TEST REPORT

Dt&C Co., Ltd.						
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1. Report No : DRTFCC2407-0074	4					
2. Customer						
• Name (FCC) : BLUEBIRD INC. / Nar	ne (IC) : BLUEBIRD INC.					
• Address (FCC) : 3F, 115, Irwon-ro, G Address (IC) : 3F, 115, Irwon-ro, Gan	angnam-gu, Seoul, 06355, Korea gnam-gu Seoul 06355 Korea (Republic Of)					
3. Use of Report : FCC & ISED Cert	ification					
4. Product Name / Model Name : Er FCC ID : SS4S50F1 IC : 22515-S50F1	nterprise Full Touch Handheld Computer / S50					
5. FCC Regulation(s): Part 15.247 IC Standard(s): RSS-247 Issue 3, Test Method used: KDB558074 D						
6. Date of Test : 2024.04.25 ~ 2024	.05.22					
7. Location of Test : 🛛 Permanent	Testing Lab 🔲 On Site Testing					
8. Testing Environment : See apper	ided test report.					
9. Test Result : Refer to the attache	d test result.					
The results shown in this test report ref This test report is not related to KOLAS	er only to the sample(s) tested unless otherwise stated. accreditation.					
Tested by Affirmation	Technical Manager					
Name : SeungMin Gil	Seur Name : Jae Jin Lee					
	14					
	2024.07.19.					
	Dt&C Co., Ltd.					
If this report is required to c	onfirmation of authenticity, please contact to report@dtnc.net					



Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by		
DRTFCC2407-0074	Jul. 19, 2024	Initial issue	SeungMin Gil	JaeJin Lee		



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1. General Information

1.1. Description of EUT

Equipment Class	Spread Spectrum Transmitter(DSS)
Product Name	Enterprise Full Touch Handheld Computer
Model Name(s)	S50, S70
HVIN(Hardware Version Identification Number)	S5S7F1
FVIN(Firmware Version Identification Number)	R1.00
EUT Serial Number	Conducted: S50A5LAWBA326 Radiated: S50A5LAWBA325
Power Supply	DC : 3.85 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Max. RF Output Power	9.44 dBm (0.009 W)
Modulation Technique (Data rate)	GFSK(1 Mbps), π/4DQPSK(2 Mbps), 8DPSK(3 Mbps)
Number of Channels	79
Antenna Specification	Antenna Type: LDS Antenna Gain : -1.41 dBi (PK)

1.2. Declaration by the applicant / manufacturer

- NA

1.3. Testing Laboratory

Dt&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042.

The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014.

- FCC & IC MRA Designation No. : KR0034

- ISED#: 5740A

www.dtnc.net			
Telephone	:	+ 82-31-321-2664	
FAX	:	+ 82-31-321-1664	

1.4. Testing Environment

Ambient Condition			
Temperature	+21 °C ~ +23 °C		
 Relative Humidity 	40 % ~ 43 %		

1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
Antenna-port conducted emission	0.9 dB (The confidence level is about 95 %, $k = 2$)
AC power-line conducted emission	3.4 dB (The confidence level is about 95 %, $k = 2$)
Radiated emission (1 GHz Below)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz ~ 18 GHz)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (18 GHz Above)	5.7 dB (The confidence level is about 95 %, k = 2)

1.6. Information about the FHSS characteristics

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following :
 - A) The hopping sequence is pseudorandom
 - Note 1 : Pseudorandom Frequency Hopping Sequence Table as below:
 - Channel: 08, 24, 40, 56, 42, 54, 72, 09, 01, 11, 33, 41, 34, 42, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 41, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 52, 71, 08, 24, 06, 24, 48, 56, 45, 46, 70, 01, 72, 06, 25, 33, 12, 28, 49, 60, 45, 58, 74, 13, 05, 18, 37, 49 etc

The System receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchroniztation with the transmit ted signals.

- B) All channels are used equally on average
- C) The receiver input bandwidth equals the transmit bandwidth
- D) The receiver hops in sequenc e with the transmit signal
- 15.247(g) : In accordance with the Bluetooth Industry Standard, the system is designed to comply with all
 of the regulations in Section 15.247 when the transmitter is presented with a continuous data
 (or information) system.
- 15.247(h) : In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection / hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

1.7. Conclusion of worst-case and operation mode

The EUT has three types of modulation (GFSK, π /4DQPSK and 8DPSK). Therefore all applicable requirements were tested with all the modulations. And packet type was tested at the worst case(DH5).

EUT Operation test setup

Bluetooth tester was used to control the transmit parameters during test.

Tested frequency information

- Hopping Function : Enable

	Tested Frequency (MHz)			
Hopping Band	2 402 ~ 2 480			

- Hopping Function : Disable

	Tested Frequency (MHz)			
Lowest Channel	2 402			
Middle Channel	2 441			
Highest Channel	2 480			

1.8. Test Equipment List

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N	
Spectrum Analyzer	KEYSIGHT	N9020A	23/12/15	24/12/15	MY48011146	
Spectrum Analyzer	Agilent Technologies	N9020A	23/06/23	24/06/23	US47360812	
Spectrum Analyzer	Agilent Technologies	N9020A	23/12/15	24/12/15	MY50110097	
DC Power Supply	Agilent Technologies	66332A	23/12/15	24/12/15	66332A _220926-1	
BlueTooth Tester	TESCOM	TC-3000C	23/12/15	24/12/15	3000C000396	
Power Splitter	Anritsu	K241B	23/12/15	24/12/15	1301183	
Multimeter	FLUKE	17B+	23/12/15	24/12/15	36390701WS	
Signal Generator	Rohde Schwarz	SMBV100A	23/12/15	24/12/15	255571	
Signal Generator	ANRITSU	MG3695C	23/12/15	24/12/15	173501	
Thermohygrometer	BODYCOM	BJ5478	23/12/15	24/12/15	120612-1	
Thermohygrometer	BODYCOM	BJ5478	23/12/15	24/12/15	090205-4	
Thermohygrometer	BODYCOM	BJ5478	23/06/23	24/06/23	N/A	
Loop Antenna	ETS-Lindgren	6502	23/11/09	24/11/09	00060496	
Hybrid Antenna	Schwarzbeck	VULB 9160	23/12/15	24/12/15	3362	
Horn Antenna	ETS-Lindgren	3117	23/06/23	24/06/23	00143278	
Horn Antenna	A.H.Systems Inc.	SAS-574	23/06/23	24/06/23	155	
PreAmplifier	tsj	MLA-0118-B01-40	23/12/15	24/12/15	1852267	
PreAmplifier	tsj	MLA-1840-J02-45	23/06/23	24/06/23	16966-10728	
PreAmplifier	H.P	8447D	23/12/15	24/12/15	2944A07774	
High Pass Filter	Wainwright Instruments	WHKX12-935-1000- 15000-40SS	23/06/23	24/06/23	8	
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300- 18000-60SS	23/06/23	24/06/23	1	
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	23/06/23	24/06/23	3	
Attenuator	Hefei Shunze	SS5T2.92-10-40	23/06/23	24/06/23	16012202	
Attenuator	Aeroflex/Weinschel	56-3	23/06/23	24/06/23	Y2370	
Attenuator	SMAJK	SMAJK-2-3	23/06/23	24/06/23	3	
Attenuator	SMAJK	SMAJK-2-3	23/06/23	24/06/23	2	
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	23/12/15	24/12/15	1338004 1911481	
EMI Test Receiver	ROHDE&SCHWARZ	ESCI7			100910	
PULSE LIMITER	ROHDE&SCHWARZ	ESH3-Z2	23/08/21	24/08/21	101333	
LISN	SCHWARZBECK	NSLK 8128 RC	23/10/26	24/10/26	8128 RC-387	
Digital Thermo Hygrometer	CAS	TE-303N	24/02/07	25/02/07	220502531	
Cable	DT&C	Cable	24/01/03	25/01/03	G-2	
Cable	HUBER+SUHNER	SUCOFLEX 100	24/01/03	25/01/03	G-3	
Cable	DT&C	Cable	24/01/03	25/01/03	G-4	
Cable	OMT	YSS21S	24/01/03	25/01/03	G-5	
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-1	
Cable	Junkosha	MWX241	24/01/03	25/01/03	mmW-4	
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-1	
Cable	HUBER+SUHNER	SUCOFLEX100	24/01/03	25/01/03	M-2	
Cable	JUNKOSHA	MWX241/B	24/01/03	25/01/03	M-3	
Cable	JUNKOSHA	J12J101757-00	24/01/03	25/01/03	M-7	
Cable	HUBER+SUHNER	SUCOFLEX106	24/01/03	25/01/03	M-9	
Cable	Dt&C	Cable	24/01/03	25/01/03	RFC-69	
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0185	
Test Software	tsj	Noise Terminal Measurement	NA	NA	Version 2.00.0190	

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017

Note2: The cable is not a regular calibration item, so it has been calibrated by Dt&C itself.



2. Antenna Requirement

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.

Conclusion: Comply

The antenna is attached on the device by means of unique coupling method. Therefore this E.U.T complies with the requirement of Part 15.203

3. Summary of Test Results

FCC part section(s)	RSS section(s)	Test Description		Iest Description(Using in 2 400~ 2 483.5 MHz)Condition			Status Note 1
15.247(a) 15.247(b)	RSS-247[5.1] RSS-247[5.4]	Maximum Peak Conducted Output Power	For FCC =< 0.125 W(conducted) For IC =< 0.125 W(conducted) =< 4 Watt(e.i.r.p)		с		
		20 dB Bandwidth	NA		С		
15 247(2)	DSS 24715 11	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.		с		
15.247(a) RSS-247[5.1]	Number of Hopping Channels >= 15 hops		Conducted	с			
		Time of Occupancy	=< 0.4 seconds		С		
-	RSS-Gen[6.7]	Occupied Bandwidth (99 %)	NA		с		
15.247(d)	RSS-247[5.5]	Unwanted Emissions (Conducted)	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		С		
15.247(d) 15.205 15.209	RSS-247[5.5] RSS-Gen[8.9] RSS-Gen[8.10]	Unwanted Emissions (Radiated)	Part 15.209 Limits (Refer to section 9)	Radiated	C Note3		
15.207	RSS-Gen[8.8]	AC Power-Line Part 15.207 Limits Conducted Emissions (Refer to section 10)		AC Line Conducted	С		
15.203	-	Antenna Requirement	Part 15.203 (Refer to section 2)	-	С		

Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

Note 3: This test item was performed in three orthogonal EUT positions and the worst case data was reported.



4. Maximum Peak Conducted Output Power

4.1. Test Setup

Refer to the APPENDIX I.

4.2. Limit

FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

- §15.247(a)(1), 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 operating in the 2 400 MHz - 2 483.5 MHz band may have hopping channel carrier frequencies that are separated by 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.
- 2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 MHz 5 805 MHz band : 1 Watt. For all other frequency hopping systems in the 2 400 MHz 2 483.5 MHz band: 0.125 watts.

IC Requirements

- RSS-247[5.1] (b), For FHSs 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, FHSs operating in the band 2 400-2 483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.
- 2. RSS-247[5.4] (b), For FHSS operating in the band 2 400 MHz 2 483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p shall not exceed 4 W, except as provided in section 5.4(e)

4.3. Test Procedure

- 1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
- 2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using ;
 Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
 RBW ≥ 20 dB BW
 VBW ≥ RBW
 Sweep = auto
 Detector function = peak
 Trace = max hold

4.4. Test Results

Modulation	Tested Channel	Burst Average Output Power		Peak Output Power		Antenna Gain	e.i.r.p ^{Note3}
	Testeu Channel	dBm	mW	dBm	mW	(dBi)	(dBm)
	Lowest	7.67	5.85	7.87	6.12	-1.41	6.46
<u>GFSK</u>	Middle	8.22	6.64	8.49	7.06	-1.41	7.08
	Highest	7.34	5.42	7.64	5.81	-1.41	6.23
	Lowest	6.36	4.33	8.56	7.18	-1.41	7.15
<u>π/4DQPSK</u>	Middle	6.93	4.93	9.13	8.18	-1.41	7.72
	Highest	6.04	4.02	8.32	6.79	-1.41	6.91
	Lowest	6.37	4.34	8.89	7.74	-1.41	7.48
<u>8DPSK</u>	Middle	6.92	4.92	9.44	8.79	-1.41	8.03
	Highest	6.02	4.00	8.64	7.31	-1.41	7.23

Note 1: The average output power was tested using an average power meter for reference only.

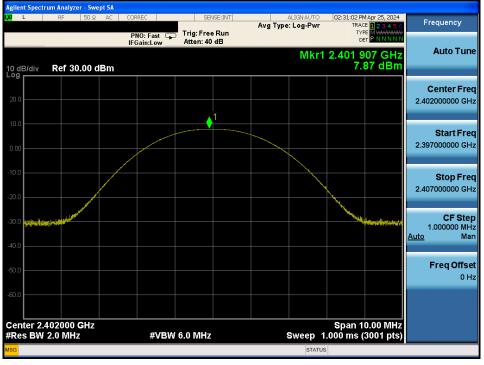
Note 2: See next pages for actual measured spectrum plots.

Note 3: e.i.r.p = $P_{cond} + G_{EUT}$

 P_{cond} = measured power at feedpoint of the EUT antenna, in dBm (Peak Conducted Output Power) G_{EUT} = gain of the EUT radiating element (antenna), in dBi





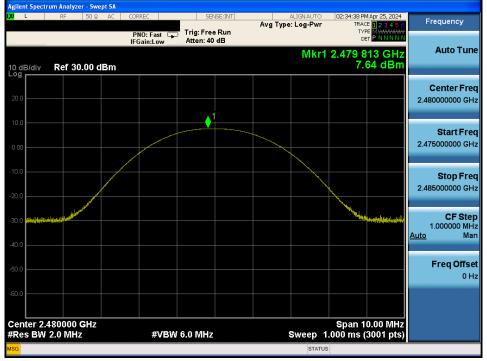


Peak Output Power <u>Middle Channel & Modulation : GFSK</u>

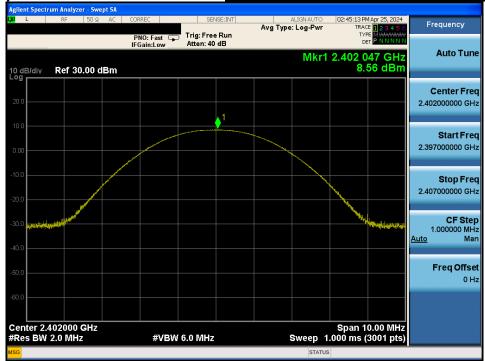




Highest Channel & Modulation : GFSK

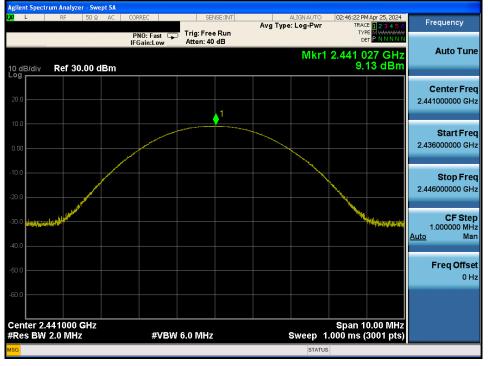


Peak Output Power <u>Lowest Channel & Modulation : π/4DQPSK</u>





Middle Channel & Modulation : π/4DQPSK

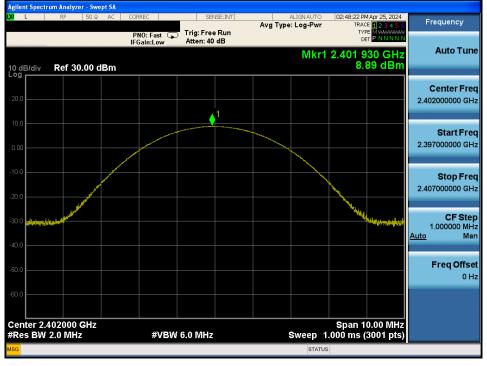


Peak Output Power <u>Highest Channel & Modulation : π/4DQPSK</u>

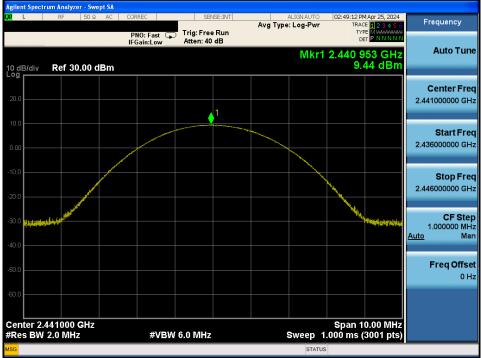




Lowest Channel & Modulation : 8DPSK



Peak Output Power <u>Middle Channel & Modulation : 8DPSK</u>



Highest Channel & Modulation : 8DPSK



5. 20 dB BW & Occupied BW

5.1. Test Setup

Refer to the APPENDIX I.

5.2. Limit

Limit : Not Applicable

5.3. Test Procedure

- 1. The 20 dB bandwidth was measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
- 2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
 - RBW = 1 % to 5 % of the 20 dB BW & Occupied BW
 - $VBW \ge 3 \times RBW$

Span = between two times and five times the 20 dB bandwidth & Occupied BW

Sweep = auto

Detector function = peak

Trace = max hold

5.4. Test Results

Modulation	Tested Channel	20 dB BW (MHz)	Occupied BW (MHz)			
	Lowest	0.885	0.827			
<u>GFSK</u>	Middle	0.882	0.825			
	Highest	0.884	0.829			
	Lowest	1.326	1.191			
<u>π/4DQPSK</u>	Middle	1.331	1.196			
	Highest	1.339	1.196			
	Lowest	1.336	1.204			
<u>8DPSK</u>	Middle	1.329	1.210			
	Highest	1.325	1.206			





20 dB BW & Occupied BW



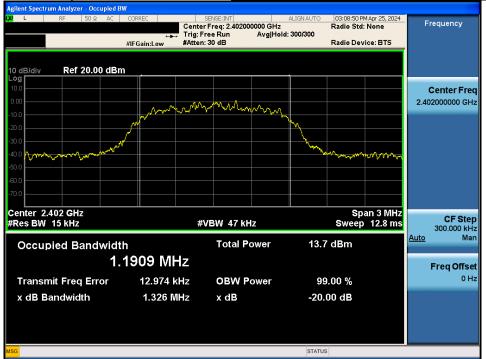






20 dB BW & Occupied BW

Lowest Channel & Modulation : π/4DQPSK



Middle Channel & Modulation : π/4DQPSK

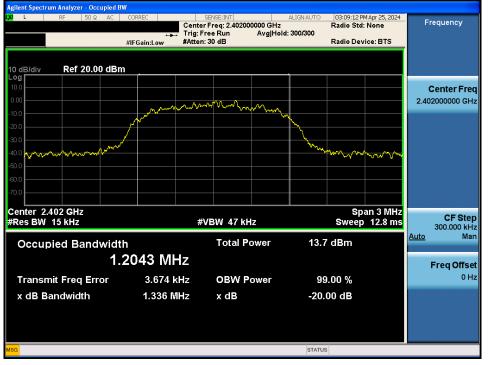


20 dB BW & Occupied BW

Highest Channel & Modulation : π/4DQPSK



Lowest Channel & Modulation : 8DPSK

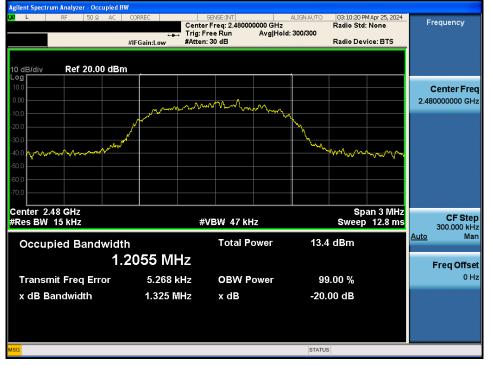


20 dB BW & Occupied BW

Middle Channel & Modulation : 8DPSK



Highest Channel & Modulation : 8DPSK





6. Carrier Frequency Separation

6.1. Test Setup

Refer to the APPENDIX I.

6.2. Limit

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater.

6.3. Test Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the markerdelta function was recorded as the measurement results.

The spectrum analyzer is set to :

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

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.

VBW ≥ RBW Sweep = auto

Detector function = peak Trace = max hold

6.4. Test Results

FH mode

Hopping Mode	Modulation	Peak of reference channel(MHz)	Peak of adjacent Channel(MHz)	Test Result (MHz)
	GFSK	2 439.908	2 440.912	1.004
Enable	π/4DQPSK	2 440.000	2 441.004	1.004
	8DPSK	2 440.167	2 441.164	0.997

AFH mode

Hopping Mode	Modulation	Peak of reference channel(MHz)	Peak of adjacent Channel(MHz)	Test Result (MHz)
	GFSK	2 439.916	2 440.910	0.994
Enable	π/4DQPSK	2 439.996	2 441.003	1.007
	8DPSK	2 440.162	2 441.165	1.003

Note 1 : See next pages for actual measured spectrum



Carrier Frequency Separation (FH) <u>Hopping mode : Enable&GFSK</u>



Carrier Frequency Separation (FH)

Hopping mode : Enable&π/4DQPSK





Carrier Frequency Separation (FH)

Hopping mode : Enable&8DPSK





Carrier Frequency Separation (AFH) <u>Hopping mode : Enable&GFSK</u>

Agilent Spectrum Analyzer - Swept SA				
L RF 50Ω AC	CORREC SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	03:36:51 PM Apr 25, 2024 TRACE 1 2 3 4 5 6 TYPE MIMMAN	Frequency
	PNO: Wide 🖵 Trig: Free Run IFGain:Low #Atten: 30 dB		Mkr1 994 kHz	Auto Tune
10 dB/div Ref 20.00 dBm			-0.08 dB	
10.0 0.00 -10.0				Center Freq 2.441000000 GHz
-20.0				Start Freq 2.439500000 GHz
-50.0 -60.0 -70.0				Stop Freq 2.442500000 GHz
Center 2.441000 GHz #Res BW 51 kHz	#VBW 150 kHz	Sweep 1.	Span 3.000 MHz 200 ms (3001 pts)	CF Step 300.000 kHz
MKR MODE TRC SCL X	994 kHz (Δ) −0.08 dB	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
2 F 1 f 2.439 3 4 5	916 GHz 7.64 dBm		=	Freq Offset 0 Hz
6 7 8 9 10 11				
		, , ,	>	
MSG		STATUS		

Carrier Frequency Separation (AFH) <u>Hopping mode : Enable&π/4DQPSK</u>



Carrier Frequency Separation (AFH) <u>Hopping mode : Enable&8DPSK</u>

Image: Solution of the second seco	Agilent Spectrum Analyzer - Swept SA					
Log ΔMkr1 1.003 MHz -0.05 dB Auto Tune 100 dB/div Ref 20.00 dBm -0.05 dB Center Freq 2.44100000 GHz 100 -00 100 100 100 Start Freq 2.44100000 GHz 200 100 100 100 100 100 100 200 100	L RF 50Ω AC	CORREC			TRACE 1 2 3 4 5 6	
Log Δ2 Δ3 Δ2 Δ3 Δ		PNO: Wide 😱 IFGain:Low		ΔΝ	1kr1 1.003 MHz	
30.0 40.0 50.0	10.0 0.00	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	14	2		
600 Stop Freq 700 Span 3.000 MHz Center 2.441000 GHz #VBW 150 kHz #Res BW 51 kHz #VBW 150 kHz Sweep 1.200 ms (3001 pts) 1 A2 2 F 1 f 2 F 1 A2 6 641 dBm 7 641 dBm	-30.0					
#Res BW 51 kHz #VBW 150 kHz Sweep 1.200 ms (3001 pts) 300.000 kHz MKR MODE TRC SCL × Y FUNCTION FUNCTION VALUE Man 1 Δ2 1 f (Δ) 1.003 MHz (Δ) -0.05 dB Function Function Value Man 3 - - - - - - - Man 4 - - - - - - - - - - Man 3 -	-60.0					2.442500000 GHz
1 Δ2 1 f (Δ) 1.003 MHz (Δ) -0.05 dB 2 F 1 f 2.440 162 GHz 6.41 dBm - - - Freq Offset 0 Hz 3 - - - - - - 0 Hz 0 Hz 6 - - - - - - 0 Hz 0 Hz 7 - - - - - - - 0 Hz 9 - - - - - - - 0 Hz 10 - - - - - - - - 0 Hz 11 - - - - - - - - 0 Hz - 0 Hz 0 Hz 0 Hz 0 Hz - 0 Hz - 0 Hz <	#Res BW 51 kHz	#VBW [/]		-	.200 ms (3001 pts)	300.000 kHz
MSG STATUS	Δ2 1 f (Δ) 2 F 1 f 2.44 3 4 4 4 4 5 6 6 6 7 8 9 9 10 11 11	1.003 MHz (Δ) 0 162 GHz	-0.05 dB		×	

7. Number of Hopping Channels

7.1. Test Setup

Refer to the APPENDIX I.

7.2. Limit

Limit : >= 15 hops

7.3. Test Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 2 400 MHz ~ 2 483.5 MHz were examined.

The spectrum analyzer is set to :

Cross for Ellimodo - E0 Mile		Stop Fraguenov - 0.444 5 Mile						
Span for FH mode = 50 MHz	Start Frequency = 2 391.5 MHz,	Stop Frequency = 2 441.5 MHZ						
	Start Frequency = 2 441.5 MHz,	Stop Frequency = 2 491.5 MHz						
Span for AFH mode = 30 MHz	Start Frequency = 2 426.0 MHz,	Stop Frequency = 2 456.0 MHz						
RBW = To identify clearly the indi	vidual channels, set the RBW to lea	ss than 30 % of the channel spacing						
or the 20 dB bandwidth, w	vhichever is smaller.							
VBW ≥ RBW	Sweep = auto	Sweep = auto						
Detector function = peak	Trace = max hold	Trace = max hold						

7.4. Test Results

FH mode

Hopping mode	Modulation	Test Result (Total Hops)						
	GFSK	79						
Enable	π/4DQPSK	79						
	8DPSK	79						

AFH mode

Hopping mode	Modulation	Test Result (Total Hops)					
	GFSK	20					
Enable	π/4DQPSK	20					
	8DPSK	20					

Note 1 : See next pages for actual measured spectrum plots.

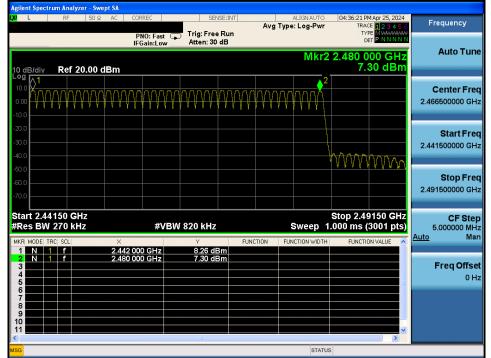


Number of Hopping Channels 1(FH)

Hopping mode : Enable & GFSK

LXI L	RF	SO Ω AC	CORREC		CEL	VSE:INT		ALIGN AUTO	04/22/00 0	M Apr 25, 2024	
	N	JU M AC			Trig: Free		Avg Typ	e: Log-Pwr	TRA	CE 1 2 3 4 5 6 PE MWWWWWW	Frequency
10 dB/div	Ref 20).00 dBm	PNO: Fas IFGain:Lo	st 😱 iw	Atten: 30			Mkr2	□ 2.441 0	et P NNNNN 100 GHz 26 dBm	Auto Tune
10.0			WW	W	WW	WW	WW			AMA	Center Freq 2.416500000 GHz
-20.0											Start Freq 2.391500000 GHz
-50.0 y v -60.0											Stop Freq 2.441500000 GHz
#Res BV	TRC SCL	z ×			320 kHz	FUN		Sweep 1	.000 ms (4150 GHz 3001 pts) IN VALUE	CF Step 5.000000 MHz <u>Auto</u> Man
2 N 3 4 5 6 7 8	1 f 1 f		02 000 GHz 11 000 GHz		7.76 dl 8.26 dl						Freq Offset 0 Hz
9 10 11 <					Ш			STATU	s	×	

Number of Hopping Channels 2(FH) <u>Hopping mode : Enable & GFSK</u>





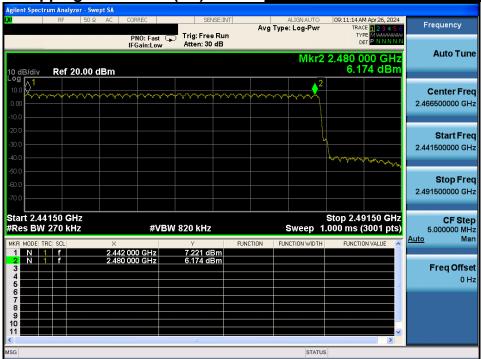
Number of Hopping Channels 1(FH)

Hopping mode : Enable&π/4DQPSK

Agnent Spectr	RF			RREC	071	VSE:INT		ALIGN A		00:00:00 4	M Apr 26, 202	4	
	KF	1 20 2					Avg	Type: Log		TRA	M Apr 26, 202 CE <mark>1 2 3 4 5</mark> PE M M M M	6	Frequency
10 dB/div	Ref	20.00 c	IFO	NO: Fast G Gain:Low	Atten: 30			N	lkr2	□ 2.441 0	000 GH	2	Auto Tune
Log 10.0 0.00					~~~~~	•~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~	~~~~	ᠬ᠋ᡎ᠆ᡎ	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Center Freq 2.416500000 GHz
-20.0 -30.0 -40.0	Jacob Concerne	, and the second second											Start Freq 2.391500000 GHz
-50.0 -60.0 -70.0													Stop Freq 2.441500000 GHz
Start 2.39 #Res BW	270 k		× 2.402 00		V 820 kHz 6.804 d	FU	NCTION	Swee	ep 1.	000 ms (4150 GH 3001 pts)	CF Step 5.000000 MHz <u>uto</u> Man
2 N 1 3 4 5 6	f		2.441 00		6.741 d								Freq Offset 0 Hz
7 8 9 9 10 11												×	
MSG									STATUS				

Number of Hopping Channels 2(FH)

Hopping mode : Enable &π/4DQPSK





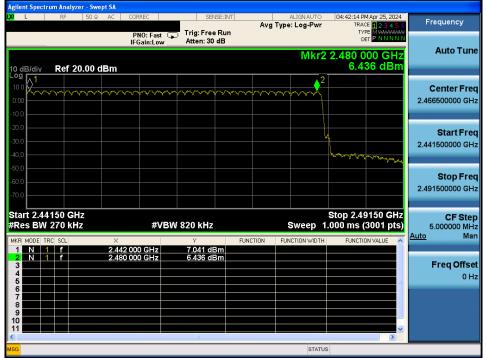
Number of Hopping Channels 1(FH)

Hopping mode : Enable&8DPSK

Image: Nikr2 2.441 000 GHz Center 10 dB/div Ref 20.00 dBm 7.328 dBm 0.00 1 Center 10.00 1 Center 2.41650000 2.41650000	Tune Freq
PN0: Fast Trig: Free Run Mkr2 2.441 000 GHz Auto 10 dB/div Ref 20.00 dBm 7.328 dBm Center 100 1 2.41650000 Center 100 1 1 1 1	Tune Freq
Inc. rad Atten: 30 dB Det PANNNN 10 dB/div Ref 20.00 dBm 7.328 dBm Auto 100 1 Center 2.41650000 100 1 Center 2.41650000	Freq
In Gaint ow Auto 10 dB/div Ref 20.00 dBm 7.328 dBm 100 1 1 1 100 1 1 1 1 100 1 1 1 1 1 100 1 <t< td=""><td>Freq</td></t<>	Freq
In dB/div Ref 20.00 dBm T.328 dBm 100 1 <t< td=""><td>Freq</td></t<>	Freq
10 dB/div Ref 20.00 dBm 7.328 dBm 10 0 0.00 0.00 0.00 0.00 0.00 0.00 0.00	
Log	
10 0 Cente 0.00	
0.00	
0.00 2.41650000 -100 200	0 GHz
-200	
Star	-
	Freq
-30.0 2.39150000	0 GHz
	_
-60.0 Stop	Freq
2,44150000	0 GHz
Start 2.39150 GHz Stop 2.44150 GHz CF	Step
#Res BW 270 kHz #VBW 820 kHz Sweep 1.000 ms (3001 pts) 5.0000	
Auto	Man
MKH MUDE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE 🛆	
1 N 1 f 2.402 000 GHz 6.642 dBm	
2 N 1 f 2.441 000 GHz 7.328 dBm Freq 0	ffeat
	0 Hz
MSG STATUS	

Number of Hopping Channels 2(FH)

Hopping mode : Enable & 8DPSK





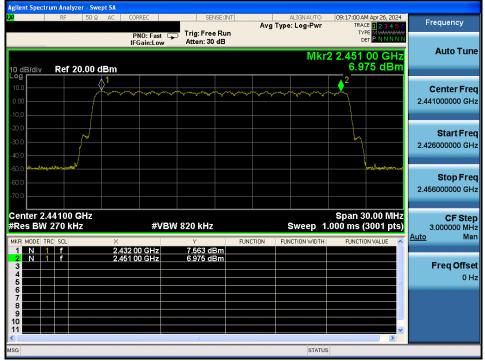
Number of Hopping Channels 1(AFH)

Hopping mode : Enable & GFSK

LXI	r Spectru	RF	50	Q	AC	COR	REC			SEM	√SE:IN	Т			ALIG	GN AU	TO	09:	16:01 A	M Apr 26, 2024	ŧ	_
										-	-		A١	g Typ	e: L	og-P	wr		TRA	CE 1 2 3 4 5 PE M WWWW	6	Frequency
						PI IEC	10: Fa Gain:L	stĢ		:Free en:30									D		N	
							Janne	5M								M	lke	2.2	451	00 GH:		Auto Tune
10 dE	7/46.2	Dot	f 20.00) de	200											IV	INI.	~ ~.		87 dBn		
Log	5/017	Rei	20.00	- ui	9111 1														2			
10.0						$\neg r$		\overline{n}		m	م ۲	\sim	h				$\neg \tau$	- X	_			Center Freq
0.00				+	VV	¥	V	V V	\mathbb{N}	\square	¥	ΥV	!₩	\mathbb{V}	Hł	LŲ	¥	V	{			2.441000000 GHz
-10.0				\square			r	ĩ ĩ	r T		7		¥	* 1	· •			r	<u>\</u>			
-20.0			(\square															\downarrow			
-30.0																						Start Freq
-40.0																			1			2.426000000 GHz
-50.0			. Jul																Ľ			
			-419-17																	A Maria minara sa an		Stop Freq
-60.0																						2.456000000 GHz
-70.0																						
Cen	ter 2.4	410	0 GHz															Sp	an 3	0.00 MH	,	CF Step
	s BW 2						#	VBW	/ 820	kНz					Sw	/eep) 1	.000	ms (3001 pts	5	3.000000 MHz
MKB 1	MODE TRI	d sol	1		X			1	Y			ELIN	ICTION	E	INCTI	ON W	IDTH		ELINCTI	ON VALUE		<u>Auto</u> Man
1	N 1	f			2.4	32 00) GH	z	8.4	61 dI												
2	N 1	f			2.4	51 0() GH	z	7.9	87 dI	3m											Freq Offset
4																						0 Hz
5																						
7																						
8																						
10																						
11										11										>		
MSG																ST	TATUS	6				
		_		_		_	_			_	_	_	_	_	_	_	_	_			-	

Number of Hopping Channels 1(AFH)

Hopping mode : Enable &π/4DQPSK





Number of Hopping Channels 1(AFH) Hopping mode : Enable & 8DPSK

Agilent	i Speci	trum																					
L <mark>XI</mark>			RF		50 Ω	AC	COF	REC		-	ENSE:	NT			ALIGN A		09:18		4 Apr 26, 20		-	requency	
										T			Avg	Туре	e: Log-l	Pwr			E 1234			requeries	
							P	NO: Fas	a 🖵	Trig: Fr		n											
		_					IFU	Gain:Lo	w	Auen.	30 a 🗆											Auto Tu	Ino
															n n	vikr:	2 2.4	51	00 GF	z		Autoru	me
10 dE	2/div		Dof	20	00.4	dBm												6.6	17 dB	m			
Log	57019			20.	00												2						
10.0						ℚ'																Center Fi	roa
					1	\sim	\sim	- m	\sim	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	\sim	~~~~	and a second	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	- v	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
0.00					1																2.4	1000000	Hz
-10.0																							
-20.0																							
				~	7													1.				Start Fr	req
-30.0																		~ }			2.4	26000000 0	Hz
-40.0																							
-50.0	1.1.1	-	-4110-5																an besterditer	S, et la		Oton F.	
-60.0																						Stop Fr	
-70.0																					2.4	56000000 0	Ήz
-70.0																							
0.000			4.04		1												0		0.00 84				
Cent					12					000 1-11	_						sp	an J	0.00 MI	14		CF St	
#Res	SBW	V Z	γŲ.	KHZ				Ŧ	VBW	820 kH	Z				swee	р 1.	.0001	ms (3001 pt			3.000000 N	
MKR N	IODE -	TRC	SCL			×				Y		FUN	CTION	FUN	ICTION V	VIDTH	FI	UNCTIC	IN VALUE	~	<u>Auto</u>	N	Man
1	N	1	f			2	432 0	0 GHz		7.701	dBm												
	N	1	f			2	451 0	0 GHz		6.617	dBm												
3																						Freq Off	set
4																				_		0	Hz
6																				=	_		
7																							
8																							
9																							
10																				~			
<									-										>				
MSG		-	-	_	_	_		_					_	_	-	TATUO		_		,			_
MSG				_			_	_						_	5	STATUS		_					

8. Time of Occupancy

8.1. Test Setup

Refer to the APPENDIX I.

8.2. Limit

The maximum permissible time of occupancy is 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.

8.3. Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to :

Center frequency = 2 441 MHz

Span = zero

RBW = 1 MHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW

Detector function = peak

Trace = max hold

8.4. Test Results

FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	79	2.880	3.750	0.307
Enable	2 DH 5	79	2.880	3.750	0.307
	3 DH 5	79	2.880	3.750	0.307

AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
	DH 5	20	2.880	3.750	0.154
Enable	2 DH 5	20	2.880	3.750	0.154
	3 DH 5	20	2.880	3.750	0.154

Note 1 : Dwell Time = 0.4 × Hopping channel × Burst ON time ×

((Hopping rate ÷ Time slots) ÷ Hopping channel)

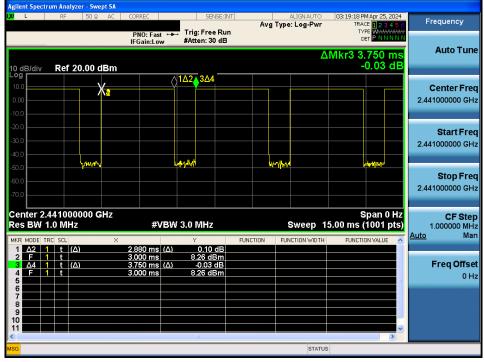
- Time slots for DH5 = 6 slots (TX = 5 slots / RX = 1 slot)
- Hopping Rate = 1 600 for FH mode & 800 for AFH mode

Note 2 : See next pages for actual measured spectrum plots.



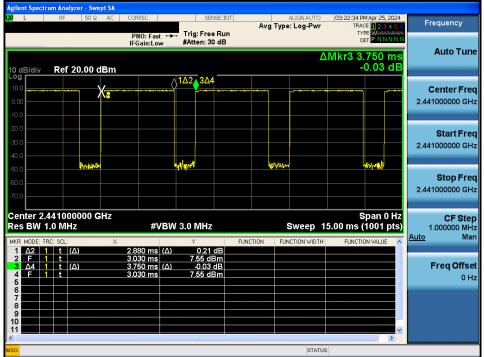
<u>Hopping mode : Enable&DH5</u>

Time of Occupancy (FH)



Time of Occupancy (FH)

Hopping mode : Enable&2-DH5





Time of Occupancy (FH)

Hopping mode : Enable&3-DH5

ent Spectrum Analyzer Swept SA :27 PM Apr 26, 2024 01:35Frequency Avg Type: Log-Pwr TRACE 123 TYPE WANN DET PNN Trig: Free Run Atten: 30 dB PNO: Fast +++ IFGain:Low Auto Tune ∆Mkr3 3.750 ms -0.05 dB Ref 20.00 dBm 10 dB/div Log **r** <u>∆1∆2</u>3∆4 **Center Freq** Xa 2.441000000 GHz Start Freq 2.441000000 GHz di. 1. ht Stop Freq 2.441000000 GHz Center 2.441000000 GHz Res BW 1.0 MHz Span 0 Hz Sweep 15.00 ms (1001 pts) CF Step 1.000000 MHz Man #VBW 3.0 MHz Auto FUNCTIO 0.91 dB 7.39 dBm -0.05 dB 7.39 dBm s (A) 3.000 ms 3.750 ms (Δ) 3.000 ms Freq Offset 4567 0 Hz 10 11 STATUS

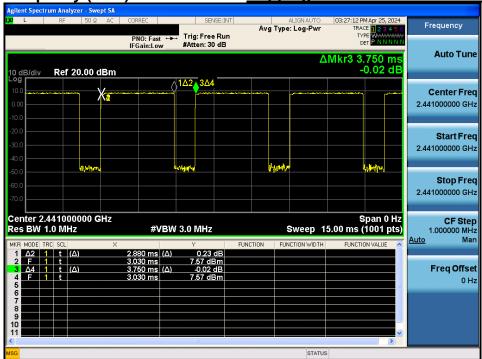


Time of Occupancy (AFH)

Hopping mode : Enable&DH5

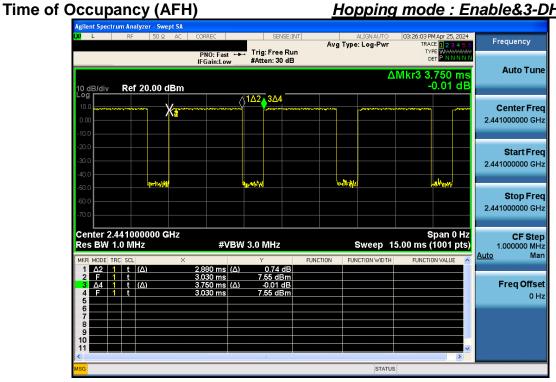
nt Spectrum Analyzer Swent SA :49 PM Apr 25, 2024 Frequency Avg Type: Log-Pwr TYPE WWW DET P N N Trig: Free Run #Atten: 30 dB PNO: Fast ↔→ IFGain:Low Auto Tune ΔMkr3 3.750 ms 0.02 dB Ref 20.00 dBm 10 dB/div -og **r** <u>∆1∆2</u>3∆4 **Center Freq** Xz 2.441000000 GHz Start Freq 2.441000000 GHz de ha Stop Freq 2.441000000 GHz Center 2.441000000 GHz Res BW 1.0 MHz Span 0 Hz Sweep 15.00 ms (1001 pts) CF Step 1.000000 MHz Man #VBW 3.0 MHz Auto 0.16 dB 8.19 dBm 0.02 dB 8.19 dBm Δ2 1 t (Δ) (Δ) 2.970 ms 3.750 ms (∆) 2.970 ms Freq Offset 456 0 Hz 10 11 STATUS

Time of Occupancy (AFH) <u>Hopping mode : Enable&2-DH5</u>





Hopping mode : Enable&3-DH5





9. Unwanted Emissions

9.1. Test Setup

Refer to the APPENDIX I.

9.2. Limit

Part 15.247(d), Part 15.205, Part 15.209 & RSS-247 [5.5], RSS-Gen [8.9], RSS-Gen [8.10] In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of Part 15.247 the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated 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) (see §15.205(c)).

- Part 15.209 & RSS-Gen[8.9]: General requirement IC Limit (µA/m) Measurement Distance (m) Frequency (MHz) FCC Limit (uV/m) 2 400 / F (kHz) 0.009 - 0.4906.37/F (F in kHz) 300 0.490 - 1.70524 000 / F (kHz) 63.7/F (F in kHz) 30 1.705 - 30.0 30 0.08 30

Frequency (MHz)	FCC Limit (uV/m)	IC Limit (uV/m)	Measurement Distance (m)
30 ~ 88	100 **	100	3
88 ~ 216	150 **	150	3
216 ~ 960	200 **	200	3
Above 960	500	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §15.231 and 15.241.



- Part 15.205(a): Restricted band of operation

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.414 25 ~ 8.414 75	108 ~ 121.94	1 300 ~ 1 427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1 435 ~ 1 626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.173 5 ~ 2.190 5	12.519 75 ~ 12.520 25	149.9 ~ 150.05	1 645.5 ~ 1 646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.576 75 ~ 12.577 25	156.524 75 ~ 156.525 25	1 660 ~ 1 710	8.025 ~ 8.5	22.01 ~ 23.12
4.177 25 ~ 4.177 75	13.36 ~ 13.41	156.7 ~ 156.9	1 718.8 ~ 1 722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.207 25 ~ 4.207 75	16.42 ~ 16.423	162.012 5 ~ 167.17	2 200 ~ 2 300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.694 75 ~ 16.695 25	167.72 ~ 173.2	2 310 ~ 2 390	10.6 ~ 12.7	36.43 ~ 36.5
6.267 75 ~ 6.268 25	16.804 25 ~ 16.804 75	240 ~ 285	2 483.5 ~ 2 500	13.25 ~ 13.4	Above 38.6
6.311 75 ~ 6.312 25	25.5 ~ 25.67	322 ~ 335.4	2 655 ~ 2 900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3 260 ~ 3 267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3 332 ~ 3 339		
8.376 25 ~ 8.386 75	74.8 ~ 75.2	960 ~ 1 240	3 345.8 ~ 3 358		
			3 600 ~ 4 400		

- RSS-Gen[8.10]: Restricted frequency bands

MHz	MHz	MHz	MHz	MHz	GHz
0.090 ~ 0.110	8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3 345.8 ~ 3 358	9.0 ~ 9.2
0.495 ~ 0.505	8.376 25 ~ 8.386 75	74.8 ~ 75.2	960 ~ 1 427	3 500 ~ 4 400	9.3 ~ 9.5
2.173 5 ~ 2.190 5	8.414 25 ~ 8.414 75	108 ~ 138	1 435 ~ 1 626.5	4 500 ~ 5 150	10.6 ~ 12.7
3.020 ~ 3.026	12.29 ~ 12.293	149.9 ~ 150.05	1 645.5 ~ 1 646.5	5 350 ~ 5 460	13.25 ~ 13.4
4.125 ~ 4.128	12.519 75 ~ 12.520 25	156.524 75 ~	1 660 ~ 1 710	7 250 ~ 7 750	14.47 ~ 14.5
4.177 25 ~ 4.177 75	12.576 75 ~ 12.577 25	156.525 25	1 718.8 ~ 1 722.2	8 025 ~ 8 500	15.35 ~ 16.2
4.207 25 ~ 4.207 75	13.36 ~ 13.41	156.7 ~ 156.9	2 200 ~ 2 300		17.7 ~ 21.4
5.677 ~ 5.683	16.42 ~ 16.423	162.01 25 ~ 167.17	2 310 ~ 2 390		22.01 ~ 23.12
6.215 ~ 6.218	16.694 75 ~ 16.695 25	167.72 ~ 173.2	2 483.5 ~ 2 500		23.6 ~ 24.0
6.267 75 ~ 6.268 25	16.804 25 ~ 16.804 75	240 ~ 285	2 655 ~ 2 900		31.2 ~ 31.8
6.311 75 ~ 6.312 25	25.5 ~ 25.67	322 ~ 335.4	3 260 ~ 3 267		36.43 ~ 36.5
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3 332 ~ 3 339		Above 38.6



9.3. Test Procedures

9.3.1. Test Procedures for Unwanted Emissions(Radiated)

- The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
- For measurements above 1 GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Measurement Instrument Setting

- Frequencies less than or equal to 1 000 MHz The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasipeak detection (QP) at frequency below 1 GHz.
- Frequencies above 1 000 MHz
 The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
 The result of Average measurement is calculated using PK result and duty correction factor.



9.3.2. Test Procedures for Unwanted Emissions(Conducted)

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 25 GHz RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40 001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2 001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

9.4. Test Results

9.4.1. Unwanted Emissions(Radiated)

Test Notes.

- 1. The radiated emissions below 1 GHz were investigated from 9 kHz and the worst case data was reported.
- 2. Information of Distance Correction Factor
 - For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
 - In this case, the distance correction factor is applied to the result.
 - Calculation of distance factor
 - At frequencies below 30 MHz = $40 \log(\text{tested distance / specified distance})$
 - At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
 - When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied.
- 3. Sample Calculation.
 - Margin = Limit Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL AG

Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss,

AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

9 kHz ~ 1 GHz Data (Modulation : GFSK)

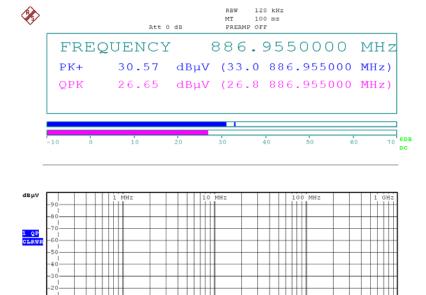
Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
798.50	Н	Z	QP	27.30	5.39	N/A	N/A	32.69	46.02	13.33
886.96	Н	Z	QP	26.80	6.95	N/A	N/A	33.75	46.02	12.27
-	-	-	-	-	-	-	-	-	-	-

TM1 & Lowest & Z & Hor

Detector Mode : QP

GH:







Test Notes.

1. The radiated emissions above 1 GHz were investigated up to 25 GHz. And no other spurious and harmonic emissions were found below listed frequencies.

2. Information of Distance Correction Factor

For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.

In this case, the distance correction factor is applied to the result.

- Calculation of distance factor

At frequencies below 30 MHz = 40 log(tested distance / specified distance)

At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)

When distance factor is "N/A", the measurements were performed at the specified distance and distance factor is not applied. 3. DCCF Calculation. (DCCF = Duty Cycle Correction Factor)

- Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels, where T = pulse width = 2.88 ms

- 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = 100 / (2.88 X 20) = 1.74 = 2
- The Worst Case Dwell Time = T [ms] x H' = 2.88 ms X 2 = 5.76 ms
- DCCF = 20 Log(The Worst Case Dwell Time / 100 ms) dB = 20 log(5.76 / 100) = -24.79 dB

4. Sample Calculation.

Margin = Limit - Result / Result = Reading + TF+ DCCF + DCF / TF = AF + CL + HL + AL - AG

Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain, HL = High pass filter Loss, AL = Attenuator Loss, DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

1 GHz ~ 25 GHz Data (Modulation : GFSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 386.58	Н	Х	PK	51.75	4.46	N/A	N/A	56.21	74.00	17.79
2 386.58	Н	Х	AV	51.75	4.46	-24.79	N/A	31.42	54.00	22.58
4 803.80	Н	Х	PK	50.38	1.64	N/A	N/A	52.02	74.00	21.98
4 803.80	Н	Х	AV	50.38	1.64	-24.79	N/A	27.23	54.00	26.77

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 881.62	Н	Х	PK	49.79	1.88	N/A	N/A	51.67	74.00	22.33
4 881.62	Н	Х	AV	49.79	1.88	-24.79	N/A	26.88	54.00	27.12

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 489.37	Н	Х	PK	53.22	5.10	N/A	N/A	58.32	74.00	15.68
2 489.37	Н	Х	AV	53.22	5.10	-24.79	N/A	33.53	54.00	20.47
4 960.44	Н	Х	PK	49.12	2.52	N/A	N/A	51.64	74.00	22.36
4 960.44	Н	Х	AV	49.12	2.52	-24.79	N/A	26.85	54.00	27.15

1 GHz ~ 25 GHz Data (Modulation : π /4DQPSK)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 385.96	Н	Х	PK	51.63	4.46	N/A	N/A	56.09	74.00	17.91
2 385.96	Н	Х	AV	51.63	4.46	-24.79	N/A	31.30	54.00	22.70
4 805.06	Н	Х	PK	49.72	1.64	N/A	N/A	51.36	74.00	22.64
4 805.06	Н	Х	AV	49.72	1.64	-24.79	N/A	26.57	54.00	27.43

Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.10	Н	Х	PK	49.24	1.89	N/A	N/A	51.13	74.00	22.87
4 882.10	Н	Х	AV	49.24	1.89	-24.79	N/A	26.34	54.00	27.66

Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 487.52	Н	Х	PK	52.68	5.06	N/A	N/A	57.74	74.00	16.26
2 487.52	Н	Х	AV	52.68	5.06	-24.79	N/A	32.95	54.00	21.05
4 959.80	Н	Х	PK	48.75	2.52	N/A	N/A	51.27	74.00	22.73
4 959.80	Н	Х	AV	48.75	2.52	-24.79	N/A	26.48	54.00	27.52

1 GHz ~ 25 GHz Data (Modulation : <u>8DPSK</u>)

Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 382.93	Н	Х	PK	51.67	4.44	N/A	N/A	56.11	74.00	17.89
2 382.93	Н	Х	AV	51.67	4.44	-24.79	N/A	31.32	54.00	22.68
4 804.02	Н	Х	PK	49.30	1.64	N/A	N/A	50.94	74.00	23.06
4 804.02	Н	Х	AV	49.30	1.64	-24.79	N/A	26.15	54.00	27.85

Middle Channel

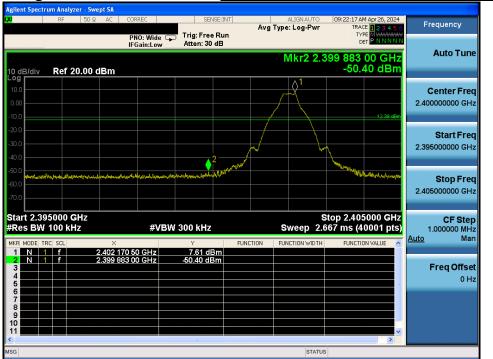
Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4 882.87	Н	Х	PK	49.65	1.90	N/A	N/A	51.55	74.00	22.45
4 882.87	Н	Х	AV	49.65	1.90	-24.79	N/A	26.76	54.00	27.24

Highest Channel

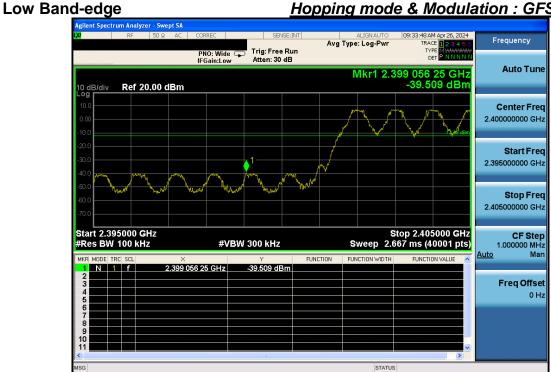
Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 491.77	Н	Х	PK	52.02	5.15	N/A	N/A	57.17	74.00	16.83
2 491.77	Н	Х	AV	52.02	5.15	-24.79	N/A	32.38	54.00	21.62
4 959.07	Н	Х	PK	48.97	2.52	N/A	N/A	51.49	74.00	22.51
4 959.07	Н	Х	AV	48.97	2.52	-24.79	N/A	26.70	54.00	27.30

9.4.2. Unwanted Emissions(Conducted)

Low Band-edge



Lowest Channel & Modulation : GFSK



Hopping mode & Modulation : GFSK



ns Lowest Channel & Modulation : GFSK

Conducted Spurious Emissions

Agilent Spectr											
L)U	RF	50 Ω 🧥 DC 🛛	CORREC		SENSE	INT	Ava Tva	ALIGNAUTO	TRA	M Apr 26, 2024 CE 1 2 3 4 5 6	Frequency
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			IFGain:Lo	w At	tten: 30 d	8					Auto Tune
										5.4 kHz	Auto Tulk
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0.00											15.004500 MHz
-10.0										12.39 dBm	
-20.0										12.00 0.01	
-30.0											Start Fred
											9.000 kHz
-40.0											
-50.0											Stop Fred
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-70.0											
Start 9 k⊦	7								Ston 3	0.00 MHz	CF Step
#Res BW		z	#\	/BW 30	0 kHz		:	Sweep 5.3	333 ms (4	0001 pts)	2.999100 MHz
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Agilent Spectrum Analyzer - S	iwept SA										
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	PNO: Fast	Trig: Free Run	AVg I	ype: Log-Pwr	TRACE 1 2 3 4 5 TYPE MWWWW	A					
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				Mkr	5 7.566 32 GH	Auto Tune					
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-50.0						Stop Freq					
-60.0						10.000000000 GHz					
-70.0						10.00000000 GHZ					
Start 30 MHz					Stop 10.000 GH	CF Step					
#Res BW 1.0 MHz	#V	BW 3.0 MHz		Sweep 18	.67 ms (40001 pts						
MKR MODE TRC SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto Man					
1 N 1 f	2.402 11 GHz	7.69 dBm									
3 N 1 f	2.479 13 GHz 3.302 15 GHz	-35.71 dBm -39.54 dBm				Freq Offset					
4 N 1 f	5.866 69 GHz	-39.55 dBm				0 Hz					
5 N 1 f	7.566 32 GHz	-40.14 dBm									
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8											
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MSG	STATUS										

0 Hz



10 11

Conducted Spurious Emissions <u>Lowest Channel & Modulation : GFSK</u>



STATUS

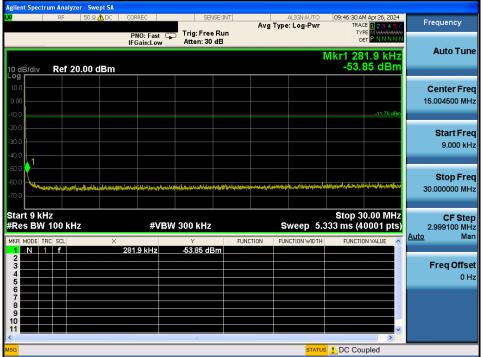


Reference for limit

Middle Channel & Modulation : GFSK



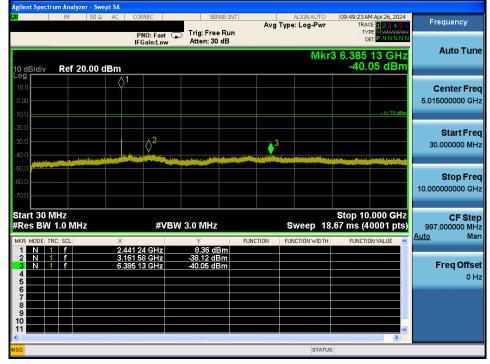
Conducted Spurious Emissions <u>Middle Channel & Modulation : GFSK</u>





Conducted Spurious Emissions

Middle Channel & Modulation : GFSK

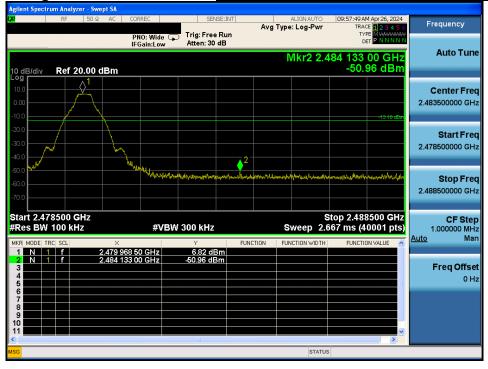


Agilent Spo	ectrur		lyzer - S	wept S	54													
L X I		RF	50	ΩA	.c c	ORREC			SENSE:]	NT	Ave		ALIGN AUTO : Log-Pwr		53 AM Apr 26 TRACE <mark>1 2</mark>			Frequency
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4 N	1	f		18	8.957 6	525 G	Hz	-34.81	dBm									0 Hz
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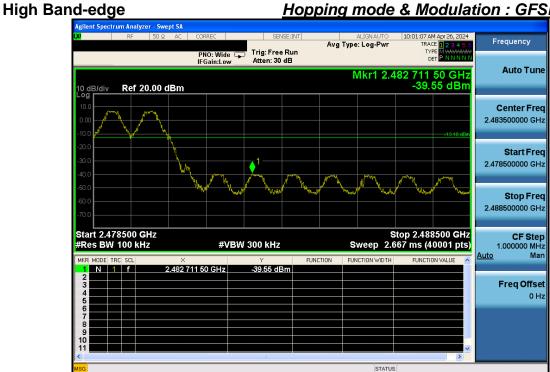


High Band-edge

Highest Channel & Modulation : GFSK



Hopping mode & Modulation : GFSK





Conducted Spurious Emissions <u>Highest Channel & Modulation : GFSK</u>

<mark>u</mark> i	RF	50 Ω <u>Λ</u> DC	CORREC	St	ENSE:INT	Aug Tree	ALIGNAUTO e: Log-Pwr		M Apr 26, 2024 CE <mark>1 2 3 4 5 6</mark>	Frequency
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10 dB/div	Ref 2	0.00 dBm	IFGain:Low	Atten: 3				Vikr1 29	9.9 kHz 90 dBm	Auto Tun
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Agilent Spectrur										
L <mark>XI</mark>	RF 50 Ω	AC COR	REC	SENSI	EINT	Ava Tvp	ALIGNAUTO e: Log-Pwr		1 Apr 26, 2024 E 1 2 3 4 5 6	Frequency
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		IFG	iain:Low _	Atten: 30 a	0		ML	5 7 000		Auto Tune
10 dB/div	Ref 20.00 (dBm					IVIKI	5 7.202 -40.	56 dBm	
Log 10.0										Center Freq
0.00										5.015000000 GHz
-10.0									-13.10 dBm	
-20.0										
-30.0		2	.3				5			Start Freq 30.000000 MHz
-40.0					\Diamond		ut And December 2 hours have been			30.000000 WH2
-50.0		Construction of the local division of the lo								
-60.0										Stop Freq
-70.0										10.00000000 GHz
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MKR MODE TRC	SCL	×		Y	FUNC	TION FU	NCTION WIDTH	FUNCTIO	N VALUE	<u>Auto</u> Man
1 N 1 2 N 1	f f	2.480 13 2.403 11	1 GHz	7.53 dBr -36.85 dBr	n					
3 N 1 4 N 1	f f	3.150 1 ⁴ 5.864 69		-39.26 dBr -39.72 dBr	n n					Freq Offset
5 N 1	f	7.202 1		-40.56 dBr					=	0 Hz
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Conducted Spurious Emissions High

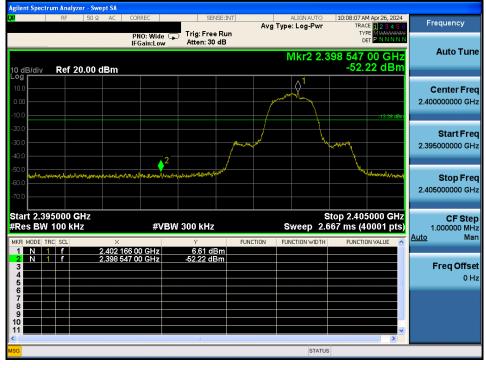
Highest Channel & Modulation : GFSK





Low Band-edge

Lowest Channel & Modulation : π/4DQPSK



Low Band-edge

Hopping mode & Modulation : π/4DQPSK





sions <u>Lowest Channel & Modulation : π/4DQPSK</u>

Conducted Spurious Emissions

Frequency TRACE 123 TYPE MINA DET PNN Avg Type: Log-Pwr Trig: Free Run Atten: 30 dB PNO: Fast 🖵 IFGain:Low Auto Tune Mkr1 281.9 kHz -54.07 dBm Ref 20.00 dBm 10 dB/div Log **Center Freq** 15.004500 MHz Start Freq 9.000 kHz Stop Freq 30.000000 MHz Start 9 kHz #Res BW 100 kHz Stop 30.00 MHz Sweep 5.333 ms (40001 pts) CF Step 2.999100 MHz Man #VBW 300 kHz Auto FUNCTION FUNCTION WIDTH FUNCTION VALU -54.07 dBm N 1 f 281.9 kHz **Freq Offset** 0 Hz 10 11 STATUS 1 DC Coupled

Agilent Spectrum Analyze								
XI RF	50Ω AC CORR		SENSE:INT	Avg	ALIGN AUTO Type: Log-Pwr	10:34:15 AM TRACE	Apr 26, 2024 1 2 3 4 5 6 M	Frequency
	PN IFG		ig: Free Run ten: 30 dB			DE"	PNNNNN	Auto Tum
10 dB/div Ref 20	.00 dBm				Mkr	40.6 ² 40.6-	40 GHz 57 dBm	Auto Tune
10.0	≬ 1							Center Free
0.00								5.015000000 GH
-10.0							-13.39 dBm	
-30.0	() ²	3		<mark>4</mark>		5		Start Fre 30.000000 MH
-40.0				Y	The second second second		States of the Street	
-50.0								Stop Fre
-70.0								10.00000000 GH
Start 30 MHz						Stop 10.		CF Ste
#Res BW 1.0 MHz		#VBW 3.0			Sweep 18			997.000000 MHz Auto Man
MKR MODE TRC SCL	× 2.402 11		Ƴ 7.85 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION	N VALUE	
2 N 1 f 3 N 1 f	2.479 13 3.323 84	GHz -3	5.25 dBm 3.62 dBm					Freq Offse
4 N 1 f 5 N 1 f	<u>5.620 93</u> 7.956 40	GHz -3 GHz -4	9.35 dBm 0.67 dBm				=	0 H
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Conducted Spurious Emissions <u>L</u>

Lowest Channel & Modulation : π/4DQPSK

