FCC/ISED RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

LED alarm clock with Bluetooth speaker

ISSUED TO
RHK Technology Inc.

1050 East Maple Road Troy, Mi 48083

Report No.:	BL-HK1860442-601
EUT Name:	LED alarm clock with Bluetooth speaker
Model Name:	SB700
Brand Name:	Sonic Alert
Test Standard:	47 CFR Part 15 Subpart C RSS-Gen (Issue 4, November 2014) RSS-247 (Issue 2, February 2017)
FCC ID:	OQY-SB7000109
ISED Number:	3824A-SB7001119
Test conclusion:	Pass
Test Date:	Jul. 07, 2018 ~ Jul. 20, 2018
Date of Issue:	Aug. 21, 2018

Tested by: Zou Liu
Zou Liu
(Engineer)
Date Aug. 21. 2018

Approved by:
Wei Yanquan
(Chief Engineer)
Date Aug. 21. 2018

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jul. 23, 2018	Initial Issue
Rev. 02	Aug. 21, 2018	Add test cables to the test equipment on page 14.

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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	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. 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. 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.
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℃ to 25℃
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	RHK Technology Inc.
Address	1050 East Maple Road Troy, Mi 48083

2.2 Manufacturer Information

Manufacturer	Nicepoint Electronic Ltd.
Address	Flat M 10/F .,Yue Cheung Center 1-3 Wong Chuk Yeung St., Fo Tan,N.T.H.K.

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	LED alarm clock with Bluetooth speaker
Model Name Under Test	SB700
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Ancillary Equipment

Ancillary Equipment 1	Adapter	
	Brand Name	BP
	Model No.	SO12B0502200U
	Serial No.	N/A
	Rated Input	100-240 V~, 50/60 Hz, 0.4 A
	Rated Output	5 V⎓ 2.2 A
Ancillary Equipment 2	Vibrator	

2.6 Technical Information

Network and Wireless connectivity	Bluetooth 4.2(BR+EDR)

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

Modulation Technology	FHSS
Modulation Type	GFSK, ∏/4-DQPSK, 8-DPSK
Product Type	☒ Mobile ☐ Portable ☐ 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	PCB Antenna
Antenna Gain	0 dBi (In test items related to antenna gain, the final results reflect this figure.)
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	-	-

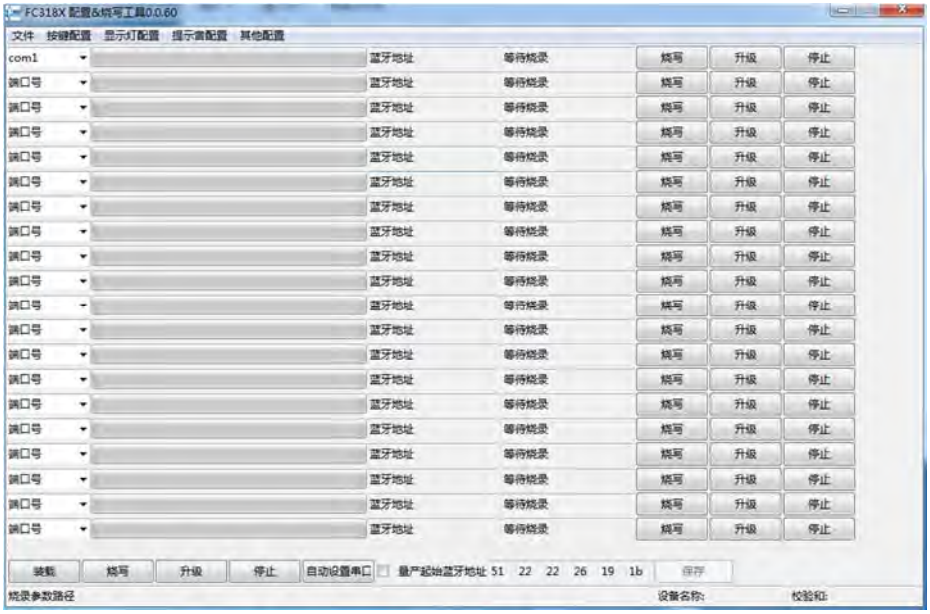
2.7 Additional Instructions

EUT Software Settings:

Mode	☒ Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

Power level setup in software			
Test Software Version	FC318X		
Support Units (Software installation media)	Description	Manufacturer	Model
	Notebook	Lenovo	X220
Mode	Channel	Frequency (MHz)	Soft Set
DH5	CH0	2402	TX LEVEL is built-in set parameters and cannot be changed and selected.
	CH39	2441	
	CH78	2480	
2DH5	CH0	2402	
	CH39	2441	
	CH78	2480	
3DH5	CH0	2402	
	CH39	2441	
	CH78	2480	

Run Software:



3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C (10-1-16 Edition)	Miscellaneous Wireless Communications Services
2	FCC PUBLIC NOTICE DA 00-705 (Mar. 30, 2000)	Filling and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
3	RSS-Gen (Issue 4, Nov. 2014)	General Requirements for Compliance of Radio Apparatus
4	RSS-247 (Issue 2, February 2017)	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices
5	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]
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]
5	Carrier Frequency Separation	15.247(a)	RSS-247, 5.1 (2)	Hopping Mode	ANNEX A.4	Pass	Note [2]
6	Time of Occupancy (Dwell time)	15.247(a)	RSS-247, 5.1 (4)	Hopping Mode	ANNEX A.5	Pass	Note [2]
7	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	RSS-247, 5.5	Low/Middle/ High	ANNEX A.6	Pass	Note [2]
8	Conducted Emission	15.207	RSS-GEN, 8.8	Low/Middle/ High	ANNEX A.7	Pass	Note [2]
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]: Please refer to section 5.1

Note [2]: Because of the modulation of Π/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.

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℃ to +25℃
Working Voltage of the EUT	NV (Normal Voltage)	5.0 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	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
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2018.06.21	2019.06.20
LISN	SCHWARZBECK	NSLK 8127	8127-687	2018.06.21	2019.06.20
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	ROHDE&SCHWARZ	HMP2020	018141664	2018.06.21	2019.06.20
Temperature Chamber	ANGELANTIONI SCIENCE	NTH64-40A	1310	2018.06.26	2019.06.25
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	N/A	2019.01.05
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2019.02.20
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	N/A	2016.08.09	2018.08.08
Shielded Enclosure	ChangNing	CN-130701	130703	--	--
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2018.06.11	2019.06.10
Power Amplifier	OPHIR RF	5225F	1037	2018.02.16	2019.02.15
Power Amplifier	OPHIR RF	5273F	1016	2018.02.16	2019.02.15
Directional Coupler	Werlantone	C5982-10	109275	N/A	N/A
Directional Coupler	Werlantone	CHP-273E	S00801z-01	N/A	N/A

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Feld Strength Meter	Narda	EP601	511WX51129	2018.05.21	2019.05.20
Mouth Simulator	B&K	4227	2423931	2017.11.16	2018.11.15
Sound Calibrator	B&K	4231	2430337	2017.11.16	2018.11.15
Sound Level Meter	B&K	NL-20	00844023	2017.11.16	2018.11.15
Ear Simulator	B&K	4185	2409449	2017.11.16	2018.11.15
Ear Simulator	B&K	4195	2418189	2017.11.16	2018.11.15
Audio analyzer	B&K	UPL 16	100129	2017.11.16	2018.11.15
Software	BALUN	BL410	-	-	-
Cable	ROHDE&SCHWARZ	JUNFLON	APR0914004	-	-

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.

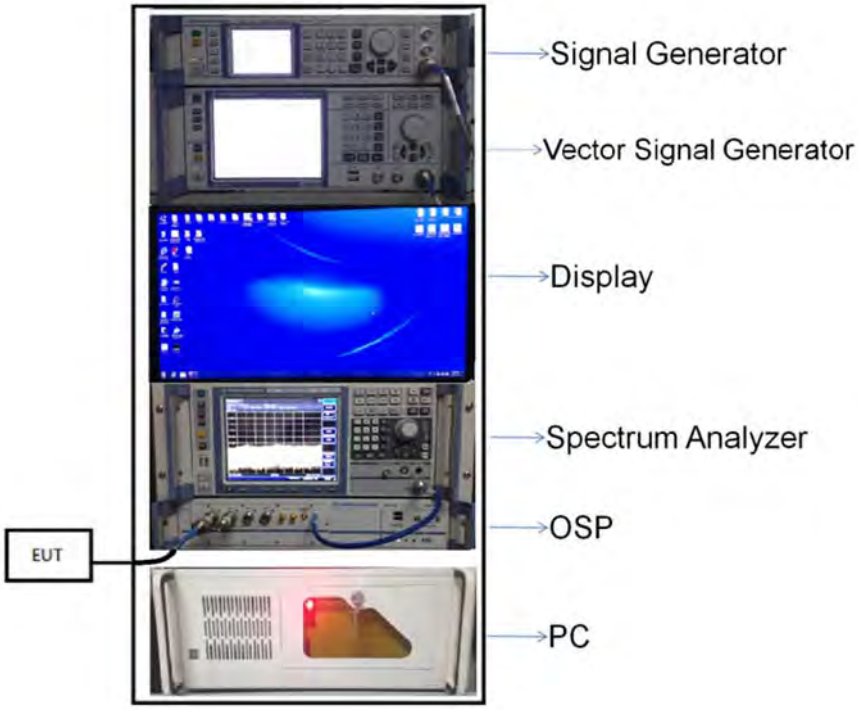
Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

4.4 Description of Test Setup

4.4.1 For Antenna Port Test

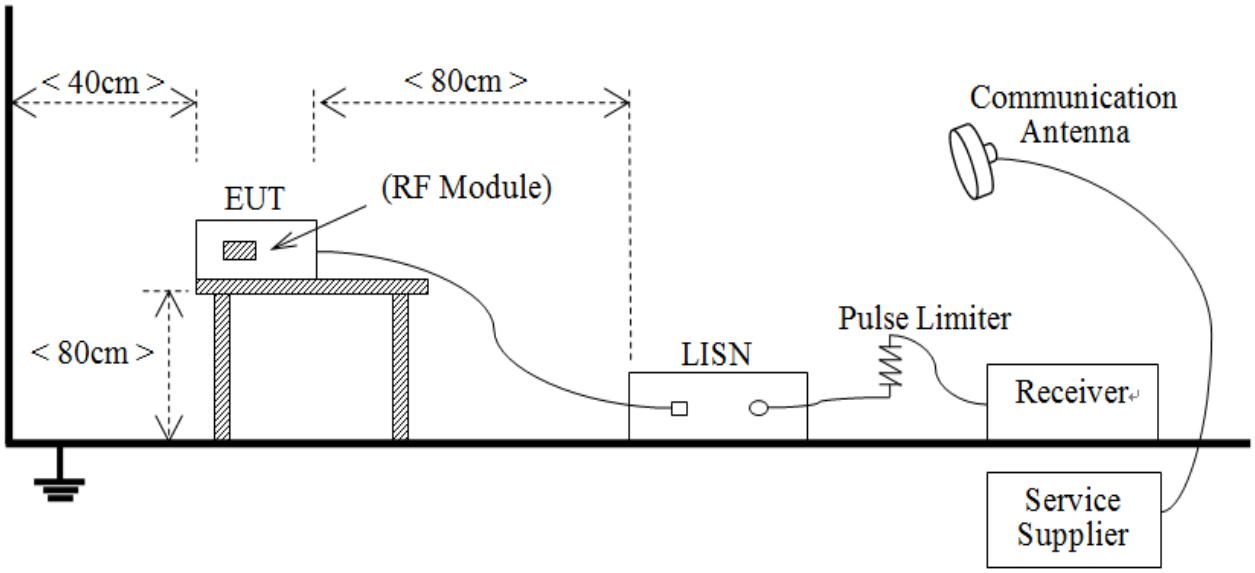
Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

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



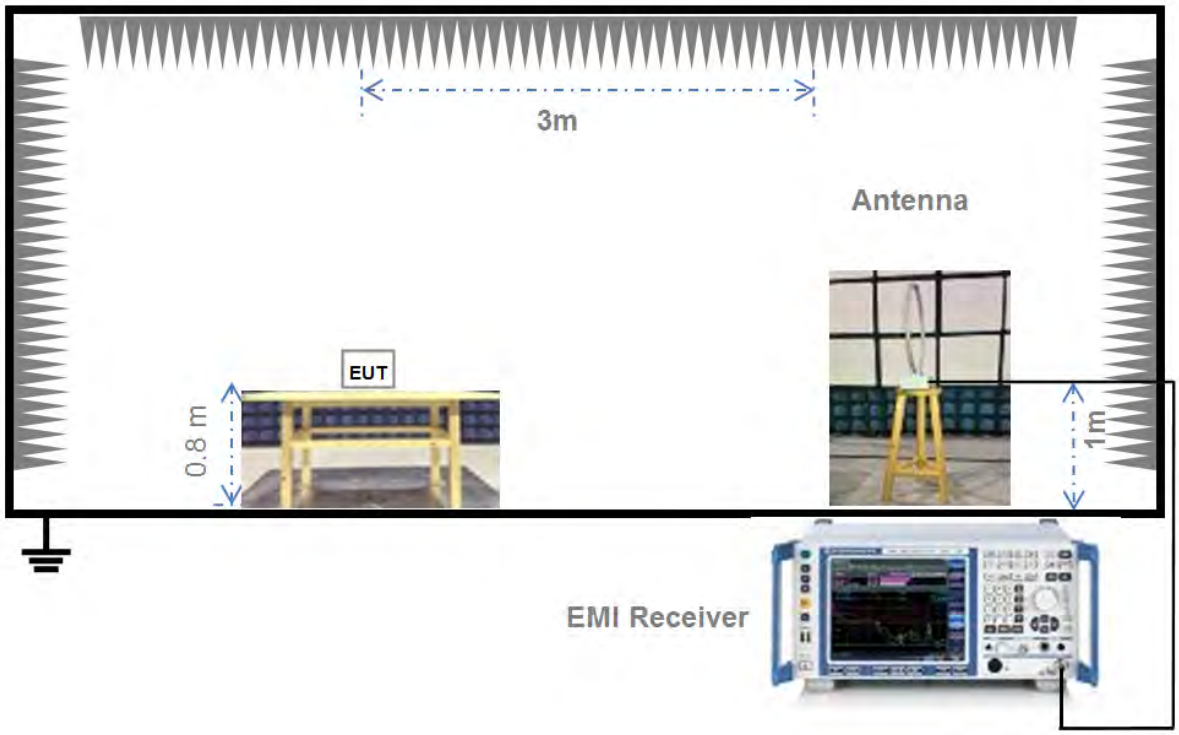
(Diagram 1)

4.4.2 For AC Power Supply Port Test



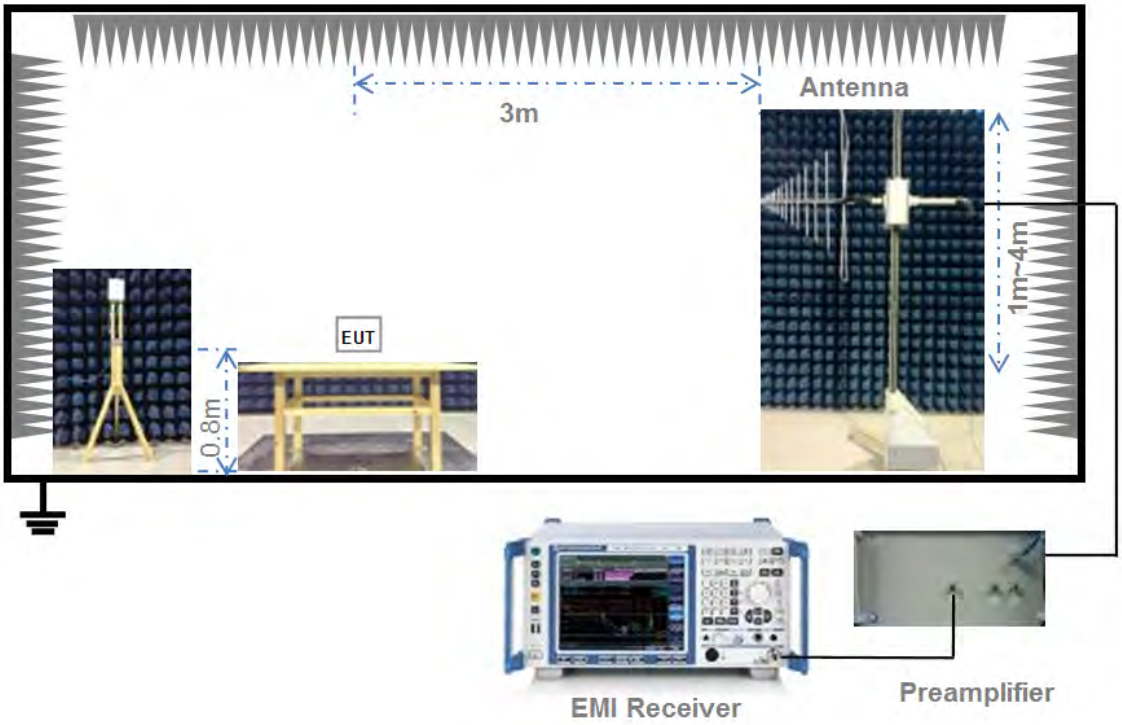
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



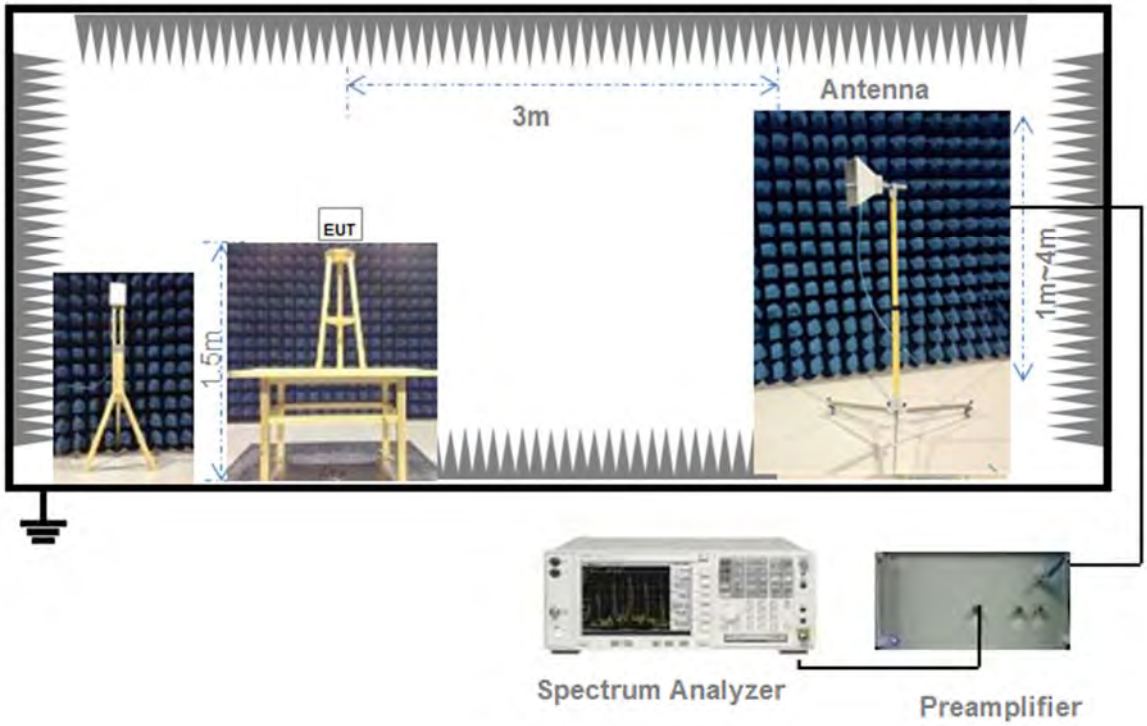
(Diagram 3)

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 (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 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 (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)

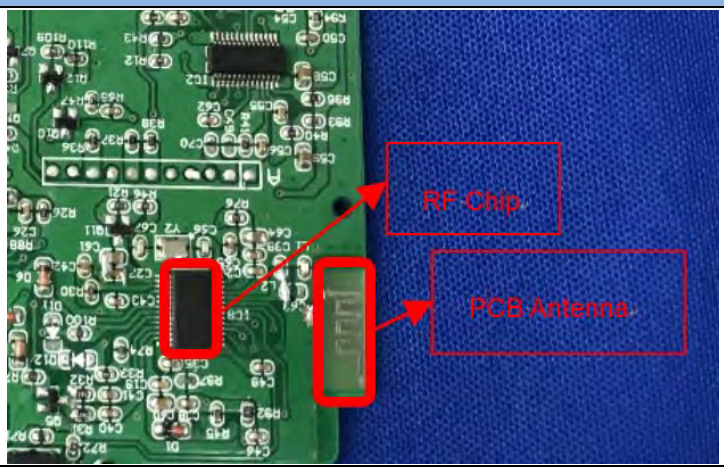
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply 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:

Protected Method	Description
The antenna is embedded in the product.	The antenna is welded on the mainboard, can't be replaced by the consumer

Reference Documents	Item
Photo	

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 ≥ 1% of the span

VBW ≥ 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 ≥ 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) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ 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

{Total of Dwell} = {Pulse Time} * (1600 / 2) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (1600 / 4) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For AFH Mode:
For DH1 package type

{Total of Dwell} = {Pulse Time} * (800 / 2) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (800 / 4) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (800 / 6) / {Number of Hopping Frequency} * {Period}
{Period} = 0.4 s * {Number of Hopping Frequency}

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 ≥ 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 50µH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBµV)	
	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*log[Field Strength (µV/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 ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ 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 ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ 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

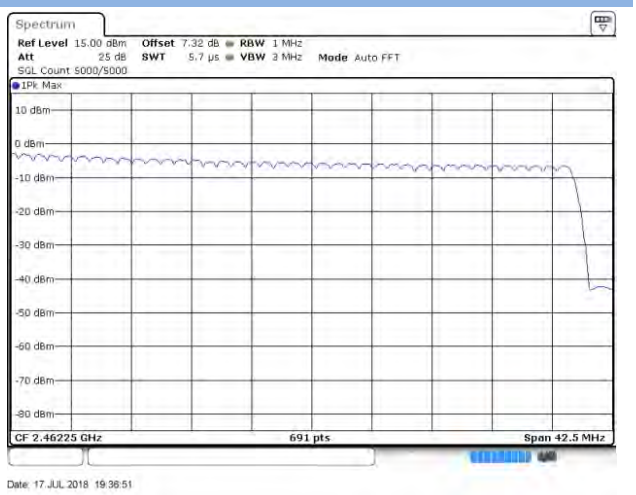
Test Data

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
GFSK	2400 - 2483.5	79	15	Pass
8-DPSK	2400 - 2483.5	79	15	Pass

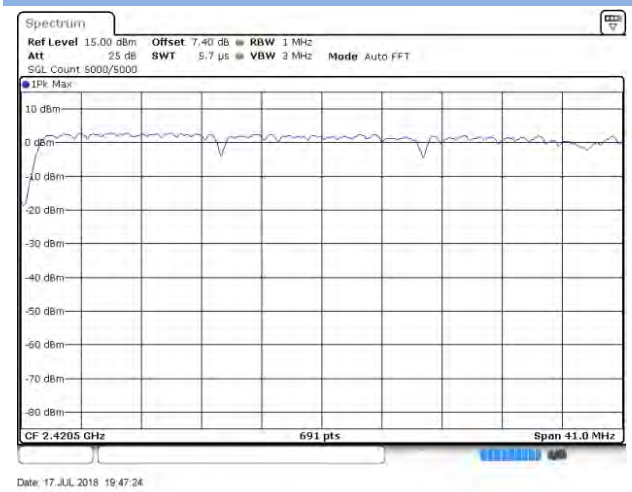
Test plots

GFSK 2.4 GHz ~ 2.4415 GHz

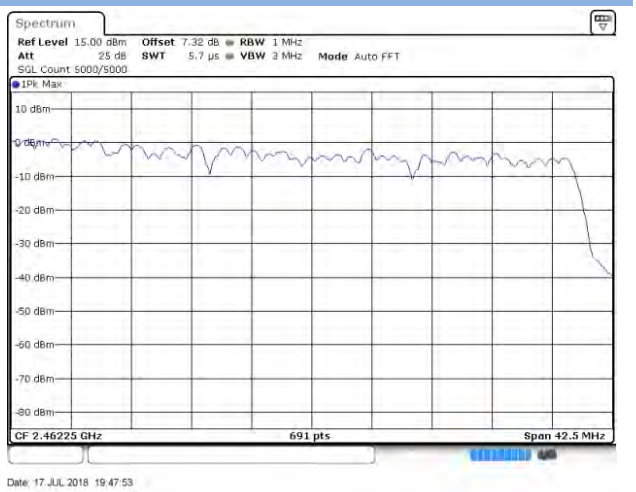
GFSK 2.4415 GHz ~ 2.4835 GHz



8-DPSK 2.4 GHz ~ 2.4415 GHz



8-DPSK 2.4415 GHz ~ 2.4835 GHz



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	3.71	2.35	30	1000	Pass
Middle	0.68	1.17			Pass
High	-4.43	0.36			Pass

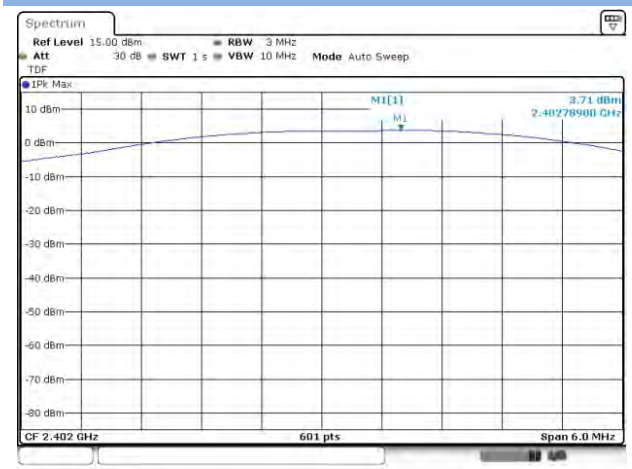
Channel	Measured Output Peak Power				Limit		Verdict
	∏/4-DQPSK		8-DPSK		dBm	mW	
	dBm	mW	dBm	mW			
Low	4.48	2.81	4.14	2.59	21	125	Pass
Middle	3.98	2.50	3.44	2.21			Pass
High	-0.73	0.85	-0.6	0.87			Pass

E.I.R.P Test Data (For ISED)

Channel	E.I.R.P						Limit		Verdict
	GFSK		∏/4-DQPSK		8-DPSK		dBm	mW	
	dBm	mW	dBm	mW	dBm	mW			
Low	3.71	2.35	4.48	2.81	4.14	2.59	36	4000	Pass
Middle	0.68	1.17	3.98	2.50	3.44	2.21			Pass
High	-4.43	0.36	-0.73	0.85	-0.6	0.87			Pass

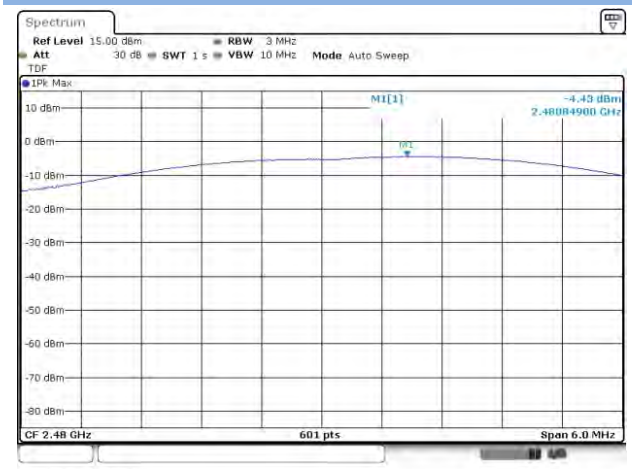
Test plots

GFSK LOW CHANNEL

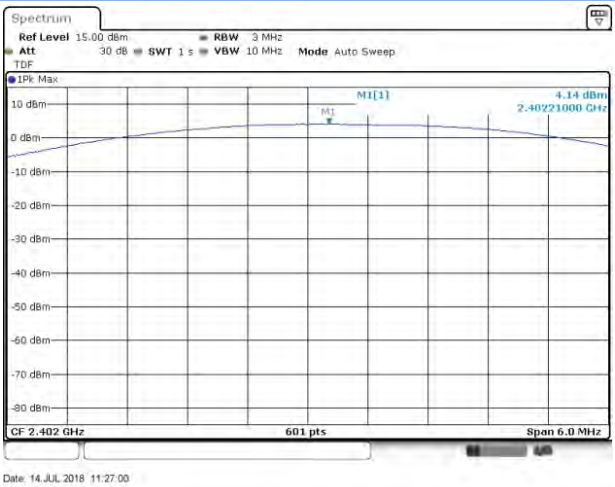


GFSK MIDDLE CHANNEL

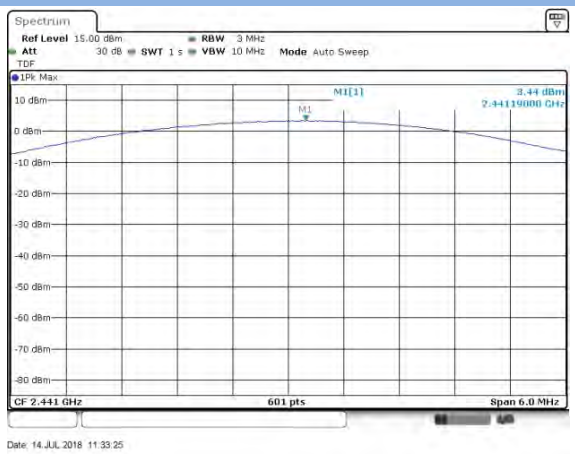
GFSK HIGH CHANNEL



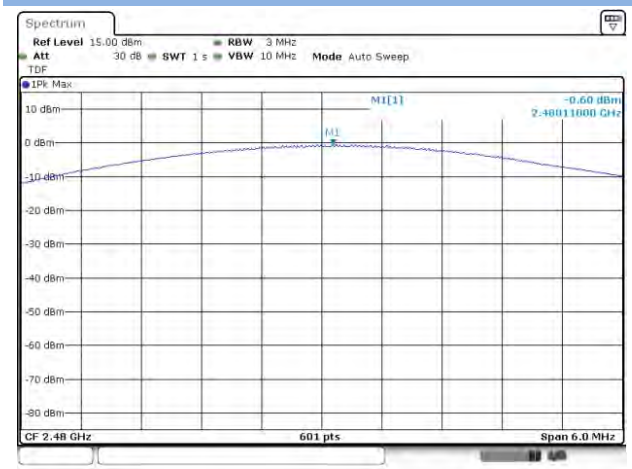
Π/4-DQPSK LOW CHANNEL



Π/4-DQPSK MIDDLE CHANNEL

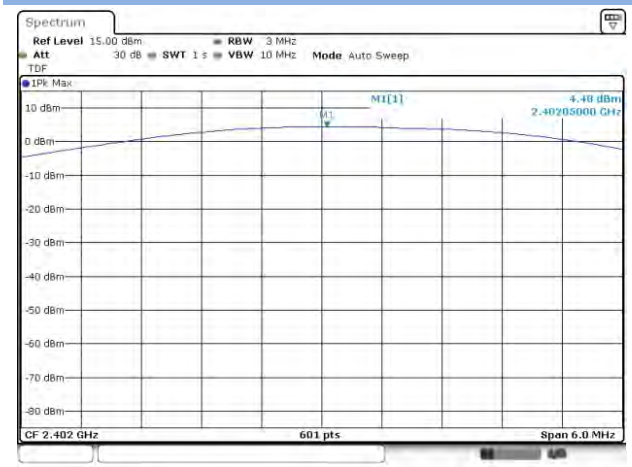


Π/4-DQPSK HIGH CHANNEL



Date: 14.JUL.2018 11:39:06

8-DPSK LOW CHANNEL

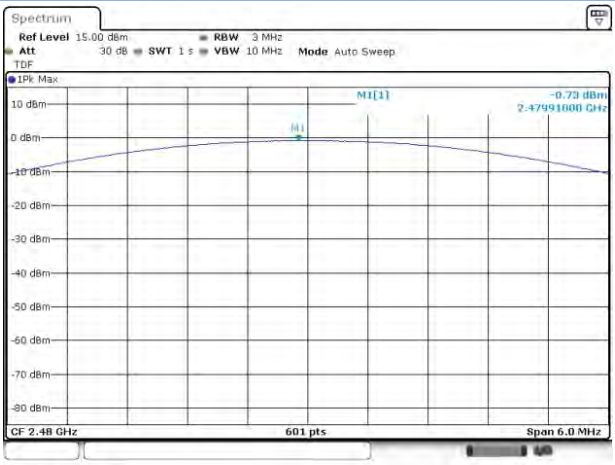


Date: 13.JUL.2018 21:47:28

8-DPSK MIDDLE CHANNEL

Date: 13.JUL.2018 21:48:42

8-DPSK HIGH CHANNEL



Date: 13.JUL.2018 21:49:38

A.3 20 dB and 99% bandwidth

Test Data

GFSK		
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	0.878418	1.128799
Middle	0.873779	1.232996
High	0.873779	1.232996
8-DPSK		
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	1.260986	1.367583
Middle	1.287109	2.057887
High	1.265137	1.393632

Test plots

20 dB Bandwidth

GFSK LOW CHANNEL

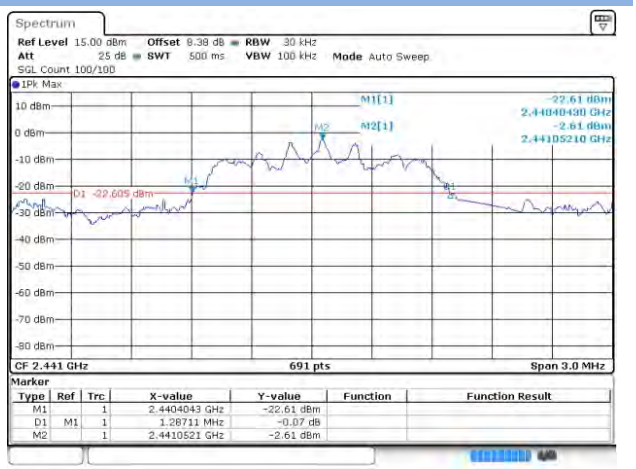
GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL

8-DPSK LOW CHANNEL

Date: 14.JUL.2018 11:27:56

8-DPSK MIDDLE CHANNEL



Date: 14.JUL.2018 11:34:22

8-DPSK HIGH CHANNEL

Date: 14.JUL.2018 11:40:02

99% Bandwidth

GFSK LOW CHANNEL

Date: 14.JUL.2018 11:09:13

GFSK MIDDLE CHANNEL

Date: 14.JUL.2018 11:16:08

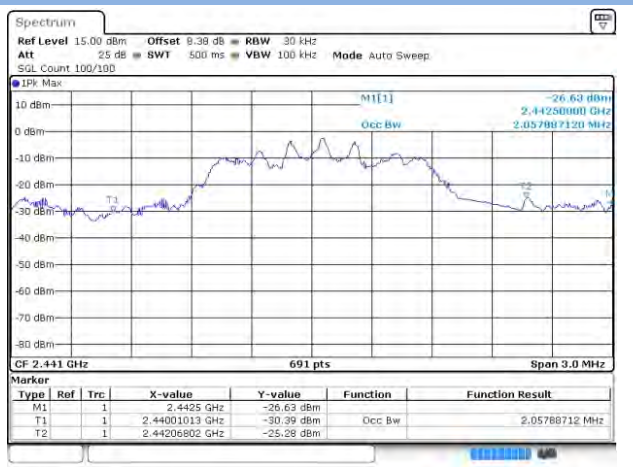
GFSK HIGH CHANNEL

Date: 14.JUL.2018 11:21:17

8-DPSK LOW CHANNEL

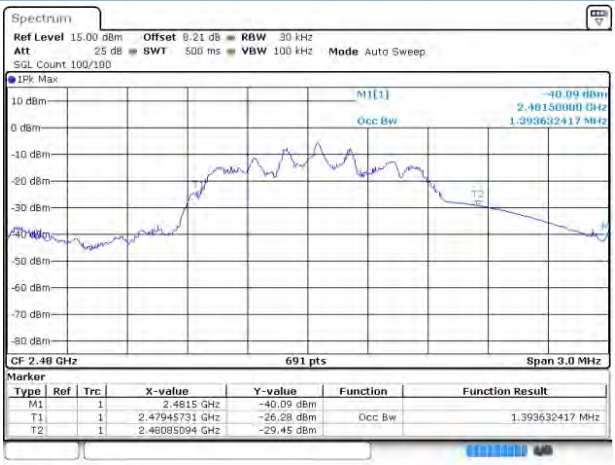
Date: 14.JUL.2018 11:28:53

8-DPSK MIDDLE CHANNEL



Date: 14.JUL.2018 11:35:18

8-DPSK HIGH CHANNEL



Date: 14.JUL.2018 11:40:58

A.4 Hopping Frequency Separation

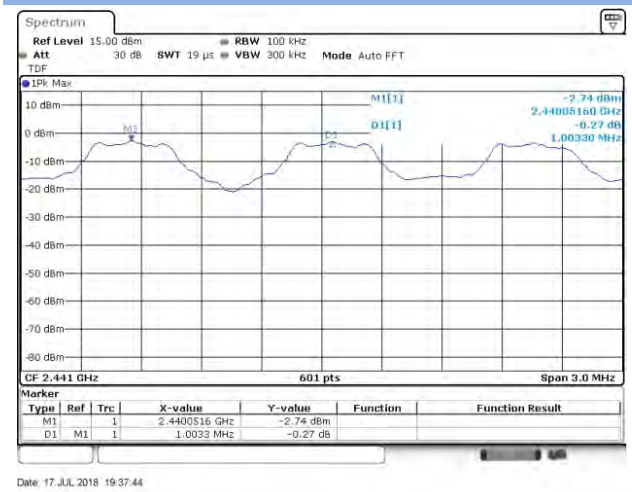
Test Data

Note: The systems operate with an output power no greater than 125 mw, The data provided in the section A.2.

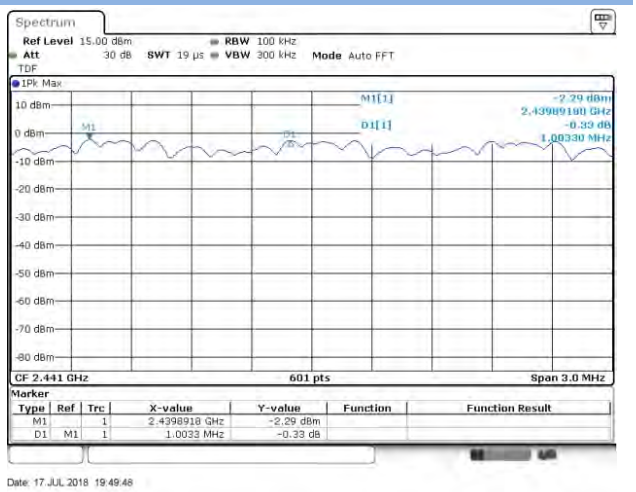
Mode	Frequency separation (MHz)	Max 20 dB Bandwidth (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Verdict
GFSK	1.0033	0.878	0.586	Pass
8-DPSK	1.0033	1.287	0.858	Pass

Test Plots

GFSK



8-DPSK



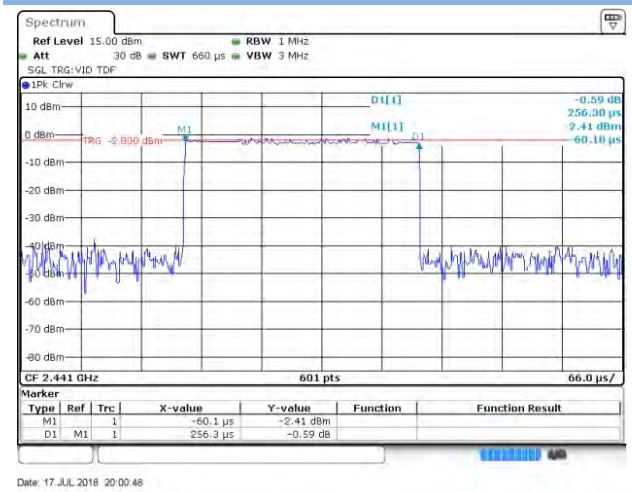
A.5 Average Time of Occupancy

Test Data

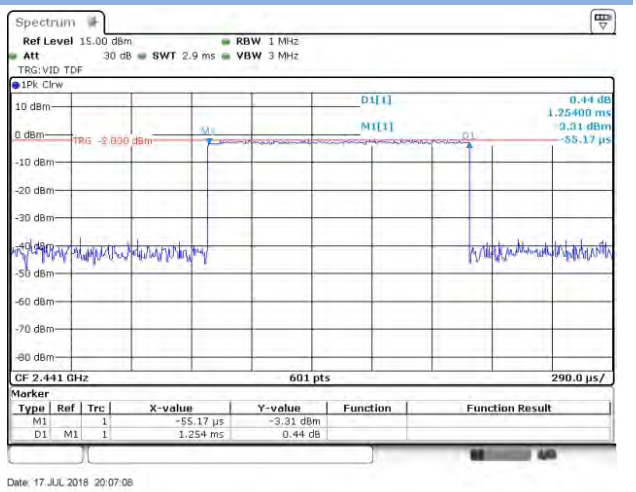
GFSK				
DH Packet	Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
DH 1	0.2563	82.016	0.4	Pass
DH 3	1.254	200.640	0.4	Pass
DH 5	2.9286	312.384	0.4	Pass
8-DPSK				
DH Packet	Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
DH 1	0.2469	79.008	0.4	Pass
DH 3	0.57907	92.651	0.4	Pass
DH 5	1.13783	121.369	0.4	Pass
AFH Mode				
DH Packet	Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
DH 1	0.25637	41.019	0.4	Pass
DH 3	1.25573	100.458	0.4	Pass
DH 5	2.937	156.640	0.4	Pass

Test Plots

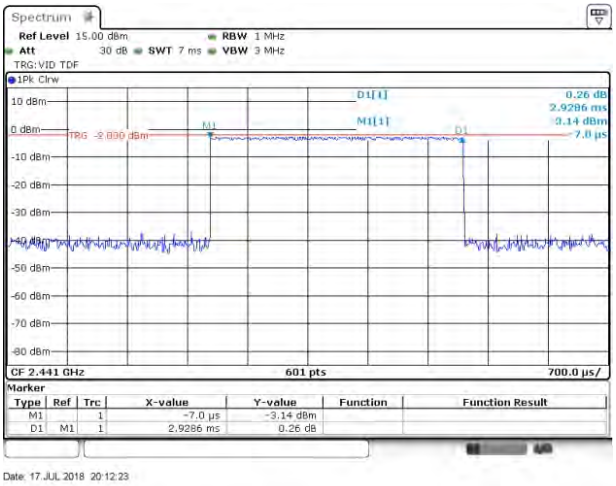
GFSK DH1



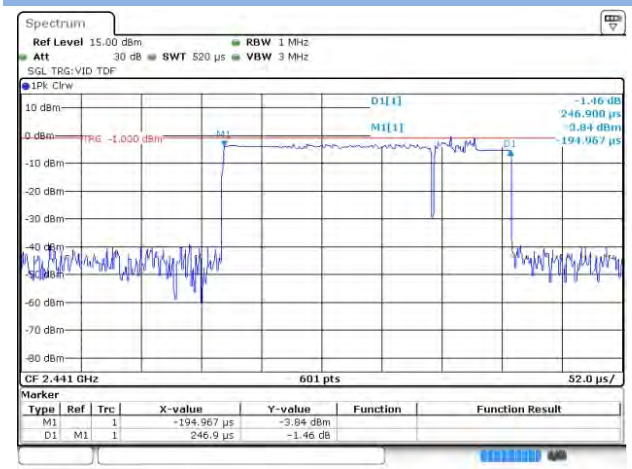
GFSK DH3



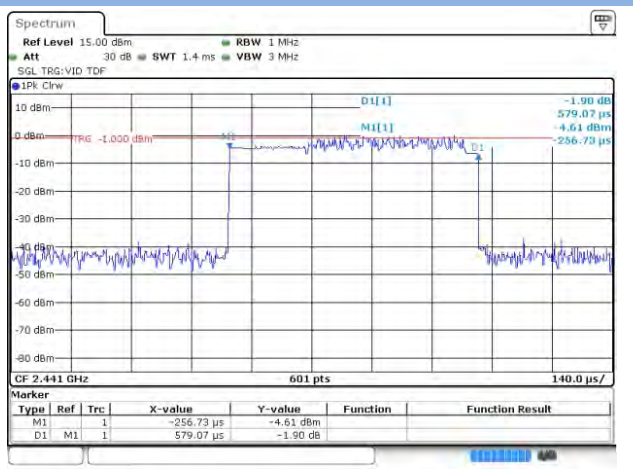
GFSK DH5



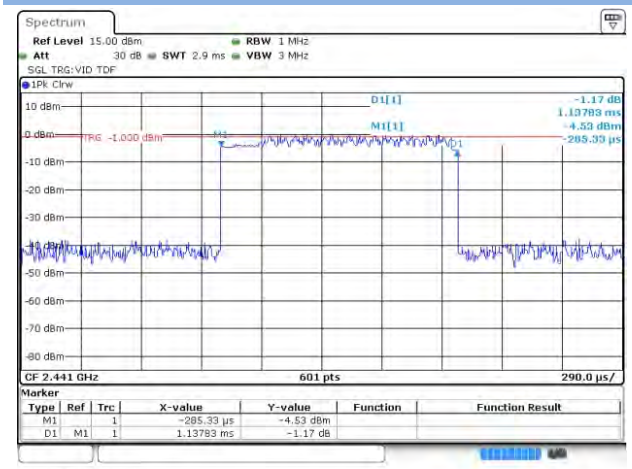
8-DPSK DH1



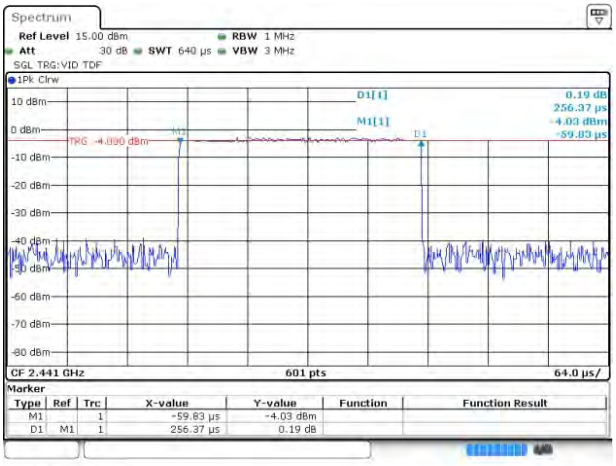
8-DPSK DH3



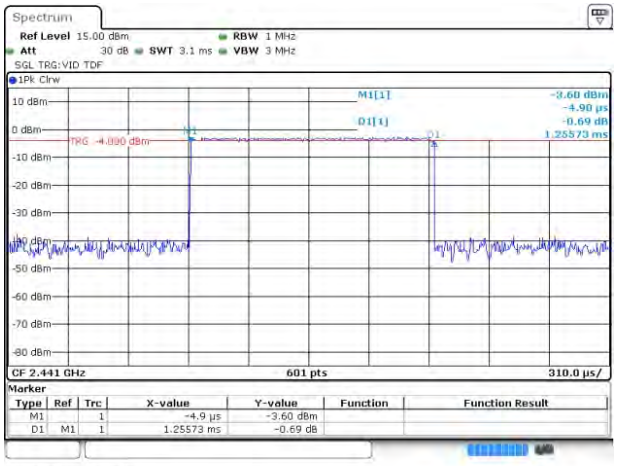
8-DPSK DH5



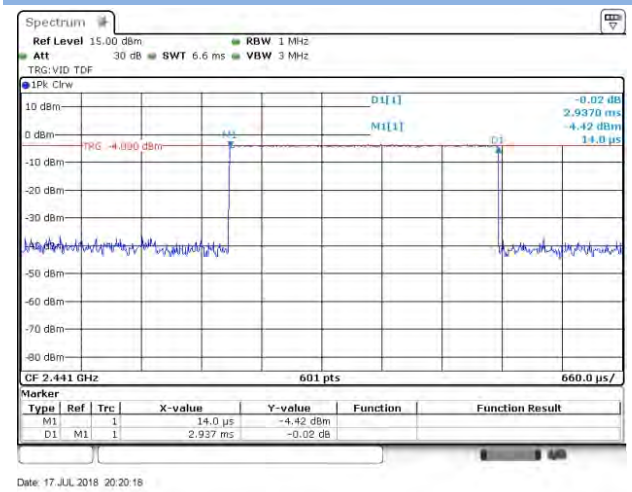
AFH Mode DH1



AFH Mode DH3



AFH Mode DH5


Spectrum
Ref Level 15.00 dBm
RBW 1 MHz
Att 30 dB
SWT 6.6 ms
VBW 3 MHz
TRG:VID TDF
1Pk Clrw
D1[1] -0.02 dB
2.9370 ms
M1[1] -4.42 dBm
14.0 µs
TRG -4.890 dBm
CF 2.441 GHz
601 pts
660.0 µs/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 14.0 µs -4.42 dBm
D1 M1 1 2.937 ms -0.02 dB
Date: 17.JUL.2018 20:20:18

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

Test Data

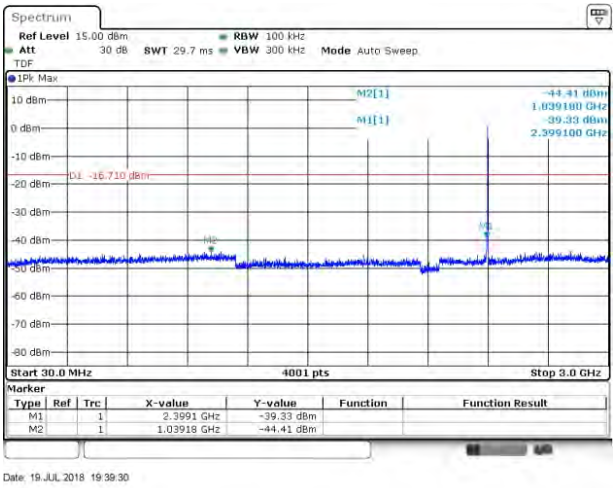
GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-22.01	3.29	-16.71	Pass
Middle	-28.79	-1.63	-21.63	Pass
High	-33.82	-5.6	-25.6	Pass
8-DPSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-22.5	3.12	-16.88	Pass
Middle	-29.12	-1.97	-21.97	Pass
High	-36.51	-5.75	-25.75	Pass

Hopping Mode				
Mode	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
GFSK	-23.25	2.23	-17.77	Pass
8-DPSK	-24.43	2.51	-17.49	Pass

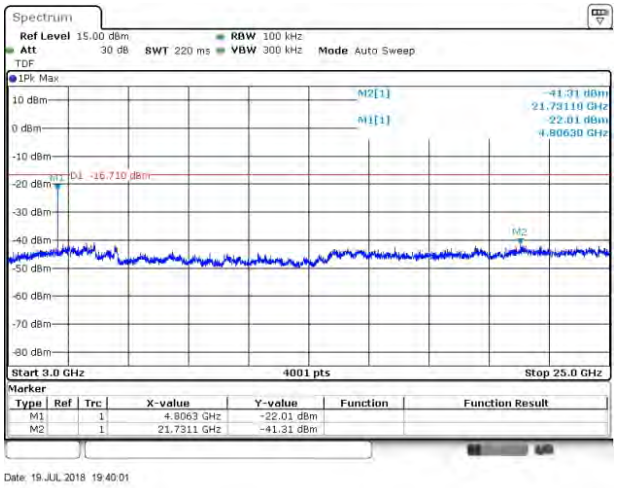
Test Plots

GFSK LOW CHANNEL, CARRIER LEVEL

GFSK LOW CHANNEL , SPURIOUS 30 MHz ~ 3 GHz

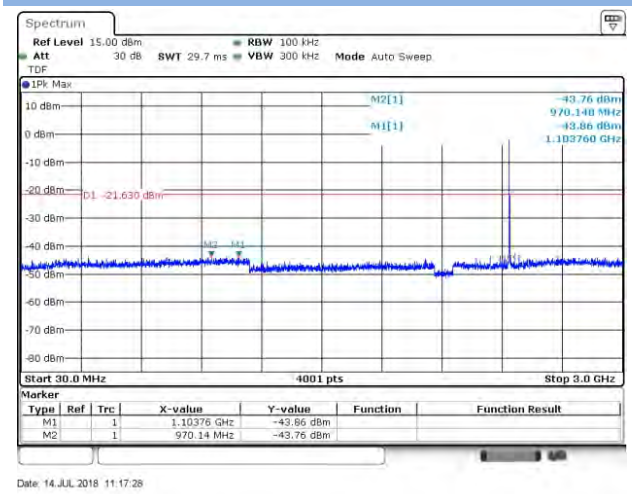


GFSK LOW CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

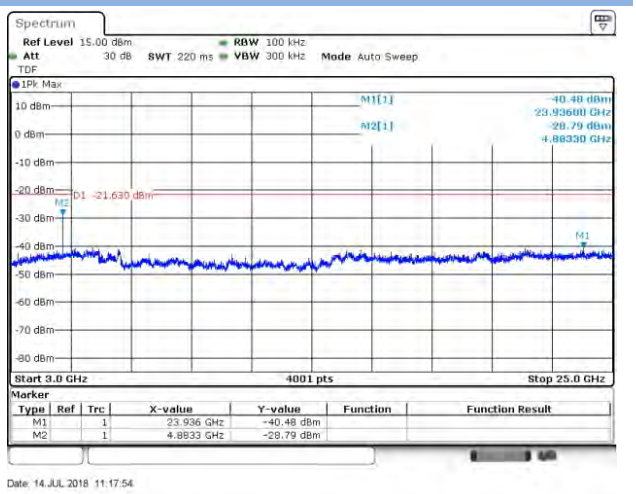


GFSK MIDDLE CHANNEL, CARRIER LEVEL

GFSK MIDDLE CHANNEL , SPURIOUS 30 MHz ~ 3 GHz

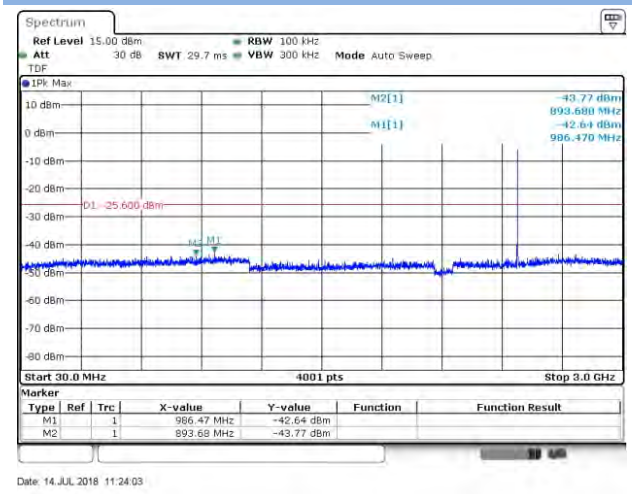


GFSK MIDDLE CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

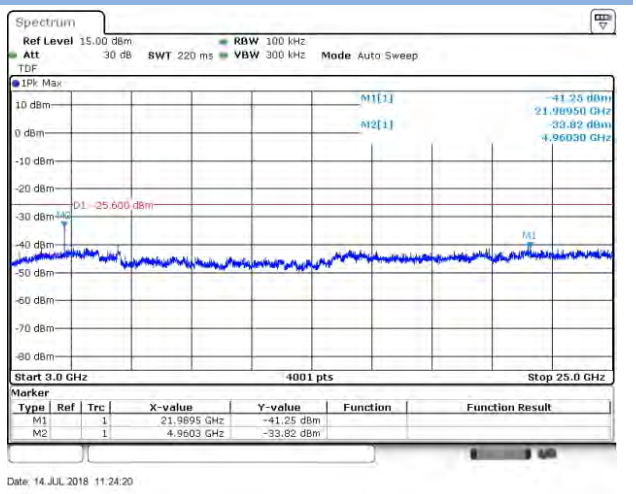


GFSK HIGH CHANNEL, CARRIER LEVEL

GFSK HIGH CHANNEL , SPURIOUS 30 MHz ~ 3 GHz

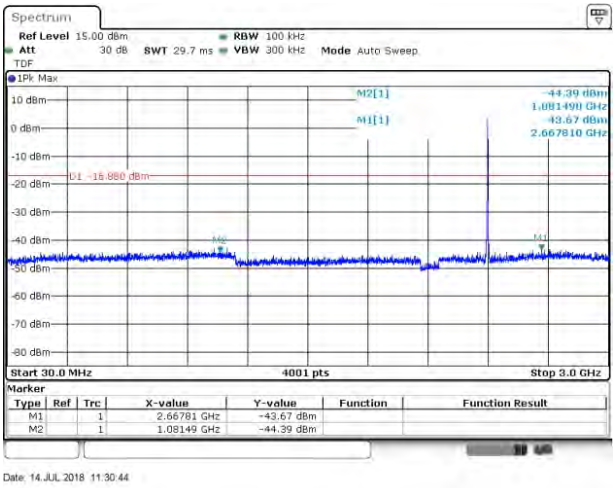


GFSK HIGH CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

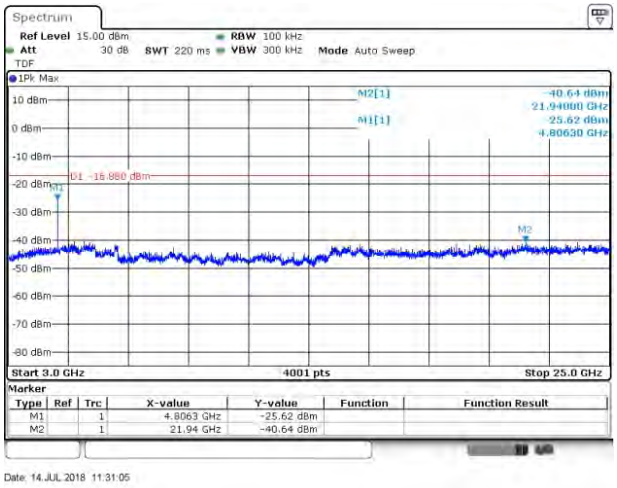


8-DPSK LOW CHANNEL, CARRIER LEVEL

8-DPSK LOW CHANNEL , SPURIOUS 30 MHz ~ 3 GHz

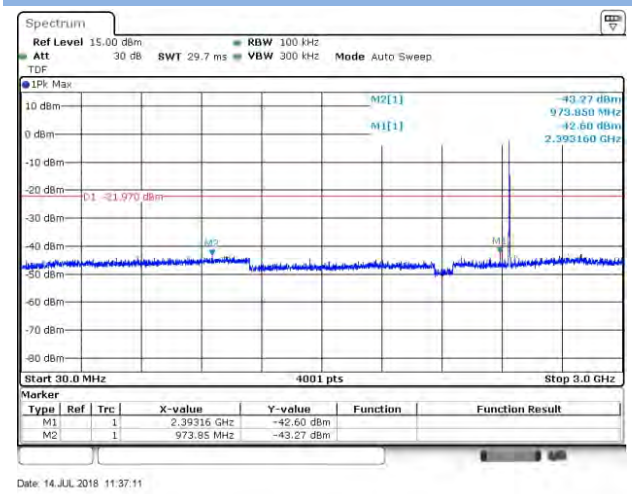


8-DPSK LOW CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

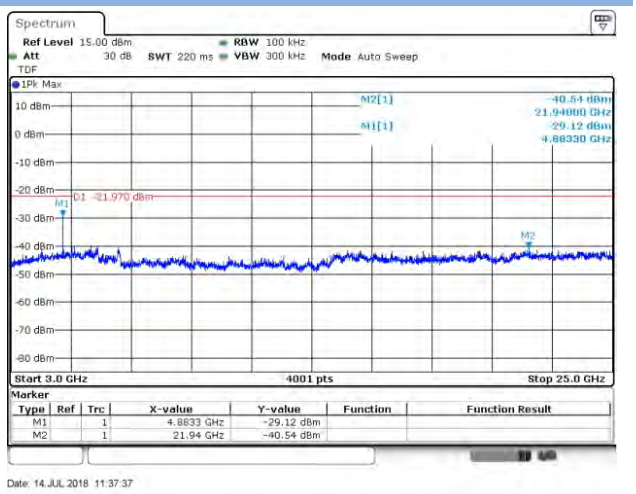


8-DPSK MIDDLE CHANNEL, CARRIER LEVEL

8-DPSK MIDDLE CHANNEL , SPURIOUS 30 MHz ~ ~ 3 GHz

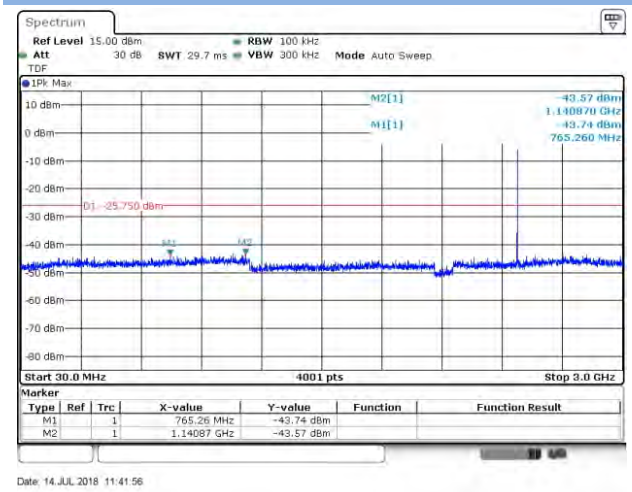


8-DPSK MIDDLE CHANNEL , SPURIOUS 3 GHz ~ 25 GHz

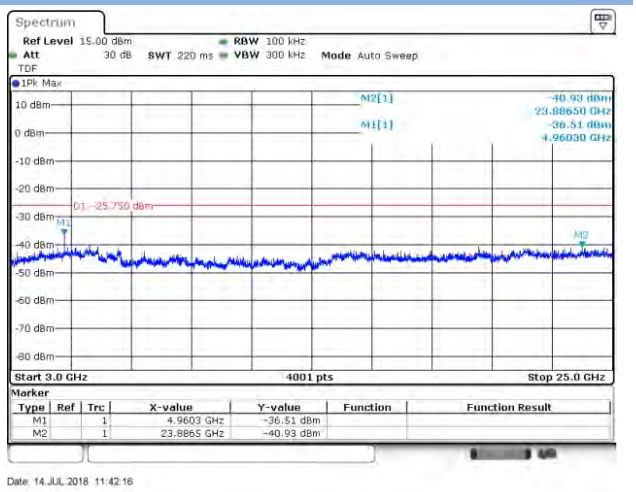


8-DPSK HIGH CHANNEL, CARRIER LEVEL

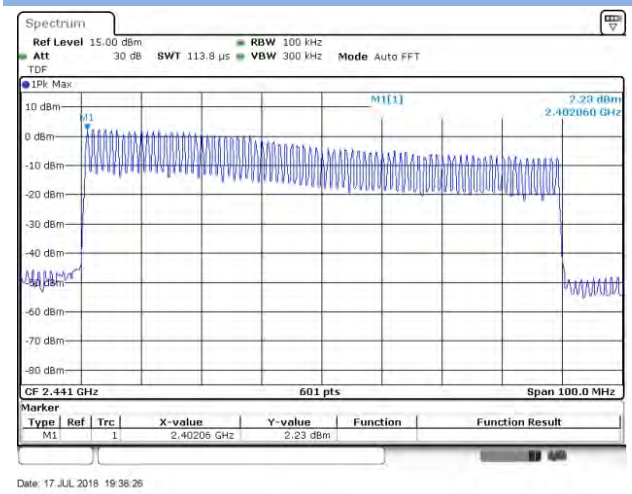
8-DPSK HIGH CHANNEL , SPURIOUS 30 MHz ~ 3 GHz



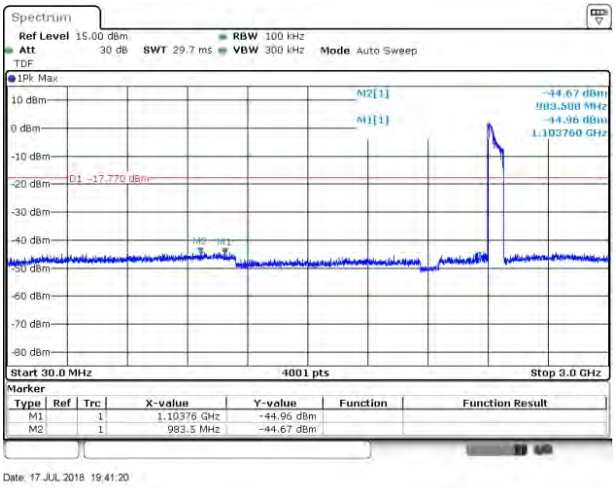
8-DPSK HIGH CHANNEL , SPURIOUS 3 GHz ~ 25 GHz



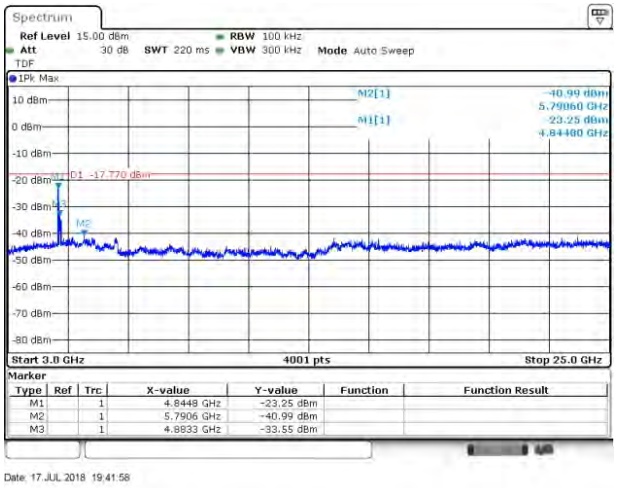
GFSK HOPPING, CARRIER LEVEL



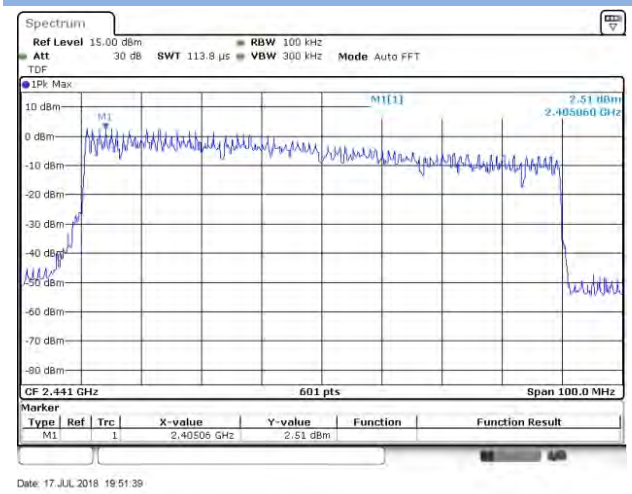
GFSK Hopping Mode, SPURIOUS 30 MHz ~ 3 GHz



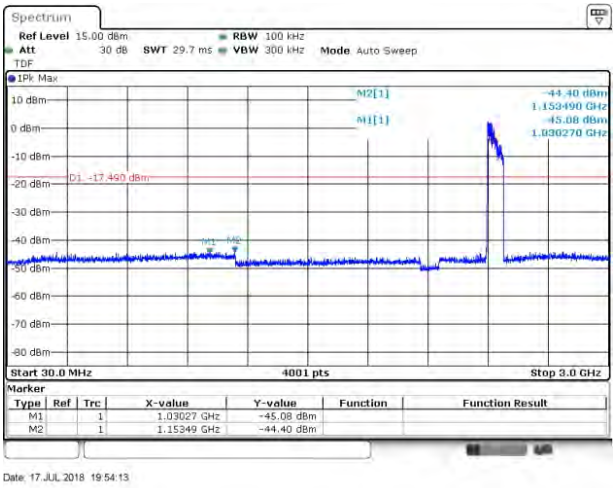
GFSK Hopping Mode, SPURIOUS 30 3GHz ~ 25 GHz



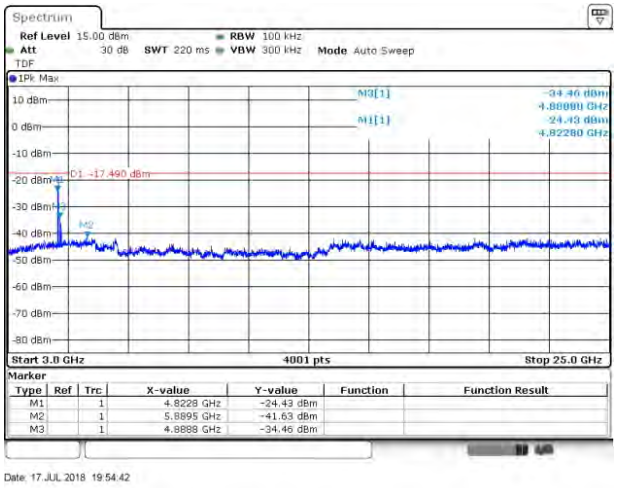
8-DPSK HOPPING, CARRIER LEVEL



8-DPSK Hopping Mode, SPURIOUS 30 MHz ~ 3 GHz



8-DPSK Hopping Mode, SPURIOUS 30 3GHz ~ 25 GHz



A.7 Conducted Emissions

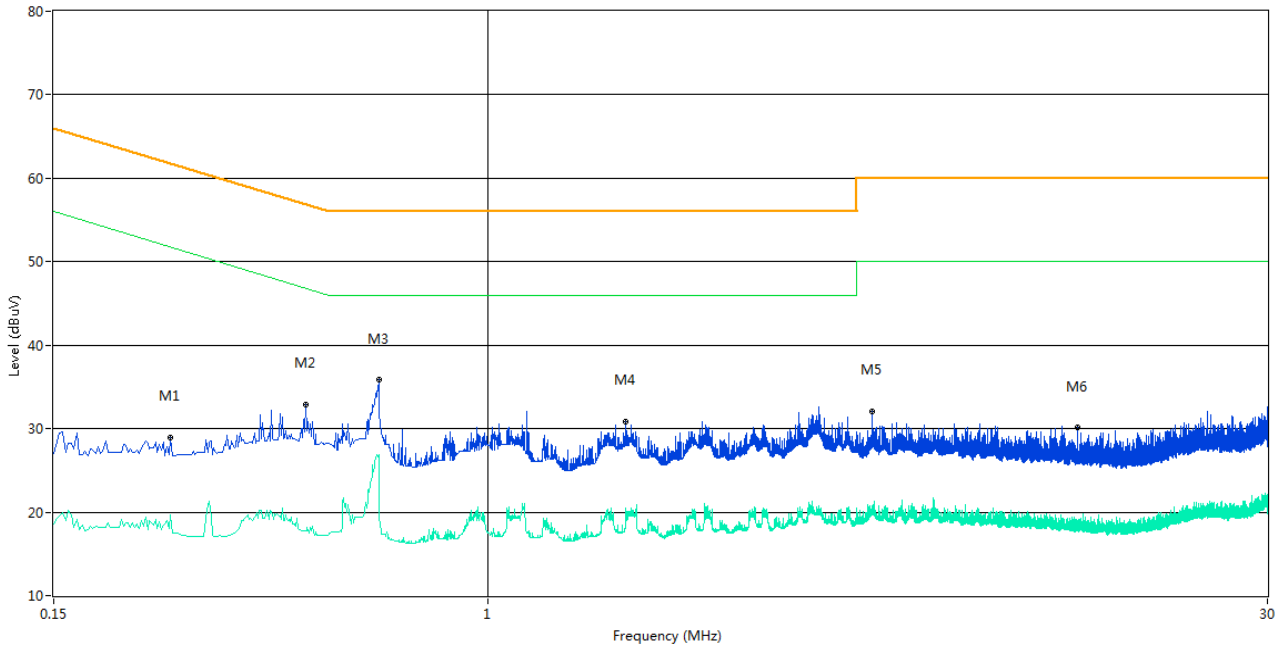
Note [1]: The EUT is working in the Normal link mode.

Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

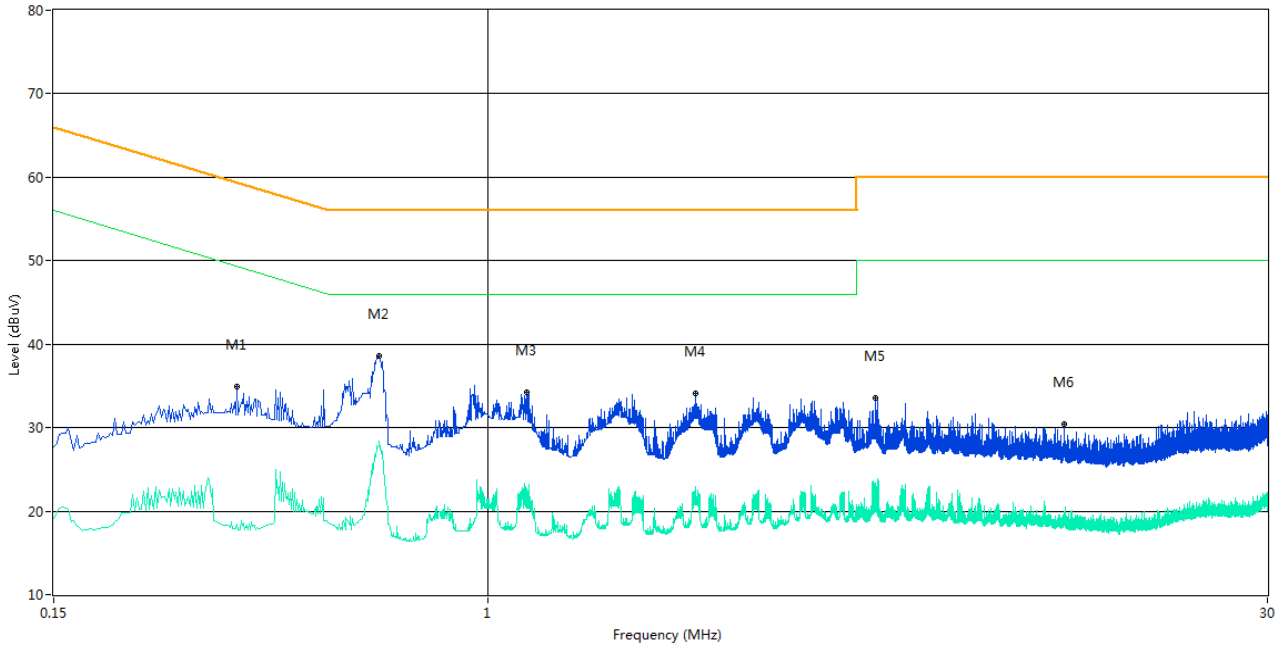
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.250	29.0	10.04	61.8	32.80	Peak	L Line	Pass
1**	0.250	19.7	10.04	51.8	32.10	AV	L Line	Pass
2	0.450	32.9	10.04	56.9	24.00	Peak	L Line	Pass
2**	0.450	17.8	10.04	46.9	29.10	AV	L Line	Pass
3	0.620	35.8	10.05	56.0	20.20	Peak	L Line	Pass
3**	0.620	26.9	10.05	46.0	19.10	AV	L Line	Pass
4	1.824	30.9	10.08	56.0	25.10	Peak	L Line	Pass
4**	1.824	20.5	10.08	46.0	25.50	AV	L Line	Pass
5	5.344	32.1	10.18	60.0	27.90	Peak	L Line	Pass
5**	5.344	19.2	10.18	50.0	30.80	AV	L Line	Pass
6	13.092	30.2	10.40	60.0	29.80	Peak	L Line	Pass
6**	13.092	18.1	10.40	50.0	31.90	AV	L Line	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.334	35.0	10.04	59.4	24.40	Peak	N Line	Pass
1**	0.334	18.4	10.04	49.4	31.00	AV	N Line	Pass
2	0.622	38.6	10.05	56.0	17.40	Peak	N Line	Pass
2**	0.622	28.4	10.05	46.0	17.60	AV	N Line	Pass
3	1.182	34.2	10.06	56.0	21.80	Peak	N Line	Pass
3**	1.182	22.6	10.06	46.0	23.40	AV	N Line	Pass
4	2.474	34.1	10.10	56.0	21.90	Peak	N Line	Pass
4**	2.474	22.6	10.10	46.0	23.40	AV	N Line	Pass
5	5.422	33.5	10.18	60.0	26.50	Peak	N Line	Pass
5**	5.422	21.0	10.18	50.0	29.00	AV	N Line	Pass
6	12.350	30.4	10.38	60.0	29.60	Peak	N Line	Pass
6**	12.350	19.9	10.38	50.0	30.10	AV	N Line	Pass

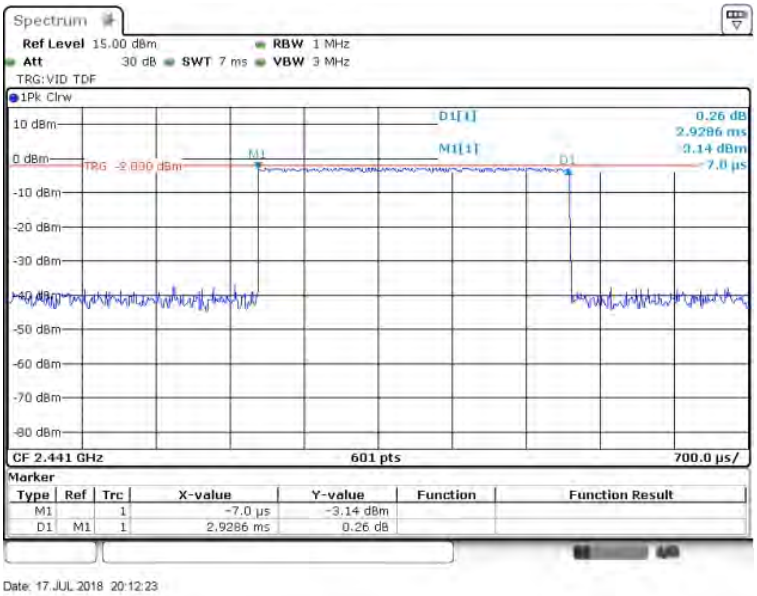
A.8 Radiated Spurious Emission

Duty cycle correction factor for average measurement.

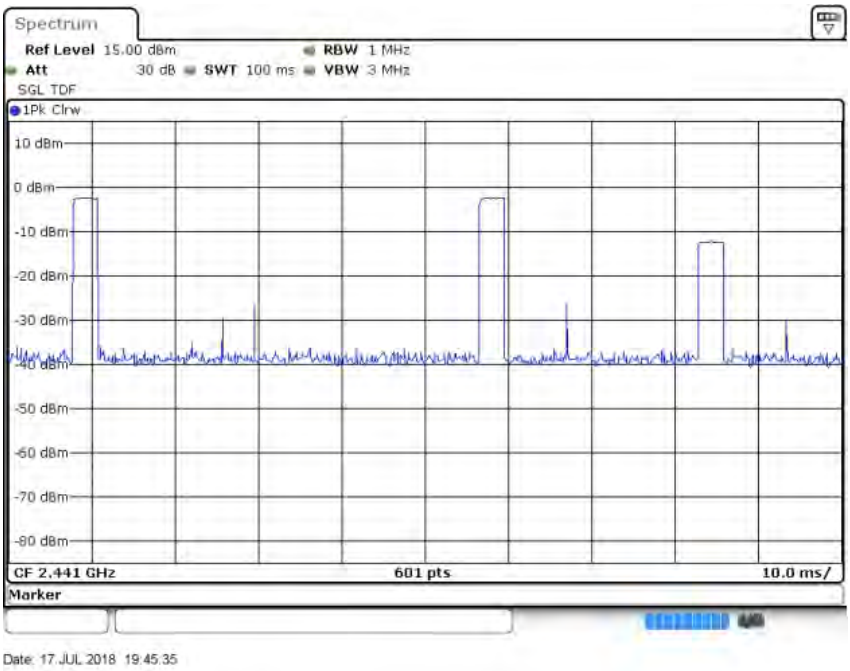
Note:

1. Duty cycle = on time/100 milliseconds = 4* 2.9286 / 100 =8.79 %
2. Duty cycle correction factor = 20*log (Duty cycle) = -21.12 dB
3. DH5 has the highest duty cycle and is reported.

DH5 on time/100 ms (One Pulse) Plot on Channel 39



DH5 on time/100 ms (Count Pulses) Plot on Channel 39



Test Data and Plots

Note [1]: The symbol of "--" in the table which means not application.

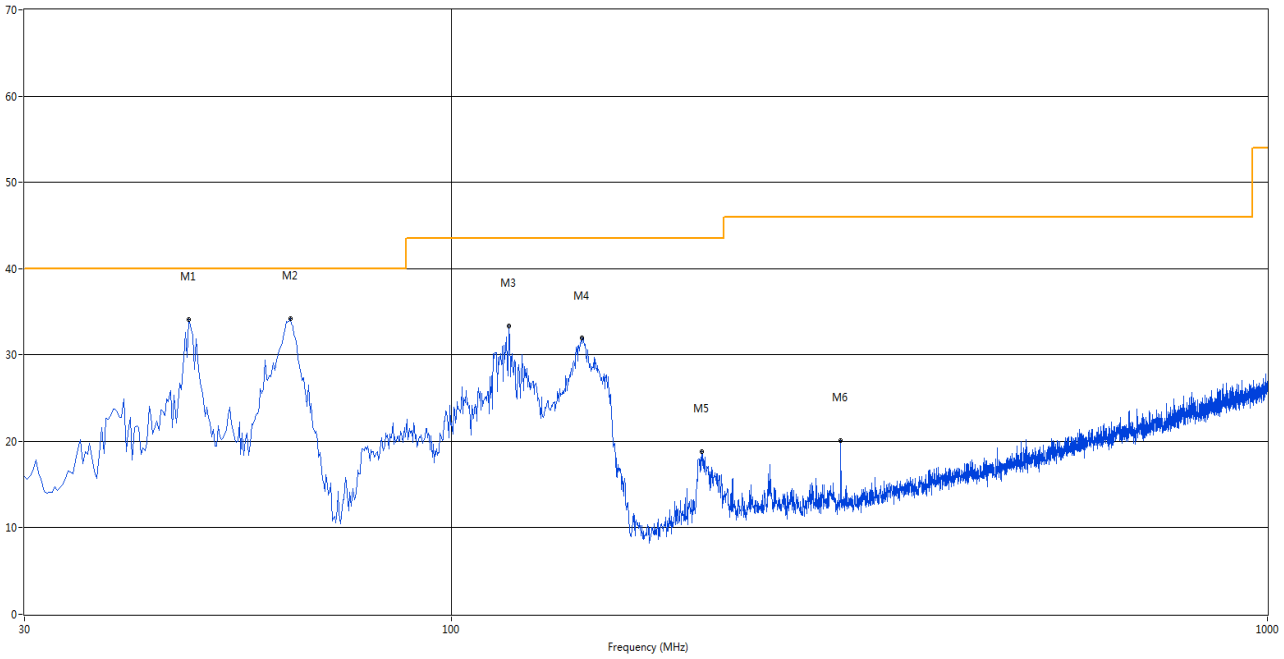
Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [3]: The EUT is working in the Normal link mode below 1 GHz.

Note [4]: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

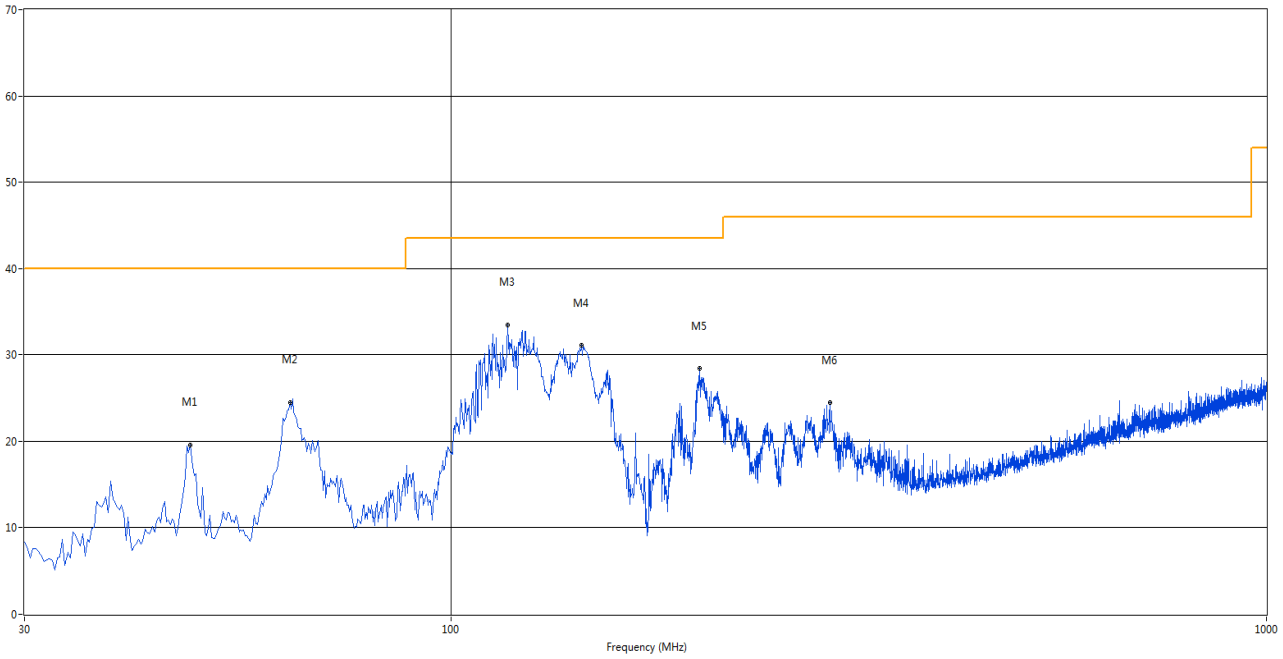
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

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	47.703	34.16	-23.28	40.0	5.84	Peak	356.30	100	Vertical	Pass
2	63.465	34.23	-25.09	40.0	5.77	Peak	341.90	100	Vertical	Pass
3	117.543	33.41	-25.64	43.5	10.09	Peak	261.80	100	Vertical	Pass
4	144.702	31.89	-27.65	43.5	11.61	Peak	0.00	100	Vertical	Pass
5	202.660	18.79	-23.96	43.5	24.71	Peak	319.20	100	Vertical	Pass
6	299.902	20.10	-21.27	46.0	25.90	Peak	292.50	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	47.945	19.56	-23.25	40.0	20.44	Peak	279.60	100	Horizontal	Pass
2	63.465	23.80	-25.09	40.0	16.20	Peak	329.20	100	Horizontal	Pass
3	117.300	33.47	-25.56	43.5	10.03	Peak	106.10	100	Horizontal	Pass
4	144.702	31.09	-27.65	43.5	12.41	Peak	293.20	100	Horizontal	Pass
5	201.690	28.38	-23.99	43.5	15.12	Peak	79.40	100	Horizontal	Pass
6	291.415	24.39	-21.64	46.0	21.61	Peak	145.50	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.

GFSK LOW CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1681.87	48.49	-16.86	74	25.52	Peak	96	150	Vertical	Pass
2	2402.04	80.04	-12.30	74	-6.04	Peak	73	150	Vertical	N/A
3	4882.38	52.86	-3.89	74	21.14	Peak	34.7	150	Vertical	Pass
4	8089.02	47.51	20.20	74	26.49	Peak	276.8	150	Vertical	Pass
5	15121.05	43.44	9.79	74	30.56	Peak	40.3	150	Vertical	Pass
6	19249.58	46.66	11.23	74	27.34	Peak	146.6	150	Vertical	Pass

GFSK LOW CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1699.89	41.40	-16.66	74	32.60	Peak	66.4	150	Horizontal	Pass
2	2402.08	87.86	-11.99	74	-13.86	Peak	5.3	150	Horizontal	N/A
3	4882.96	52.43	-4.00	74	21.57	Peak	130.8	150	Horizontal	Pass
4	8504.58	48.78	13.90	74	25.22	Peak	104.6	150	Horizontal	Pass
5	15849.00	46.67	9.47	74	27.33	Peak	293.8	150	Horizontal	Pass
6	24231.28	45.24	12.28	74	28.76	Peak	73.8	150	Horizontal	Pass

GFSK MIDDLE CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1682.87	48.91	-16.85	74	25.10	Peak	122	150	Vertical	Pass
2	2440.71	80.78	-12.34	74	-6.78	Peak	327.3	150	Vertical	N/A
3	4882.74	52.89	-3.87	74	21.11	Peak	207	150	Vertical	Pass
4	10166.81	46.57	17.59	74	27.43	Peak	148.4	150	Vertical	Pass
5	16535.36	49.61	20.20	74	24.39	Peak	54.5	150	Vertical	Pass
6	22514.14	44.28	11.56	74	29.72	Peak	67	150	Vertical	Pass

GFSK MIDDLE CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1703.39	40.69	-16.66	74	33.31	Peak	92.1	150	Horizontal	Pass
2	2440.57	87.01	-12.22	74	-13.01	Peak	130.7	150	Horizontal	N/A
3	4882.55	52.49	-3.89	74	21.51	Peak	248.4	150	Horizontal	Pass
4	9088.60	47.25	18.20	74	26.75	Peak	103.1	150	Horizontal	Pass
5	14153.91	42.89	9.71	74	31.11	Peak	146	150	Horizontal	Pass
6	19319.47	43.48	11.02	74	30.52	Peak	250.2	150	Horizontal	Pass

GFSK HIGH CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1684.43	47.19	-16.84	74	26.82	Peak	201.4	150	Vertical	Pass
2	2480.32	79.17	-12.30	74	-5.17	Peak	82.8	150	Vertical	N/A
3	4879.63	52.83	-3.84	74	21.17	Peak	258.5	150	Vertical	Pass
4	8032.86	43.95	14.44	74	30.05	Peak	93.7	150	Vertical	Pass
5	15495.42	45.48	10.59	74	28.52	Peak	224.1	150	Vertical	Pass
6	20138.10	42.78	11.09	74	31.22	Peak	25.9	150	Vertical	Pass

GFSK HIGH CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1702.70	41.31	-16.63	74	32.69	Peak	246.7	150	Horizontal	Pass
2	2480.25	87.92	-12.10	74	-13.92	Peak	327.2	150	Horizontal	N/A
3	4878.72	52.18	-3.89	74	21.82	Peak	321.3	150	Horizontal	Pass
4	8605.66	47.92	18.27	74	26.08	Peak	116	150	Horizontal	Pass
5	15557.82	43.50	8.70	74	30.50	Peak	69.5	150	Horizontal	Pass
6	18064.06	49.00	9.53	74	25.00	Peak	88.3	150	Horizontal	Pass

8-DPSK LOW CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1683.02	47.87	-16.85	74	26.14	Peak	109.3	150	Vertical	Pass
2	2402.10	79.56	-12.27	74	-5.56	Peak	149.5	150	Vertical	N/A
3	4882.01	52.89	-3.87	74	21.11	Peak	48.4	150	Vertical	Pass
4	11132.70	44.62	17.00	74	29.38	Peak	214.1	150	Vertical	Pass
5	14278.70	43.54	8.84	74	30.46	Peak	33.3	150	Vertical	Pass
6	21276.21	47.01	12.07	74	26.99	Peak	156.9	150	Vertical	Pass

8-DPSK LOW CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1702.81	40.17	-16.62	74	33.83	Peak	40.8	150	Horizontal	Pass
2	2402.04	88.06	-11.99	74	-14.06	Peak	75.3	150	Horizontal	N/A
3	4881.84	52.50	-3.87	74	21.50	Peak	323.3	150	Horizontal	Pass
4	9133.53	44.89	13.81	74	29.11	Peak	258.9	150	Horizontal	Pass
5	17960.07	44.88	20.01	74	29.12	Peak	358.2	150	Horizontal	Pass
6	18656.82	47.93	9.69	74	26.07	Peak	52.8	150	Horizontal	Pass

8-DPSK MIDDLE CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1681.34	48.75	-16.69	74	25.26	Peak	21.2	150	Vertical	Pass
2	2440.55	80.41	-12.43	74	-6.41	Peak	347.2	150	Vertical	N/A
3	4883.83	52.98	-3.87	74	21.02	Peak	169.9	150	Vertical	Pass
4	11469.63	45.05	19.72	74	28.96	Peak	263	150	Vertical	Pass
5	15797.01	48.24	20.76	74	25.76	Peak	278.3	150	Vertical	Pass
6	22474.21	47.61	12.48	74	26.39	Peak	8.3	150	Vertical	Pass

8-DPSK MIDDLE CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1704.42	41.11	-16.63	74	32.89	Peak	159.9	150	Horizontal	Pass
2	2440.49	86.69	-11.99	74	-12.69	Peak	9.4	150	Horizontal	N/A
3	4879.45	52.45	-3.80	74	21.55	Peak	136.3	150	Horizontal	Pass
4	10908.07	46.22	18.24	74	27.78	Peak	331.3	150	Horizontal	Pass
5	16524.96	45.46	11.08	74	28.54	Peak	244.9	150	Horizontal	Pass
6	23821.96	44.26	12.97	74	29.74	Peak	136.7	150	Horizontal	Pass

8-DPSK HIGH CHANNEL 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1683.98	48.36	-16.86	74	25.65	Peak	23.8	150	Vertical	Pass
2	2480.42	79.77	-12.27	74	-5.77	Peak	38	150	Vertical	N/A
3	4882.98	52.84	-3.80	74	21.16	Peak	148	150	Vertical	Pass
4	11907.65	49.87	18.69	74	24.13	Peak	337.1	150	Vertical	Pass
5	16015.39	47.53	20.10	74	26.47	Peak	249.4	150	Vertical	Pass
6	24600.67	46.69	11.05	74	27.31	Peak	315.2	150	Vertical	Pass

8-DPSK HIGH CHANNEL 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1701.01	40.51	-16.65	74	33.49	Peak	281.3	150	Horizontal	Pass
2	2480.59	88.44	-12.46	74	-14.44	Peak	101.7	150	Horizontal	N/A
3	4880.25	52.78	-3.84	74	21.22	Peak	310.2	150	Horizontal	Pass
4	10694.68	46.79	18.25	74	27.21	Peak	165.7	150	Horizontal	Pass
5	14320.30	49.90	11.59	74	24.10	Peak	7.2	150	Horizontal	Pass
6	22344.43	44.70	11.21	74	29.30	Peak	135.5	150	Horizontal	Pass

Hopping Mode:

GFSK MODE 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1683.02	47.18	-16.86	74	26.83	Peak	215.5	150	Vertical	Pass
2	2440.33	79.29	-12.30	74	-5.29	Peak	129.2	150	Vertical	N/A
3	4883.39	52.86	-3.87	74	21.14	Peak	300.6	150	Vertical	Pass
4	9953.41	42.82	15.98	74	31.18	Peak	213.7	150	Vertical	Pass
5	15797.01	44.38	9.38	74	29.63	Peak	98.7	150	Vertical	Pass
6	24201.33	46.37	8.22	74	27.63	Peak	126.3	150	Vertical	Pass

GFSK MODE 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1701.97	40.89	-16.65	74	33.11	Peak	311.1	150	Horizontal	Pass
2	2440.54	86.73	-11.99	74	-12.73	Peak	329.4	150	Horizontal	N/A
3	4881.88	52.33	-3.90	74	21.67	Peak	336.9	150	Horizontal	Pass
4	6606.49	50.27	14.32	74	23.74	Peak	344.7	150	Horizontal	Pass
5	17741.68	44.77	13.20	74	29.23	Peak	104.3	150	Horizontal	Pass
6	20647.26	47.18	10.96	74	26.82	Peak	175.2	150	Horizontal	Pass

8-DPSK MODE 1 GHz to 25 GHz, ANT V

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1684.21	48.10	-16.85	74	25.91	Peak	122.3	150	Vertical	Pass
2	2440.75	79.27	-12.30	74	-5.27	Peak	21.2	150	Vertical	N/A
3	4881.20	52.86	-3.81	74	21.14	Peak	189	150	Vertical	Pass
4	11615.64	47.97	20.01	74	26.03	Peak	47.5	150	Vertical	Pass
5	15464.23	43.59	9.52	74	30.41	Peak	263	150	Vertical	Pass
6	23782.03	46.74	10.97	74	27.26	Peak	184.8	150	Vertical	Pass

8-DPSK MODE 1 GHz to 25 GHz, ANT H

No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1701.99	40.81	-16.62	74	33.19	Peak	198.1	150	Horizontal	Pass
2	2440.97	88.11	-11.99	74	-14.11	Peak	294.1	150	Horizontal	N/A
3	4882.33	52.83	-3.81	74	21.17	Peak	303.4	150	Horizontal	Pass
4	7752.08	48.65	13.77	74	25.35	Peak	353.3	150	Horizontal	Pass
5	14632.28	45.55	9.04	74	28.45	Peak	87.1	150	Horizontal	Pass
6	18282.45	45.67	11.71	74	28.33	Peak	193.5	150	Horizontal	Pass

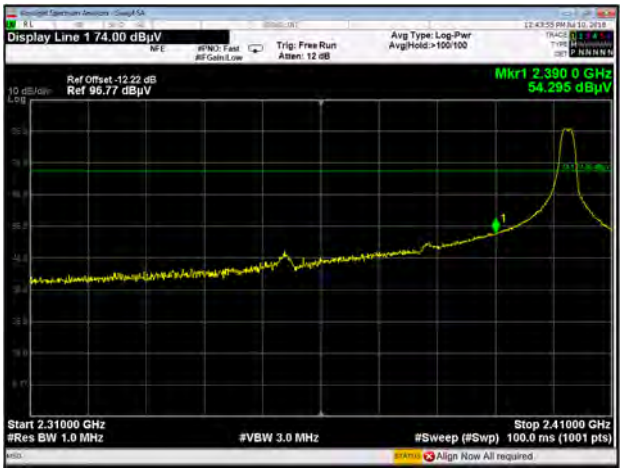
A.9 Band Edge (Restricted-band band-edge)

Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.
Note [2]: 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.
Note [3]: 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.
Note [4]: The Level (dBuV/m) has been corrected by factor.

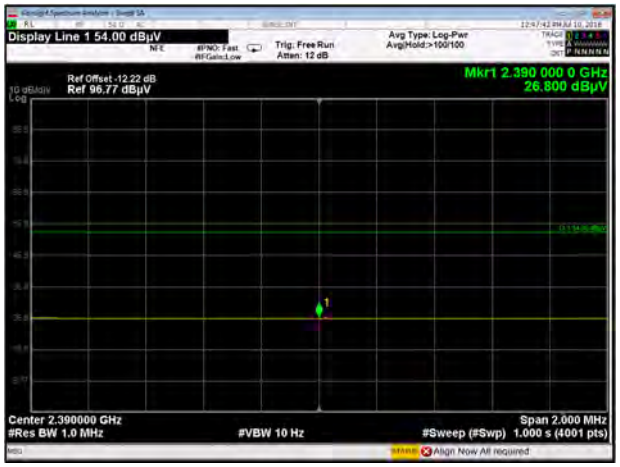
Test Mode	Test Channel	Frequency (MHz)	Level (dBuV/m)	Factor (dB)	Limit Line (dBuV/m)	Margin (dB)	Remark	Verdict
GFSK	Low	2390.00	54.30	-12.22	74	19.71	PEAK	Pass
		2390.00	26.80	-12.22	54	27.20	AVERAGE	Pass
GFSK	HIGH	2483.50	49.74	-11.35	74	24.26	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK	Low	2390.00	54.57	-12.22	74	19.43	PEAK	Pass
		2390.00	26.99	-12.22	54	27.01	AVERAGE	Pass
8-DPSK	HIGH	2483.50	48.65	-11.35	74	25.35	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
GFSK(Hopping)	Low	2390.00	57.60	-12.22	74	16.40	PEAK	Pass
		2390.00	27.22	-12.22	54	26.78	AVERAGE	Pass
GFSK(Hopping	HIGH	2483.50	50.76	-11.35	74	23.24	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK (Hopping)	Low	2390.00	41.31	-12.22	74	32.69	PEAK	Pass
		2390.00	N/A	N/A	54	N/A	AVERAGE	Pass
8-DPSK (Hopping)	HIGH	2483.50	42.64	-11.35	74	31.36	PEAK	Pass
		2483.50	N/A	N/A	54	N/A	AVERAGE	Pass

Test Plots

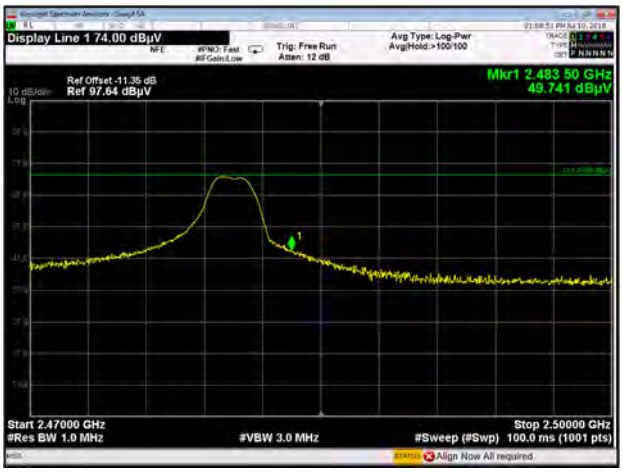
GFSK LOW CHANNEL , PEAK



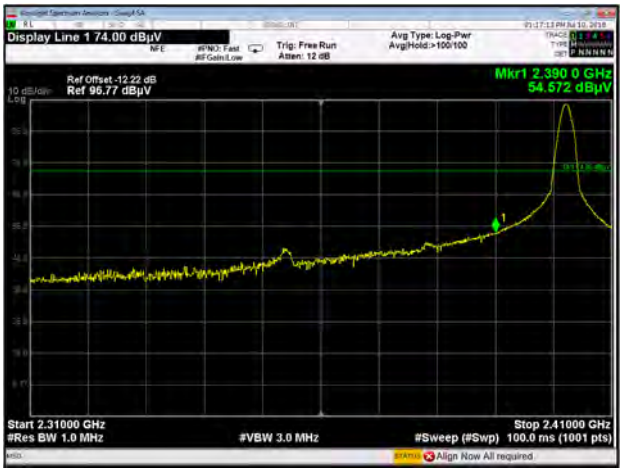
GFSK LOW CHANNEL, AV



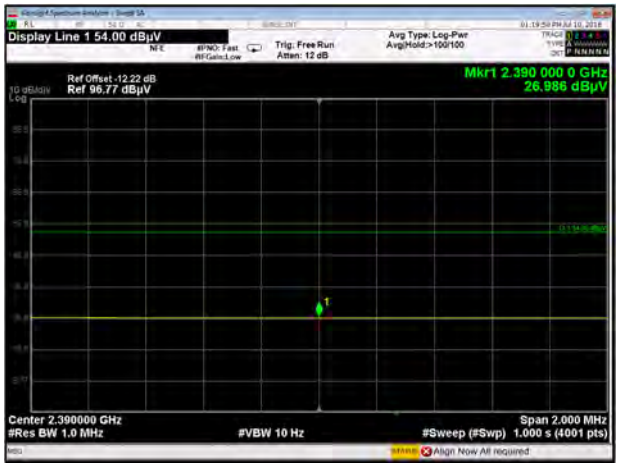
GFSK HIGH CHANNEL , PEAK



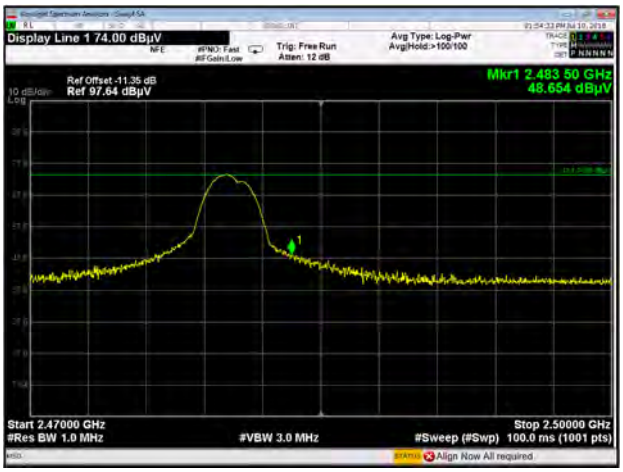
8-DPSK LOW CHANNEL , PEAK



8-DPSK LOW CHANNEL , AV

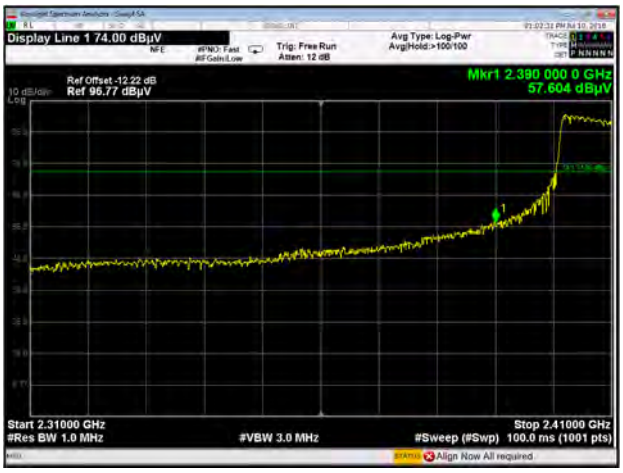


8-DPSK HIGH CHANNEL , PEAK



Hopping Mode:

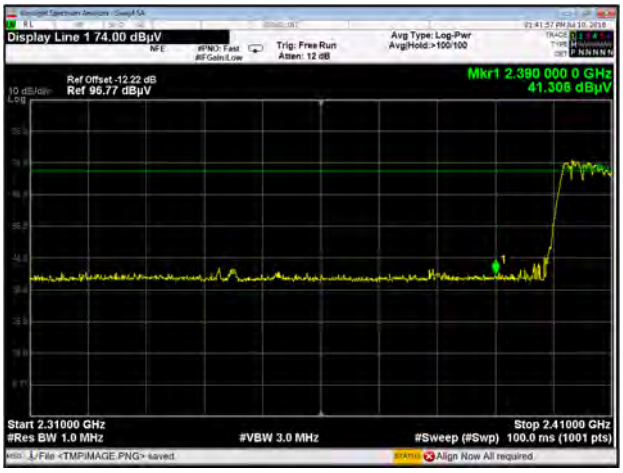
GFSK LOW FREQUENCY BAND, PEAK



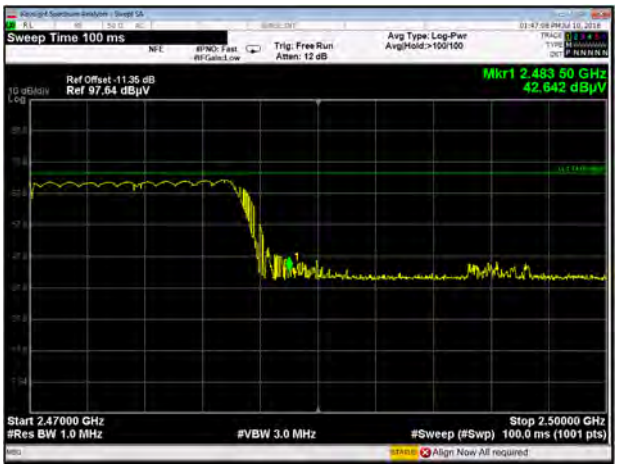
GFSK LOW FREQUENCY BAND, AV

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-HK1860442-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL- HK1860442-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL- HK1860442-AI.PDF”.

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