

Test Report

- **Report No.:** MTi211220022-04E1
- Date of issue: May 20, 2022

Applicant: Raycon Inc.

Product: USB Dongle

- Model(s): RBH861 DONGLE, RBH861 Pro DONGLE, H61 DONGLE, H61 Pro DONGLE
- FCC ID: 2AZOV-RBH861USB

Shenzhen Microtest Co., Ltd. http://www.mtitest.com





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Test Result Certification				
Applicant:	Raycon Inc.			
Address:	1115 Broadway, Suite 12, New York, NY 10010			
Manufacturer:	Raycon Inc.			
Address:	1115 Broadway, Suite 12, New York, NY 10010			
Factory:	Raycon Inc.			
Address:	1115 Broadway, Suite 12, New York, NY 10010			
Product description				
Product name:	USB Dongle			
Trademark: Raycon				
Model name:	RBH861 DONGLE			
Serial Model:	RBH861 Pro DONGLE, H61 DONGLE, H61 Pro DONGLE			
Standards:	FCC 47 CFR Part 15 Subpart C			
Test method:	ANSI C63.10-2013			
Date of Test				
Date of test:	2022-02-17 ~ 2022-03-29			
Test result:	Pass			

Test Engineer :

Crndy Rim

(Cindy Qin)

Reviewed By: :

(con chen

(Leon Chen)

Approved By: :

Tom Kue

(Tom Xue)



1 General Description

1.1 Description of the EUT

Product name:	USB Dongle
Model name:	RBH861 DONGLE
Series Model:	RBH861 Pro DONGLE, H61 DONGLE, H61 Pro DONGLE
Model difference:	All the models are the same circuit and RF module, except the model name.
Electrical rating:	Input: DC 5V
Hardware version:	v2
Software version:	1.0
Accessories:	N/A
EUT serial number:	MTi211220022-04-S0001
RF specification:	
Bluetooth version:	V5.2
Operation frequency:	2402 MHz ~ 2480 MHz
Modulation type:	GFSK, π/4-DQPSK,8DPSK
Antenna designation: Ceramic antenna, antenna Gain: 3.59 dBi	
Max. peak conducted output power:	-0.67 dBm

1.2 Description of test modes

1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474



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Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	-	-

1.2.2 Test channels

Channel	Frequency	
Lowest (CH0)	2402MHz	
Middle (CH39)	2441MHz	
Highest (CH78)	2480MHz	

Note: The test software has been used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting mode.

1.2.3 Description of support units

Support equipment list					
Description	Model	Serial No.	Manufacturer		
Laptop	E485	/	Lenovo		

1.3 Measurement uncertainty

Parameter	Measurement uncertainty	
AC power line conducted emission (9 kHz~30 MHz)	±2.5 dB	
Occupied Bandwidth	±3 %	
Conducted RF output power	±0.16 dB	
Conducted spurious emissions	±0.21 dB	
Radiated emission (9 kHz ~ 30 MHz)	±4.0 dB	
Radiated emission (30 MHz~1 GHz)	±4.2 dB	
Radiated emission (above 1 GHz)	±4.3 dB	

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



2 Summary of Test Result

No.	FCC reference	Description of test	Result
1	§ 15.203	Antenna requirement	Pass
2	§ 15.207	AC power line conducted emissions	N/A
3	15.247(a)(1)	20dB occupied bandwidth	Pass
4	15.247(b)(1)	Conducted peak output power	Pass
5	15.247(a)(1)	Carrier Frequencies Separation	Pass
6	15.247(a)(1)	Average time of occupancy (Dwell time)	Pass
7	15.247(a)(1)	Number of hopping channels	Pass
8	15.247(d)	Conducted emission at the band edge	Pass
9	15.247(d)	Conducted spurious emissions	Pass
10	15.247(d)	Radiated spurious emissions	Pass

Note: N/A means not applicable.



3 Test Facilities and Accreditations

3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868
FCC Registration No.:	448573



4 Equipment List

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTi-E002	EMI Test Receiver	R&S	ESCI3	101368	2021/06/02	2022/06/01
MTi-E023	Artificial power network	Schwarzbeck	NSLK8127	NSLK8127# 841	2021/06/02	2022/06/01
MTi-E025	Artificial power network	Schwarzbeck	NSLK8127	8127183	2021/06/02	2022/06/01
MTI-E043	EMI test receiver	R&S	ESCI7	101166	2021/06/02	2022/06/01
MTI-E046	Active Loop Antenna	Schwarzbeck	FMZB 1519 B	00044	2021/05/30	2023/05/29
MTI-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTI-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTI-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2021/06/02	2022/06/01
MTI-E048	Pre-amplifier	Agilent	8449B	3008A01120	2021/06/02	2022/06/01
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2021/04/16	2022/04/15
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2021/05/06	2022/05/05
MTi-E135	Horn antenna	Schwarzbeck	BBHA 9170	00987	2021/05/30	2023/05/29
MTi-E136	Pre-amplifier	Space-Dtronics	EWLAN1840G -G45	210405001	2021/06/02	2022/06/01
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2021/06/23	2022/06/22
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2021/06/02	2022/06/01
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2021/06/02	2022/06/01
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2021/06/02	2022/06/01
MTI-E010S	EMI Measurement Software	Farad	EZ-EMC Ver. EMEC-3A1	/	/	/
MTI-E014S		Tonscend	TS®JS1120 V2.6.88.0330	/	/	/

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5 Test Result

5.1 Antenna requirement

15.203 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 of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Description of the antenna of EUT

The antenna of EUT is Ceramic antenna (Antenna Gain: 3.59 dBi). which is no consideration of replacement.



5.2 AC power line conducted emissions

5.2.1 Limits

Frequency (MHz)	Detector type / Bandwidth	Limit-Quasi-peak dBµV	Limit-Average dBµV
0.15 -0.5	Average / 9 kHz	66 to 56	56 to 46
0.5 -5		56	46
5 -30		60	50

Note 1: the limit decreases with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz.

5.2.2 Test Procedures

a) The test setup is refer to the standard ANSI C63.10-2013.

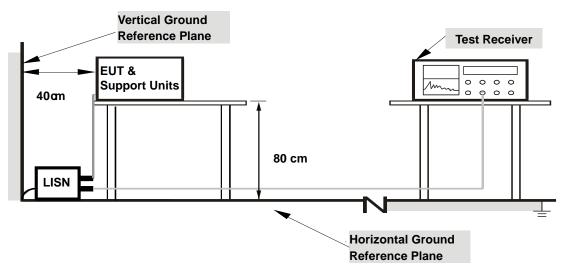
b) The EUT is connected to the main power through a line impedance stabilization network (LISN). All support equipment is powered from additional LISN(s).

c) Emissions were measured on each current carrying line of the EUT using an EMI test receiver connected to the LISN powering the EUT.

d) The test receiver scanned from 150 kHz to 30 MHz for emissions in each of the test modes described in Item 1.2.

e) The test data of the worst-case condition(s) was recorded.

5.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the test setup.

5.2.4 Test Result

Notes:

Not applicate. The device is power by DC power source and does not apply to conducted emissions.



5.3 20dB occupied bandwidth

5.3.1 Limits

None, for reporting purposes only.

5.3.2 Test setup



5.3.3 Test procedures

- a) Test method: ANSI C63.10-2013 Section 6.9.2.
- b) The transmitter output of EUT is connected to the spectrum analyzer.
- c) Spectrum analyzer setting: RBW=30 kHz, VBW=100 kHz, detector= Peak

5.3.4 Test results

Mode	Test channel	Frequency (MHz)	20dB Bandwidth (MHz)
	CH0	2402	1.010
GFSK	CH39	2441	1.000
	CH78	2480	1.068
	CH0	2402	1.270
π/4-DQPSK	CH39	2441	1.286
	CH78	2480	1.275
	CH0	2402	1.259
8DPSK	CH39	2441	1.257
	CH78	2480	1.256



GFSK mode - 20dB occupied bandwidth



CH39





π /4-DQPSK mode - 20dB occupied bandwidth



CH39

	ım Analyzer - Oce										
Center Fr	RF 50 Ω eq 2.44100	AC 00000 GH	z	Center F	NSE:INT SOUR	0000 GHz	ALIGN AUTO	Radio Std	M Mar 02, 2022 : None	F	requency
			Gain:Low	, Trig: Fre #Atten: 3		Avg Hol	d: 300/300	Radio Dev	rice: BTS		
10 dB/div	Ref Offset Ref 20.0						Mkr1		12 GHz 22 dBm		
Log 10.0 0.00				<u>N.</u> (1						Center Freq 11000000 GHz
-20.0		m			\r/		ww	L			
-50.0											
Center 2.4 #Res BW				#VE	3W 100 k	Hz			an 3 MHz p 3.2 ms		CF Step 300.000 kHz
Occup	ied Band		59 MI	Ηz	Total P	ower	3.98	dBm		<u>Auto</u>	Man Freq Offset
Transm	nit Freq Err	or	9.821 I	κHz	OBW P	ower	99	.00 %			0 Hz
x dB Ba	andwidth		1.286 N	1Hz	x dB		-20.1	00 dB			



8DPSK mode - 20dB occupied bandwidth



CH39



CH78





5.4 Conducted peak output power

5.4.1 Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.4.2 Test setup

сит	Spectrum
EUT	Analyzer

5.4.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 7.8.5.

b) The EUT was set to continuously transmitting in the max power during the test.

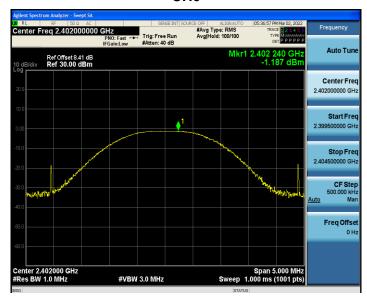
c) The transmitter output of EUT is connected to the spectrum analyzer.

d) Spectrum analyzer setting: RBW > 20dB occupied bandwidth, VBW ≥ RBW, detector= Peak

5.4.4 Test results

Mode	Test channel	Frequency (MHz)	Conducted peak output power (dBm)	Limit (dBm)
	CH0	2402	-1.19	≤ 20.97
GFSK	CH39	2441	-1.49	≤ 20.97
	CH78	2480	-0.72	≤ 20.97
	CH0	2402	-1.17	≤ 20.97
π/4-DQPSK	CH39	2441	-1.47	≤ 20.97
	CH78	2480	-0.74	≤ 20.97
	CH0	2402	-1.07	≤ 20.97
8DPSK	CH39	2441	-1.3	≤ 20.97
	CH78	2480	-0.67	≤ 20.97

GFSK mode - peak conducted output power



CH39



CH78





CH0

$\pi/4\text{-}DQPSK$ mode - peak conducted output power

enter Freq 2.402000000 GHz Frequency #Avg Type: RMS AvgiHold: 100/100 Trig: Free Run #Atten: 40 dB PPPPP Auto Tun Ref Offset 8.41 dB Ref 30.00 dBm -1.480 dE Center Freq 2.40200000 GH Start Freq <mark>♦</mark>1 2.399500000 GH Stop Free 2.404500000 GH CF Stej 500.000 kH Auto Ma Freq Offse 0 H nter 2.402000 GHz es BW 3.0 MHz Span 5.000 MHz Sweep 1.000 ms (1001 pts #VBW 8.0 MHz

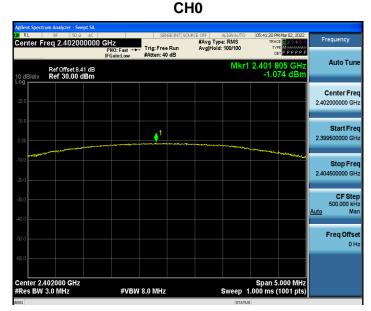
CH39

LXIRL	um Analyzer - Swept SA RF 50 ฉ AC		SENSE:INT S			IO PM Mar 02, 2022	Frequency
Center F	req 2.44100000	0 GHz PN0: Fast ↔ IFGain:Low	. Trig: Free Run #Atten: 40 dB	#Avg Type: F Avg Hold: 10		TYPE M	Frequency
10 dB/div	Ref Offset 8.24 dB Ref 30.00 dBm	IPGalli.LUW	pricent to ab		Mkr1 2.441 -1	030 GHz .470 dBm	Auto Tune
20.0							Center Freq 2.441000000 GHz
0.00			↓ 1				Start Free 2.438500000 GHz
-10.0							Stop Fred 2.443500000 GH:
-30.0							CF Step 500.000 kH Auto Mar
-50.0							Freq Offse 0 Ha
-60.0	441000 GHz					5 000 MHz	
#Res BW		#VBW	8.0 MHz	Sw	spar eep 1.000 m/	n 5.000 MHz s (1001 pts)	





8DPSK mode – peak conducted output power



CH39

Agilent Spect	rum Analyzer - Swept S RF ס ג א		SE	VSE:INT SOURC		ALIGNAUTO	05:41:55 PM	1 Mar 02, 2022	-
Center F	req 2.4410000	PNO: Fast +	Trig: Free		#Avg Type Avg Hold:		TYP	E 123456 E M + + + + + + + + + + + + + + + + + +	Frequency
10 dB/div	Ref Offset 8.24 d Ref 30.00 dBr		#Atten: 4	∂dB		Mkr1	2.440 8	85 GHz 03 dBm	Auto Tune
20.0									Center Fred 2.441000000 GHz
0.00			↓ ¹						Start Free 2.438500000 GHz
-10.0						******			Stop Free 2.443500000 GHz
-20.0									CF Step 500.000 kH
-40.0									<u>Auto</u> Mar Freq Offse
-60.0									0 H
Center 2. #Res BW	441000 GHz 3.0 MHz	#VB	W 8.0 MHz			Sweep 1	Span 5 .000 ms (.000 MHz 1001 pts)	
MSG						STATUS			





5.5 Carrier frequency separation

5.5.1 Limits

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 2400-2483.5 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

5.5.2 Test setup

	Spectrum
EUT	Analyzer

5.5.3 Test procedure

- a) Test method: ANSI C63.10-2013 Section 7.8.2.
- b) The EUT was set to hopping mode during the test.
- c) The transmitter output of EUT is connected to the spectrum analyzer.
- d) Spectrum Setting: RBW = 30 kHz, VBW = 100 kHz, detector= Peak.

5.5.4 Test results

Mode	Test channel	Test Result (MHz)	Limit (MHz)	Result
GFSK	Hop-mode	0.994	>=0.712	Pass
π/4-DQPSK	Hop-mode	0.998	>=0.857	Pass
8DPSK	Hop-mode	0.996	>=0.839	Pass

Carrier frequency separation



π/4-DQPSK



8DPSK





5.6 Average time of occupancy

5.6.1 Limits

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.

5.6.2 Test setup



5.6.3 Test procedure

- a) Test method: ANSI C63.10-2013 Section 7.8.4
- b) The EUT was set to hopping mode during the test.
- c) The tranistter output of EUT is connneted to the specturm analyzer.

d) Spectrum analyzer setting: RBW = 1MHz, VBW = 3MHz, Span = 0Hz, Detector = Peak, weep time: As necessary to capture the entire dwell time per hopping channel.

e) 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:

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

Mode	Data Packet	Frequency (MHz)	Pulse width (ms)	Number of pulses in 3.16 s	Average time of occupancy (s)	Limit (s)	Result
	DH1	2441	0.37	32	0.119	<=0.4	Pass
GFSK	DH3	2441	1.62	16	0.259	<=0.4	Pass
	DH5	2441	2.87	11	0.316	<=0.4	Pass
	2DH1	2441	0.38	32	0.122	<=0.4	Pass
π/4-DQPS K	2DH3	2441	1.63	16	0.261	<=0.4	Pass
	2DH5	2441	2.88	11	0.317	<=0.4	Pass
	3DH1	2441	0.39	32	0.125	<=0.4	Pass
8DPSK	3DH3	2441	1.63	16	0.261	<=0.4	Pass
	3DH5	2441	2.88	11	0.317	<=0.4	Pass

5.6.4 Test results

Notes:

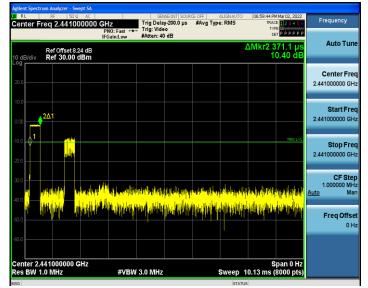
1. Period time = 0.4 (s) * 79 = 31.6(s)

2. Average time of occupancy = Pulse width * Number of pulses in 3.16s * 10

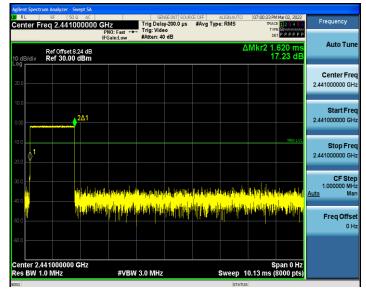


GFSK mode - Average time of occupancy

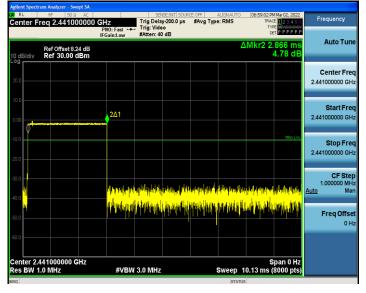
Pulse width – DH1



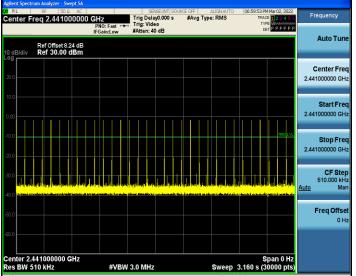
Pulse width – DH3



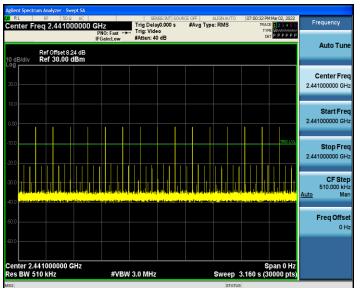
Pulse width – DH5



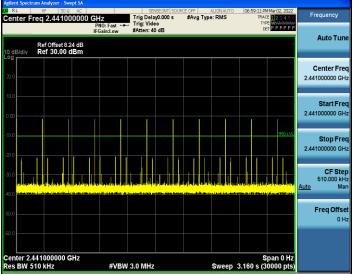
Number of pulses in 3.16 s – DH1



Number of pulses in 3.16 s – DH3



Number of pulses in 3.16 s – DH5

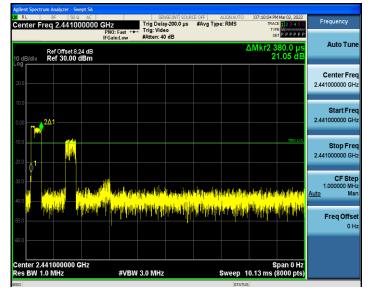


Address: 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, ChinaTel: (86-755)88850135Fax: (86-755) 88850136Web: www.mtitest.comE-mail: mti@51mti.com

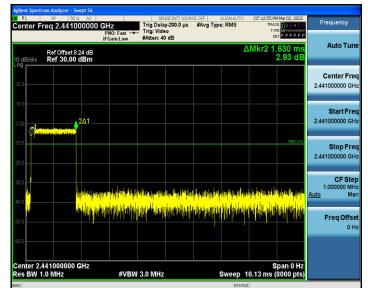


$\pi/4\text{-}D\text{QPSK}$ - Average time of occupancy

Pulse width – 2DH1



Pulse width – 2DH3



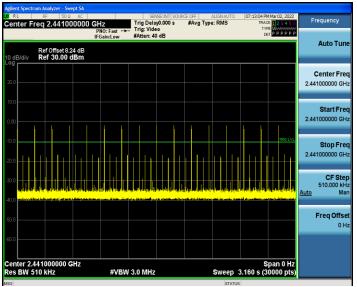
Pulse width - 2DH5



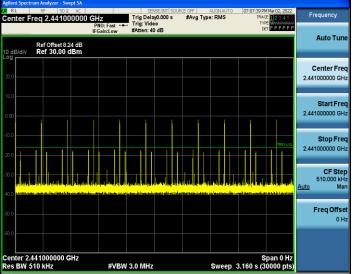
Number of pulses in 3.16 s - 2DH1



Number of pulses in 3.16 s – 2DH3



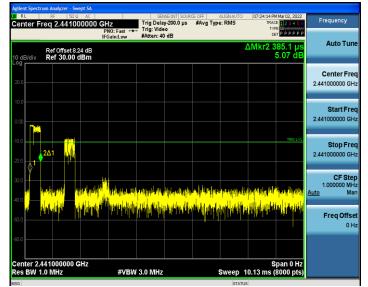
Number of pulses in 3.16 s - 2DH5



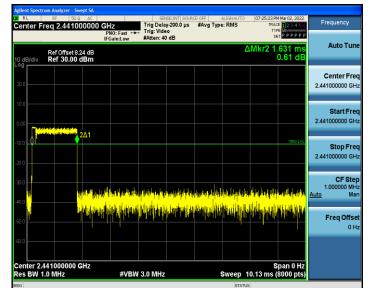


8DPSK - Average time of occupancy

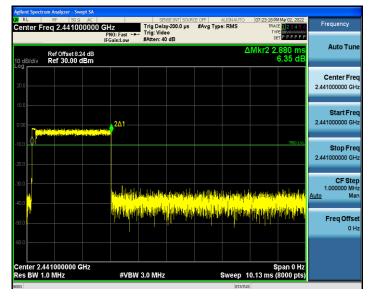
Pulse width – 3DH1



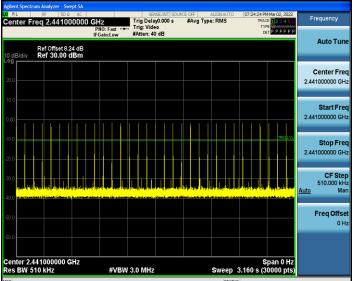
Pulse width – 3DH3



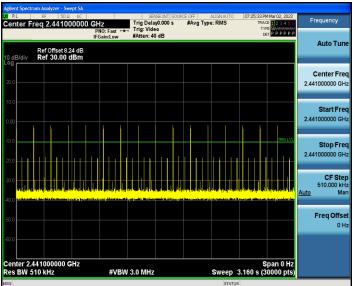
Pulse width - 3DH5



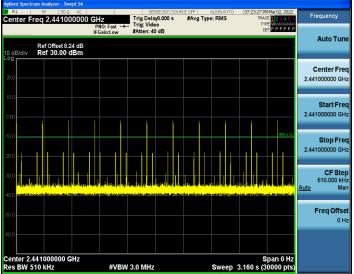
Number of pulses in 3.16 s - 3DH1



Number of pulses in 3.16 s – 3DH3



Number of pulses in 3.16 s – 3DH5





5.7 Number of hopping channels

5.7.1 Limit

Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels.

5.7.2 Test setup

БЛТ	Spectrum
EUT	Analyzer

5.7.3 Test procedure

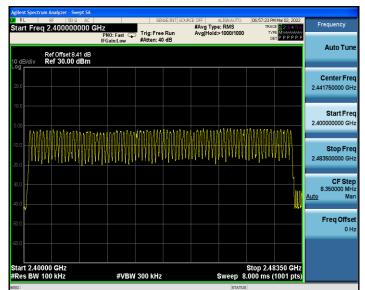
- a) Test method: ANSI C63.10-2013 Section 7.8.3
- b) The EUT was set to hopping mode during the test.
- c) The tranistter output of EUT is connneted to the specturm analyzer.
- d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

5.7.4 Test results

Mode	Quantity of Hopping Channel	Limit	Results
GFSK	79	≥15	Pass
π/4-DQPSK	79	≥15	Pass
8DPSK	79	≥15	Pass



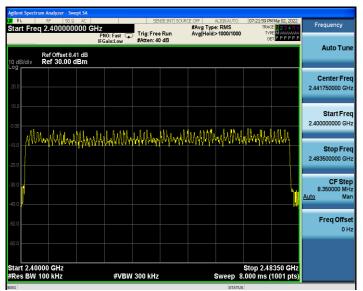
Number of hopping channels



π/4-DQPSK

Agilent Spectrum Analyzer - Swept SA RL RF 50 Q AC Center Freq 2.441750000		URCE OFF ALIGNAUTO 07:0 #Avg Type: RMS Avg Hold: 1000/1000	6:38 PM Mar 02, 2022 TRACE 1 2 3 4 5 6 TYPE M MAAAAAAA	Frequency
Ref Offset 8.41 dB 10 dB/div Ref 30.00 dBm	PNO: Fast Ing: Free Kun IFGain:Low #Atten: 40 dB	Avginera: 1000/1000	DETPPPPP	Auto Tun
20.0				Center Fre 2.441750000 GH
0.00				Start Fre 2.400000000 GF
-10.0 11 11 11 11 11 11 11 11 11 11 11 11 11	Anna Amhan Arand Analan	whenthemerchentre	NUMMIN	Stop Fre 2.483500000 GF
30.0				CF Ste 8.350000 Mi
-40.0			nt.	<u>Auto</u> Ma
50.0				Freq Offs 0 F
-60.0				
Start 2.40000 GHz #Res BW 100 kHz	#VBW 300 kHz	Stop Sweep 8.000	2.48350 GHz ms (1001 pts)	

8DPSK



GFSK



5.8 Conducted emissions at the band edge

5.8.1 Limits

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 this section, 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)).

5.8.2 Test setup



5.8.3 Test procedure

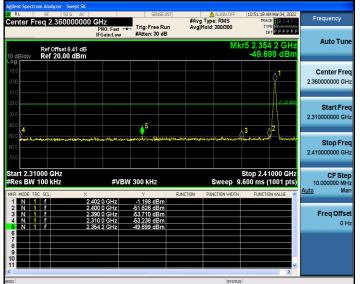
- a) Test method: ANSI C63.10-2013 Section 6.10.4
- b) The EUT was set to non-hopping mode & hopping mode during the test.
- c) The transmitter output of EUT is connected to the spectrum analyzer.
- d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

5.8.4 Test results



GFSK mode - conducted emissions at the band edge

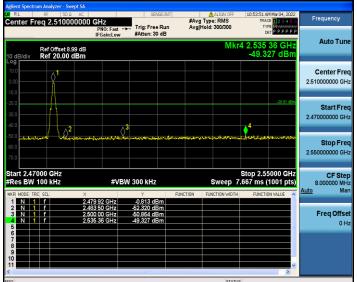
Low band-edge (no-hopping mode mode)



Low band-edge (hopping mode)

RL	RF	50 Ω	AC		SB	VSE:INT		ALIGN OFF		M Mar 04, 2022	Frequency
				PNO: Fast (IFGain:Low	➡ Trig: Free #Atten: 3			Type: RMS Hold:>300/300	Th	CE 123456 PE MUMUUUUU ET P P P P P P	
) dB/div		fset 8.9 2 0.00 c						Mkr	5 2.387 3 -49.2	60 GHz 47 dBm	Auto Tun
•9 0.0 1.00 0.0											Center Fre 2.352500000 GH
0.0 0.0 0.0									6 5,3	-21 22 dt5n	Start Fre 2.300000000 GH
0.0		e fille dy st	ad the second	hay you all you can had	an a	and and and pro-	na je ditektore dae	288 - 44 aya (1999 - 2014) 	nerendered and		Stop Fre 2.405000000 GH
tart 2.30 Res BW	100 kl			#VB	W 300 kHz			Sweep	10.07 ms (CF Ste 10.500000 MH Auto Ma
KR MODE TP	AC SOL		2.400	060 GHz 000 GHz	- <u>1.234 d</u> -50.937 d	3m 3m	INCTION	FUNCTION WIDTH	FUNCTI	ON VALUE 🔺	Freq Offs
3 N 1 4 N 1 5 N 1 6 7	f		2.310	000 GHz 000 GHz 360 GHz	-51.345 di -52.227 di -49.247 di	Bm					0F
8 9 0 1					Ш					×	
G								STATU			

High band-edge (non-hopping mode)



High band-edge (hopping mode)

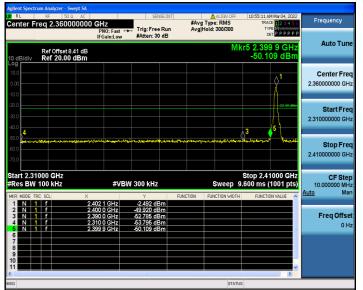
Agilent Spectrum Analyzer - Swept SA						
Center Freq 2.51000000		SENSE:IN		ALIGN OFF	11:03:16 AM Mar 04, 202 TRACE 1 2 3 4 5	Frequency
	PNO: Fast -> IFGain:Low	Trig: Free Run #Atten: 30 dB		old: 300/300	DET P P P P	P Auto Tuno
Ref Offset 8.93 dB 10 dB/div Ref 20.00 dBm Log				Mkr	4 2.529 84 GH: -49.286 dBn	2
10.0						Center Fred
						2.510000000 GHz
					-21.05 dB	Start Fred
-30.0						2.47000000 GHz
-40.0				4-		
-50.0	الإلاروم المدور والمالي والمحالي والمحالي والمحالي والمحالية المحالية المحالية والمحالية	a fan ywer fer were staar waarde staar de staar	yar farsis trade and a	ประการสมมาร์	an a	Stop Fred
-80.0						2.55000000 GHz
Start 2.47000 GHz #Res BW 100 kHz	#VBW	300 kHz			Stop 2.55000 GH: .667 ms (1001 pts	
MKR MODE TRC SCL X	.472 08 GHz	۲ -1.051 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Adto Mai
2 N 1 f 2	.483 50 GHz .500 00 GHz	-52.203 dBm -52.396 dBm				Freq Offse
	.529 84 GHz	-49.286 dBm				0 Hz
6 7						
8						
10						
<		Ш			>	
MSG				STATUS		



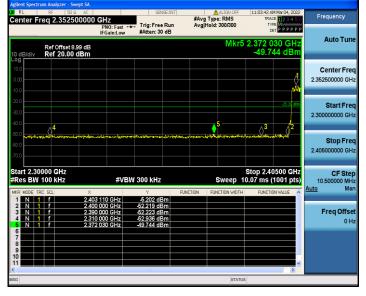
π /4-DQPSK mode - conducted emissions at the band edge

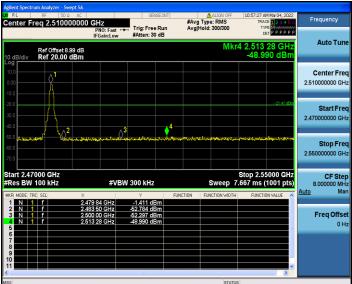
Low band-edge (non-hopping mode)

High band-edge (non-hopping mode)



Low band-edge (hopping mode)





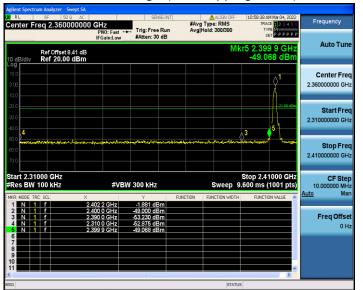
High band-edge (hopping mode)

Agilent Spectrum Analyzer - Swept SA				
RL RF 50Ω AC Center Freq 2.510000000	GH7	T ALIGN OFF #Avg Type: RMS	11:04:50 AM Mar 04, 2022 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Hold: 300/300	TYPE MUMERAN DET P P P P P P	Auto Tune
Ref Offset 8.93 dB 10 dB/div Ref 20.00 dBm			-48.844 dBm	
10.0 0 m 0 1				Center Free 2.510000000 GH
-10.0 Aprt/06/47-pt				2.51000000 3H
-20.0			-24.61 dBm	Start Free
-40.0	4			2.470000000 GH
-50.0	water and the second second	onto the second contraction of the second	Hang-Antonial, Marangleon Carlles	Stop Fre
-70.0				2.550000000 GH
Start 2.47000 GHz #Res BW 100 kHz	#VBW 300 kHz	Sweep 7	Stop 2.55000 GHz .667 ms (1001 pts)	CF Ste 8.000000 MH
	71 12 GHz -4.612 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Mar
3 N 1 f 2.50	33 50 GHz -52.410 dBm 00 00 GHz -50.572 dBm 00 56 GHz -48.844 dBm			Freq Offse
5 5 6 2.50	48.844 UBIII		3	ОН
7 8 9				
10			×	
ISG	Ш	STATU	s	

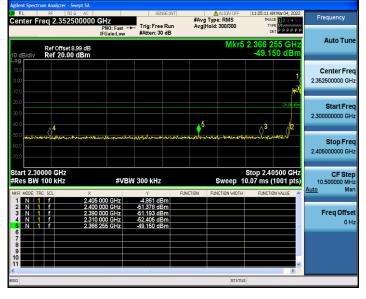


8DPSK mode - conducted emissions at the band edge

Low band-edge (non-hopping mode)



Low band-edge (hopping mode)



nomeput RF 50.0 AC enter Freq 2.510000000 GHz FRio:Factor Trig:Free Run FCated ow #Atten: 30 dB Frequency #Avg Type: RMS Avg|Hold: 300/300 Auto Tur 2.549 84 (-48.471 d Ref Offset 8.99 dB Ref 20.00 dBm Center Free 2.51000000 GH; Start Fre 2.47000000 GH Stop Fred 2.55000000 GH: Stop 2.55000 GHz 7.667 ms (1001 pts) CF Step 8.000000 MH: #VBW 300 kHz Ma uto Freq Offse 0 H

High band-edge (non-hopping mode)

High band-edge (hopping mode)

Agilent Spectrum Analyzer - Swept SA				
🗶 RL RF 50 Q AC Start Freq 2.470000000 G		ALIGN OFF #Avg Type: RMS	11:05:52 AM Mar 04, 2022 TRACE 1 2 3 4 5 6	Frequency
Ref Offset 8.93 dB 10 dB/div Ref 20.00 dBm	PNO: Fast Trig: Free Run IFGain:Low #Atten: 30 dB	AvgjHoid>300/300	12.544 48 GHz -48.925 dBm	Auto Tune
10.0 0.00 -10.0 400-74 (10)				Center Free 2.510000000 GH
-20.0			22.37 dBe	Start Free 2.470000000 GH
-50.0 \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	to a second second second second		-การสุขายของคราครัฐไห้การ _{สุบ} ไหร	Stop Fre 2.550000000 GH
Start 2.47000 GHz #Res BW 100 kHz	#VBW 300 kHz	Sweep 7.	Stop 2.55000 GHz 667 ms (1001 pts)	CF Ste j 8.000000 MH <u>Auto</u> Ma
1 N 1 f 2.41 2 N 1 f 2.42 3 N 1 f 2.54 4 N 1 f 2.54 6	75 04 GHz 2.274 dBm 33 50 GHz 51.546 dBm 000 GHz 50.786 dBm 14 48 GHz 48.925 dBm		3	Freq Offse 0 H
9 10 11 4 MSG	1	STATUS	~	



5.9 Conducted spurious emissions

5.9.1 Limits

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 this section, 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)).

5.9.2 Test setup



5.9.3 Test procedure

- a) Test method: ANSI C63.10-2013 Section 6.10.4
- b) The EUT was set to non-hopping mode & hopping mode during the test.
- c) The transmitter output of EUT is connected to the spectrum analyzer.
- d) Spectrum analyzer setting: RBW = 100 kHz, VBW = 300 kHz, Detector = Peak.

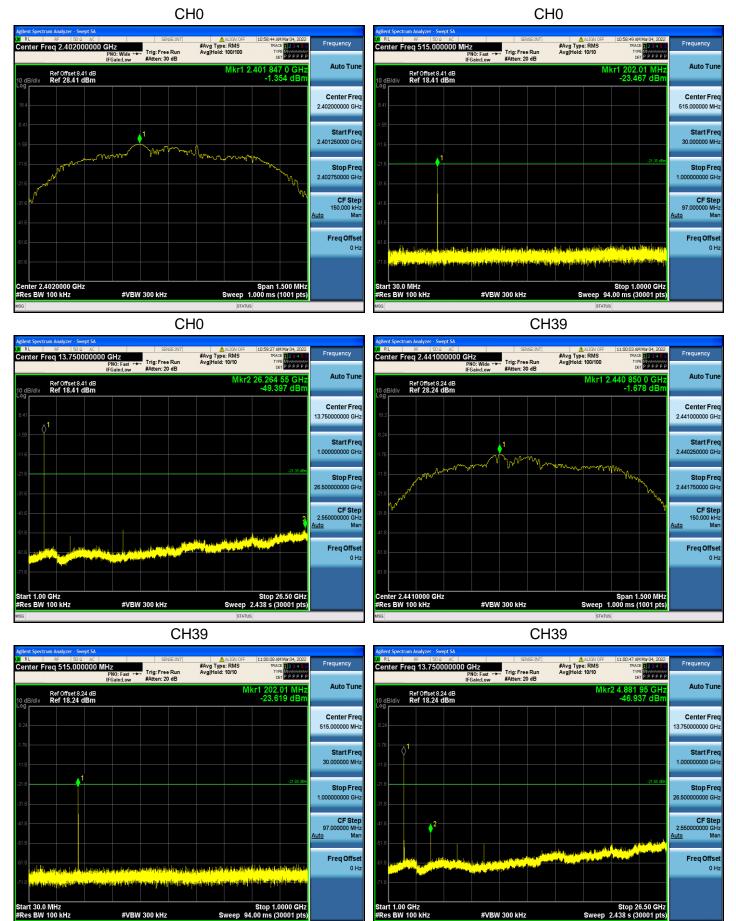
5.9.4 Test results

Notes:

All modes of operation of the EUT were investigated, and only the worst-case results are reported. The worst-case mode: TX mode (8DPSK).



Conducted spurious emissions -8DPSK mode



Address: 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, ChinaTel: (86-755)88850135Fax: (86-755) 88850136Web: www.mtitest.comE-mail: mti@51mti.com



Conducted spurious emissions -8DPSK mode



ALIGN O #Avg Type: RMS Avg|Hold: 10/10 Frequency nter Freq 515.000000 MHz Trig: Free Run #Atten: 20 dB 12345 Mixia PPPPP Auto Tun Ref Offset 8.99 dB Ref 18.99 dBm 1 202.01 MF -22.884 dB Center Freq 515.000000 MH; Start Free 30.000000 MH Stop Freq 1.00000000 GH CF Step 97.000000 MHz Ма Freq Offse 0 H; Stop 1.0000 GHz Sweep 94.00 ms (30001 pte tart 30.0 MHz Res BW 100 kHz #VBW 300 kHz

CH78

LXI RL	RF 50 Ω			SB	ISE:INT		ALIGN OFF		1 Mar 04, 2022	Frequency
Center Fr	eq 13.7500		PNO: Fast +>-	Trig: Free		#Avg Typ Avg Hold:		TYP	E 1 2 3 4 5 6 E M H H H H H H H H T P P P P P P P	requeriey
		1	FGain:Low	#Atten: 20) dB					Auto Tune
10 dB/div	Ref Offset 8.9 Ref 18.99 (MK	2 4.960 -48.7	15 GHz 16 dBm	Hato Falle
	1101000									
8.99										Center Freq
										13.750000000 GHz
-1.01	1									
										Start Freq
-11.0										1.000000000 GHz
-21.0									-21.69 dBm	
2110										Stop Freq 26.50000000 GHz
-31.0										26.50000000 GHz
										CF Step
-41.0	<u>2</u>									2.55000000 GHz
-51.0									فور والمر	<u>Auto</u> Man
01.0					المربق	والمراجعة والمتحاط	الأخرقية بالربطة	and the second second		
-61.0	artha an Andrea	and the second	Sugar, March			<u>د. بر المقان</u>	and produced in	and the second		Freq Offset 0 Hz
and the second	and the second se	A CONTRACTOR	San San Barrier							0 Hz
-71.0										
Start 1.00 #Res BW			#\/R\M	300 kHz			Sween	Stop 2	6.50 GHz 0001 pts)	
MSG	100 KH2		77 V D 99	300 KH2			status	-	ooo r pisj	



5.10 Radiated spurious emission

5.10.1 Limits

§ 15.247 (d) 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 this section, 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 § 15.205(c)).

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

§ 15.209 Radiated emission limits; general requirements.

Note 1: the tighter limit applies at the band edges.

Note 2: the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector

§ 15.35 (b) requirements:

When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.



According to ANSI C63.10-2013, the tests shall be performed in the frequency range shown in the following table:

Frequency range of measurements for unlicensed wireless device

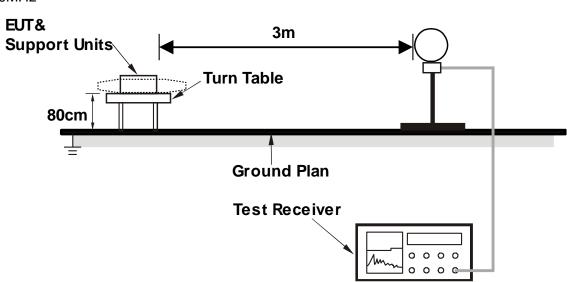
Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Frequency range of measurements for unlicensed wireless device with digital device

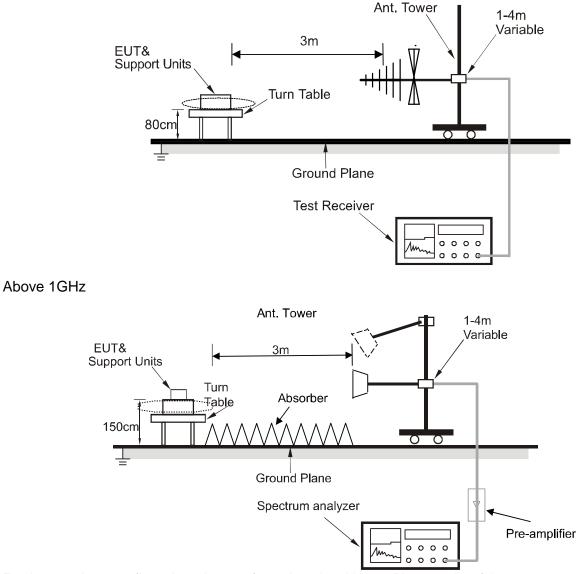
Highest frequency generated or used in the device or on which the device operates or tunes	Upper frequency range of measurement
Below 1.705 MHz	30 MHz
1.705 MHz to 108 MHz	1000 MHz
108 MHz to 500 MHz	2000 MHz
500 MHz to 1000 MHz	5000 MHz
	5th harmonic of the highest frequency or 40 GHz, whichever is lower



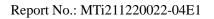
5.10.2 Test setup Below 30MHz



30MHz~1GHz



For the actual test configuration, please refer to the related item - Photographs of the test setup.





5.10.3 Test procedure

a) Test method: ANSI C63.10-2013 Section 6.3, 6.4, 6.5, 6.6, 6.10.

b) The EUT is placed on an on-conducting table 0.8 meters above the ground plane for measurement below 1GHz, 1.5 meters above the ground plane for measurement above 1GHz.

c) Emission blew 18 GHz were measured at a 3 meters test distance, above 18 GHz were measured at 1.5-meter test distance with the application of a distance correction factor

d) The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

KDB 558074 D01 15.247 Meas Guidance v05r02

The use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the unwanted emission limit is subject to an average field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

Test instrument setup

Frequency	Test receiver / Spectrum analyzer setting
9 kHz ~ 150 kHz	Quasi Peak / RBW: 200 Hz
150 kHz ~ 30 MHz	Quasi Peak / RBW: 9 kHz
30 MHz ~ 1 GHz	Quasi Peak / RBW: 120 kHz
Above 1 GHz	Peak / RBW: 1 MHz, VBW: 3MHz, Peak detector AVG / RBW: 1 MHz, VBW: 1/T, Peak detector

5.10.4 Test results

Notes:

The amplitude of spurious emissions which are attenuated more than 20 dB below the limits are not reported.

All modes of operation of the EUT were investigated, and only the worst-case results are reported.

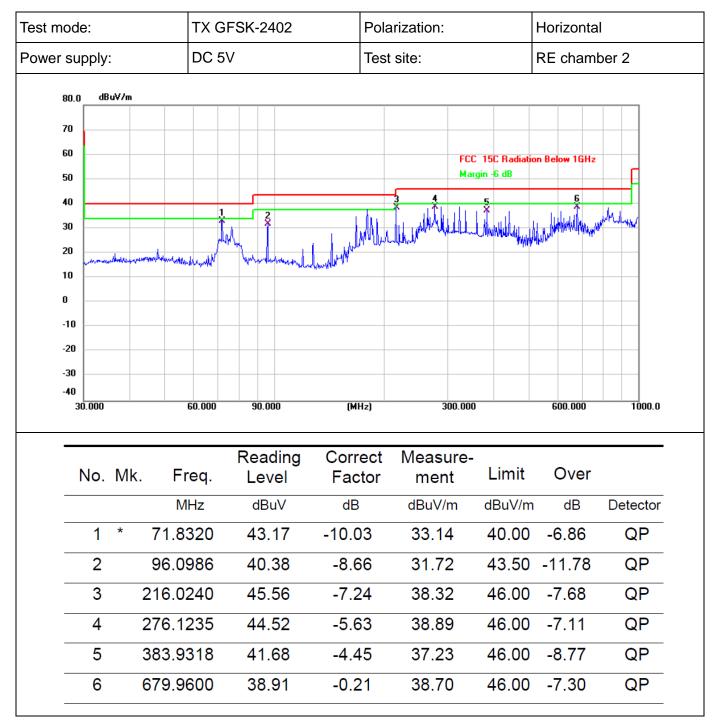
There were no emissions found below 30MHz within 20dB of the limit.

Calculation formula:

Measurement ($dB\mu V/m$) = Reading Level ($dB\mu V$) + Correct Factor (dB/m) Over (dB) = Measurement ($dB\mu V/m$) – Limit ($dB\mu V/m$)

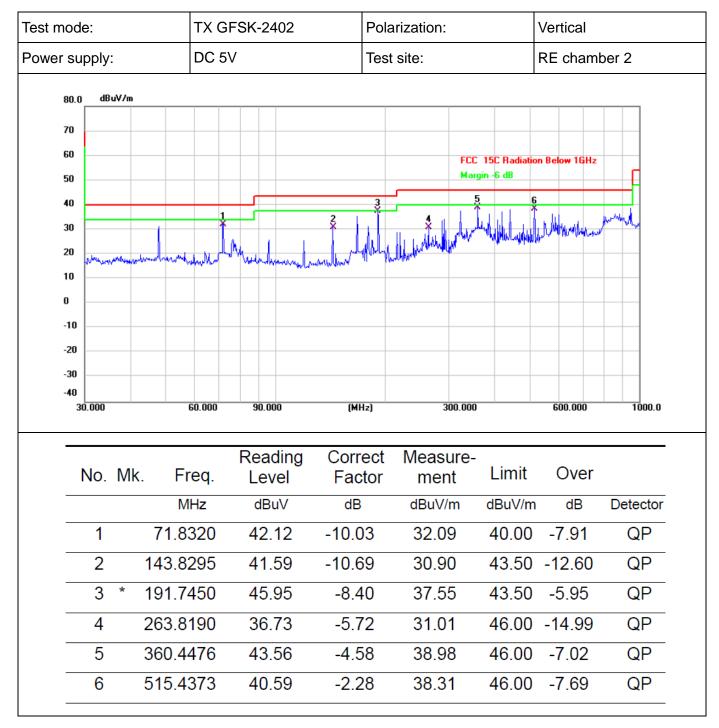


Radiated emissions between 30MHz – 1GHz





Radiated emissions between 30MHz – 1GHz





Radiated emissions 1 GHz ~ 25 GHz

Frequency	Reading Level	Correct Factor	Measuremen t	Limits	Over	Detector	Polarization						
(MHz)	(dBµV)	(dB/m)	(dBµV/m)	(dBµV/m)	(dB)	Peak/AVG	H/V						
	GFSK - 2402 MHz TX mode												
4804	45.43	1.52	46.95	74	-27.05	Peak	V						
4804	40.13	1.52	41.65	54	-12.35	AVG	V						
7206	40.8	5.46	46.26	74	-27.74	Peak	V						
7206	37.22	5.46	42.68	54	-11.32	AVG	V						
9608	42.82	6.33	49.15	74	-24.85	Peak	V						
9608	39.65	6.33	45.98	54	-8.02	AVG	V						
4804	45.6	1.52	47.12	74	-26.88	Peak	Н						
4804	42.33	1.52	43.85	54	-10.15	AVG	Н						
7206	40.98	5.46	46.44	74	-27.56	Peak	Н						
7206	37.12	5.46	42.58	54	-11.42	AVG	Н						
9608	43.21	6.33	49.54	74	-24.46	Peak	Н						
9608	39.65	6.33	45.98	54	-8.02	AVG	Н						
			GFSK - 2441 N	MHz TX mod	е								
4882	40.93	1.68	42.61	74	-31.39	Peak	V						
4882	35.19	1.68	36.87	54	-17.13	AVG	V						
7323	41.37	5.45	46.82	74	-27.18	Peak	V						
7323	34.91	5.45	40.36	54	-13.64	AVG	V						
9674	42.83	6.35	49.18	74	-24.82	Peak	V						
9674	37.33	6.35	43.68	54	-10.32	AVG	V						
4880	41.74	1.68	43.42	74	-30.58	Peak	Н						
4882	35.68	1.68	37.36	54	-16.64	AVG	н						
7323	40.98	5.45	46.43	74	-27.57	Peak	н						
7323	35.17	5.45	40.62	54	-13.38	AVG	Н						
9674	41.73	6.35	48.08	74	-25.92	Peak	Н						
9674	35.77	6.35	42.12	54	-11.88	AVG	Н						



Frequency	Reading Level	Correct Factor	Measuremen t	Limits	Over	Detector	Polarization					
(MHz)	(dBµV)	(dB/m)	(dBµV/m)	(dBµV/m)	(dB)	Peak/AVG	H/V					
	GFSK - 2480 MHz TX mode											
4960	42.67	1.83	44.5	74	-29.5	Peak	V					
4960	36.73	1.83	38.56	54	-15.44	AVG	V					
7440	41.29	5.43	46.72	74	-27.28	Peak	V					
7440	34.72	5.43	40.15	54	-13.85	AVG	V					
9920	42.67	6.41	49.08	74	-24.92	Peak	V					
9920	37.57	6.41	43.98	54	-10.02	AVG	V					
4960	44.26	1.83	46.09	74	-27.91	Peak	Н					
4960	37.97	1.83	39.8	54	-14.2	AVG	Н					
7440	40.86	5.43	46.29	74	-27.71	Peak	Н					
7440	34.77	5.43	40.2	54	-13.8	AVG	Н					
9920	42.58	6.41	48.99	74	-25.01	Peak	Н					
9920	36.24	6.41	42.65	54	-11.35	AVG	Н					



Radiated emissions at band edge

Frequency	Reading Level	Correct Factor	Measurement	Limits	Over	Detector	Polarization						
(MHz)	(dBµV)	(dB/m)	(dBµV/m)	(dBµV/m)	(dB)	Peak/AVG	H/V						
	GFSK – Low band-edge												
(MHz)	(dBµV)	(dB/m)	(dBµV/m)	(dBµV/m)	(dB)	Peak/AVG	H/V						
2310	48.23	-6.6	41.63	74	-32.37	Peak	V						
2310	38.63	-6.6	32.03	54	-21.97	AVG	V						
2390	49.21	-6.23	42.98	74	-31.02	Peak	V						
2390	39.03	-6.23	32.8	54	-21.2	AVG	V						
2310	48.55	-6.6	41.95	74	-32.05	Peak	Н						
2310	38.69	-6.6	32.09	54	-21.91	AVG	Н						
2390	47.99	-6.23	41.76	74	-32.24	Peak	Н						
2390	39.16	-6.23	32.93	54	-21.07	AVG	Н						
			GFSK – Higl	h band-edge									
2483.5	50.67	-5.79	44.88	74	-29.12	Peak	V						
2483.5	39.42	-5.79	33.63	54	-20.37	AVG	V						
2500	48.91	-5.72	43.19	74	-30.81	Peak	V						
2500	38.78	-5.72	33.06	54	-20.94	AVG	V						
2483.5	49.36	-5.79	43.57	74	-30.43	Peak	Н						
2483.5	39.88	-5.79	34.09	54	-19.91	AVG	Н						
2500	48.33	-5.72	42.61	74	-31.39	Peak	Н						
2500	38.82	-5.72	33.1	54	-20.9	AVG	Н						



Photographs of the Test Setup

See the appendix – Test Setup Photos.



Photographs of the EUT

See the appendix - EUT Photos.

----End of Report----