UL Korea Ltd.
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Order No.:	11592966
Report No.:	17-11592966-FCC1
Date:	May 23, 2017
Model No.:	RMBLE-M5
FCC ID :	2AISERMBLEM5
IC ID :	21613-RMBLEM5

FCC/IC
RF Test Report

in accordance with
FCC Part 15 Subpart C §15.247
IC RSS-247

for

Bluetooth Low Energy Module

Honeywell Analytics Asia Pacific Co., Ltd.
7F SangAm IT Tower, 434 Worldcup Buk-ro, Mapo-gu, Seoul 03922, South Korea

Summary of Test Results:

The following tests were performed on a sample submitted for evaluation of compliance with FCC Part 15 C Section 15.247 and IC RSS-247 issue 2, RSS-GEN issue 4

No	FCC Reference Clause No.	IC Reference Clause No.	Conformance Requirements	Result	Remark
1	15.247(a)(2)	RSS-247 5.2(1)	6 dB Bandwidth Occupied Bandwidth	Complied*	Note 1
2	15.247(b)(3)	RSS-247 5.4(4)	Maximum peak output power	Complied	-
3	15.247(e)	RSS-247 5.2(2)	Power spectral density	Complied*	Note 1
4	15.247(d)	RSS-247 5.5	Band Edge Conducted spurious emission	Complied	-
5	15.205(a) 15.209(a)	RSS-247 5.5 RSS-GEN 8.9	Radiated spurious emissions	Complied	-
6	15.207(a)	RSS-GEN 8.8	AC power line conducted emissions	Complied	

Note1: Test was performed by modular transmitter (FCC ID: 2AISERMBLEM5/IC ID: 21613-RMBLEM5, Test Report no. 16-11355707-FCC1 issued on November.02,2016 by UL Korea Ltd.)

Note2: In case of Bluetooth LE(2.4 GHz), The tests are not significantly different between the 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.

Conclusion:

The test items listed above have been performed and the results recorded by UL Korea Ltd. in accordance with the procedures stated in each test requirement and specification. The test items were determined to ensure the requirements set out in the FCC CFR 47 Part 15 Subpart C §15.247 and IC RSS-247. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

Witness tested by
Hyunsik Yun, WiSE Laboratory Engineer
Consumer Technology Division
UL Korea Ltd.
May 23, 2017

Reviewed by
Changyoung Choi, WiSE Senior Engineer
Consumer Technology Division
UL Korea Ltd.
May 23, 2017

Test Report Details

Witnessed By:	UL Korea Ltd. 26th FL. GFC Center, 737 Yeoksam-dong, Gangnam-gu, Seoul, 135-984, Korea
Test Site:	ENG Co., Ltd 135-60 Gyeongchungdae-ro, Gonjiam-eup, Gwangju-si, Gyeonggi-do, Korea 464-942
Applicant:	Honeywell Analytics Asia Pacific Co., Ltd. 7F SangAm IT Tower, 434 Worldcup Buk-ro, Mapo-gu, Seoul 03922, South Korea
Manufacturer:	RAE Systems by Honeywell No.990E. Hwujwang Road, JIADING DISTRICT, Shanghai 201815, China
Applicant Contact:	Hyun mook Kim
Title:	Sr Quality Engineer
Phone:	82-2-6909-0371
E-mail:	hyunmook.kim@honeywell.com
Product Type:	Bluetooth Low Energy Module
Model Number:	RMBLE-M5
Host Model Number:	SPLI AA BAX B C NZZ
Application Purpose:	FCC C2PC (Added Host to the LMA)
Trademark	N/A
Sample Serial Number:	N/A
Test standards:	FCC Part 15 C Section 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz IC RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Sample Receive Date:	April 10, 2017
Testing Start Date:	April 27, 2017
Testing Complete Date:	May 22, 2017
Overall Results:	Pass

The test reports apply only to the specific test samples and test results submitted for UL's review. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. UL Korea Ltd. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from UL Korea Ltd. issued reports. This report shall not be used to claim, constitute or imply product certification, approval, or any agency of the National Authorities. This report may contain test results that are not covered by the NVLAP or KOLAS accreditation.

Report Directory

1. General Product Information

1.1. Equipment Description

RMBLE-M5 is a Bluetooth Low Energy Module

1.2. Details of Test Equipment (EUT)

- Equipment Type : Bluetooth Low Energy Module
- Model No. : RMBLE-M5
- Type of test Equipment : Portable type
- Operating characteristic : Short range wireless device operating in the 2 400 MHz ~ 2 483.5 MHz ISM frequency band
- Manufacturer : RAE Systems by Honeywell
  No.990E. Hwujwang Road, JIADING DISTRICT, Shanghai 201815, China

1.3. Equipment Configuration

The EUT is consisted of the following component provided by the manufacturer.

Use*	Product Type	Manufacturer	Model	Comments
EUT	Bluetooth Low Energy Module	RAE Systems by Honeywell	RMBLE-M5	-
Note: Use = EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment. SIM - Simulator (Not Subjected to Test)				

1.4. Technical Data

Item	Description
Frequency Ranges	2 402 MHz ~ 2 480 MHz
Output power	Max. -14.0 dBm
Kind of modulation (s)	GFSK
Channel	40 channels (Bluetooth Low Energy)
Antenna Gain	Max. -1.50 dBi
Working temperature	-40 ~ 60 ℃
Supply Voltage	DC 3.30 V

Note;
1. All the technical data described above were provided by the manufacturer.

1.5. Antenna Information

Antenna Type : PCB Pattern antenna
Manufacturer : RAE Systems by Honeywell
Transmit Gain dBi : Max. -1.50 dBi

1.6. Equipment Type :

☐ Radio and ancillary equipment for fixed or semi-fixed use
☐ Radio and ancillary equipment for vehicular mounted use
☒ Radio and ancillary equipment for portable or handheld use

☒ Stand alone ☐ Host connected

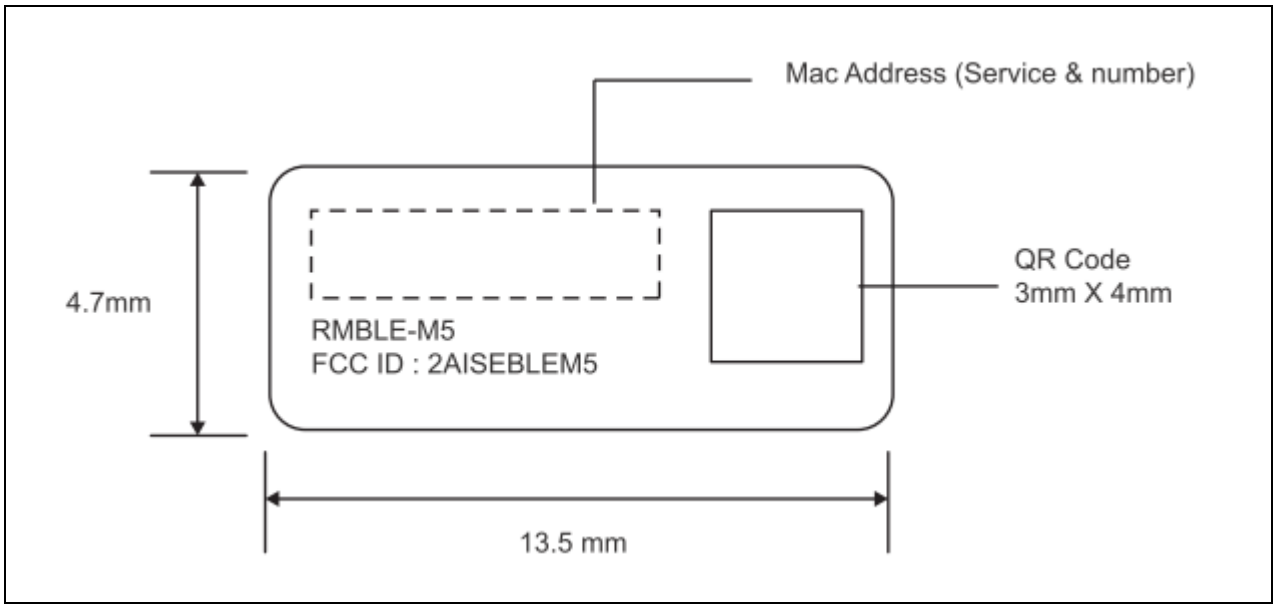
☒ Self contained single unit ☐ Module with associated connection or interface

1.7. Technical descriptions and documents

The following documents was provided by the manufacturer.

No.	Document Title and Description
1	User Manual

1.8. Equipment Marking Plate

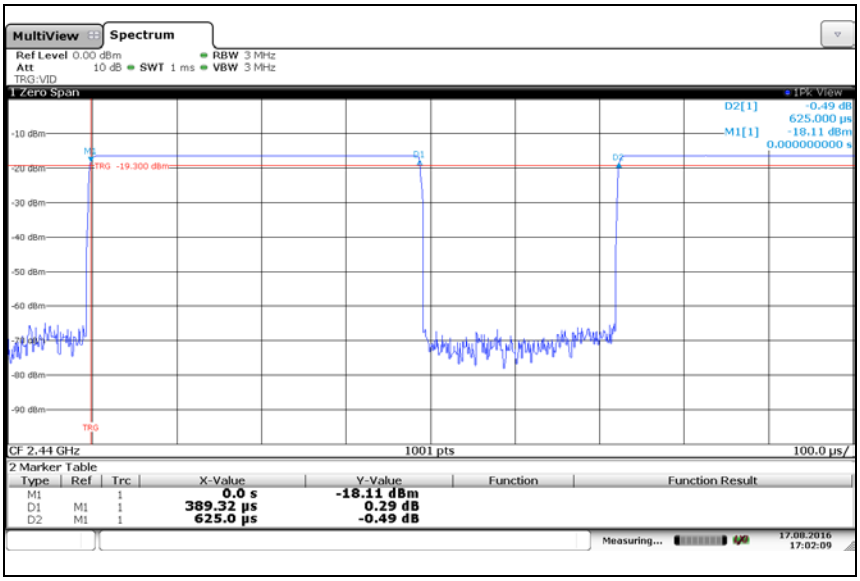


1.9. Description of host model name

Model name	Description of designation	Description of design
SPLI AA BAX B C NZZ	AA (Gas)	1) O1: O2 2) C1: CO 3) H1: H2S (L) 4) H2: H2S (H) 5) G1: H2 6) N1: NO2 7) F6: CH4 (CAT) 8) FR: CH4 (IR)
	B (Color)	C: Charcoal Y: Yellow
	C (Entry)	N: ¾ NPT M: M20

1.10. Duty Cycle

Modulation Type	Data Rate	On Time (ms)	Period (ms)	Duty Cycle X (linear)	Duty Cycle (%)	Duty Cycle Correction Factor(dB)	1/T Minimum VBW(kBW)
GFSK	1 Mbps	0.389 320	0.625 000	0.622 900	62.29	2.06	1.600



2. Test Specification

The following test specifications and standards have been applied and used for testing.

1) FCC Part 15 C Section 15.247 : Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
2) IC RSS-247 Issue2 : Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
3) IC RSS-GEN Issue 4 : General Requirements for Compliance of Radio Apparatus
4) ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices and Electronic Equipment in the range of 9 kHz to 40 GHz
5) KDB 558074 v04 : Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

3. Test Conditions

3.1. Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	Bluetooth Low Energy Module	RAE Systems by Honeywell	RMBLE-M5	-
AE	Gas Detector	Honeywell Analytics Asia Pacific Co., Ltd.	SPLIF6BAXCMNZZ	C2PC Full Tested (Contain RMBLE-M5)
AE	Gas Detector	Honeywell Analytics Asia Pacific Co., Ltd.	SPLIC1BAXCMNZZ	Only Radiated Spurious Emission Tested (Contain RMBLE-M5)
AE	Gas Detector	Honeywell Analytics Asia Pacific Co., Ltd.	SPLIFRBAXCMNZZ	Only Radiated Spurious Emission Tested (Contain RMBLE-M5)
AE	Note PC	Dell Inc.	Latitude E5470	-

Note;
1. Use* : EUT=Equipment Under Test, AE=Auxiliary/Associated Equipment, SIM=Simulator (Not Subjected to Test)
2. Please refer to the 'Letter of EMC&RF Test Sample(Sensepoint XRL)' document for the basis of selection of the representative host models.

3.2. Input/Output Ports

No	Port Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
1	Power Input	DC	N	N	Connected to DC Power supply
2	USB port	I/O	N	Y	Connected to Note PC

Note:
*AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

3.3. Power Interface

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	3.3 V	-	-	DC	-	Rating of EUT
1	24.0 V	-	-	DC	-	Host Power

3.4. Operating Frequencies

Mode #	Frequency tested
1	Operating frequency range : 2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy) - Low : 2 402 MHz - Mid : 2 440 MHz - High : 2 480 MHz

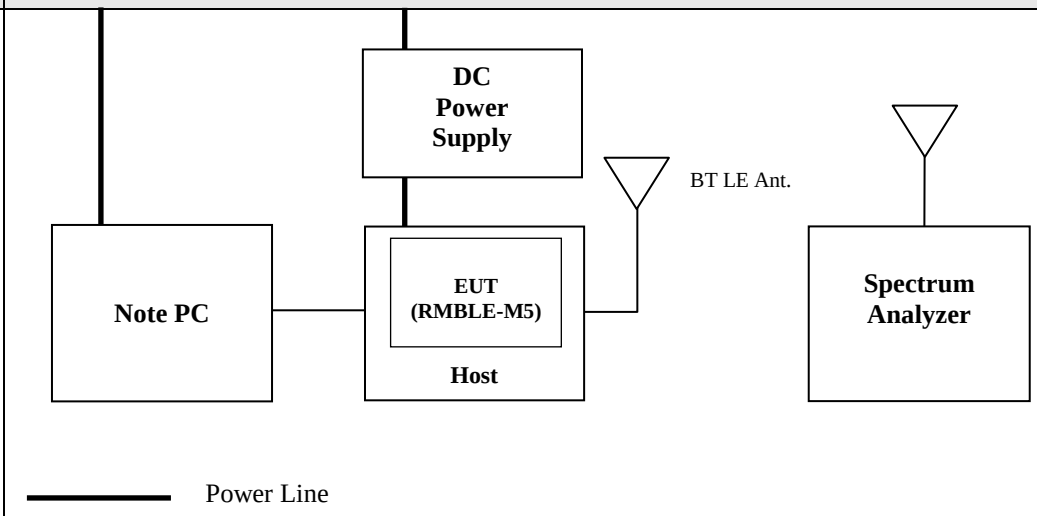
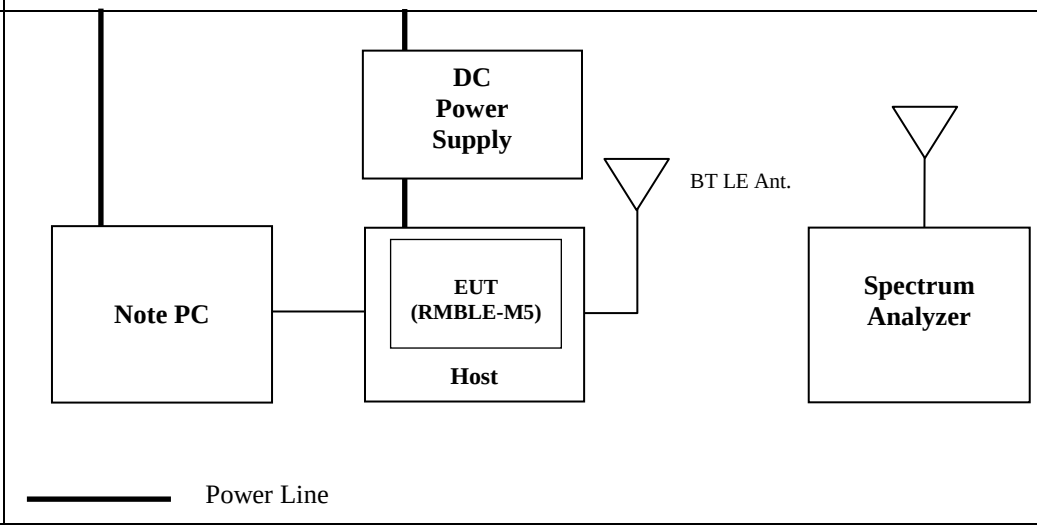
3.5. Operation Modes

Mode #	Description
1	Carrier on mode: Signal from the RF module was generated continuously for the representative channels (Low, Mid, High) by the test program incorporated

3.6. Environment Conditions

Parameters	Environment condition
Temperature	-40°C to +60°C
Humidity	No more than 80 %
Supply voltage	DC 3.30 V (Rated nominal voltage)
Note ;. - Test has been carried out for three frequencies specified above under the normal condition.	

3.7. Test Configurations

Mode #	Description
1	
1	
Note ;. - Antenna-port conducted tests can't be performed on an EUT. - All tests are conducted by radiated compliance measurements.	

3.8. List of Test Equipment

No	Description	Manufacturer	Model	Identifier	Cal. Due
1	Signal & Spectrum Analyzer	R&S	FSW 43	100578	17.05.04 18.05.04
2	DC Power Supply	Agilent	U8100A	MY52060004	17.07.29
3	Slidacs	Hanchang Transformer	HCS-2SD10	-	-
4	Signal Generator	R&S	SMF100A	101441	18.01.19
5	Test Receiver	R&S	ESU 26	100303	18.01.19
6	Trilog Broadband Antenna	Schwarzbeck	VULB9163	9163 770	19.02.13
7	Pre-Amplifier	SONOMA INSTRUMENT	310N	344015	18.01.19
8	Pre-Amplifier	R&S	SCU 18D	19006450	18.04.24
9	Pre-Amplifier	CERNEX	CBL18265035	28706	18.03.29
10	Horn Antenna	R&S	HF 907	102426	19.01.06
11	Horn Antenna	Schwazbeck	BBHA9170	BBHA9170440	18.11.28
12	Loop Antenna	R&S	HFH2-Z2	100341	19.04.21
13	Antenna Mast	INNCO SYSTEM	MA4000-EP	4600814	-
14	Antenna Mast	INNCO SYSTEM	MA4000-XP-ET	-	-
15	Turn Table	INNCO SYSTEM	DT3000-3T	1310814	-
16	Camera Controller	PONTIS	HDCon4102	6531445048	-
17	CO3000 Controller	INNCO SYSTEM	Co3000-4Port	CO3000/806/ 34130814/L	-
18	CO3000 Controller	INNCO SYSTEM	Co3000-4Port	CO3000/807/ 34130814/L	
19	Attenuator	R&S	6 dB	272.4110.50	18.01.19
20	EMI Test Receiver	R&S	ECSI7	100722	18.01.19
21	LISN	R&S	ENV216	100110	17.07.29

4. Overview of Technical requirements

The following essential requirements and test specifications are relevant to the presumption of conformity FCC Part 15 C Section 15.247and RSS-247, RSS-GEN				Reported
FCC Reference Clause No.	IC Reference Clause No.	Essential technical requirements	Test method	
15.247(b)(3)	RSS-247 5.4(4)	Maximum peak output power	KDB 558074	[X]
15.247(d)	RSS-247 5.5	Band Edge	KDB 558074	[X]
15.205(a) 15.209(a)	RSS-247 5.5 RSS-GEN 8.9	Radiated spurious emissions	ANSI C63.10 KDB 558074	[X]
15.207(a)	RSS-GEN 8.8	AC power line conducted emissions	ANSI C63.10	[X]

5. Test Results

5.1. Maximum Peak Output Power

TEST: Maximum Peak Output Power		
Method	This tests are conducted by radiated compliance measurements. Set the spectrum analyzer as below. a) Set RBW = 3 MHz. b) Set the video bandwidth (VBW) ≥ 3 × RBW. c) Detector = Peak. d) Trace mode = max hold. e) Sweep = auto couple. f) Allow the trace to stabilize. The field strength levels shall be converted to equivalent conducted power levels for comparison to the applicable output power limit. This is accomplished by first measuring the radiated field strength. The radiated field strength is converted to EIRP.(refer to ANSI C63.10 for guidance).	
Reference Clause	Part15 C Section 15.247 (b)(3) RSS-247 5.4(4)	
Parameters recorded during the test	Laboratory Ambient Temperature	21.1 °C
	Relative Humidity	46.3 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2 402 MHz - 2 480 MHz	Enclosure

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	1
Supplementary information: None		

Limits

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2400 ~2483.5 MHz, and 5725 ~ 5850 MHz band: 1 Watt. As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.1. Measurement Results

Table 1. Data Table of Maximum Peak Output Power

Operating Mode	Data Rate [Mbps]	Channel	Channel Frequency [MHz]	E-field [dBuV/m]	EIRP [dBm]	Output Power [dBm]	Limit [dBm]
GFSK	1	Low	2 402	71.28	-23.98	-22.48	30
		Middle	2 440	71.63	-23.63	-22.13	
		High	2 480	72.57	-22.69	-21.19	

Supplementary information:

- The test result is derived by using radiated method.
- The measurement distance(D) is 3m.
- EIRP (dBm) = E (dBuV/m) + 20 log(D) – 104.8
- Output Power (dBm) = EIRP – Antenna gain (-1.5 dBm)

5.2. Radiated Spurious Emissions Measurement

TEST: Radiated spurious emissions measurement		
Method	Radiated emissions from the EUT were measured according to ANSI C63.10 procedure. 1. The EUT was placed on the top of a rotating table 0.8 meters and 1.5 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. The antenna is varied from 1 to 4 meters above the ground to find the maximum field strength. Measurement are made with both horizontal and vertical polarizations For fundamental investigation, the EUT was positioned for 3 orthogonal orientations. 2. For measurement below 1GHz, the resolution bandwidth is set to 100 kHz for peak detection or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak. 3. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements. 4. For 2.4GHz transmitter measurement, the spectrum from 30 MHz to 26GHz is investigated for Low, Mid and High channels.	
Reference Clause	Part15 C Section 15.205 (a), 15.209(a) RSS-247 5.5/ RSS-GEN 8.9, 8.10	
Parameters recorded during the test	Laboratory Ambient Temperature	21.1 °C
	Relative Humidity	46.3 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 25 GHz	Enclosure

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	1
Supplementary information: None		

Limits

According to §15.247(d), 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. 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))

According to § 15.209(a), the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency [MHz]	Distance [meters]	Field Strength [dBuV/m]	Field Strength [uV/m]
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

5.2.1. Measurement Results

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : Continuous Wave
Power setting : Max. Power condition declared by the manufacturer

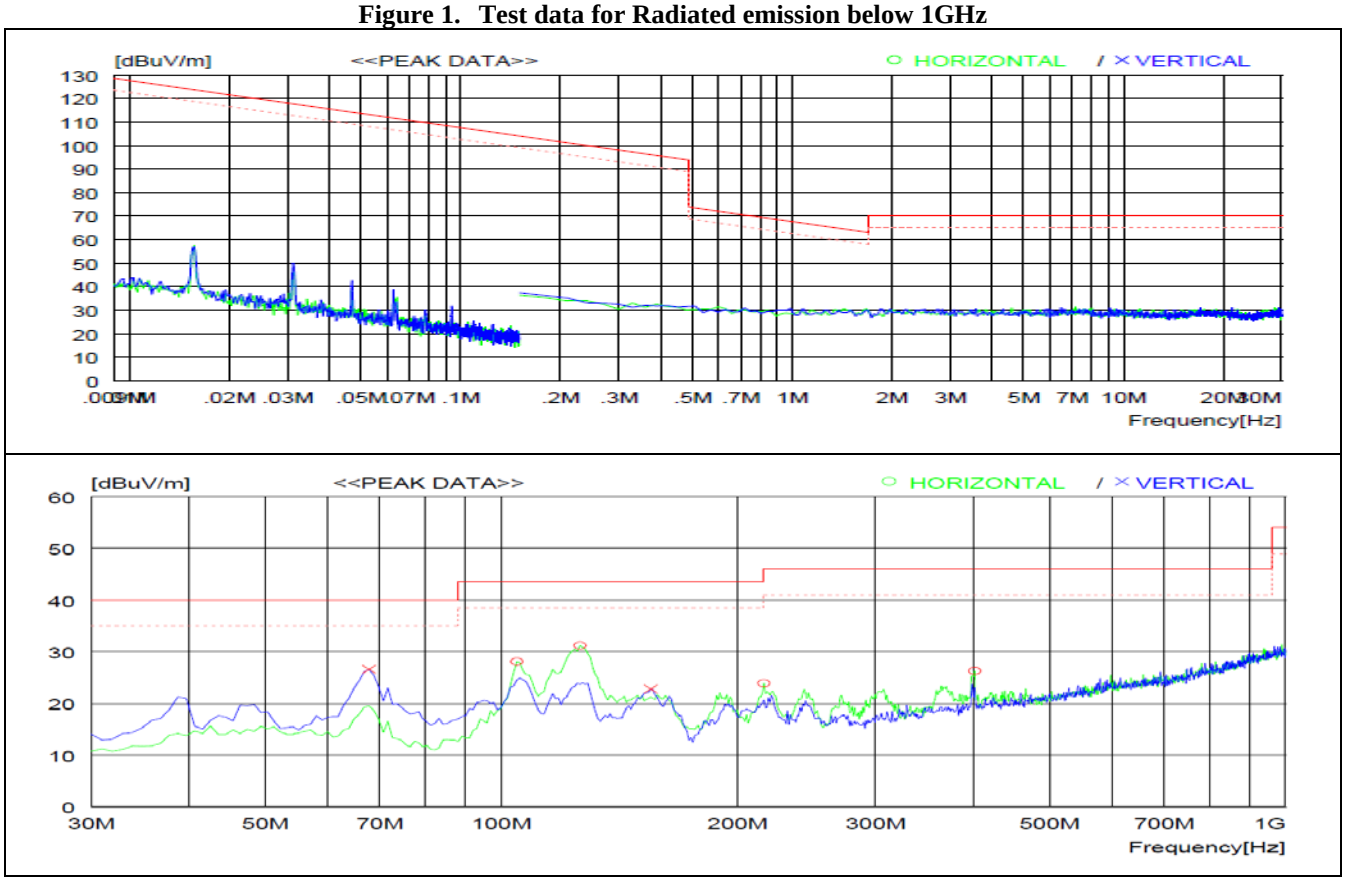
Host Model Name: SPLIF6BAXCMNZZ

Table 2. Data Table of Radiated emission Below 1 GHz

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
67.83	V	PK	42.3	-15.7	26.6	40.0	13.4
104.69	H	PK	41.8	-13.7	28.1	40.0	11.9
126.03	H	PK	47.1	-15.9	31.2	43.5	12.3
155.13	V	PK	38.7	-15.9	22.8	43.5	20.7
216.24	H	PK	35.4	-11.5	23.9	46.0	22.1
401.51	H	PK	33.2	-6.9	26.3	46.0	19.7

Supplementary information:
- According to KDB 414788, a used anechoic chamber were equivalent to those on an open fields site based on comparison measurements.
- GFSK high channel is worst case configuration.
- The worst case is y-axis and reported.
- Factor = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)
- Quasi-peak measurements are omitted because the peak data meets the limit.

Figure 1. Test data for Radiated emission below 1GHz



Data Table of Radiated emission Above 1 GHz – Low Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7205.00	H	PK	56.6	-1.3	55.3	74.0	18.7
7205.00	H	AV	43.9	0.8	44.7	54.0	9.3
7205.00	V	PK	52.6	-1.3	51.3	74.0	22.7
7205.00	V	AV	41.2	0.8	42.0	54.0	12.0

Table 3. Data Table of Radiated emission Above 1 GHz – Middle Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor * [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7324.00	H	PK	50.4	-1.3	49.1	74.0	24.9
7324.00	H	AV	38.2	0.8	39.0	54.0	15.0
7324.00	V	PK	48.1	-1.3	46.8	74.0	27.2
7324.00	V	AV	37.0	0.8	37.8	54.0	16.2

Table 4. Data Table of Radiated emission Above 1 GHz – High Channel

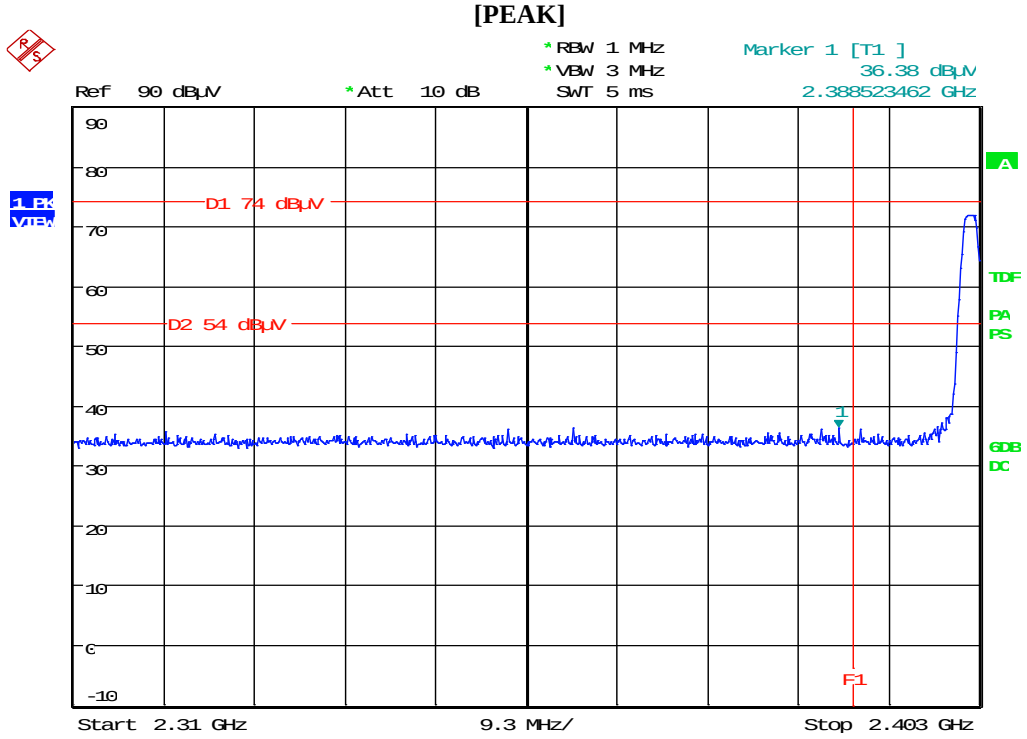
Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor * [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7443.00	H	PK	47.4	-1.2	46.2	74.0	27.8
7443.00	H	AV	36.1	0.9	37.0	54.0	17.0
7443.00	V	PK	48.1	-1.2	46.9	74.0	27.1
7443.00	V	AV	36.8	0.9	37.7	54.0	16.3

Supplementary information:

- Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.
- No other spurious and harmonic emissions were found greater than listed emissions on above table.
- The worst case is y-axis and reported.
- * Factor(PK) = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- * Factor(AV) = AF + CL + AG + Duty factor (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)

Figure 2. GFSK : Low – Restricted Bands

[PEAK]



[AVERAGE]

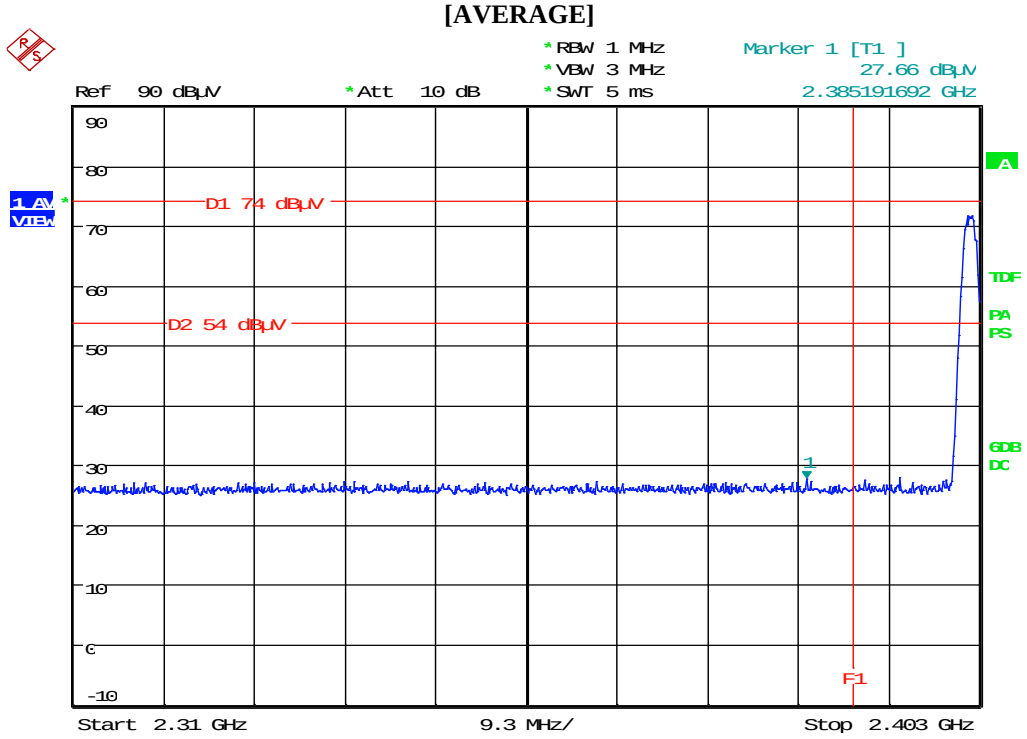
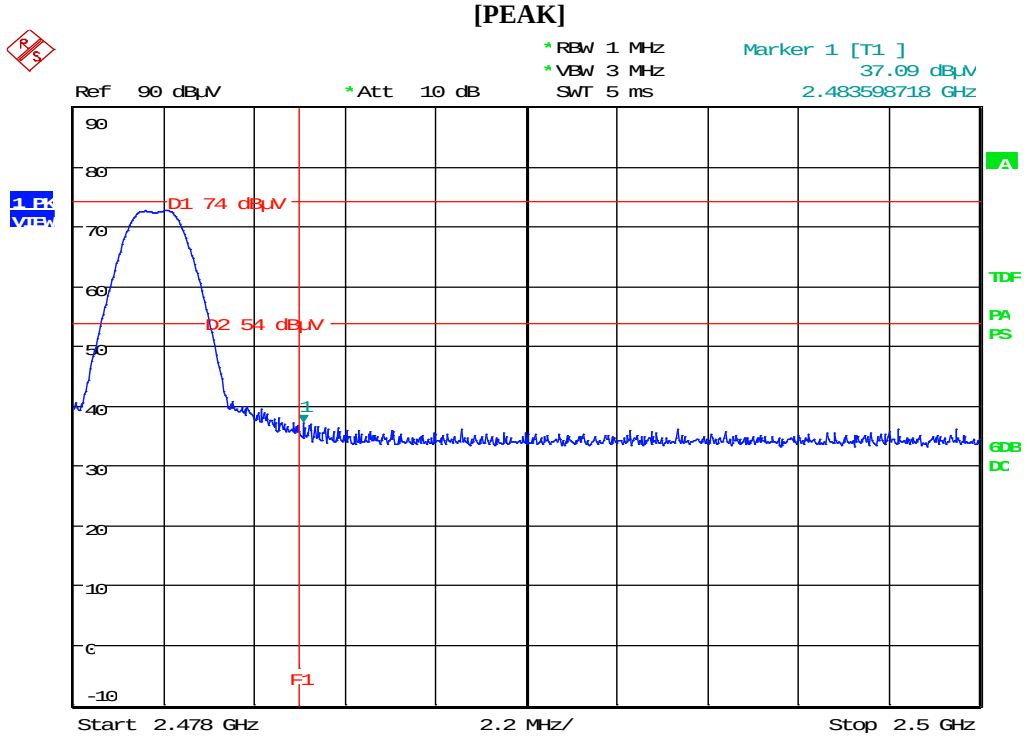


Figure 3. GFSK : High – Restricted Bands

[PEAK]



[AVERAGE]

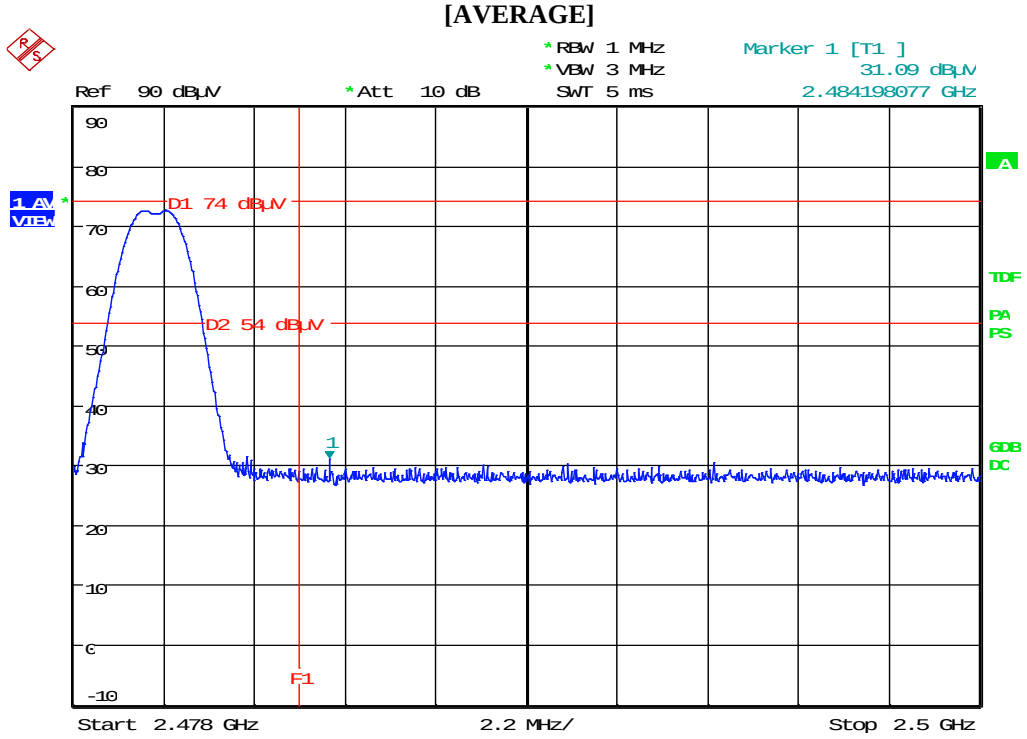


Figure 4. GFSK : Low

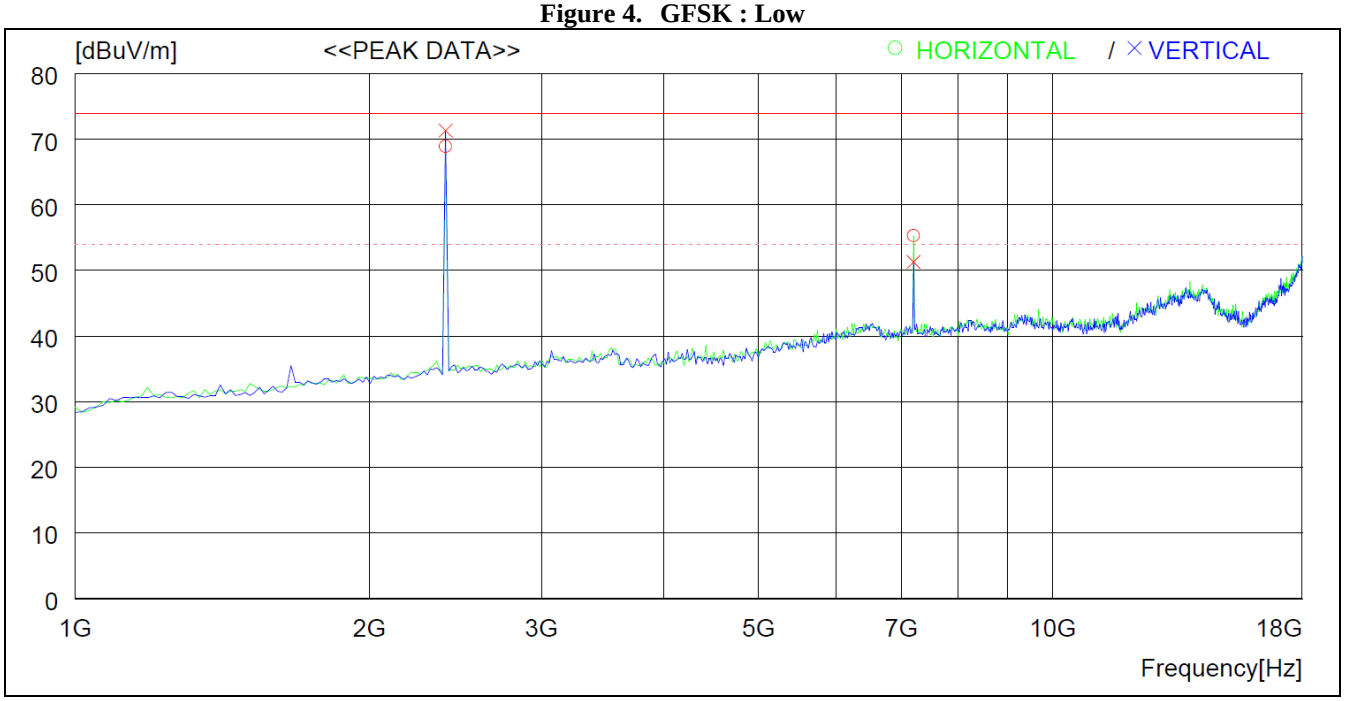


Figure 5. GFSK: Mid

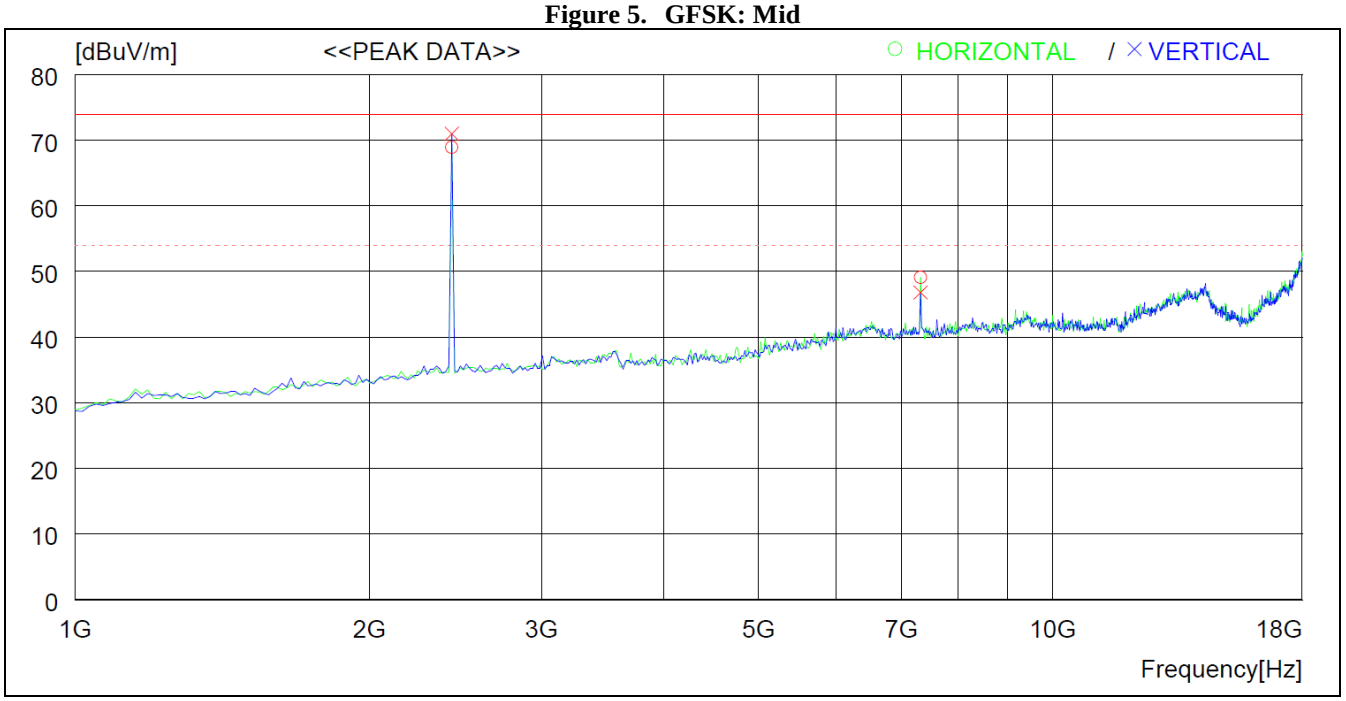
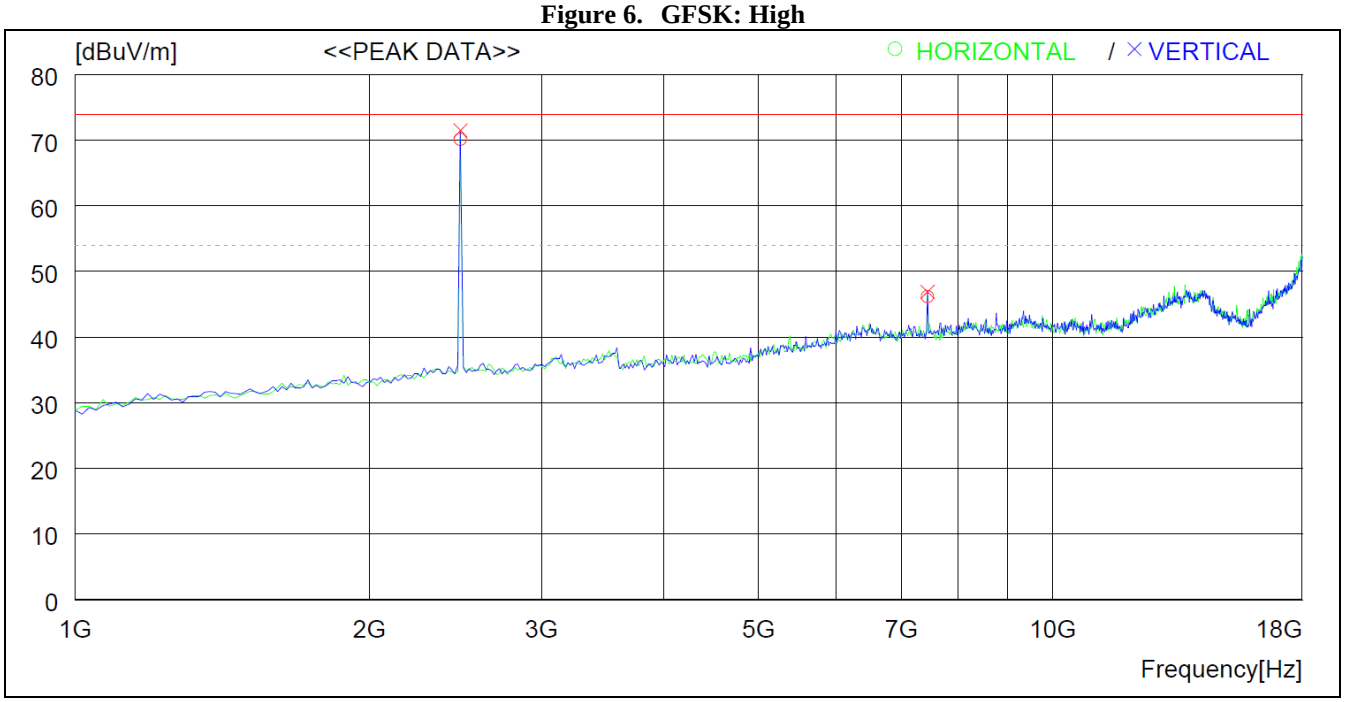


Figure 6. GFSK: High



Host Model Name: SPLIC1BAXCMNZZ

Table 5. Data Table of Radiated emission Below 1 GHz

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
67.83	V	PK	42.7	-15.7	27.0	40.0	13.0
105.66	H	PK	42.2	-13.9	28.3	43.5	15.2
126.03	H	PK	46.9	-15.9	31.0	43.5	12.5
152.22	V	PK	39.0	-16.0	23.0	43.5	20.5
299.66	H	PK	33.9	-9.8	24.1	46.0	21.9
401.51	H	PK	33.1	-6.9	26.2	46.0	19.8

Supplementary information:

- According to KDB 937606, a used anechoic chamber were equivalent to those on an open fields site based on comparison measurements.
- GFSK high channel is worst case configuration.
- The worst case is y-axis and reported.
- Factor = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)
- Quasi-peak measurements are omited because the peak data meets the limit.

Table 6. Data Table of Radiated emission Above 1 GHz – Low Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7205.00	H	PK	56.1	-1.3	54.8	74.0	19.2
7205.00	H	AV	44.1	0.8	44.9	54.0	9.1
7205.00	V	PK	52.3	-1.3	51.0	74.0	23.0
7205.00	V	AV	41.4	0.8	42.2	54.0	11.8

Table 7. Data Table of Radiated emission Above 1 GHz – Middle Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7324.00	H	PK	50.5	-1.3	49.2	74.0	24.8
7324.00	H	AV	38.2	0.8	39.0	54.0	15.0
7324.00	V	PK	48.2	-1.3	46.9	74.0	27.1
7324.00	V	AV	37.2	0.8	38.0	54.0	16.0

Table 8. Data Table of Radiated emission Above 1 GHz – High Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7443.00	H	PK	47.2	-1.2	46.0	74.0	28.0
7443.00	H	AV	35.5	0.9	36.4	54.0	17.6
7443.00	V	PK	48.8	-1.2	47.6	74.0	26.4
7443.00	V	AV	37.0	0.9	37.9	54.0	16.1

Supplementary information:

- Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.
- No other spurious and harmonic emissions were found greater than listed emissions on above table.
- The worst case is y-axis and reported.
- * Factor(PK) = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- * Factor(AV) = AF + CL + AG + Duty factor (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)

Host Model Name: SPLIFRBAXCMNZZ

Table 9. Data Table of Radiated emission Below 1 GHz

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
67.83	V	PK	43.1	-15.7	27.4	40.0	12.6
106.63	H	PK	41.5	-13.9	27.6	43.5	15.9
125.06	H	PK	47.1	-15.9	31.2	43.5	12.3
154.16	V	PK	39.3	-16.0	23.3	43.5	20.2
241.46	H	PK	34.7	-10.9	23.8	46.0	22.2
401.51	H	PK	33.0	-7.0	26.0	46.0	20.0

Supplementary information:

- According to KDB 937606, a used anechoic chamber were equivalent to those on an open fields site based on comparison measurements.
- GFSK high channel is worst case configuration.
- The worst case is y-axis and reported.
- Factor = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)
- Quasi-peak measurements are omited because the peak data meets the limit.

Table 10. Data Table of Radiated emission Above 1 GHz – Low Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7205.00	H	PK	56.2	-1.3	54.9	74.0	19.1
7205.00	H	AV	44.0	0.8	44.8	54.0	9.2
7205.00	V	PK	52.4	-1.3	51.1	74.0	22.9
7205.00	V	AV	41.7	0.8	42.5	54.0	11.5

Table 11. Data Table of Radiated emission Above 1 GHz – Middle Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7324.00	H	PK	50.2	-1.3	48.9	74.0	25.1
7324.00	H	AV	38.0	0.8	38.8	54.0	15.2
7324.00	V	PK	47.6	-1.3	46.3	74.0	27.7
7324.00	V	AV	36.9	0.8	37.7	54.0	16.3

Table 12. Data Table of Radiated emission Above 1 GHz – High Channel

Frequency [MHz]	Pol.	Detect Mode	Reading [dB(μV)]	Factor* [dB]	Level [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
7443.00	H	PK	47.5	-1.2	46.3	74.0	27.7
7443.00	H	AV	35.6	0.9	36.5	54.0	17.5
7443.00	V	PK	47.3	-1.2	46.1	74.0	27.9
7443.00	V	AV	36.6	0.9	37.5	54.0	16.5

Supplementary information:

- Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.
- No other spurious and harmonic emissions were found greater than listed emissions on above table.
- The worst case is y-axis and reported.
- * Factor(PK) = AF + CL + AG (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- * Factor(AV) = AF + CL + AG + Duty factor (AF : Antenna factor, CL : Cable loss, AG: Pre-Amp gain)
- Level = Reading + Factor (Factor = AF + CL + AG)
- Margin = Limit (dBuV/m) - Level (dBuV/m)

5.3. AC power line conducted emissions

TEST: AC Power line conducted emissions			
Method	Measurements were made on a ground plane that extends 1-meter minimum beyond all sides of the system under test. All power was connected to the system through Artificial Mains Network (AMN). Conducted voltage measurements on mains lines were made at the output of the AMN.		
Reference Clause	Part15 C Section 15.207 (a) RSS-GEN 8.8		
Parameters recorded during the test	Laboratory Ambient Temperature	23.0 °C	
	Relative Humidity	46.1 %	
	Frequency range	Measurement Point	
Fully configured sample scanned over the following frequency range	0.15 MHz to 30 MHz	AC Input of DC Power supply	

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
2	1	2
Supplementary information: None		

Limits

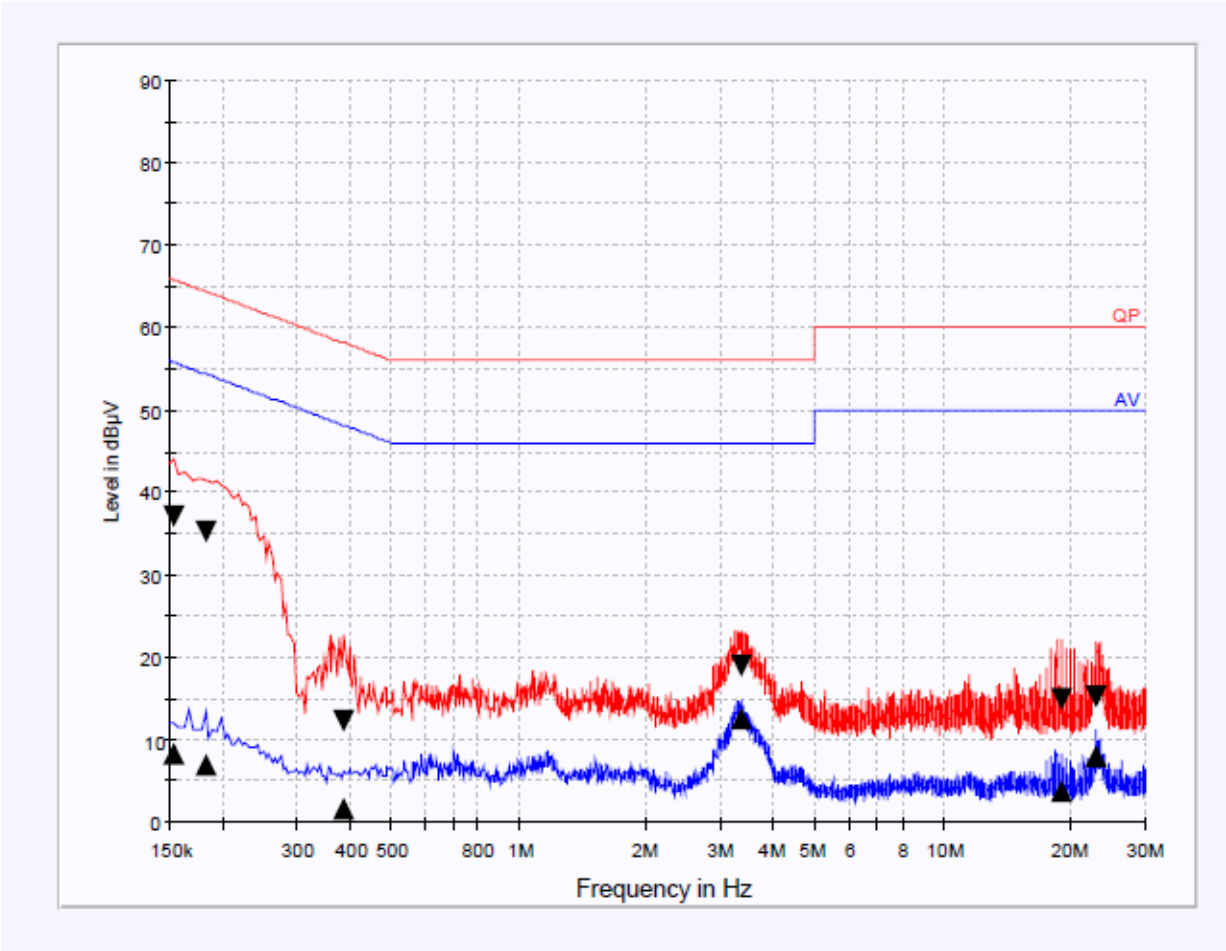
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency[MHz]	Limit[dBuV]	
	Quasi-Peak	Average(2)
0.15 to 0.50	66 to 56(1)	56 to 46(1)
0.50 to 5	56	46
5 to 30	60	50

Note;
1. The level decreases linearly with the logarithm of the frequency.
2. A linear average detector is required.

Table 13. Graphical representation & Test Data (Host Model Name: SPLIF6BAXCMNZZ)

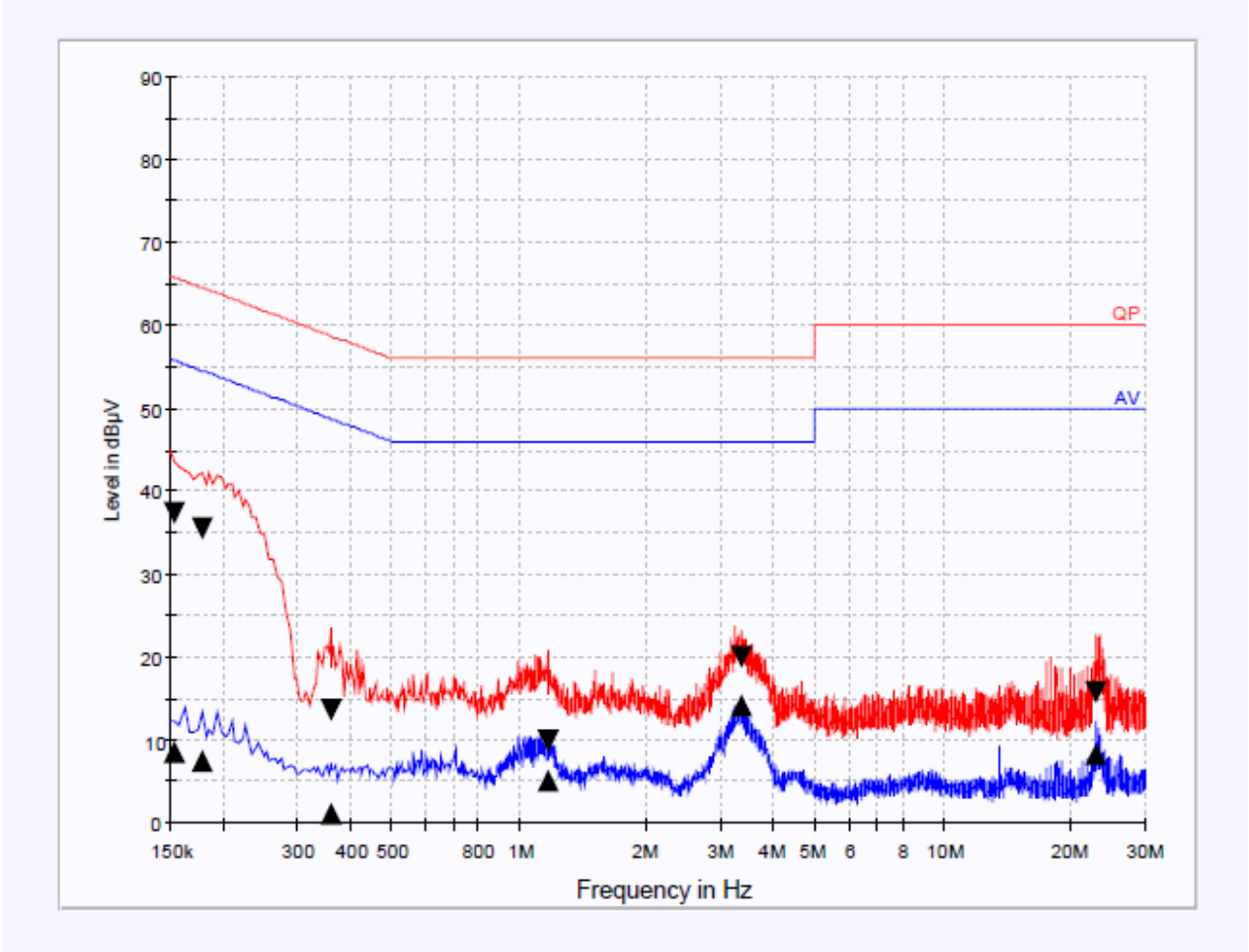
[L1]



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	37.1	8.3	9.000	L1	9.6	28.6	65.8	47.4	55.8
0.182000	35.2	7.1	9.000	L1	9.6	29.1	64.4	47.3	54.4
0.386000	12.2	1.5	9.000	L1	9.6	45.9	58.1	46.7	48.1
3.326000	18.9	12.6	9.000	L1	9.7	37.1	56.0	33.4	46.0
18.998000	15.1	3.8	9.000	L1	10.0	44.9	60.0	46.2	50.0
22.994000	15.3	7.9	9.000	L1	10.0	44.7	60.0	42.1	50.0

[NEUTRAL]

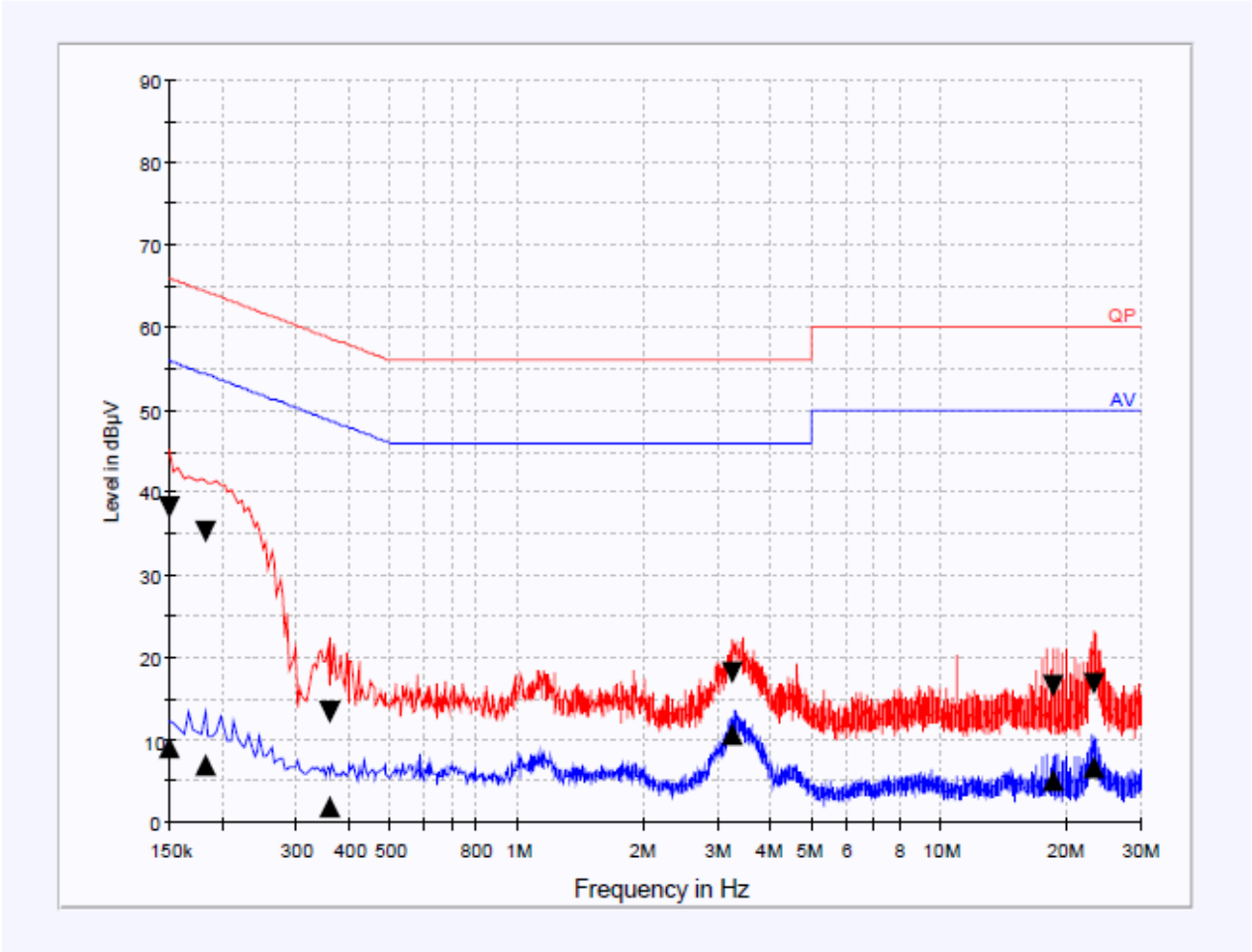


Limit and Margin1

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	37.3	8.4	9.000	N	9.6	28.5	65.8	47.3	55.8
0.178000	35.5	7.4	9.000	N	9.6	29.1	64.6	47.2	54.6
0.358000	13.7	1.2	9.000	N	9.6	45.1	58.8	47.6	48.8
1.170000	9.8	5.0	9.000	N	9.6	46.2	56.0	41.0	46.0
3.338000	20.1	14.2	9.000	N	9.7	35.9	56.0	31.8	46.0
22.990000	15.7	8.4	9.000	N	10.1	44.3	60.0	41.6	50.0

Table 14. Graphical representation & Test Data (Host Model Name: SPLIC1BAXCMNZZ)

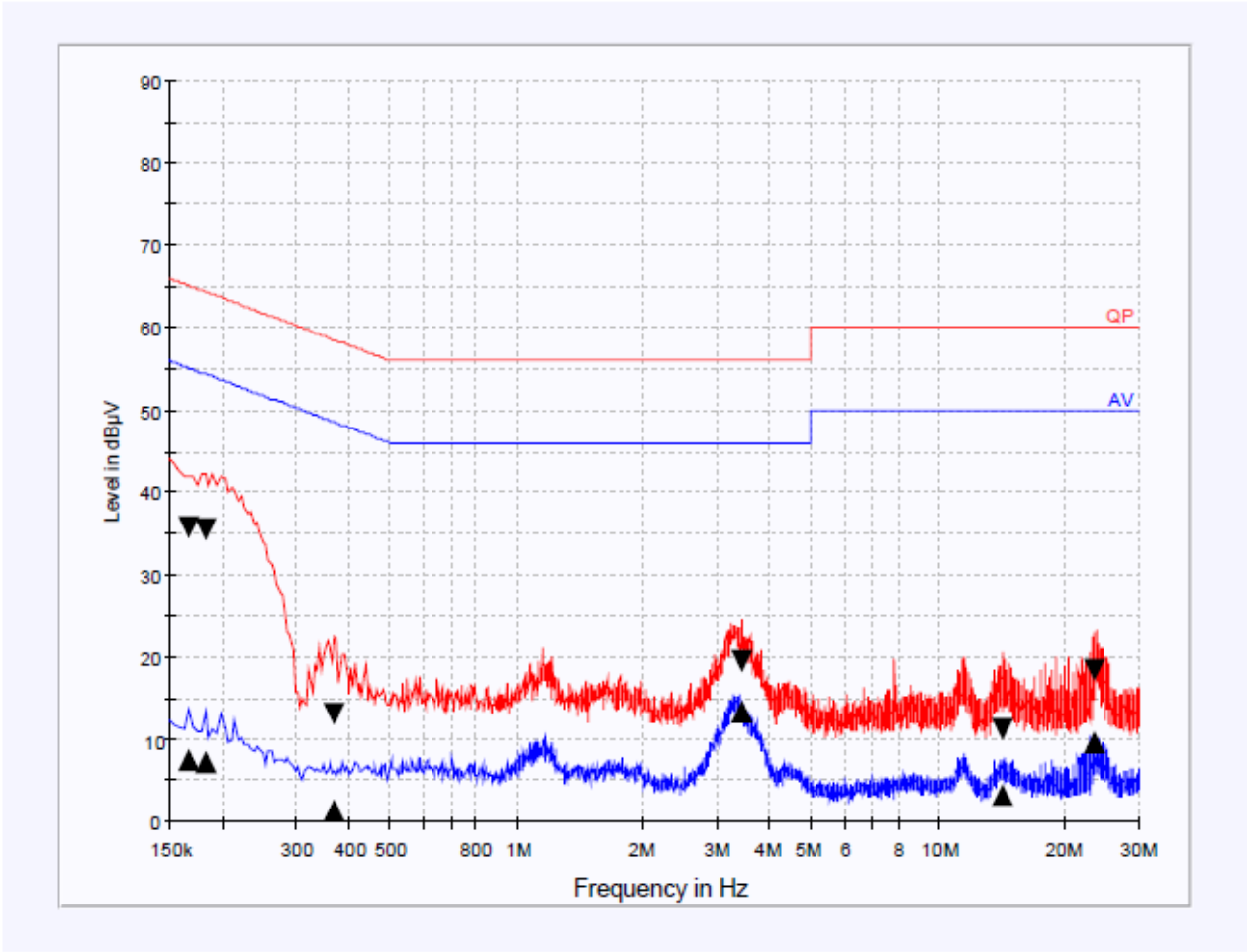
[L1]



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	38.1	9.2	9.000	L1	9.6	27.9	66.0	46.8	56.0
0.182000	35.3	7.0	9.000	L1	9.6	29.1	64.4	47.3	54.4
0.362000	13.4	1.9	9.000	L1	9.6	45.3	58.7	46.8	48.7
3.246000	18.1	10.7	9.000	L1	9.7	37.9	56.0	35.3	46.0
18.506000	16.6	5.0	9.000	L1	10.0	43.4	60.0	45.0	50.0
23.258000	16.9	6.7	9.000	L1	10.0	43.1	60.0	43.3	50.0

[NEUTRAL]

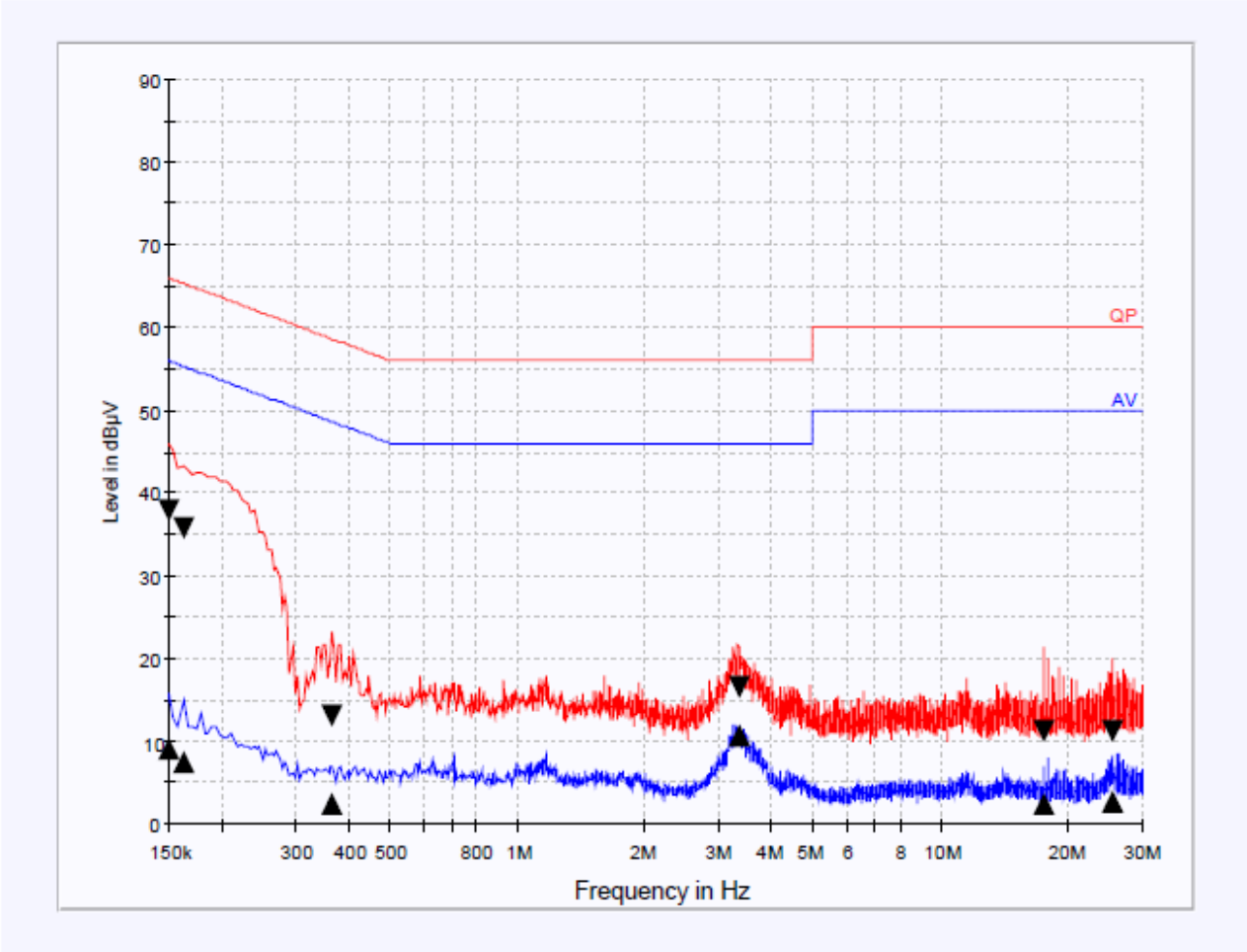


Limit and Margin1

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	35.7	7.5	9.000	N	9.6	29.5	65.2	47.7	55.2
0.182000	35.4	7.2	9.000	N	9.6	28.9	64.4	47.2	54.4
0.370000	13.0	1.4	9.000	N	9.6	45.5	58.5	47.1	48.5
3.422000	19.5	13.4	9.000	N	9.7	36.5	56.0	32.6	46.0
14.198000	11.1	3.3	9.000	N	9.9	48.9	60.0	46.7	50.0
23.502000	18.5	9.7	9.000	N	10.1	41.5	60.0	40.3	50.0

Table 15. Graphical representation & Test Data (Host Model Name: SPLI FR BAXCMNZZ)

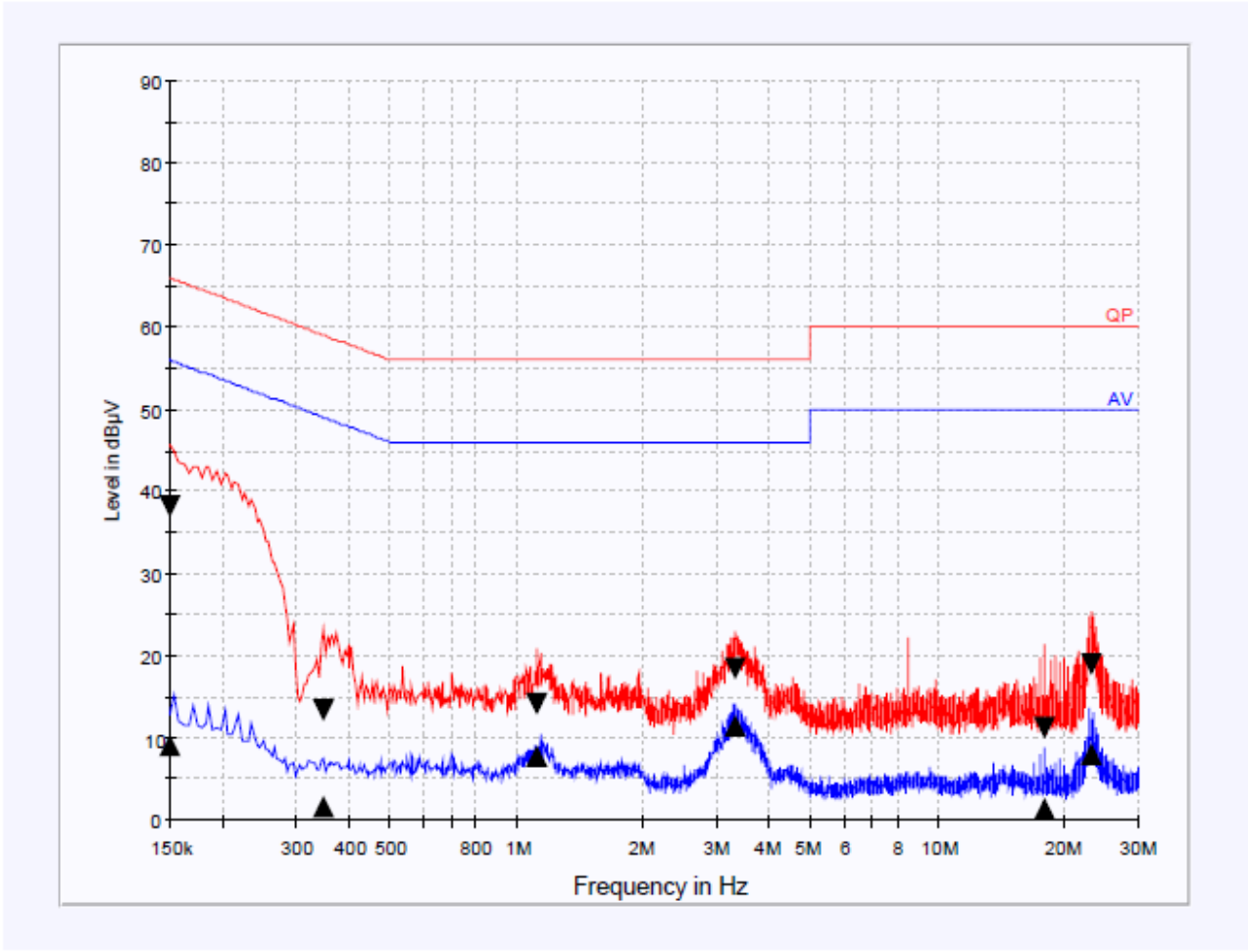
[L1]



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	38.0	9.1	9.000	L1	9.6	28.0	66.0	46.9	56.0
0.162000	35.7	7.5	9.000	L1	9.6	29.6	65.4	47.9	55.4
0.366000	13.2	2.3	9.000	L1	9.6	45.4	58.6	46.3	48.6
3.326000	16.6	10.7	9.000	L1	9.7	39.4	56.0	35.3	46.0
17.482000	11.1	2.3	9.000	L1	10.0	48.9	60.0	47.7	50.0
25.534000	11.1	2.7	9.000	L1	10.0	48.9	60.0	47.3	50.0

[NEUTRAL]



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	38.3	9.2	9.000	N	9.6	27.7	66.0	46.8	56.0
0.346000	13.3	1.6	9.000	N	9.6	45.8	59.1	47.5	49.1
1.114000	14.2	7.8	9.000	N	9.6	41.8	56.0	38.2	46.0
3.318000	18.5	11.5	9.000	N	9.7	37.5	56.0	34.5	46.0
17.982000	11.2	1.2	9.000	N	10.0	48.8	60.0	48.8	50.0
23.202000	18.9	7.9	9.000	N	10.1	41.1	60.0	42.1	50.0

5.4. Antenna Requirement

5.4.1. Standard Applicable

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in Db that the gain of the antenna exceeds 6 dBi.

5.4.2. Antenna Connected Construction

The antenna used of this product is PCB Pattern Antenna Assembly and peak max gain of each antennas as below . :

Band	2 402 – 2 480 MHz
Antenna Gain (dBi)	-1.50

APPENDIX A. ACCREDITATIONS AND AUTHORIZATIONS

ENG Co., Ltd. has been accredited / filed / authorized by the agencies listed in the following table;

Certificate	Nation	Agency	Code	Mark
Site Filing	USA	FCC	KR0160	Test Facility list & NSA Data
Certification	Korea	KC	KR0160	Test Facility list & NSA Data
Site Filing	CANADA	IC	12721A	Test Facility list & NSA Data

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competent of calibration and testing laboratory”.

APPENDIX B. MEASUREMENT UNCERTAINTIES

Test Items	Expanded Uncertainty	
Conducted RF Power	± 0.95 dB	
Radiated Spurious Emissions	0.009 MHz to 30 MHz	± 2.09 dB
	30 MHz to 1 000 MHz	± 4.74 dB
	1 GHz to 18 GHz	± 4.83 dB
AC Power-line Conducted Emissions	0.009 MHz to 30 MHz	± 2.07 dB