



# FCC CFR47 Part 15 Subpart C ISED RSS-247 Certification Test Report

For the

**Product** : Touchpoint Plus Wireless  
**Model** : Touchpoint Plus Wireless  
**FCC ID** : 2AISE-TPPLW  
**IC** : 21613-TPPLW  
**Applicant** : Honeywell Analytics Asia Pacific  
Co., Ltd.  
**FCC Rule** : CFR 47 Part 15 Subpart C  
**ISED Rule** : RSS-247 Issue 2

We hereby certify that the above product has been tested by us with the listed rules and found in compliance with the regulation. The test data and results are issued on the test report no. TR-W1810-020

Signature

A handwritten signature in black ink, appearing to read 'Choi, Yeong-min', is written over a horizontal line.

Choi, Yeong-min / Technical Manager

Date: 2018-10-31

**Test Laboratory: ENG Co., Ltd.**

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Report No.: TR-W1810-020



ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942

Report Form\_01 (Rev.0)

# FCC/ISED CERTIFICATION TEST REPORT

**Project Number** : EA1807C-103  
**Test Report Number** : TR-W1810-020  
**Type of Equipment** : Touchpoint Plus Wireless  
**Model Name** : Touchpoint Plus Wireless  
**FCC ID** : 2AISE-TPPLW  
**ISED Cert. Number** : 21613-TPPLW  
**Multiple Model Name** : N/A  
**Applicant** : Honeywell Analytics Asia Pacific Co., Ltd.  
**Address** : 7F Sangam IT Tower, 434 Wordcup Buk-ro, Mapo-gu, Seoul, 03922, Republic of Korea  
**Manufacturer** : Honeywell Analytics Asia Pacific Co., Ltd.  
**Address** : 7F Sangam IT Tower, 434 Wordcup Buk-ro, Mapo-gu, Seoul, 03922, Republic of Korea  
**Regulation** : FCC Part 15 Subpart C Section 15.247, ISED RSS-247 Issue2  
**Total page of Report** : 42 Pages  
**Date of Receipt** : 2018-07-18  
**Date of Issue** : 2018-10-31  
**Test Result** : PASS

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.

Prepared by	Song, In-young / Senior Engineer	 _____ Signature	2018-10-31 _____ Date
Reviewed by	Choi, Yeong-min / Technical Manager	 _____ Signature	2018-10-31 _____ Date

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### Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1810-020	2018-10-31	Initial Release
-	-	-

## 1. TEST SUMMARY

### 1.1 Regulations and results

The sample submitted for evaluation (Referred to below as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	ISED Reference Section	Description	P	F	N.T.	Note
15.247(a)(2)	RSS-247 5.2 a)	6 dB Bandwidth Occupied Bandwidth	P			
15.247(b)(3)	RSS-247 5.4 d)	Maximum peak output power	P			
15.247(e)	RSS-247 5.2 b)	Power spectral density	P			
15.247(d)	RSS-247 5.5	Band Edge Conducted spurious emission	P			
15.205(a) 15.209(a)	RSS 247 5.5 RSS-GEN 8.9	Radiated spurious emissions	P			
15.207(a)	RSS GEN 8.8	AC power line conducted emissions	P			

#### Remark:

P means Passed

F means Failed

N.T. means Not Tested

### 1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013, and RSS-Gen Issue 4, KDB 558074 D01DTS Meas. Guidance v05: Measurement Procedure PK is used for power measurement.

### 1.3 Additions, deviations, exclusions from standards





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

### 1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart C Section 15.247, RGG-Gen and RSS-247

### 1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Description details of test facilities were submitted to the FCC and IC, designated by the RRA (Radio Research Agency), and accredited by Korea and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea according to the requirement of ISO 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED(Canada)	IC 12721A	
RRA	KR0160	
Korean Agency for Technology and Standards	KT733	

## 2. EUT (Equipment Under Test) INFORMATION

### 2.1 General Description

The Honeywell Analytics Asia Pacific Co., Ltd., Model Touchpoint Plus Wireless (referred to as the EUT in this report) is a Touchpoint Plus Wireless, which is an entry level (or upgrade) Touch-screen digital Controller for general industrial and commercial gas detection systems. The product specification described herein was obtained from product data sheet or user's manual.

Trade mark	<b>Honeywell</b>
Operating Frequency	2 405 ~ 2 475 MHz
Max. RF Output Power	5.49 dBm
Modulation Types	DSSS(O-QPSK)
Number of Channels	15 CH
Channel Bandwidth	5 MHz
Generated or used Freq. in EUT	32.768 kHz, 8 MHz, 16 MHz, 25 MHz
Type of Antenna	<input type="checkbox"/> Integrated Type <input checked="" type="checkbox"/> Dedicated Type (Dipole Antenna Type)
Antenna Gain	5 dBi
Operating Temperature	-10 °C ~ + 55 °C
Normal Test Voltage	AC 120 V
Electrical Rating	AC 120 V / DC 24 V
Test SW Version	SSCOM Serial/Net data debugger, Version: 5.13.1
RF power setting in TEST SW	-17
Hardware Version Identification Number(HVIN)	Touchpoint Plus Wireless
Firmware Version Identification Number(FVIN)	9.4.0

### 2.2 Additional Model

- None.

### 3. TEST CONDITION

#### 3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
Touchpoint Plus Wireless	Touchpoint Plus Wireless	N/A	Honeywell Analytics Asia Pacific Co., Ltd.
Test Jig	TTL-232R-3V3	N/A	N/A
Notebook PC	E5470	ZU10190-15008	DELL
Adapter for Notebook PC	LA65NM130	N/A	DELL

#### 3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is O-QPSK.

Operating Mode	Test Channel	Frequency	Measured Output Power(dBm)
DC 24 V	Low Channel	2 405 MHz	5.37
	Middle Channel	2 440 MHz	4.86
	High Channel	2 475 MHz	4.49
AC 120 V, 60 Hz	Low Channel	2 405 MHz	<b>5.49</b>
	Middle Channel	2 440 MHz	<b>4.93</b>
	High Channel	2 475 MHz	<b>4.52</b>

#### 3.3 Available channel list and frequency

Frequency band (MHz)		2 400 ~ 2 483.5	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2 405	19	2 445
12	2 410	20	2 450
13	2 415	21	2 455
14	2 420	22	2 460
15	2 425	23	2 465
16	2 430	24	2 470
17	2 435	25	2 475
18	2 440		



### 3.4 Preliminary Testing for Worst case configuration

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. Since the EUT is a fixed type device, all spurious emission tests were performed in one axis direction.

Based on preliminary testing following operating modes were selected for the final test as listed below

#### 3.4.1 Conducted Emission Test mode

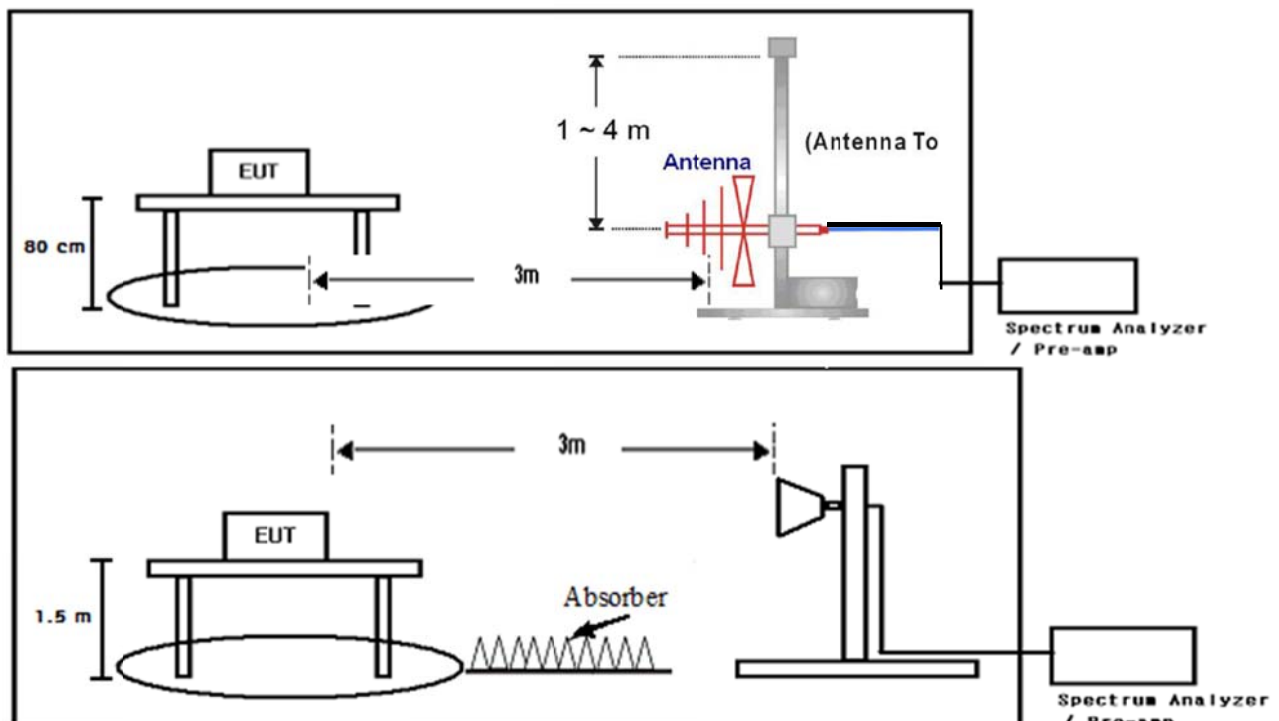
Operating Mode	Test Channel	Frequency
AC 120 V, 60 Hz	Low Channel	2 405 MHz
	Middle Channel	2 440 MHz
	High Channel	2 475 MHz

#### 3.4.2 Radiated Emission & AC Power-line Conducted Emission Test mode

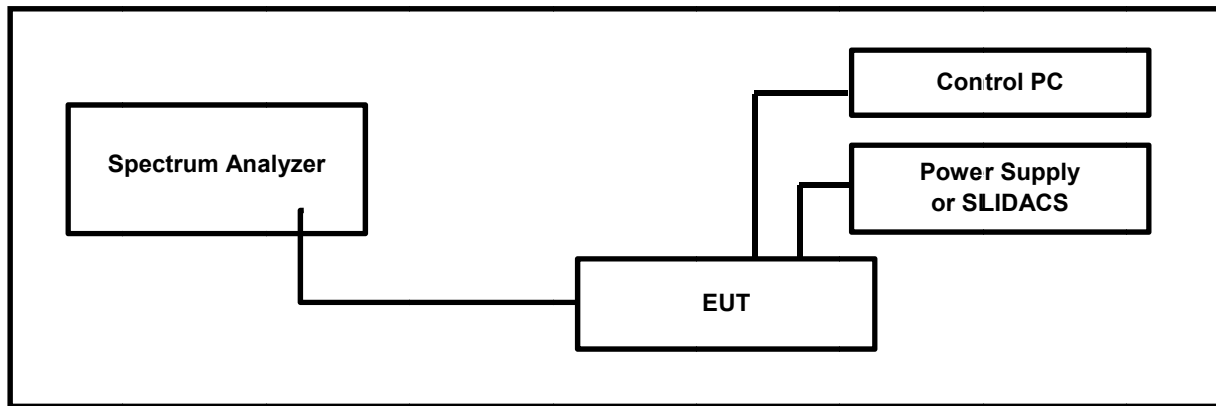
Operating Mode	Test Channel	Frequency
AC 120 V, 60 Hz	Low Channel	2 405 MHz
	Middle Channel	2 440 MHz
	High Channel	2 475 MHz

### 3.5 Test Setup Drawing

#### [Radiated Test]



[Conducted Test]



**3.6 EUT Modifications**

- No EMC Relevant Modifications were performed by this test laboratory.

**4. ANTENNA REQUIREMENT**

According to FCC CFR 47 Part 15 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

**4.1 Antenna Description**

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4	Dipole Antenna	5	Reverse Polarity N-type

**4.2 Conclusion**

The antenna connector type of the EUT is Reverse Polarity N Antenna, so the EUT met the requirement.

## 5. TEST RESULT

### 5.1 6 dB Bandwidth

#### 5.1.1 Limit

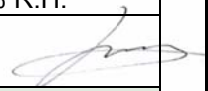
The minimum 6 dB bandwidth shall be at least 500 kHz acc to Section 15.247 (a) (2), and RSS-247 5.2 (a).

#### 5.1.2 Method of Measurement

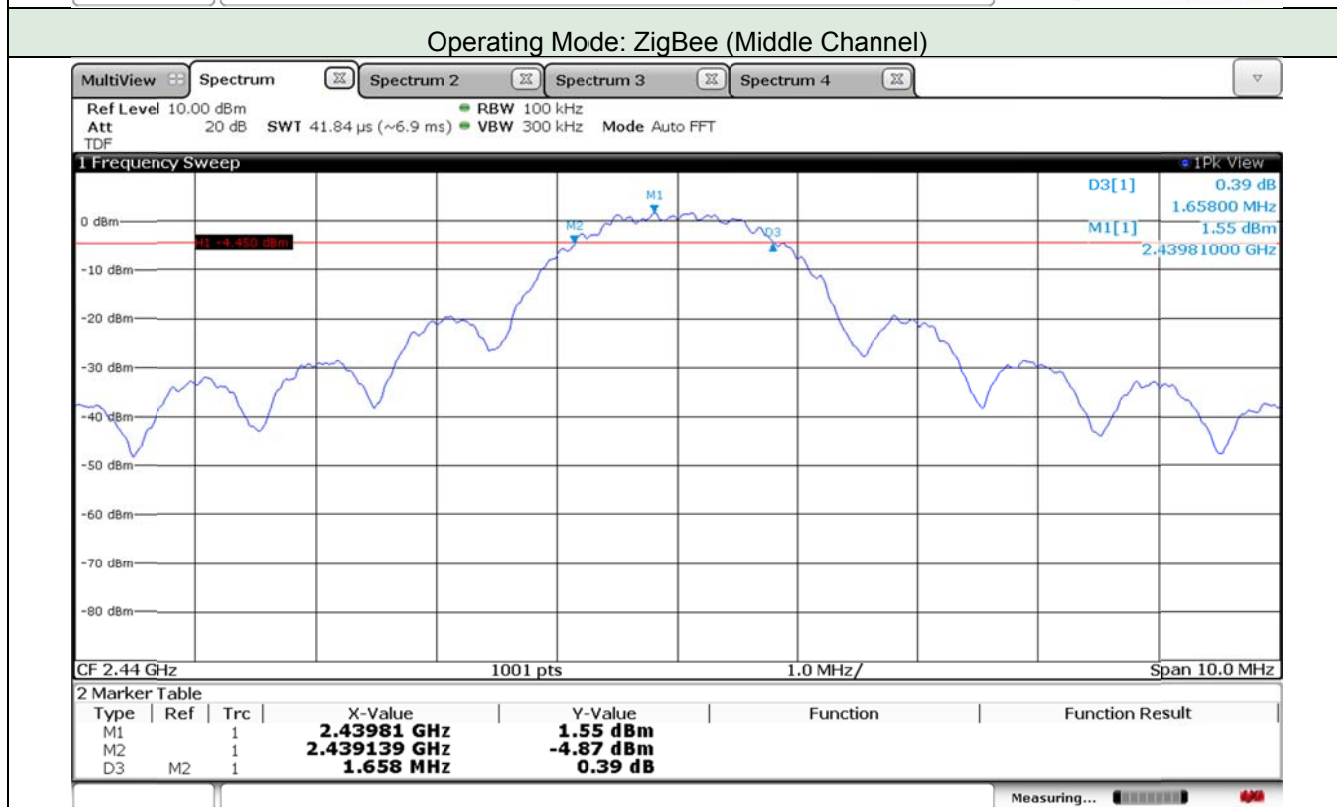
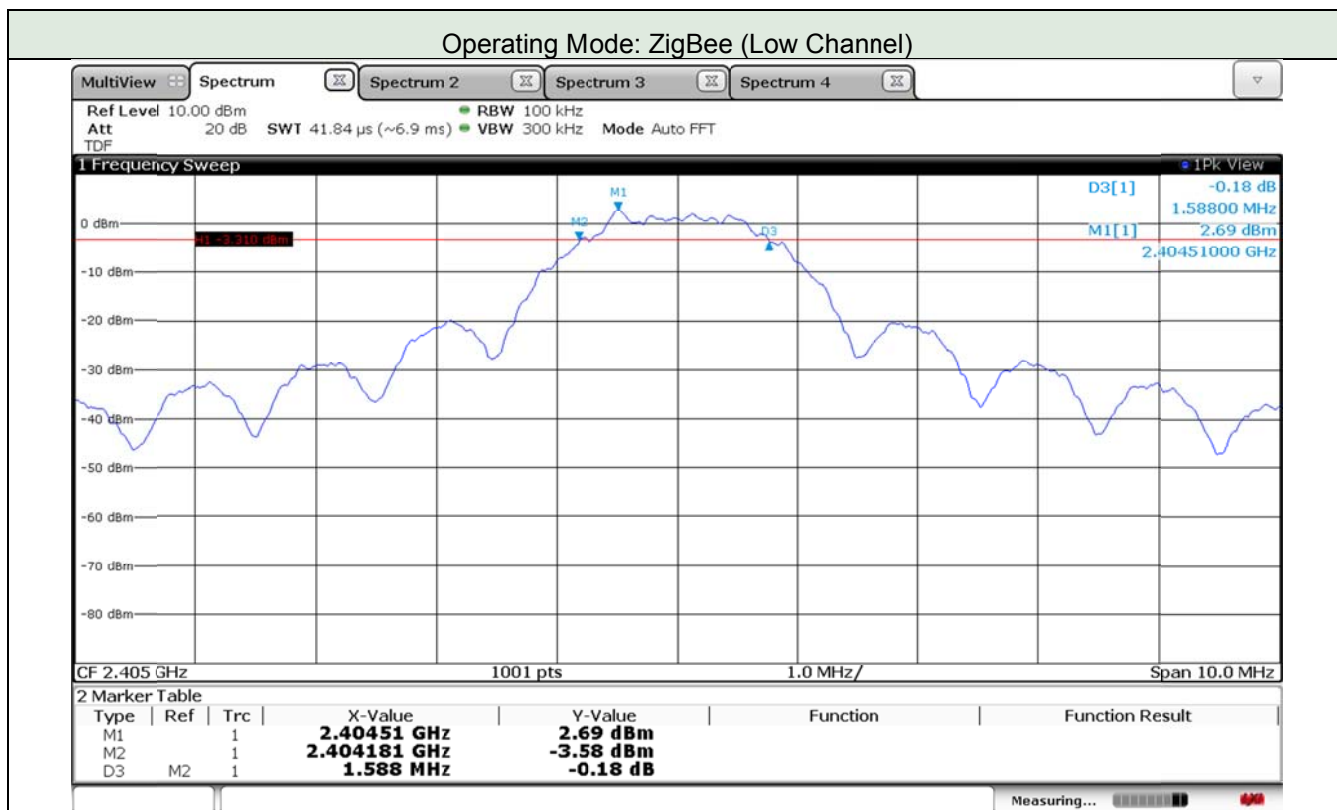
Reference to KDB 558074 D01 DTS Meas Guidance v05: 8.2 and sub-clause 11.8.1 Option 1 of ANSI C63.10-2013.

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW  $\geq$  3 X RBW, peak detector and max hold.

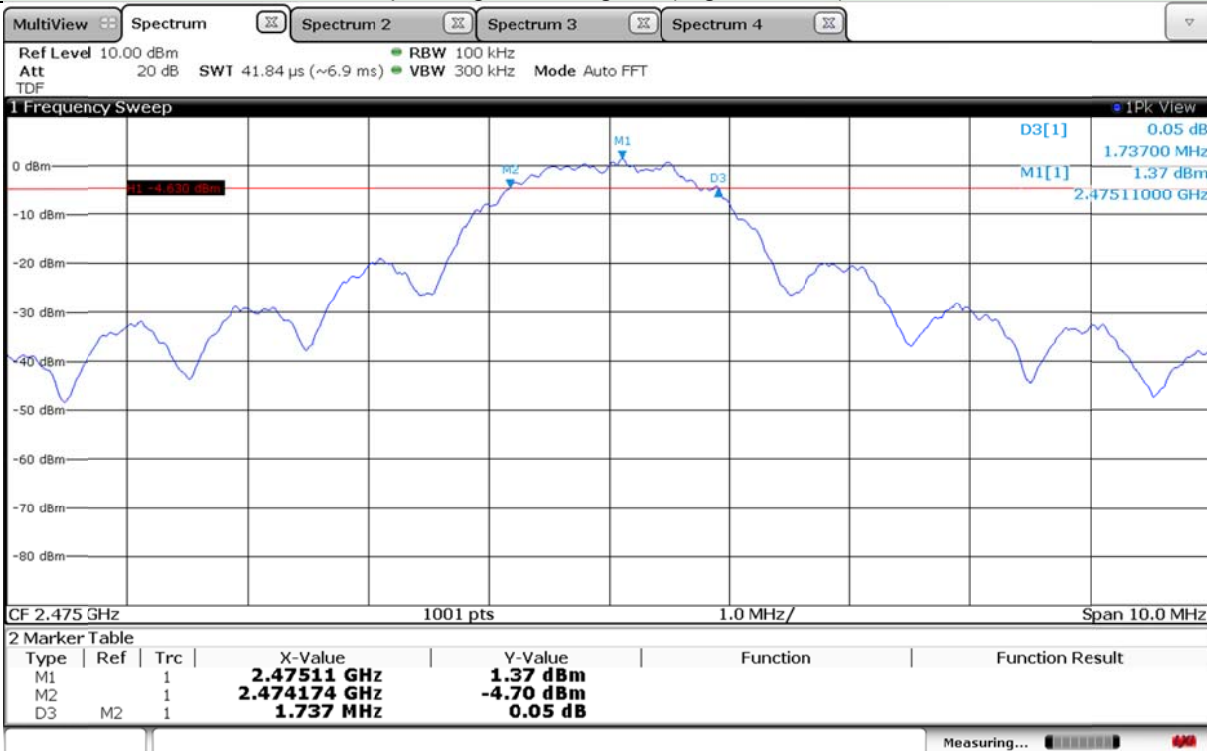
#### 5.1.3 Test Data

Date of Test	2018-09-07	Temperature	(24.0 $\pm$ 1.0) °C
		Relative humidity	(56.0 $\pm$ 3.0) % R.H.
<b>Test Result</b>	<b>PASS</b>	Tested by	In-yong Song 
Operating Mode: ZigBee			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 405	1.59	0.5
Middle	2 440	1.66	
High	2 475	1.74	

### 5.1.4 Test Plots



Operating Mode: ZigBee (High Channel)



## 5.2 99 % Bandwidth

### 5.2.1 Limit

Not applicable. For reporting purpose only.


### 5.2.2 Method of Measurement

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1 % to 5 % of the OBW.

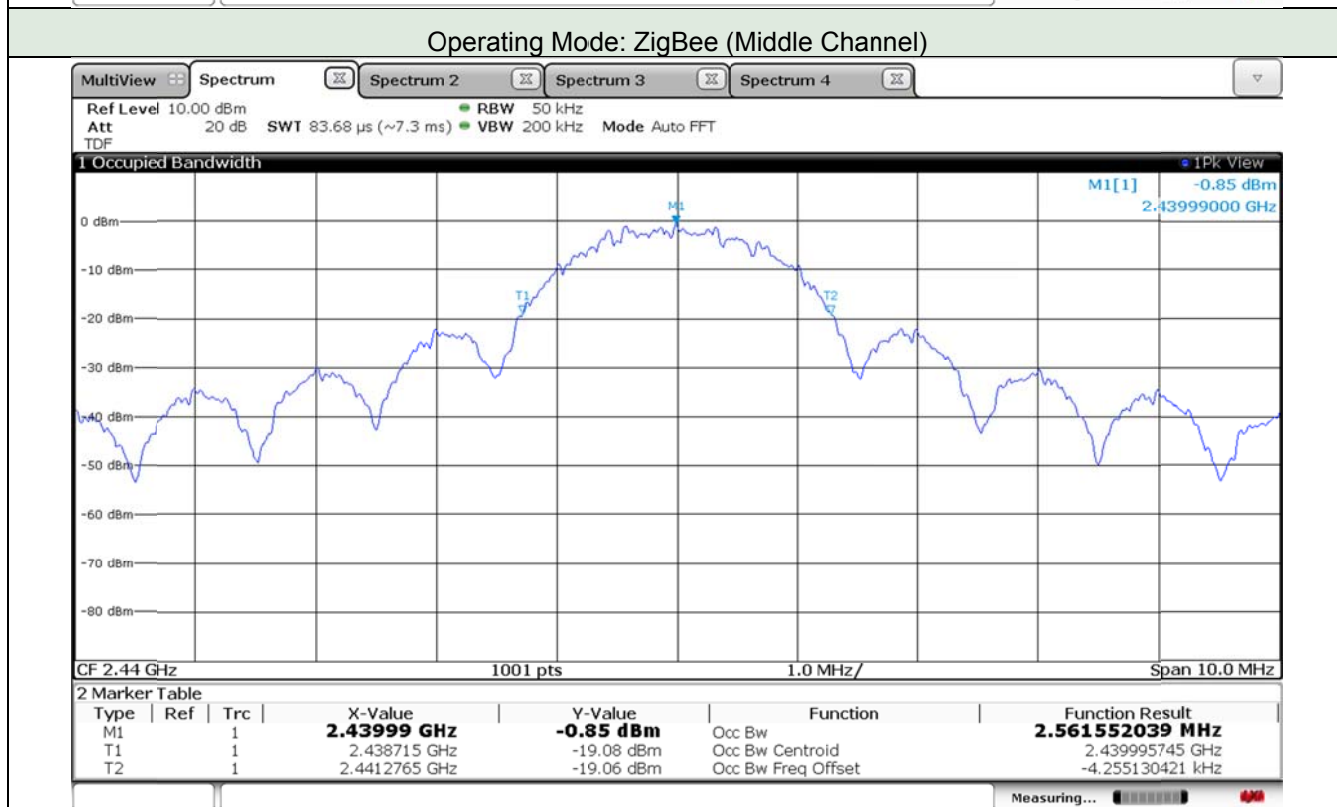
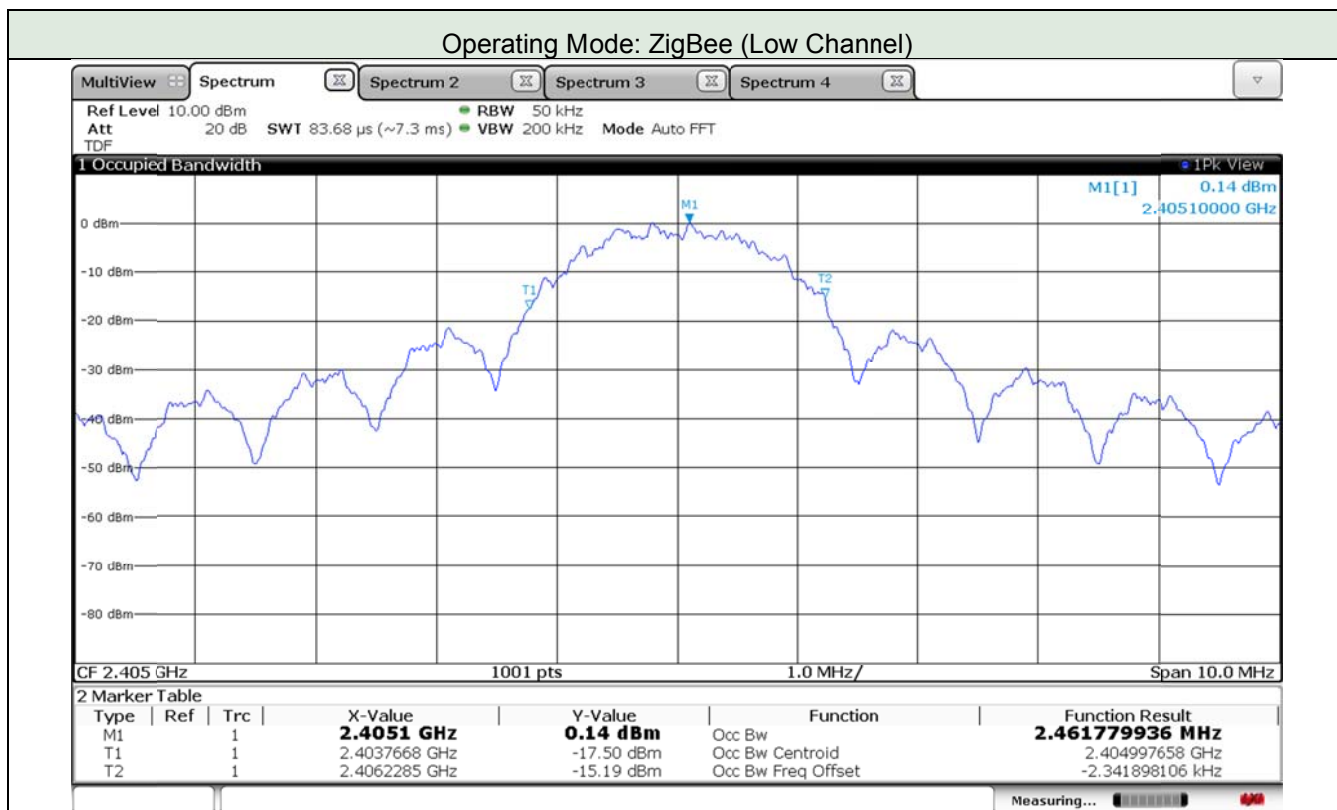
The span is set to capture all products of the modulation process, including the emission skirts.

The VBW is set to 3 times the RBW. The sweep time is coupled and peak detection and max hold mode is used. The spectrum analyzer internal 99% bandwidth function is utilized.

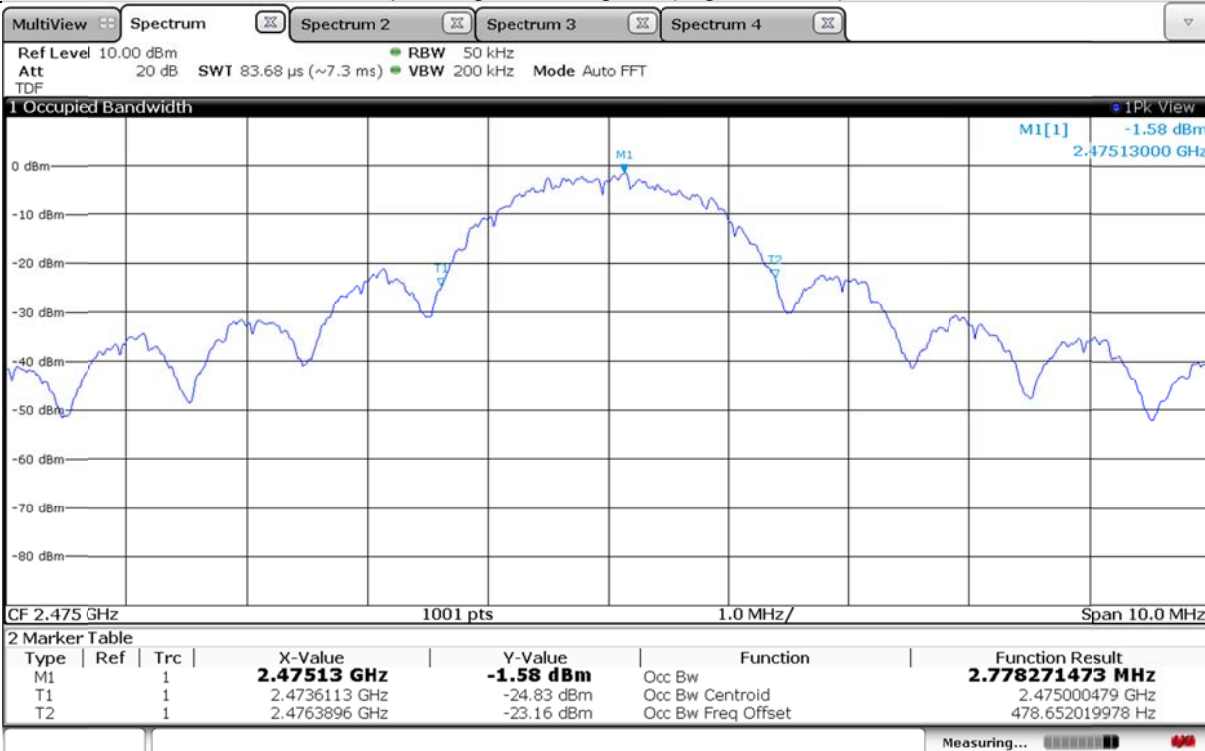
### 5.2.3 Test Data

Date of Test	2018-09-07	Temperature	(24.0 ± 1.0) °C
		Relative humidity	(56.0 ± 3.0) % R.H.
<b>Test Result</b>	<b>PASS</b>	Tested by	In-yong Song 
Operational Mode: ZigBee			
Channel	Frequency (MHz)	99 % Bandwidth (MHz)	
Low	2 405	2.46	
Middle	2 440	2.56	
High	2 475	2.78	

## 5.2.4 Test Plots



Operating Mode: ZigBee (High Channel)





### 5.3 Maximum Peak Output Power

#### 5.3.1 Limit

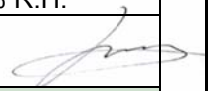
Acc. To section 15.247 and RSS-247 5.4 d), For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 5.3.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05: 8.3.1.1 RBW ≥ DTS bandwidth

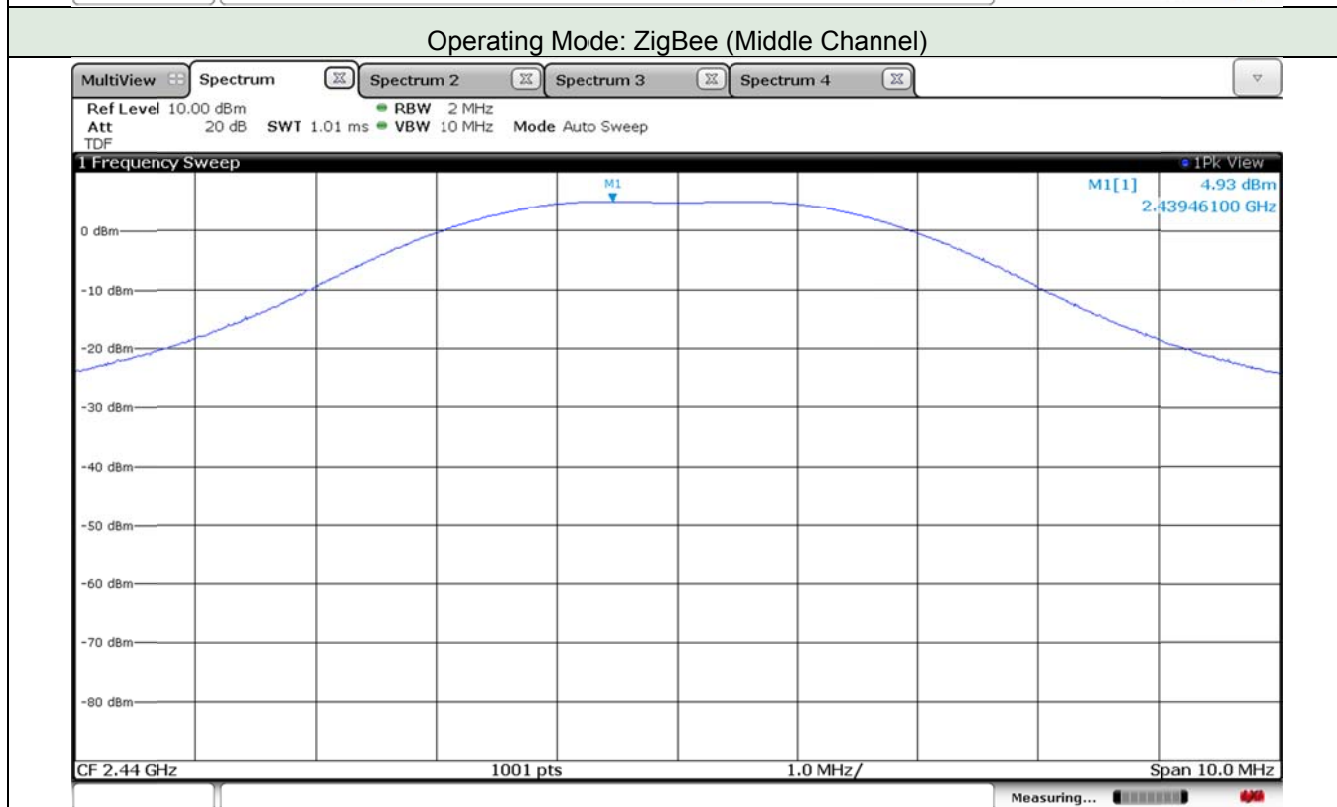
The cable assembly insertion loss was entered as an offset in the spectrum analyzer to allow for direct reading of power.

#### 5.3.3 Test Data for Output Power

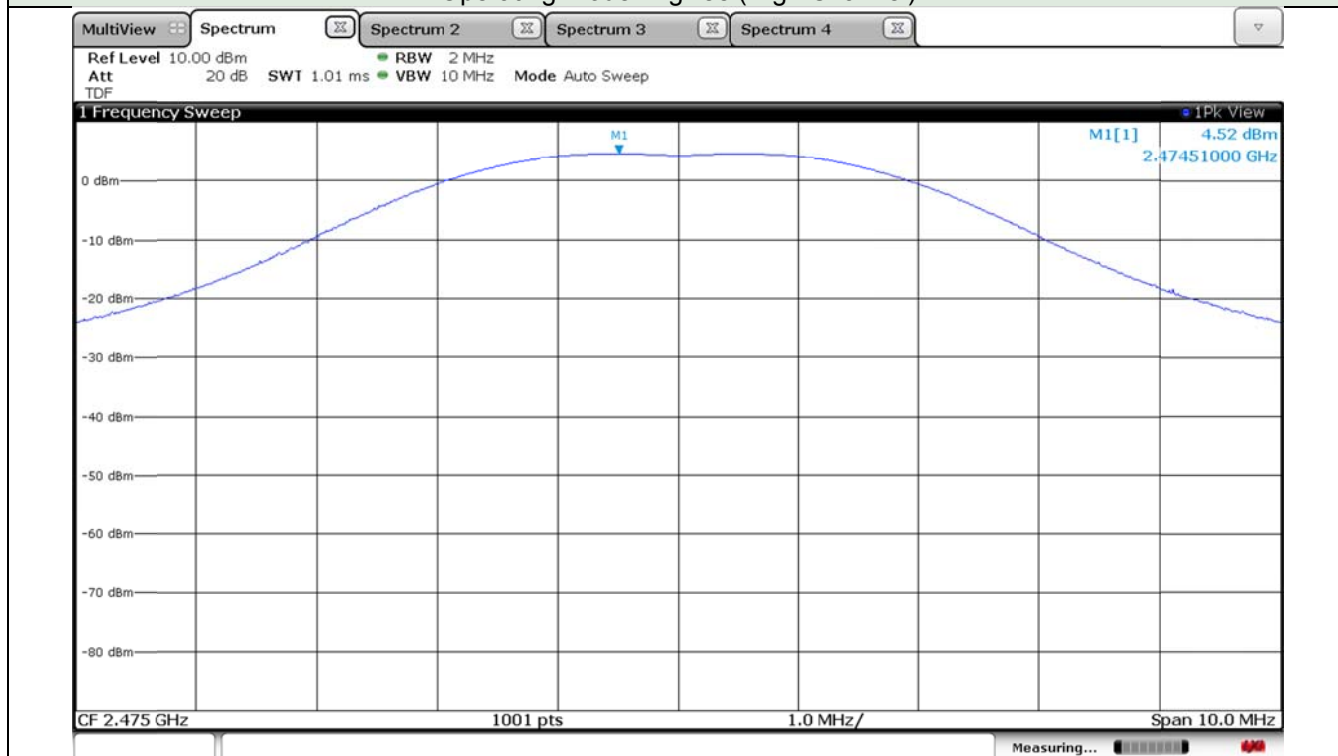
Date of Test	2018-09-07	Temperature	(24.0 ± 1.0) °C	
		Relative humidity	(56.0 ± 3.0) % R.H.	
<b>Test Result</b>	<b>PASS</b>	Tested by	In-yong Song 	
Operating Mode: ZigBee				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 405	5.49	30	24.51
Middle	2 440	4.93		25.07
High	2 475	4.52		25.48

Remark. Margin = Limit – Measured Value

### 5.3.4 Test Plots



Operating Mode: ZigBee (High Channel)



## 5.4 Peak Power Spectral Density

### 5.4.1 Limit

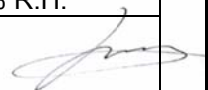
Acc. To section 15.247 and RSS-247 5.2 b), the power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 5.4.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05: 8.4 Method PKPSD (peak PSD).

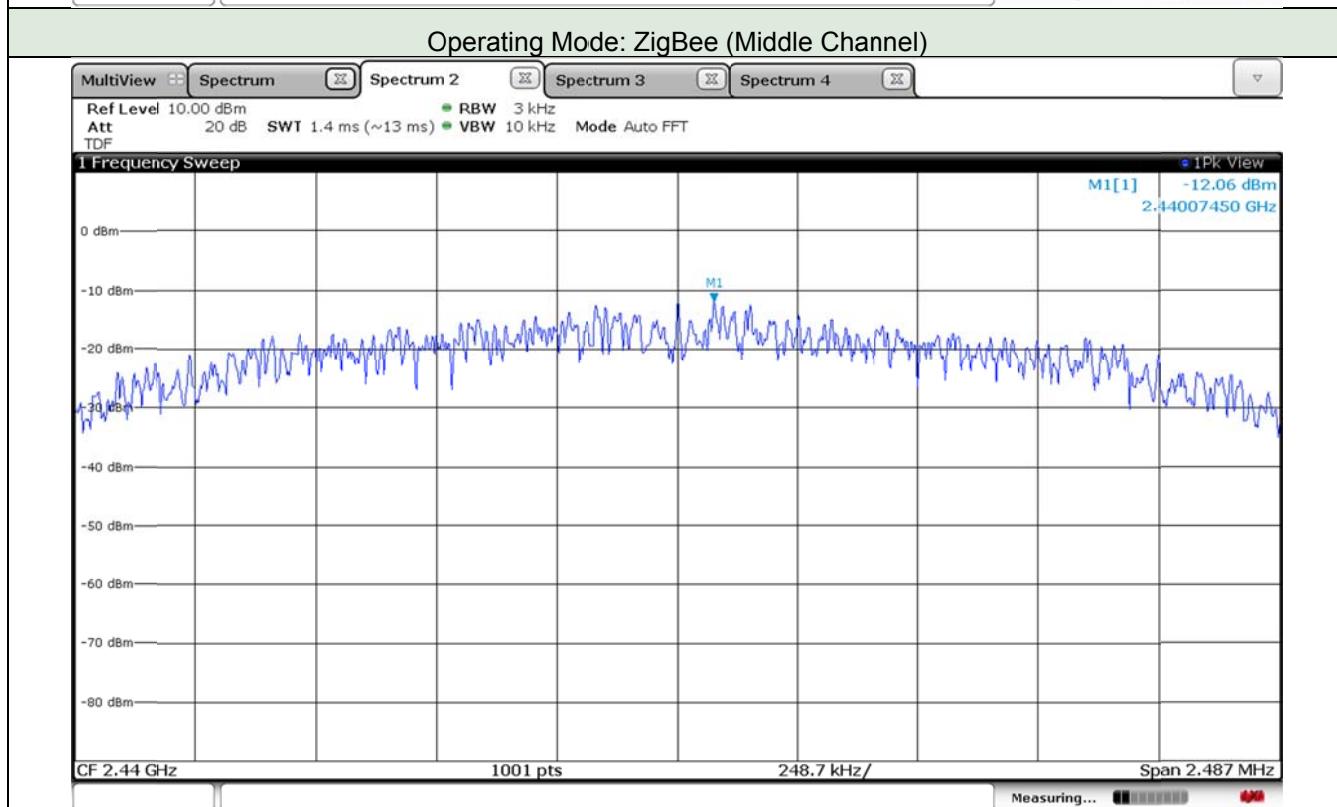
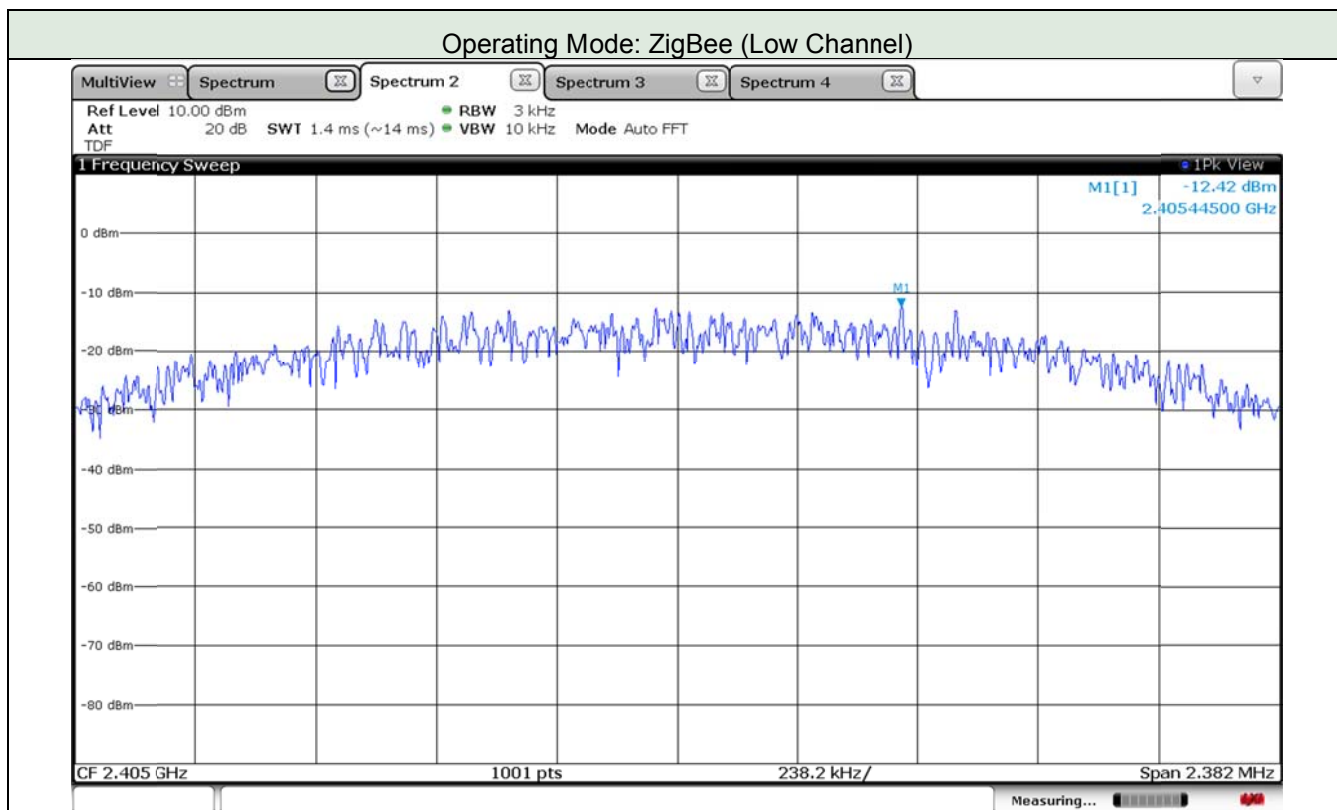
The transmitter output is connected to a spectrum analyzer with the RBW set from 3 kHz to 100 kHz, VBW  $\geq$  3 X RBW, peak detector and max hold.

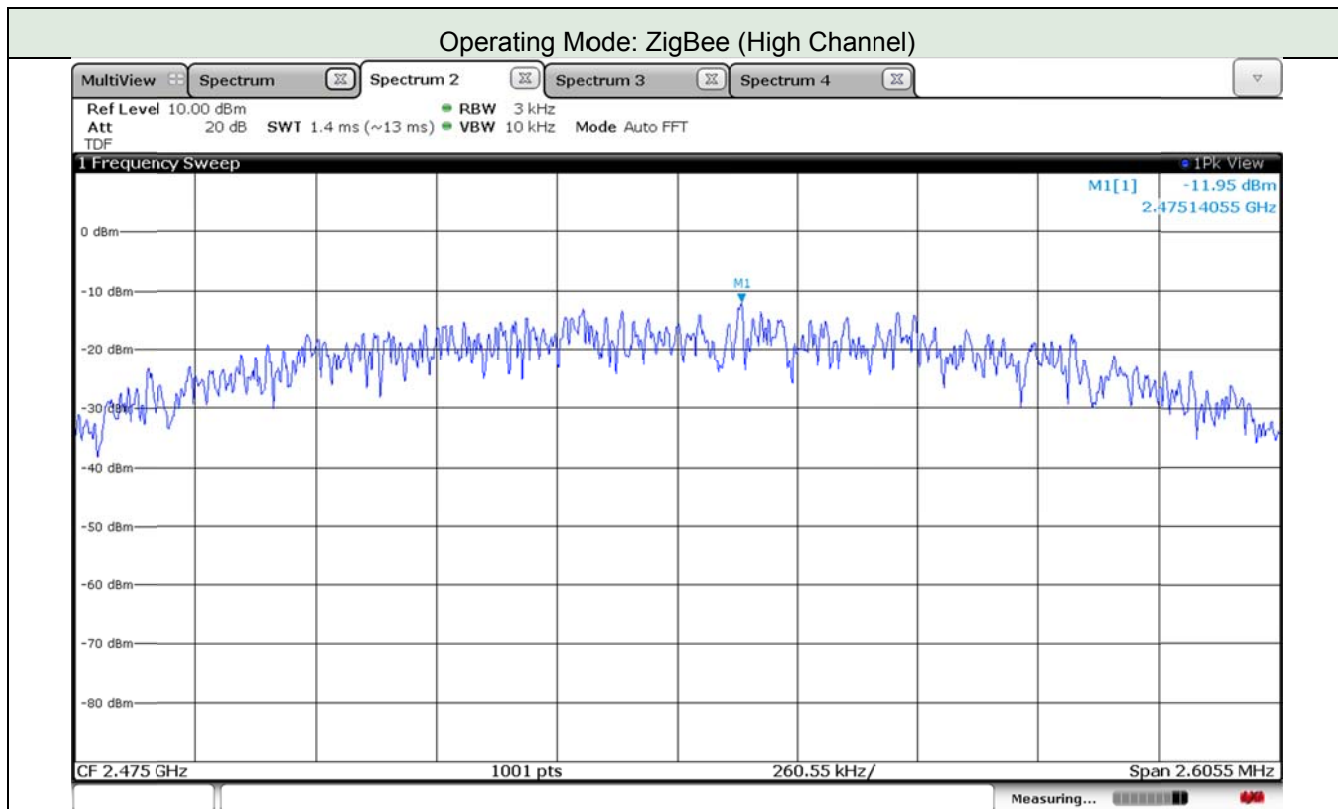
### 5.4.3 Test Data

Date of Test	2018-09-07	Temperature	(24.0 $\pm$ 1.0) °C	
		Relative humidity	(56.0 $\pm$ 3.0) % R.H.	
<b>Test Result</b>	<b>PASS</b>	Tested by	In-yong Song 	
Operating Mode: ZigBee				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 405	-12.42	8	20.42
Middle	2 440	-12.06		20.06
High	2 475	-11.95		19.95

Remark. Margin = Limit – Measured Value

### 5.4.4 Test Plots





## 5.5 Out of Band Emission

### 5.5.1 Limit

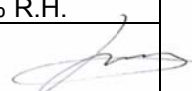
Acc. To section 15.247(d) and RSS-247 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

### 5.5.2 Method of Measurement

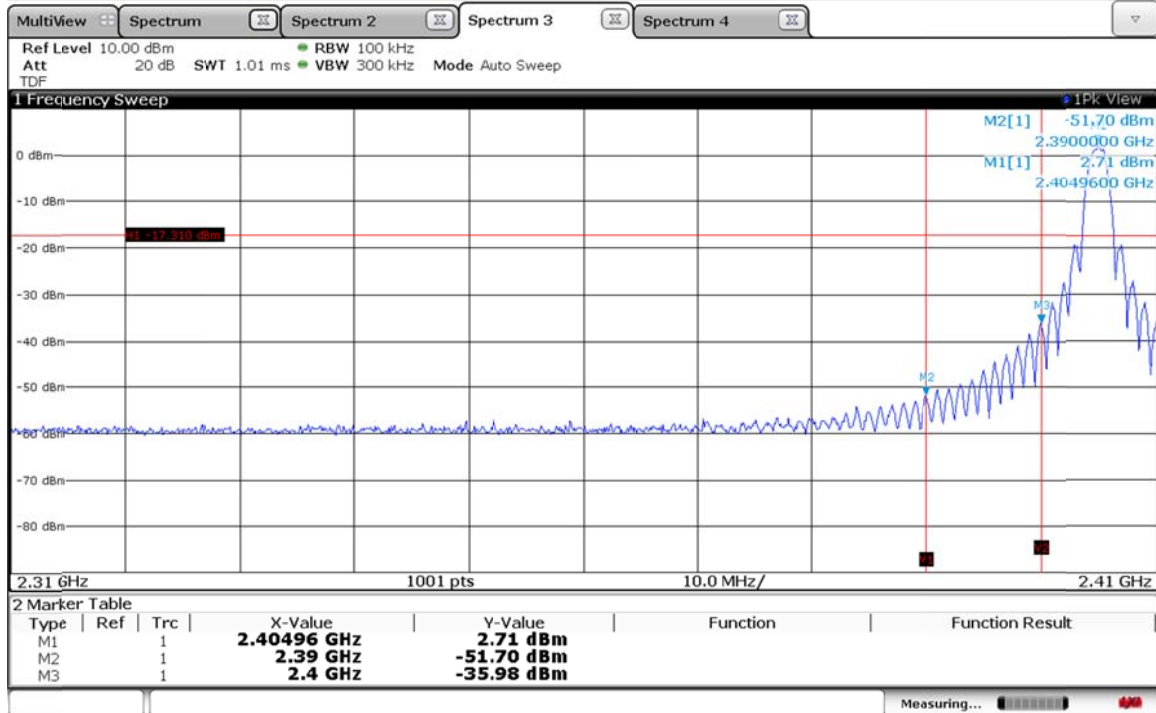
Reference to KDB 558074 D01 DTS Meas Guidance v05: 8.5 Emissions in non-restricted frequency bands and sub-clause 11.11 of ANSI C63.10-2013.

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW  $\geq 3 \times$  RBW, peak detector and max hold. Measurements utilizing these settings are made of the in-band reference level, band-edge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

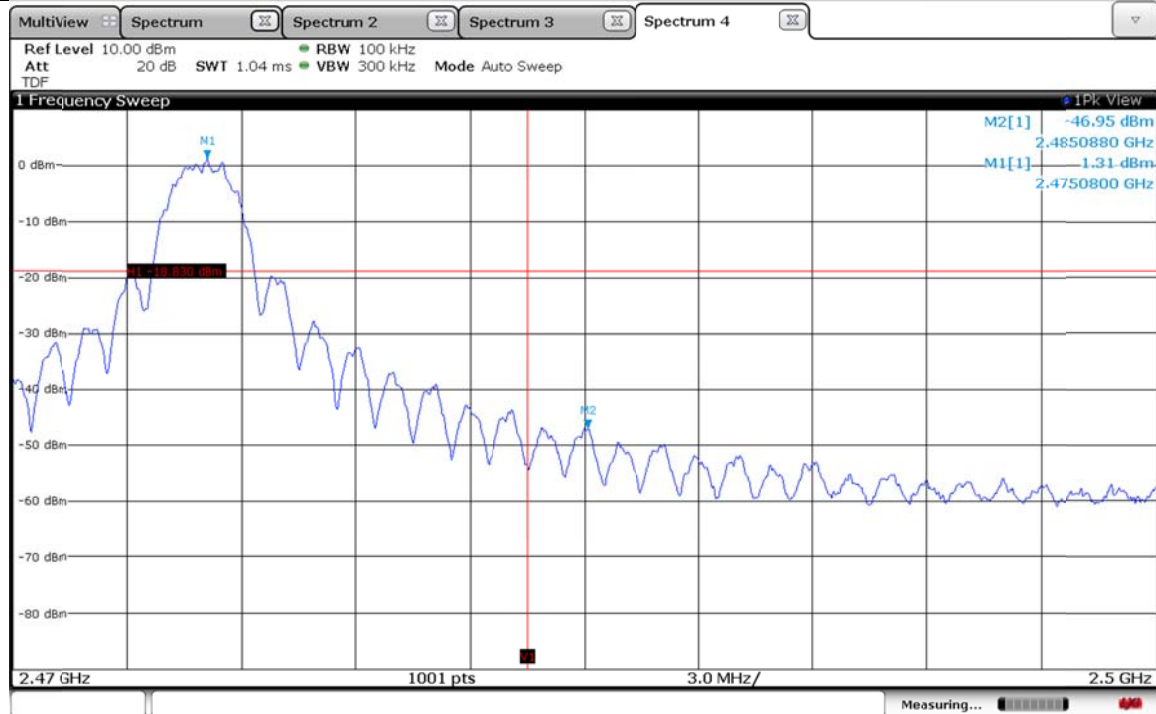
### 5.5.3 Test Data for Operating mode: ZigBee

Date of Test	2018-09-07	Temperature	(24.0 ± 1.0) °C
		Relative humidity	(56.0 ± 3.0) % R.H.
<b>Test Result</b>	<b>PASS</b>	Tested by	In-yong Song 

#### Band-edge and Restricted band – Low channel

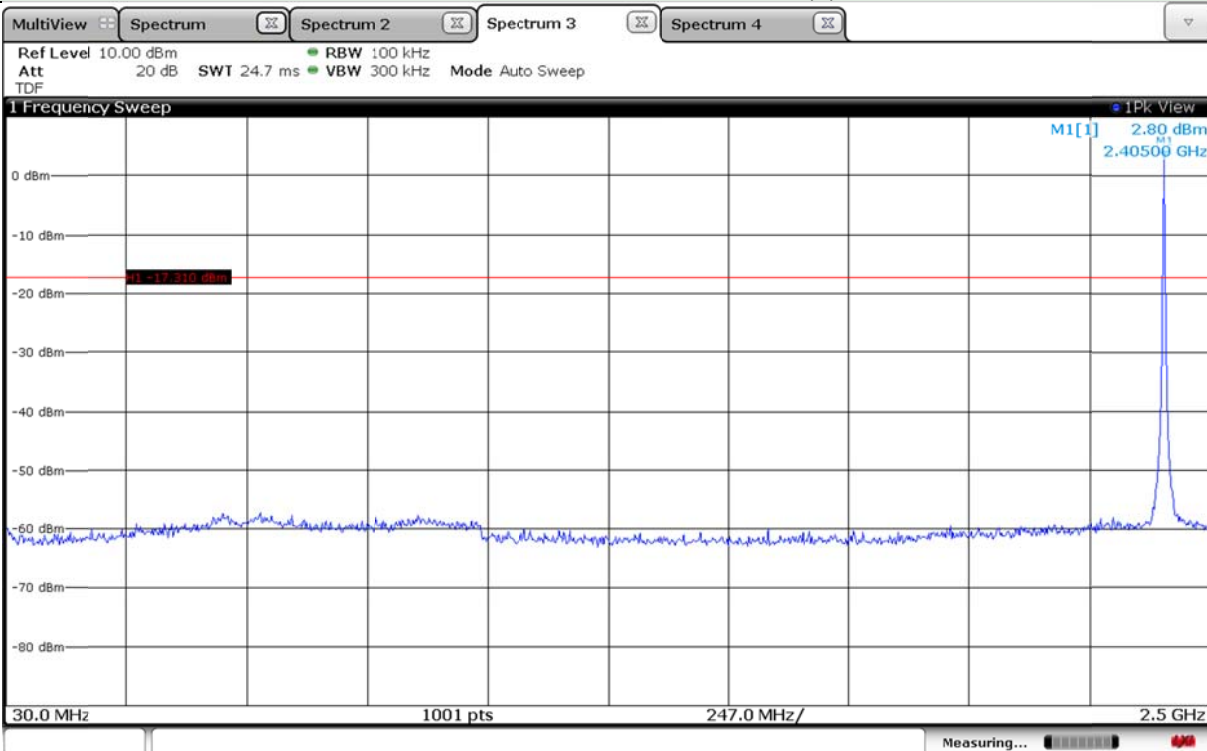


#### Band-edge and Restricted band – High channel

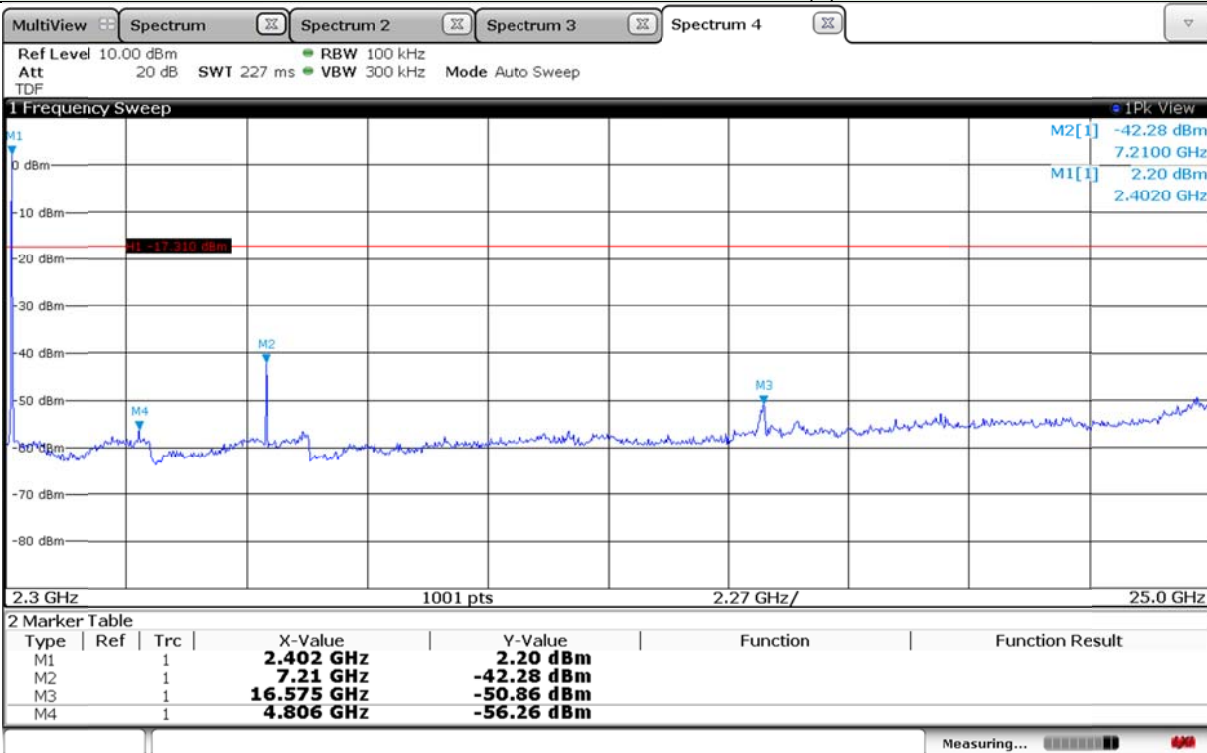




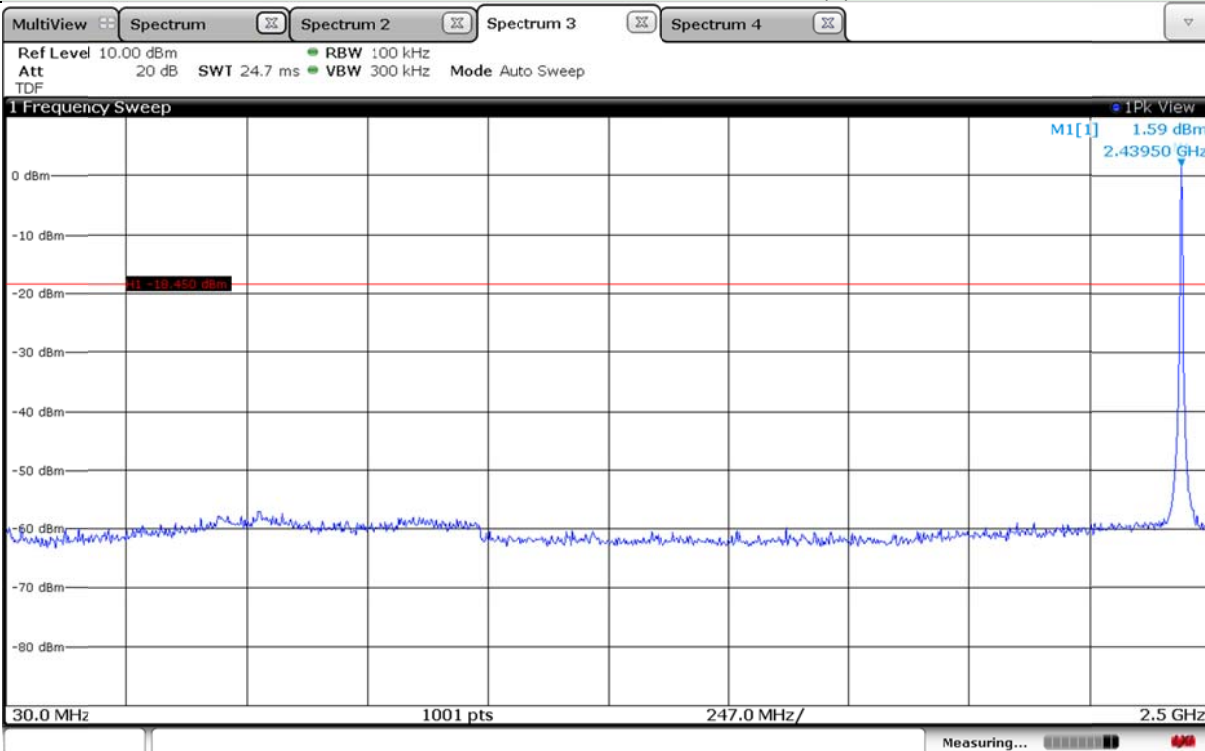
### Non-restricted band – Low Channel (1)



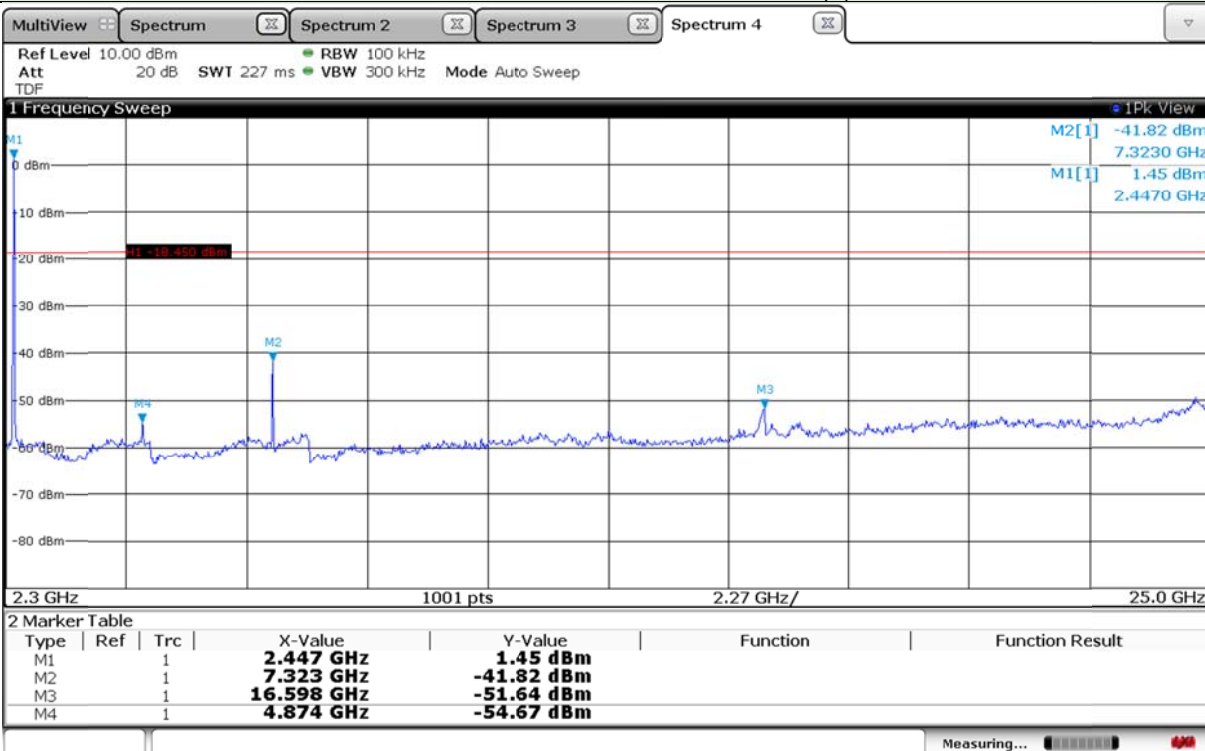
### Non-restricted band – Low Channel (2)



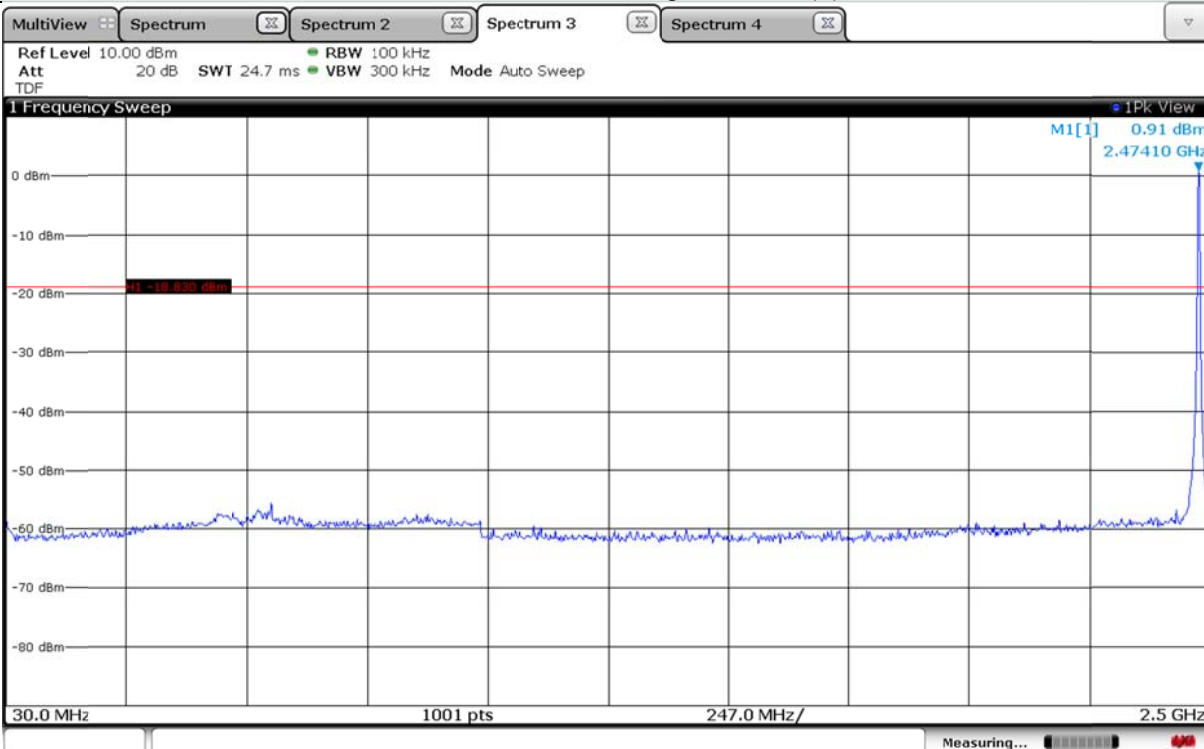
### Non-restricted band – Middle Channel (1)



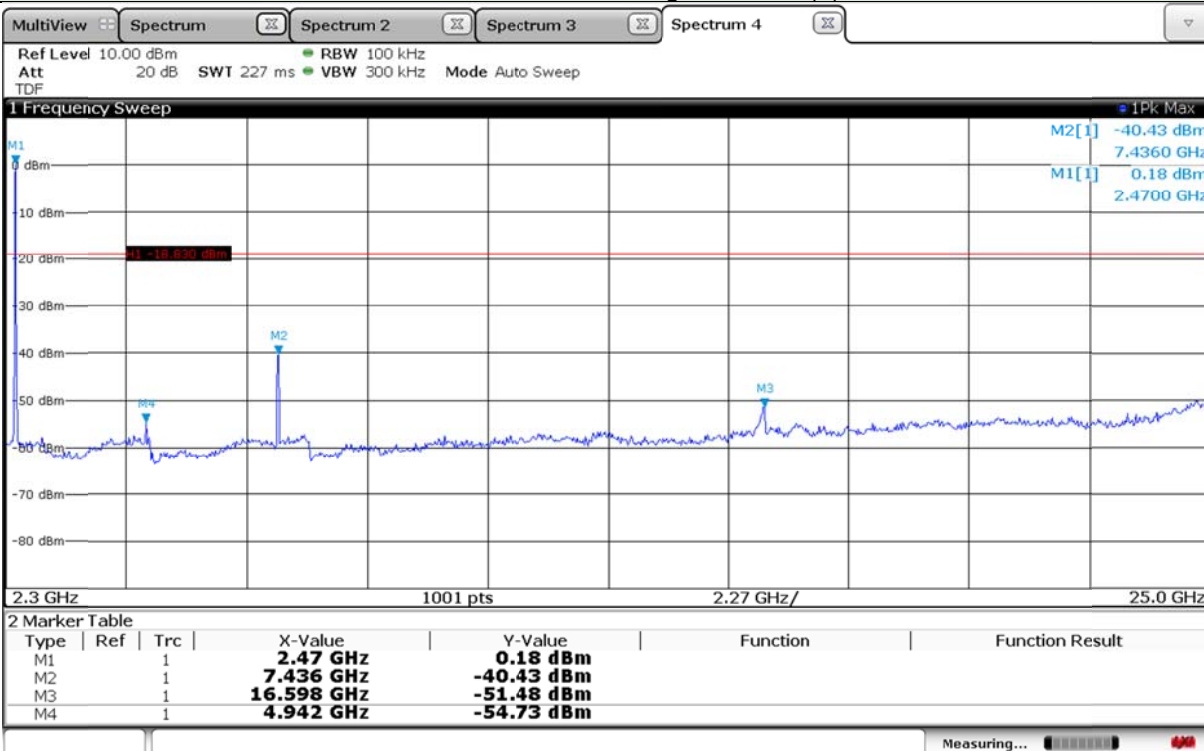
### Non-restricted band – Middle Channel (2)



### Non-restricted band – High Channel (1)



### Non-restricted band – High Channel (2)



## 5.6 Radiated Emission

### 5.6.1 Limit

Acc. To section 15.205,15.209, and RSS-Gen 8.9, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

### 5.6.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05: 8.5 Radiated emission measurements and sub-clause 11.12.1 of ANSI C63.10.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz 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 25 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.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to  $\geq 1/T$ , where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

### 5.6.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we **declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01.**

### 5.6.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.1 dB	30 MHz ~ 1 GHz	± 4.8 dB
1 GHz ~ 18 GHz	± 5.0 dB	18 GHz ~25 GHz	± 5.3 dB

### 5.6.5 Sample Calculated Example

At 80 MHz

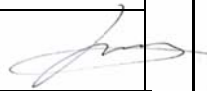
Limit = 40.0 dBuV/m

Result = Receiver reading value + Antenna Factor + Cable Loss – Pre-amplifier gain = 30 dBuV/m

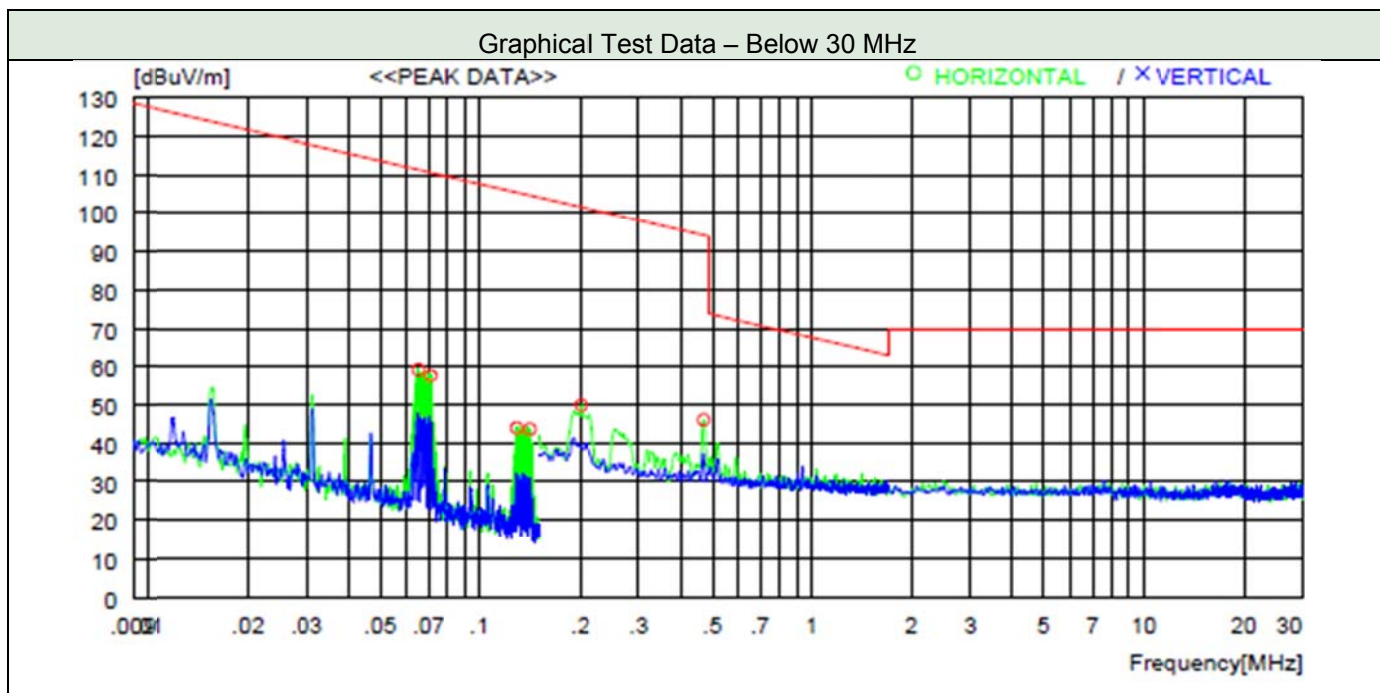
Margin = Limit – Result = 40 – 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

### 5.6.6 Test Data

Date of Test	2018-09-13	Temperature	(23 ± 2) °C		
		Relative humidity	(52 ± 3) % R.H.		
<b>Measurement Frequency Range</b>		9 kHz ~ 25 GHz			
<b>Test Result</b>	<b>PASS</b>	Tested By	In-yong Song 		
Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m
Above 1 GHz	Peak	1 MHz	3 MHz		3 m
	Average		3 MHz		3 m

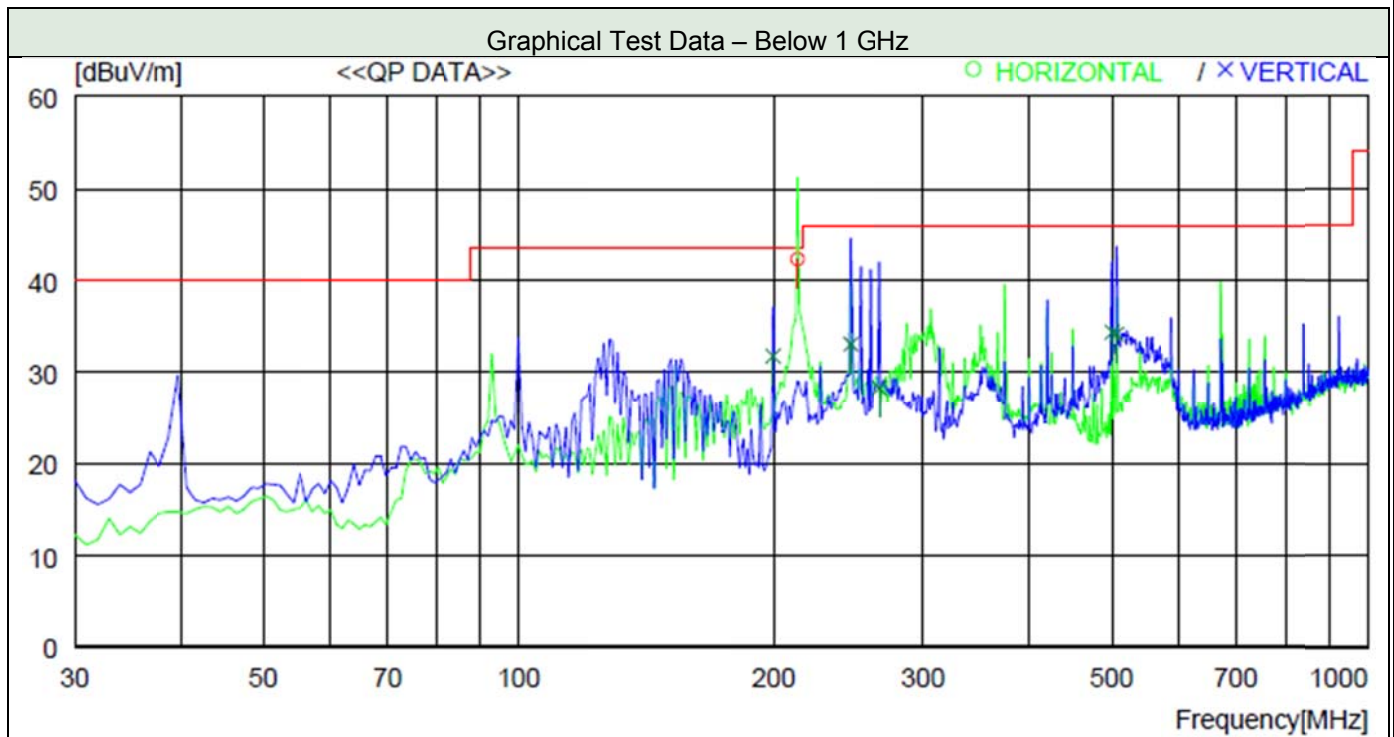
#### 5.6.6.1 Test Data below 30 MHz



Tabulated Test Data – Low / Middle / High Channel

Frequency (MHz)	Receiver Reading (dBuV)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Degree)
* Spurious emissions that 20 dB below the limits didn't be recorded										

### 5.6.6.2 Test Data from 30 MHz to 1 GHz



Tabulated Test Data

Frequency (MHz)	Pol.	Detect Mode	Reading (dB $\mu$ V)	Factor* (dB)	Loss* (dB)	Gain (dB)	Result (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
199.75	V	Q.P.	44.2	11.4	8.9	32.7	31.8	43.5	11.7
213.33	H	Q.P.	54.1	11.8	9.0	32.6	42.3	43.5	1.2
246.31	V	Q.P.	43.8	12.7	9.2	32.6	33.1	46.0	12.9
266.68	V	Q.P.	38.5	13.0	9.4	32.6	28.3	46.0	17.7
500.45	V	Q.P.	38.9	17.6	10.8	32.9	34.4	46.0	11.6
506.27	V	Q.P.	38.6	17.7	10.8	32.9	34.2	46.0	11.8

Except above frequencies, no emissions were detected above the noise floor which was at least 20 dB below the specification limit.

Note: "H" means Horizontal polarity, "V" means Vertical polarity.

O-QPSK lowest channel is worst case configuration.

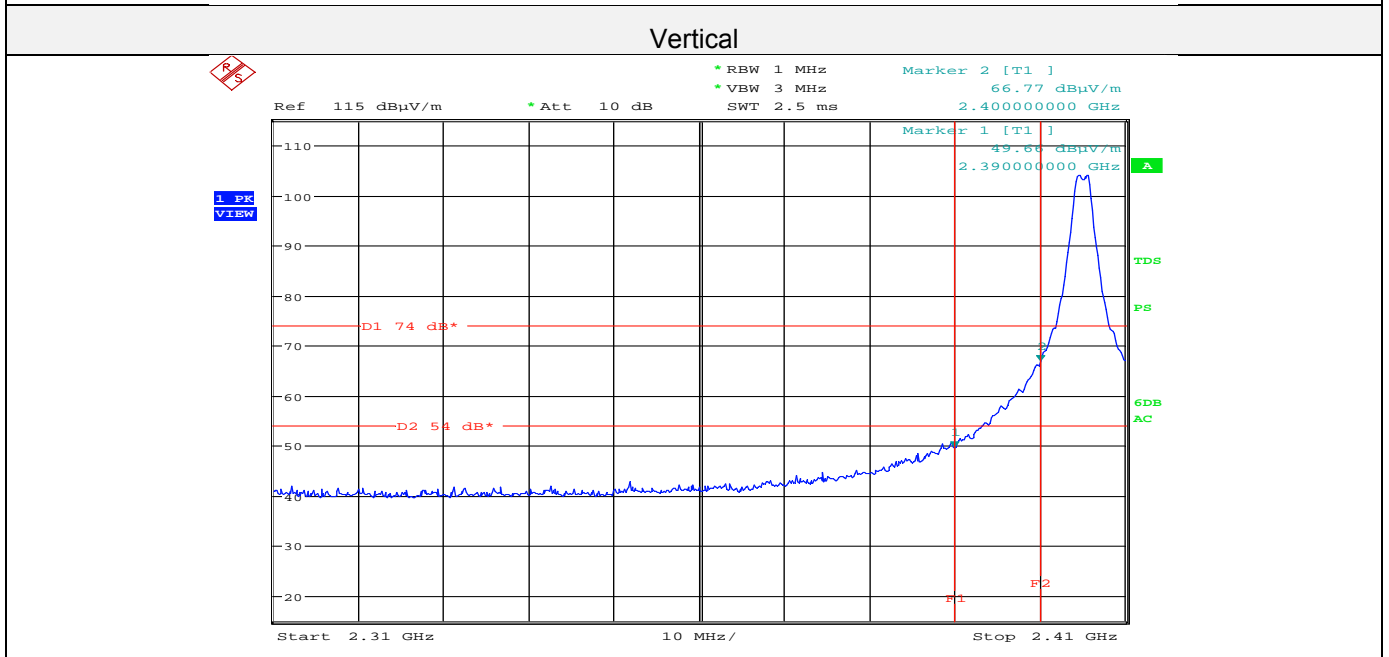
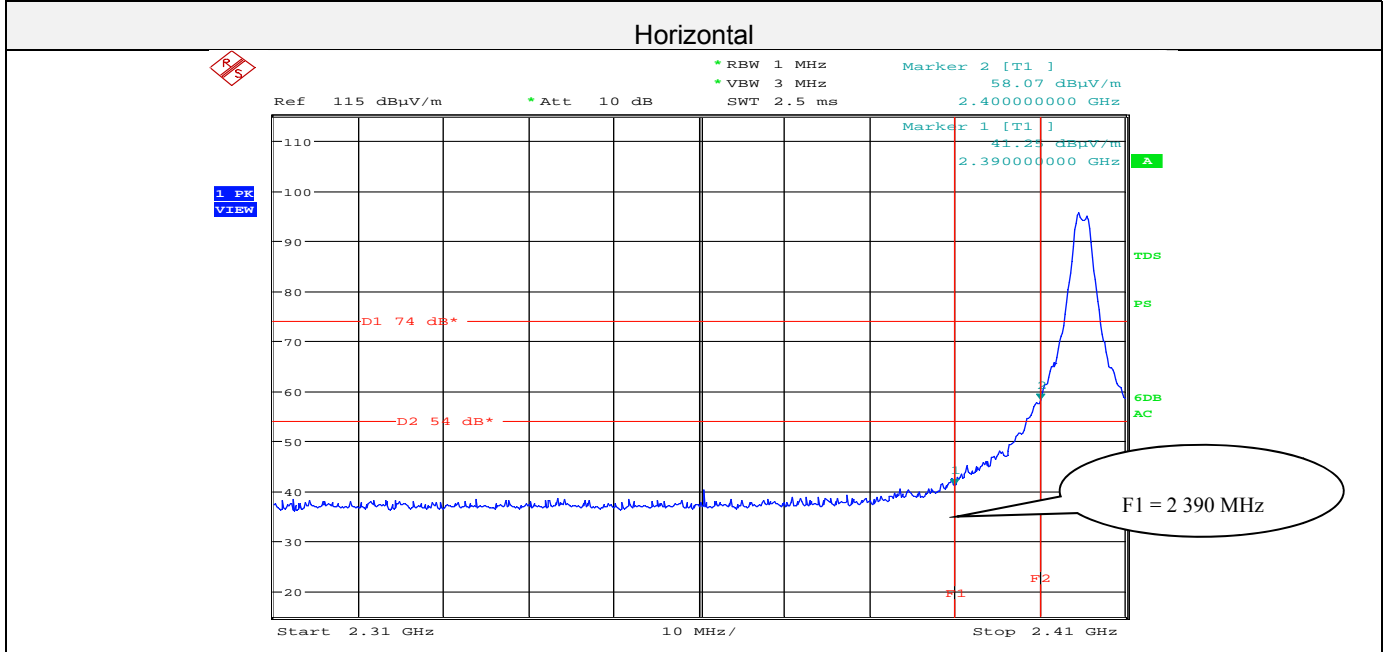
Quasi-peak measurements are omitted because the peak data meets the limit.

### 5.6.6.3 Test Data above 1 GHz

Detector Mode	Resolution BW	Video BW	Sweep Time	Measurement distance
PEAK	1 MHz	3 MHz	Auto	3 m
RMS	1 MHz	3 MHz	Auto	3 m

### 5.6.6.3.1 Test Data for Band edge (Restricted band)

#### Graphical Test Data – Low Channel (Peak)



#### Tabulated Test Data – Low Channel

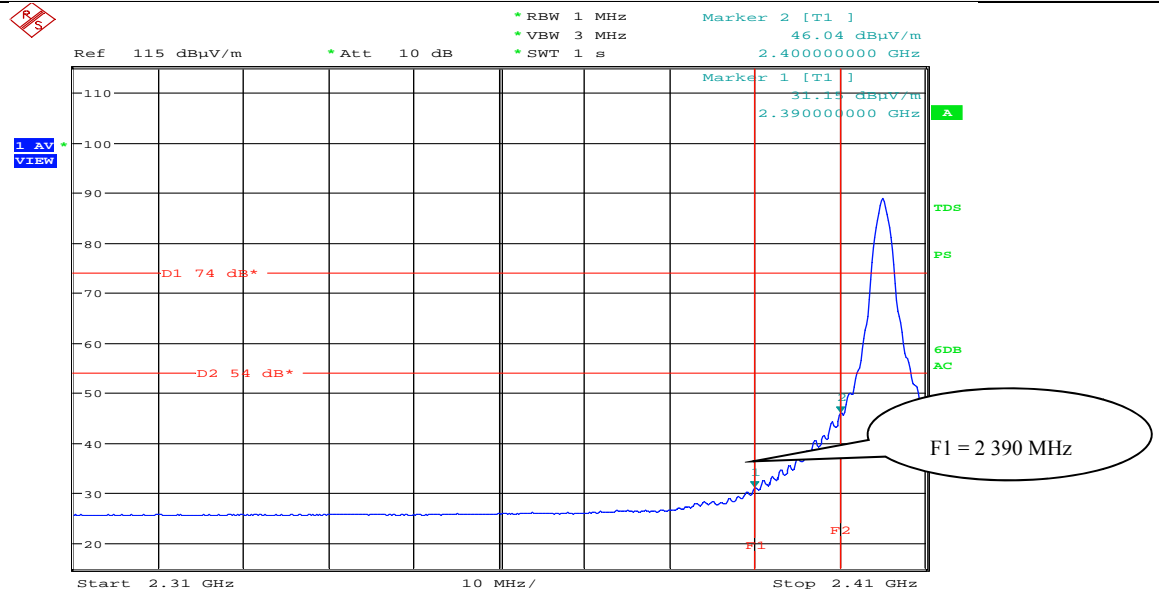
Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390	Peak	H	41.25	-	41.25	74.00	32.75	280	333
2 390	Peak	V	49.66	-	49.66	74.00	24.34	220	168

**NOTE:** "H" means Horizontal polarity, "V" means Vertical polarity.

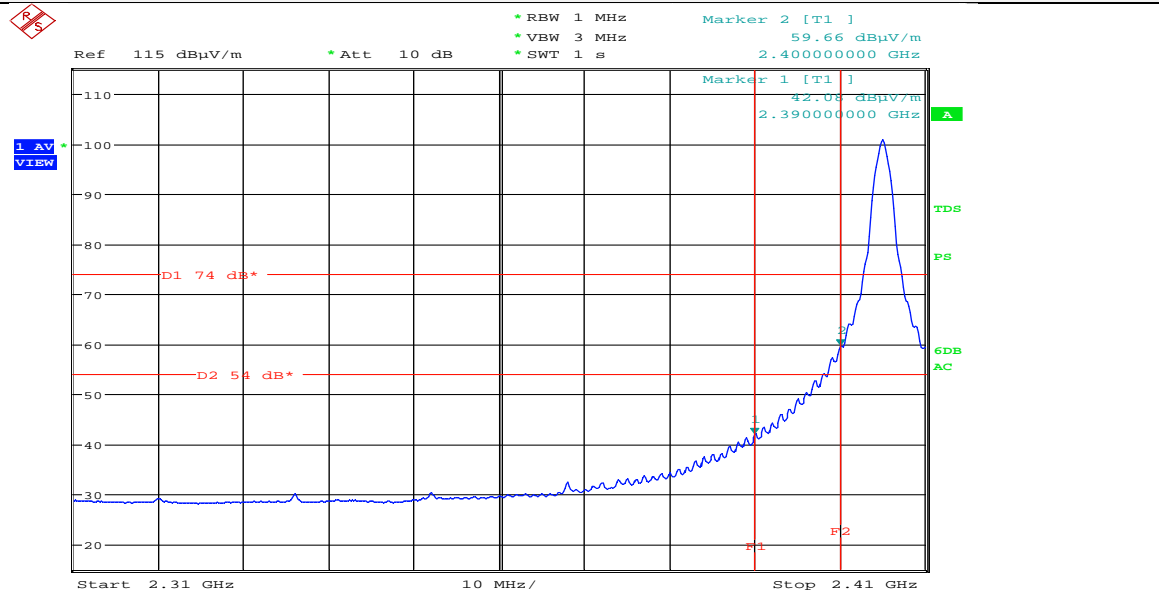


### Graphical Test Data – Low Channel (Average)

#### Horizontal



#### Vertical



### Tabulated Test Data – Low Channel

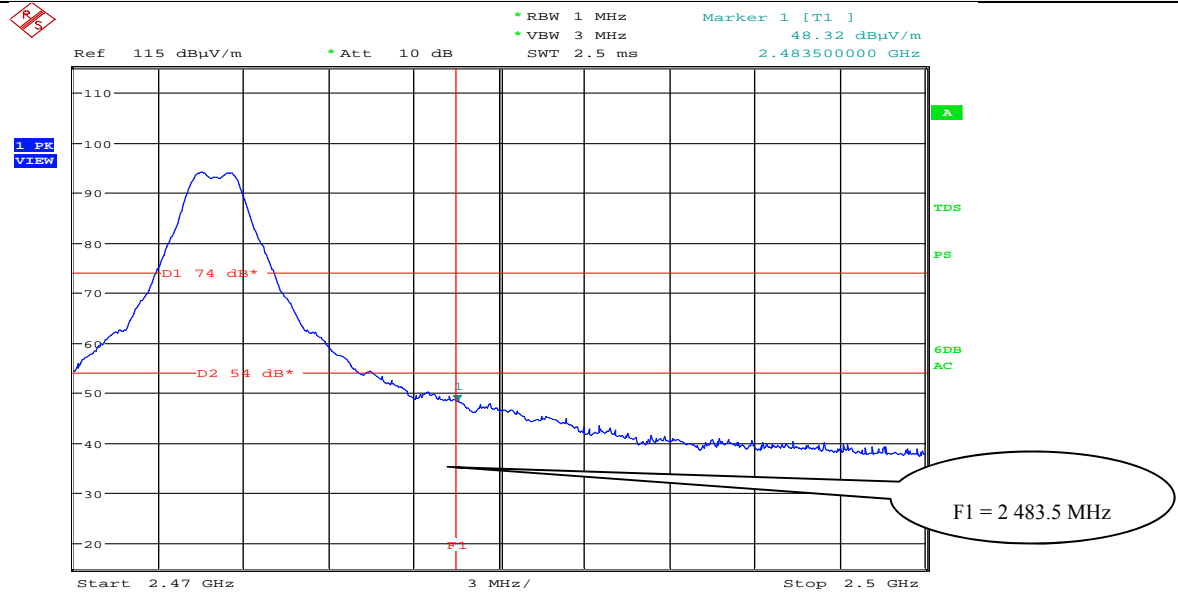
Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390	Average	H	31.15	-	31.15	54.00	22.85	280	333
2 390	Average	V	42.08	-	42.08	54.00	11.92	220	168

**NOTE:** "H" means Horizontal polarity, "V" means Vertical polarity.

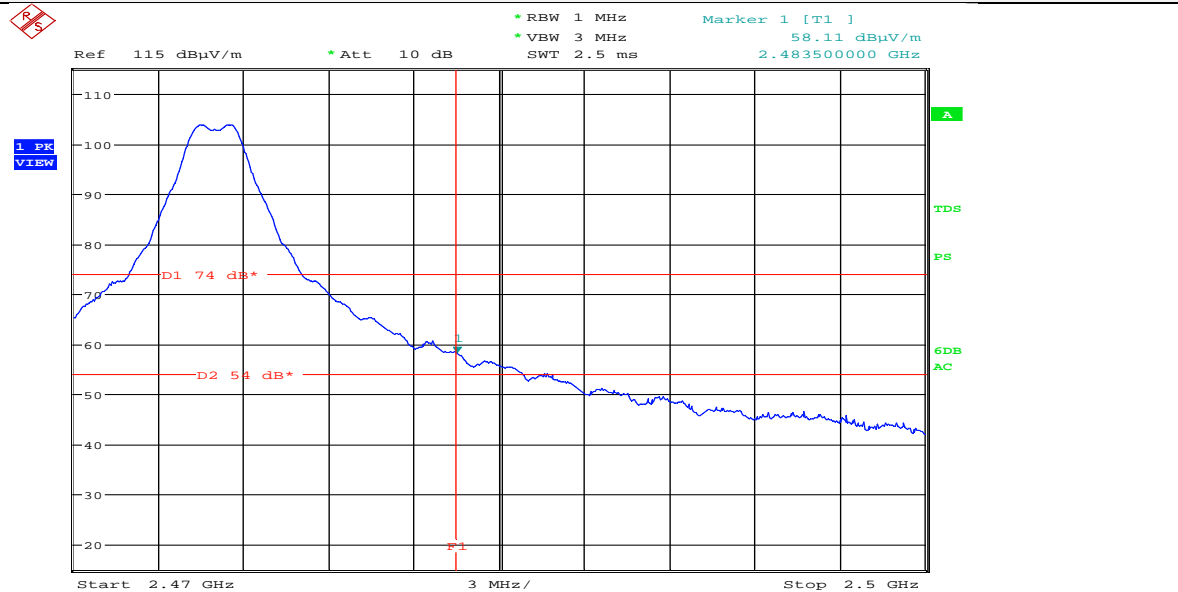
Result = Receiver Reading + Duty Factor

### Graphical Test Data – High Channel (Peak)

#### Horizontal



#### Vertical



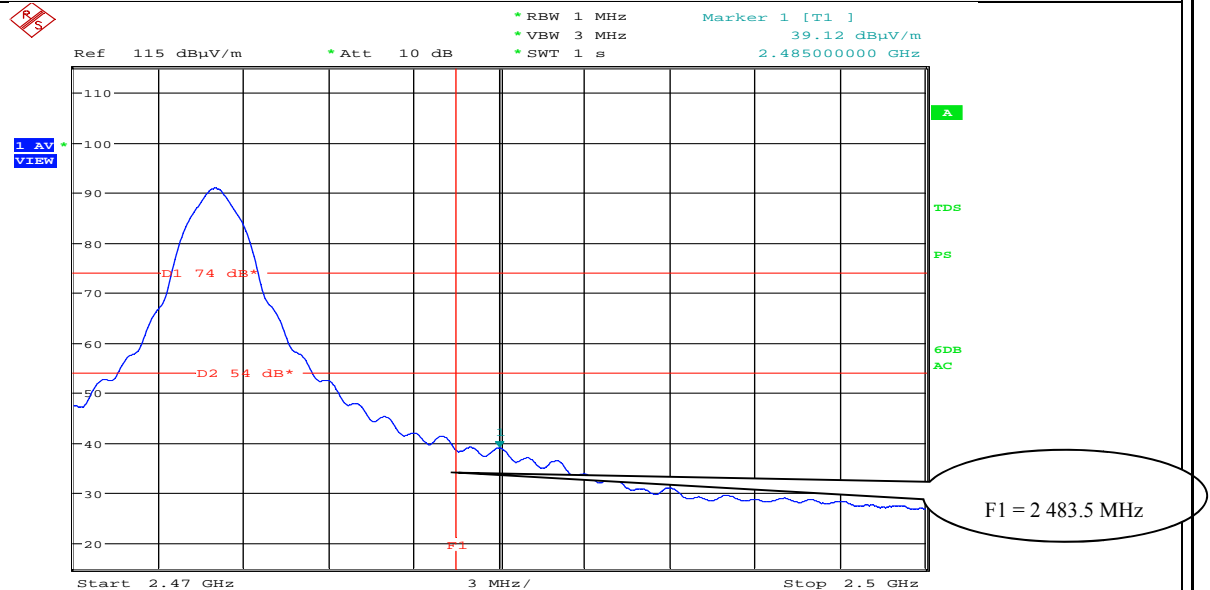
### Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	48.32	-	48.32	74.00	25.68	285	294
2 483.5	Peak	V	58.11	-	58.11	74.00	15.89	285	303

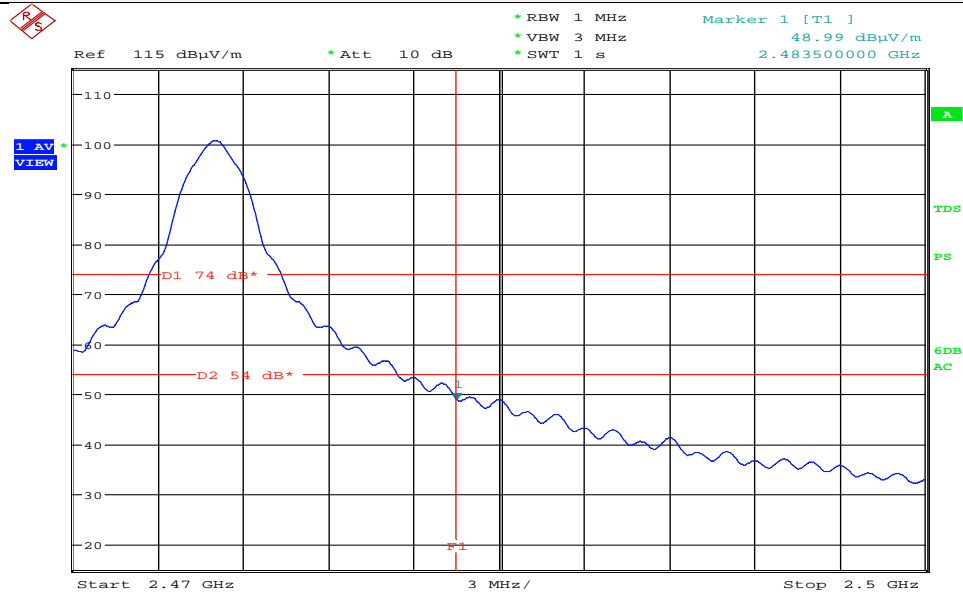
**NOTE:** "H" means Horizontal polarity, "V" means Vertical polarity.

### Graphical Test Data – High Channel (Average)

#### Horizontal



#### Vertical



### Tabulated Test Data – High Channel

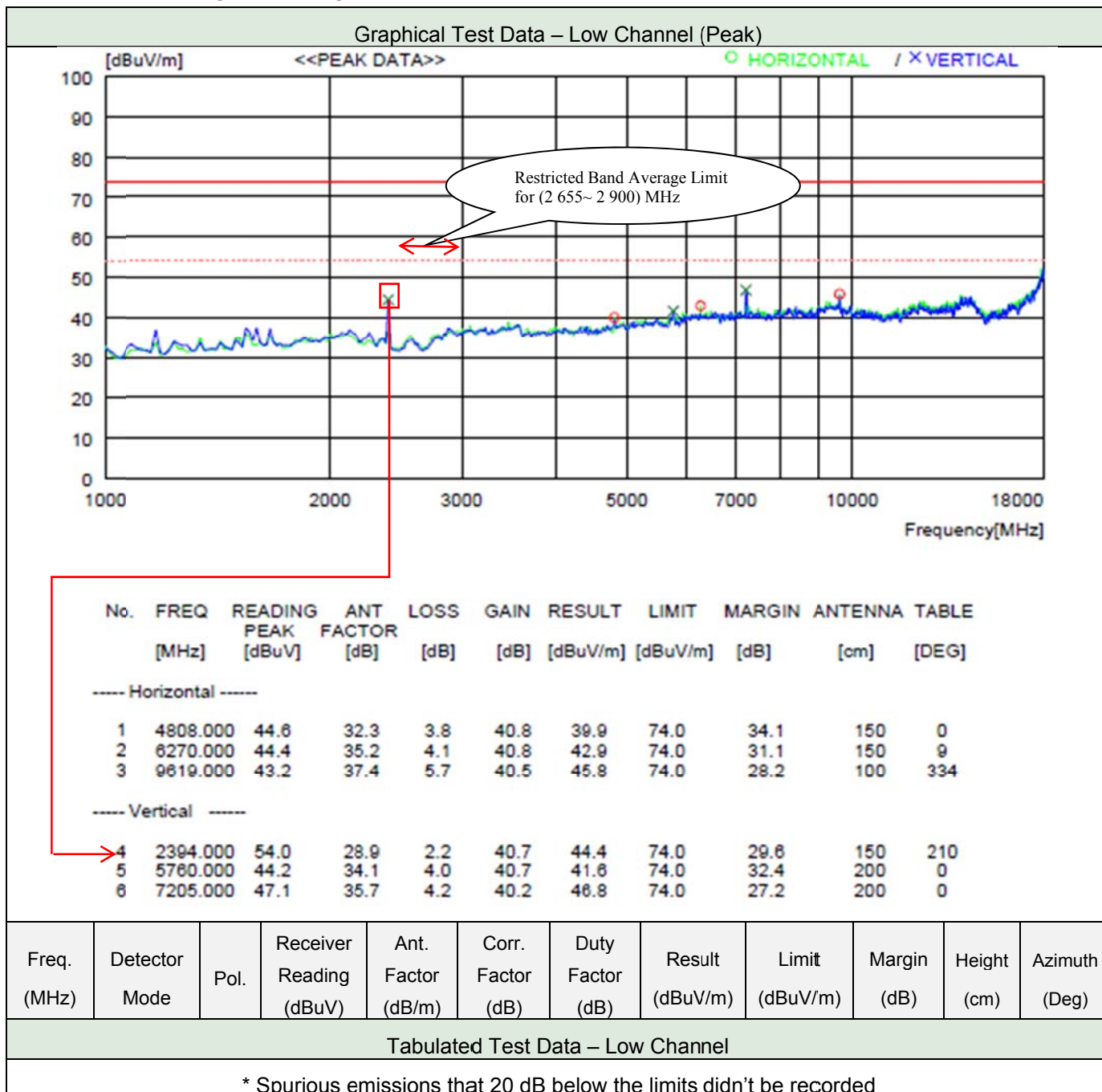
Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Average	H	39.12	-	39.12	54.00	14.88	285	294
2 483.5	Average	V	48.99	-	48.99	54.00	5.01	285	303

**NOTE:** "H" means Horizontal polarity, "V" means Vertical polarity.

Result = Receiver Reading + Duty Factor

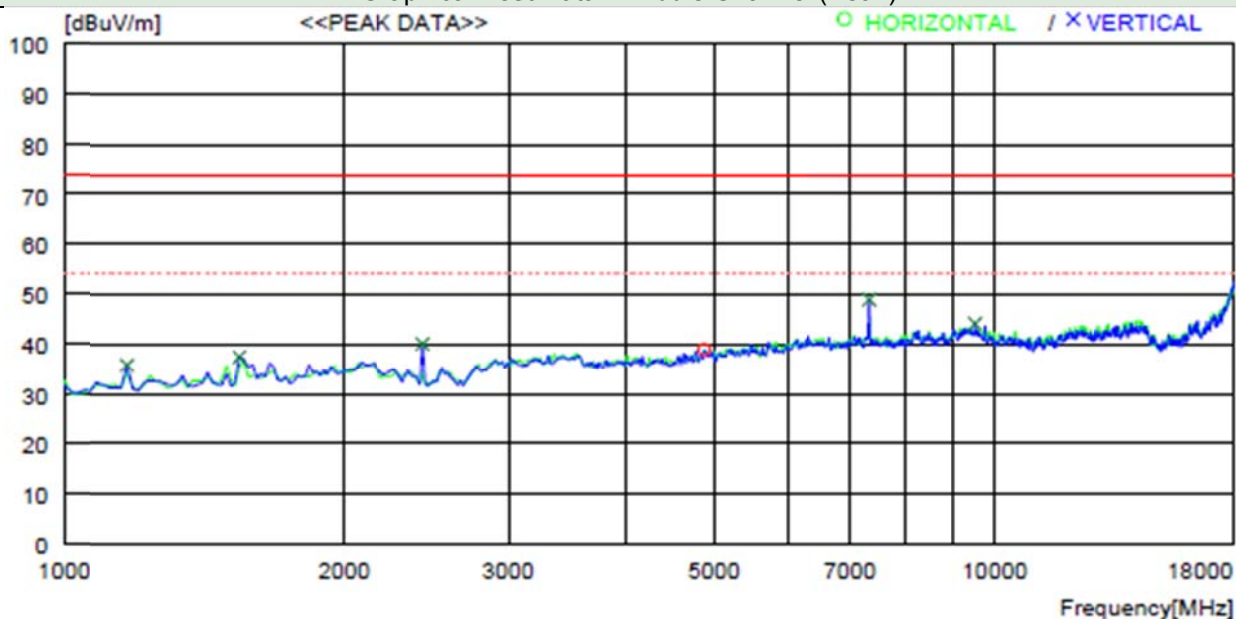
### 5.6.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)

#### 5.6.6.4.1 Operating mode: ZigBee



Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Graphical Test Data – Middle Channel (Peak)



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	4876.000	43.2	32.5	3.9	40.7	38.9	74.0	35.1	100	181
---- Vertical ----										
2	1170.000	49.5	24.6	2.0	40.4	35.7	74.0	38.3	200	0
3	1544.000	49.7	28.0	2.4	40.7	37.4	74.0	36.6	200	319
4	2428.000	49.5	29.0	2.2	40.7	40.0	74.0	34	200	343
5	7324.000	49.2	35.8	4.2	40.2	49.0	74.0	25	200	27
6	9517.000	41.2	37.5	5.7	40.3	44.1	74.0	29.9	200	0

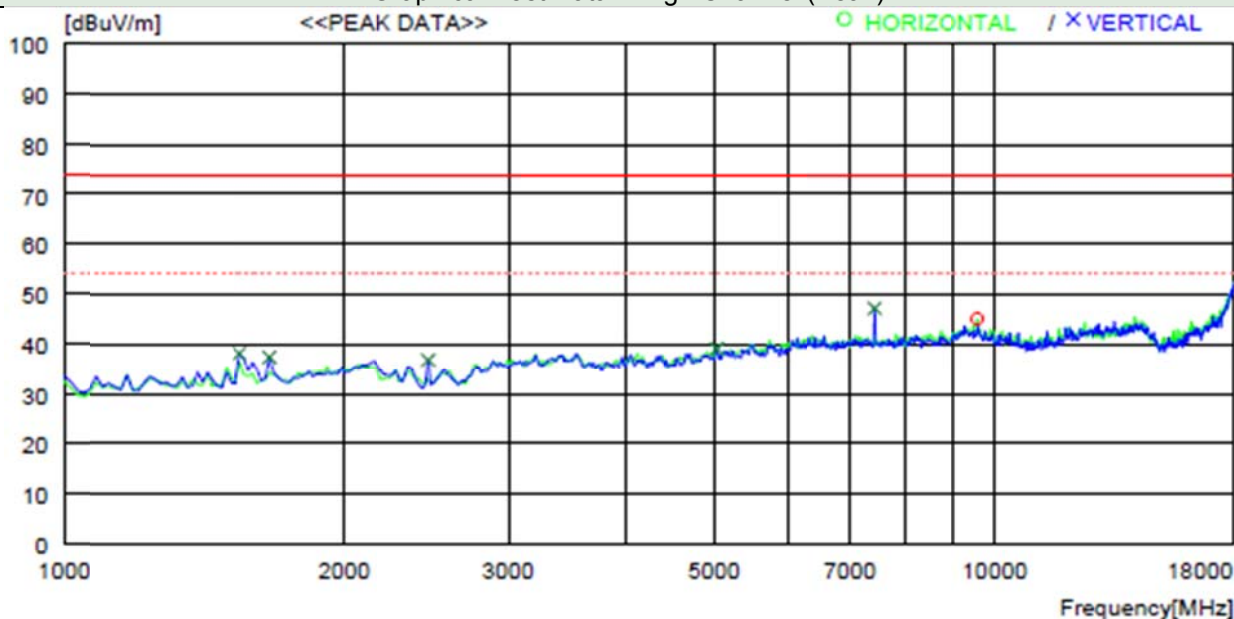
Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Tabulated Test Data – Middle Channel

\* Spurious emissions that 20 dB below the limits didn't be recorded

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
---- Horizontal ----										
1	9568.000	42.3	37.5	5.7	40.4	45.1	74.0	28.9	200	351
---- Vertical ----										
2	1544.000	50.4	28.0	2.4	40.7	38.1	74.0	35.9	200	0
3	1663.000	48.9	28.5	2.6	40.6	37.4	74.0	36.6	200	136
4	2462.000	46.2	29.1	2.2	40.7	36.8	74.0	37.2	200	0
5	5029.000	43.2	32.8	3.8	40.7	39.1	74.0	34.9	200	0
6	7426.000	47.4	35.9	4.2	40.3	47.2	74.0	26.8	150	138

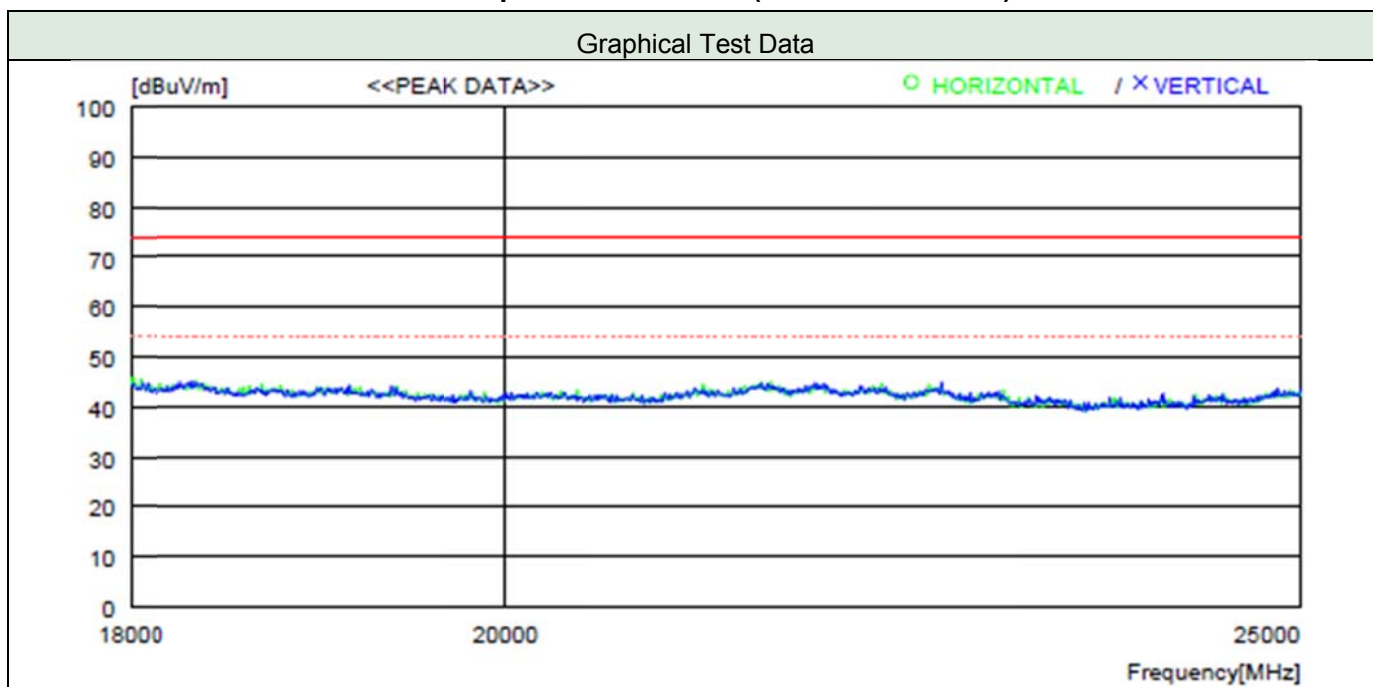
Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Tabulated Test Data – High Channel

\* Spurious emissions that 20 dB below the limits didn't be recorded

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

### 5.6.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)



Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
Low / Middle / High Channel											
* Spurious emissions that 20 dB below the limits didn't be recorded											

**NOTE:** Peak results are met average limit, so average measurement was not performed.

Emission was scanned up to 25 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

## 5.7 AC Power Line Conducted Emission

### 5.7.1 Limit

Acc. to section 15.207 (a), following table shall be applied.

Frequency Range (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 -30	60	50

### 5.7.2 Method of Measurement

The EUT was placed on a wooden table, 0.8 m height above the horizontal ground plane and 40 cm from the vertical ground plane. 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.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

The test was performed for both Neutral and Hot lines.

### 5.7.3 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 150 kHz	$\pm$ 2.00 dB	150 kHz ~ 30 MHz	$\pm$ 2.00 dB

### 5.7.4 Sample Calculated Example

At 5.31 MHz

QP Limit = 60.0 dBuV

Correction Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dB

Q.P Reading from the Test receiver = 20.8 dBuV


(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

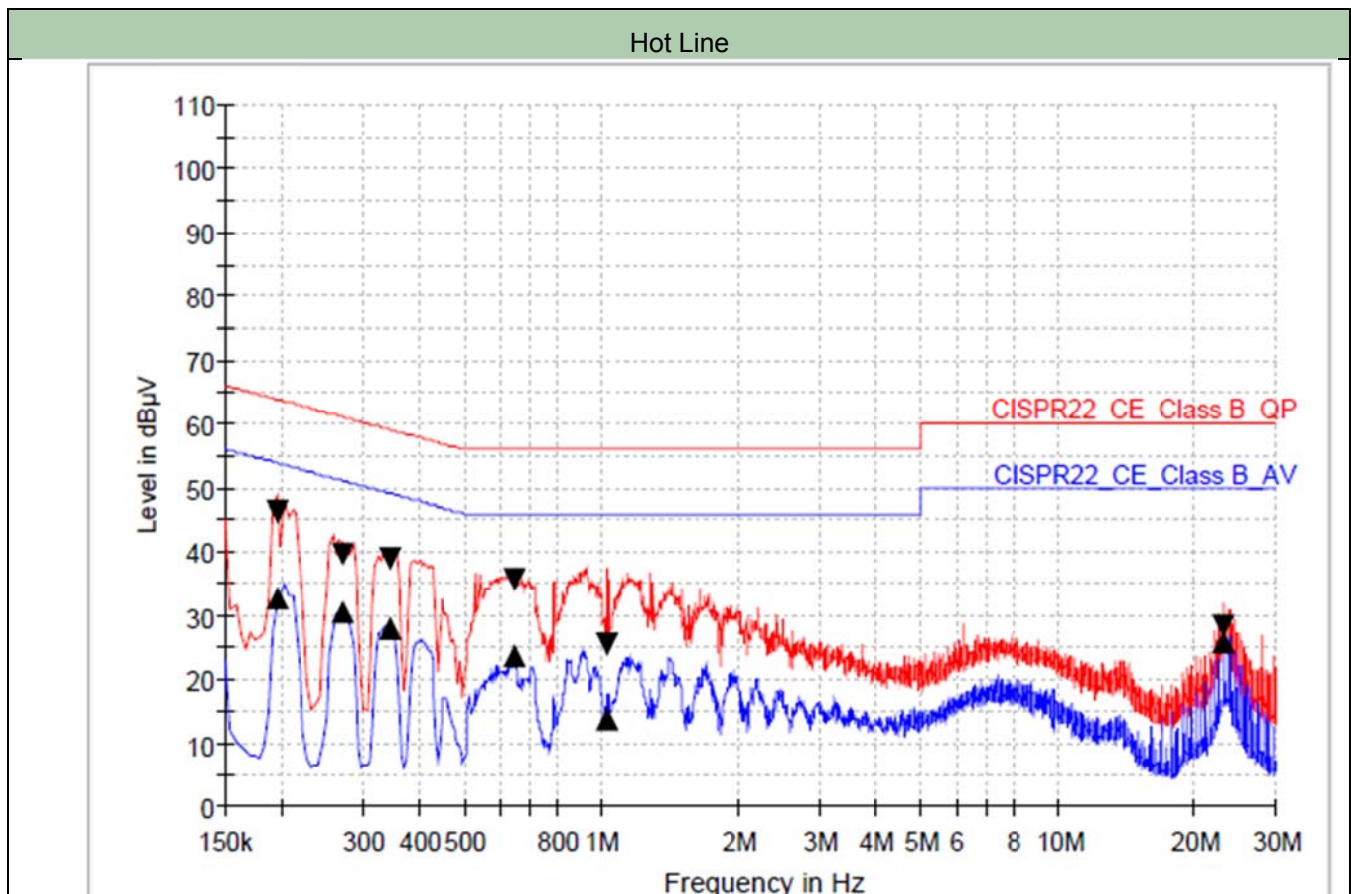
Therefore Q.P Margin = 60 - 20.8 = 39.2

so the EUT has 39.2 dB margin at 5.31 MHz



### 5.7.5 Worst Case Test Data

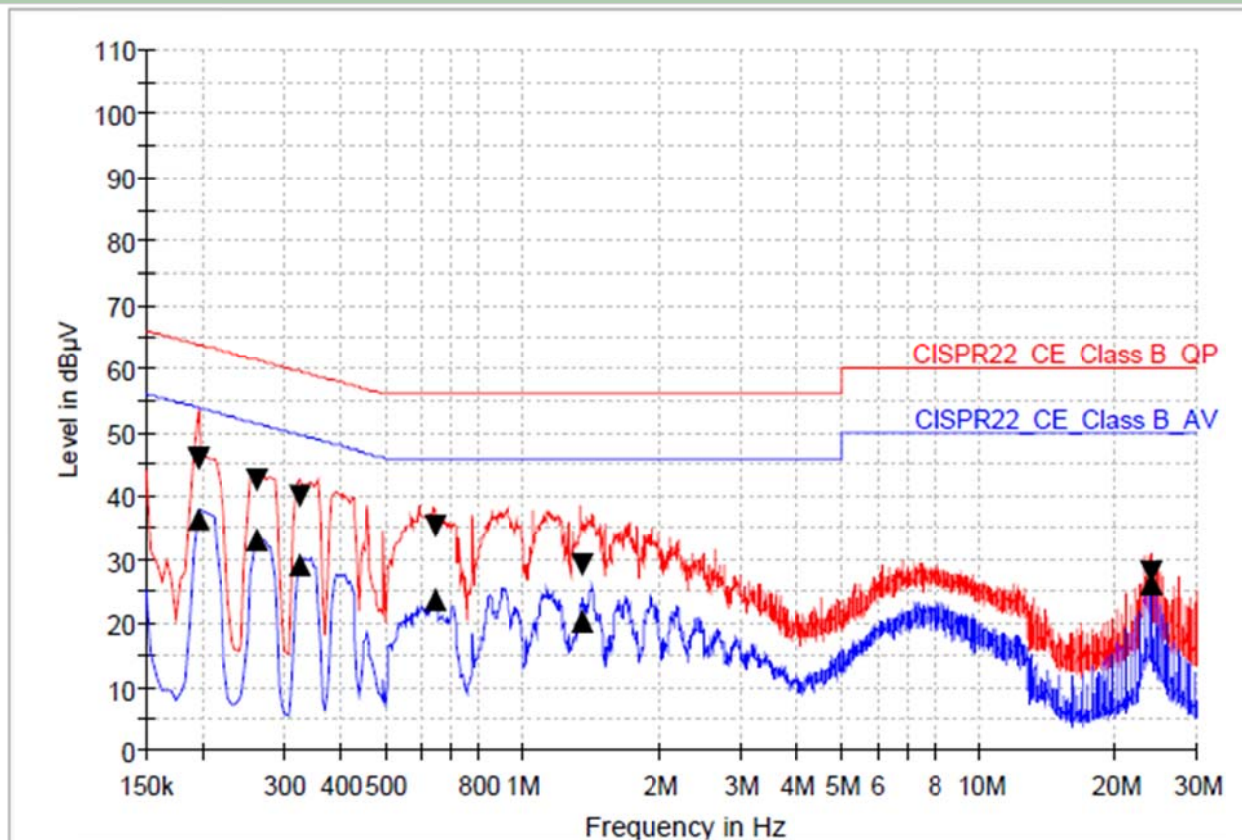
Date of Test	2018-10-01	Temperature	(23 ± 1.0) °C
		Relative humidity	(48 ± 2) % R.H.
<b>Measurement Frequency Range</b>		9 kHz ~ 30MHz	
<b>Test Result</b>	<b>PASS</b>	Tested By	In-yong Song 



### Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.4	32.6	9.000	L1	9.6	17.4	63.9	21.2	53.9
0.270000	39.8	30.6	9.000	L1	9.6	21.3	61.1	20.6	51.1
0.346000	38.9	28.0	9.000	L1	9.6	20.1	59.1	21.1	49.1
0.642000	35.9	23.8	9.000	L1	9.7	20.1	56.0	22.2	46.0
1.034000	25.4	13.7	9.000	L1	9.7	30.6	56.0	32.3	46.0
23.026000	28.4	25.7	9.000	L1	10.1	31.6	60.0	24.3	50.0

Neutral Line



### Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.194000	46.1	36.3	9.000	N	9.6	17.8	63.9	17.5	53.9
0.262000	42.5	33.1	9.000	N	9.6	18.9	61.4	18.3	51.4
0.326000	40.2	29.2	9.000	N	9.6	19.3	59.6	20.4	49.6
0.642000	35.5	23.6	9.000	N	9.7	20.5	56.0	22.4	46.0
1.350000	29.0	20.5	9.000	N	9.7	27.0	56.0	25.5	46.0
23.958000	28.2	26.1	9.000	N	10.1	31.8	60.0	23.9	50.0

## Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal Date
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2019-04-26
Attenuator	56-10	58769	WEINSCHTEL	2019-01-22
Test Receiver	ESU 26	100303	Rohde & Schwarz	2019-01-18
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2019-04-21
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2019-09-14
Horn Antenna	HF 907	102426	Rohde & Schwarz	2018-11-25
Horn Antenna	BBHA 9170	BBHA 9170 #783	Schwarzbeck	2018-11-28
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2019-01-18
Pre-Amplifier	310N	344015	Sonoma Instrument	2019-01-18
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2019-04-24
Pre-Amplifier	CBL18265035	28706	CERNEX	2019-03-29
Band Reject Filter	BRM50702	G318	MICRO-TRONICS	2018-11-08
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/34130814/L	INNCO SYSTEM	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/34130814/L	INNCO SYSTEM	N/A
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2019-02-12
LISN	ENV216	100110	Rohde & Schwarz	2019-07-27

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.