



RF TEST REPORT

Applicant	Quectel Wireless Solutions Co., L	.td.
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FCC ID XMR202303AF20

TA

Product Wi-Fi & Bluetooth Module

Brand Quectel

Model AF20

Report No. R2212A1318-R2V1

Issue Date June 6, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

In ling

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Version	Revision description	Issue Date
Rev.0	Initial issue of report.	June 1, 2023
Rev.1	Update information in page 6.	June 6, 2023
Note: This revised report (Report No.: R2212A1318-R2V1) supersedes and replaces		
the previously issued report (Report No.: R2212A1318-R2). Please discard or destroy		
the previously issued report and dispose of it accordingly.		



Summary	of	Measurement	Results
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Number	Test Case	Clause in FCC rules	Verdict	
1	Frequency Hopping System	15.247 (g), (h)	PASS	
2	Peak Power Output	15.247(b)(1)	PASS	
3	99% Bandwidth and 20dB Bandwidth	15.247(a)(1) C63.10 6.9	PASS	
4	Frequency Separation	15.247(a)(1)	PASS	
5	Time of Occupancy (Dwell Time)	15.247(a)(1)(iii)	PASS	
6	Band Edge Compliance	15.247(d)	PASS	
7	Number of Hopping Frequency	15.247(a)(1)(iii)	PASS	
8	Spurious RF Conducted Emissions	15.247(d)	PASS	
9	Unwanted Emissions	15.247(d),15.205,15.209	PASS	
10	Conducted Emissions	15.207	PASS	
Date of Testing: March 16, 2023 ~ May 8, 2023				

Date of Sample Received: March 15, 2023

Note: PASS: The EUT complies with the essential requirements in the standard.

FAIL: The EUT does not comply with the essential requirements in the standard.

All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co.,

Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.

1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3 Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China
City:	Shanghai
Post code:	201201
Country:	P. R. China
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Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

2 General Description of Equipment under Test

2.1 Applicant and Manufacturer Information

Applicant	Quectel Wireless Solutions Co., Ltd.	
Applicant address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233	
Manufacturer	Quectel Wireless Solutions Co., Ltd.	
Manufacturer address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233	

2.2 General information

EUT Description				
Model	AF20			
SN:	D1A20JK2000002	4		
Hardware Version	R1.0			
Software Version	NA			
Power Supply	External power sup	oply		
Antenna Type	External Antenna			
Antenna Connector	SMA Male (Center Pin) (module use unique antenna connector meet with the standard FCC Part 15.203 unique antenna connector requirement)			
Test Mode(s)	Basic Rate Enhanced Data Rate (EDR)			
	Frequency Hopping Spread Spectrum (FHSS)			
	GFSK	π/4 DQPSK	8DPSK	
Packet Type (Maximum Payload)	DH5	2DH5	3DH5	
Max. Output Power	6.95 dBm			
Operating Frequency Range(s)	2402-2480 MHz			
	Auxiliary test eq	uipment		
	Manufacturer: Que	ctel Wireless Solution	ns Co., Ltd.	
Antenna	Brand: Quectel			
	Model: YE0038AA .			
	Antenna Gain: Bluetooth: 0.73 dBi			
Note:				
1. The EUT is sent from the applicant to TA and the information of the EUT is declared by				

the applicant.

2. The antenna gain is provided by the manufacturer.

3. The antenna is for testing only and will not be sold with the equipment.



3 Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15C (2022) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

4 Information about the FHSS characteristics

4.1 Frequency Hopping System Requirement

Standard requirement:

(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 hop sets 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.

Compliance for section 15.247(g):

According to Bluetooth Core Specification, the Bluetooth system transmits the packets with the pseudorandom hopping frequency with a continuous data and short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Bluetooth Core Specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

According to Bluetooth Core Specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

4.2 Pseudorandom Frequency Hopping Sequence

Frequency Hopping Systems. A spread spectrum system in which the carrier is modulated with the coded information in a conventional manner causing a conventional spreading of the RF energy about the frequency carrier. The frequency of the carrier is not fixed but changes at fixed intervals under the direction of a coded sequence. The wide RF bandwidth needed by such a system is not required by spreading of the RF energy about the carrier but rather to accommodate the range of frequencies to which the carrier frequency can hop. The test of a frequency hopping system is that the near term distribution of hops appears random, the long term distributed in both direction and magnitude of change in the hop set.

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 pioneer 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.

The selection scheme chooses a segment of 32 hop frequencies spanning about 64 MHz and visits these hops in a pseudo-random order. Next, a different 32-hop segment is chosen, etc. In the page, master page response, slave page response, page scan, inquiry, inquiry response and inquiry scan hopping sequences, the same 32-hop segment is used all the time (the segment is selected by the address; different devices will have different paging segments).

When the basic channel hopping sequence is selected, the output constitutes a pseudo-random sequence that slides through the 79 hops. The principle is depicted in the figure below.



Hop selection scheme in CONNECTION state.

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45, etc. 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.

4.3 Equal Hopping Frequency Use

All Bluetooth units participating in the Pico net are time and hop-synchronized to the channel. Each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event.

4.4 System Receiver Input Bandwidth

Each channel bandwidth is 1MHz. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



4.5 Test Configuration

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated 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 lie-down position (X axis) and the worst case was recorded.

Test Cases	Test Modes	
Peak Power Output -Conducted	DH5/2DH5/3DH5	
Occupied Bandwidth (20dB)	DH5/2DH5/3DH5	
Frequency Separation	DH5/2DH5/3DH5	
Time of Occupancy (Dwell Time)	DH5/2DH5/3DH5	
Band Edge Compliance	DH5/2DH5/3DH5	
Number of Hopping Frequency	DH5/2DH5/3DH5	
Spurious RF Conducted Emissions	DH5/2DH5/3DH5	
Unwanted Emission	DH5/2DH5/3DH5	
Conducted Emission	DH5/2DH5/3DH5	



5 Test Case Results

5.1 Peak Power Output

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The EUT is controlled by the Bluetooth test set to ensure max power transmission with proper modulation. The peak detector is used. RBW is set to 2 MHz; VBW is set to 6 MHz. These measurements have been tested at following channels: 0, 39, and 78.

Test Setup



Limits

Rule Part 15.247 (b) (1)specifies that " 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."

|--|

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=0.44 dB.



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Test Results

Channel	CH0	СН39	CH78
Power Index	9	9	9

Channel	Frequency	Peak Output Power (dBm)			Limit	Conclusion
Channel	(MHz)	DH5	2DH5	3DH5	(dBm)	Conclusion
0	2402	6.65	5.43	5.96	21	PASS
39	2441	6.95	5.78	6.22	21	PASS
78	2480	5.95	4.94	5.31	21	PASS

Power 1-DH5 2402MHz







Power 1-DH5 2441MHz

Power 1-DH5 2480MHz







Power 2-DH5 2402MHz









Power 2-DH5 2480MHz









Power 3-DH5 2441MHz







5.2 99% Bandwidth and 20dB Bandwidth

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The occupied bandwidth is measured using spectrum analyzer. RBW is set to 30kHz and VBW is set to 100kHz on spectrum analyzer. -20dB occupied bandwidths are recorded.

Test Setup



Limits

No specific occupied bandwidth requirements in part 15.247(a) (1).

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=936 Hz.



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Test Results

Test Mode		Channel	Frequency (MHz)	99% bandwidth(MHz)	20dB Bandwidth(MHz)
		0	2402	0.921	1.006
	DH5	39	2441	0.923	0.995
		78	2480	0.921	0.953
	BT 2DH5	0	2402	1.184	1.313
BT		39	2441	1.195	1.324
		78	2480	1.187	1.280
3DI		0	2402	1.191	1.299
	3DH5	39	2441	1.188	1.293
		78	2480	1.195	1.298



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OBW 1-DH5 2402MHz



OBW 1-DH5 2441MHz





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OBW 1-DH5 2480MHz



OBW 2-DH5 2402MHz





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OBW 2-DH5 2441MHz



OBW 2-DH5 2480MHz





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OBW 3-DH5 2402MHz



OBW 3-DH5 2441MHz





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OBW 3-DH5 2480MHz





Frequency Separation 5.3

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 30 kHz and VBW is set to 100 kHz on spectrum analyzer. Set EUT on Hopping on mode.

Test setup



Limits

Rule Part 15.247(a)(1)specifies that "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, provided the systems operate with an output power no greater than 125 mW."

Note: The value of two-thirds of 20 dB bandwidth is always greater than 25 kHz.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=936 Hz.



Test Results:

Test Mode	Carrier frequency (MHz)	Carrier frequency separation(kHz)	20dB Bandwidth(kHz)	Limit (kHz)	Conclusion
	2402	1.000	1.006	0.671	PASS
DH5	2441	0.990	0.995	0.663	PASS
	2480	1.000	0.953	0.635	PASS
	2402	1.160	1.313	0.875	PASS
2DH5	2441	1.000	1.324	0.883	PASS
	2480	0.860	1.280	0.853	PASS
	2402	0.950	1.299	0.866	PASS
3DH5	2441	1.010	1.293	0.862	PASS
	2480	1.130	1.298	0.865	PASS
Note: The I	imit is two-thirds o	f 20 dB bandwidth.			



CFS 1-DH5 2402MHz

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CFS 1-DH5 2441MHz





CFS 1-DH5 2480MHz

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CFS 2-DH5 2402MHz



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CFS 2-DH5 2441MHz

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CFS 2-DH5 2480MHz

STATUS





Keysight Spectrum Analyzer - Swept SA

Center Freq 2.402500000 GHz

CFS 3-DH5 2402MHz

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Ref Offse 10 dB/div Ref 20.	et 10.93 dB 00 dBm					0.	194 dBn
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Center 2.402500 G #Res BW 30 kHz	SHZ 2 402 149 CHz	#VBW 1	00 KHz	FUNCTION WIDTH	Swee	Span ep 3.200 ms	3.000 MH (1001 pt
Center 2.402500 G #Res BW 30 kHz MKR MODE TRC SCL 1 N 1 f 2 N 1 f 3 4	X 2.402 149 GHz 2.403 100 GHz	#VBW 11 Y 0,194 dBm -2,849 dBm	FUNCTION	FUNCTION WIDTH	Swee	Span ep 3.200 ms FUNCTION VALUE	3.000 MH (1001 pts
Image: Center 2.402500 G #Res BW 30 kHz MKR MODE TRC SCL 1 1 2 N 1 3 4 5 6 7 8	X 2.402 149 GHz 2.403 100 GHz	#VBW 1 Y 0.194 dBm -2.849 dBm	00 kHz	FUNCTION WIDTH	Swee	Span ep 3.200 ms FUNCTION VALUE	3.000 MH
Center 2.402500 G #Res BW 30 kHz MR MODE TRC SCL 1 N 1 f 2 N 1 f 3 1 f 3 5 6 6 7 7 8 8 9 9 10	X 2.402 149 GHz 2.403 100 GHz	#VBW 11 Y 0.194 dBm -2.849 dBm	FUNCTION	FUNCTION WIDTH	Swee	Span ep 3.200 ms FUNCTION VALUE	3.000 M⊦ (1001 pts

CFS 3-DH5 2441MHz





CFS 3-DH5 2480MHz

weysight Spectrum Analyzer - Swept SA					
R RF 50 Ω AC CORREC Center Freq 2.479500000 GHz	SENSE:PULS	E	#Avg Type: RM	03:08: MS	41 PM Mar 12, 2023 TRACE 1 2 3 4 5 6
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Center 2.479500 GHz #Res BW 30 kHz	#VBW 100	kHz		Spa Sweep 3.200 m	n 3.000 MHz is (1001 pts)
	Y 0.517 dBm	FUNCTION F	UNCTION WIDTH	FUNCTION VALUE	<u>^</u>
2 N 1 f 2.480 151 GHz	-0.147 dBm				
4					=
6					
8					
10					•
MS3			STATUS		4





5.4 Time of Occupancy (Dwell Time)

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 1MHz and VBW is set to 1MHz on spectrum analyzer. The dwell time is calculated by:

Dwell time = Pulse Time * Number of Pulses in 31.6 seconds:

In normal mode, The selected EUT Packet type uses a slot type of DH5 packet and a hopping rate of 1600(ch*hop/s) for all channels. So the final hopping rate for all channel is 1600/5=320(ch*hop/s) In AFH mode, The selected EUT Packet type uses a slot type of DH5 packet and a hopping rate of 800(ch*hop/s) for all channels. So the final hopping rate for all channel is 800/5=160(ch*hop/s)

Test Setup



Limits

Rule Part15.247(a) specifies that "Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed."

|--|

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2.

Requirements	Uncertainty					
Dwell Time	DH5	<i>U</i> =0.70ms	2DH5	<i>U</i> =0.70ms	3DH5	<i>U</i> =0.70ms



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Test Results:

In normal mode:

Test Mode	Carrier frequency (MHz)	Number of Pulses in 31.6 seconds	Pulse Time (ms)	Dwell time (ms)	Limit (ms)	Conclusion
	2402	114	2.886	329.004	400	PASS
DH5	2441	94	2.886	271.284	400	PASS
	2480	111	2.885	320.235	400	PASS
	2402	106	2.888	306.128	400	PASS
2DH5	2441	107	2.886	308.802	400	PASS
	2480	104	2.886	300.144	400	PASS
	2402	108	2.889	312.012	400	PASS
3DH5	2441	103	2.888	297.464	400	PASS
	2480	116	2.890	335.240	400	PASS
Note: Dwell tim	າe = Pulse Tim	e * Number of Pulses i	n 31.6 seconds			



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Keysight Spectrum Analyzer - Swept SA IX R RF 50 Ω AC CORREC Center Freq 2.402000000 GHz	SENSE:PULSE Trig Delay-500.0 PNO: Fast ↔ Trig: Video IFGain:Low #Atten: 40 dB	μs #Avg Type: RMS	01:55:23 PM Mar 12, 2023 TRACE 2 3 4 5 6 Type Wwwww DET P.N.N.N.N
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Center 2.402000000 GHz			Span 0 Hz
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Dwell 1-DH5 2402MHz Accumulated





Keysight Spectrum Analyzer - Swept SA R RF 50 Ω AC CORREC	SENSE:PULSE	"A 7 DHA	02:04:03 PM Mar 12, 2023			
Center Freq 2.441000000 GHz	Fig Delay-500.0 µs PNO: Fast ↔→ Trig: Video FGain:Low #Atten: 40 dB	#Avg Type: RMS	TYPE WWWWWW DET P NNNN			
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-60.0						
-70.0						
Center 2,441000000 GH2 Span 0 Hz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 10.00 ms (10001 pts)						
MKR MODE TRC SCL X 1 Δ2 1 t (Δ) 2.886 ms 2 E 1 t 486.0 us	Y FUNCTION FU (Δ) 2.90 dB	JNCTION WIDTH FI	JNCTION VALUE			
			=			
9						
MSG	m	STATUS	4			

Dwell 1-DH5 2441MHz One Burst

Dwell 1-DH5 2441MHz Accumulated





Dwell 1-DH5 2480MHz One Burst

Keysight Spectrum Analyzer - Swept SA								
LX R RF 50 Ω AC CORREC	SENSE:PU	SENSE:PULSE			02:08:31 PM Mar 12, 2023			
Center Freq 2.480000000 GHz	PNO: Fast →→ Tri IFGain:Low #A	g Delay-500.0 μ g: Video tten: 40 dΒ	s #Avg Type	RMS	TR T	ACE 1 2 3 4 5 6 YPE WWWWWW DET P NNNNN		
Ref Offset 10.92 dB ΔMkr1 2.885 ms 10 dB/div Ref 20.00 dBm 3.54 dB								
	• 102							
						TRIG LVL		
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-70.0								
Center 2.480000000 GHz Res BW 1.0 MHz	#VBW 3.0) MHz		Sweep	10.00 ms (Span 0 Hz 10001 pts)		
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8 9 10 11								
MSG			STATUS					

Dwell 1-DH5 2480MHz Accumulated




Keysight Spectrum Analyzer - Swept SA 02:25:16 PM Mar 12, 202 Trig Delay-500.0 µs Trig: Video #Atten: 40 dB #Avg Type: RMS TRACE 1 2 3 4 5 TYPE W Center Freq 2.402000000 GHz PNO: Fast IFGain:Low -----ΔMkr1 2.888 m Ref Offset 10.93 dB Ref 20.00 dBm -0.97 dB 10 dB/div Log√ 1Δ2 X_2 en general die alleman gewen die het fiel allem gester geheren de lie die geheren die het geheren geheren die bester die bester die bester 1111 Center 2.402000000 GHz Res BW 1.0 MHz Span 0 Hz Sweep 10.00 ms (10001 pts) #VBW 3.0 MHz FUNCTION | FUNCTION WIDTH MKR MODE EUNCTION VALUE 1 t (Δ) 2.888 ms (Δ) 498.0 μs -0.97 dB -1.99 dBm Δ2 F F 7 8 10 11 STATUS

Dwell 2-DH5 2402MHz One Burst

Dwell 2-DH5 2402MHz Accumulated





Keysight Spectrum Analyzer - Swept SA	SENSE:PU Tri PNO: Fast ↔ Tri IFGain:Low #A	LSE g Delay-500.0 μs g: Video tten: 40 dB	#Avg Type	e: RMS	02:30:57 PM Mar 12, 2023 TRACE 2 2 4 5 6 TYPE WWWWWW DET P NNNNN
Ref Offset 10.83 dB 10 dB/div Ref 20.00 dBm					ΔMkr1 2.886 ms -0.30 dB
10.0 C.00					TRICI VI
-10.0 X 11 - 11 11 - 11 11 - 11 11 - 11 11 - 11 11					
-30.0			alaria pada kan salaha Tana sa tahun tahun ba		l Pertada Marpine, ett Pasarphinne - Anna al al anna anna anna anna anna ann
-50.0	and the second sec	n, minimu and a start	dalindad V x dag last mus		lander vir heren in terrenter site.
-70.0					
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 3.	0 MHz		Sweep	Span 0 Hz 10.00 ms (10001 pts)
MCR MODE TRC SCL X 1 Δ2 1 t (Δ) 2.886 ms 2 F 1 t 4.0 4.0 3 4 4.0 4.0 4.0 5 5 5 5.0 5.0	s (Δ) -0.30 dB s -9.00 dBm	FUNCTION	FUNCTION WIDTH	FL	NCTION VALUE
7 8 9 10 11					•
MS3			STATUS		, P

Dwell 2-DH5 2441MHz One Burst

Dwell 2-DH5 2441MHz Accumulated





Dwell 2-DH5 2480MHz One Burst

Keysight Spectrum Analyzer - Swept SA						
Center Freq 2.480000000 GHz	PNO: Fast IFGain:Low #A	LSE g Delay-500.0 μ g: Video tten: 40 dΒ	s #Avg Type	e: RMS	02:51:55 TR T	PM Mar 12, 2023 ACE 1 2 3 4 5 6 YPE WWWWWW DET P N N N N N
Ref Offset 10.92 dB 10 dB/div Ref 20.00 dBm					ΔMkr1 2	2.886 ms 0.35 dB
						TRIG LVL
-30.0	Train and a star and a star and a star a	an the first state of the state	1990 - Santa S	T (1) [] [] [] [] [] [] [] [] [] [] [] [] []	<mark>nandatar (</mark> angeleter)	un de sector de sector
-40.0 <mark>///////////////////////////////////</mark>	<mark>a da istricto da camanda</mark>	n na manifel na professional		<mark>Linnin minin her a</mark>	unit-rijit-dear	<mark>ikles</mark> hkikapi
-60.0						
4 Center 2.48000000 GHz Res BW 1.0 MHz	#VBW 3.0	0 MHz		Sweep	10.00 ms (Span 0 Hz 10001 pts)
	Y (A) 0.35 dB	FUNCTION	FUNCTION WIDTH	FU	UNCTION VALUE	<u>^</u>
2 F 1 t 478.0 µ	is -10.43 dBm					
4 5 6						=
/ 8 9 9						
MSG			STATUS			

Dwell 2-DH5 2480MHz Accumulated





Dwell 3-DH5 2402MHz One Burst

Keysight Spectrum Analyzer - Swept SA						
\mathbb{I} R RF 50 Ω AC CORREC	SENSE:PU	LSE	ε #Δνα Τνο	DMS	02:59:29	PM Mar 12, 2023
Center Freq 2.402000000 GHZ	PNO: Fast +++ Tri IFGain:Low #A	g: Video tten: 40 dB	s #∧vgiyp	e. Ring	T I	PE WWWWWWW DET P NNNN
Ref Offset 10.93 dB 10 dB/div Ref 20.00 dBm					ΔMkr1 2	.889 ms 2.54 dB
10.0	140					
						TRIG LVL
-20.0	Lists missi bit, to	trilitian is monthful	nation to al later contra hadronati		r og se dari kræderik kali skali ska	at a danituas
-40.0 <mark> ₁₄il ₁ </mark>	aloration of the second second	n han de la faire de la fa La faire de la f				
-60.0						
Center 2.402000000 GHz						Span 0 Hz
Res BW 1.0 MHz	#VBW 3.0) MHz		Sweep	10.00 ms (10001 pts)
MKR MODE TRC SCL X 1 Δ2 1 t (Δ) 2.889 m	γ (Δ) 2.54 dB	FUNCTION	FUNCTION WIDTH	Fl	JNCTION VALUE	^
2 F 1 t 355.0 µ	ıs -10.98 dBm					
5						=
7 8 9						
MSG			STATUS			

Dwell 3-DH5 2402MHz Accumulated





Dwell 3-DH5 2441MHz One Burst

	SENSE:PU	LSE C Delay-500.0 u	s #Ava Tvo	PMS	03:04:27 TR	PM Mar 12, 2023
Center Freq 2.44 1000000 GHZ	PNO: Fast +++ Tri IFGain:Low #A	g: Video tten: 40 dB	5 m/(81)b		Т	YPE WWWWWW DET P NNNN
Ref Offset 10.83 dB 10 dB/div Ref 20.00 dBm					ΔMkr1 2	2.888 ms 1.93 dB
	102					
						TRIG LVL
-30.0 -30.0	a l provi cap specta			allet Mitter and I	un jil pirilih), in pirita.	a <mark>n bara dan kandar tara</mark>
-40.0	and the market of the part	alan <mark>ana 2001 a</mark> ra	al and the second state of the second state of the	<mark>alerialia helerialia. 1</mark>		<u>Yekerin ati (o</u>
-70.0						
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 3.0) MHz		Sweep	10.00 ms (Span 0 Hz 10001 pts)
MKR MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH	Fl	JNCTION VALUE	^
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	is (Δ) 1.93 dB is -9.91 dBm					
6 7 8 8						
		III				
MSG			STATUS			

Dwell 3-DH5 2441MHz Accumulated





Report No.: R2212A1318-R2V1



Keysight Spectrum Analyzer - Swept SA Key R SO Ω AC CORREC Center Freq 2.480000000 GHz	SENSE:PUL Tri PNO: Fast ↔ Tri IFGain:Low #At	LSE g Delay-500.0 μ g: Video tten: 40 dB	ıs #Avg Tyj	be: RMS	03:08:52 TRJ T	PM Mar 12, 2023 ACE 1 2 3 4 5 6 YPE WWWWWWW DET PNNNNN
Ref Offset 10.92 dB 10 dB/div Ref 20.00 dBm					ΔMkr1 2	2.890 ms 1.09 dB
	1Δ2					
-10.0						TRIG LVL
-20.0	bilitaria de la terra	lande al la constante de service	ale - a secol bi a bi ta a shera a	d Bartlath Ir - and and	alth a dish tana sa	us at there at the
-40.0 Utrainer		<mark>h in aite partir</mark>		Tradition and the second second		
-60.0						
Center 2.480000000 GHz Res BW 1.0 MHz	#VBW 3.0) MHz		Sweep	10.00 ms (Span 0 Hz 10001 pts)
MKR MODE TRC SCL X 1 $\Delta 2$ 1 t (Δ) 2.890 m 2 E 1 t (Δ) 498.0 u	Υ s (Δ) 1.09 dB s -3 16 dBm	FUNCTION	FUNCTION WIDTH	FI	JNCTION VALUE	
	-5.10 dBiii					=
6 7 8						
9 10 11						
MS3		III	STATUS			4

Dwell 3-DH5 2480MHz Accumulated





Band Edge Compliance 5.5

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The lowest and highest channels were measured. The peak detector is used. RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. EUT test for Hopping On mode and Hopping Off mode.

Test Setup



Limits

Rule Part 15.247(d) specifies that "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."

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
2GHz-3GHz	1.407 dB





RF Test Report Test Results Hopping On

Kevsight Spectrum Analyzer - Swept SA							
X R RF 50 Ω AC CORREC	SEI	NSE:PULSE				01:57:21	PM Mar 12, 2023
Center Freq 2.402000000 GHz	PNO: Wide ↔ IFGain:Low	Trig: Free Rur #Atten: 40 dB	ו	#Avg Type: RM Avg Hold: 200	MS 0/2000	AT T	ACE 1 2 3 4 5 6 TYPE MWWWW DET P NNNNN
Ref Offset 10.93 dB 10 dB/div Ref 20.00 dBm					Mk	r1 2.404 6.	872 GHz 212 dBm
13.0						1	
0.00		, mm	<u>ر</u> ۲	w-~	proved by the second se		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
-10.0			hy for	had	۲ ۱	yn,	\sim
-20.0							
-30.0	- M						
-40.0 Downford and a start and and	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
-50.0							
-70.0							
Center 2 402000 CHz						Snan	9 000 MH-7
#Res BW 100 kHz	#VB	W 300 kHz			Sweep	5pan 1.000 ms	8.000 MH2 (1001 pts)
MSG				STATUS			

Band Edge(Hopping) 1-DH5 2402MHz Hopping Ref

Band Edge(Hopping) 1-DH5 2402MHz Hopping Emission





Report No.: R2212A1318-R2V1

Band Edge(Hopping) 1-DH5 2480MHz Hopping Ref



Band Edge(Hopping) 1-DH5 2480MHz Hopping Emission





Report No.: R2212A1318-R2V1

Band Edge(Hopping) 2-DH5 2402MHz Hopping Ref



Band Edge(Hopping) 2-DH5 2402MHz Hopping Emission





Report No.: R2212A1318-R2V1

Band Edge(Hopping) 2-DH5 2480MHz Hopping Ref



Band Edge(Hopping) 2-DH5 2480MHz Hopping Emission





Report No.: R2212A1318-R2V1

Band Edge(Hopping) 3-DH5 2402MHz Hopping Ref



Band Edge(Hopping) 3-DH5 2402MHz Hopping Emission





Report No.: R2212A1318-R2V1

Band Edge(Hopping) 3-DH5 2480MHz Hopping Ref



Band Edge(Hopping) 3-DH5 2480MHz Hopping Emission







RF Test Report Hopping Off





Band Edge 1-DH5 2402MHz No-Hopping Emission





Report No.: R2212A1318-R2V1



Band Edge 1-DH5 2480MHz No-Hopping Ref

Band Edge 1-DH5 2480MHz No-Hopping Emission





Report No.: R2212A1318-R2V1





Band Edge 2-DH5 2402MHz No-Hopping Emission





Report No.: R2212A1318-R2V1

Keysight Spectrum Analyzer - Swept SA 02:49:23 PM Mar 12, 2023 :PULSE #Avg Type: RMS Avg|Hold: 100/100 TRACE 1 2 3 4 5 TYPE MWWWW DET P NNNN Center Freq 2.480000000 GHz Trig: Free Run PNO: Wide IFGain:Low #Atten: 40 dB Mkr1 2.480 184 GHz 2.170 dBm Ref Offset 10.92 dB Ref 20.00 dBm 10 dB/div Log 1 $\sim r_{m}$ Mr. Ant ብሌ www vvv Center 2.480000 GHz #Res BW 100 kHz Span 8.000 MHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz STATUS

Band Edge 2-DH5 2480MHz No-Hopping Ref







Report No.: R2212A1318-R2V1





Band Edge 3-DH5 2402MHz No-Hopping Emission





Report No.: R2212A1318-R2V1



Band Edge 3-DH5 2480MHz No-Hopping Ref

Band Edge 3-DH5 2480MHz No-Hopping Emission





5.6 Number of hopping Frequency

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 100kHz and VBW is set to 300kHz on spectrum analyzer. Set EUT on Hopping on mode.

Test setup



Limits

Rule Part 15.247(a) (1) (iii) specifies that" Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels."

Limits ≥ 15 channels



Test Results:

Test Mode		Number of hopping channels	conclusion
	DH5	79	PASS
BT	2DH5	79	PASS
	3DH5	79	PASS

Hopping No. 1-DH5 2402MHz





TA

Hopping No. 2-DH5 2402MHz

Keysight Spectrum Analyzer - Swept SA Key R RE 50 Ω AC CORREC Center Freq 2.441750000 GHz	PNO: Fast ↔ Trig: IFGain:Low #Atte	E : Free Run en: 40 dB	#Avg Type Avg Hold:	: RMS 2000/2000	02:25:08 TR 1	PM Mar 12, 2023 ACE 1 2 3 4 5 6 YPE MWWWWW DET PNNNNN	
Ref Offset 10.93 dB Mkr1 2.401 670 0 GHz 10 dB/div Ref 20.00 dBm -0.806 dBm							
10.0 1 c.00	nppmanp	ᠵ᠆ᢅᢣᠯᡒᠰᢧᡟᡟᡁᠰᡁᡯᡵ	ylpArwntwaA	ᡃ᠕ᡛ᠋᠆᠆ᡔᡪᡧᡘ᠇ᡳ᠋ᢩ᠇ᠰ	ᠵᢥᡁᡶ᠈ᠯᡣᢑᠰᠰᡆ		
-20.0							
-50.0 -60.0							
-70.0 Start 2.40000 GHz #Res BW 100 kHz	#VBW 300	kHz		Sweet	Stop 2.4 8.000 ms	48350 GHz (1001 pts)	
MRR MODE TRC SCL X N 1 f 2.401 670 0 GH 2 N 1 f 2.480 243 5 GH 3 4	z0.806 dBm z1.021 dBm	FUNCTION	FUNCTION WIDTH	FI	JNCTION VALUE		
5 6 7 8 9 9 10							
11 MS3			STATUS			*	

Hopping No. 3-DH5 2402MHz





5.7 Spurious RF Conducted Emissions

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. Set RBW 100kHz and VBW 300 kHz, Sweep is set to ATUO.

The test is in transmitting mode.

Test setup



Limits

Rule Part 15.247(d) pacifies that "In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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."

Test Mode	Carrier frequency (MHz)	Reference value (dBm)	Limit
DH5	2402	6.010	-13.990
	2441	6.470	-13.530
	2480	5.520	-14.480
2DH5	2402	3.300	-16.700
	2441	3.780	-16.220
	2480	2.900	-17.100
3DH5	2402	3.390	-16.610
	2441	3.670	-16.330
	2480	2.960	-17.040



TA

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-26GHz	1.407 dB



Report No.: R2212A1318-R2V1

RF Test Report Test Results:

The signal beyond the limit is carrier.



Tx. Spurious 1-DH5 2402MHz Ref

Tx. Spurious 1-DH5 2402MHz Emission





Report No.: R2212A1318-R2V1



Tx. Spurious 1-DH5 2441MHz Ref



STATUS





Report No.: R2212A1318-R2V1



Tx. Spurious 1-DH5 2480MHz Ref







Report No.: R2212A1318-R2V1



Tx. Spurious 2-DH5 2402MHz Ref







Report No.: R2212A1318-R2V1



Tx. Spurious 2-DH5 2441MHz Ref







Report No.: R2212A1318-R2V1



Tx. Spurious 2-DH5 2480MHz Ref







Report No.: R2212A1318-R2V1





Tx. Spurious 3-DH5 2402MHz Emission





Report No.: R2212A1318-R2V1



Tx. Spurious 3-DH5 2441MHz Ref







Report No.: R2212A1318-R2V1



Tx. Spurious 3-DH5 2480MHz Ref









5.8 Unwanted Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10. The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The radiated emissions measurements were made in a typical installation configuration.

Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

During the test, below 30MHz, the center of the loop shall be 1 meters; above 30MHz, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.

Set the spectrum analyzer in the following:

9kHz~150 kHz

```
RBW=200Hz, VBW=1kHz/ Sweep=AUTO
```

150 kHz~30MHz

```
RBW=9KHz, VBW=30KHz,/ Sweep=AUTO
```

Below 1GHz

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz

(a) PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO

(b) AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO

detector; The 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.

The dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.

If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak- average correction factor, derived form the appropriate duty cycle calculation.

This setting method can refer to KDB 558074 D01.

This mode was measured in the following mode: EUT with cradle and EUT without cradle. The worst emission was found in EUT with cradle mode and the worst case was recorded.

The test is in transmitting mode.



Test setup

9kHz~ 30MHz







Above 1GHz



Note: Area side:2.4mX3.6m



Limits

Rule Part 15.247(d) specifies that "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))."

Limit in restricted band

Frequency of emission (MHz)	Field strength(µV/m)	Field strength(dBµV/m)
0.009–0.490	2400/F(kHz)	1
0.490–1.705	24000/F(kHz)	1
1.705–30.0	30	1
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

§15.35(b)

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit. Peak Limit=74dB μ V/m

Average Limit=54dBµV/m


Report No.: R2212A1318-R2V1

Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.17 dB
200MHz-1GHz	4.84 dB
1-18GHz	4.35 dB
18-26.5GHz	5.90 dB
26.5GHz~40GHz	5.92 dB



Test Results:

The signal beyond the limit is carrier.

A symbol (dB V/) in the test plot below means (dBµV/m)



The bandage was performed in all EDR mode (2DH5 and 3DH5), 3DH5 was selected as the worse condition. The test data of the worst-case condition was recorded in this report.







TA

RF Test Report Result of RE Test result

Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, the Emissions in the frequency band 9kHz-30MHz and 18GHz -26.5GHz are more than 20dB below the limit are not reported.

The following graphs display the maximum values of horizontal and vertical by software. For above 1GHz, Blue trace uses the peak detection, Green trace uses the average detection.

During the test, the Radiates Emission from 30MHz to 1GHz was performed in all modes with all channels, BT 3DH5 Channel 0 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

A symbol (dB V/) in the test plot below means ($^{dB}\mu$ V/m)

Continuous TX mode:



Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
34.796394	15.69	40.00	24.31	100.0	V	1.0	17.6
48.428438	24.04	40.00	15.96	100.0	V	34.0	20.5
67.369563	16.45	40.00	23.55	100.0	V	70.0	17.2
89.689300	11.04	43.50	32.46	207.0	Н	248.0	16.2
138.342250	10.00	43.50	33.50	208.0	Н	69.0	14.9
193.803000	14.94	43.50	28.56	109.0	Н	120.0	18.4

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain) 2. Margin = Limit – Quasi-Peak



TA

Report No.: R2212A1318-R2V1

DH5-Channel 0



Note: The signal beyond the limit is carrier. Radiates Emission from 1GHz to 3GHz



Radiates Emission from 3GHz to 18GHz

<u>.</u>	eurofins	1
		TA

RF	Test	Ret	oort

RF T	est Report		Report No.: R2212A1318-R2V1						
Frequency (MHz)	MaxPeak (dB	Average (dB	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1049.500000		43.76	54.00	10.24	500.0	200.0	Н	121.0	-8.7
1050.000000	47.65		74.00	26.35	500.0	200.0	Н	111.0	-8.7
1149.500000	50.70		74.00	23.30	500.0	200.0	Н	116.0	-8.1
1149.750000		47.12	54.00	6.88	500.0	200.0	V	327.0	-8.1
1438.500000	45.83		74.00	28.17	500.0	100.0	Н	296.0	-6.2
1449.750000		34.61	54.00	19.39	500.0	200.0	V	318.0	-6.2
1661.000000	45.63		74.00	28.37	500.0	100.0	V	120.0	-5.1
1665.250000		34.26	54.00	19.74	500.0	200.0	Н	157.0	-5.1
1990.750000	48.60		74.00	25.40	500.0	200.0	V	201.0	-3.5
1993.250000		35.66	54.00	18.34	500.0	100.0	V	151.0	-3.5
2657.000000	55.84		74.00	18.16	500.0	200.0	V	188.0	-0.4
2658.750000		41.15	54.00	12.85	500.0	100.0	V	291.0	-0.3
7766.250000		44.37	54.00	9.63	500.0	200.0	V	168.0	-1.1
7766.250000	50.54		74.00	23.46	500.0	200.0	V	168.0	-1.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



Report No.: R2212A1318-R2V1

DH5-Channel 39









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RF	Test	Re	por

RF T	est Report		Report No.: R2212A1318-R2V1						
Frequency (MHz)	MaxPeak (dB	Average (dB	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1049.250000	48.18		74.00	25.82	500.0	100.0	Н	179.0	-8.7
1049.500000		43.72	54.00	10.28	500.0	200.0	Н	111.0	-8.7
1149.750000	50.67		74.00	23.33	500.0	200.0	Н	120.0	-8.1
1149.750000		47.71	54.00	6.29	500.0	200.0	Н	120.0	-8.1
1442.000000	45.48		74.00	28.52	500.0	100.0	Н	291.0	-6.2
1449.500000		34.81	54.00	19.19	500.0	200.0	V	241.0	-6.2
1692.000000	45.02		74.00	28.98	500.0	100.0	V	345.0	-5.0
1694.250000		33.54	54.00	20.46	500.0	100.0	V	48.0	-5.0
1991.000000	49.27		74.00	24.73	500.0	200.0	V	205.0	-3.5
1991.250000		35.83	54.00	18.17	500.0	100.0	V	170.0	-3.5
2658.500000		40.79	54.00	13.21	500.0	100.0	V	286.0	-0.3
2661.250000	55.26		74.00	18.74	500.0	200.0	V	282.0	-0.3
7766.250000		43.86	54.00	10.14	500.0	200.0	V	166.0	-1.1
7766.250000	49.12		74.00	24.88	500.0	200.0	V	166.0	-1.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



Report No.: R2212A1318-R2V1

DH5-Channel 78







Radiates Emission from 3GHz to 18GHz

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RF Te	est Report	Report No.: R2212A1318-R2V1							
Frequency (MHz)	MaxPeak (dB µ V/m)	Average (dB	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1149.250000	50.33		74.00	23.67	500.0	200.0	V	330.0	-8.1
1149.500000		46.48	54.00	7.52	500.0	200.0	V	325.0	-8.1
1308.000000	41.20		74.00	32.80	500.0	200.0	V	73.0	-7.1
1310.750000		31.99	54.00	22.01	500.0	100.0	V	172.0	-7.1
1641.250000	43.39		74.00	30.61	500.0	200.0	Н	142.0	-5.2
1648.250000		33.20	54.00	20.80	500.0	200.0	V	27.0	-5.2
1914.250000	44.41		74.00	29.59	500.0	200.0	V	0.0	-3.9
1920.000000		35.27	54.00	18.73	500.0	200.0	Н	146.0	-3.9
2294.500000	46.38		74.00	27.62	500.0	100.0	V	342.0	-2.2
2296.000000		34.97	54.00	19.03	500.0	100.0	V	43.0	-2.2
2660.000000		37.95	54.00	16.05	500.0	100.0	V	248.0	-0.3
2662.250000	51.98		74.00	22.02	500.0	200.0	V	172.0	-0.3
7766.250000		43.87	54.00	10.13	500.0	200.0	V	166.0	-1.1
7766.250000	49.62		74.00	24.38	500.0	200.0	V	166.0	-1.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



Report No.: R2212A1318-R2V1

The Radiates Emission was performed in all EDR mode(2DH5 and 3DH5), 3DH5 was selected as the worse condition. The test data of the worst-case condition was recorded in this report.





Note: The signal beyond the limit is carrier. Radiates Emission from 1GHz to 3GHz



Radiates Emission from 3GHz to 18GHz

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RF 1	est Report		Report No.: R2212A1318-R2V1						
Frequency (MHz)	MaxPeak (dB	Average (dB µ V/m)	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1049.750000	48.72		74.00	25.28	500.0	200.0	Н	184.0	-8.7
1049.750000		44.66	54.00	9.34	500.0	200.0	Н	184.0	-8.7
1149.250000	51.34		74.00	22.66	500.0	200.0	Н	229.0	-8.1
1149.750000		48.34	54.00	5.66	500.0	200.0	Н	225.0	-8.1
1449.500000		34.73	54.00	19.27	500.0	100.0	Н	162.0	-6.2
1450.000000	44.75		74.00	29.25	500.0	100.0	Н	224.0	-6.2
1747.500000	45.22		74.00	28.78	500.0	200.0	Н	45.0	-4.7
1749.250000		34.42	54.00	19.58	500.0	200.0	V	26.0	-4.7
2077.750000		34.73	54.00	19.27	500.0	200.0	V	91.0	-3.1
2077.750000	46.84		74.00	27.16	500.0	200.0	V	91.0	-3.1
2701.500000	48.89		74.00	25.11	500.0	100.0	V	281.0	-0.1
2709.500000		37.06	54.00	16.94	500.0	200.0	Н	288.0	-0.1
5996.250000		36.17	54.00	17.83	500.0	200.0	V	235.0	-2.0
5998.125000	48.13		74.00	25.87	500.0	200.0	V	235.0	-2.0

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



TA

Report No.: R2212A1318-R2V1

3DH5-Channel 39

RF Test Report



Note: The signal beyond the limit is carrier. Radiates Emission from 1GHz to 3GHz



Radiates Emission from 3GHz to 18GHz

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RF	Test	Re	por

RF 1	est Report		Report No.: R2212A1318-R2V1						
Frequency (MHz)	MaxPeak (dB	Average (dB	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1049.250000	48.27		74.00	25.73	500.0	200.0	Н	112.0	-8.7
1049.750000		43.79	54.00	10.21	500.0	200.0	Н	112.0	-8.7
1149.750000		47.71	54.00	6.29	500.0	200.0	Н	121.0	-8.1
1149.750000	50.81		74.00	23.19	500.0	200.0	V	334.0	-8.1
1442.000000	46.17		74.00	27.83	500.0	200.0	Н	148.0	-6.2
1449.750000		35.10	54.00	18.90	500.0	100.0	V	260.0	-6.2
1663.750000	45.95		74.00	28.05	500.0	200.0	Н	194.0	-5.1
1665.250000		34.43	54.00	19.57	500.0	100.0	V	160.0	-5.1
1992.750000	48.89		74.00	25.11	500.0	200.0	V	204.0	-3.5
1996.500000		36.33	54.00	17.67	500.0	100.0	V	151.0	-3.5
2663.000000		41.42	54.00	12.58	500.0	200.0	V	184.0	-0.3
2663.250000	56.86		74.00	17.14	500.0	100.0	V	179.0	-0.3
7766.250000		44.42	54.00	9.58	500.0	200.0	V	178.0	-1.1
7766.250000	49.61		74.00	24.39	500.0	200.0	V	178.0	-1.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



TA

Report No.: R2212A1318-R2V1

3DH5-Channel 78

RF Test Report



Note: The signal beyond the limit is carrier. Radiates Emission from 1GHz to 3GHz



Radiates Emission from 3GHz to 18GHz

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RF	Test	Re	por

RF T	est Report		Report No.: R2212A1318-R2V1						
Frequency (MHz)	MaxPeak (dB	Average (dB	Limit (dB µ V/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1049.500000	47.65		74.00	26.35	500.0	200.0	Н	272.0	-8.7
1050.000000		43.45	54.00	10.55	500.0	200.0	Н	286.0	-8.7
1149.750000		48.26	54.00	5.74	500.0	200.0	V	358.0	-8.1
1150.000000	52.44		74.00	21.56	500.0	200.0	Н	286.0	-8.1
1449.750000	43.97		74.00	30.03	500.0	200.0	Н	171.0	-6.2
1449.750000		35.55	54.00	18.45	500.0	200.0	Н	171.0	-6.2
1663.000000		34.45	54.00	19.55	500.0	200.0	V	261.0	-5.1
1663.500000	46.68		74.00	27.32	500.0	200.0	Н	268.0	-5.1
1996.000000	44.09		74.00	29.91	500.0	200.0	Н	268.0	-3.5
1996.250000	47.66		74.00	26.34	500.0	200.0	V	164.0	-3.5
2659.250000		39.90	54.00	14.10	500.0	200.0	V	188.0	-0.3
2662.750000	57.87		74.00	16.13	500.0	100.0	V	170.0	-0.3
7766.250000		44.68	54.00	9.32	500.0	200.0	V	169.0	-1.1
7766.250000	49.70		74.00	24.30	500.0	200.0	V	169.0	-1.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)



During the test, the Radiates Emission from 18GHz to 26.5GHz was performed in all modes with all channels, Bluetooth 3DH5-Channel 0 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.



Radiates Emission from 18GHz to 26.5GHz



5.9 Conducted Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

The EUT is placed on a non-metallic table of 80cm height above the horizontal metal reference ground plane. During the test, the EUT was operating in its typical mode. The test method is according to ANSI C63.10. Connect the AC power line of the EUT to the L.I.S.N. Use EMI receiver to detect the average and Quasi-peak value. RBW is set to 9 kHz, VBW is set to 30kHz.The measurement result should include both L line and N line.

The test is in transmitting mode.

Test Setup



Note: AC Power source is used to 120V/60Hz.

Limits

Frequency	Conducted Limits(dBµV)						
(MHz)	Quasi-peak	Average					
0.15 - 0.5	66 to 56 [*]	56 to 46 [*]					
0.5 - 5	56	46					
5 - 30	60	50					
^{*:} Decrease	* [:] Decreases with the logarithm of the frequency.						

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96, U=2.69 dB.



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Test Results:

Following plots, Blue trace uses the peak detection, Green trace uses the average detection. During the test, the Conducted Emission was performed in all modes with all channels, BT 3DH5 channel 0 is selected as the worst condition. The test data of the worst-case condition was recorded in this report.



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.26	27.70		61.28	33.58	1000.0	9.000	L1	ON	21.1
0.29		17.98	50.60	32.62	1000.0	9.000	L1	ON	21.0
0.57	36.26		56.00	19.74	1000.0	9.000	L1	ON	20.8
0.58		25.57	46.00	20.43	1000.0	9.000	L1	ON	20.8
0.89		17.82	46.00	28.18	1000.0	9.000	L1	ON	20.3
0.90	28.65		56.00	27.35	1000.0	9.000	L1	ON	20.3
2.18	21.21		56.00	34.79	1000.0	9.000	L1	ON	19.7
4.88		15.35	46.00	30.65	1000.0	9.000	L1	ON	19.5
10.60	27.44		60.00	32.56	1000.0	9.000	L1	ON	19.5
10.94		18.47	50.00	31.53	1000.0	9.000	L1	ON	19.5
12.51		17.19	50.00	32.81	1000.0	9.000	L1	ON	19.6
12.52	25.74		60.00	34.26	1000.0	9.000	L1	ON	19.6

Remark: Correct factor=cable loss + LISN factor

L line

Conducted Emission from 150 KHz to 30 MHz



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.28	27.86		60.94	33.08	1000.0	9.000	Ν	ON	21.1
0.36		22.69	48.69	26.00	1000.0	9.000	Ν	ON	21.0
0.57		35.64	46.00	10.36	1000.0	9.000	Ν	ON	20.8
0.58	40.33		56.00	15.67	1000.0	9.000	Ν	ON	20.8
0.88	29.84		56.00	26.16	1000.0	9.000	Ν	ON	20.3
0.89		25.29	46.00	20.71	1000.0	9.000	Ν	ON	20.3
2.14		19.88	46.00	26.12	1000.0	9.000	Ν	ON	19.7
2.39	21.64		56.00	34.36	1000.0	9.000	Ν	ON	19.6
10.65		21.52	50.00	28.48	1000.0	9.000	Ν	ON	19.5
11.13	26.47		60.00	33.53	1000.0	9.000	Ν	ON	19.6
13.03		19.21	50.00	30.79	1000.0	9.000	Ν	ON	19.6
13.56	24.05		60.00	35.95	1000.0	9.000	Ν	ON	19.6

Remark: Correct factor=cable loss + LISN factor

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RF Test Report

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N line Conducted Emission from 150 KHz to 30 MHz



6 Main Test Instruments

Date of Testing: March 25, 2023

Name	Manufacturer	Туре	Serial Number	Calibratio n Date	Expiration Date
EMI Test Receiver	R&S	ESCI3	100948	2022-05-25	2023-05-24
Signal Analyzer	R&S	FSV40	101298	2022-05-14	2023-05-13
Loop Antenna	Schwarzbeck	FMZB1519	1519-047	2020-04-02	2023-04-01
Software	R&S	EMC32	9.26.01	/	/

Date of Testing: March 16, 2023 ~ May 8, 2023

Name	Manufacturer	Туре	Serial Number	Calibratio n Date	Expiration Date
DC Power Supply	UNI-T	UTP1306S+	2205D0517232	2022-12-10	2023-12-09
Spectrum Analyzer	KEYSIGHT	N9020A	MY51330870	2022-05-14	2023-05-13
EMI Test Receiver	R&S	ESCI3	100948	2022-05-25	2023-05-24
Signal Analyzer	R&S	FSV40	101298	2022-05-14	2023-05-13
TRILOG Broadband Antenna	SCHWARZBEC K	VULB 9163	01111	2022-10-25	2025-10-24
Horn Antenna	Schwarzbeck	BBHA 9120D	430	2021-07-26	2024-07-25
Horn Antenna	ETS-Lindgren	3160-09	00102643	2021-10-10	2024-10-09
Software	R&S	EMC32	9.26.01	/	/
LISN	R&S	ENV216	102191	2022-12-13	2024-12-09
EMI Test Receiver	R&S	ESR	101667	2022-05-25	2023-05-24
Software	R&S	EMC32	10.35.10	1	/



ANNEX A: The EUT Appearance

The EUT Appearance are submitted separately.



ANNEX B: Test Setup Photos

The Test Setup Photos are submitted separately.

****** END OF REPORT ******