

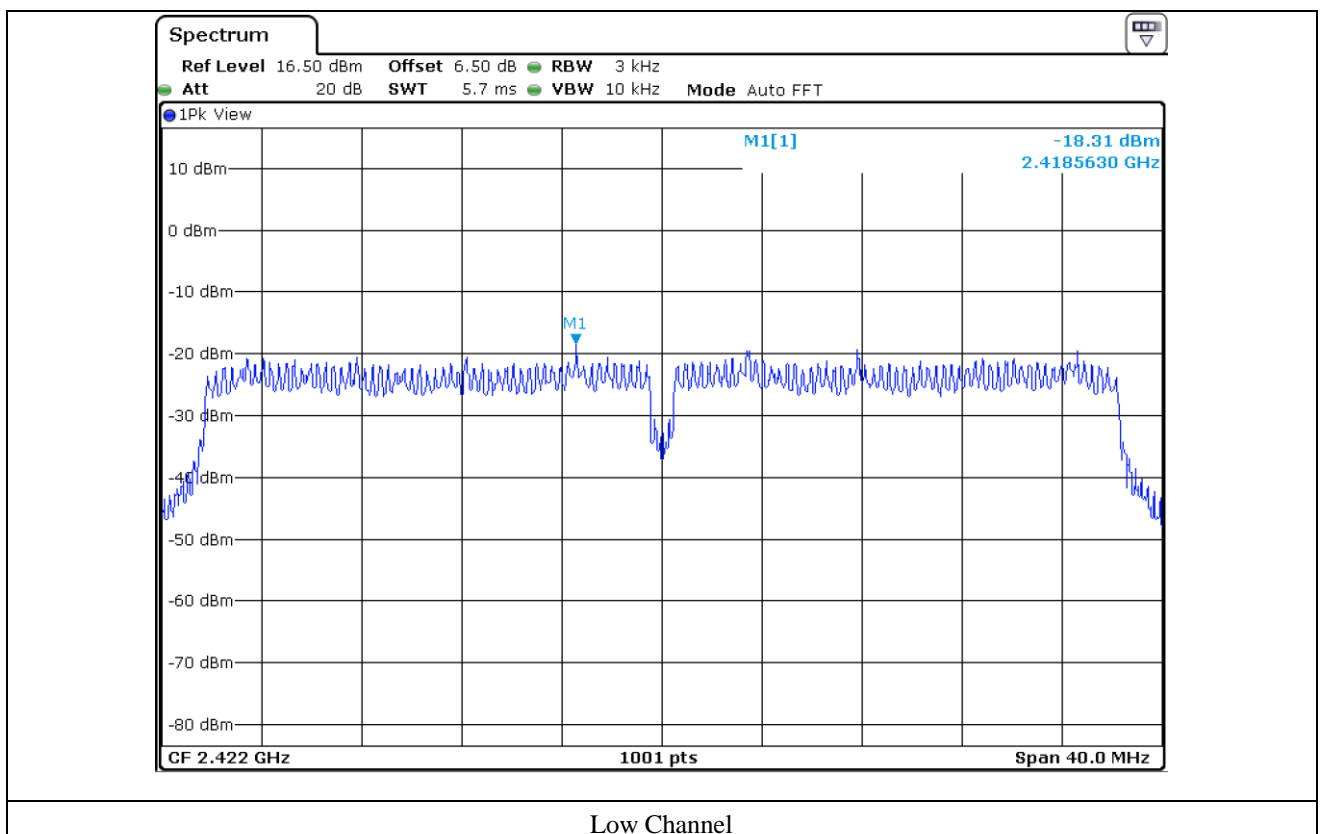
-. Operating Condition : Continuous transmitting mode

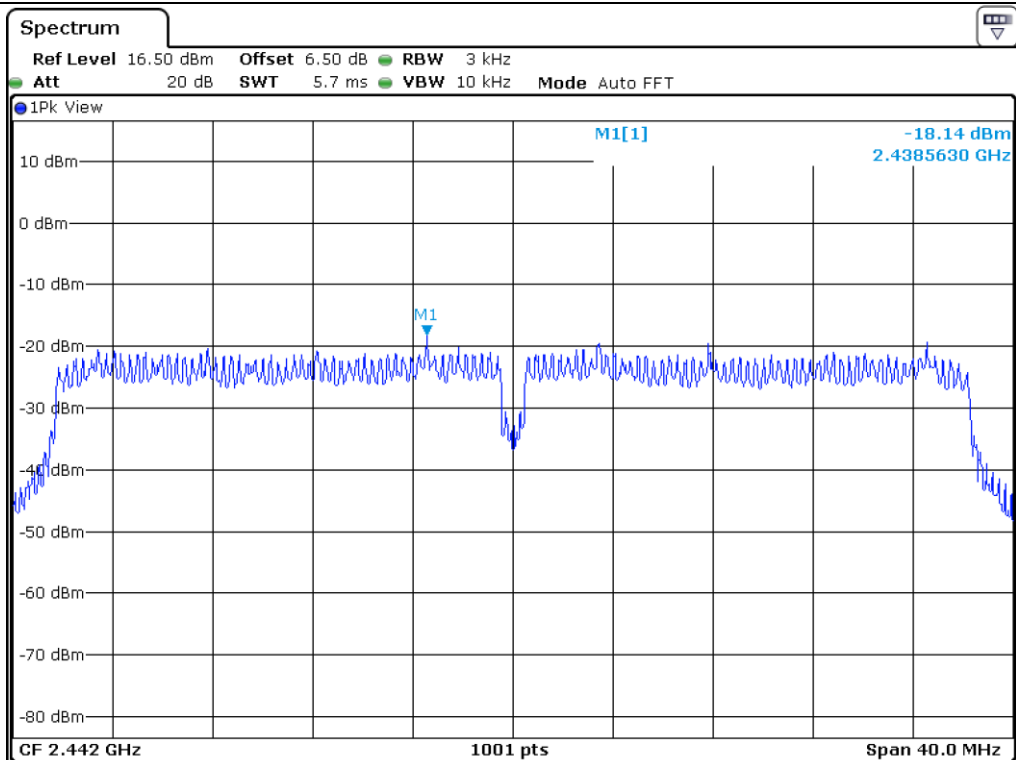
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 422	-18.31	8.00	26.31
Middle	2 442	-18.14	8.00	26.14
High	2 452	-18.91	8.00	26.91

Remark. Margin = Limit – Measured value

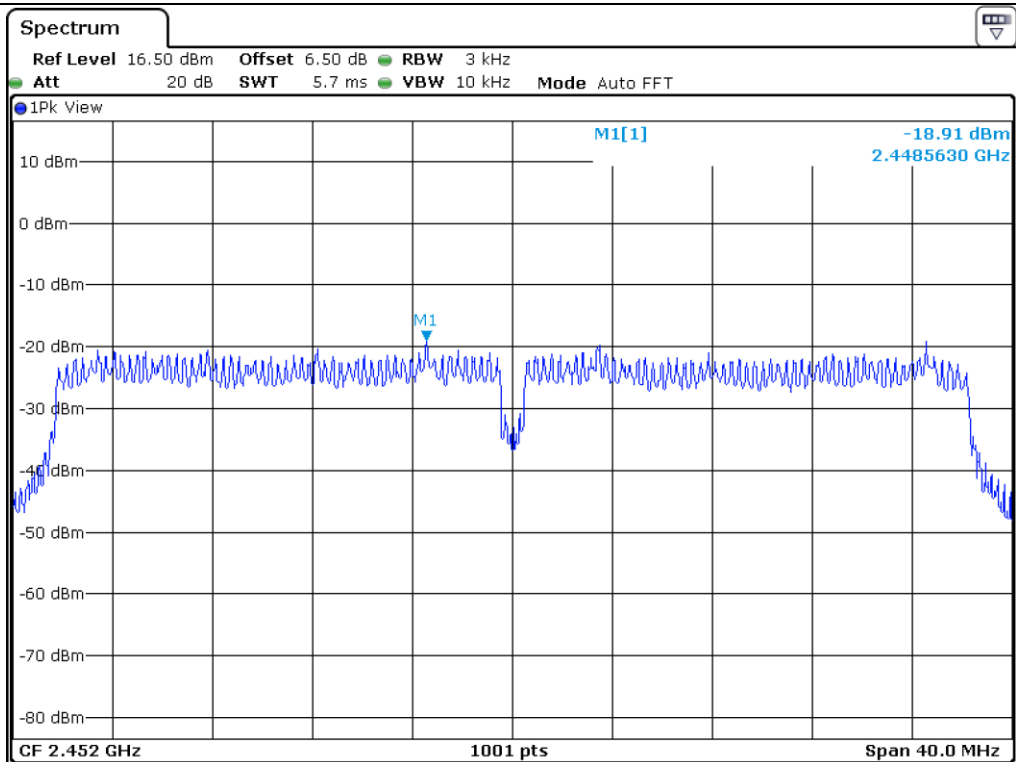


Tested by: Min-Gu Ji / Assistant Manager





Middle Channel



High Channel

## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

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

### 11.2 Test set-up

The radiated emissions measurements were on the 3 m, open-field test site. 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.

### 11.3 Test equipment used

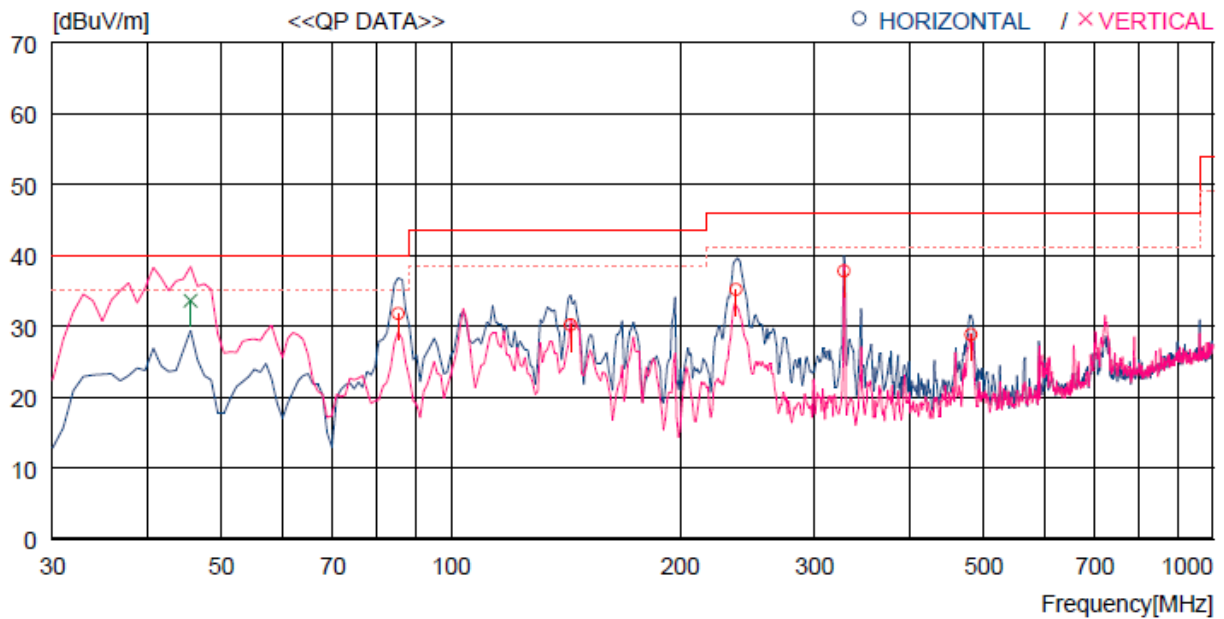
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 27, 2017 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 27, 2017 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Sep. 04, 2017 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 28, 2018 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Oct. 26, 2017 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102346	Oct. 24, 2017 (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)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 16, 2018(1Y)

All test equipment used is calibrated on a regular basis.

## 11.4 Test data for DC 12 V

### 11.4.1 Test data for 30 MHz ~ 1 000 MHz

- Test Date : May 05, 2018
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
---- Horizontal ----										
1	85.290	53.6	8.8	2.4	33.0	31.8	40.0	8.2	300	218
2	143.490	52.1	7.9	3.1	32.9	30.2	43.5	13.3	200	109
3	236.610	52.4	11.9	4.0	33.1	35.2	46.0	10.8	100	359
4	327.790	52.2	14.0	4.7	33.1	37.8	46.0	8.2	100	21
5	481.051	40.2	16.8	5.1	33.3	28.8	46.0	17.2	100	359
---- Vertical ----										
6	45.520	51.1	13.9	1.7	33.1	33.6	40.0	6.4	100	0

Tested by: Min-Gu Ji / Assistant Manager

#### 11.4.2 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)
Any emissions were not observed from the EUT.									

#### 11.4.3 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 ~ 26.5 GHz
- . 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)
Any emissions were not observed from the EUT.									



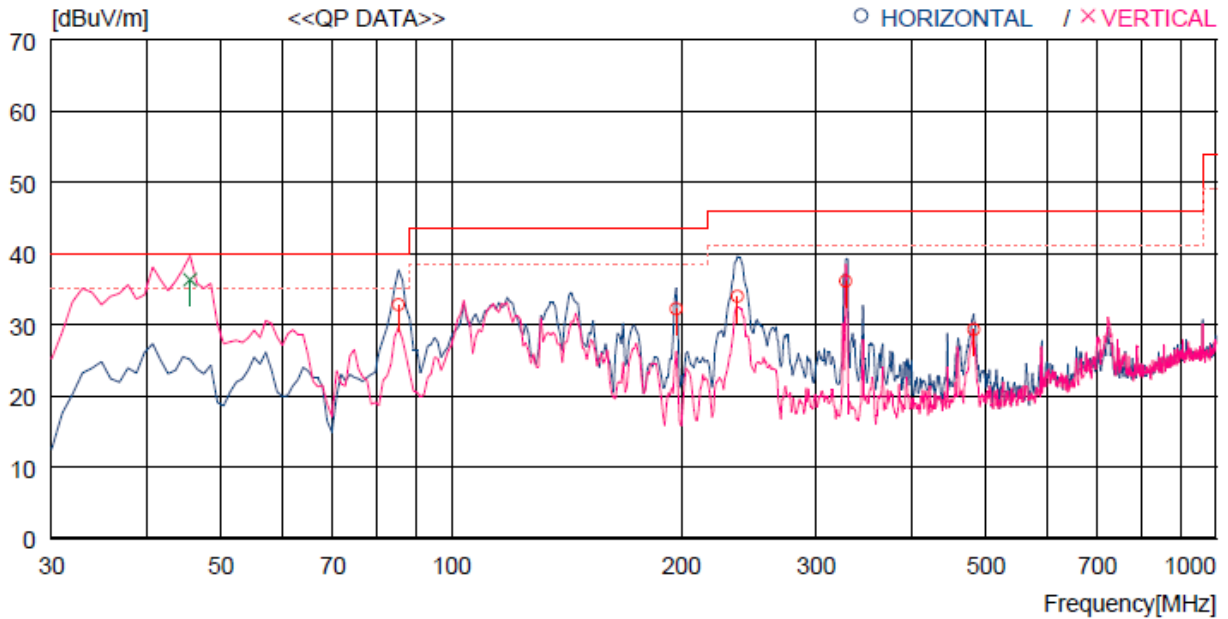
Tested by: Min-Gu Ji / Assistant Manager



## 11.5 Test data for DC 24 V

### 11.5.1 Test data for 30 MHz ~ 1 000 MHz

- Test Date : May 05, 2018
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
---- Horizontal ----										
1	85.290	54.6	8.8	2.4	33.0	32.8	40.0	7.2	200	0
2	236.610	51.2	11.9	4.0	33.1	34.0	46.0	12.0	100	101
3	327.790	50.5	14.0	4.7	33.1	36.1	46.0	9.9	100	328
4	482.021	40.1	16.8	5.7	33.3	29.3	46.0	16.7	200	0
5	196.840	51.2	10.5	3.7	33.2	32.2	43.5	11.3	200	0
---- Vertical ----										
6	45.520	53.8	13.9	1.7	33.1	36.3	40.0	3.7	100	69

*Signature*

Tested by: Min-Gu Ji / Assistant Manager

### 11.5.2 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)
Any emissions were not observed from the EUT.									

### 11.5.3 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 ~ 26.5 GHz
- . 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)
Any emissions were not observed from the EUT.									



Tested by: Min-Gu Ji / Assistant Manager

## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

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

### 12.2 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  $\Omega$  / 50  $\mu$ H + 5  $\Omega$  Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

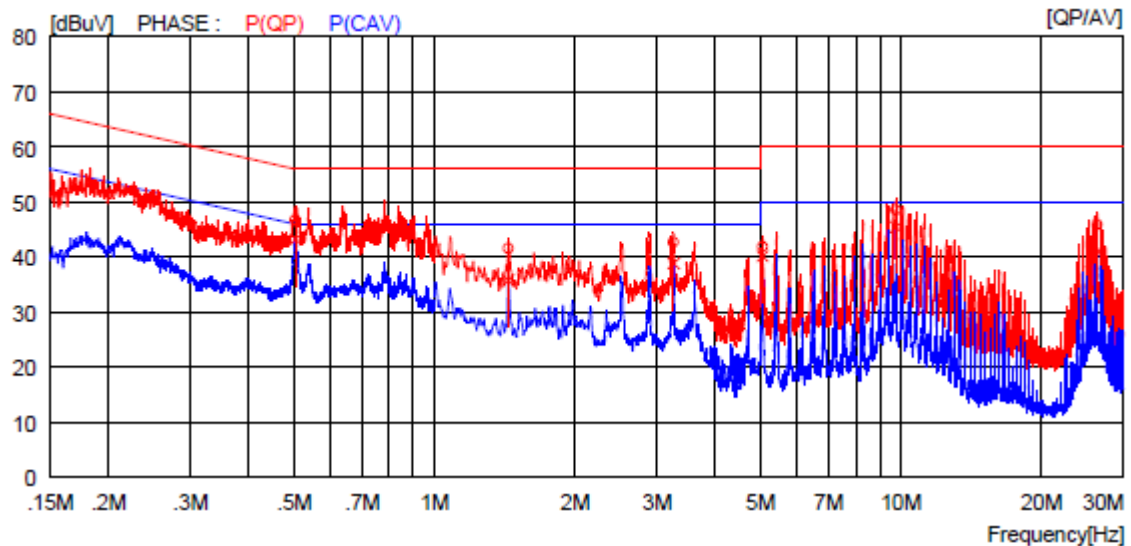
### 12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Oct. 27, 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.

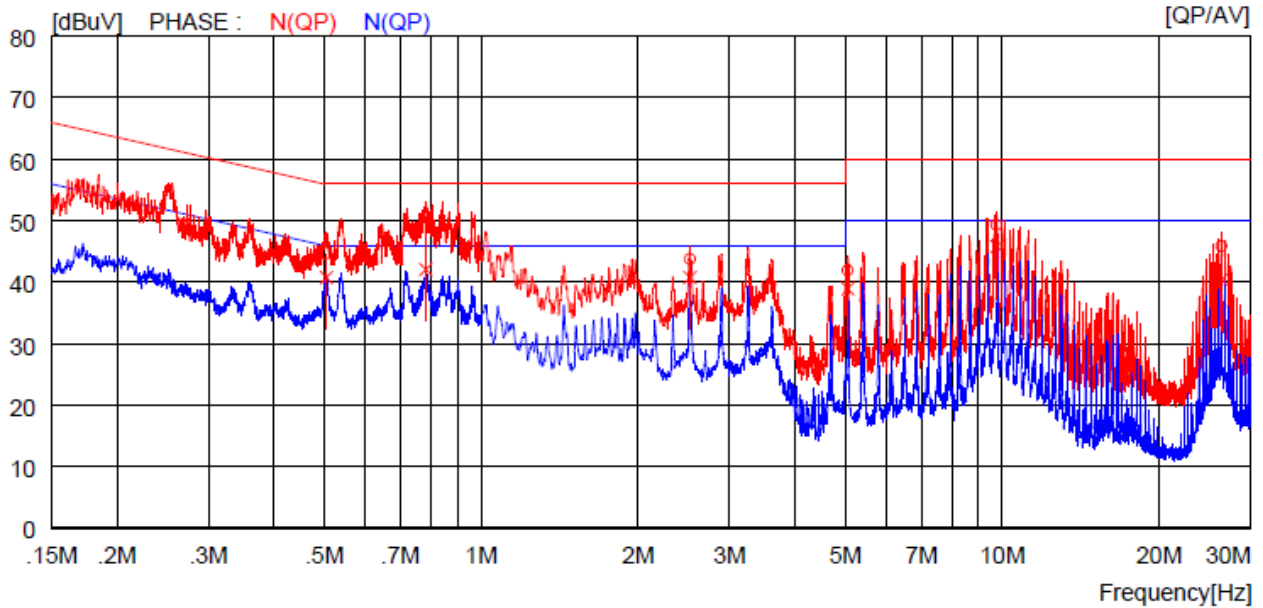
## 12.4 Test data for DC 12 V

- Test Date : May 05, 2018
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- 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	0.50400	36.8	----	9.9	46.7	----	56.0	----	9.3	----	P (QP)
2	1.44000	31.5	----	10.0	41.5	----	56.0	----	14.5	----	P (QP)
3	3.25600	32.4	----	10.2	42.6	----	56.0	----	13.4	----	P (QP)
4	5.05500	31.6	----	10.2	41.8	----	60.0	----	18.2	----	P (QP)
5	9.76000	38.1	----	10.4	48.5	----	60.0	----	11.5	----	P (QP)
6	26.39000	35.2	----	10.7	45.9	----	60.0	----	14.1	----	P (QP)
7	0.50400	----	33.3	9.9	----	43.2	----	46.0	----	2.8	P (CAV)
8	1.44000	----	25.7	10.0	----	35.7	----	46.0	----	10.3	P (CAV)
9	3.25600	----	28.6	10.2	----	38.8	----	46.0	----	7.2	P (CAV)
10	5.05500	----	29.9	10.2	----	40.1	----	50.0	----	9.9	P (CAV)
11	9.76000	----	35.0	10.4	----	45.4	----	50.0	----	4.6	P (CAV)
12	26.39000	----	30.3	10.7	----	41.0	----	50.0	----	9.0	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	0.50500	34.8	----	9.9	44.7	----	56.0	----	11.3	----	N(QP)
2	0.78400	40.6	----	10.0	50.6	----	56.0	----	5.4	----	N(QP)
3	2.51600	33.8	----	10.0	43.8	----	56.0	----	12.2	----	N(QP)
4	5.05500	31.7	----	10.2	41.9	----	60.0	----	18.1	----	N(QP)
5	9.76000	38.9	----	10.4	49.3	----	60.0	----	10.7	----	N(QP)
6	26.39000	35.2	----	10.7	45.9	----	60.0	----	14.1	----	N(QP)
7	0.50500	----	30.9	9.9	----	40.8	----	46.0	----	5.2	N(CAV)
8	0.78400	----	32.1	10.0	----	42.1	----	46.0	----	3.9	N(CAV)
9	2.51600	----	30.8	10.0	----	40.8	----	46.0	----	5.2	N(CAV)
10	5.05500	----	28.8	10.2	----	39.0	----	50.0	----	11.0	N(CAV)
11	9.76000	----	35.4	10.4	----	45.8	----	50.0	----	4.2	N(CAV)
12	26.39000	----	29.8	10.7	----	40.5	----	50.0	----	9.5	N(CAV)

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

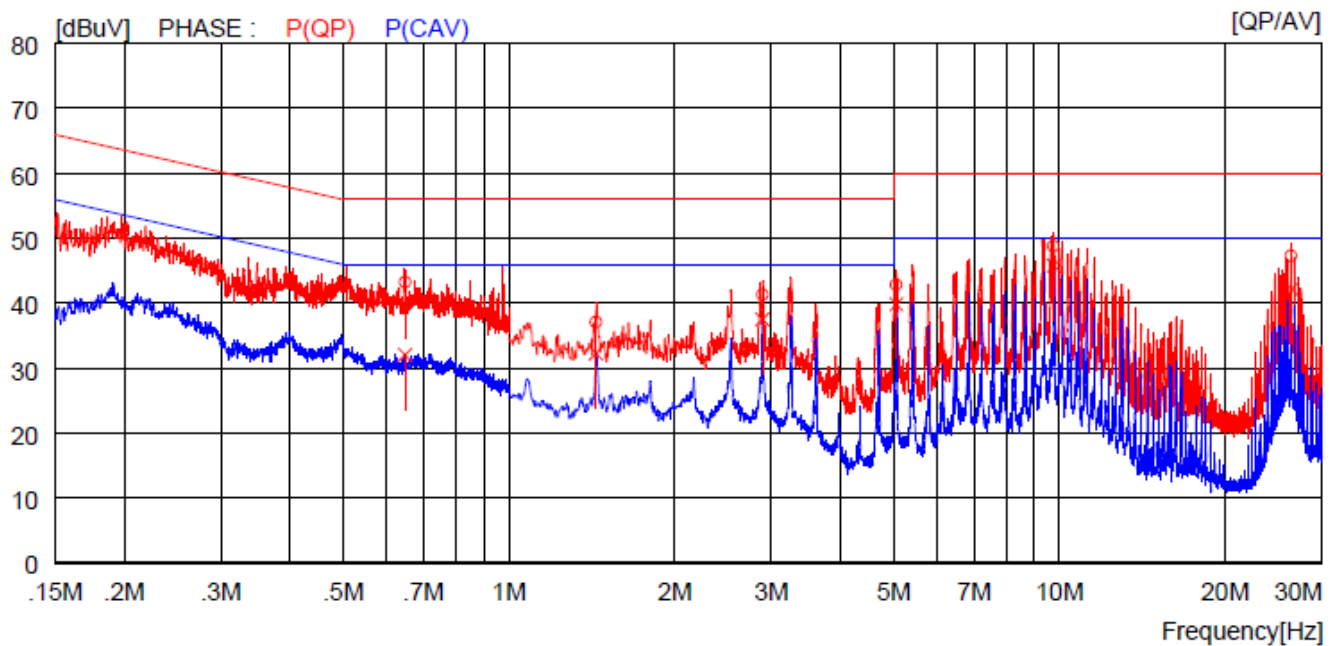
The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

*Signature*

Tested by: Min-Gu Ji / Assistant Manager

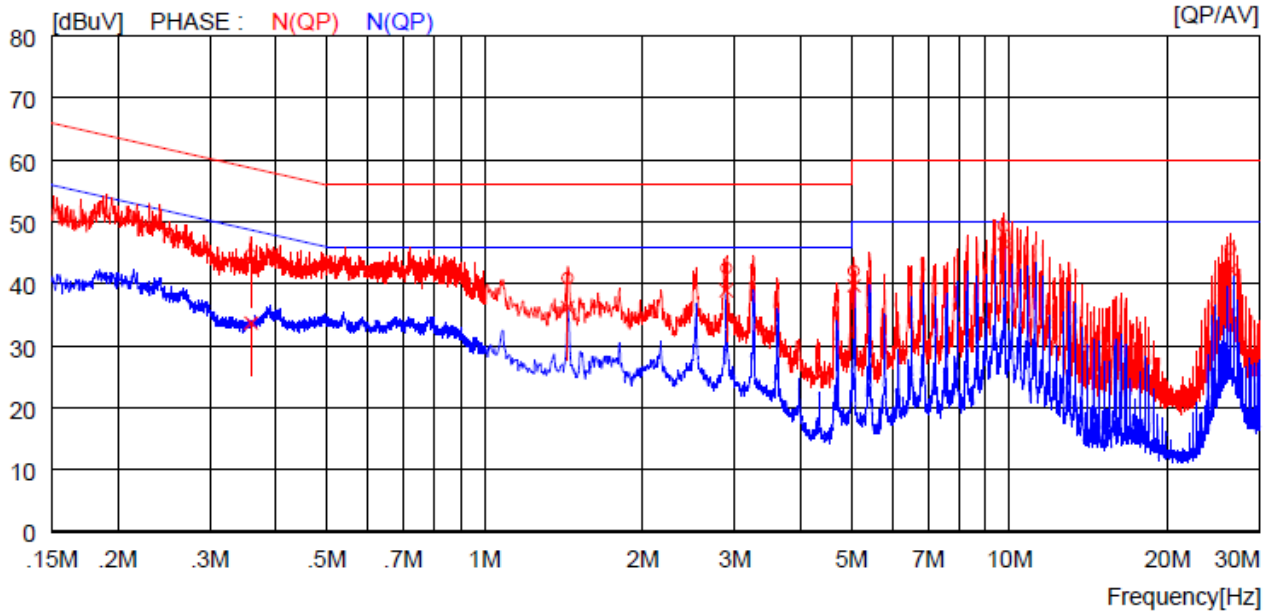
## 12.5 Test data for DC 24 V

-. Test Date : May 05, 2018  
 -. Resolution bandwidth : 9 kHz  
 -. Frequency range : 0.15 MHz ~ 30 MHz  
 -. 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	0.64800	33.2	----	10.0	43.2	----	56.0	----	12.8	----	P (QP)
2	1.44000	27.1	----	10.0	37.1	----	56.0	----	18.9	----	P (QP)
3	2.88800	31.2	----	10.1	41.3	----	56.0	----	14.7	----	P (QP)
4	5.05500	32.6	----	10.2	42.8	----	60.0	----	17.2	----	P (QP)
5	9.76000	38.4	----	10.4	48.8	----	60.0	----	11.2	----	P (QP)
6	26.39000	36.6	----	10.7	47.3	----	60.0	----	12.7	----	P (QP)
7	0.64800	----	22.1	10.0	----	32.1	----	46.0	----	13.9	P (CAV)
8	1.44000	----	22.3	10.0	----	32.3	----	46.0	----	13.7	P (CAV)
9	2.88800	----	27.4	10.1	----	37.5	----	46.0	----	8.5	P (CAV)
10	5.05500	----	29.7	10.2	----	39.9	----	50.0	----	10.1	P (CAV)
11	9.76000	----	35.4	10.4	----	45.8	----	50.0	----	4.2	P (CAV)
12	26.39000	----	31.5	10.7	----	42.2	----	50.0	----	7.8	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	0.35900	34.8	----	9.9	44.7	----	58.8	----	14.1	----	N (QP)
2	1.44000	30.9	----	10.0	40.9	----	56.0	----	15.1	----	N (QP)
3	2.88800	32.4	----	10.1	42.5	----	56.0	----	13.5	----	N (QP)
4	5.05500	31.8	----	10.2	42.0	----	60.0	----	18.0	----	N (QP)
5	9.76000	38.9	----	10.4	49.3	----	60.0	----	10.7	----	N (QP)
6	26.39000	35.0	----	10.7	45.7	----	60.0	----	14.3	----	N (QP)
7	0.35900	----	23.8	9.9	----	33.7	----	48.8	----	15.1	N (CAV)
8	1.44000	----	26.2	10.0	----	36.2	----	46.0	----	9.8	N (CAV)
9	2.88800	----	28.9	10.1	----	39.0	----	46.0	----	7.0	N (CAV)
10	5.05500	----	29.5	10.2	----	39.7	----	50.0	----	10.3	N (CAV)
11	9.76000	----	36.0	10.4	----	46.4	----	50.0	----	3.6	N (CAV)
12	26.39000	----	31.6	10.7	----	42.3	----	50.0	----	7.7	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.

*[Signature]*

Tested by: Min-Gu Ji / Assistant Manager