TEST REPORT



CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501

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1. Client

- Name : EVERINT Co., Ltd.
- Address : (Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si Chungcheongbuk-do, Korea
- Date of Receipt : 2022-03-16

2. Manufacturer

- Name : EVERINT Co., Ltd.
- Address : (Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si Chungcheongbuk-do, Korea
- 3. Use of Report : For CE Conformance
- 4. Test Sample / Model: BLUETOOTH MODULE / BT-TYPE-A
- 5. Date of Test : 2022-03-28 to 2022-04-05
- 6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247

RSS-247 & RSS-Gen

- **7. Testing Environment:** Temp.: (24 ± 1) °C, Humidity: (48 ± 3) % R.H.
- 8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Ji-Hye, Kim: (Signature)	Technical Manager Won-Jae, Hwang: (Signature)
Remark. Th	is report is not related to KOLAS accre	editation and relevant regulation.
		2022-04-06

Republic of KOREA CTK Co., Ltd.



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REPORT REVISION HISTORY

Date	Revision	Page No
2022-04-06	Issued (CTK-2022-01043)	all

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1. General Product Description

1.1 Client Information

Company	EVERINT Co., Ltd.
Contact Point	(Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si Chungcheongbuk-do, Korea
Contact Person	Name : JiSung Shin E-mail : jsshin@bixolon.kf Tel : +82-31-218-5582 Fax : +82-31-218-5589

1.2 Product Information

FCC ID	2AKMF-BTTYPEA
ISED	22266-BTTYPEA
Product Description	BLUETOOTH MODULE
Model name	BT-TYPE-A
Variant Model name	-
Operating Frequency	2 402 MHz - 2 480 MHz
RF Output Power	5.586 dBm (3.619 mW)
Antenna Specification	Antenna type : Chip Antenna Peak Gain : 0.85 dBi
Number of channels	79
Channel Spacing	1 MHz
Type of Modulation	GFSK(1Mbps), π /4-DQPSK(2Mbps), 8-DPSK(3Mbps)
Power Source	DC 3.3 V
Hardware Rev	V100
Software Rev	4.0.2

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253R6N
AC/DC Adapter	HP	HSTNN-CA40	-

1.4 Model Differences

Not applicable



2. Facility and Accreditations

2.1 Test Facility

The radiated measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

The conducted measurement facility is located at 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.



3. Test Specifications

3.1 Standards

Section in FCC	Section in RSS	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	RSS-247 5.1(b)	Carrier Frequency Separation	С	
15.247(a)	RSS-247 5.1(d)	Number of Hopping Frequencies	С	
15.247(a)	RSS-247 5.1(a)	20 dB Bandwidth	С	Conducted
15.247(a)	RSS-247 5.1(d)	Time of occupancy (Dwell Time)	С	Conducted
15.247(b)	RSS-247 5.4(b)	Maximum peak conducted output power	С	
15.247(d)	RSS-247 5.5	Unwanted emission	С	
15.209	RSS-Gen 6.13	Transmitter emission	С	Radiated
15.207(a)	RSS-Gen 8.8	AC Conducted Emission C Line Conducted		
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
Note 2: The data in this test report are traceable to the national or international standards.				
<u>Note 3</u> : The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013, RSS-247 Issue 2, RSS-GEN Issue 5				

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests. The results are only attached worst cases.

Test Frequency

Lowest channel	Middle channel	Highest channel
2 402 MHz	2 441 MHz	2 480 MHz

Test mode

Modulation	Packet type	Data rate	Duty Cycle
GFSK	DH5	1 Mbps	77.4 %
8-DPSK	3-DH5	3 Mbps	77.6 %



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3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter. Coverage factor k = 2, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	1.5 dB (C.L.: Approx. 95 %, <i>k</i> = 2)
Power Spectral Density	1.5 dB (C.L.: Approx. 95 %, <i>k</i> = 2)
Occupied Bandwidth	0.1 MHz (C.L.: Approx. 95 %, k = 2)
Unwanted Emission(conducted)	3.0 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f \leq 1 GHz)	4.66 dB (C.L.: Approx. 95 %, k = 2)
Radiated Emissions (f > 1 GHz)	4.76 dB (C.L.: Approx. 95 %, k = 2)
Line Conducted Emission	1.96 dB (C.L.: Approx. 95 %, <i>k</i> = 2)

3.4 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 6.0.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0
	ESR7 : EMC32 Ver. 8.53.0



4. Technical Characteristic Test

4.1 Carrier Frequency Separation

Test Procedures

ANSI C63.10-2013 - Section 7.8.2

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled. After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

- a) Span = 5 MHz (wide enough to capture the peaks of two adjacent channels)
- b) RBW = 30 kHz (Start with the RBW set to approximately 30% of the channel spacing;

adjust as necessary to best identify the center of each individual channel)

- c) VBW = 30 kHz (\geq RBW)
- e) Detector function = peak
- d) Sweep = autof) Trace = max hold

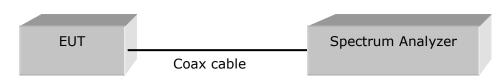


Figure 1 : Measurement setup for the carrier frequency separation

Limit

FHSS operating in the band 2400-2483.5 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.

Test Results

Test mode	Channel	Adjacent Hopping Channel Separation [kHz]	Two-third of 20dB bandwidth [kHz]	Minimum Bandwidth [kHz]	Result
GFSK	Middle	1 000	678.7	25	Complies
8-DPSK	Middle	1 000	878.0	25	Complies

See next pages for actual measured spectrum plots.



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gilent Spectrum Analyzer - Swept SA 21 AM Mar 28, 2022 TRACE 1 2 3 4 5 6 TYPE M WWWWW DET P P P P P P Frequency Center Freq 2.441000000 GHz Avg Type: Log-Pwr Avg|Hold:>100/100 Trig: Free Run PNO: Wide 🖵 IFGain:Low #Atten: 30 dB Ext Gain: -0.82 dB Auto Tune ΔMkr2 1.000 MHz -0.011 dB 10 dB/div Ref 20.00 dBm **Center Freq** 2.441000000 GHz $\sqrt{1}$ <mark>∖2∆1</mark> 0.00 Start Freq 2 438500000 GHz Stop Freq 2.443500000 GHz 30. CF Step 500.000 kHz Man Auto 50.1 Freq Offset 0 Hz Center 2.441000 GHz Span 5.000 MHz #Res BW 30 kHz #VBW 30 kHz Sweep 6.733 ms (1001 pts) STATUS

Test mode : GFSK

Test mode : 8-DPSK





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4.2 Number of Hopping Frequencies

Test Procedures

ANSI C63.10-2013 - Section 7.8.3

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

The spectrum analyzer is set to:

a) Frequency range	1: Start = 2389.5 MHz, Stop = 2439.5 MHz
	2: Start = 2439.5 MHz, Stop = 2489.5 MHz

b) RBW = 300 kHz (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)

c) VBW = 300 kHz (\geq RBW)	d) Sweep = auto
e) Detector function = peak	f) Trace = max hold



Limit

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

Test Results

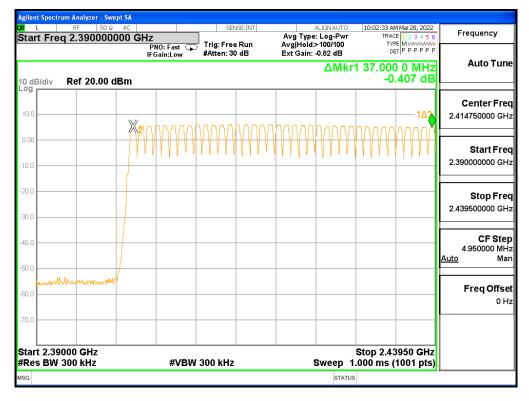
Test mode	Total number of Hopping Channels	Result
GFSK	79	Complies
8-DPSK	79	Complies

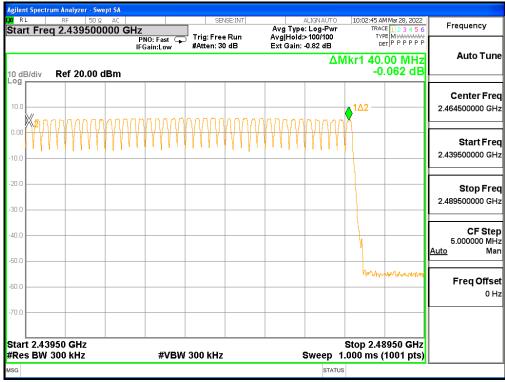
See next pages for actual measured spectrum plots.



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Test mode : GFSK







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Test mode : 8-DPSK

igilent Spectrum Analyzer - Swej V L RF 50 Ω		SENSE:IN	T ALIGN AU	TO 10:22:49 AM Mar 28, 2022	
Start Freq 2.3900000	PNO: Fas				Frequency
10 dB/div Ref 20.00 d	IFGain:Lo Bm	w #Atten: 30 dB	Ext Gain: -0.82 dE	lkr1 37.000 0 MHz -0.871 dB	Auto Tun
og 10.0	Xerron		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	142	Center Fre 2.414750000 G⊦
0.00					Start Fre 2.390000000 G⊦
0.0					Stop Fre 2.439500000 GH
0.0					CF Ste 4.950000 MH <u>Auto</u> Ma
0.0 Wallerlich. (1/ Jacob Markel Mark					Freq Offs 0 F
70.0				Stop 2.43950 GHz	
Res BW 300 kHz	#\	/BW 300 kHz	-	o 1.000 ms (1001 pts)	

RL RF 50Ω AC		SENSE:INT	ALIGN AUT		4 Mar 28, 2022	Frequency
art Freq 2.439500000 G	PNO East T	rig: Free Run Atten: 30 dB	Avg Type: Log-Pw Avg Hold:>100/100 Ext Gain: -0.82 dB	TYF	E 1 2 3 4 5 6 PE M WAAWAAAAA T P P P P P P T P P P P P P	
dB/div Ref 20.00 dBm			Ĺ	Mkr1 40. -0	00 MHz .860 dB	Auto Tu
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00 X2V-WAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA		YVVYVYVY				Start Fi 2.439500000 G
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						CF S 5.000000 M Auto
0.0				En	nhavennamin	Freq Off
1.0						C
art 2.43950 GHz Res BW 300 kHz	#VBW 30	IO kHz	Sweep	Stop 2.48 1.000 ms (



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4.3 20 dB bandwidth & 99% Bandwidth

Test Procedures

ANSI C63.10-2013 - Section 6.9.2 RSS-GEN Issue 5 - Section 6.7

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 - Section 6.9.3 RSS-GEN Issue 5 - Section 6.7

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

The spectrum analyzer is set to:

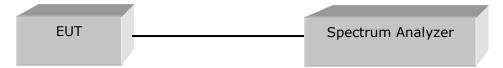
Center frequency = the highest, middle and the lowest channels

a) Span = 3 MHz (between 2 times and 5 times the OBW)

- b) RBW = 30 kHz (1% to 5% of the OBW)
- c) VBW = 100 kHz (approximately 3 times RBW)
- d) Sweep = auto

e) Detector function = peak

f) Trace = max hold



Limit

Limit : N/A



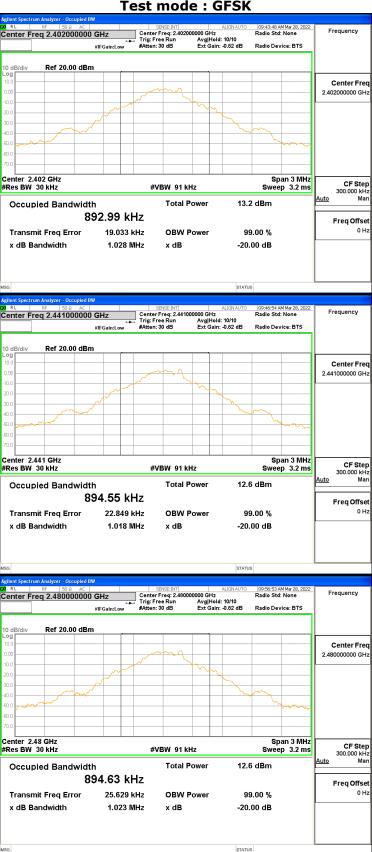
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Test Results

Test mode	Frequency [MHz]	20 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
	2 402	1.028	0.893	Complies
GFSK	2 441	1.018	0.895	Complies
	2 480	1.023	0.895	Complies
	2 402	1.316	1.197	Complies
8-DPSK	2 441	1.317	1.198	Complies
	2 480	1.315	1.197	Complies

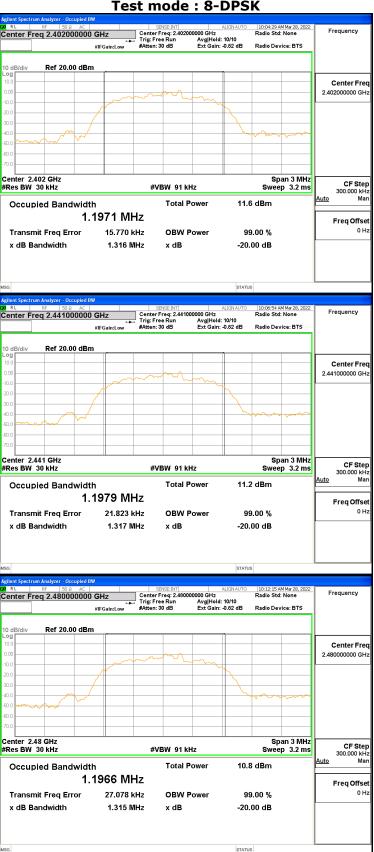
See next pages for actual measured spectrum plots.





Test mode : GFSK





Test mode : 8-DPSK



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4.4 Time of Occupancy

Test Procedures

ANSI C63.10-2013 - Section 7.8.4

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

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

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

c) 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 Earbuds (R) 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.

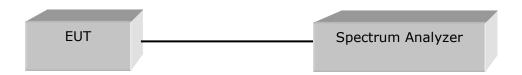
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

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)



Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



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Test Results

Test mode	Mode	Number of hops Channels	Transmit time per hop(msec)	Result (msec)	Limit (msec)
	DH1	79	0.397	127.04	400
GFSK	DH3	79	1.654	264.64	400
	DH5	79	2.899	309.23	400
	3-DH1	79	0.403	128.96	400
8-DPSK	3-DH3	79	1.648	263.68	400
	3-DH5	79	2.908	310.19	400

*** Remark:**

Average time of occupancy = Transmit time per hop * Number of hopping channels in 31.6s

According the BLUETOOTH STANDARD SPECIFICATION, the nominal hop rate is 1600 hop/s. All bluetooth units participating in the piconet are time and hop synchronized to the channel.

- The maximum number of hopping channels in 31.6s for DH1 = 1600 / 2 / 79 * 31.6 = 320

- The maximum number of hopping channels in 31.6s for DH3 = 1600 / 4 / 79 * 31.6 = 160

- The maximum number of hopping channels in 31.6s for DH5 = 1600 / 6 / 79 * 31.6 = 107

See next pages for actual measured spectrum plots.





Transmit time for PACKET Type DH1(GFSK)

Transmit time for PACKET Type DH3(GFSK)

Agilent Spectrum Analyze									
	50 Ω AC		SENSE:	INT		ALIGNAUTO : Log-Pwr		M Mar 28, 2022	Frequency
Center Freq 2.44	Р	1Z NO: Fast ↔ Gain:Low	Trig: Free R #Atten: 30 dl		Ext Gain:	5	TYI Di	PE WWWWWWW ET P N N N N N	Auto Tune
10 dB/div Ref 20	.00 dBm					1	-21.4	68.73 μs 40 dBm	
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-40.0 -50.0 				V Mu	nana la parte de	Antriadyarty	3∆1 Minlyntv		Stop Fre 2.441000000 GH
Center 2.4410000 Res BW 1.0 MHz	000 GHz	#VBW	1.0 MHz			<u> </u>	.000 ms (pan 0 Hz 1001 pts)	CF Ste 1.000000 MI Auto Ma
MKR MODE TRC SCL 1 N 1 t 2 Δ1 1 t (Δ) 3 Δ1 1 t (Δ) 4	1.6	3.73 μs 554 ms (Δ) 196 ms (Δ)	-21.40 dBm -23.05 dB -36.27 dB		TION FUP	NCTION WIDTH	FUNCTIO	DN VALUE	Freq Offs
5 6 7 8 9 10 11									
sg						STATUS	5		



Transmit time for PACKET Type DH5(GFSK)





Agitani Spectrum Analyzer - Swept SA Action Spectrum Analyzer - Swept SA Frequency Frequency Frequency Frequency Auto Tune Center Freq 2.441000000 GHz IFGain:Low Trig: Free Run IFGain:Low Trig: Free Run #Atten: 30 dB Avg Type: Log-Pwr Ext Gain: -0.82 dB Trye: Image: Spectrum Analyzer - SpectrumA





Transmit time for PACKET Type 3-DH3(8-DPSK)

	-p-sc ii	R		50 \$	<mark>/ept SΛ</mark> 2 AC					ENSE:INT			6	LIGNAUT	0	10:09:29	AM Mar 2	8 2022		
ent	er F				0000	0 GH	lz		1			Avg Ty		Log-Pw		TR	ACE 1 2	3456		Frequency
						Р	NO: Fast Gain:Lov		⁴ Trig: Fr #Atten:			Ext Ga	in: -C	0.82 dB			DET P N			
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Transmit time for PACKET Type 3-DH5(8-DPSK)

L	RF 50 \$	2 AC			SENSE	INT		ALIGN AUTO	10:10:05 A	M Mar 28, 2022	_
nter Fre	q 2.4410	00000					Avg Typ	e: Log-Pwr		CE 1 2 3 4 5 6 PE WAAAAAAA	Frequency
			PNO: Fast IFGain:Lov		Trig: Free F #Atten: 30 d		Ext Gain	: -0.82 dB		ET P NNNNN	
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4.5 Maximum peak Conducted Output Power

Test Procedures

ANSI C63.10-2013 - Section 7.8.5

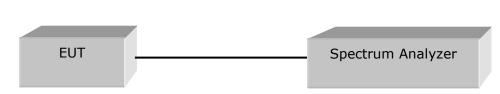
This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) Span = 5 MHz (approximately 5 times of the 20 dB bandwidth)
- b) RBW = 3 MHz (greater than the 20 dB bandwidth of the emission being measured)
- c) VBW = 3 MHz (\geq RBW)
- e) Trace = max hold

d) Detector = peakf) Sweep = auto



Limit

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels.



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Test Results

Test mode	Frequency [MHz]	Output Power [dBm]	Output power [mW]	Result
	2 402	5.327	3.410	Complies
GFSK	2 441	4.723	2.967	Complies
	2 480	4.688	2.943	Complies
	2 402	5.586	3.619	Complies
8-DPSK	2 441	5.140	3.266	Complies
	2 480	4.733	2.974	Complies

See next pages for actual measured spectrum plots.



Agilant Spectrum Analyzer - Swent SA		ode : GFSK	, 	
Agilent Spectrum Analyzer - Swept SA	SENSE:I	NT ALIGNAUTO Avg Type: Log-Pwr	09:43:33 AM Mar 28, 2022	Frequency
	PNO: Fast Trig: Free Ru IFGain:Low #Atten: 30 dE	in Avg Hold:>30/30	TYPE MWAAAAAA DET P P P P P	
10 dB/div Ref 20.00 dBm		Mkr1	2.401 995 GHz 5.327 dBm	Auto Tune
Log				Center Freq
10.0	1			2.402000000 GHz
0.00				Start Freq
-10.0				2.399500000 GHz
-20.0				Stop Freq 2.404500000 GHz
-30.0				
-40.0				CF Step 500.000 kHz Auto Man
-50.0				Freq Offset
-60.0				0 Hz
-70.0				
Center 2.402000 GHz #Res BW 3.0 MHz	#VBW 3.0 MHz	Sweep 1	Span 5.000 MHz I.000 ms (1001 pts)	
MSG		STATU		
Agilent Spectrum Analyzer - Swept SA	SENSE:I	NT ALIGN AUTO	09:46:41 AM Mar 28, 2022	
04 RL RF 50 Ω AC Center Freq 2.441000000 (GHz PNO: Fast Trig: Free Ru IFGain:Low #Atten: 30 dE	Avg Type: Log-Pwr In Avg Hold:>30/30	TRACE 1 2 3 4 5 6 TVPE M 4444444 DET P P P P P P	Frequency
10 dB/div Ref 20.00 dBm	ir Gain. Low		2.441 160 GHz 4.723 dBm	Auto Tune
				Center Freq
10.0		1		2.441000000 GHz
0.00				Start Freq
-10.0				2.438500000 GHz
-20.0				Stop Freq 2.443500000 GHz
-30.0				CF Step
-40.0				500.000 kHz Auto Man
-60.0				Freq Offset
-70.0				0 Hz
Center 2.441000 GHz #Res BW 3.0 MHz	#VBW 3.0 MHz	Sweep 1	Span 5.000 MHz 1.000 ms (1001 pts)	
MSG		STATU	S	
Agilent Spectrum Analyzer - Swept SA QXI R L RF 50 Ω AC	SENSE:I	NT ALIGN AUTO	09:56:38 AM Mar 28, 2022	Frequency
Center Freq 2.480000000	Hz PNO: Fast Trig: Free Ru IFGain:Low #Atten: 30 dE	Avg Type: Log-Pwr in Avg Hold:>30/30 8 Ext Gain: -0.82 dB	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P	Trequency
10 dB/div Ref 20.00 dBm		Mkr1	2.479 860 GHz 4.688 dBm	Auto Tune
10 dB/div Ref 20.00 dBm				Center Freq
10.0	1			2.480000000 GHz
0.00				Start Freq
-10.0				2.477500000 GHz
-20.0				Stop Freq 2.482500000 GHz
-30.0				
-40.0				CF Step 500.000 kHz Auto Man
-50.0				Freq Offset
-60.0				0 Hz
-70.0				
Center 2.480000 GHz #Res BW 3.0 MHz	#VBW 3.0 MHz	Sween 4	Span 5.000 MHz I.000 ms (1001 pts)	
MSG	". 20 0.0 MHZ	STATUS		



gilent Spectrum Analyzer - Swept SA	Fest mode	: 8-DPS	K	
RL RF 50 Ω AC	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	10:04:14 AM Mar 28, 2022	Frequency
enter Freq 2.402000000 GHz PNO: F IFGain:1	ast Trig: Free Run ow #Atten: 30 dB	Avg Type: Log-Pwr Avg Hold:>30/30 Ext Gain: -0.82 dB	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P	
			2.401 925 GHz 5.586 dBm	Auto Tune
dB/div Ref 20.00 dBm			0.000 0.001	
0.0	1			Center Free 2.402000000 GH
	V			2.40200000 011
.00				Start Fre
0.0				2.399500000 GH
0.0				
				Stop Fre 2.404500000 GH
0.0				
3.0				CF Ste 500.000 kH
0.0				Auto Ma
				FreqOffse
0.0				0 H
1.0				
enter 2.402000 GHz Res BW 3.0 MHz	#VBW 3.0 MHz	Sweep 1	Span 5.000 MHz 000 ms (1001 pts)	
3		STATUS	(1)	
ilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC	SENSE:INT	ALIGN AUTO	10:06:39 AM Mar 28, 2022	
enter Freq 2.441000000 GHz PNO: F		Avg Type: Log-Pwr Avg Hold:>30/30	TRACE 1 2 3 4 5 6	Frequency
IFGain:		Ext Gain: -0.82 dB	2.440 970 GHz	Auto Tun
dB/div Ref 20.00 dBm		WIKI I	5.140 dBm	
pg				Center Fre
0.0	1			2.441000000 GH
00				
				Start Fre 2.438500000 GH
				2.4000000000
0.0				Stop Fre
0.0				2.443500000 GH
0.0				CF Ste
				500.000 kH <u>Auto</u> Ma
0.0				
				Freq Offse 0 H
0.0				01
enter 2.441000 GHz			Span 5.000 MHz	
Res BW 3.0 MHz a	#VBW 3.0 MHz	Sweep 1.	000 ms (1001 pts)	
lent Spectrum Analyzer - Swept SA				
RL RF 50 Ω AC enter Freq 2.480000000 GHz	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr Avg Hold:>30/30	10:12:02 AM Mar 28, 2022 TRACE 1 2 3 4 5 6 TYPE MWWWWWW DET P P P P P	Frequency
PNO: F IFGain:I		Ext Gain: -0.82 dB		Auto Tun
dB/div Ref 20.00 dBm		WIKP1	2.479 980 GHz 4.733 dBm	
dB/div Ref 20.00 dBm				Center Fre
0.0	1			2.480000000 GH
00				
				Start Fre 2.477500000 GH
0.0				Stop Fre
0.0				2.482500000 GH
				CF Ste
				500.000 kH Auto Ma
0.0				Mio
0.0				Freq Offs
				0 H
enter 2.480000 GHz			Span 5.000 MHz	
Res BW 3.0 MHz	#VBW 3.0 MHz		000 ms (1001 pts)	
3		STATUS		



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4.6 Unwanted Emissions (Conducted)

Test Procedures

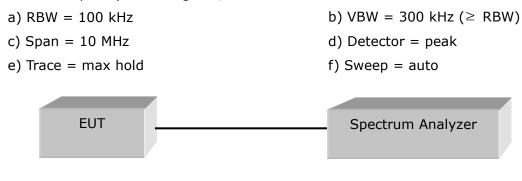
ANSI C63.10-2013 - Section 7.8.6, 7.8.8

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels



Limit

> 20 dBc

Test Results

All conducted emission in any 100 kHz bandwidth outside of the spectrum band was at least 20 dB lower than the highest level of the in-band spectral density. Therefore the applying equipment meets the requirement.

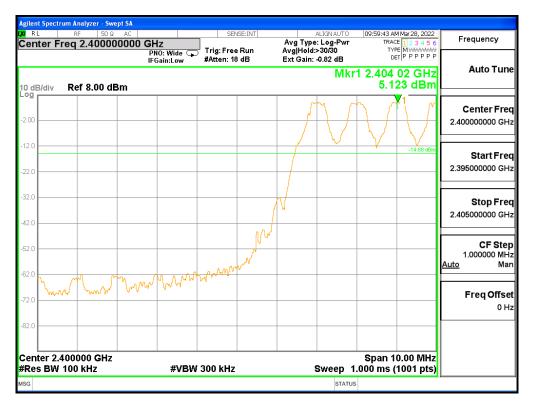
See next pages for actual measured spectrum plots.



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Band Edge

Test Mode : Hopping mode, GFSK







gilent Spectri ØRL	um Analyzer - Swept SA RF 50 Ω AC		SENSE:INT	ALIGN AUTO	10:15:57 AM Mar 28, 2022	<u>.</u>
	req 2.40000000		Trig: Free Run	Avg Type: Log-Pwr Avg Hold:>30/30	TRACE 1 2 3 4 5 6 TYPE M WWWWW	Frequency
		PNO: Wide 😱 IFGain:Low	#Atten: 18 dB	Ext Gain: -0.82 dB	DETPPPPP	
0 dB/div	Ref 8.00 dBm			Mk	r1 2.404 17 GHz 2.848 dBm	Auto Tun
2.00				mmm	Warm Man	Center Fre 2.400000000 GH
2.0					-17.15 dBm	Start Fre 2.395000000 G⊦
2.0				λ		Stop Fre 2.405000000 G⊦
2.0			- market			CF Ste 1.000000 M⊦ <u>Auto</u> Ma
2.0	- Martinania	North (M. Marked)				Freq Offso 0 ⊦
enter 2.4	100000 GHz				Span 10.00 MHz	
Res BW		#VBW	300 kHz	Sweep ′	1.000 ms (1001 pts)	
ŝG				STATU	S	

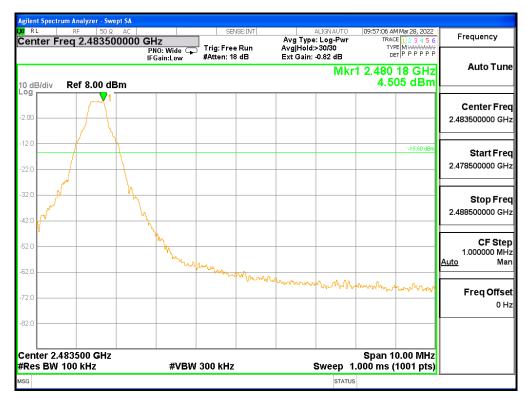
Test Mode : Hopping mode, 8-DPSK





								um Analyzer - Sv	
Frequency	09:44:01 AM Mar 28, 2022	ALIGN AUTO	A	SENSE:INT	SEM			RF 50 9	RL
	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P P		Avg Typ Avg Hold Ext Gain		Trig: Free #Atten: 18	GHz PNO: Wide 🖵 IFGain:Low		req 2.4000	enter F
Auto Tu	l 2.402 17 GHz 5.367 dBm	Mkr1					dBm	Ref 8.00 d	dB/div
Center Fr		- <mark>1</mark>	(9
2.400000000 G									00
Start Fr	-14.63 dBm								.0
2.395000000 G									
		ha	al al						
Stop Fr 2.405000000 G			1	لر					.0
2.403000000 G	<u></u>			- John -					.0
CF St				كمر					
1.000000 M <u>Auto</u> M	Lapportune			م م م م	willow	~			
					¥4.7	Maryman	mm	wanne	0.0
Freq Offs 0									.0
	Span 10.00 MHz 000 ms (1001 pts)	Sweep 1.		Hz	300 kHz	#VBW	z	400000 GHz 100 kHz	
	[STATUS							G

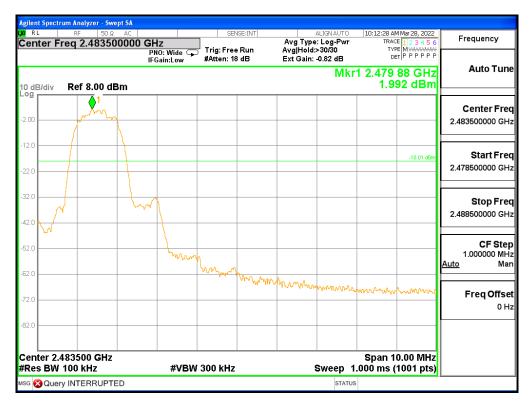
Test Mode : Non-Hopping mode, GFSK





RL RE 50Ω AC		SENSE:INT	ALIGNAUTO	10:04:42 AM Mar 28, 2022	
enter Freq 2.40000000	PNO: Wide C IFGain:Low	Trig: Free Run #Atten: 18 dB	Avg Type: Log-Pwr Avg Hold:>30/30 Ext Gain: -0.82 dB	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P	Frequency
dB/div Ref 8.00 dBm			Mk	r1 2.402 17 GHz 2.878 dBm	Auto Tur
.00					Center Fre 2.400000000 GH
2.0				-17.12 dBm	Start Fr 2.395000000 G
2.0				m	Stop Fr 2.40500000 G
.0		www.		how when we	CF Sto 1.000000 M <u>Auto</u> M
0 Win want w	unnun un				Freq Offs 0
2.0 enter 2.400000 GHz Res BW 100 kHz	#VBW	300 kHz	Sween	Span 10.00 MHz 1.000 ms (1001 pts)	
G G G G G G G G G G G G G G G G G G G		NIE	STATU		

Test Mode : Non-Hopping mode, 8-DPSK



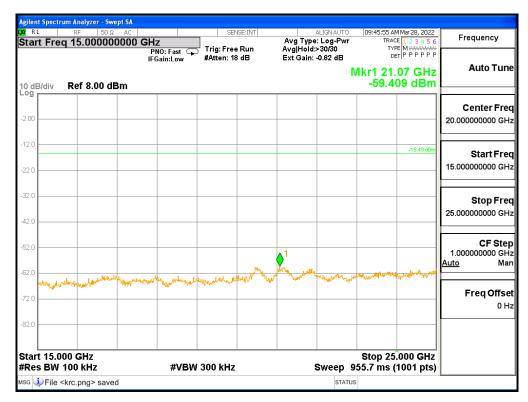


Spurious Emission

Test Mode : GFSK

[Lowest channel]

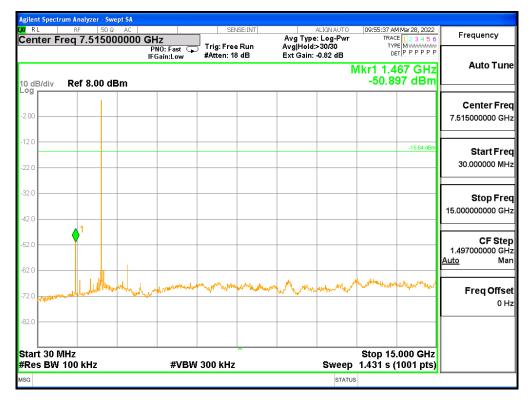
tart Freq 30.000000 MHz Trig: Free Run IFGain:Low Avg Type: Log-Pwr AvgHoid>3030 Trid: 2.3.4.5.6 Frequency PN0: Fast IFGain:Low Trig: Free Run #Atten: 18 dB Avg Type: Log-Pwr AvgHoid>3030 Trid: 2.3.4.5.6 Auto Tur 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fm 7.515000000 G 00 20 20 20 20 20 20 20 20 20 20 20 20 2	G								STATUS			
tart Freq 30.000000 MHz Trig: Free Run IFGaint.ow Avg Type: Log-Pwr Avg[Hold>30/30 Trace 12.3.150 Wret Ministrop Frequency 0 Mkr1 1.437 GHz -52.660 dBm Auto Tul Center Fn 7.51500000 G Auto Tul Center Fn 30.00000 M 0			z		#VE	300 kHz			Sweep			
tart Freq 30.000000 MHz Trig: Free Run Avg Type: Log-Pwr AvglHold>30/30 Avg Type												
tart Freq 30.000000 MHz Trig: Free Run IFGain:Low Avg Type: Log-Pwr AvgHoid>3030 Trid: 2.3.4.5.6 Frequency PN0: Fast IFGain:Low Trig: Free Run #Atten: 18 dB Avg Type: Log-Pwr AvgHoid>3030 Trid: 2.3.4.5.6 Auto Tur 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fm 7.515000000 G 00 20 20 20 20 20 20 20 20 20 20 20 20 2	20											
Avg Type: Log-Pwr AvgHold>30/30 Trace Trace Trig: Free Run AvgHold>30/30 Trace Tr	2.0	myloung	he way of the second	when when	when when	hand	mouthe	- Anno	ahdda, der tha M	why war have	And Andrew Street Street	Freq Offs
Avg Type: Log-Pwr AvgHold>30/30 Trace I 2 3 4 5 6 AvgHold>30/30 Frequency PN0: Fast IFGain:Low Trig: Free Run #Atten: 18 dB Avg Type: Log-Pwr AvgHold>30/30 Trive Mutanting Type PP PP P Auto Tur 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fn 7.51500000 G -51549 dBm 20 -1549 dBm -1549 dBm -1549 dBm Start Fn 30.000000 M Start Fn 30.000000 G 20 -1 -1549 dBm -552 FF -559 FF -559 FF 20 -1 -1549 dBm -1549 dBm -550 FF -550 FF 20 -1 -1549 dBm -550 FF -550 FF -550 FF -550 FF 20 -1 -1 -1549 dBm -550 FF	2.0			_								<u>Auto</u> M
Avg Type: Log-Pwr AvgHold>30/30 Trace 12 3 4 5 6 AvgHold>30/30 Frequency PN0: Fast IFGain:Low Trig: Free Run #Atten: 18 dB Avg Type: Log-Pwr AvgHold>30/30 Trive Mutanting Type Mutanting Ext Gain: 0.82 dB Trive Mutanting Type Mutanting Ext Gain: 0.82 dB Mkr1 1.437 GHz -52.660 dBm Auto Tul 0 dB/div Ref 8.00 dBm -52.660 dBm -51549 dbm Start Fri 30.000000 M 20	2.0	<u> </u>										CF Ste 1.49700000 GF
tart Freq 30.000000 MHz Trig: Free Run Avg Type: Log-Pwr AvgHold>30/30 Trid: 2.3.4.5 G Frequency PN0: Fast IFGain:Low Trig: Free Run Avg Type: Log-Pwr AvgHold>30/30 Trid: 1.4.37 GHz Auto Tur 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fm 00 -1549 dbm -1549 dbm Start Fr 30.000000 MHz 20 -1549 dbm Start Fr 30.000000 MHz Start Fr 20 -1549 dbm Start Fr 30.000000 MHz Start Fr	2.0	- 1										15.00000000 G
tart Freq 30.000000 MHz Trig: Free Run Avg Type: Log-Pwr Avg Hold>30/30 Trid: 2.3.4.5.6 Frequency PN0: Fast IFGain:Low Trig: Free Run Avg Type: Log-Pwr Avg Hold>30/30 Trive: Microsoft Avg Type: Log-Pwr Avg Hold>30/30 Trive: Microsoft Auto Tur 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fm 00 -15.49 dbm -15.49 dbm Start Fm	2.0											
tart Freq 30.000000 MHz Trig: Free Run Avg Type: Log-Pwr TRACE 12.3.4.5.6 Frequency PNO: Fast IFGain:Low Trig: Free Run Avg Type: Log-Pwr Ref E 2.3.4.5.6 Frequency 0 dB/div Ref 8.00 dBm -52.660 dBm -52.660 dBm Center Fr 7.515000000 G 00 -15.49 dBm -15.49 dBm Start Fr	2.0											30.000000 M
tart Freq 30.000000 MHz PN0: Fast IFGain:Low PN0: Fast IFGAIN:Low IFGAIN:Low PN0: Fast IFGAIN:Low PN0: Fast IFGAIN:Low PN0: Fast IFGAIN:Low IFGAIN:Low PN0: Fast IFGAIN:Low IFGAIN	2.0										-15.49 dBm	
tart Freq 30.000000 MHz PN0: Fast IFGain:Low PN0: Fast IFGAIN:Low IFGAIN:Low PN0: Fast IFGAIN:Low PN0: Fast IFGAIN:Low PN0: Fast IFGAIN:Low IFGAIN:Low PN0: Fast IFGAIN:Low IFGAIN	.00											7.515000000 G
tart Freq 30.000000 MHz PN0: Fast IFGain:Low Avg Type: Log-Pwr Avg[Hold>30/30 Trig: Free Run #Atten: 18 dB Avg[Hold>30/30 Ext Gain: -0.82 dB Mkr1 1.437 GHz -52.660 dBm												
tart Freq 30.000000 MHz PN0: Fast IFGain:Low PN0: Fast IFGain:Low Avg Type: Log-Pwr Avg[Hold>30/30 Ext Gain: 0.82 dB PN0: Fast Ext Gain: 0.82 dB PN0: Fast PP P P P P P) dB/div	Ref 8	.00 dB	m					N			Auto Tu
tart Freq 30.000000 MHz Avg Type: Log-Pwr TRACE 123456 Frequency		-			PNO: Fast IFGain:Low				-0.82 dB	D	ETPPPPP	Auto Tu
	RL tart Fro	RF eq 30.0	50 Ω 00000	AC MHz				Avg Type		TRAC	CE 1 2 3 4 5 6	Frequency

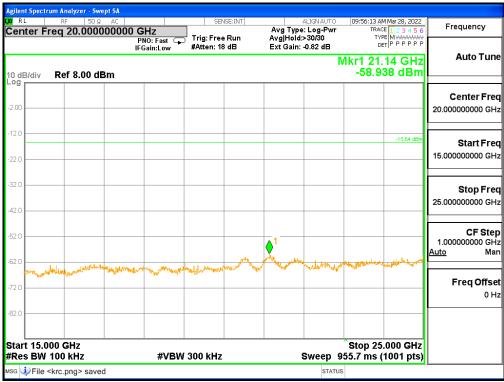




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[Middle Channel]

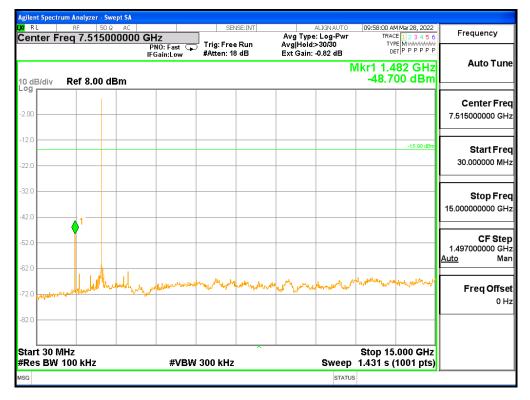


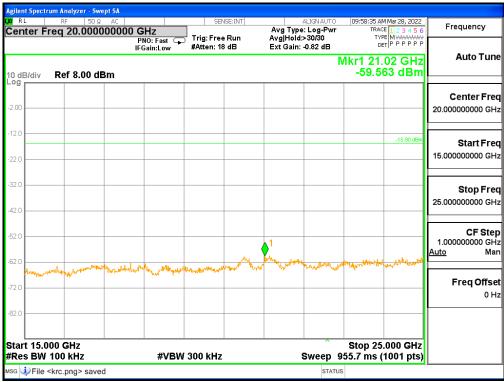




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[Highest Channel]





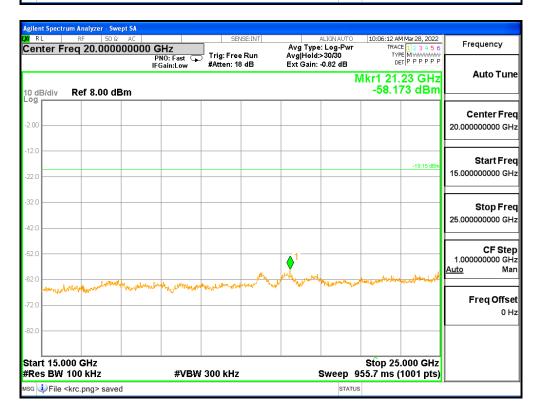


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Test Mode : 8-DPSK

RL		50 Ω AC		SEN	ISE:INT		ALIGN AUTO		4 Mar 28, 2022	Erequency
enter F	req 7.51	500000) GHz PNO: Fast 🖵 IFGain:Low	Trig: Free #Atten: 18		Avg Type Avg Hold: Ext Gain:		TYF	E 1 2 3 4 5 6 PE M WWWWWW T P P P P P P	Frequency
0 dB/div	Ref 8.0	0 dBm					Ν		37 GHz 01 dBm	Auto Tun
.00										Center Fre 7.515000000 G⊦
2.0									-19.15 dBm	Start Fre 30.000000 MH
2.0										Stop Fre 15.000000000 Gi
.0	1									CF Ste 1.497000000 GI <u>Auto</u> M
1.0 174-501-6 4	mentralit	hannling	an manager	- Waltered	h ^{arth} raithachai	M	NUMANAN	Ward at the all and the	washing .	Freq Offs 0 I
2.0								.		
tart 30 Pes Bia	MHZ I 100 kHz		#\/B\A(300 kHz			Sweep		.000 GHz 1001 pts)	

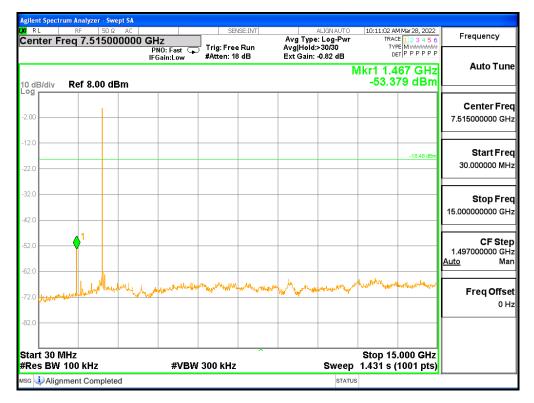
[Lowest channel]





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[Middle Channel]

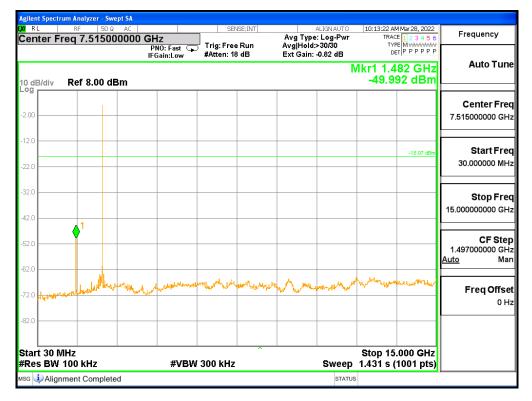






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[Highest Channel]







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4.7 Radiated Emission

Test Location

 \boxtimes 10 m SAC (test distance : \square 10 m, \boxtimes 3 m) \boxtimes 3 m SAC (test distance : 3 m)

Test Procedures

ANSI C63.10-2013 - Section 6.5, 6.6

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Instrument Settings

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10th harmonic)

a) RBW = 1 MHz for f \geq 1 GHz, 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz

- b) VBW \geq RBW
- c) Sweep time = auto couple



Limit :

Unwanted emissions that do not fall within the restricted frequency bands of Table 1 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

_			• •		
MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
¹ 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475- 156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	² Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

Table 1. Restricted Frequency Bands

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2 Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

Table 2. General Field Strength Limits for Licence-Exempt Transmitters

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

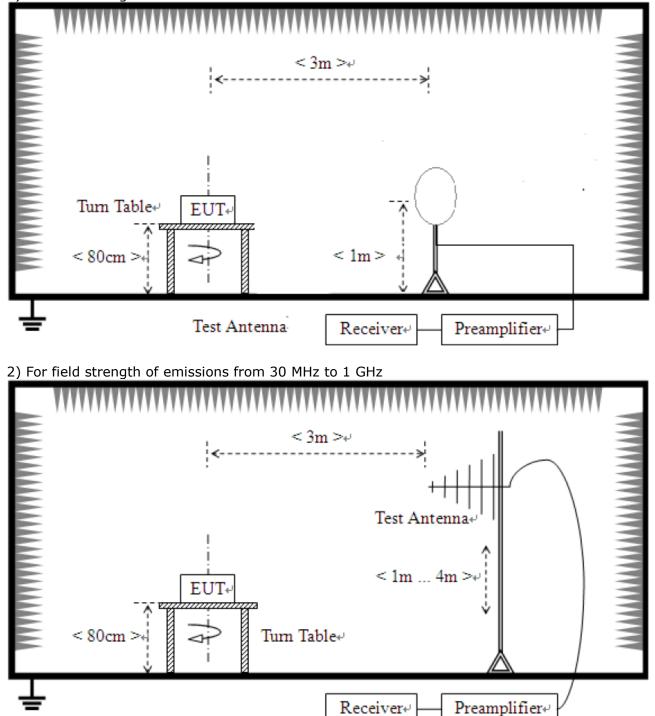
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.(Duty Cycle is > 98%,)
- 4) Duty Cycle is < 98%, VBW setting will need to > 1/T.



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Test Setup:

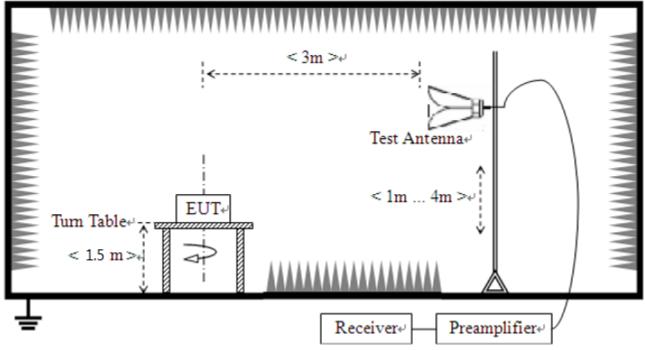






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3) For field strength of emissions above 1 GHz





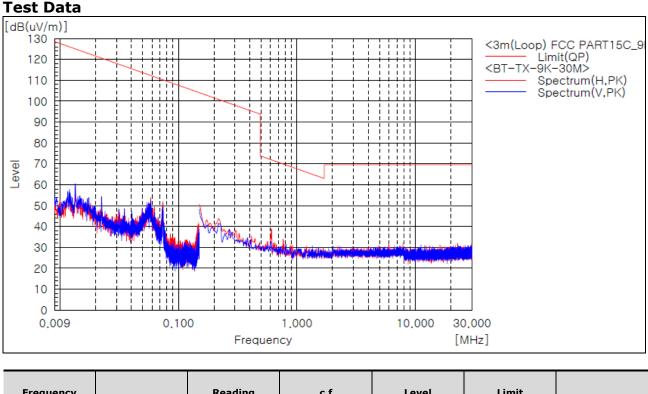
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Test results

1) 9 kHz to 30 MHz

Test mode : Transmitter (Worst Case)

The requirements are: \boxtimes Complies



Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]		
	The emissions 9 kHz to 30 MHz were 20 dB lower than the limit.							

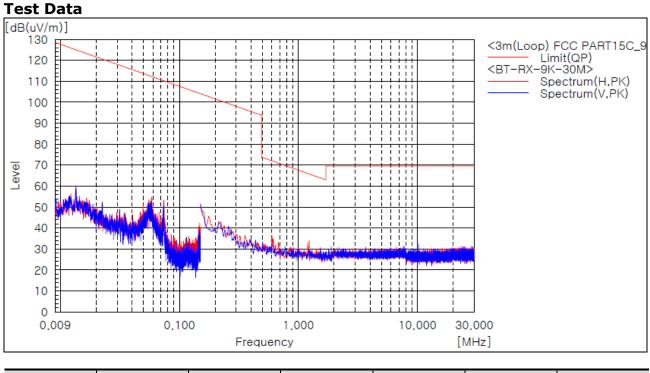
- 1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
- 4. This data is the Peak(PK) value.



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Test mode : Receiver (Worst Case)

The requirements are: \Box Complies



Frequency [MHz]	(P)	Reading [dBuV]	c.f [dB(1/m)]	Level [dB(uV/m)]	Limit [dB(uV/m)]	Margin [dB]		
The emissions 9 kHz to 30 MHz were 20 dB lower than the limit.								

- The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
- 4. This data is the Peak(PK) value.



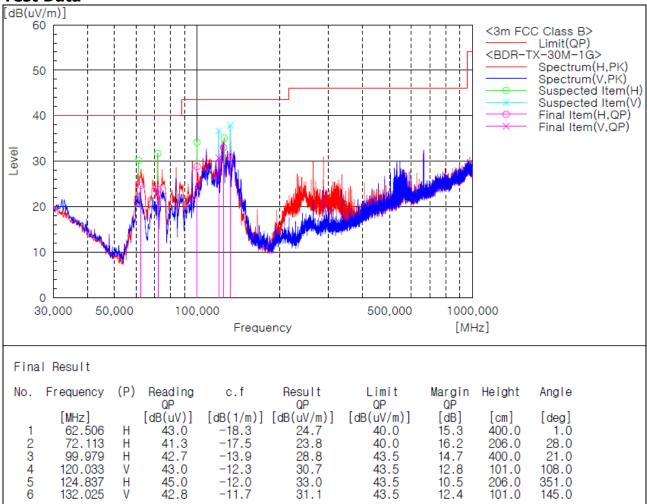
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2) 30 MHz to 1 GHz

Test mode : GFSK, Transmitter (Worst Case)

The requirements are: \square Complies

Test Data



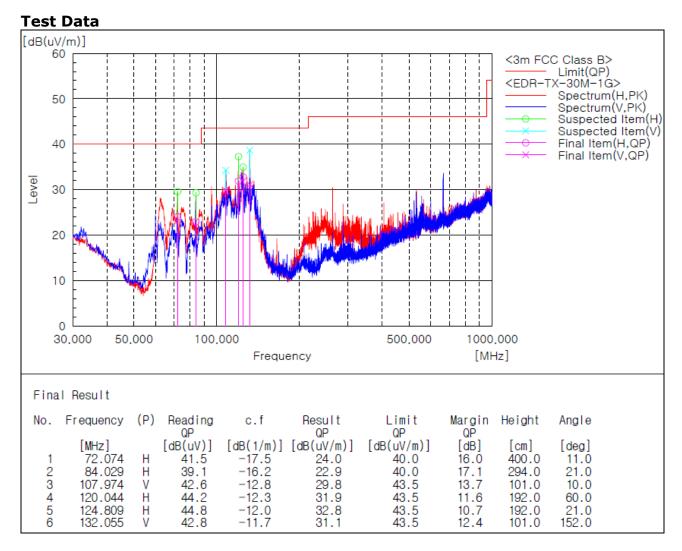
- The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain



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Test mode : 8-DPSK, Transmitter (Worst Case)

The requirements are: \square Complies



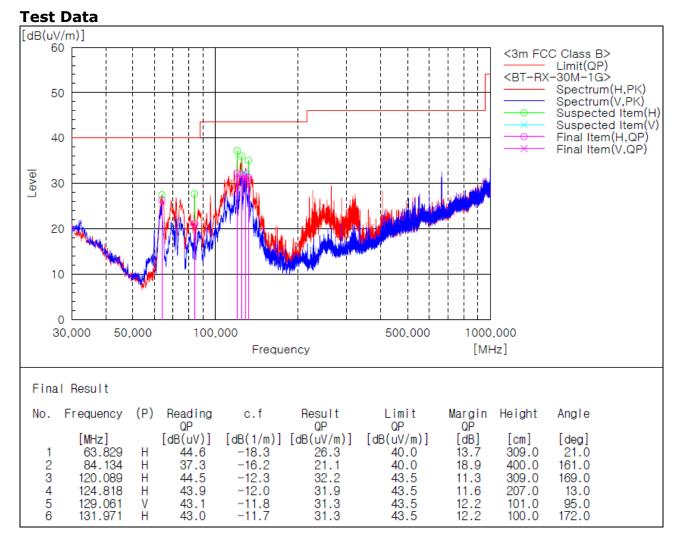
- The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain



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Test mode : Receiver (Worst Case)

The requirements are: Complies



- The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Result = Reading + c.f(Correction factor)
- 3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator Amp Gain

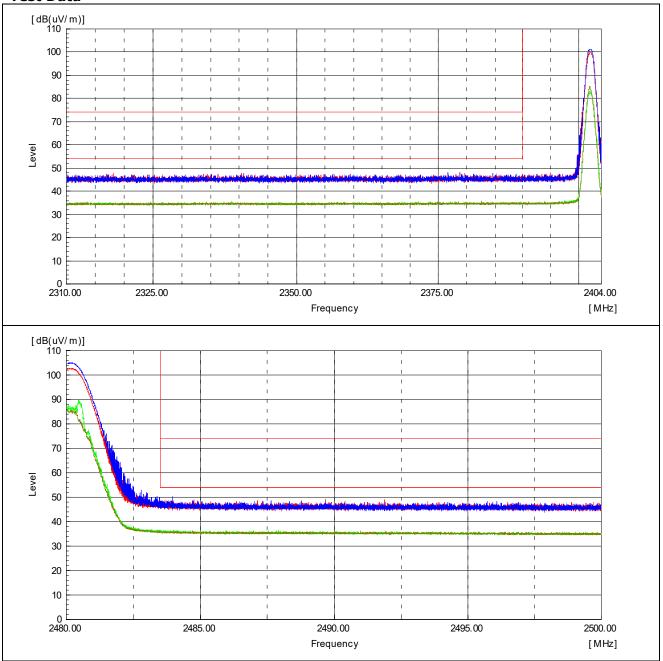


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3) above 1 GHz

The requirements are: \square Complies

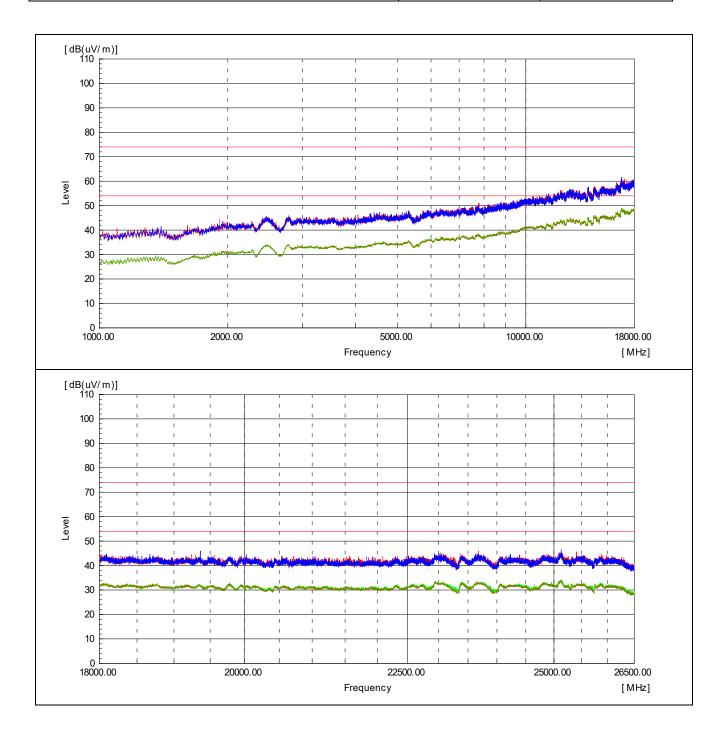




Test Data



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Test mode : GFSK, Transmitter

Lowest	Lowest channel (2 402 MHz)										
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	
	The emissions above 1 GHz were 20 dB lower than the limit.										

Lowest	Lowest channel (2 441 MHz)										
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.T	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	
	The emissions above 1 GHz were 20 dB lower than the limit										

The emissions above 1 GHz were 20 dB lower than the limit.

Lowest	Lowest channel (2 480 MHz)										
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.T	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	margin		
	The emissions above 1 GHz were 20 dB lower than the limit.										

Remarks

- 1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Correction factor = Antenna factor + Cable loss Amp Gain



Test mode : 8-DPSK, Transmitter

Lowest	Lowest channel (2 402 MHz)										
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.T	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	margin		
	The emissions above 1 GHz were 20 dB lower than the limit.										

Lowest	Lowest channel (2 441 MHz)									
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.T	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]
	The emissions above 1 GHz were 20 dB lower than the limit									

The emissions above 1 GHz were 20 dB lower than the limit.

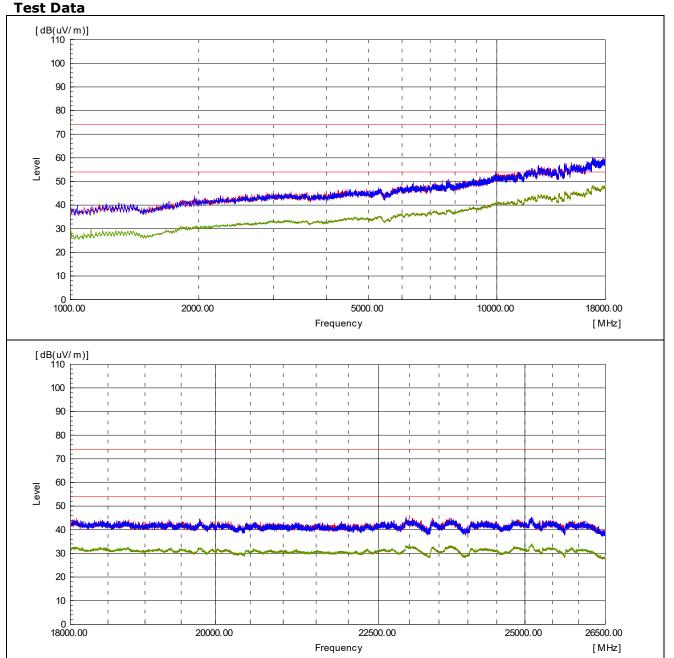
Lowest	Lowest channel (2 480 MHz)										
Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.T	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	
	The emissions above 1 GHz were 20 dB lower than the limit.										

Remarks

- 1. The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.
- 2. Correction factor = Antenna factor + Cable loss Amp Gain



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Test mode : Receiver (Worst Case)



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Test mode : Receiver

Frequency [MHz]	(P)	Reading PK [dBuV]	Reading AV [dBuV]	C.f	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit PK [dB(uV/m)]		Margin PK [dB]	
	The emissions above 1 GHz were 20 dB lower than the limit.									

Remarks

 The unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in stand-up position(Z axis) and the worst case was recorded.

2. Correction factor = Antenna factor + Cable loss - Amp Gain



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4.8 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

RSS-Gen - Section 8.8

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

Frequency	Conducted Limit (dBuV)					
(MHz)	Quasi-peak	Average**				
0.15 ~ 0.5	66 to 56*	56 to 46*				
0.5 ~ 5	56	46				
5 ~ 30	60	50				

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

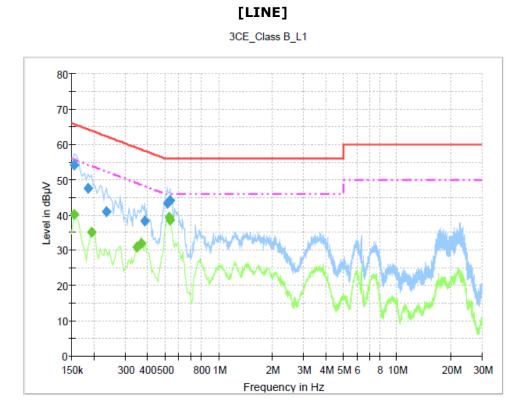
Test Results

The requirements are: \square Complies



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Test Data



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154500	54.1	1000.0	9.000	On	L1	9.9	11.7	65.8
0.186000	47.5	1000.0	9.000	On	L1	10.0	16.7	64.2
0.235500	40.8	1000.0	9.000	On	L1	9.8	21.4	62.3
0.384000	38.4	1000.0	9.000	On	L1	10.0	19.8	58.2
0.514500	43.4	1000.0	9.000	On	L1	10.0	12.6	56.0
0.537000	44.2	1000.0	9.000	On	L1	10.0	11.8	56.0

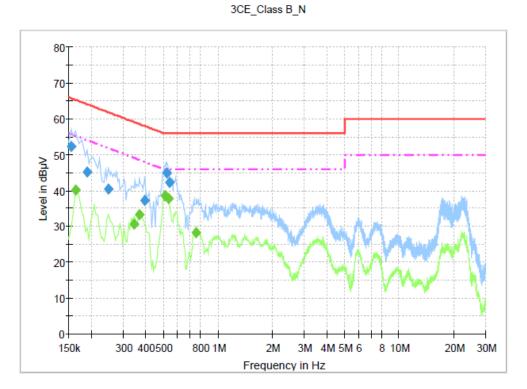
Final Result 2

ncy	CAverage	Meas.	Bandwidth	Filter	Line	Corr.	Margin	Limit	
)	(dBµV)	Time	(kHz)			(dB)	(dB)	(dBµV)	
		(ms)							
500	40.2	1000.0	9.000	On	L1	9.9	15.6	55.8	
000	35.1	1000.0	9.000	On	L1	10.0	18.7	53.8	
000	30.9	1000.0	9.000	On	L1	9.9	18.1	49.0	
500	32.0	1000.0	9.000	On	L1	10.0	16.5	48.5	
000	39.4	1000.0	9.000	On	L1	10.0	6.6	46.0	
000	38.5	1000.0	9.000	On	L1	10.0	7.5	46.0	
) 500 000 500 500) (dBµV) <u>500</u> 40.2 <u>5000</u> 35.1 <u>5000</u> 30.9 <u>500</u> 32.0 <u>5000</u> 39.4) (dBµV) Time (ms) 500 40.2 1000.0 500 35.1 1000.0 500 30.9 1000.0 500 32.0 1000.0 500 39.4 1000.0	(dBµV) Time (ms) (kHz) 500 40.2 1000.0 9.000 6000 35.1 1000.0 9.000 6000 30.9 1000.0 9.000 500 32.0 1000.0 9.000 6000 39.4 1000.0 9.000	(dBμV) Time (ms) (kHz) 500 40.2 1000.0 9.000 On 6000 35.1 1000.0 9.000 On 6000 30.9 1000.0 9.000 On 5500 32.0 1000.0 9.000 On 5000 39.4 1000.0 9.000 On	(dBμV) Time (ms) (kHz) 500 40.2 1000.0 9.000 On L1 6000 35.1 1000.0 9.000 On L1 6000 30.9 1000.0 9.000 On L1 500 32.0 1000.0 9.000 On L1 6000 39.4 1000.0 9.000 On L1	(dBμV) Time (ms) (kHz) (dB) 500 40.2 1000.0 9.000 On L1 9.9 6000 35.1 1000.0 9.000 On L1 10.0 6000 30.9 1000.0 9.000 On L1 9.9 500 32.0 1000.0 9.000 On L1 10.0 6000 39.4 1000.0 9.000 On L1 10.0	(dBµV) Time (ms) (kHz) (dB) (dB) 5500 40.2 1000.0 9.000 On L1 9.9 15.6 6000 35.1 1000.0 9.000 On L1 10.0 18.7 6000 30.9 1000.0 9.000 On L1 9.9 18.1 5500 32.0 1000.0 9.000 On L1 10.0 16.5 6000 39.4 1000.0 9.000 On L1 10.0 6.6	



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[NEUTRAL]



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154500	52.2	1000.0	9.000	On	N	9.9	13.6	65.8
0.190500	45.0	1000.0	9.000	On	N	10.0	19.0	64.0
0.249000	40.4	1000.0	9.000	On	N	9.7	21.4	61.8
0.393000	37.2	1000.0	9.000	On	N	10.0	20.8	58.0
0.523500	44.9	1000.0	9.000	On	N	10.0	11.1	56.0
0.541500	42.3	1000.0	9.000	On	N	10.0	13.7	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.163500	40.2	1000.0	9.000	On	Ν	10.0	15.1	55.3
0.343500	30.7	1000.0	9.000	On	N	9.9	18.4	49.1
0.370500	33.3	1000.0	9.000	On	Ν	10.0	15.2	48.5
0.510000	38.5	1000.0	9.000	On	N	10.0	7.5	46.0
0.537000	37.8	1000.0	9.000	On	N	10.0	8.2	46.0
0.762000	28.2	1000.0	9.000	On	Ν	9.9	17.8	46.0



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4.9 Frequency Hopping System Requirements

Standard Applicable

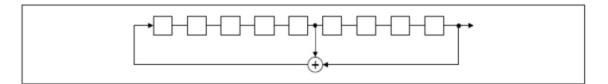
According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

EUT Pseudorandom Frequency Hopping Sequence

The pseudo random sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage, and the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones. Number of shift register stages: 9 Length of pseudo-random sequence: $2^9-1 = 511$ bits Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

0246	62 64 78 1	73 75 77

Each frequency used equally on the average by each transmitter. The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



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Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule. This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

*Example for a Bluetooth device using channel numbers would be : Ch 44, 35, 78, 03, 15, 21, 76, 40, 56, 13, 02, 19, 67, 39, 78, 20, 21, 64, 75 etc.



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APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	Signal Analyzer	Agilent	N9020A	MY46471102	2022-01-13	2023-01-13
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2022-03-25	2023-03-25
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2021-10-20	2022-10-20
4	BILOG ANTENNA	TESEQ	CBL6111D	58490	2021-03-03	2023-03-03
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2020-05-20	2022-05-20
6	ATTENUATOR	PASTERNACK	PE7047-6	NONE	2022-02-22	2023-02-22
7	6dB Attenuator	BIRD	5W 6dB	1744	2021-11-18	2022-11-18
8	AMPLIFIER	SONOMA	310	291721	2022-01-21	2023-01-21
9	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2022-01-11	2023-01-11
10	Preamplifier	Agilent	8449B	3008A01504	2021-12-17	2022-12-17
11	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2021-10-21	2022-10-21
12	Horn Antenna	SCHWARZBECK	BBHA9170	00967	2021-05-25	2022-05-25
13	Low Noise Amplifier	TESTEK	TK-PA1840H	200115-L	2021-05-21	2022-05-21
14	Band Reject Filter	Micro Tronics	BRM50702	G444	2021-10-08	2022-10-08
15	LISN	Rohde & Schwarz	ENV216	101235	2022-01-12	2023-01-12
16	EMI Test Receiver	Rohde & Schwarz	ESC13	100032	2022-01-11	2023-01-11

	Cable	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable (Conducted)	Junkosha Inc.	MWX221	1512S151	2022-03-28
2	RF Cable (Line Conducted)	Canare Corporation	L-5D2W	N/A	2021-10-20
3	RF Cable (9kHZ-30MHz Radiated)	HUBER+SUHNER	NA	NA	2021-02-20
4	RF Cable (9kHZ-1GHz Below Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2021-02-20
5	RF Cable (30MHz-1GHz Below Radiated)	HUBER+SUHNER	SUCOFLEX 104	N/A	2021-02-20
6	RF Cable (1GHz-18GHz Radiated)	HUBER+SUHNER	SUCOFLEX 102	MY2374/2	2021-02-20
7	RF Cable (1GHz-40GHz Radiated)	HUBER+SUHNER	SUCOFLEX 102	MY4728/2	2021-02-20
8	RF Cable (18GHz-40GHz Radiated)	HUBER+SUHNER	SUCOFLEX 102	803010/2	2021-10-27