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

For the

Product	**: Bluetooth Low Energy Module**
Model	**: RMBLE-M5**
FCC ID	**: 2AISERMBLEM5**
IC	**: 21613-RMBLEM5**
Applicant	**: Honeywell Analytics Asia Pacific Co., Ltd.**
FCC Rule	**: CFR 47 Part 15 Subpart C**
IC Rule	**: IC 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-W1803-014**

Signature

Choi , Yeong-min / Technical Manager

Date: 2018-03-29

Test Laboratory: ENG Co., Ltd.

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FCC/IC CERTIFICATION TEST REPORT

Project Number	**: EA1802C-065**
Test Report Number	**: TR-W1803-014**
Type of Equipment	**: Bluetooth Low Energy Module**
Model Name	**: RMBLE-M5**
FCC ID	**: 2AISERMBLEM5**
ISED Cert. Number	**: 21613-RMBLEM5**
Multiple Model Name	**: N/A**
Applicant	**: Honeywell Analytics Asia Pacific Co., Ltd.**
Address	**: 7F SangAm IT Tower, 434 Worldcup Buk-ro, Mapo-gu, Seoul 03922, South Korea**
Manufacturer	**: Honeywell Analytics Asia Pacific Co., Ltd.**
Address	**: 7F SangAm IT Tower, 434 Worldcup Buk-ro, Mapo-gu, Seoul 03922, South Korea**
Regulation	**: FCC Part 15 Subpart C Section 15.247, IC RSS-247 Issue 2**
Total page of Report	**: 32 Pages**
Date of Receipt	**: 2018-02-19**
Date of Issue	**: 2018-03-29**
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) 2018-03-29 (Date)

Reviewed by Choi, Yeong-min / Technical Manager _____ (Signature) 2018-03-29 (Date)

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1803-014	2018-03-29	Initial Release

ENG Co., Ltd. 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 12813 Report Form_01 (Rev.0)
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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	IC Reference Section	Description	P	F	N.T.	Note
15.247(a)(2)	RSS-247 5.2(1)	6 dB Bandwidth Occupied Bandwidth			N.T.	Note1
15.247(b)(3)	RSS-247 5.4(4)	Maximum peak output power	P			
15.247(e)	RSS-247 5.2(2)	Power spectral density			N.T.	Note1
15.247(d)	RSS-247 5.5	Band Edge Conducted spurious emission			N.T.	Note1
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						

Note1. Test was performed by modular transmitter (FCC ID: 2AISERMBLEM5, ISED Certification Number: IC: 21613-RMBLEM5, Test Report no. 16-11355707-FCC1 issued on November.02, 2016 by UL Korea Ltd.), so the test was not performed.

Note2: In case of Bluetooth LE (2.4 GHz), the tests are not significantly different between two versions of RSS-247. RSS-247 Issue1 covers Issue2 and limits are same. It is judged that the EUT complies with RSS-247 issue2 without the additional test.

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 v04: Measurement Procedure PK is used for power.

1.3 Additions, deviations, exclusions from standards

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

1.4 Purpose of the test

The EUT, HOST Model: BW Ultra(4 gas + VOC), BW Ultra(4 gas + ECC), BW Ultra(4 gas + IR), 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 ISED, Canada, accredited as a Conformity Assessment Body (CAB) by the FCC, designated by the RRA (Radio Research Agency), 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 EUT is a portable gas detector shall have a certified Bluetooth Low Energy Module, Model: RMBLE-M5., The product specification described herein was obtained from product data sheet or user's manual.

Certified BLE Module	FCC ID: 2AISERMBLEM5 ISED Canada ID: IC: 21613-RMBLEM5 Model Name: RMBLE-M5
Application Purpose	FCC C2PC (Add Host to the LMA)
Equipment Type	Radio and ancillary equipment for portable or handheld use, Stand alone / Self contained single unit
Operating Frequency	2 402 MHz to 2 480 MHz
Max. RF Output Power	Max. -14.0 dBm
Modulation Type(s)	GFSK
Number of Channels	40 Channels
Channel Bandwidth	2 MHz
Generated or Used Freq. in EUT	37.768 kHz, 38.4 MHz
Type of Antenna	■ Integrated Type (PCB Pattern antenna) □ Dedicated Type
Antenna Gain	Max. : -1.50 dBi
Operating Temperature	-40 ℃ ~ 60 ℃
Electrical Rating	DC 3.7 V, AC 120 V (60 Hz)

2.2 Description of host model name (Portable Gas Detector)

HOST Model name		Description of designation
Basic Model	BW Ultra(4 gas + VOC)	VOC PID Sensor Type (Photo Ionization Detector)
Additional Model	BW Ultra(4 gas + ECC)	SO2 Gas Sensor Type (Electrochemical Sensor)
	BW Ultra(4 gas + IR)	CO2 IR Gas Sensor Type (Infrared Sensor)

The basic model was tested acc. to clause 1.1 in this test report and additional models were tested radiated spurious emission only.

BW Ultra can accommodate maximum 5 gas sensors. The 1st, 2nd, 3rd and 4th gas sensors are fixed but 5th gas sensor is various. In 5th gas sensor, BW Ultra can have 1) Electrochemical type sensor, 2) Infrared type sensor or 3) photo ionization detector (PID) sensor. BW Ultra was tested for SO2 sensor (Electrochemical sensor), CO2 IR sensor (infrared sensor) and VOC PID sensor.

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.	Manufacturer.	Comments
Bluetooth Low Energy Module	RMBLE-M5	RAE Systems by Honeywell	-
Portable Gas Detector (EUT)	BW Ultra(4 gas + VOC)	Honeywell Analytics Asia Pacific Co., Ltd..	-
Portable Gas Detector (EUT)	BW Ultra(4 gas + ECC)	Honeywell Analytics Asia Pacific Co., Ltd..	-
Portable Gas Detector (EUT)	BW Ultra(4 gas + IR)	Honeywell Analytics Asia Pacific Co., Ltd..	-
AC ADAPTER (AE)	ADS-6AE-06	Shenzhen Honor Electronic Co., Ltd.	-
Notebook PC (AE)	Latitude E5470	Dell Inc.	-

Note1. EUT=Equipment Under Test, AE=Auxiliary/Associated Equipment

3.2 Mode of operation during the test

Signal from the RF module was generated continuously for the representative channels (Low, Mid, High) by the test program incorporated For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission was performed with the EUT set to transmit at the channel with the highest output power as worst case scenario. The voltage test mode recorded battery mode(DC 3.7 V) data only because battery mode(DC 3.7 V) data is worst case than AC mode(AC120 V) data.

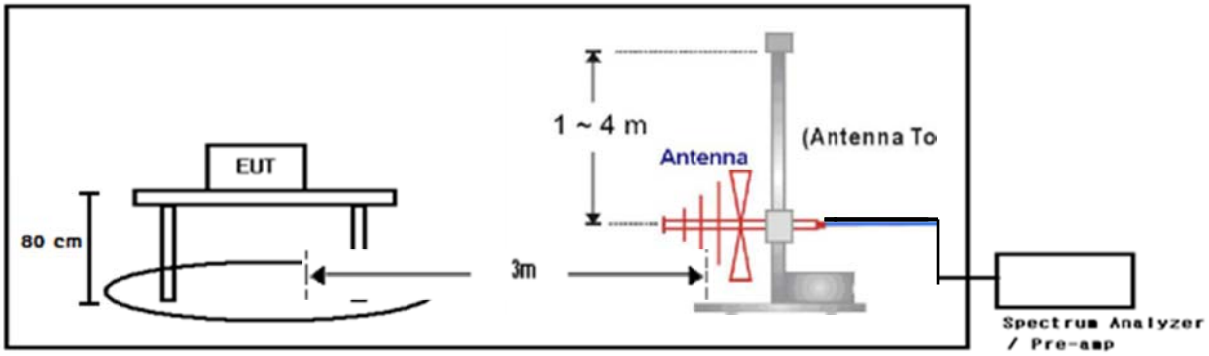
Based on preliminary testing following operating modes were selected for the final test as listed below.

3.2.1 Radiated Emission Test Mode

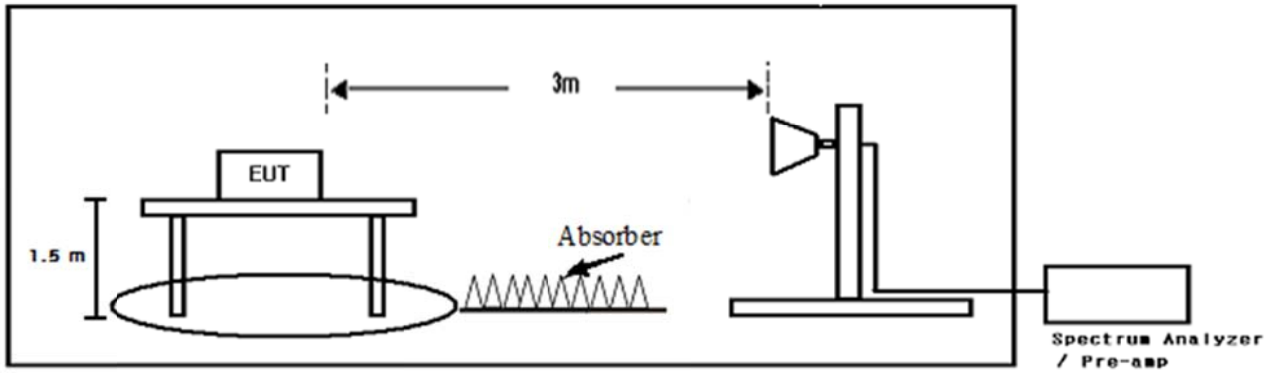
Operating Mode	Channel	Frequency (MHz)	Output Power (dBm)
BLE	Low	2402	-17.93
	Middle	2440	-18.09
	High	2480	-19.93

3.3 Test Setup Drawing

(Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



3.4 EUT Modifications

- None.

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)	Max Peak Gain (dBi)
2.402 – 2.480	-1.50

Note. The used antenna is same with original certified equipment, so the EUT met the requirement.

5. TEST RESULT

5.1 Maximum Peak Output Power

5.1.1 Limit

Acc. To section 15.247, 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.

5.1.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v04: 9.1.1 RBW ≥ DTS bandwidth.

Antenna-port conducted tests can't be performed on the EUT, so the tests were performed by radiated compliance measurements.

5.1.3 Test Data for Output Power

Date of Test	2018-03-12	Temperature	17.2 °C
		Relative humidity	36.8 % R.H.
Test Result	***PASS***	Tested by	Do-heon Kim

Channel	Frequency (MHz)	Measured Value (dBuV/m)	EIRP (dBm)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2 402	75.80	-19.43	-17.93	30	47.93
Middle	2 440	75.64	-19.59	-18.09		48.09
High	2 480	73.80	-21.43	-19.93		49.93

Note: The test result is derived by using radiated method.

The measurement distance (D) is 3m.

EIRP (dBm) = E (dBuV/m) + 20 log (D) – 104.77

Output Power (dBm) = EIRP – Antenna gain (-1.5 dBi)

5.2 Radiated Emission

5.2.1 Limit

Acc. To section 15.205 and 15.209, 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

5.2.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v04: 12.1 Radiated emission measurements.

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 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.

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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

Used Software for measurement is manufactured by TSJ.

5.2.3 Radiated 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.

5.2.4 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	± 3.2 dB	30 MHz ~ 1 GHz	± 3.8 dB
1 GHz ~ 18 GHz	± 4.9 dB	18 GHz ~ 40 GHz	± 5.1 dB

5.2.5 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

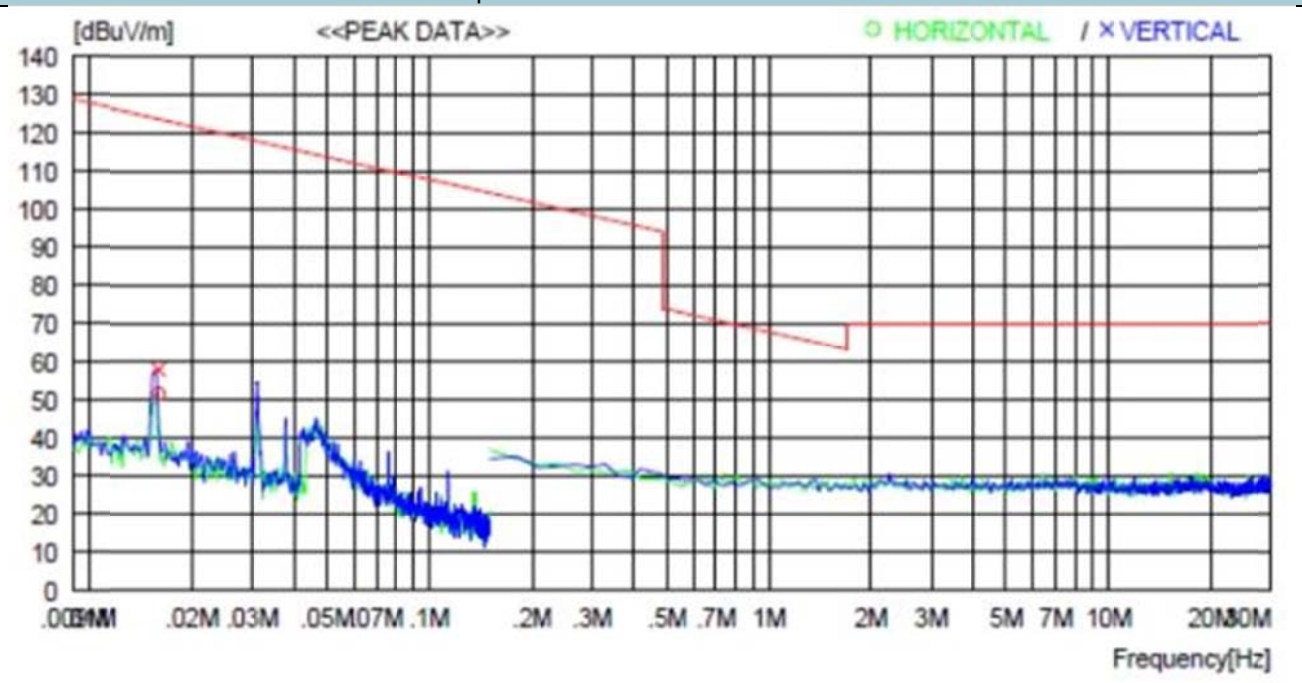
5.2.6 Test Data – HOST Model Name: BW Ultra(4 gas + VOC)

Date of Test	2018-03-12	Temperature	17.2 °C
		Relative humidity	36.8 % R.H.
Measurement Frequency Range		9 kHz ~ 26 GHz	
Test Result	***PASS***	Tested By	Do-heon Kim

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

5.2.6.1 Test Data below 30 MHz

Graphical Test Data – Below 30 MHz



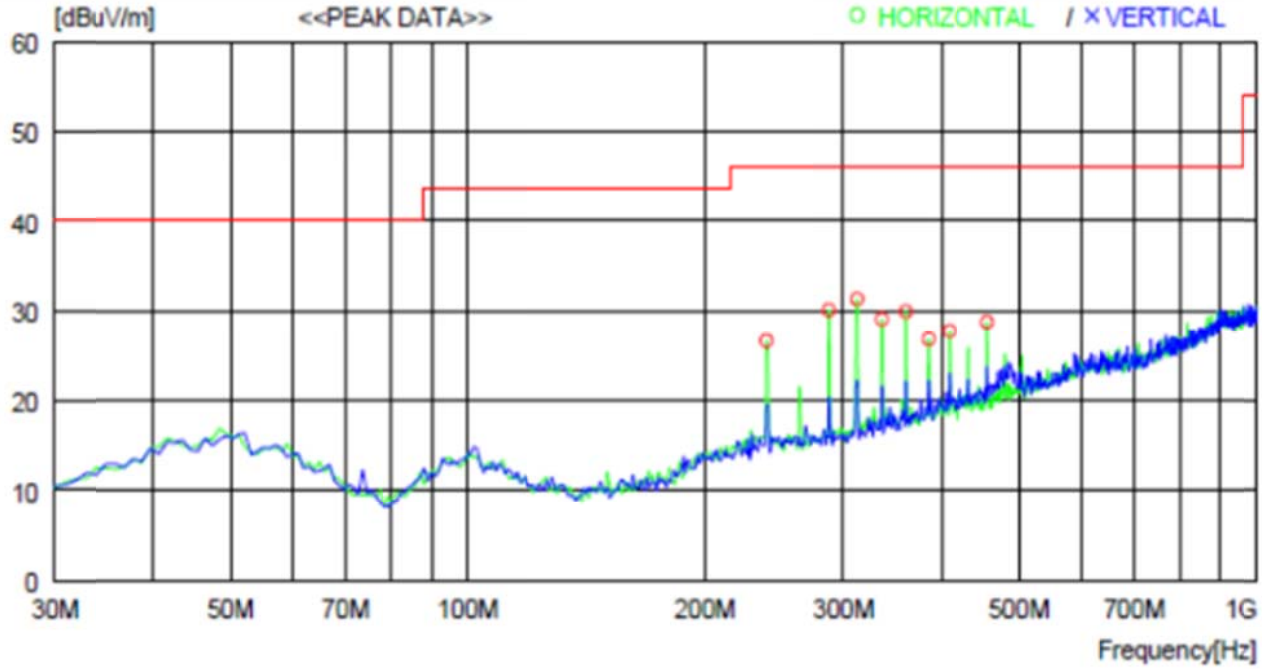
Tabulated Test Data – Low / Middle / High Channel

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										

Note: The test results below 30 MHz in our SAC (Semi Anechoic Chamber) was compared with other OATS (Open Area Test Site) and found the result was almost same with OATS.

5.2.6.2 Test Data from 30 MHz to 1 GHz

Graphical Test Data –Low Channel



Tabulated Test Data

Frequency (MHz)	Pol.	Detect Mode	Reading (dBµV/m)	Factor* (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
239.520	H	Peak	37.5	12.5	26.6	46.0	19.4
288.020	H	Peak	40.0	13.3	30.1	46.0	15.9
312.270	H	Peak	40.6	13.7	31.3	46.0	14.7
335.550	H	Peak	37.6	14.3	29.0	46.0	17.0
359.800	H	Peak	37.8	14.9	29.9	46.0	16.1
384.050	H	Peak	33.9	15.6	26.8	46.0	19.2
408.300	H	Peak	34.1	16.1	27.7	46.0	18.3
455.831	H	Peak	34.2	16.8	28.7	46.0	17.3

Note: “H” means Horizontal polarity, “V” means Vertical polarity.

GFSK lowest channel is worst case configuration.

The worst case is z-axis and reported.

Corr. Factor = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)

Level = Reading + Corr. Factor

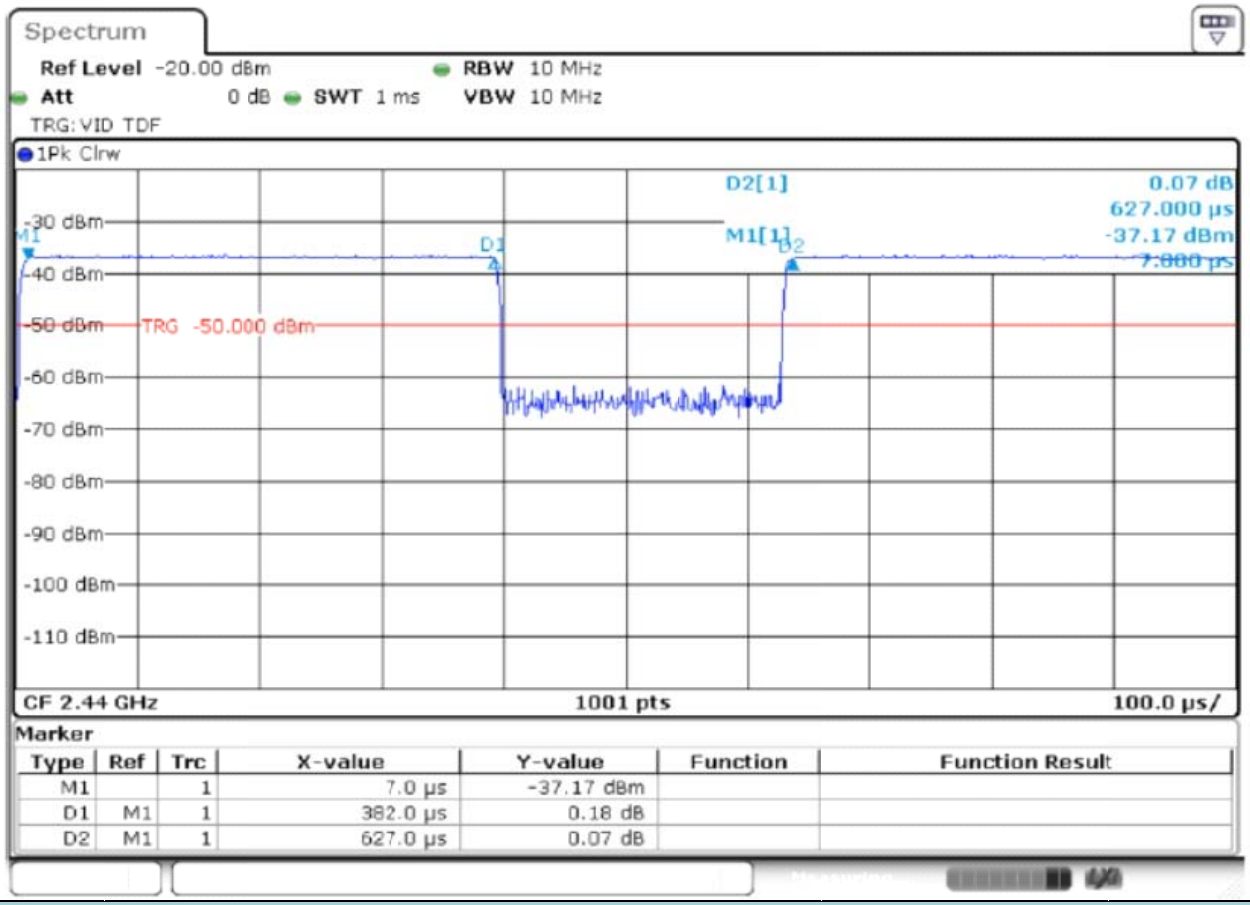
Margin = Limit (dBuV/m) - Level (dBuV/m)

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

5.2.6.3Test Data above 1 GHz

5.2.6.3.1 Duty Cycle

Graphical Test Data - Duty Cycle



Tabulated Test Data

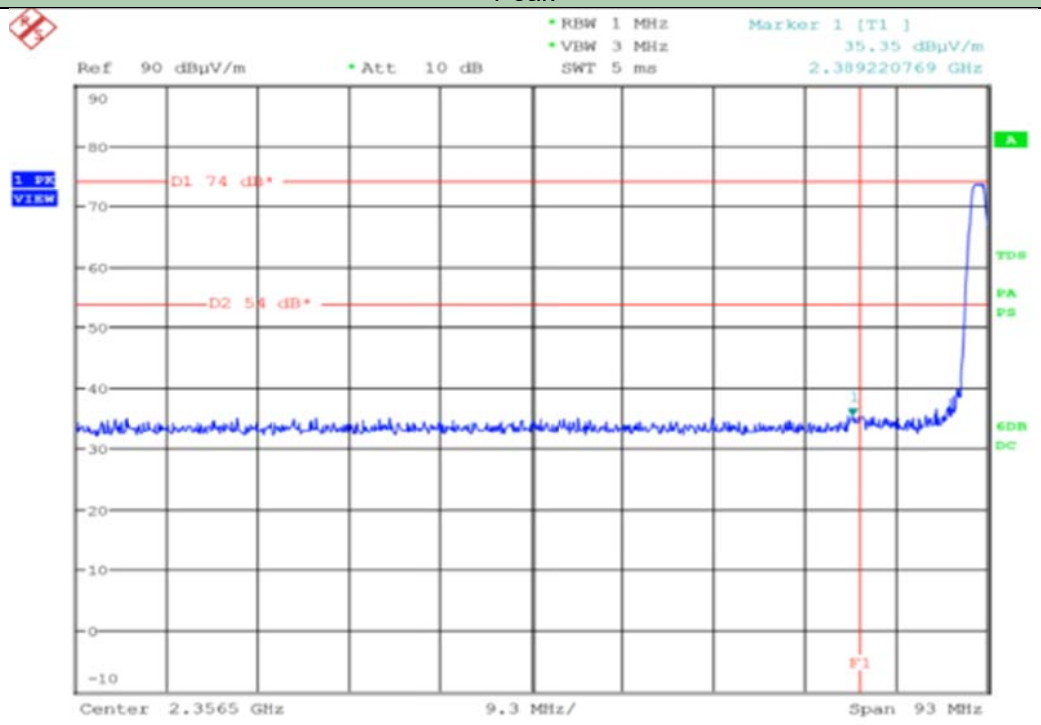
Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
BLE	0.382 00	0.627 00	56.85	2.5

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

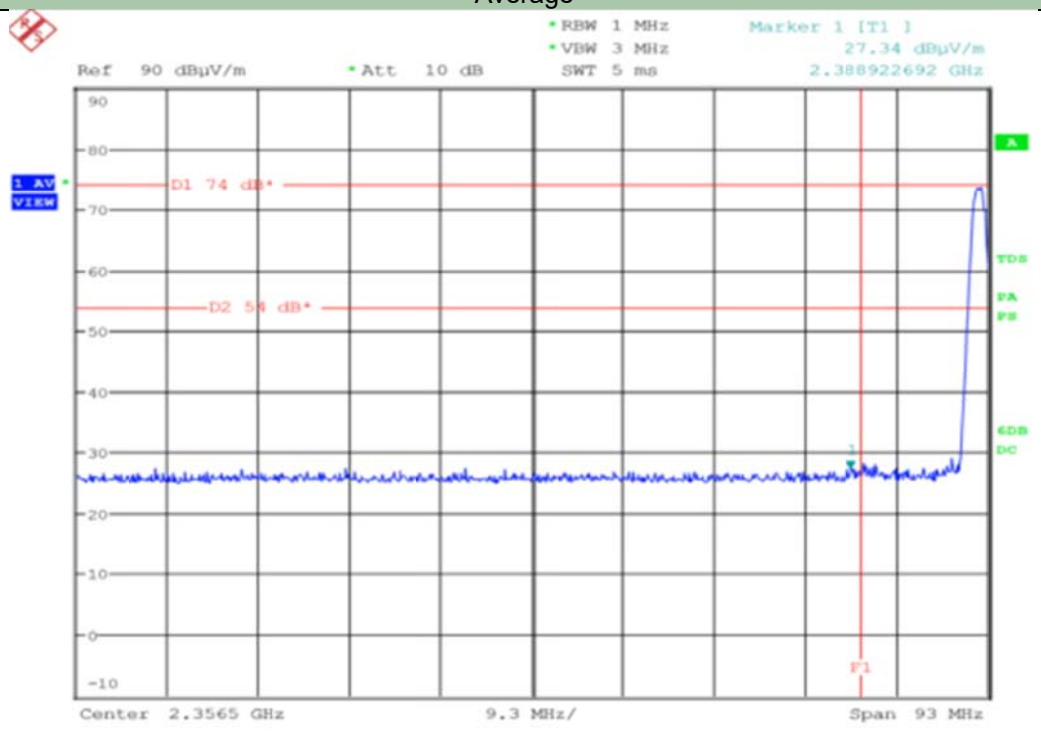
5.2.6.3.2 Test Data for Band edge (Restricted band)

Graphical Test Data – Low Channel

Peak

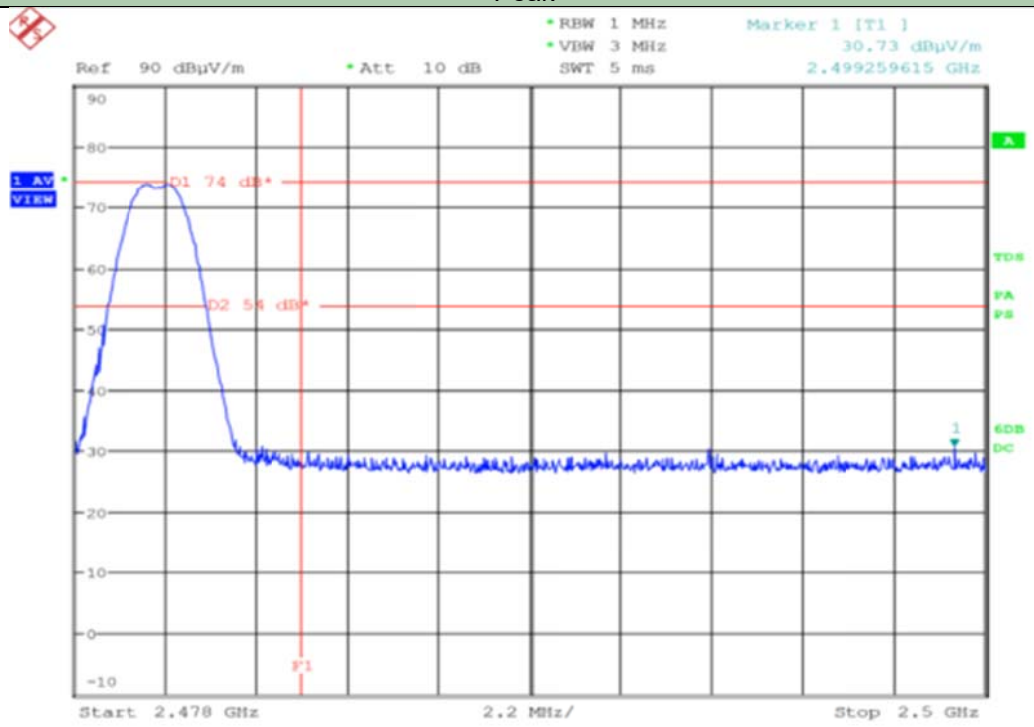


Average

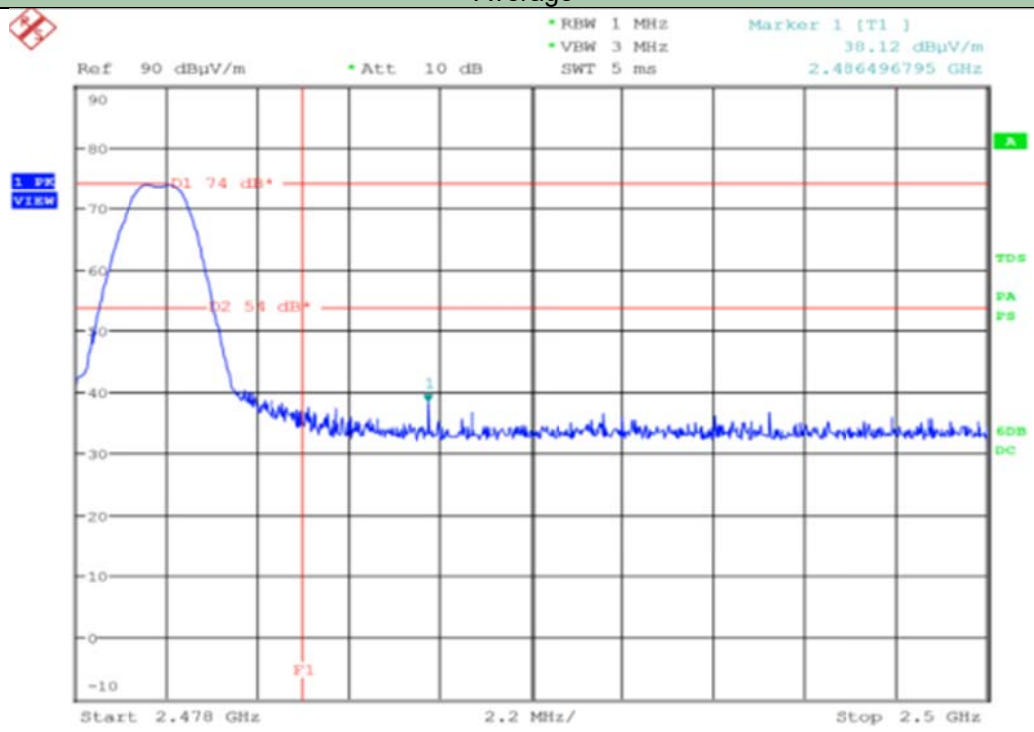


Graphical Test Data – High Channel

Peak



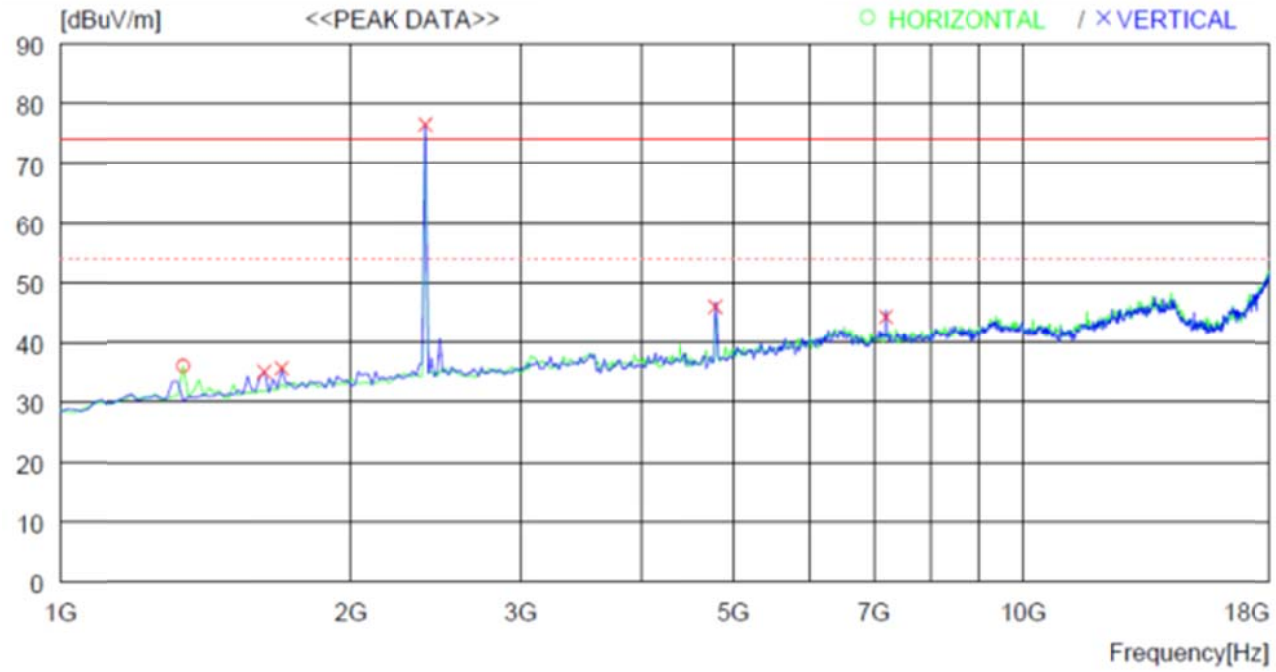
Average



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

5.2.6.3.3.1 Low Channel

Graphical Test Data



Tabulated Test Data – Low Channel

Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1340.000	H	Peak	49.8	25.3	36.0	74.0	38.0
1629.000	V	Peak	47.5	26.3	35.0	74.0	39.0
1697.000	V	Peak	47.7	26.6	35.6	74.0	38.4
4791.000	V	Peak	52.0	32.3	46.0	74.0	28.0
7205.000	V	Peak	46.2	35.7	44.3	74.0	29.7

Note. “H” means Horizontal polarity, “V” means Vertical polarity.

No other spurious and harmonic emissions were found greater than listed emissions on above table.

The worst case is z-axis and reported.

* Factor (Peak) = AF + CL + AG (AF: Antenna factor, CL: Cable loss, AG: Pre-Amp gain)

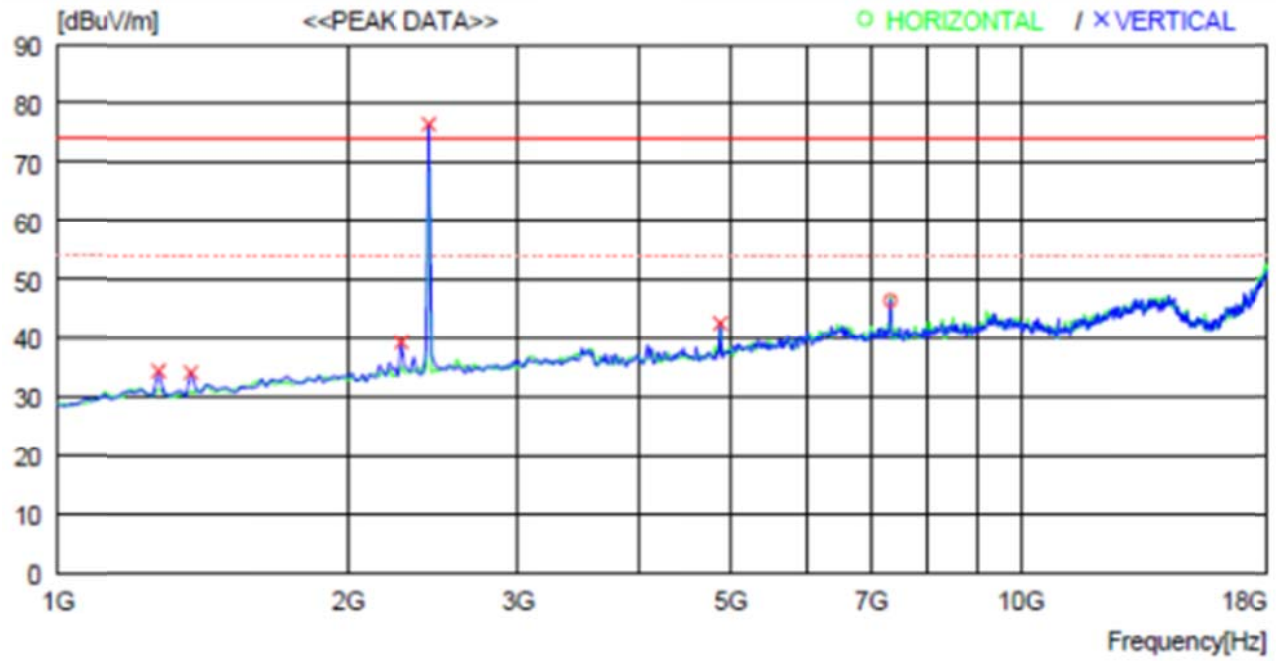
* Factor (Average) = AF + CL + AG + Duty factor

Level = Reading + Factor

Margin = Limit (dBuV/m) - Level (dBuV/m)

5.2.6.3.3.2 Middle Channel

Graphical Test Data



Tabulated Test Data – Middle Channel

Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1272.000	H	Peak	48.5	25.0	34.4	74.0	39.6
1374.000	H	Peak	47.8	25.4	34.1	74.0	39.9
2275.000	H	Peak	49.2	28.5	39.3	74.0	34.7
4876.000	H	Peak	47.9	32.5	42.6	74.0	31.4
7324.000	V	Peak	48.1	35.8	46.5	74.0	27.5

Note. “H” means Horizontal polarity, “V” means Vertical polarity.

No other spurious and harmonic emissions were found greater than listed emissions on above table.

The worst case is z-axis and reported.

* Factor (Peak) = AF + CL + AG (AF: Antenna factor, CL: Cable loss, AG: Pre-Amp gain)

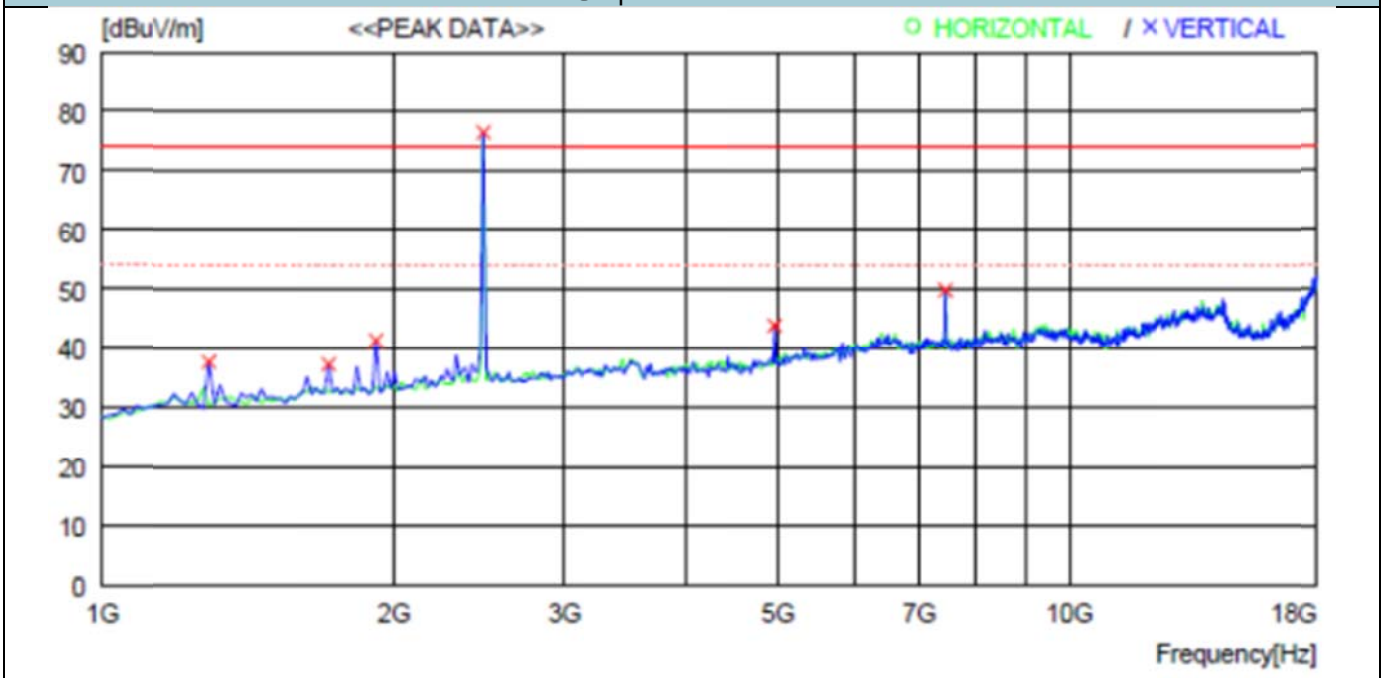
* Factor (Average) = AF + CL + AG + Duty factor

Level = Reading + Factor

Margin = Limit (dBuV/m) - Level (dBuV/m)

5.2.6.3.3.3 High Channel

Graphical Test Data



Tabulated Test Data – High Channel

Frequency (MHz)	Pol.	Detect Mode	Reading (dBµV/m)	Factor* (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1289.000	V	Peak	51.7	25.1	37.7	74.0	36.3
1714.000	V	Peak	49.4	26.6	37.3	74.0	36.7
1918.000	V	Peak	52.4	27.4	41.3	74.0	32.7
4961.000	V	Peak	48.8	32.6	43.9	74.0	30.1
7443.000	V	Peak	50.6	36.0	49.9	74.0	24.1

Note. “H” means Horizontal polarity, “V” means Vertical polarity.

No other spurious and harmonic emissions were found greater than listed emissions on above table.

The worst case is z-axis and reported.

* Factor (Peak) = AF + CL + AG (AF: Antenna factor, CL: Cable loss, AG: Pre-Amp gain)

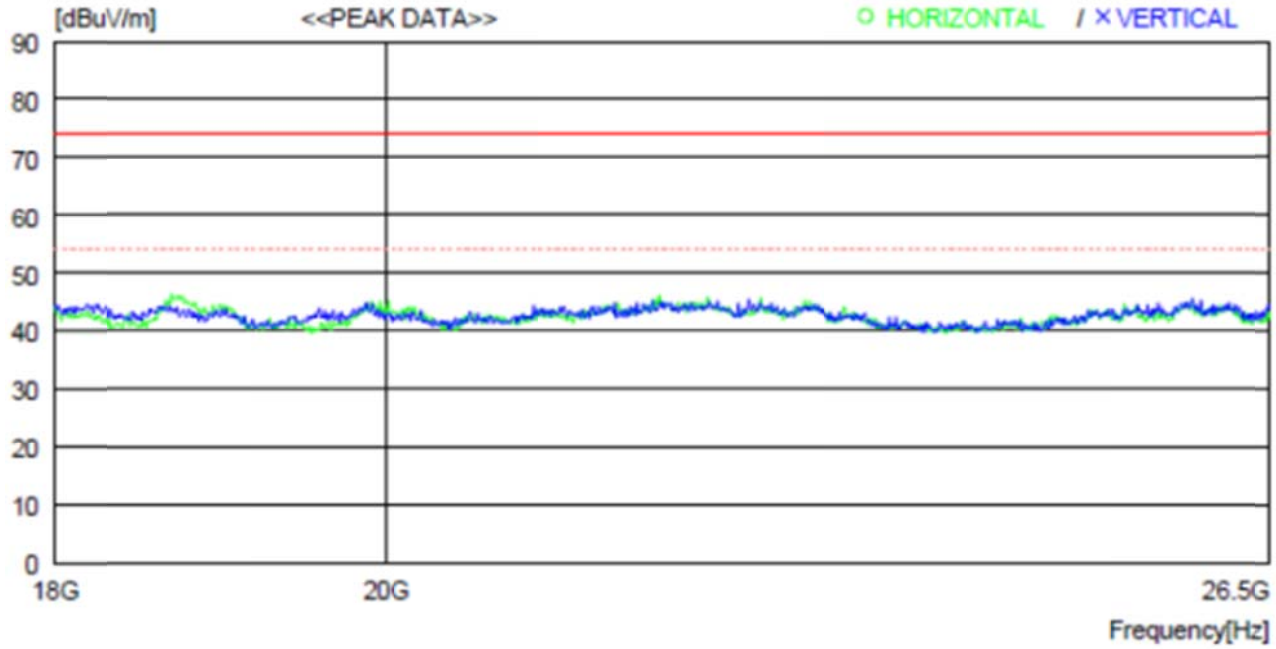
* Factor (Average) = AF + CL + AG + Duty factor

Level = Reading + Factor

Margin = Limit (dBuV/m) - Level (dBuV/m)

5.2.6.4 Test Data for Harmonic & Spurious emission (18 GHz to 26 GHz)

Graphical Test Data – 18 GHz to 26 GHz



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										

Note: Emission was scanned up to 26 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit.

5.2.7 Test Data - HOST Model Name: BW Ultra(4 gas + ECC)

5.2.7.1 Test Data from 30 MHz to 1 GHz

Tabulated Test Data – Low Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
288.020	H	Peak	35.9	13.3	26.0	46.0	20
312.270	H	Peak	38.1	13.7	28.8	46.0	17.2
335.550	H	Peak	36.0	14.3	27.4	46.0	18.6
359.800	H	Peak	34.0	14.9	26.1	46.0	19.9
384.050	H	Peak	32.0	15.6	24.9	46.0	21.1
408.300	H	Peak	31.1	16.1	24.7	46.0	21.3
431.581	H	Peak	30.5	16.5	24.6	46.0	21.4
455.831	H	Peak	32.7	16.8	27.2	46.0	18.8
480.081	H	Peak	30.4	17.2	25.4	46.0	20.6

Note: “H” means Horizontal polarity, “V” means Vertical polarity.

GFSK lowest channel is worst case configuration.

The worst case is z-axis and reported.

* Factor (Peak) = AF + CL + AG (AF: Antenna factor, CL: Cable loss, AG: Pre-Amp gain)

* Factor (Average) = AF + CL + AG + Duty factor

Level = Reading + Factor

Margin = Limit (dBuV/m) - Level (dBuV/m)

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

5.2.7.2 Test Data above 1 GHz

5.2.7.2.1 Low Channel

Tabulated Test Data – Low Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1153.000	H	Peak	52.7	24.5	37.9	74.0	36.1
1374.000	H	Peak	50.0	25.4	36.3	74.0	37.7
2275.000	V	Peak	49.3	28.5	39.4	74.0	34.6
4791.000	V	Peak	50.6	32.3	45.3	74.0	28.7
7205.000	V	Peak	51.6	35.7	50.8	74.0	23.2

5.2.7.2.2 Middle Channel

Tabulated Test Data – Middle Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1238.000	H	Peak	50.8	24.9	36.6	74.0	37.4
1323.000	H	Peak	48.6	25.2	34.7	74.0	39.3
1935.000	V	Peak	49.4	27.4	38.3	74.0	35.7
4876.000	V	Peak	48.6	32.5	43.7	74.0	30.3
7324.000	V	Peak	54.3	35.8	53.5	74.0	20.5

5.2.7.2.3 High Channel

Tabulated Test Data – High Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1340.000	H	Peak	48.7	25.3	34.9	74.0	39.1
1986.000	V	Peak	51.0	27.6	40.2	74.0	33.8
2173.000	V	Peak	49.5	28.2	39.4	74.0	34.6
2241.000	V	Peak	50.1	28.4	40.2	74.0	33.8
4961.000	H	Peak	32.6	32.6	43.5	74.0	30.5
7443.000	V	Peak	36.0	36.0	54.4	74.0	19.6

Note. “H” means Horizontal polarity, “V” means Vertical polarity.

No other spurious and harmonic emissions were found greater than listed emissions on above table.

The worst case is z-axis and reported.

5.2.8 Test Data – Host Model Name: BW Ultra(4 gas + IR)

5.2.8.1 Test Data from 30 MHz to 1 GHz

Tabulated Test Data – Low Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBµV/m)	Factor* (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
263.770	H	Peak	32.0	13.0	21.7	46.0	24.3
288.020	H	Peak	40.1	13.3	30.2	46.0	15.8
312.270	H	Peak	37.8	13.7	28.5	46.0	17.5
359.800	H	Peak	33.4	14.9	25.5	46.0	20.5
408.300	H	Peak	31.6	16.1	25.2	46.0	20.8
455.831	H	Peak	31.5	16.8	26.0	46.0	20

Note: “H” means Horizontal polarity, “V” means Vertical polarity.

GFSK lowest channel is worst case configuration.

The worst case is z-axis and reported.

Corr. Factor = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)

Level = Reading + Corr. Factor (Factor = AF + CL + AG)

Margin = Limit (dBuV/m) - Level (dBuV/m)

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

5.2.8.2 Test Data above 1 GHz

5.2.8.2.1 Low Channel

Tabulated Test Data – Low Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1323.000	H	Peak	52.6	25.2	38.7	74.0	35.3
1595.000	H	Peak	52.7	26.2	40.1	74.0	33.9
2071.000	V	Peak	50.5	27.9	40.0	74.0	34.0
4791.000	H	Peak	46.5	32.3	41.2	74.0	32.8
7205.000	V	Peak	50.4	35.7	49.6	74.0	24.4

5.2.8.2.2 Middle Channel

Tabulated Test Data – Middle Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1170.000	V	Peak	50.5	24.6	35.9	74.0	38.1
1374.000	V	Peak	52.9	25.4	39.2	74.0	34.8
3142.000	V	Peak	49.3	30.1	41.3	74.0	32.7
4876.000	H	Peak	46.2	32.5	41.3	74.0	32.7
7324.000	H	Peak	45.9	35.8	45.1	74.0	28.9

5.2.8.2.3 High Channel

Tabulated Test Data – High Channel							
Frequency (MHz)	Pol.	Detect Mode	Reading (dBμV/m)	Factor* (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1153.000	V	Peak	24.5	24.5	37.7	74.0	36.3
1340.000	V	Peak	25.3	25.3	37.5	74.0	36.5
1612.000	H	Peak	26.3	26.3	40.2	74.0	33.8
4961.000	V	Peak	32.6	32.6	41.2	74.0	32.8
7443.000	H	Peak	36.0	36.0	51.9	74.0	22.1

Note. “H” means Horizontal polarity, “V” means Vertical polarity.

No other spurious and harmonic emissions were found greater than listed emissions on above table.

The worst case is z-axis and reported.

5.3 AC Power Line Conducted Emission

5.3.1 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

5.3.2 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 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.

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.

5.3.3 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	± 2.05 dB	150 kHz ~ 30 MHz	± 2.05 dB

5.3.4 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)

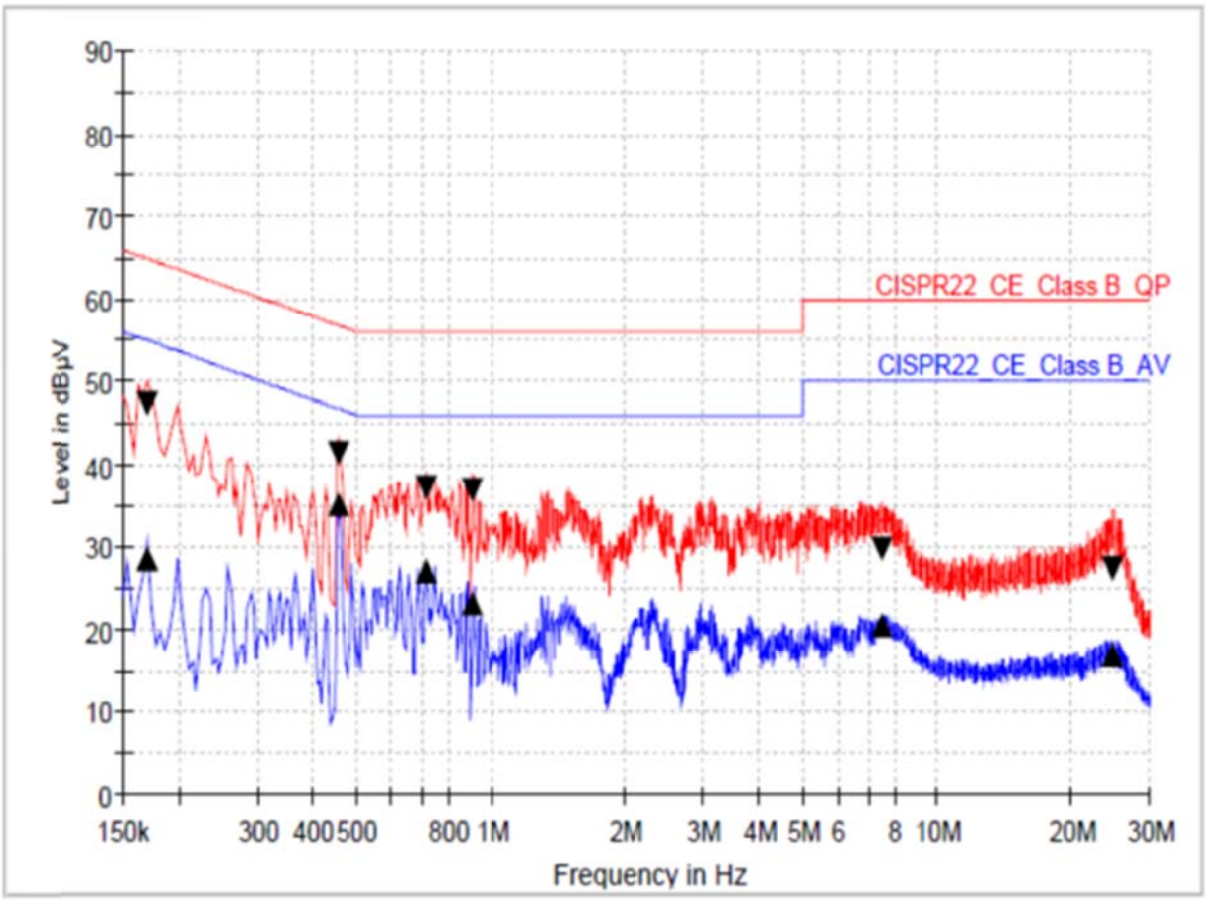
Therefore Q.P Margin = 60 - 20.8 = 39.2 so the EUT has 39.2 dB margin at 5.31 MHz

5.3.5 Worst Case Test Data

Date of Test	2018-03-14	Temperature	18.1 °C
		Relative humidity	37.4 % R.H.
Measurement Frequency Range		9 kHz ~ 30 MHz	
Test Result	***PASS***	Tested By	Do-heon Kim

5.3.5.1 Host Model Name: BW Ultra(4 gas + VOC)

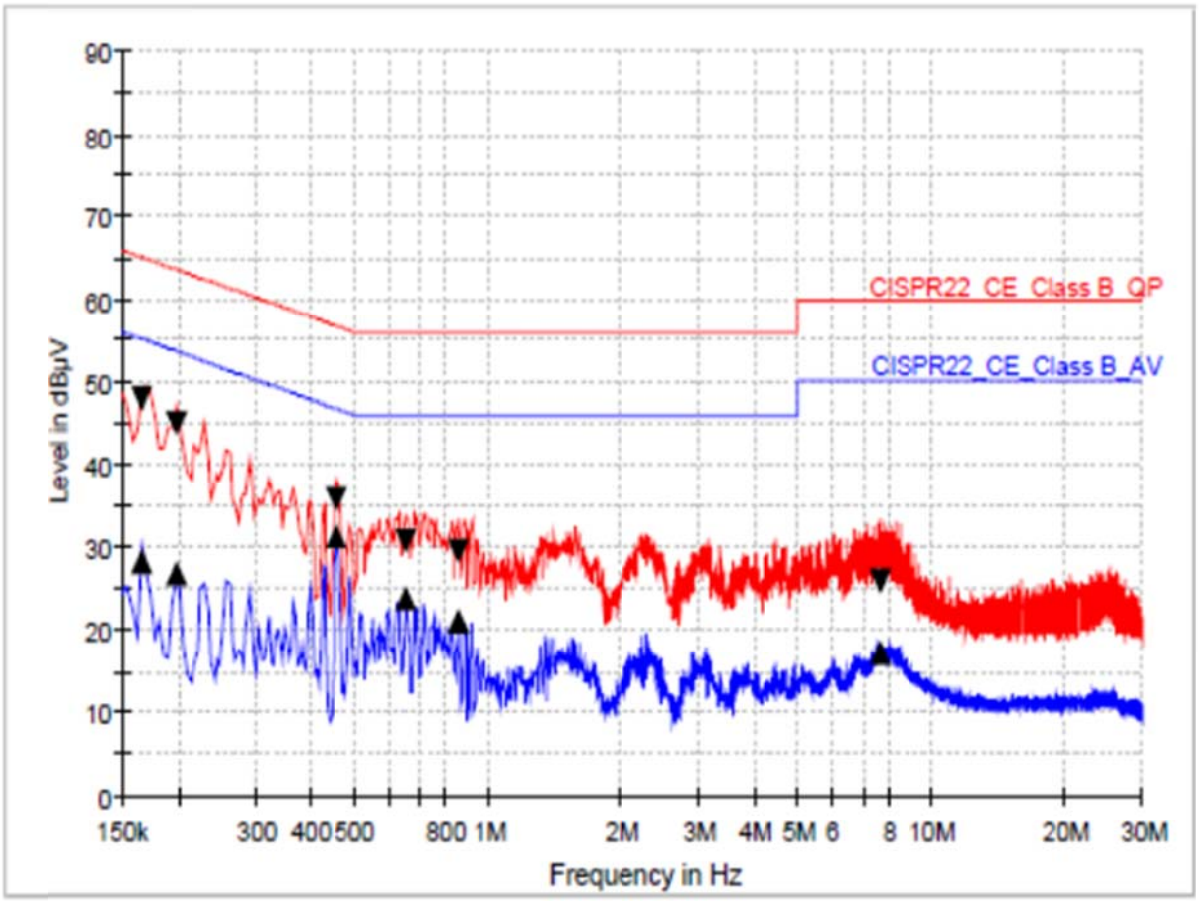
Hot Line



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)
0.170000	47.5	28.7	9.000	L1	9.6	17.5	65.0	26.2	55.0
0.458000	41.3	35.2	9.000	L1	9.6	15.4	56.7	11.5	46.7
0.714000	37.1	27.3	9.000	L1	9.6	18.9	56.0	18.7	46.0
0.910000	36.8	23.2	9.000	L1	9.6	19.2	56.0	22.8	46.0
7.542000	29.8	20.5	9.000	L1	9.7	30.2	60.0	29.5	50.0
24.814000	27.5	17.0	9.000	L1	9.9	32.5	60.0	33.0	50.0

Neutral Line

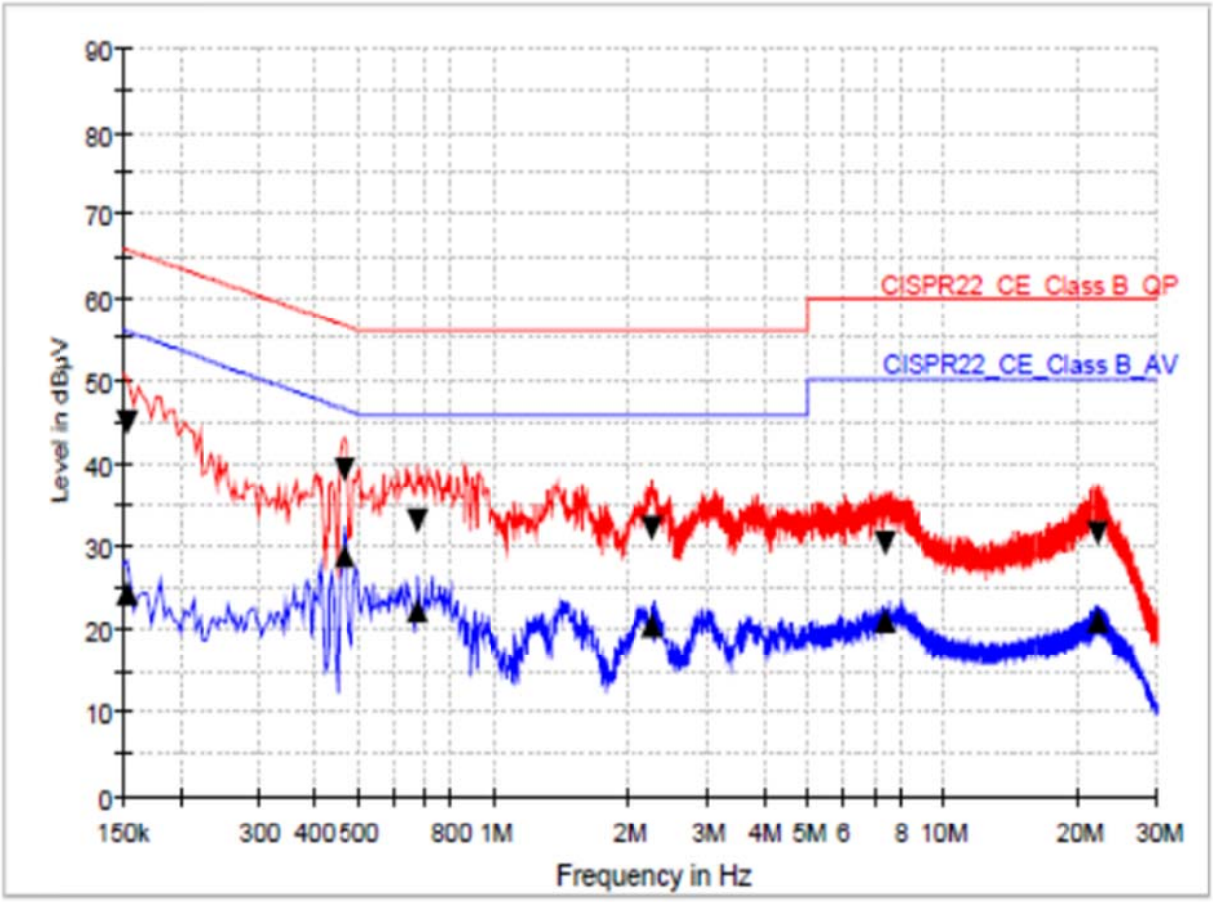


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.166000	47.8	28.4	9.000	N	9.6	17.3	65.2	26.7	55.2
0.198000	45.0	26.7	9.000	N	9.6	18.7	63.7	27.0	53.7
0.458000	35.9	31.3	9.000	N	9.6	20.9	56.7	15.5	46.7
0.658000	30.6	23.7	9.000	N	9.6	25.4	56.0	22.3	46.0
0.858000	29.6	21.2	9.000	N	9.6	26.4	56.0	24.8	46.0
7.650000	26.1	17.3	9.000	N	9.7	33.9	60.0	32.7	50.0

5.3.5.2 Host Model Name: BW Ultra(4 gas + ECC)

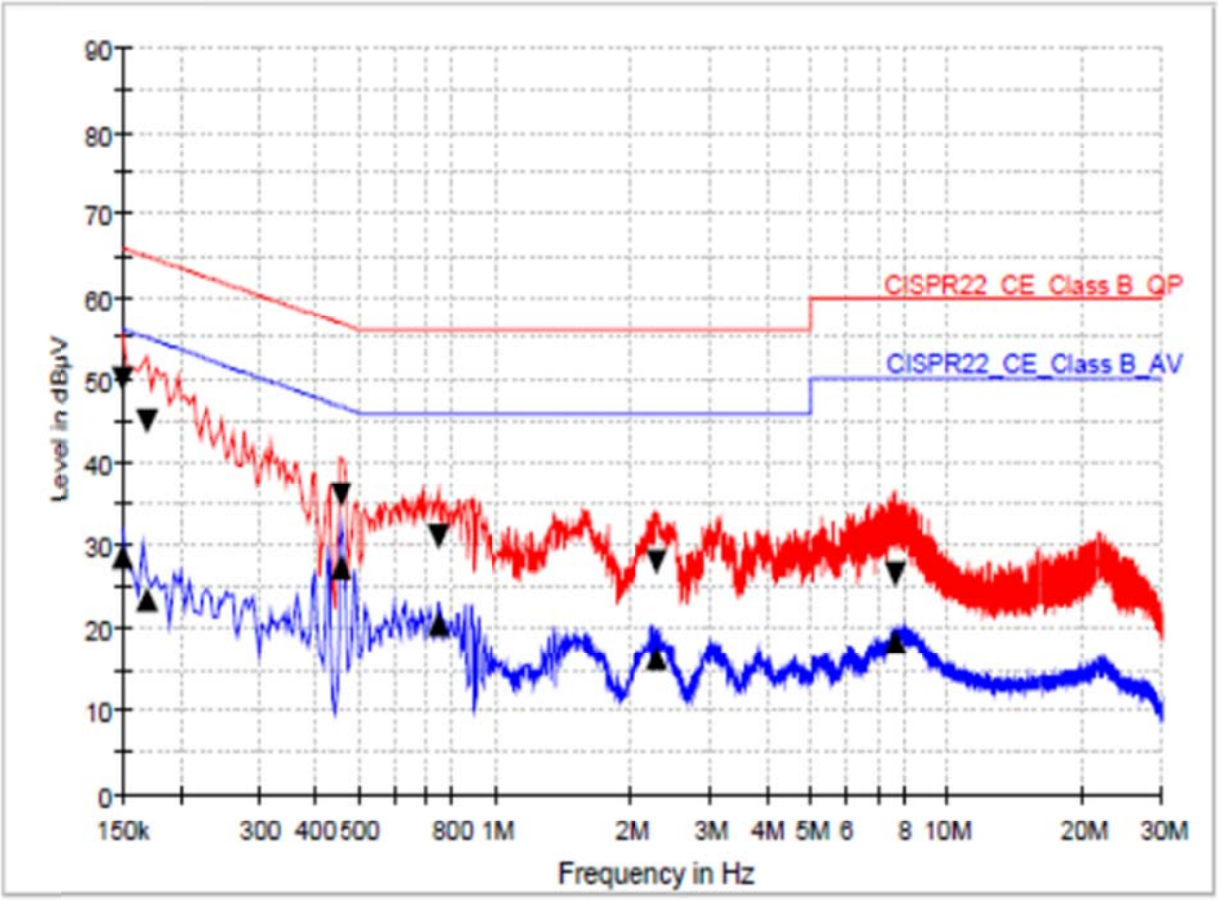
Hot Line



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)
0.154000	45.0	24.4	9.000	L1	9.6	20.8	65.8	31.4	55.8
0.466000	39.4	29.0	9.000	L1	9.6	17.2	56.6	17.6	46.6
0.678000	33.1	22.3	9.000	L1	9.6	22.9	56.0	23.7	46.0
2.250000	32.2	20.7	9.000	L1	9.6	23.8	56.0	25.3	46.0
7.434000	30.5	21.2	9.000	L1	9.7	29.5	60.0	28.8	50.0
22.242000	31.4	21.1	9.000	L1	9.8	28.6	60.0	28.9	50.0

Neutral Line

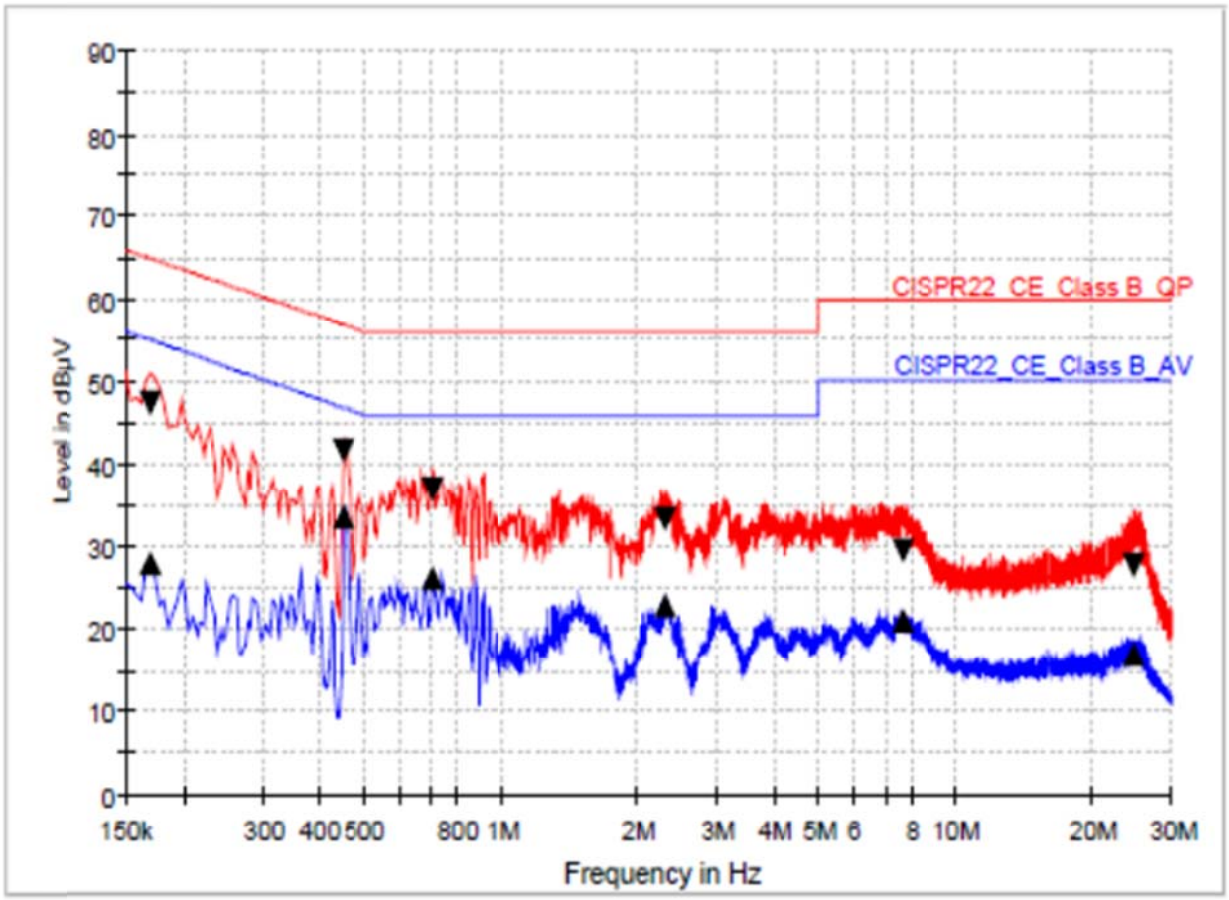


Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.150000	50.0	28.7	9.000	N	9.6	16.0	66.0	27.3	56.0
0.170000	45.1	23.5	9.000	N	9.6	19.9	65.0	31.4	55.0
0.458000	36.0	27.6	9.000	N	9.6	20.8	56.7	19.2	46.7
0.746000	31.1	20.6	9.000	N	9.6	25.0	56.0	25.4	46.0
2.294000	27.9	16.3	9.000	N	9.6	28.1	56.0	29.7	46.0
7.706000	26.7	18.5	9.000	N	9.7	33.3	60.0	31.5	50.0

5.3.5.3 Host Model Name: BW Ultra(4 gas + IR)

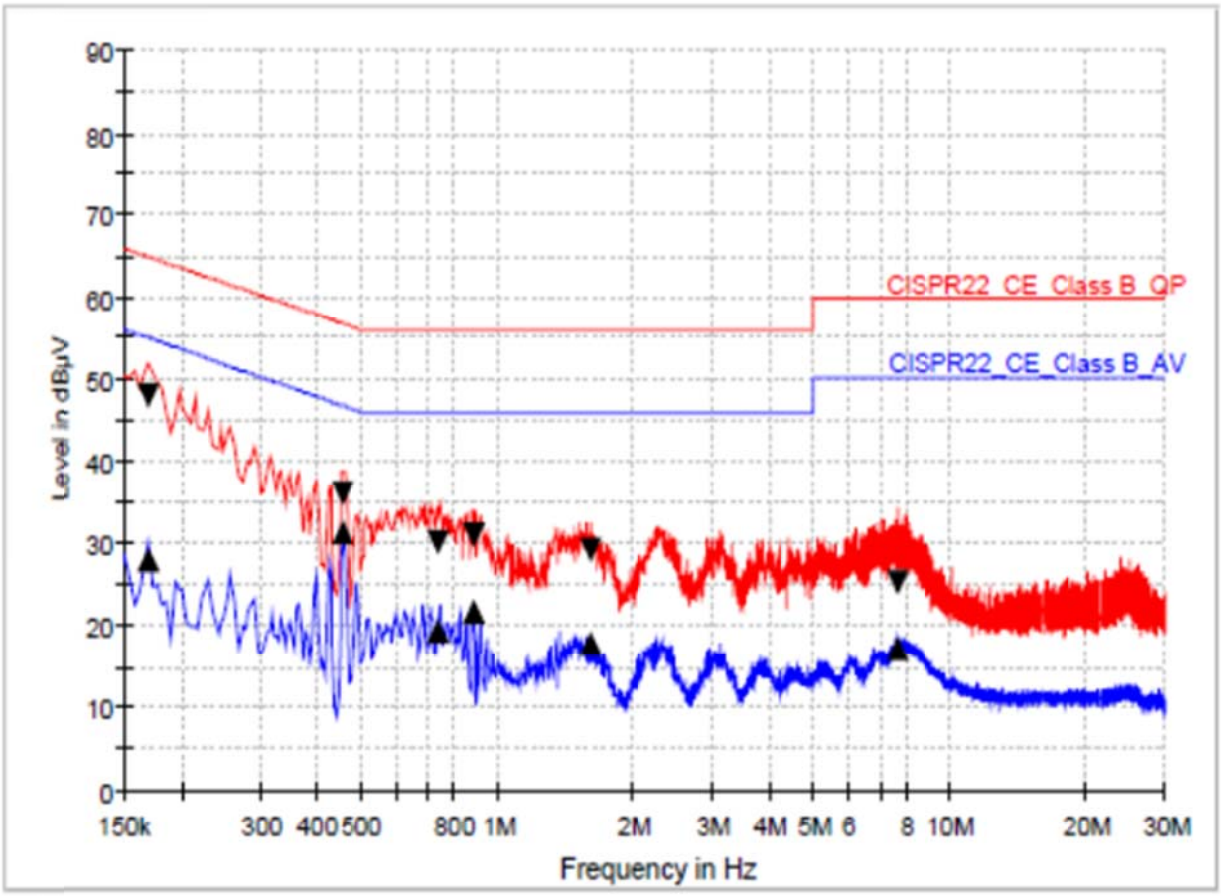
Hot Line



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)
0.170000	47.4	28.0	9.000	L1	9.6	17.5	65.0	26.9	55.0
0.454000	41.8	33.6	9.000	L1	9.6	15.0	56.8	13.2	46.8
0.710000	37.0	26.2	9.000	L1	9.6	19.0	56.0	19.8	46.0
2.298000	33.3	23.0	9.000	L1	9.6	22.7	56.0	23.0	46.0
7.654000	29.6	21.1	9.000	L1	9.7	30.4	60.0	28.9	50.0
24.778000	27.8	17.0	9.000	L1	9.9	32.2	60.0	33.0	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)
0.170000	48.0	28.0	9.000	N	9.6	17.0	65.0	27.0	55.0
0.458000	36.2	31.2	9.000	N	9.6	20.5	56.7	15.5	46.7
0.738000	30.0	19.3	9.000	N	9.6	26.0	56.0	26.7	46.0
0.886000	31.0	21.7	9.000	N	9.6	25.0	56.0	24.3	46.0
1.606000	29.1	18.0	9.000	N	9.6	26.9	56.0	28.0	46.0
7.686000	25.2	17.4	9.000	N	9.7	34.8	60.0	32.6	50.0

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal Date
Test Receiver	ESU 26	100303	Rohde & Schwarz	2019-01-18
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2019-06-15
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2019-09-14
Horn Antenna	HF 907	102426	Rohde & Schwarz	2019-01-06
Horn Antenna	BBHA 9170	BBHA9170 #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	2018-04-24
Pre-Amplifier	CBL18265035	28706	CERNEX	2018-03-29
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	-
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	-
Camera Controller	HDCon4102	6531445048	PONTIS	-
CO3000 Controller	Co3000-4Port	CO3000/806/ 34130814/L	INNCO SYSTEM	-
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2019-02-12
LISN	ENV216	100110	Rohde & Schwarz	2018-07-28

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.