

FCC/ISED

RF

TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.



FOR
Navigation and Multimedia device

ISSUED TO
Robert Bosch Car Multimedia GmbH

Robert-Bosch-Str. 200, 31139 Hildesheim, Germany



Tested by: Hu Chao
(Engineer)

Date: Aug. 01, 2018

Approved by: Wei Yanguan
(Chief Engineer)

Date: Aug. 01, 2018

Report No.: BL-SZ1870190-601
EUT Name: Navigation and Multimedia device
Model Name: AIVIH60A0
Brand Name: Bosch
Test Standard: 47 CFR Part 15 Subpart C
RSS-Gen (Issue 5, April 2018)
RSS-247 (Issue 2, February 2017)
FCC ID: YBN-AIVIH60A0
ISED Number: 9595A- AIVIH60A0

Test conclusion: Pass
Test Date: Jul. 17, 2018 ~ Jul. 20, 2018
Date of Issue: Aug. 01, 2018

NOTE: This test report of test results only related to testing samples, which can be duplicated completely for the legal use with the approval of the applicant; it shall not be reproduced except in full, without the written approval of Shenzhen BALUN Technology Co., Ltd. BALUN Laboratory. Any objections should be raised within thirty days from the date of issue. To validate the report, please contact us.

Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Aug. 01, 2018</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	ADMINISTRATIVE DATA (GENERAL INFORMATION)	5
1.1	Identification of the Testing Laboratory	5
1.2	Identification of the Responsible Testing Location	5
1.3	Laboratory Condition	5
1.4	Announce	5
2	PRODUCT INFORMATION	6
2.1	Applicant Information	6
2.2	Manufacturer Information	6
2.3	Factory Information	6
2.4	General Description for Equipment under Test (EUT)	6
2.5	Ancillary Equipment	6
2.6	Technical Information	7
2.7	Additional Instructions	8
3	SUMMARY OF TEST RESULTS	9
3.1	Test Standards	9
3.2	Verdict	10
4	GENERAL TEST CONFIGURATIONS	11
4.1	Test Environments	11
4.2	Test Equipment List	11
4.3	Measurement Uncertainty	12
4.4	Description of Test Setup	13
4.4.1	For Antenna Port Test	13
4.4.2	For AC Power Supply Port Test	13
4.4.3	For Radiated Test (Below 30 MHz)	14
4.4.4	For Radiated Test (30 MHz-1 GHz)	14
4.4.5	For Radiated Test (Above 1 GHz)	15
4.5	Measurement Results Explanation Example	16

4.5.1	For conducted test items:	16
4.5.2	For radiated band edges and spurious emission test:.....	16
5	TEST ITEMS.....	17
5.1	Antenna Requirements.....	17
5.1.1	Relevant Standards.....	17
5.1.2	Antenna Anti-Replacement Construction	18
5.1.3	Antenna Gain	18
5.2	Number of Hopping Frequencies	19
5.2.1	Limit.....	19
5.2.2	Test Setup.....	19
5.2.3	Test Procedure.....	19
5.2.4	Test Result	19
5.3	Peak Output Power and E.I.R.P.....	20
5.3.1	Test Limit.....	20
5.3.2	Test Setup.....	20
5.3.3	Test Procedure.....	20
5.3.4	Test Result	20
5.4	Occupied Bandwidth	21
5.4.1	Limit.....	21
5.4.2	Test Setup.....	21
5.4.3	Test Procedure.....	21
5.4.4	Test Result	21
5.5	Carrier Frequency Separation	22
5.5.1	Limit.....	22
5.5.2	Test Setup.....	22
5.5.3	Test Procedure.....	22
5.5.4	Test Result	22
5.6	Time of Occupancy (Dwell time)	23
5.6.1	Limit.....	23
5.6.2	Test Setup.....	23
5.6.3	Test Procedure.....	23
5.6.4	Test Result	23
5.7	Conducted Spurious Emission & Authorized-band band-edge	24

5.7.1	Limit.....	24
5.7.2	Test Setup	24
5.7.3	Test Procedure	24
5.7.4	Test Result	24
5.8	Conducted Emission	25
5.8.1	Limit.....	25
5.8.2	Test Setup	25
5.8.3	Test Procedure	25
5.8.4	Test Result	25
5.9	Radiated Spurious Emission	26
5.9.1	Limit.....	26
5.9.2	Test Setup	26
5.9.3	Test Procedure	26
5.9.4	Test Result	27
5.10	Band Edge (Restricted-band band-edge).....	28
5.10.1	Limit.....	28
5.10.2	Test Setup	28
5.10.3	Test Procedure	28
5.10.4	Test Result	28
ANNEX A	TEST RESULT	29
A.1	Number of Hopping Frequency	29
A.2	Peak Output Power and E.I.R.P.....	30
A.3	20 dB and 99% bandwidth	31
A.4	Hopping Frequency Separation.....	31
A.5	Average Time of Occupancy	31
A.6	Conducted Spurious Emissions & Authorized-band band-edge	31
A.7	Conducted Emissions.....	31
A.8	Radiated Spurious Emission	32
A.9	Band Edge (Restricted-band band-edge).....	42
ANNEX B	TEST SETUP PHOTOS	44

1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	<p>The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1.</p> <p>The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.</p> <p>The laboratory is a testing organization accredited by American Association for Laboratory Accreditation(A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01.</p> <p>The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.</p>
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20°C to 25°C
Ambient Relative Humidity	45% to 55%
Ambient Pressure	100 kPa to 102 kPa

1.4 Announce

- (1) The test report reference to the report template version v5.10.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.
- (5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.
- (6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Robert Bosch Car Multimedia GmbH
Address	Robert-Bosch-Str. 200, 31139 Hildesheim, Germany

2.2 Manufacturer Information

Manufacturer	Robert Bosch Car Multimedia GmbH
Address	Robert-Bosch-Str. 200, 31139 Hildesheim, Germany

2.3 Factory Information

Factory 1	Bosch Car Multimedia Portugal, S.A.
Address 1	Rua Max Grundig, 35-Lomar, 4705-820 Braga
Factory 2	Robert Bosch (Malaysia)
Address 2	Free Trade Zone 11900, Bayan Lepas, Penang
Factory 3	Bosch Automotive Products (Wuhu) Co., Ltd.
Address 3	No. 88 Guandoumen Road, Jiujiang District; Wuhu City, Anhui Province 241000; China

2.4 General Description for Equipment under Test (EUT)

EUT Name	Navigation and Multimedia device
Model Name Under Test	AIVIH60A0
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	001
Software Version	X308
Dimensions (Approx.)	27.8*15.6*17cm
Weight (Approx.)	N/A

2.5 Ancillary Equipment

Note: Not applicable.

2.6 Technical Information

Network and Wireless connectivity	Bluetooth 4.0 (BR+EDR) WIFI 802.11a, 802.11b, 802.11g and 802.11n (HT20/40), 802.11ac
-----------------------------------	--

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Product Type	<input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable <input type="checkbox"/> Fix Location
Transfer Rate	DH5: 1 Mbps 2DH5: 2 Mbps 3DH5: 3 Mbps
Frequency Range	The frequency range used is 2400 MHz to 2483.5 MHz.
Number of channel	79 (at intervals of 1 MHz)
Tested Channel	0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz)
Antenna Type	Integrated Antenna
Antenna Gain	1.7dBi
Antenna System(MIMO Smart Antenna)	N/A

All channel was listed on the following table:

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	2402	21	2423	42	2444	63	2465
1	2403	22	2424	43	2445	64	2466
2	2404	23	2425	44	2446	65	2467
3	2405	24	2426	45	2447	66	2468
4	2406	25	2427	46	2448	67	2469
5	2407	26	2428	47	2449	68	2470
6	2408	27	2429	48	2450	69	2471
7	2409	28	2430	49	2451	70	2472
8	2410	29	2431	50	2452	71	2473
9	2411	30	2432	51	2453	72	2474
10	2412	31	2433	52	2454	73	2475
11	2413	32	2434	53	2455	74	2476
12	2414	33	2435	54	2456	75	2477
13	2415	34	2436	55	2457	76	2478
14	2416	35	2437	56	2458	77	2479
15	2417	36	2438	57	2459	78	2480
16	2418	37	2439	58	2460	-	-
17	2419	38	2440	59	2461	-	-
18	2420	39	2441	60	2462	-	-
19	2421	40	2442	61	2463	-	-
20	2422	41	2443	62	2464	-	-

2.7 Additional Instructions

EUT Software Settings:

Mode	<input checked="" type="checkbox"/> Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually. And the software is installed on the lab test computer.
Test Software Version	Dut labtool V2.0.0.89

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Miscellaneous Wireless Communications Services
2	RSS-Gen (Issue 5, Apr. 2018)	General Requirements for Compliance of Radio Apparatus
3	RSS-247 (Issue 2, February 2017)	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
4	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	ISED Part No.	Channel	Test Result	Verdict	Remark
1	Antenna Requirement	15.203	RSS-247, 5.4 (6)	N/A	--	Pass	Note ¹
2	Number of Hopping Frequencies	15.247(a)	RSS-247, 5.1 (4)	Hopping Mode	ANNEX A.1	Pass	Note ^{2, 4}
3	Peak Output Power and E.I.R.P	15.247(b)	RSS-247, 5.4 (2)	Low/Middle/High	ANNEX A.2	Pass	--
4	Occupied Bandwidth	15.247(a)	RSS-247, 5.1 (1)	Low/Middle/High	ANNEX A.3	Pass	Note ^{2, 4}
5	Carrier Frequency Separation	15.247(a)	RSS-247, 5.1 (2)	Hopping Mode	ANNEX A.4	Pass	Note ^{2, 4}
6	Time of Occupancy (Dwell time)	15.247(a)	RSS-247, 5.1 (4)	Hopping Mode	ANNEX A.5	Pass	Note ^{2, 4}
7	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	RSS-247, 5.5	Low/Middle/High	ANNEX A.6	Pass	Note ^{2, 4}
8	Conducted Emission	15.207	RSS-GEN, 8.8	Low/Middle/High	ANNEX A.7	N/A	Note ^{2, 5}
9	Radiated Spurious Emission	15.209 15.247(d)	RSS-247, 5.5	Hopping Mode, Low/Middle/High	ANNEX A.8	Pass	Note ²
10	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	RSS-247, 5.5	Hopping Mode, Low/Middle/High	ANNEX A.9	Pass	Note ²
11	Receiver Spurious Emissions	--	RSS-Gen, 7.1.2	--	--	N/A	Note ³

Note ¹: The Antenna is fixed install and not removable.

Note ²: Because of the modulation of $\Pi/4$ -DQPSK same as 8-DPSK, and the test results are basically the same with them, so we chose 8-DPSK as a typical representative to appear on the report. Another we will show all the modes on the RF output power test item

Note ³: Only radio communication receivers operating in stand-alone mode within the band 30-960 MHz, as well as scanner receivers, are subject to Industry Canada requirements, so this test is not applicable.

Note ⁴: This report is partial report and referencing to the "original" report BTL-FCCP-1-1807C078 by BTL Inc. (FCC ID: YBN-AIVIL42P0) and report BTL-ISED-1-1807C078 by BTL Inc. (IC: 9595A-AIVIL42P0). This report just test Output Power, Radiated Spurious Emission and Band Edge(Restricted-band band-edge) after evaluation.

Note ⁵: The EUT only powered by battery, so the Conducted Emission test is not applicable.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% to 55%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22°C to +25°C
Working Voltage of the EUT	NV (Normal Voltage)	13.6 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-40	101544	2018.06.11	2019.06.10
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2018.06.11	2019.06.10
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2017.09.07	2018.09.06
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2018.06.11	2019.06.10
Power Splitter	KMW	DCPD-LDC	1305003215	--	--
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2018.06.11	2019.06.10
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ITECH	IT6720	6001030107 17610007	2018.06.21	2019.06.20
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2017.11.07	2019.11.08
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2017.07.22	2019.07.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2017.07.11	2019.07.10
Test Antenna-Horn(15-26.5 GHz)	SCHWARZBECK	BBHA 9170	9170-305	2018.06.21	2019.06.20
Test Antenna-Horn (18-40 GHz)	A-INFO	LB-180400KF	J211060273	2017.01.06	2019.01.05
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2019.02.20
laptop	Lenovo	X220	4286A17	N/A	N/A
Software	BALUN	BL410R	2.1.1.345	N/A	N/A
RF cable	Balun	Balun1	SRD01	2018.04.25	2018.10.24
RF cable	Balun	Balun2	SRD02	2018.04.25	2018.10.24
RF cable	Balun	EMC1	EMC01	2018.04.25	2018.10.24
RF cable	Huber&suhner	Boa-flex I	N/A	2018.04.25	2018.10.24
RF cable	Huber&suhner	Steel-flex I	N/A	2018.04.25	2018.10.24

4.3 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Measurement	Value
Occupied Channel Bandwidth	$\pm 4\%$
RF output power, conducted	± 1.4 dB
Power Spectral Density, conducted	± 2.5 dB
Unwanted Emissions, conducted	± 2.8 dB
All emissions, radiated	± 5.4 dB
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 4\%$

4.4.1 For Antenna Port Test

$$\text{Conducted value (dBm)} = \text{Measurement value (dBm)} + \text{cable loss (dB)}$$

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

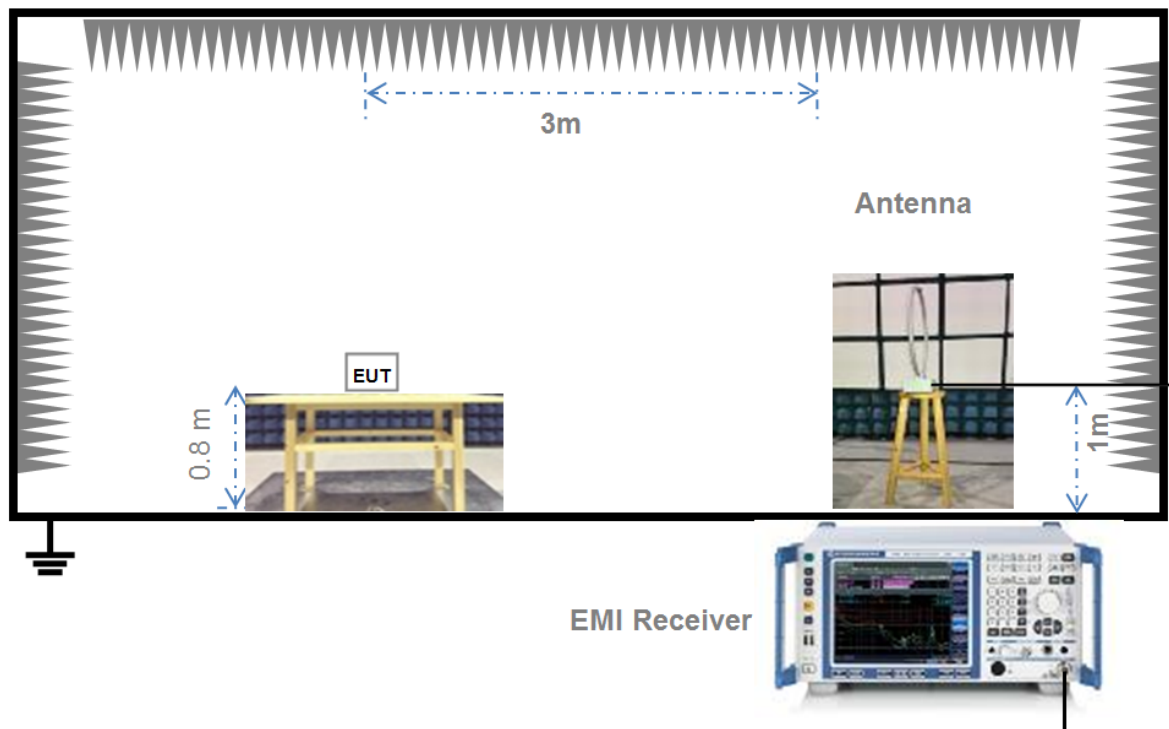
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



4.4.2 For AC Power Supply Port Test

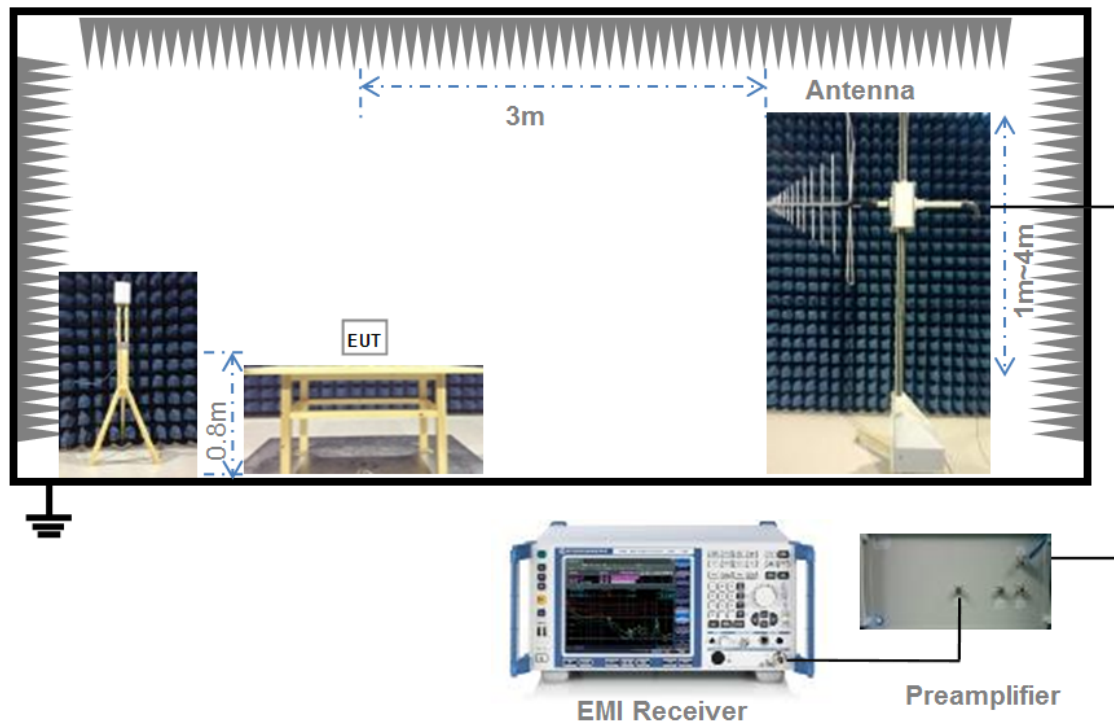


4.4.3 For Radiated Test (Below 30 MHz)



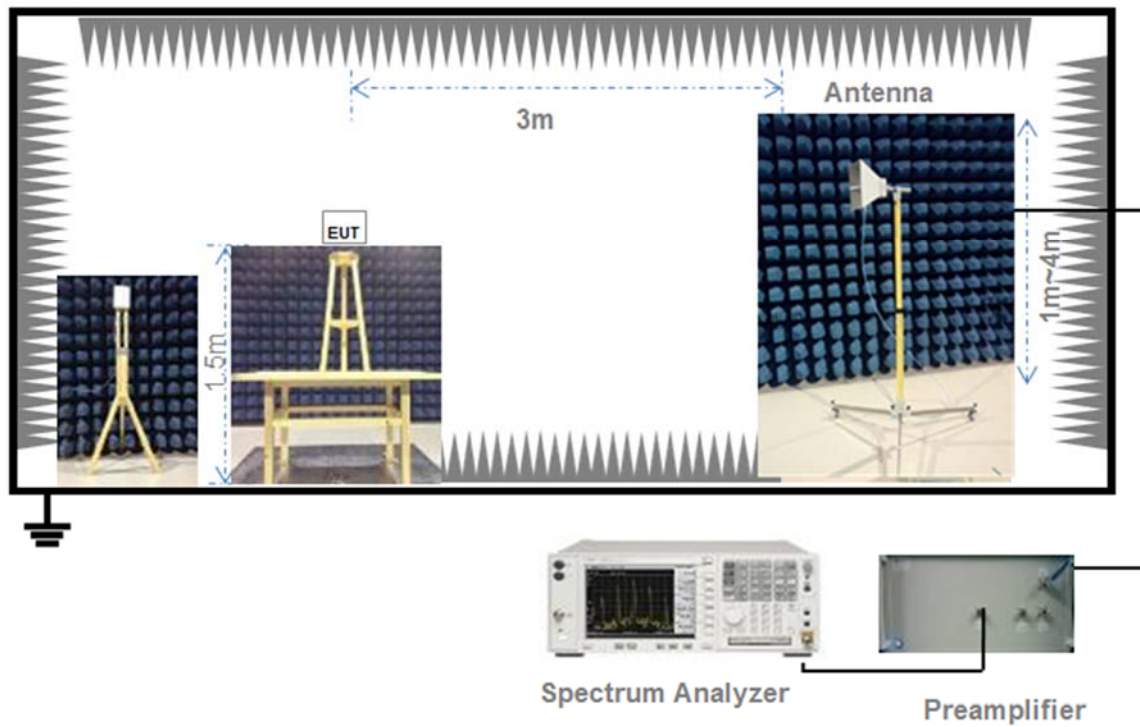
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

4.5.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.

The average level is derived from the peak level corrected with "Duty cycle correction factor".

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)

Duty cycle correction factor (dB) = $20 * \log (\text{Duty cycle})$.

Duty cycle = on time / 100 milliseconds

On time = dwell time * hopping number in 100 ms

For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then

Duty cycle correction factor (dB) = $20 * \log ((2.9 * 3) / 100) = -21.21 \text{ dB}$

Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.

Example:

Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)

= $45.61 + (-21.21) = 24.4 \text{ (dBuV/m)}$

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

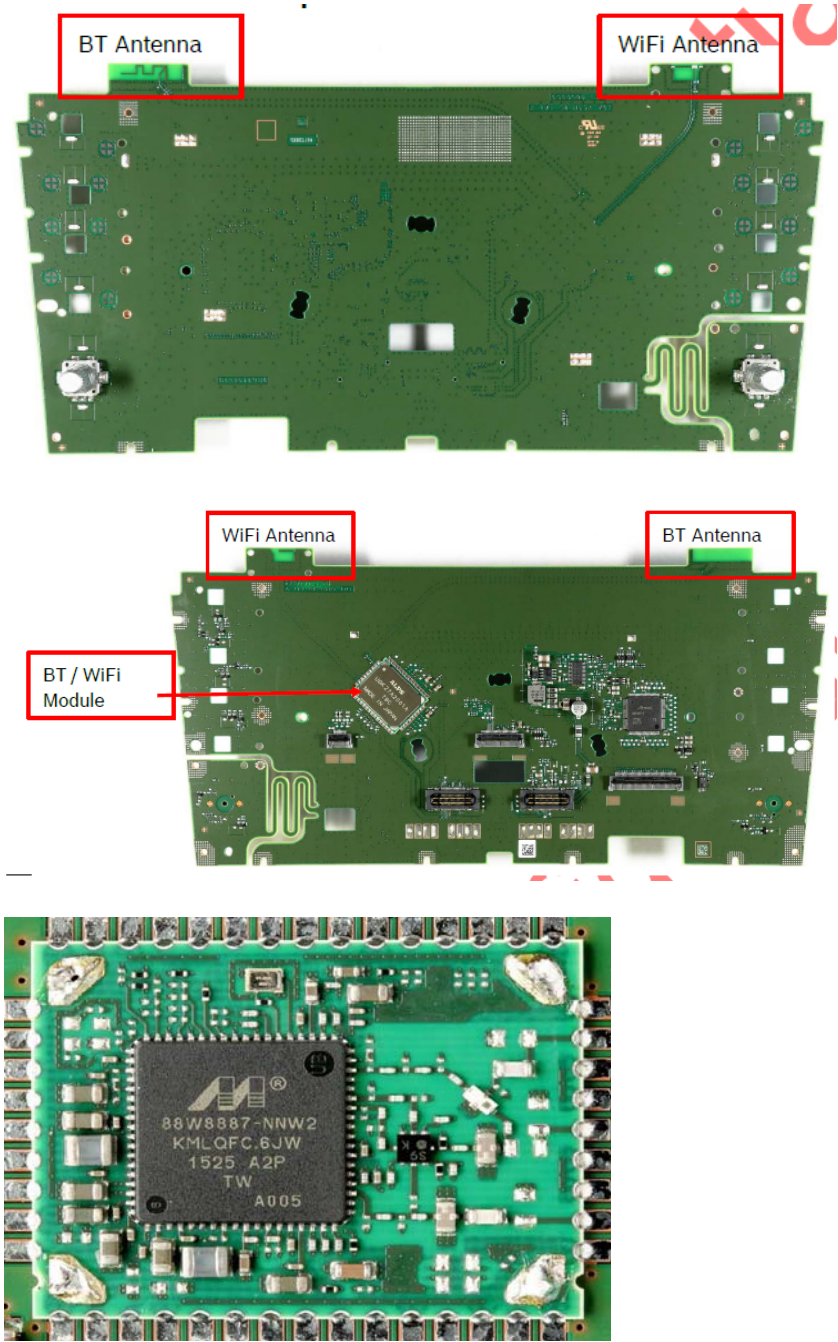
FCC §15.203 & 15.247(b); RSS-247, 5.4 (6)

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 provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Reference Documents	Item
Photo	 <p>The photographs illustrate the antenna anti-replacement construction. The top photo shows the BT Antenna and WiFi Antenna highlighted with red boxes. The middle photo shows the WiFi Antenna and BT Antenna highlighted with red boxes, and the BT / WiFi Module highlighted with a red box. The bottom photo is a close-up of the module, showing the chip number 88W8887-NNW2, KMLQFC.6JW, 1525 A2P, TW, and A005.</p>

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequencies

5.2.1 Limit

FCC §15.247(a) (1) (iii); RSS-247, 5.1 (4)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Peak Output Power and E.I.R.P

5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 (2)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a); RSS-247, 5.1 (1)

Measurement of the 20dB bandwidth of the modulated signal.

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Carrier Frequency Separation

5.5.1 Limit

FCC §15.247(a); RSS-247, 5.1 (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span

Video (or Average) Bandwidth (VBW) \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1 (4)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The average time of occupancy on any channel within the Period can be calculated with formulas:

For GFSK and 8-DPSK:

For DH1 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (1600 / 2) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

For DH3 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (1600 / 4) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

For DH5 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (1600 / 6) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

For AFH Mode:

For DH1 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (800 / 2) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

For DH3 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (800 / 4) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

For DH5 package type

$$\begin{aligned}\{\text{Total of Dwell}\} &= \{\text{Pulse Time}\} * (800 / 6) / \{\text{Number of Hopping Frequency}\} * \{\text{Period}\} \\ \{\text{Period}\} &= 0.4 \text{ s} * \{\text{Number of Hopping Frequency}\}\end{aligned}$$

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.6.4 Test Result

Please refer to ANNEX A.5

5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

FCC §15.247(d); 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.

5.7.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Conducted Emission

5.8.1 Limit

FCC §15.207; RSS-GEN, 8.8

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 within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.8.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. Field Strength (dBμV/m) = $20 \cdot \log[\text{Field Strength } (\mu\text{V/m})]$.
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

A.1 Number of Hopping Frequency

Note: The Number of Hopping Frequency please refer to the Report No. BTL-FCCP-1-1807C078 (which issued by BTL INC. on Jul. 25, 2018), **Section 5.NUMBER OF HOPPING CHANNEL.**

A.2 Peak Output Power and E.I.R.P

Peak Power Test Data

Channel	Measured Output Peak Power		Limit		Verdict
	GFSK		dBm	mW	
	dBm	mW			
Low	-4.40	0.36	30	1000	Pass
Middle	-4.68	0.34			Pass
High	-4.50	0.35			Pass

Channel	Measured Output Peak Power				Limit		Verdict
	π/4-DQPSK		8-DPSK		dBm	mW	
	dBm	mW	dBm	mW			
Low	-4.83	0.33	-4.43	0.36	21	125	Pass
Middle	-4.73	0.34	-4.59	0.35			Pass
High	-4.40	0.36	-4.08	0.39			Pass

A.3 20 dB and 99% bandwidth

Note: The 20 dB and 99% bandwidth please refer to the Report No. BTL-FCCP-1-1807C078 (which issued by BTL INC. on Jul. 25, 2018), **Section 8.BANDWIDTH TEST.**

A.4 Hopping Frequency Separation

Note: The Hopping Frequency Separation please refer to the Report No. BTL-FCCP-1-1807C078 (which issued by BTL INC. on Jul. 25, 2018), **Section 7. HOPPING CHANNEL SEPARATION MEASUREMENT.**

A.5 Average Time of Occupancy

Note: The Average Time of Occupancy please refer to the Report No. BTL-FCCP-1-1807C078 (which issued by BTL INC. on Jul. 25, 2018), **Section 6.AVERAGE TIME OF OCCUPANCY.**

A.6 Conducted Spurious Emissions & Authorized-band band-edge

Note: The Conducted Spurious Emissions & Authorized-band band-edge please refer to the Report No. BTL-FCCP-1-1807C078 (which issued by BTL INC. on Jul. 25, 2018), **Section 10.ANTENNA CONDUCTED SPURIOUS EMISSION.**

A.7 Conducted Emissions

Note: Not applicable.

A.8 Radiated Spurious Emission

Test Data and Plots

Note¹: The symbol of "--" in the table which means not application.

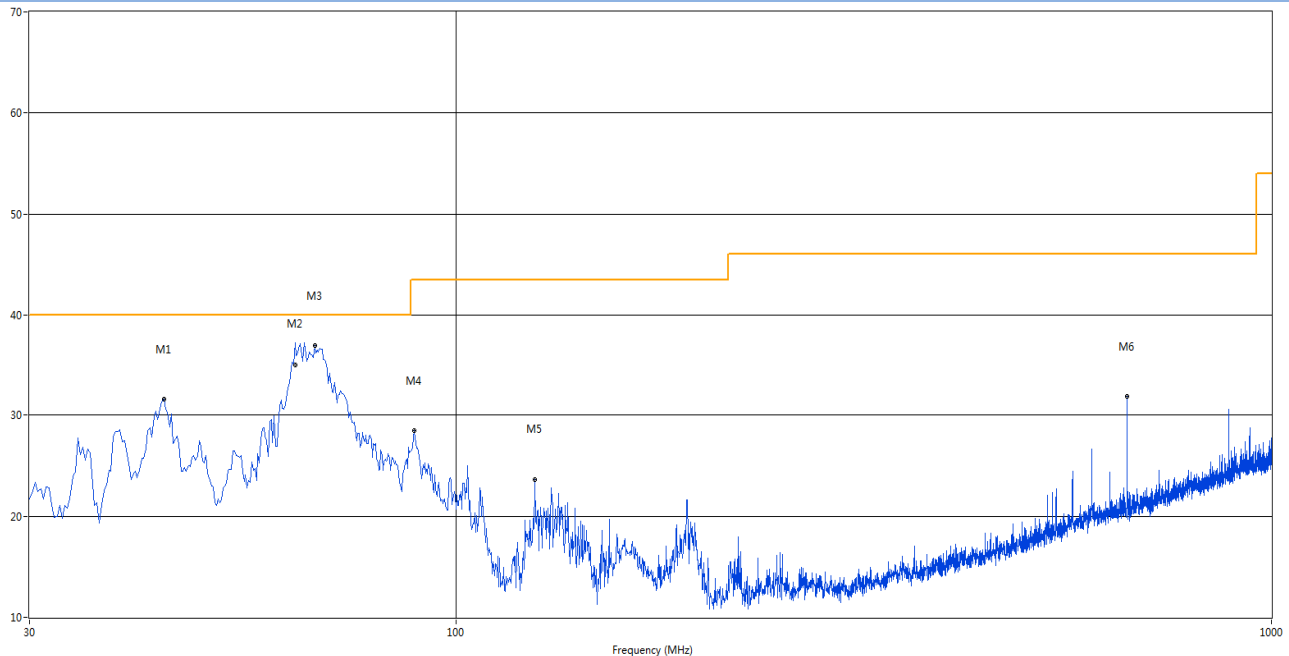
Note²: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note³: The EUT is working in the Normal link mode below 1 GHz.

Note⁴: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

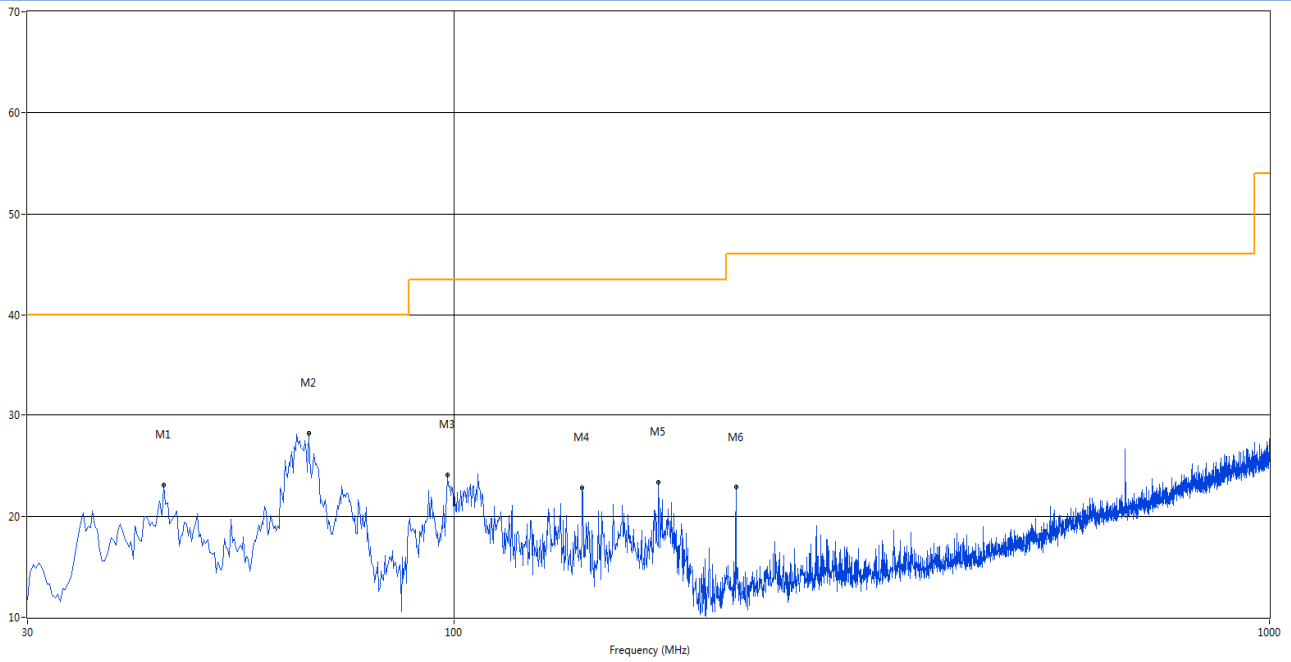
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	43.822	31.55	-23.55	40.0	8.45	Peak	95.00	100	Vertical	Pass
2	63.327	42.71	-25.09	40.0	-2.71	Peak	90.40	102	Vertical	N/A
2*	63.327	34.95	-25.09	40.0	5.05	QP	90.40	102	Vertical	Pass
3	67.103	36.88	-25.82	40.0	3.12	Peak	63.60	100	Vertical	Pass
4	88.927	28.43	-26.78	43.5	15.07	Peak	360.00	200	Vertical	Pass
5	125.060	23.67	-26.89	43.5	19.83	Peak	143.60	100	Vertical	Pass
6	665.350	31.84	-13.08	46.0	14.16	Peak	1.40	100	Vertical	Pass

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	44.065	23.08	-23.57	40.0	16.92	Peak	142.10	200	Horizontal	Pass
2	66.375	28.21	-25.50	40.0	11.79	Peak	190.30	200	Horizontal	Pass
3	98.143	24.08	-24.96	43.5	19.42	Peak	360.00	200	Horizontal	Pass
4	143.732	22.84	-27.71	43.5	20.66	Peak	296.40	200	Horizontal	Pass
5	178.167	23.38	-26.13	43.5	20.12	Peak	270.50	100	Horizontal	Pass
6	221.818	22.86	-24.03	46.0	23.14	Peak	257.00	100	Horizontal	Pass

Test Data and Plots (1 GHz ~ 10th Harmonic)

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious from 12.75GHz-25GHz is noise only, do not show on the report.

GFSK LOW CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.213	31.50	-14.20	54.0	-22.50	AV	220	150	Vertical	Pass
1	1861.866	50.98	-14.20	74.0	-23.02	Peak	220	150	Vertical	Pass
2**	2111.901	42.65	-12.04	54.0	-11.35	AV	197	150	Vertical	Pass
2	2111.672	48.72	-12.04	74.0	-25.28	Peak	197	150	Vertical	Pass
3**	2402.000	80.79	-11.21	54.0	26.79	AV	93	150	Vertical	N/A
3	2402.000	86.86	-11.21	74.0	12.86	Peak	93	150	Vertical	N/A
4**	2970.326	34.79	-9.69	54.0	-19.21	AV	171	150	Vertical	Pass
4	2969.901	47.69	-9.69	74.0	-26.31	Peak	171	150	Vertical	Pass
5**	3695.94	36.40	-6.05	54.0	-17.60	AV	206	150	Vertical	Pass
5	3695.728	45.33	-6.05	74.0	-28.67	Peak	206	150	Vertical	Pass
6**	5171.977	37.51	-1.26	54.0	-16.49	AV	8	150	Vertical	Pass
6	5172.692	48.06	-1.26	74.0	-25.94	Peak	8	150	Vertical	Pass

GFSK LOW CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.950	26.54	-14.86	54.0	-27.47	AV	269	150	Horizontal	Pass
1	1827.306	46.71	-14.86	74.0	-27.29	Peak	269	150	Horizontal	Pass
2**	2111.367	39.16	-11.93	54.0	-14.84	AV	149	150	Horizontal	Pass
2	2111.283	45.81	-11.93	74.0	-28.19	Peak	149	150	Horizontal	Pass
3**	2402.000	81.70	-11.21	54.0	27.70	AV	71	150	Horizontal	N/A
3	2402.000	86.91	-11.21	74.0	12.91	Peak	71	150	Horizontal	N/A
4**	2908.565	38.23	-9.73	54.0	-15.77	AV	149	150	Horizontal	Pass
4	2908.748	48.24	-9.73	74.0	-25.76	Peak	149	150	Horizontal	Pass
5**	3695.518	35.54	-6.36	54.0	-18.46	AV	259	150	Horizontal	Pass
5	3695.567	46.16	-6.36	74.0	-27.84	Peak	259	150	Horizontal	Pass
6**	5447.191	37.64	-0.85	54.0	-16.36	AV	226	150	Horizontal	Pass
6	5447.106	48.35	-0.85	74.0	-25.65	Peak	226	150	Horizontal	Pass

GFSK MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1862.000	32.43	-13.91	54.0	-21.57	AV	218	150	Vertical	Pass
1	1862.000	51.97	-13.91	74.0	-22.03	Peak	218	150	Vertical	Pass
2**	2112.000	42.97	-11.85	54.0	-11.03	AV	195	150	Vertical	Pass
2	2112.000	49.03	-11.85	74.0	-24.97	Peak	195	150	Vertical	Pass
3**	2441.000	81.47	-10.93	54.0	27.47	AV	90	150	Vertical	N/A
3	2441.000	87.75	-10.93	74.0	13.75	Peak	90	150	Vertical	N/A
4**	2970.500	35.31	-8.93	54.0	-18.69	AV	168	150	Vertical	Pass
4	2970.500	48.50	-8.93	74.0	-25.50	Peak	168	150	Vertical	Pass
5**	3696.000	36.67	-5.41	54.0	-17.33	AV	203	150	Vertical	Pass
5	3696.000	46.13	-5.41	74.0	-27.87	Peak	203	150	Vertical	Pass
6**	5172.750	37.60	-0.86	54.0	-16.40	AV	6	150	Vertical	Pass
6	5172.750	48.88	-0.86	74.0	-25.12	Peak	6	150	Vertical	Pass

GFSK MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1828.000	27.40	-14.38	54.0	-26.60	AV	267	150	Horizontal	Pass
1	1828.000	47.17	-14.38	74.0	-26.83	Peak	267	150	Horizontal	Pass
2**	2112.000	39.91	-11.85	54.0	-14.09	AV	147	150	Horizontal	Pass
2	2112.000	46.72	-11.85	74.0	-27.28	Peak	147	150	Horizontal	Pass
3**	2441.000	82.38	-10.93	54.0	28.38	AV	69	150	Horizontal	N/A
3	2441.000	87.47	-10.93	74.0	13.47	Peak	69	150	Horizontal	N/A
4**	2909.000	38.71	-8.95	54.0	-15.29	AV	147	150	Horizontal	Pass
4	2909.000	48.89	-8.95	74.0	-25.11	Peak	147	150	Horizontal	Pass
5**	3696.000	35.68	-5.41	54.0	-18.32	AV	257	150	Horizontal	Pass
5	3696.000	46.28	-5.41	74.0	-27.72	Peak	257	150	Horizontal	Pass
6**	5448.000	38.15	-0.65	54.0	-15.85	AV	224	150	Horizontal	Pass
6	5448.000	48.93	-0.65	74.0	-25.07	Peak	224	150	Horizontal	Pass

GFSK HIGH CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.764	31.76	-14.35	54.0	-22.24	AV	220	150	Vertical	Pass
1	1861.155	51.28	-14.35	74.0	-22.72	Peak	220	150	Vertical	Pass
2**	2111.385	42.63	-12.29	54.0	-11.37	AV	197	150	Vertical	Pass
2	2111.691	48.88	-12.29	74.0	-25.12	Peak	197	150	Vertical	Pass
3**	2480.000	80.49	-10.15	54.0	26.49	AV	92	150	Vertical	N/A
3	2480.000	87.50	-10.15	74.0	13.50	Peak	92	150	Vertical	N/A
4**	2969.66	35.06	-9.41	54.0	-18.94	AV	170	150	Vertical	Pass
4	2969.696	47.55	-9.41	74.0	-26.45	Peak	170	150	Vertical	Pass
5**	3695.17	36.24	-6.24	54.0	-17.76	AV	205	150	Vertical	Pass
5	3695.028	45.89	-6.24	74.0	-28.11	Peak	205	150	Vertical	Pass
6**	5172.694	36.64	-1.72	54.0	-17.37	AV	9	150	Vertical	Pass
6	5172.257	48.17	-1.72	74.0	-25.83	Peak	9	150	Vertical	Pass

GFSK HIGH CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.081	26.99	-14.72	54.0	-27.01	AV	269	150	Horizontal	Pass
1	1827.626	46.50	-14.72	74.0	-27.50	Peak	269	150	Horizontal	Pass
2**	2111.819	39.79	-11.87	54.0	-14.21	AV	149	150	Horizontal	Pass
2	2111.494	46.63	-11.87	74.0	-27.37	Peak	149	150	Horizontal	Pass
3**	2480.000	81.89	-10.15	54.0	27.89	AV	72	150	Horizontal	N/A
3	2480.000	87.08	-10.15	74.0	13.08	Peak	72	150	Horizontal	N/A
4**	2908.399	38.35	-9.58	54.0	-15.65	AV	150	150	Horizontal	Pass
4	2908.576	48.83	-9.58	74.0	-25.17	Peak	150	150	Horizontal	Pass
5**	3695.59	35.15	-5.97	54.0	-18.85	AV	260	150	Horizontal	Pass
5	3695.557	46.21	-5.97	74.0	-27.79	Peak	260	150	Horizontal	Pass
6**	5447.898	37.40	-0.88	54.0	-16.60	AV	227	150	Horizontal	Pass
6	5447.304	48.30	-0.88	74.0	-25.71	Peak	227	150	Horizontal	Pass

8-DPSK LOW CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.284	32.03	-14.24	54.0	-21.97	AV	221	150	Vertical	Pass
1	1861.447	51.82	-14.24	74.0	-22.18	Peak	221	150	Vertical	Pass
2**	2111.754	42.82	-12.76	54.0	-11.18	AV	197	150	Vertical	Pass
2	2111.593	48.18	-12.76	74.0	-25.82	Peak	197	150	Vertical	Pass
3**	2402.000	80.51	-11.21	54.0	26.51	AV	93	150	Vertical	N/A
3	2402.000	87.11	-11.21	74.0	13.11	Peak	93	150	Vertical	N/A
4**	2969.666	35.22	-8.99	54.0	-18.78	AV	170	150	Vertical	Pass
4	2969.981	48.30	-8.99	74.0	-25.70	Peak	170	150	Vertical	Pass
5**	3695.851	36.43	-5.97	54.0	-17.57	AV	206	150	Vertical	Pass
5	3695.298	46.09	-5.97	74.0	-27.91	Peak	206	150	Vertical	Pass
6**	5172.333	37.02	-1.11	54.0	-16.98	AV	8	150	Vertical	Pass
6	5172.035	48.11	-1.11	74.0	-25.90	Peak	8	150	Vertical	Pass

8-DPSK LOW CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.408	27.11	-15.10	54.0	-26.89	AV	270	150	Horizontal	Pass
1	1827.311	46.63	-15.10	74.0	-27.37	Peak	270	150	Horizontal	Pass
2**	2111.167	39.81	-12.36	54.0	-14.19	AV	149	150	Horizontal	Pass
2	2111.791	46.11	-12.36	74.0	-27.89	Peak	149	150	Horizontal	Pass
3**	2402.000	82.08	-11.21	54.0	28.08	AV	72	150	Horizontal	N/A
3	2402.000	86.97	-11.21	74.0	12.97	Peak	72	150	Horizontal	N/A
4**	2908.782	38.04	-9.24	54.0	-15.96	AV	150	150	Horizontal	Pass
4	2908.199	48.57	-9.24	74.0	-25.43	Peak	150	150	Horizontal	Pass
5**	3695.781	34.72	-6.37	54.0	-19.28	AV	259	150	Horizontal	Pass
5	3695.837	45.70	-6.37	74.0	-28.30	Peak	259	150	Horizontal	Pass
6**	5447.683	37.44	-0.98	54.0	-16.56	AV	226	150	Horizontal	Pass
6	5447.174	48.26	-0.98	74.0	-25.74	Peak	226	150	Horizontal	Pass

8-DPSK MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.508	32.31	-14.61	54.0	-21.69	AV	221	150	Vertical	Pass
1	1861.553	51.12	-14.61	74.0	-22.88	Peak	221	150	Vertical	Pass
2**	2111.985	42.09	-12.30	54.0	-11.91	AV	198	150	Vertical	Pass
2	2111.219	49.03	-12.30	74.0	-24.97	Peak	198	150	Vertical	Pass
3**	2441.000	81.26	-10.93	54.0	27.26	AV	93	150	Vertical	N/A
3	2441.000	87.38	-10.93	74.0	13.38	Peak	93	150	Vertical	N/A
4**	2969.893	34.42	-9.09	54.0	-19.58	AV	170	150	Vertical	Pass
4	2969.868	48.10	-9.09	74.0	-25.90	Peak	170	150	Vertical	Pass
5**	3695.199	35.87	-6.10	54.0	-18.13	AV	206	150	Vertical	Pass
5	3695.937	45.57	-6.10	74.0	-28.43	Peak	206	150	Vertical	Pass
6**	5172.712	37.02	-0.88	54.0	-16.98	AV	9	150	Vertical	Pass
6	5172.046	48.33	-0.88	74.0	-25.67	Peak	9	150	Vertical	Pass

8-DPSK MIDDLE CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.087	26.98	-14.98	54.0	-27.02	AV	270	150	Horizontal	Pass
1	1827.975	47.17	-14.98	74.0	-26.83	Peak	270	150	Horizontal	Pass
2**	2111.476	39.24	-12.83	54.0	-14.76	AV	149	150	Horizontal	Pass
2	2111.177	46.11	-12.83	74.0	-27.89	Peak	149	150	Horizontal	Pass
3**	2441.000	81.69	-10.93	54.0	27.69	AV	71	150	Horizontal	N/A
3	2441.000	86.58	-10.93	74.0	12.58	Peak	71	150	Horizontal	N/A
4**	2908.69	37.80	-9.65	54.0	-16.20	AV	150	150	Horizontal	Pass
4	2908.282	48.01	-9.65	74.0	-25.99	Peak	150	150	Horizontal	Pass
5**	3695.719	35.40	-5.70	54.0	-18.60	AV	260	150	Horizontal	Pass
5	3695.897	45.47	-5.70	74.0	-28.54	Peak	260	150	Horizontal	Pass
6**	5447.452	37.91	-1.61	54.0	-16.09	AV	227	150	Horizontal	Pass
6	5447.56	48.89	-1.61	74.0	-25.11	Peak	227	150	Horizontal	Pass

8-DPSK HIGH CHANNEL 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.243	31.79	-14.50	54.0	-22.21	AV	221	150	Vertical	Pass
1	1861.585	51.27	-14.50	74.0	-22.73	Peak	221	150	Vertical	Pass
2**	2111.948	42.84	-12.27	54.0	-11.16	AV	197	150	Vertical	Pass
2	2111.185	48.21	-12.27	74.0	-25.79	Peak	197	150	Vertical	Pass
3**	2480.000	80.90	-10.15	54.0	26.90	AV	92	150	Vertical	N/A
3	2480.000	87.63	-10.15	74.0	13.63	Peak	92	150	Vertical	N/A
4**	2970.269	35.27	-8.93	54.0	-18.73	AV	171	150	Vertical	Pass
4	2969.611	47.96	-8.93	74.0	-26.04	Peak	171	150	Vertical	Pass
5**	3695.391	36.31	-6.30	54.0	-17.69	AV	206	150	Vertical	Pass
5	3695.188	45.80	-6.30	74.0	-28.20	Peak	206	150	Vertical	Pass
6**	5172.107	36.81	-1.61	54.0	-17.19	AV	8	150	Vertical	Pass
6	5172.666	48.18	-1.61	74.0	-25.82	Peak	8	150	Vertical	Pass

8-DPSK HIGH CHANNEL 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.65	26.65	-15.34	54.0	-27.35	AV	270	150	Horizontal	Pass
1	1827.193	46.72	-15.34	74.0	-27.28	Peak	270	150	Horizontal	Pass
2**	2111.255	39.90	-12.85	54.0	-14.10	AV	149	150	Horizontal	Pass
2	2111.441	46.72	-12.85	74.0	-27.28	Peak	149	150	Horizontal	Pass
3**	2480.000	82.19	-10.15	54.0	28.19	AV	72	150	Horizontal	N/A
3	2480.000	86.87	-10.15	74.0	12.87	Peak	72	150	Horizontal	N/A
4**	2908.287	38.22	-9.69	54.0	-15.78	AV	150	150	Horizontal	Pass
4	2908.946	48.79	-9.69	74.0	-25.21	Peak	150	150	Horizontal	Pass
5**	3695.464	35.19	-5.83	54.0	-18.81	AV	259	150	Horizontal	Pass
5	3695.915	46.10	-5.83	74.0	-27.90	Peak	259	150	Horizontal	Pass
6**	5447.172	37.22	-1.21	54.0	-16.78	AV	226	150	Horizontal	Pass
6	5447.5	48.29	-1.21	74.0	-25.71	Peak	226	150	Horizontal	Pass

Hopping Mode:

GFSK MODE 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit(dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.898	31.69	-14.75	54.0	-22.32	AV	220	150	Vertical	Pass
1	1861.278	51.77	-14.75	74.0	-22.23	Peak	220	150	Vertical	Pass
2**	2111.284	42.68	-12.13	54.0	-11.32	AV	197	150	Vertical	Pass
2	2111.777	48.86	-12.13	74.0	-25.14	Peak	197	150	Vertical	Pass
3**	2438.000	81.42	-11.02	54.0	27.42	AV	93	150	Vertical	N/A
3	2438.000	87.26	-11.02	74.0	13.26	Peak	93	150	Vertical	N/A
4**	2969.618	35.30	-9.85	54.0	-18.70	AV	171	150	Vertical	Pass
4	2970.491	48.18	-9.85	74.0	-25.82	Peak	171	150	Vertical	Pass
5**	3695.699	35.82	-5.60	54.0	-18.18	AV	205	150	Vertical	Pass
5	3695.482	46.01	-5.60	74.0	-27.99	Peak	205	150	Vertical	Pass
6**	5171.984	37.02	-0.97	54.0	-16.99	AV	9	150	Vertical	Pass
6	5172.515	47.99	-0.97	74.0	-26.01	Peak	9	150	Vertical	Pass

GFSK MODE 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit(dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.157	27.24	-14.82	54.0	-26.76	AV	270	150	Horizontal	Pass
1	1827.553	46.73	-14.82	74.0	-27.27	Peak	270	150	Horizontal	Pass
2**	2111.456	39.62	-12.33	54.0	-14.38	AV	150	150	Horizontal	Pass
2	2111.527	46.03	-12.33	74.0	-27.97	Peak	150	150	Horizontal	Pass
3**	2438.000	82.12	-11.02	54.0	28.12	AV	71	150	Horizontal	N/A
3	2438.000	87.31	-11.02	74.0	13.31	Peak	71	150	Horizontal	N/A
4**	2908.471	38.18	-9.32	54.0	-15.82	AV	149	150	Horizontal	Pass
4	2908.07	48.24	-9.32	74.0	-25.76	Peak	149	150	Horizontal	Pass
5**	3695.808	35.45	-5.44	54.0	-18.55	AV	260	150	Horizontal	Pass
5	3695.137	45.71	-5.44	74.0	-28.29	Peak	260	150	Horizontal	Pass
6**	5447.127	37.81	-1.14	54.0	-16.19	AV	226	150	Horizontal	Pass
6	5447.539	48.69	-1.14	74.0	-25.31	Peak	226	150	Horizontal	Pass

8-DPSK MODE 1 GHz to 12.75 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit(dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1861.551	31.98	-14.81	54.0	-22.02	AV	220	150	Vertical	Pass
1	1861.51	51.31	-14.81	74.0	-22.69	Peak	220	150	Vertical	Pass
2**	2111.349	42.39	-12.33	54.0	-11.61	AV	197	150	Vertical	Pass
2	2111.021	48.67	-12.33	74.0	-25.33	Peak	197	150	Vertical	Pass
3**	2438.000	80.98	-11.02	54.0	26.98	AV	93	150	Vertical	N/A
3	2438.000	87.61	-11.02	74.0	13.61	Peak	93	150	Vertical	N/A
4**	2969.892	34.61	-8.95	54.0	-19.39	AV	171	150	Vertical	Pass
4	2969.679	48.07	-8.95	74.0	-25.93	Peak	171	150	Vertical	Pass
5**	3695.081	36.28	-5.90	54.0	-17.72	AV	206	150	Vertical	Pass
5	3695.347	45.89	-5.90	74.0	-28.11	Peak	206	150	Vertical	Pass
6**	5172.52	37.12	-1.08	54.0	-16.88	AV	8	150	Vertical	Pass
6	5171.99	48.17	-1.08	74.0	-25.84	Peak	8	150	Vertical	Pass

8-DPSK MODE 1 GHz to 12.75 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit(dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1827.266	27.23	-14.58	54.0	-26.77	AV	270	150	Horizontal	Pass
1	1827.239	46.33	-14.58	74.0	-27.67	Peak	270	150	Horizontal	Pass
2**	2111.718	39.13	-12.75	54.0	-14.87	AV	150	150	Horizontal	Pass
2	2111.412	45.99	-12.75	74.0	-28.01	Peak	150	150	Horizontal	Pass
3**	2438.000	82.13	-11.02	54.0	28.13	AV	71	150	Horizontal	N/A
3	2438.000	87.34	-11.02	74.0	13.34	Peak	71	150	Horizontal	N/A
4**	2908.054	38.68	-9.74	54.0	-15.32	AV	149	150	Horizontal	Pass
4	2908.037	48.84	-9.74	74.0	-25.16	Peak	149	150	Horizontal	Pass
5**	3695.758	35.48	-6.09	54.0	-18.52	AV	259	150	Horizontal	Pass
5	3695.239	46.17	-6.09	74.0	-27.83	Peak	259	150	Horizontal	Pass
6**	5447.612	37.47	-1.32	54.0	-16.53	AV	227	150	Horizontal	Pass
6	5447.098	48.06	-1.32	74.0	-25.94	Peak	227	150	Horizontal	Pass

A.9 Band Edge (Restricted-band band-edge)

Note¹: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

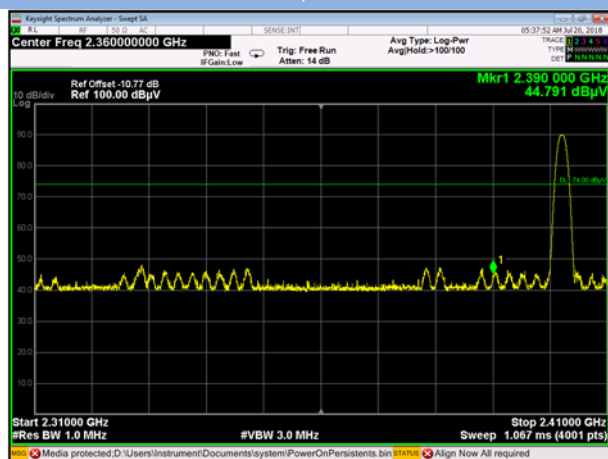
Note³: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note⁴: The Level (dBuV/m) has been corrected by factor.

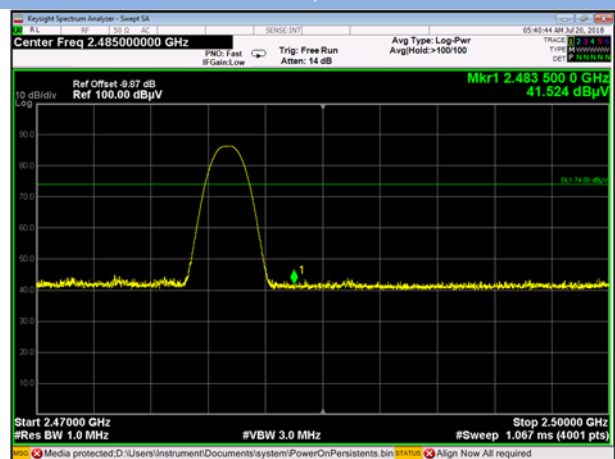
Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
GFSK	Low	2390.00	44.79	-10.77	74	29.21	PEAK	Pass
		2390.00	N/A	N/A	54	N/A	AVERAGE	Pass
GFSK	High	2483.50	41.52	-9.87	74	32.48	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK	Low	2390.00	47.55	-10.77	74	26.45	PEAK	Pass
		2390.00	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK	High	2483.50	45.46	-9.87	74	28.54	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
GFSK(Hopping)	Low	2390.00	45.52	-10.77	74	28.48	PEAK	Pass
		2390.00	N/A	N/A	54	N/A	AVERAGE	Pass
GFSK(Hopping)	High	2483.50	41.82	-9.87	74	32.18	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK (Hopping)	Low	2390.00	41.57	-10.77	74	32.43	PEAK	Pass
		2390.00	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK (Hopping)	High	2483.50	41.13	-9.87	74	32.87	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass

Test Plots

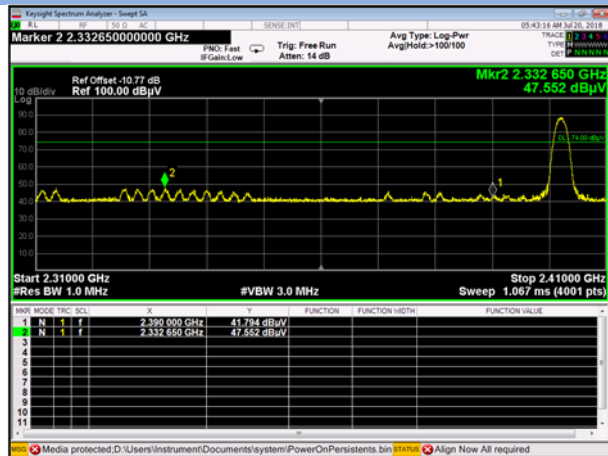
GFSK LOW CHANNEL , PEAK



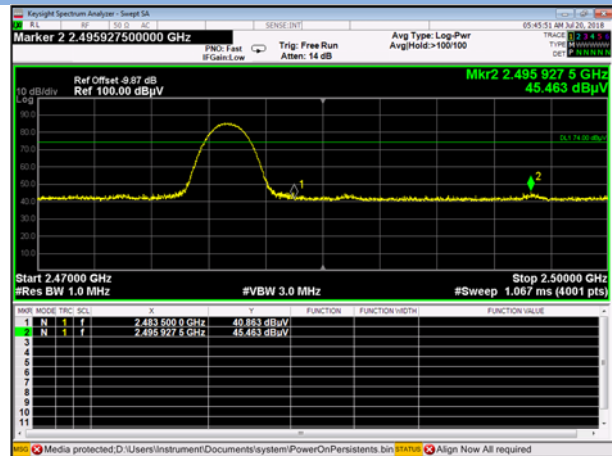
GFSK HIGH CHANNEL , PEAK



8-DPSK LOW CHANNEL , PEAK

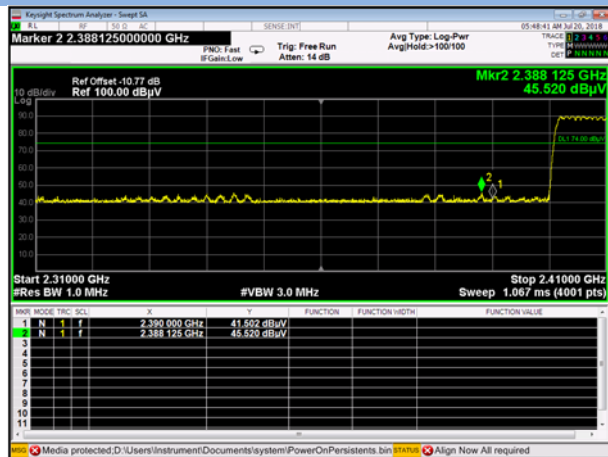


8-DPSK HIGH CHANNEL , PEAK

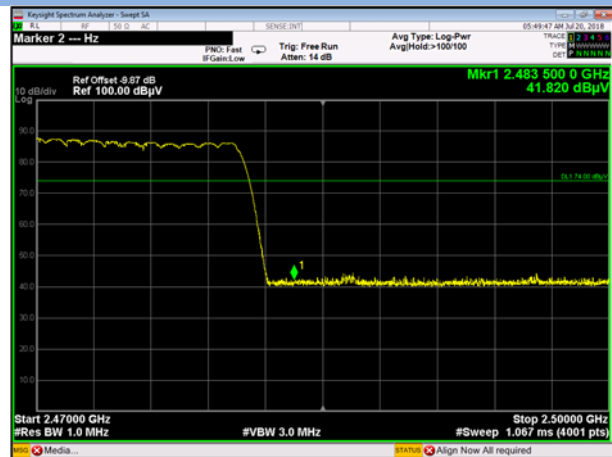


Hopping Mode:

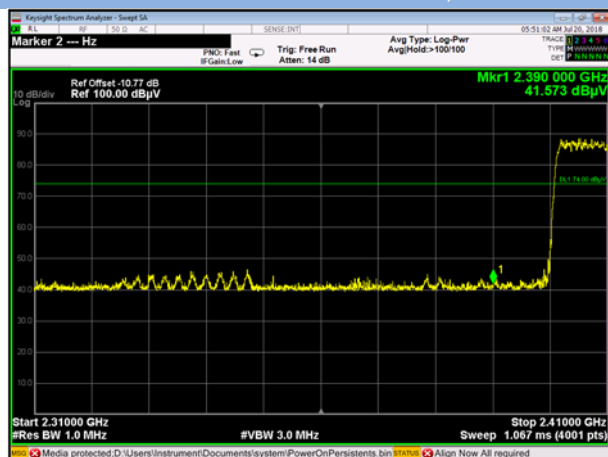
GFSK LOW FREQUENCY BAND, PEAK



GFSK HIGH FREQUENCY BAND, PEAK



8-DPSK LOW FREQUENCY BAND, PEAK



8-DPSK HIGH FREQUENCY BAND, PEAK



ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ1870190-AR1.PDF”.

--END OF REPORT--