

# **TEST REPORT**

FCC PART 15 SUBPART C 15.247

Test report On Behalf of Shenzhen Kingstar Industrial Co.Ltd. For Wireless bluetooth speaker

Model No.: F2

FCC ID: 2ADOMF2

Prepared for : Shenzhen Kingstar Industrial Co.Ltd. #1 Floor, Building A, ZaiFeng Industrial Park, Shajing Town,Bao'an District, Shenzhen, Guangdong, China

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Date of Test:Jan. 31, 2019 to Feb. 13, 2019Date of Report:Feb. 13, 2019Report Number:HK1902140243E



# **TEST RESULT CERTIFICATION**

Applicant's name	. Shenzhen Kingstar Industrial Co.Ltd.
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	. Shenzhen Kingstar Industrial Co.Ltd.
Address	#1 Floor, Building A, ZaiFeng Industrial Park, Shajing Town, Bao'an <sup>.</sup> District, Shenzhen, Guangdong, China
Factory	Shenzhen Kingstar Industrial Co.Ltd.
Address	#1 Floor, Building A, ZaiFeng Industrial Park, Shajing Town, Bao'an District, Shenzhen, Guangdong, China
Product description	
Trade Mark:	N/A
Product name	. Wireless bluetooth speaker
Model and/or type reference	. F2
Standards	. 47 CFR FCC Part 15 Subpart C 15.247

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Date of Test	
Date (s) of performance of tests:	Jan. 31, 2019 ~ Feb. 13, 2019
Date of Issue:	Feb. 13, 2019
Test Result:	Pass

**Testing Engineer** 

Gove Finl (Gary Qian)

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2

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#### 1.SUMMARY

#### 1.1. **TEST STANDARDS**

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

#### 1.2. Test Description

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i)	20dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Peak Output Power	PASS
FCC Part 15.247(b)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1)	Frequency Separation	PASS
FCC Part 15.205/15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge Compliance of RF Emission	PASS



# **Test Facility**

#### 1.3.1 Address of the test laboratory

Shenzhen HUAK Testing Technology Co., Ltd. Add.:1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park,Heping Community, Fuhai Street, Bao'an District, Shenzhen, China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 32/EN 55032 requirements.

#### 1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

#### IC Registration No.: 21210

The 3m alternate test site of Shenzhen HUAK Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 21210 on May 24, 2016.

#### FCC Registration No.: CN1229

Test Firm Registration Number : 616276

### 1.3. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen HUAK Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

Hereafter the best measurement capability for HUAK laboratory is reported:

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



# 2. GENERAL INFORMATION

# 2.1. Environmental conditions

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

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

# 2.2. General Description of EUT

Product Name:	Wireless bluetooth speaker
Model/Type reference:	F2
Power supply:	DC 3.7V by battery
Version:	V5.0
Modulation:	GFSK, π/4DQPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB Antenna
Antenna gain:	0dBi
Hardware Version:	V1.0
Software Version:	V1.0

Note: For more details, refer to the user's manual of the EUT.

# 2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

There are 79 channels provided to the EUT and Channel 00/39/78 was selected for testing.

#### **Operation Frequency :**

Channel	Frequency (MHz)
00	2402
01	2403
:	÷
38	2440
39	2441
40	2442
:	:
77	2479
78	2480

Note: The line display in grey were the channel selected for testing



NO.	TEST MODE DESCRIPTION
1	Low channel TX
2	Middle channel TX
3	High channel TX
4	Normal Operating (BT)

Note:

1. Only the result of the worst case was recorded in the report, if no other cases.

2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

3. For Conducted Test method, a temporary antenna connector is provided by the manufacture.

Conducted Emission Configure :



Radiated Emission Configure :

EUT Accessory
---------------

Item	Equipment	Model No.	ID or Specification	Remark
1	Adapter	NTR-S01	DC 5V	Support



# 2.4. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

# 2.5. Modifications

No modifications were implemented to meet testing criteria.

# 2.6. Receiver Input Bandwidth

The input bandwidth of the receiver is 1.3MHZ, In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection(e.g. single of multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

# 2.7. Example of a Hopping Sequence in Data Mode

Example of a 79 hopping sequence in data mode: 40,21,44,23,42,53,46,55,48,33,52,35,50,65,54,67 56,37,60,39,58,69,62,71,64,25,68,27,66,57,70,59 72,29,76,31,74,61,78,63,01,41,05,43,03,73,07,75 09,45,13,47,11,77,15,00,64,49,66,53,68,02,70,06 01, 51, 03, 55, 05, 04

# 2.8. Equally Average Use of Frequencies and Behaviour

The generation of the hopping sequence in connection mode depends essentially on two input values: 1. LAP/UAP of the master of the connection.

2. Internal master clock

The LAP(lower address part) are the 24 LSB's of the 48 BD\_ADDRESS. The BD\_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP(upper address part) are the 24MSB's of the 48BD\_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For ehavior zation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us.The clock has a cycle of about one day(23h30).In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire. LAP(24 bits),4LSB's(4bits)(Input 1) and the 27MSB's of the clock(Input 2) are used. With this input values different mathematical procedures(permutations, additions, XOR-operations)are performed to generate te Sequence. This will be done at the beginning of every new transmission. Regarding short transmissions the Bluetooth system has the following8ehavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer(and it Cannot be shorter) than the minimum resolution of the clock(312.5us).The hopping sequence will always Differ from the first one.



# 2.9. Equipment Used

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	R&S	ENV216	HKE-002	Dec. 27, 2018	1 Year
2.	Receiver	R&S	ESCI 7	HKE-010	Dec. 27, 2018	1 Year
3.	RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 27, 2018	1 Year
4.	Horn Antenna	Schewarzbeck	BBHA 9170	HKE-090	Dec. 27, 2018	1 Year
5.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2018	1 Year
6.	Preamplifier	Schwarzbeck	BBV 9743	HKE-006	Dec. 27, 2018	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESCI 7	HKE-010	Dec. 27, 2018	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	HKE-012	Dec. 27, 2018	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 27, 2018	1 Year
10.	Horn Antenna	Schewarzbeck	9120D	HKE-013	Dec. 27, 2018	1 Year
11.	Pre-amplifier	EMCI	EMC051845 SE	HKE-015	Dec. 27, 2018	1 Year
12.	Pre-amplifier	Agilent	83051A	HKE-016	Dec. 27, 2018	1 Year
13.	EMI Test Software EZ-EMC	Tonscend	JS1120-B Version	HKE-083	Dec. 27, 2018	N/A
14.	Shielded room	Shiel Hong	4*3*3	HKE-039	Dec. 27, 2018	3 Year

The calibration interval was one year





# 3. Peak Output Power

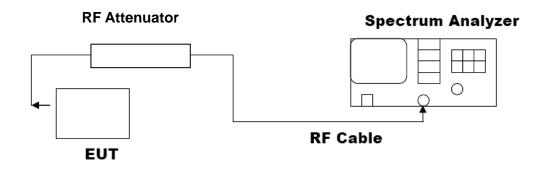
# 3.1. Measurement Procedure

For peak power test:

- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 3. RBW > 20 dB bandwidth of the emission being measured.
- 4. VBW  $\geq$ RBW.
- 5. Sweep: Auto.
- 6. Detector function: Peak.
- 7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

# 3.2. Test Set-Up (Block Diagram of Configuration)





# 3.3. Limits and Measurement Result

PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION							
Frequency (GHz)							
2.402	0.307	30	Pass				
2.441	0.807	30	Pass				
2.480	0.533	30	Pass				







CH39

NNNNN NextPeak	TRACE 1 2 3 4 5 G TYPE MWWWW DET P NNNNN 2.440 780 GHz 0.807 dBm	>100/100	Avg Type: Log Avg Hold:>100/			SHZ PNO: Fast IFGain:Low	2 AC 100000 G F IF	ctrum Analyzer - Sw RF 50 Ω 2.44078000	arker 1
GHz dBm Next Peak	TYPE MWWWW DET P NNNNN 2.440 780 GHz	: Log-Pwr >100/100	Avg Type: Log Avg Hold:>100/	e Run	Trig: Fre	PNO: Fast	100000 G	2.4407800	arker 1 dB/div
GHz dBm Next Pk Right	TYPE MWWWW DET P NNNNN 2.440 780 GHz	>100/100	Avg Hold:>100/			PNO: Fast	F IF		dB/div
dBm Next Pk Right	2.440 780 GHz 0.807 dBm	Mkr1 2.4	N	Ť			dBm	Ref 20.00 d	dB/div
				Ĭ					g
Next Pk Left					<u></u> 1				0.0
					<b>\</b> '				00
Marker Delta									1.0
Mkr→CF									1.0
Mkr→RefLv									1.0 <b></b>
More 1 of 2	Span 5.000 MHz 000 ms (1001 pts)	Sp						41000 GHz	enter 2.4
01 pts)	000 ms (1001 pts)	Sweep 1.000	Swe	4	/ 5.0 MHz	#VBV		1.5 MHz	tes BW
		STATUS							3

								ectrum Analyzer - Sw	
Peak Search	CE 1 2 3 4 5 6 PE MWWWW T P N N N N N	TYP	ALIGN AUTO : Log-Pwr >100/100			GHz PNO: Fast	Ω AC 000000	RF 50 G	<mark>x/</mark> RL Marker 1
Next Peal	315 GHz 33 dBm	2.479 8 0.5	Mkr1		, alen. or	IFGam.LOw	dBm	Ref 20.00	10 dB/div
Next Pk Righ									10.0
Next Pk Le				 	1				0.00
Next PK Le									-10.0
Marker Delt									30.0
Mkr→C									40.0
									50.0
Mkr→RefLv									70.0
<b>Mor</b> 1 of	000 MH-	Cnon-5						180000 GHz	
	.000 MHz 1001 pts)	span 5 000 ms (	Sweep 1		5.0 MHz	#VBW	2	1.5 MHz	#Res BW
			STATUS	 					ISG

	PEAK OUTPUT POWER MEASUREMENT RESULT         FOR Π/4-DQPSK MODULATION							
Frequency (GHz)	Frequency Peak Power Applicable Limits Pass of							
2.402	-0.390	30	Pass					
2.441	0.577	30	Pass					
2.480	0.612	30	Pass					





CH39

ISG					TATUS		
Center 2.4 #Res BW	441000 GHz 1.5 MHz	#VBW 5.0 MH;	Z	Swee	5 Span p 1.000 ms	.000 MHz 1001 pts)	
							More 1 of 2
70.0							
io.o							Mkr→RefLv
50.0							
40.0							Mkr→Cf
30.0							
						and the	Marker Delta
0.0	and a second sec				and a second sec	W Carrow Constant	
10.0							Next Pk Lef
0.00			1				
10.0							Next Pk Righ
0 dB/div	Ref 20.00 dBm				0.5	77 dBm	
		IFGain:Low Atten: 3		<b>.</b>	kr1 2.440 9		Next Peal
	2.44091000000			Avg Type: Log-P Avg Hold:>100/10	WI TRAC	E 1 2 3 4 5 6 E M WWWWW	Peak Search
Keysight Spi RL	ectrum Analyzer - Swept SA RF 50 Ω AC		ENSE:INT	ALIGN AU	ITO		

Keysight Spectrum Analyzer						
<sup>IXI</sup> RL RF S Marker 1 2.47985			SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWWW	Peak Search
10 dB/div Ref 20.0	I	PNO: Fast 😱 FGain:Low	Atten: 30 dB		DET PNNNNN 2.479 855 GHz 0.612 dBm	Next Peak
10.0			1			Next Pk Right
-10.0	~~~~					Next Pk Left
-20.0						Marker Delta
-40.0						Mkr→CF
-60.0						Mkr→RefLvl
Center 2.480000 G #Res BW 1.5 MHz	Hz	#VBW	5.0 MHz	Sweep 7	Span 5.000 MHz 1.000 ms (1001 pts)	More 1 of 2
MSG				STATU	s	

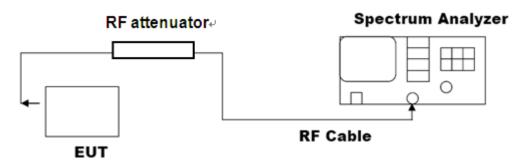


# 4. 20dB Bandwidth

# 4.1. Measurement Procedure

- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
- 3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hoping channel The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
- 4. Set SPA Trace 1 Max hold, then View.

# 4.2. Test Set-Up (Block Diagram of Configuration)





# 4.3. Limits and Measurement Results

MEASUREMENT RESULT FOR GFSK MOUDULATION						
Annlinghin Linsite		Measurement Resu	ılt			
Applicable Limits	Test Da	ita (MHz)	Criteria			
	Low Channel	1.115	PASS			
N/A	Middle Channel	1.112	PASS			
	High Channel	1.109	PASS			

#### Keysight Spectrum Analyzer - Occupied BW - 6 **.** GHZ SENSE:INT ALIGN AUTO Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold:>10/10 #Atten: 30 dB Frequency Center Freq 2.402000000 GHz Radio Std: None Radio Device: BTS 10 dB/div Log Ref 20.00 dBm **Center Freq** 2.402000000 GHz Span 3 MHz Sweep 4.133 ms Center 2.402 GHz #Res BW 30 kHz CF Step 300.000 kHz Man #VBW 100 kHz Auto Total Power 5.96 dBm **Occupied Bandwidth** 959.98 kHz Freq Offset 0 Hz 7.831 kHz Transmit Freq Error % of OBW Power 99.00 % x dB Bandwidth 1.115 MHz -20.00 dB x dB STATUS G

#### TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



#### TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



#### TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL





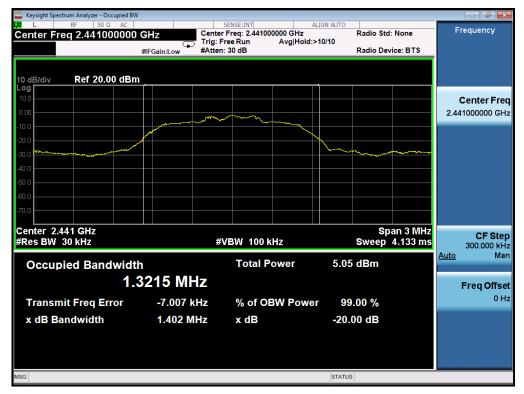
MEASUREMENT RESULT FOR II/4-DQPSK MODULATION						
Angliaghta Limita		Measurement Resu	ılt			
Applicable Limits	Test Da	ita (MHz)	Criteria			
	Low Channel	1.373	PASS			
N/A	Middle Channel	1.402	PASS			
	High Channel	1.418	PASS			

# TEST PLOT OF BANDWIDTH FOR LOW CHANNEL

Keysight Spectrum Analyzer - Occupied BV				
K         RF         50.0.         AC           Center Freq 2.402000000         Center Freq 2.402000000         Center Freq 2.402000000           10 dB/div         Ref 20.00 dBm	GHZ Center Trig: F #IFGain:Low #Atten	SENSE:INT  Freq: 2.402000000 GHz Free Run Avg Hold :: 30 dB	ALIGN AUTO   Radio Std: d:>10/10 Radio Dev	
Log 10.0 0.00 -10.0				Center Freq 2.402000000 GHz
-20.0				
-50.0				
Center 2.402 GHz #Res BW 30 kHz	#	VBW 100 kHz		an 3 MHz CF Step 4.133 ms 300.000 kHz Auto Man
Occupied Bandwidt 1.	հ 2102 MHz	Total Power	4.59 dBm	Freq Offset
Transmit Freq Error x dB Bandwidth	-10.583 kHz 1.373 MHz	% of OBW Pow x dB	er 99.00 % -20.00 dB	0 Hz
MSG			STATUS	



#### TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



#### TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL





# 5. Conducted Spurious Emission

# 5.1. Measurement Procedure

- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
- 3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
   RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
- 4. Set SPA Trace 1 Max hold, then View.

# 5.2. Test Set-Up (Block Diagram of Configuration)

The same as described in section 4.2

# 5.3. Limits and Measurement Result

LIMITS AND MEA	SUREMENT RESULT			
Applicable Limite	Measurement Result			
Applicable Limits	Test Data	Criteria		
In any 100 KHz Bandwidth Outside the	At least -20dBc than the limit			
frequency band in which the spread spectrum	Specified on the BOTTOM	PASS		
intentional radiator is operating, the radio	Channel			
frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the TOP Channel	PASS		



### TEST RESULT FOR ENTIRE FREQUENCY RANGE TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF GFSK MODULATION IN LOW CHANNEL

a RL	RF 50 Ω		SEN			ALIGN AUTO			
larker 1	1 2.40216500					: Log-Pwr >100/100	TRAC	E 1 2 3 4 5 6 E MWWWW	Peak Search
		IFGain:Lo					DE	T P NNNNN	NextPea
- ID Alla	Dof 20.00 df	2 100				Mkr1	2.402 1	65 GHz 64 dBm	Nextrea
dB/div	Ref 20.00 di			/			0.0	of abiii	
3.0									Next Pk Rig
				▲1					
.00			$\sim$	~~~					
0.0									Next Pk Le
0.0									
20.0					$\lambda$				Marker Del
0.0									Marker Dei
		Å /	/			$\wedge$ (	$\backslash$		
10.0		$ \rightarrow $			×		hand	Same -	Mkr→C
io.o		www.							
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~									
io.o									Mkr→RefL
70.0									
									Мо
enter 2.	100000 011						Span 5	.000 MHz	1 of
Res BW	402000 GHZ 100 kHz	#	/BW 300 kHz				.000 ms (	1001 pts)	
		#	/BW 300 kHz			Sweep 1	.000 ms (	1001 pts)	
Res BW				ISE:INT			.000 ms (	1001 pts)	
Res BW SG Keysight Sp RL	<b>100 kHz</b> pectrum Analyzer - Swep	t SA AC 22167 GHz	Trig: Free	Run		STATUS	.000 ms (	1001 pts)	Peak Search
Res BW SG Keysight Sp RL	Pectrum Analyzer - Swep RF 50 Ω	t SA AC	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	Peak Search
Res BW GG RL Arker 1 0 dB/div	2 100 kHz pectrum Analyzer - Swep RF 50 Ω 1 24.43066550	tSA AC <b>22167 GHz</b> PNO: Fas IFGain:Lo	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	Peak Search
Res BW Keysight Sp RL larker 1 0 dB/div	Pectrum Analyzer - Swep RF 50 Ω	tSA AC <b>22167 GHz</b> PNO: Fas IFGain:Lo	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	Peak Search
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Res BW           33           Keysight Sp           RL           Iarker 1           0           0.00           0.00           0.00           0.00           0.00           0.00           0.00	2 100 kHz pectrum Analyzer - Swep RF 50 Ω 1 24.43066550	tSA AC <b>22167 GHz</b> PNO: Fas IFGain:Lo	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	Peak Search Next Pea Next Pk Rig
Res BW           sq           Keysight Sp           RL           RL           10.0           0           0.00           0.00           0.00           0.00           0.00           0.00           0.00           0.00           0.00           0.00	2 100 kHz pectrum Analyzer - Swep RF 50 Ω 1 24.43066550	tSA AC <b>22167 GHz</b> PNO: Fas IFGain:Lo	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	
Res BW           3G           Keysight Sp           RL           RL           Iarker 1           10.0           20.0           20.0           30.0           40.0	2 100 kHz pectrum Analyzer - Swep RF 50 Ω 1 24.43066550	tSA AC <b>22167 GHz</b> PNO: Fas IFGain:Lo	t D Trig: Free	Run	Avg Type	STATUS ALIGN AUTO :: Log-Pwr >100/100	.000 ms ( TRAC TYP DE	1001 pts)	Peak Search Next Pea Next Pk Rigi
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# TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN MIDDLE CHANNEL

Keysight Spectrum Analyzer - Swept SA     K     RL     RF     50 Ω AC			ISE:INT		ALIGN AUTO			
					e: Log-Pwr :>100/100	TRAC	DE 123456 PE MWWWW	Display
	NO: Wide 🖵 Gain:Low	Atten: 30		Arginola		DI		Annotation
10 dB/div Ref 20.00 dBm					Mkr1	2.440 9	97 GHz 68 dBm	Annotation
10 dB/div Ref 20.00 dBm		``````````````````````````````````````						
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0.00		$\sim$	$\sim$					Graticule
-10.0								<u>On</u> Off
	1	<i>x x</i>		<b>x</b>				
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-30.0								On <u>Of</u>
-40.0					$\sim$	_ /	$\overline{\mathbf{x}}$	
-40.0						$\searrow$		Display Lines ►
-50.0						- Market	$\sim$	
-60.0								System Display▶
								Settings
-70.0								
Center 2.441000 GHz #Res BW 100 kHz	#VBW	300 kHz			Sweep 1	Span 5 066 ms (	.000 MHz (1000 pts)	
MSG					STATUS			
	GHz	T	ISE:INT		ALIGN AUTO e: Log-Pwr :>100/100	TRAC	DE <b>1 2 3 4 5</b> 6 PE M <del>WWWWW</del> ET P N N N N N	Peak Search
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40 JEAN Dof 20 00 dBm					Mkr	3 16.52 -52 4	4 1 GHz 27 dBm	NextPeak
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0.00								Next Pk Right
-10.0								
-20.0							DL1 -19.63 dBm	
-30.0								Next Pk Left
-40.0				<b>→</b> <sup>3</sup>		<b>2</b>	<u> </u>	
-60.0			tele de des sités	and an a state				Marker Delta
-70.0								
Start 30 MHz						Stop 2	5.00 GHz	
	#VBW	300 kHz			-		0000 pts)	Mkr→CF
#Res BW 100 kHz								
MKR MODE TRC SCL X	8 GHz	Y -48.964 dE	3m	CTION FUI	ICTION WIDTH	FUNCTION	DN VALUE	
MKR         MODE         TRC         SCL         X           1         N         1         f         24.489           2         N         1         f         21.328           3         N         1         f         16.524	8 GHz 5 GHz 1 GHz	Y -48.964 dE -50.847 dE -52.427 dE	3m 3m	CTION FUI	VCTION WIDTH	FUNCTI	JN VALUE	Mkr→RefLv
MKRI MODE         TRC         SCL         X           1         N         1         f         24.489           2         N         1         f         21.328           3         N         1         f         16.524           5         -         -         -         -	8 GHz 5 GHz 1 GHz	-50.847 dE	3m 3m	CTION FUI	VCTION WIDTH	FUNCTION		Mkr→RefLv
MKR         MODE         TRC         SCL         X           1         N         1         f         24.439           2         N         1         f         21.328           3         N         1         f         16.524           4         -         -         -           5         -         -         -           6         -         -         -           7         -         -         -	8 GHz 5 GHz 1 GHz	-50.847 dE	3m 3m		NCTION WIDTH	FUNCTI		
MKR         MODE         TRC         SCL         X           1         N         1         f         24.439           2         N         1         f         21.328           3         N         1         f         16.524           4         6         6         7         7           8         9         9         9         9	8 GHz 5 GHz 1 GHz	-50.847 dE	3m 3m		NCTION WIDTH	FUNCTI		Mkr→RefLvi More 1 of 2
MKR         MODE         TRC         SCL         X           1         N         1         f         24.489           2         N         1         f         21.328           3         N         1         f         16.524           4         6         6         6           7         8         8         8	8 GHz 5 GHz 1 GHz	-50.847 dE	3m 3m	CTION FUI	NCTION WIDTH	FUNCTION		More



Keysight Spectrum Analyzer - So RL RF 50 9		SENSE:INT	ALIGN AUTO		
- N2 N - 50	PNO: Wide 🕞		Avg Type: Log-Pwr Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P NNNN	Display
	IFGain:Low	Atten: 30 dB		2.479 997 GHz	Annotation
0 dB/div Ref 20.00	dBm		WIKI I	0.020 dBm	
-og					
10.0					Title
0.00		1			
					Graticul
10.0					
20.0			$\mathcal{A}$		Display Lin -19.94 dB
30.0					On <u>O</u>
La la	$\wedge$ $\sim$ $\sim$		$\lambda = \lambda$	$\wedge$	
40.0				$\langle \rangle \rangle$	Display Lines
50.0				w how	
60.0					System Display
					Settings
-70.0					
Center 2.480000 GHz				Span 5.000 MHz	
Res BW 100 kHz		V 300 kHz	Sweep 1.	066 ms (1000 pts)	
ISG			STATUS		
Keysight Spectrum Analyzer - So RL RF 50 9		SENSE:INT			
Acres 2 46 000644		SENSE.INT	ALIGN AUTO		Deak Search
harker 5 10.000041	1288043 GHz PNO: Fast	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N N	Peak Search
narker 5 10.00004	288043 GHz		Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz	
0 dB/div Ref 20.00	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE M TYPE DET P NNNN 16.888 6 GHz -51.432 dBm	
0 dB/div Ref 20.00	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz	Next Pea
0 dB/div Ref 20.00	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz	Next Pea
10 dB/div Ref 20.00 -99 10.0 0.00 -10.0	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz	Next Pea
10 dB/div Ref 20.00	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	3 16.888 6 GHz -51.432 dBm	Next Pea Next Pk Rigi
0 dB/div Ref 20.00 9 9 10.0 20.0 30.0 40.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	3 16.888 6 GHz -51.432 dBm	Next Pea Next Pk Rigi
ID dB/div         Ref 20.00           09	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	3 16.888 6 GHz -51.432 dBm	Next Pea Next Pk Rigi Next Pk Le
10 dB/div Ref 20.00 -99 10.0 200 -00 -00 -00 -00 -00 -00 -0	I288043 GHz PNO: Fast G IFGain:Low	Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>100/100	3 16.888 6 GHz -51.432 dBm	Next Pea Next Pk Rigi Next Pk Le
10 dB/div         Ref 20.00           0 g	I288043 GHz PNO: Fast IFGain:Low dBm	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz -51.432 dBm 0.1 -19.98 dBm	Next Pea Next Pk Rigi Next Pk Le Marker Dei
0 dB/div         Ref 20.00           0 g	1288043 GHz PNO: Fast IFGain:Low dBm #VBV	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Next Pea Next Pk Rigi Next Pk Le Marker Dei
O dB/div         Ref 20.00           0 g	I288043 GHz PN0: Fast IFGain:Low dBm dBm #VBV X 24.402 4 GHz	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.888 6 GHz -51.432 dBm 0.1 -19.98 dBm	Next Pea Next Pk Rigi Next Pk Le Marker Dei
0 dB/div         Ref 20.00           .0g	I288043 GHz PNO: Fast IFGain:Low dBm dBm dBm with the set with th	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Next Pea Next Pk Rigi Next Pk Le Marker Dei Mkr→C
O dB/div         Ref 20.00           0 g	I288043 GHz PNO: Fast IFGain:Low dBm dBm #VBV * #VBV	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Next Pea Next Pk Rigi Next Pk Le Marker Dei Mkr→C
IO         Bl/div         Ref 20.00           -09	I288043 GHz PNO: Fast IFGain:Low dBm dBm #VBV * #VBV	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Next Pea Next Pk Righ Next Pk Le Marker Delt Mkr→C
O dB/div         Ref 20.00           Og         Image: Constraint of the second se	I288043 GHz PNO: Fast IFGain:Low dBm dBm #VBV * #VBV	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Next Pea Next Pk Righ Next Pk Le Marker Dell Mkr→C Mkr→Ref Li Mor
O dB/div         Ref 20.00           0         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0           0.00         0     <	I288043 GHz PNO: Fast IFGain:Low dBm dBm #VBV * #VBV	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>100/100	16.898 6 GHz -51.432 dBm 0.1 -1999 dBm	Peak Search Next Pea Next Pk Righ Next Pk Lei Marker Delt Mkr→C Mkr→Ref Ly Mor 1 of

### TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN HIGH CHANNEL

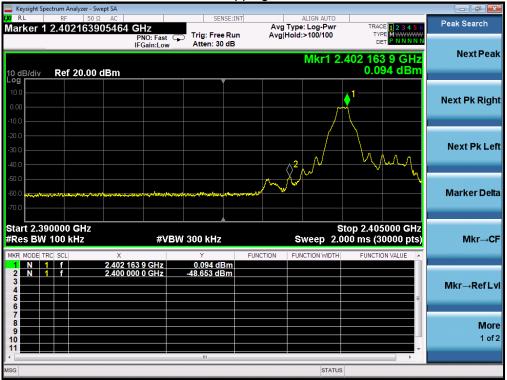
Note: The peak emissions without marker on the above plots are fundamental wave and need not to compare with the limit. The GFSK modulation is the worst case and only those data recorded in the report.



#### TEST RESULT FOR BAND EDGE

#### GFSK MODULATION IN LOW CHANNEL

#### Hopping off



Hopping on

Keysight Spectru	um Analyzer - Swept SA					
Marker 1 2.	RF 50 Ω AC 404161472049	GHz		ALIGN AUTO vg Type: Log-Pwr vg Hold:>100/100	TRACE 123456 TYPE MWWWW	Peak Search
10 dB/div	Ref 20.00 dBm	IFGain:Low Atten:			.404 161 5 GHz 1.231 dBm	Next Peak
Log 10.0 0.00 -10.0						Next Pk Right
-20.0 -30.0 -40.0				A <sup>2</sup> N		Next Pk Left
-50.0 -60.0	an Angara.		^			Marker Delta
Start 2.3900 #Res BW 10	DO KHZ	#VBW 300 kF	FUNCTION	Sweep 2.0	Stop 2.405000 GHz 000 ms (30000 pts) FUNCTION VALUE	Mkr→CF
1 N 1 2 N 1 3 4 5 6	f 2.404 1 f 2.400 0	1231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1.231 1	dBm dBm			Mkr→RefLvl
7 8 9 10 11		m				More 1 of 2
MSG				STATUS	3	

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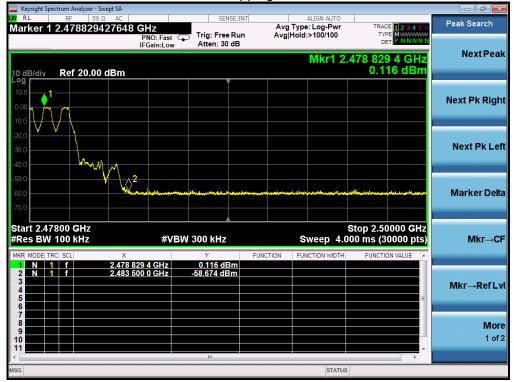


### GFSK MODULATION IN HIGH CHANNEL



Keysight Spectrum Analyzer - Swept SA	
Marker 1 2.479997666589 GHz         sense: INT         Align Auto	ak Search
PNO: Fast C Trig: Free Run Avg Hold:>100/100 TYPE	
IFGain:Low Attent to dB	Next Peak
Mkr1 2.479 997 7 GHz           10 dB/div         Ref 20.00 dBm	
	ext Pk Right
-20.0 -30.0 -40.0	Next Pk Left
-50.0 YV 2 -60.0	larker Delta
Start 2.47800 GHz         Stop 2.50000 GHz           #Res BW 100 kHz         #VBW 300 kHz         Sweep 4.000 ms (30000 pts)	Mkr→CF
	lkr→RefLvl
7     8       9     10       10     10       11     11	More 1 of 2
MSG STATUS	

Hopping on





#### **Π/4-DQPSK MODULATION IN LOW CHANNEL**

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Hopping off



Hopping on



# Page 27 of 52



### Π/4-DQPSK MODULATION IN HIGH CHANNEL

Hopping off

Start Freq 2.478000000 GHz       Trig: Free Run IFGein.Low       Avg Type: Log-Pur AvgIHod:>100/100       Trig: Free Run Avg Type: Log-Pur AvgIHod:>100/100       Trig: Free Run Avg Type: Log-Pur AvgIHod:>100/100       Avg Type: Log-Pur AvgIHod:>100/100       Start Freq 2.489000000 GHz       Start Freq 2.498000000 GHz       Stop Freq 2.500000 GHz       Stop Freq 2.500000 GHz       Avg Type: Log-Pur AvgIHod:>100/100       Avg Type: Log-Pur AvgIHod:>100/100       Avg Type: Log-Pur AvgIHod:>100/100       Function width       Function width       Function width       Function width       Function width       Function width       Function wid		ιορμ	ning on	
Start Freq 2.478000000 GHz PRO: Fast IFGein.Low Trig: Free Rum Arten: 30 dB Mkr1 2.479 999 9 GHz -1.938 dBm Center Freq 2.48900000 GHz Start Freq 2.48900000 GHz Start Freq 2.48900000 GHz Start Freq 2.48900000 GHz Start Freq 2.48900000 GHz Start Freq 2.48900000 GHz Start Start Freq 2.48900000 GHz Start Start Start Stop 2.50000 GHz Start Start Stop 2.50000 GHz Start Start Stop Start Stop 2.50000 GHz Start Start Stop Stop Stop Start Stop Stop Stop Stop Stop Stop Stop Sto				
Auto Tune Mkr1 2.479 999 9 GHz -1.938 dBm -1.938 dBm -1.938 dBm -2.47800000 GHz Start Freq 2.47800000 GHz -2.00000 GHz -2.00000 GHz -2.00000 GHz -2.00000 GHz -2.00000 GHz -2.0000 GHz -1.938 dBm -1.938 dBm -	Start Freq 2.478000000 GHz	Z PNO: Fast 😱 Trig: Free Run	Avg Type: Log-Pwr	TYPE MWWWW
Mikr'l 2.4/9 999 9 GH2 -1.938 dBm -1.938	IF	FGain:Low Atten: 30 dB		Auto Tuno
100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       100       1	10 dB/div Ref 20.00 dBm			999 9 GHZ
30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0	10.0			
600       Volume       Volume       Volume       Volume       Volume       Volume       Stop Freq       2.50000000 GHz         700       Start 2.47800 GHz       #VBW 300 kHz       Stop 2.50000 GHz       CF Step       2.50000000 Hz       2.50000000 Hz         Start 2.47800 GHz       #VBW 300 kHz       Sweep 4.000 ms (30000 pts)       4.000 ms (30000 pts)       4.000 MHz       2.20000000 Hz       2.20000000 Hz         N 1       f       2.483 500 0 GHz       -55.654 dBm       FUNCTION       FUNCTION VIDTH       FUNCTION VALUE       Freq Offset         0       Hz       -55.654 dBm       -55.654 dBm <t< td=""><td>-30.0</td><td></td><td></td><td></td></t<>	-30.0			
#Res BW 100 kHz     #VBW 300 kHz     Sweep     4.000 ms (30000 pts)       MKR MODE TRC SCL     X     Y     FUNCTION     FUNCTION WIDTH     FUNCTION VALUE       1     N     1     f     2.479 999 9 GHz     -1.938 dBm       2     N     1     f     2.483 500 0 GHz     -55.654 dBm       3     1     f     2.483 500 0 GHz     -55.654 dBm       5     5     5     5     5     5       6     6     6     6     6     6       7     6     6     6     6     6       10     7     7     7     7     7       10     7     7     7     7     7       10     7     7     7     7     7       10     7     7     7     7     7       11     7     7     7     7     7       10     7     7     7     7     7       11     7     7     7     7     7       12     7     7     7     7     7       13     7     7     7     7     7       14     7     7     7     7     7       14	-60.0	♦ and the first state of the state of th	ral new particular states and the states of the states	terrete and the terrete second
MRR MODE TRCI SCL X Y Y FUNCTION FUNCTION WIDTH FUNCTION VALUE 1 N 1 f 2.479 999 9 GHz -1.938 dBm 2 N 1 f 2.483 500 0 GHz -55.654 dBm 4 4 6 7 6 7 6 7 7 6 7 7 7 7 7 7 7 7 7 7	Start 2.47800 GHz #Res BW 100 kHz		Sweep 4.000 ms	(30000 pts) 2.200000 MHz
7 8 9 10 11 11 11 11 11 11 11 11 11 11 11 11	1         N         1         f         2.479         999         2         N         1         f         2.483         500         3         4         4         4         4         4         4         4         4         4         4         4         4         4         4         4         4         5         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1 <th1< th=""> <th1< th=""> <th1< th=""> <th1< td=""><td>9 GHz -1.938 dBm</td><td>FUNCTION FUNCTION WIDTH FUN</td><td>Freq Offset</td></th1<></th1<></th1<></th1<>	9 GHz -1.938 dBm	FUNCTION FUNCTION WIDTH FUN	Freq Offset
	6 7 8 9 10			
	MSG		STATUS	

### Hopping on

🔤 Keysight Spectrum Analyzer - Swept SA				
X RL RF 50 Ω AC Marker 1 2.478000000000	GHz	SE:INT ALIGN AL Avg Type: Log-P	Wr TRACE 1 2 3 4 5 6	Peak Search
10 dB/div <b>Ref 20.00 dBm</b>	PNO: Fast Trig: Free IFGain:Low Atten: 30	dB	1 2.478 000 0 GHz -2.164 dBm	Next Peak
10.0 .10.0				Next Pk Right
-20.0				Next Pk Left
-50.0	<u>)</u> Inner Weltzbester Main-annen projekter kaarste integree	เราสะ	ahun hiton di pana di mana kata kata kata kata kata kata kata k	Marker Delta
Start 2.47800 GHz #Res BW 100 kHz MKR MODE TRC SCL X 1 N 1 f 2478.0	#VBW 300 kHz	FUNCTION FUNCTION W	Stop 2.50000 GHz 4.000 ms (30000 pts)	Mkr→CF
	000 0 GHz -58.083 dB	m 	E	Mkr→RefLv
7 8 9 10 11			•	More 1 of 2
MSG		ST	TATUS	



# 6. Radiated Emission

# 6.1. Measurement Procedure

- 1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
- 2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
- 3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
- 4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
- 5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
- 6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
- 7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
- 8.If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
- 9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- 10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High Low scan is not required in this case.



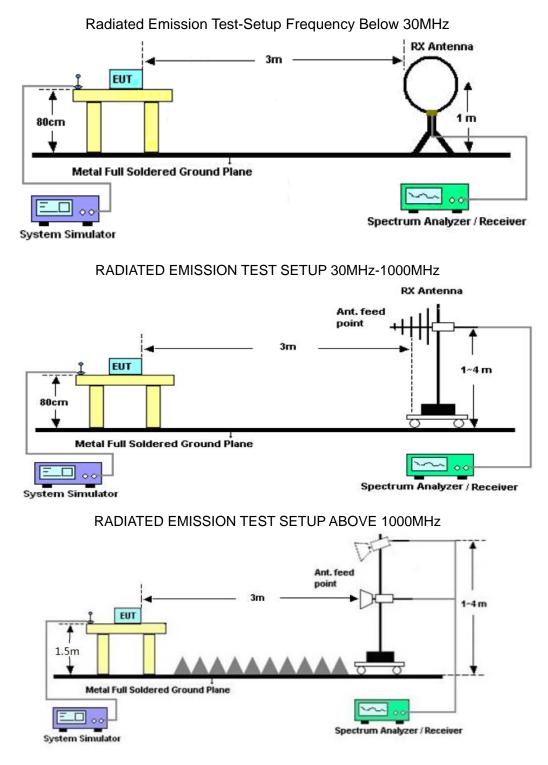
#### The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting	
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP	
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP	
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP	
Start Stan Fraguenay	1GHz~26.5GHz	
Start ~Stop Frequency	1MHz/3MHz for Peak, 1MHz/10Hz for Average	

Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP



### 6.2. Test Setup



# 6.3. Limits and Measurement Result

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
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: All modes were tested For restricted band radiated emission,

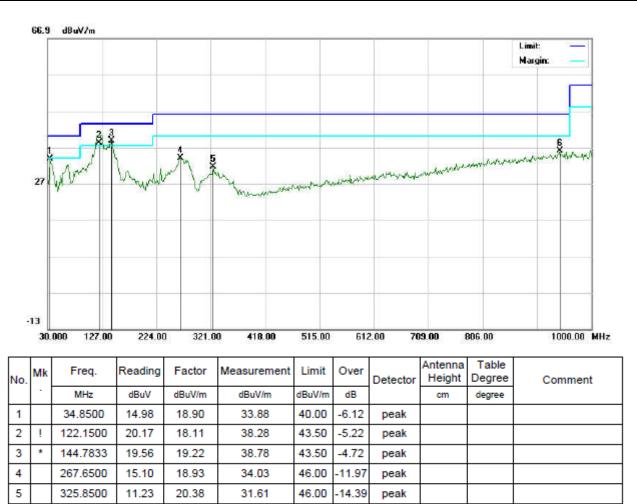
the test records reported below are the worst result compared to other modes.



#### **RADIATED EMISSION BELOW 30MHZ**

No emission found between lowest internal used/generated frequencies to 30MHz. **RADIATED EMISSION BELOW 1GHZ** 

EUT	Wireless bluetooth speaker	Model Name	F2	
Temperature	25°C	Relative Humidity	55.4%	
Pressure	960hPa	Test Voltage	Normal Voltage	
Test Mode	Mode 4	Antenna	Horizontal	



46.00

-10.01

peak

**RESULT: PASS** 

943.4167

3.92

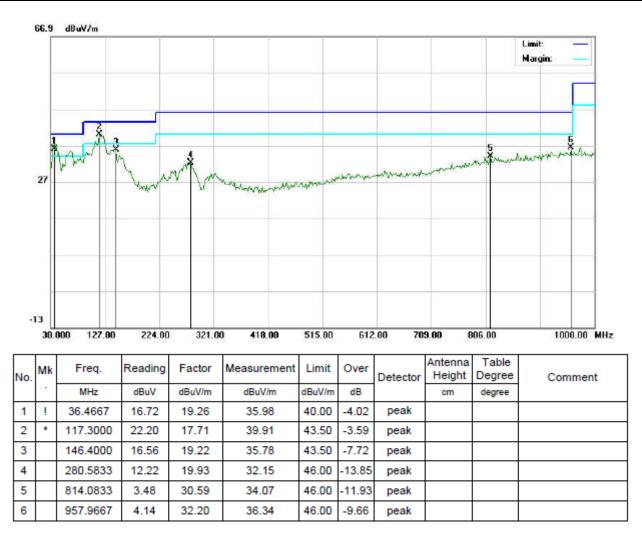
32.07

35.99

6



EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 4	Antenna	Vertical



#### **RESULT: PASS**

**Note:** 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. All test modes had been pre-tested. The mode 4 is the worst case and recorded in the report.



RADIATED EMISSION ABOVE 1GHZ

EUT	Wireless bluetooth speaker	Model Name	F2	
Temperature	25°C	Relative Humidity	55.4%	
Pressure	960hPa	Test Voltage	Normal Voltage	
Test Mode	Mode 1	Antenna	Horizontal	

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4804.062	46.39	3.76	50.15	74.00	-23.85	peak
4804.062	44.36	3.76	48.12	54.00	-5.89	AVG
7206.093	37.14	8.17	45.31	74.00	-28.69	peak
7206.093	34.05	8.17	42.22	54.00	-11.78	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Vertical

Frequency Reading	Meter	Factor	Emission	Limits	Margin	
	Reading	T actor	Level	Linits	Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4804.062	48.35	3.76	52.11	74.00	-21.89	peak
4804.062	43.42	3.76	47.18	54.00	-6.82	AVG
7206.093	38.64	8.17	46.81	74.00	-27.19	peak
7206.093	36.38	8.17	44.55	54.00	-9.45	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4882.062	47.19	3.78	50.97	74.00	-23.03	peak
4882.062	43.00	3.78	46.78	54.00	-7.22	AVG
7323.093	41.14	8.23	49.37	74.00	-24.63	peak
7323.093	38.92	8.23	47.15	54.00	-6.85	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna	Vertical

Frequency Reading	Meter	Factor	Emission	Limits	Margin	
	Reading		Level		Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4882.062	46.94	3.78	50.72	74.00	-23.28	peak
4882.062	44.87	3.78	48.65	54.00	-5.35	AVG
7323.093	41.35	8.23	49.58	74.00	-24.42	peak
7323.093	36.82	8.23	45.05	54.00	-8.95	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4960.062	46.73	3.81	50.54	74.00	-23.46	peak
4960.062	44.91	3.81	48.72	54.00	-5.28	AVG
7440.093	40.24	8.27	48.51	74.00	-25.49	peak
7440.093	37.54	8.27	45.81	54.00	-8.19	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Vertical

	Meter		Emission			
Frequency	Reading	Factor	Level	Limits	Margin	Value Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4960.062	46.90	3.81	50.71	74.00	-23.29	peak
4960.062	44.57	3.81	48.38	54.00	-5.62	AVG
7440.093	38.24	8.27	46.51	74.00	-27.49	peak
7440.093	36.57	8.27	44.84	54.00	-9.16	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

#### **RESULT: PASS**

Note:

Other emissions from 1G to 25 GHz are considered as ambient noise. No recording in the test report.

Factor = Antenna Factor + Cable loss - Amplifier gain, Over=Measure-Limit.

The "Factor" value can be calculated automatically by software of measurement system.

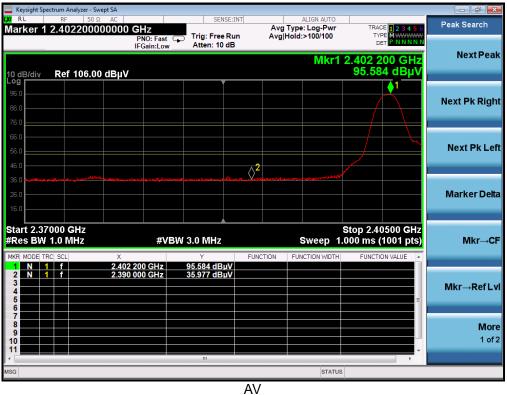
All test modes had been tested. The GFSK modulation is the worst case and recorded in the report.



#### TEST RESULT FOR RESTRICTED BANDS REQUIREMENTS

EUT	Wireless bluetooth speaker	Model Name	F2					
Temperature	25°C	Relative Humidity	55.4%					
Pressure	960hPa	Test Voltage	Normal Voltage					
Test Mode	Mode 1	Antenna	Horizontal					

ΡK



		Av		
Keysight Spectrum Analyzer - Swept SA				- F
RL RF 50 Ω AC	SENSE:	ALIGN AUTO Avg Type: RMS	TRACE 1 2 3 4 5 6	Peak Search
arker 1 2.402025000000	PNO: Fast C Trig: Free Ru		TYPE A WWWWWWW	
	IFGain:Low Atten: 10 dB		DET A NNNN	
		Mkr	1 2.402 025 GHz	NextPea
		IVIKI	93.775 dBµV	
dB/div Ref 106.00 dBµV			30.770 abuv	
6.0			<b>♦ '</b>	
				Next Pk Rig
6.0				-
6.0				
5.0				
				Next Pk L
6.0				
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6.0		~ 2		
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				Marker De
6.0				
art 2.37000 GHz			Oten 2 40500 Otta	
Res BW 1.0 MHz	#VBW 3.0 MHz*	Swoon	Stop 2.40500 GHz 1.000 ms (1001 pts)	Mkr→
Kes Bw 1.0 Minz	#VBVV J.0 MIHZ	oweep	1.000 ms (1001 pts)	
R MODE TRC SCL X	Y	FUNCTION FUNCTION WIDTH	H FUNCTION VALUE	
1 N 1 f 2.402 2 N 1 f 2.390	025 GHz 93.791 dBµV 000 GHz 26.014 dBµV			
3	20.014 dBµv			Mkr→RefL
4				wiki → Kei L
6			=	
				Mo
9				1 0
ĭ <b>E</b>			-	
	III		۱.	
3		STAT	JS	

**RESULT: PASS** 



EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Vertical

PK

Keysight Spectrum Analyzer - Swept SA					
RL RF 50 Ω AC	00 GHz	SENSE:INT	ALIGN AUTO	TRACE 1 2 3 4 5 6 TYPE MWWWWW	Peak Search
	PNO: Fast	Trig: Free Run Atten: 10 dB	Avg Hold:>100/100	2.402 165 GHz 93.533 dBµV	NextPeak
0 dB/div Ref 106.00 dBµ 99 96 0 86 0					Next Pk Right
66.0		<sup>2</sup>			Next Pk Left
26.0 16.0	an a	na n	ىرى ئىرى ئىرى بىرى يۇرىغى يۇرىيى يىرى يىرى بىرى يەر يىرى يەر		Marker Delta
Start 2.37000 GHz Res BW 1.0 MHz		3.0 MHz	Sweep 1	Stop 2.40500 GHz .000 ms (1001 pts)	Mkr→CF
1 N 1 f 2.4	02 165 GHz	93.533 dBµV 96.289 dBµV			Mkr→RefLv
7 8 9 10 11 11					More 1 of 2
G			STATUS		

AV

					AV					
	rum Analyzer - Swe									
RL	RF 50 Ω			SE	NSE:INT		ALIGN AUTO			Peak Search
/larker 1 2	.40199000			Trig: Fre	o Dun	Avg Typ	e: RMS :>100/100	TRA		I Can Search
		F	PNO: Fast ( Gain:Low	Atten: 1		Avginoid	.~100/100		PE A WWWWW ET A N N N N N	
			Oam.LOw	,						NextPea
							Mkr1	2.401	990 GHz	NOXET OF
0 dB/div	Ref 106.00	dBµV						91.62	20 dBµV	
.og					Y	Î.			. 1	
96.0									+ <b>•</b> ·	
36.0									$\frown$	Next Pk Rig
76.0										
66.0									+-++-	
56.0										Next Pk Le
46.0										
36.0					<mark>2</mark>			- Jand		
26.0										Marker De
										Marker De
16.0										
					<u> </u>					
tart 2.370									0500 GHz	
Res BW 1	.0 MHz		#VB	W 3.0 MH:	*		Sweep 1	.000 ms	(1001 pts)	Mkr→0
IKR MODE TRC	SCI	Х		Y	EUN	TION FU	NCTION WIDTH	EUNCT	ION VALUE	
1 N 1	f	2.401 99	90 GHz	91.634 di						
2 N 1	f	2.390 00	00 GHz	26.535 d						
3										Mkr→RefL
4 5										
6										
7										
8										Mo
10										1 0
11									-	
									•	
G							STATU	5		

**RESULT: PASS** 



EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Horizontal

ΡK

99       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90       90 <td< th=""><th>Keysight Spectrum Analyzer - Swept SA</th><th></th><th></th><th></th><th></th><th></th><th>_ # <b>*</b></th></td<>	Keysight Spectrum Analyzer - Swept SA						_ # <b>*</b>
Indicative       Atten: 10 dB       Det PINNNN         Mkr1 2.479 814 GHz 95.298 dBµV       Next Peal         0 dB/dlv       95.298 dBµV         1 f       2.479 814 GHz       95.298 dBµV         1 f       2.483 500 GHz       53.890 dBµV         1 f       2.483 500 GHz       95.298 dBµV         1 f       2.483 500 GHz       95.298 dBµV         1 f       2.483 500 GHz       53.890 dBµV         1 f       2.483 500 GHz       95.298 dBµV         1 f       2.483 500 GHz       95.298 dBµV         1 f       2.483 500 GHz				Avg	Type: Log-Pwr		
MKRT 2:479 814 GH2 95.298 dBµV         OB/div       Ref 106.00 dBµV       95.298 dBµV         OB/div       Quadratical data and the state and				n Avg		DET	N
36.0       36.0       36.0       Next Pk Right         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         36.0       36.0       36.0       36.0       36.0         37.0       1       f       2.479.814 GHz       95.298 dBjv/         38.0       31.0       1       f       2.483 500 GHz       53.890 dBjv/         38.0       38.0       38.0       38.0       38.0       36.0       36.0         39.0       30.0       1       f       2.483 500 GHz       53.890 dBjv/       Mkr	10 dB/div Ref 106.00 dBµV				Mkr1	2.479 814 GHz 95.298 dBµV	NextPear
560       2       2       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3       3	<b>e</b> <b>e</b> <b>e</b> <b>e</b> <b>e</b> <b>e</b> <b>e</b> <b>e</b>						Next Pk Righ
360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       360       3		2	- Angel and the star of a spin star	and the second sector of the second			Next Pk Le
Res BW 1.0 MHz     #VBW 3.0 MHz     Sweep 1.000 ms (1001 pts)       Image: Note that it is a straight of the straight	36.0 26.0 16.0				where of particulations	∽₽₺₽₼₽₽₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩	Marker Delt
1       N       1       f       2.479 814 GHz       95.298 dBµV         2       N       1       f       2.483 500 GHz       53.890 dBµV         2       N       1       f       2.483 500 GHz       53.890 dBµV         4       5       5       5       5       5       5         6       6       6       6       6       6       6       6         8       6       6       7       7       7       7       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       7       7	atart 2.47800 GHz Res BW 1.0 MHz	#VBW		FUNCTION	Sweep 1.	000 ms (1001 pts)	Mkr→C
7	1         N         1         f         2.479           2         N         1         f         2.483           3         -         -         -           4         -         -         -           5         -         -         -	9 814 GHz 3 500 GHz	95.298 dBµV	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Mkr→RefLv
	8						
SG	sg		m			•	

AV

Keysight Spectrum Analyzer - Sw	(ent SA				
	AC	SENSE:INT	ALIGN AUTO Avg Type: RMS	TRACE 1 2 3 4 5 6	Peak Search
) dB/div Ref 106.00	PNO: Fast IFGain:Low	Trig: Free Run Atten: 10 dB	Avg Hold:>100/100	2.480 013 GHz 93.223 dBµV	Next Pe
					Next Pk Rig
6.0 6.0	~ <sup>2</sup>				Next Pk L
6.0 6.0 6.0					Marker De
tart 2.47800 GHz Res BW 1.0 MHz	#VE	W 3.0 MHz*	Sweep 1	Stop 2.50013 GHz .000 ms (1001 pts)	Mkr→
1         N         1         f           2         N         1         f           3	2.480 013 GHz 2.483 500 GHz	93.241 dBµV 44.606 dBµV		=	Mkr→Refl
0 7 8 9 0 1					<b>M</b> 0 1 0
G		m	STATUS	•	



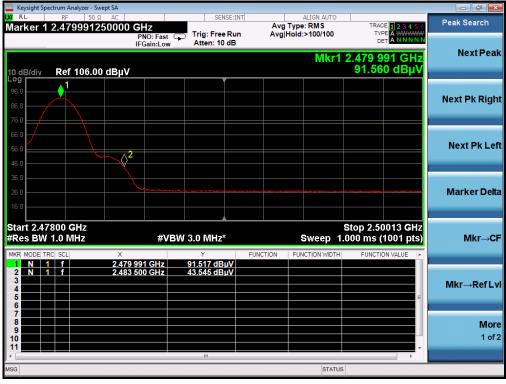


EUT	Wireless bluetooth speaker	Model Name	F2
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Vertical

### PK



AV



#### **RESULT: PASS**

**Note**: The factor had been edited in the "Input Correction" of the Spectrum Analyzer. So the Amplitude of test plots is equal to Reading level plus the Factor in dB. Use the A dB( $\mu$ V) to represent the Amplitude. Use the F dB( $\mu$ V/m) to represent the Field Strength. So A=F. All test modes had been pre-tested. The GFSK modulation is the worst case and recorded in the report.



# 7. FCC LINE CONDUCTED EMISSION TEST

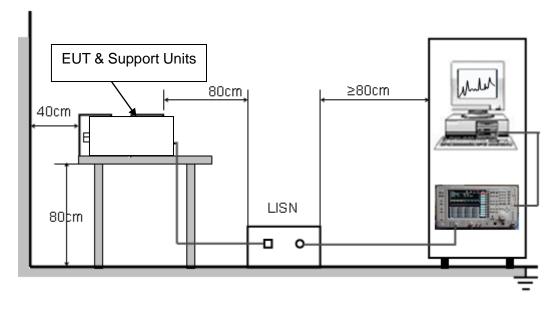
### 7.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Framerou	Maximum RF Line Voltage				
Frequency	Q.P.( dBuV)	Average( dBuV)			
150kHz~500kHz	66-56	56-46			
500kHz~5MHz	56	46			
5MHz~30MHz	60	50			

Note:

- 1. The lower limit shall apply at the transition frequency.
- 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

### 7.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST





### 7.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

- The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
- 2. Support equipment, if needed, was placed as per ANSI C63.10.
- 3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4. All support equipments received AC120V/60Hz power from a LISN, if any.
- 5. The EUT received DC 5V power from adapter which received AC120V/60Hz power from a LISN.
- 6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
- 8. During the above scans, the emissions were maximized by cable manipulation.
- 9. The test mode(s) were scanned during the preliminary test.

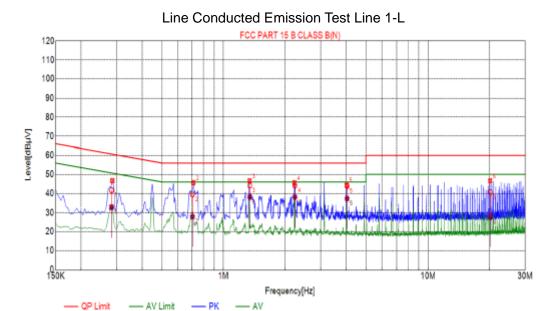
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

### 7.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

- 1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
- 2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
- 3. The test data of the worst case condition(s) was reported on the Summary Data page.



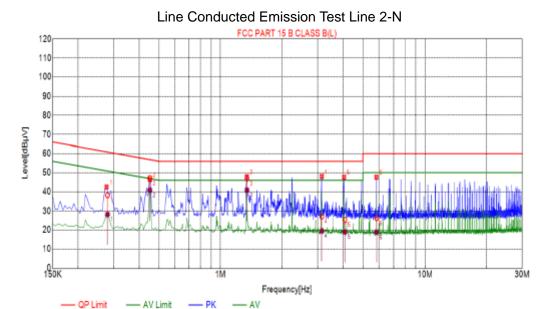
### $7.5.\ \mbox{test}$ result of line conducted emission test



Suspected List											
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector					
1	0.2850	46.70	10.04	60.67	13.97	PK					
2	0.7125	45.62	10.05	56.00	10.38	PK					
3	1.3425	46.62	10.10	56.00	9.38	PK					
4	2.2335	45.59	10.17	56.00	10.41	PK					
5	4.0245	44.39	10.25	56.00	11.61	PK					
6	20.1480	46.63	10.11	60.00	13.37	PK					

Final	Final Data List										
NO.	Freq. [MHz]	Factor [dB]	QP Value (dBµV)	QP Limit (dBµV)	QP Margin (dB)	AV Value [dBµV]	AV Limit (d8µV)	AV Margin [dB]			
1	0.2822	10.04	41.66	60.75	19.09	32.79	50.75	17.96			
2	0.7054	10.05	39.39	56.00	16.61	27.99	46.00	18.01			
3	1.3463	10.10	44.11	56.00	11.89	38.09	46.00	7.91			
4	2.2453	10.18	44.14	56.00	11.86	38.05	46.00	7.95			
5	4.0434	10.25	43.86	56.00	12.14	37.27	46.00	8.73			
6	20.2139	10.11	40.64	60.00	19.36	27.86	50.00	22.14			





Suspected List							
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector	
1	0.2760	42.44	10.04	60.94	18.50	PK	
2	0.4515	46.39	10.04	56.85	10.46	PK	
3	1.3470	47.87	10.10	56.00	8.13	РК	
4	3.1425	48.03	10.23	56.00	7.97	PK	
5	4.0470	47.63	10.25	56.00	8.37	PK	
6	5.8380	47.62	10.24	60.00	12.38	PK	

Final	Final Data List							
NO.	Freq. (MHz)	Factor (dB)	QP Value [dBµV]	QP Limit (dBµV)	QP Margin (dB)	AV Value [dBµV]	AV Limit (dBµV)	AV Margin [dB]
1	0.2788	10.04	38.05	60.85	22.80	28.23	50.85	22.62
2	0.4502	10.04	47.15	56.87	9.72	40.76	46.87	6.11
3	1.3494	10.10	46.94	56.00	9.06	40.76	46.00	5.24
4	3.1439	10.23	27.14	56.00	28.86	19.54	46.00	26.46
5	4.0825	10.25	25.34	56.00	30.66	18.96	46.00	27.04
6	5.8487	10.24	26.28	60.00	33.72	18.81	50.00	31.19

### **RESULT: PASS**

Note: All the test modes had been tested, the mode 1 was the worst case. Only the data of the worst case would be record in this test report.



# 8. Number of Hopping Frequency

### 8.1. Measurement Procedure

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

1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.

2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

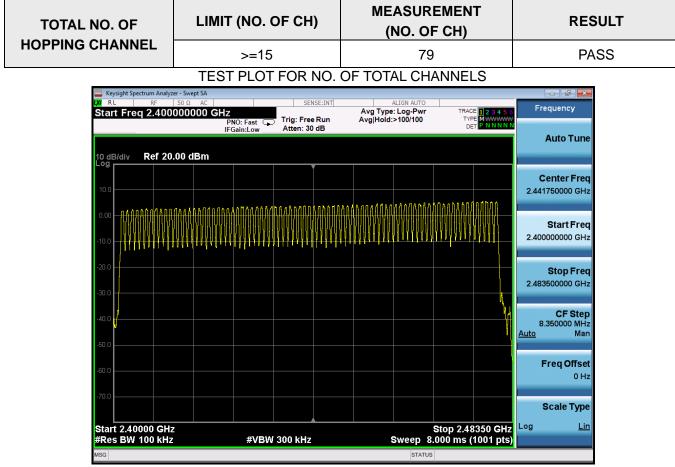
3. VBW  $\geq$  RBW. Sweep: Auto. Detector function: Peak. Trace: Max hold.

4. Allow the trace to stabilize.

## 8.2. Test Setup (Block Diagram of Configuration)

Same as described in section 4.2

### 8.3. Limits and Measurement Result



Note: The  $\Pi$ /4-DQPSK modulation is the worst case and recorded in the report.



# 9. Time Of Occupancy (Dwell Time)

### 9.1. Measurement Procedure

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

1. Span: Zero span, centered on a hopping channel.

2. RBW shall be  $\leq$  channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.

3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.

4. Detector function: Peak. Trace: Max hold.

5. Use the marker-delta function to determine the transmit time per hop.

6. Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer)  $\times$  (period specified in the requirements / analyzer sweep time)

7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

## 9.2. Test Setup (Block Diagram of Configuration)

Same as described in section 4.2

### 9.3. Limits and Measurement Result

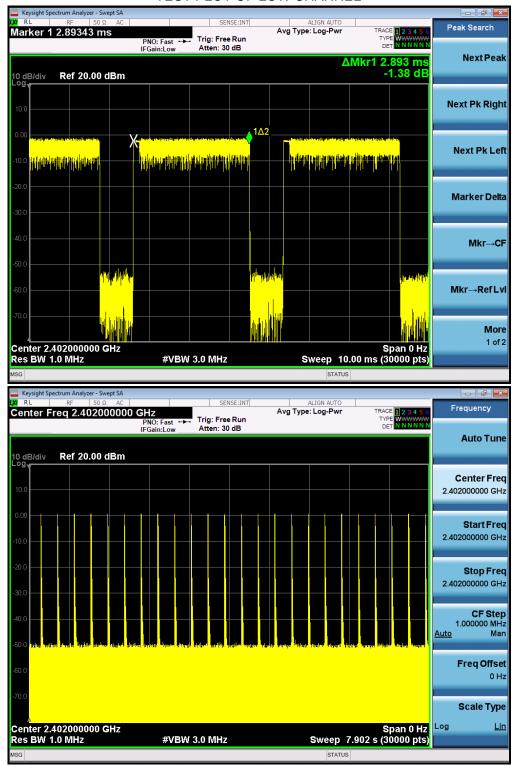
Channel	Time of Pulse for DH5 (ms)	Number of hops in the period specified in the requirements	Sweep Time (ms)	Limit (ms)
Low	2.893	24*4	277.728	400
Middle	2.871	24*4	275.616	400
High	2.842	24*4	272.832	400

Note: The  $\Pi$ /4-DQPSK modulation is the worst case and recorded in the report.



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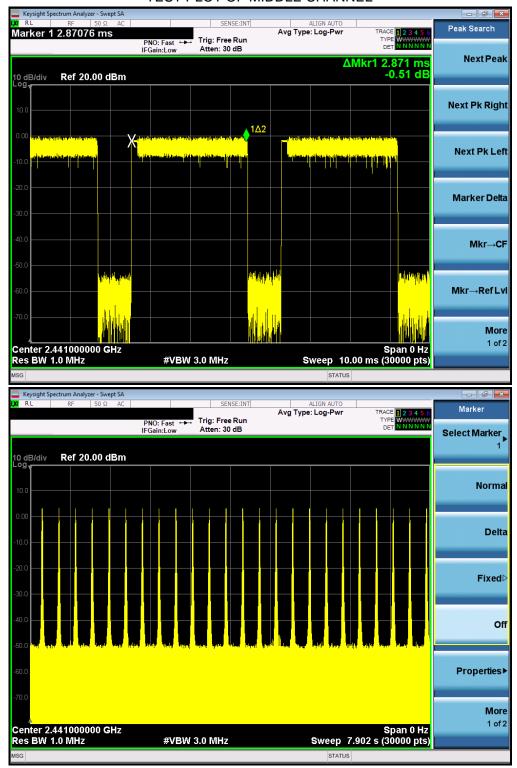
### TEST PLOT OF LOW CHANNEL





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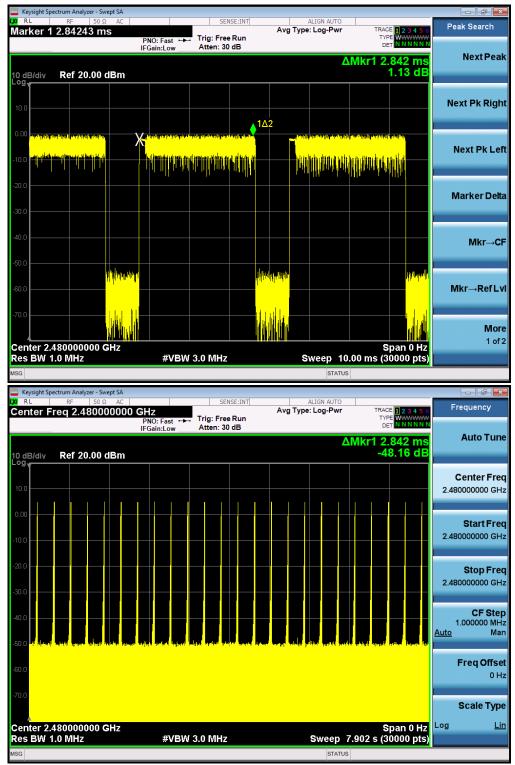
#### TEST PLOT OF MIDDLE CHANNEL





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### TEST PLOT OF HIGH CHANNEL





## **10. Frequency Separation**

## 10.1. Measurement Procedure

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

1. Span: Wide enough to capture the peaks of two adjacent channels.

2. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

3. Video (or average) bandwidth (VBW)  $\geq$  RBW.

4. Sweep: Auto. e) Detector function: Peak. f) Trace: Max hold. g) Allow the trace to stabilize.

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

## 10.2. Test Setup (Block Diagram of Configuration)

Same as described in section 4.2

### **10.3.Limits and Measurement Result**

CHANNEL	CHANNEL SEPARATION	LIMIT	RESULT			
	KHz	KHz	Dese			
CH01-CH02	995 >=25 KHz or 2/3 20 dB BW					
TEST PLOT FOR FREQUENCY SEPARATION						



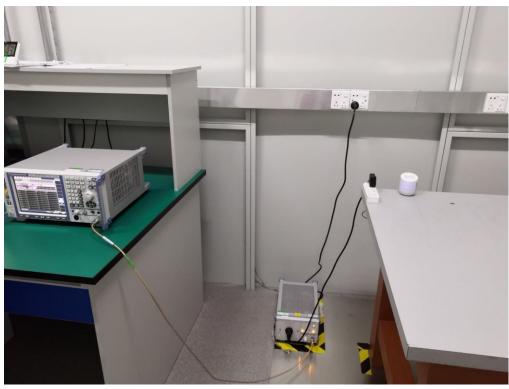
Note: The  $\Pi$ /4-DQPSK modulation is the worst case and recorded in the report.



# 11. Test Setup Photos of the EUT







----END OF REPORT----