



 Project No.:
 TM-2305000504P

 Report No.:
 TMTN2305000719NR

FCC ID: API-SPINNERBT

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### FCC 47 CFR PART 15 SUBPART C AND ANSI C63.10: 2013 TEST REPORT

### For

## JBL Bluetooth Turntable

## Model: JBL SPINNER BT

## Data Applies To: N/A

### Brand Name: JBL

Issued for

## Harman International Industries, Incorporated 8500 Balboa Blvd, Northridge, CA 91329, UNITED STATES.

Issued By

**Compliance Certification Services Inc.** 

Tainan Lab. No. 168, Ln. 523, Sec. 3, Zhongzheng Rd., Rende Dist., Tainan City, 717017, Taiwan Issued Date: August 24, 2023

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#### **REVISION HISTORY**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	August 11, 2023	Initial Issue	ALL	Polly Wang
01	August 22, 2023	See the following note rev.01	P.76.77	Polly Wang
02	August 24, 2023	See the following note rev.02	ALL	Polly Wang

#### Note:

- Rev.00 Issue Date: August 11, 2023 Original report.
- Rev.01 Issue Date: August 22, 2023
   Add 9kHz to 30MHz data for RADIATED EMISSIONS.
- Rev.02 Issue Date: August 24, 2023 Update Product Name.



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# **1. TEST REPORT CERTIFICATION**

Applicant	Harman International Industries, Incorporated 8500 Balboa Blvd, Northridge, CA 91329, UNITED STATES.
Manufacturer	<ul> <li>1.Ya Horng Electronic Co., Ltd No. 35, Shalun, Jon Sha Village, Anding Dist., Tainan City 745, Taiwan</li> <li>2. Ya Horng (Dongguan) Electronic Co.,Ltd. Room 201, Building #9, No.84 Gaoyu South Road, Tangxia Town,Dong Guan, Guangdong, China</li> </ul>
Equipment Under Test	JBL Bluetooth Turntable
Model Number	JBL SPINNER BT
Data Applies To	N/A
Brand Name	JBL
Date of Test	June 07, 2023 ~ August 21, 2023

APPLICABLE STANDARD			
STANDARD	TEST RESULT		
FCC Part 15 Subpart C AND ANSI C63.10: 2013	PASS		
Statements of Conformity			
Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.			

#### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in **ANSI C63.10: 2013** and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

7ed. Buang

**Ted Huang** Sr. Engineer



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# 2. TEST RESULT SUMMARY

FCC Standard Section	Report Section	Test Item	Result
15.203	3	ANTENNA REQUIREMENT	Pass
15.247(a)(1)	8.1	20dB BANDWIDTH	Pass
15.247(b)(1)	8.2	MAXIMUM PEAK OUTPUT POWER	Pass
15.247(a)(1)	8.3	HOPPING CHANNEL SEPARATION	Pass
15.247(a)(1)(iii)	8.4	NUMBER OF HOPPING FREQUENCY USED	Pass
15.247(a)(1)(iii)	8.5	DWELL TIME	Pass
-	8.6	DUTY CYCLE	-
15.247(d)	8.7	CONDUCTED SPURIOUS EMISSION	Pass
15.247(d)	8.8	RADIATED EMISSIONS	Pass
15.207(a)	8.9	POWERLINE CONDUCTED EMISSIONS	Pass



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# **3. EUT DESCRIPTION**

## **3.1 DESCRIPTION OF EUT & POWER**

Product	JBL Bluetooth Turntable
Model Number	JBL SPINNER BT
Data Applies To	N/A
Brand Name	JBL
Received Date	May 31, 2023
Reported Date	July 06, 2023
Frequency Range	2402MHz ~ 2480MHz
Transmit Peak Power	GFSK : -1.436dBm / 0.718mW 8DPSK: 1.775dBm / 1.505mW
Channel Spacing	1MHz
Transmit Data Rate	GFSK Mode:1 Mbps 4/πDQPSK Mode:2Mbps 8DPSK Mode:3Mbps
Modulation Type	GFSK 、π/4DQPSK 、8DPSK
Number of Channels	79 Channels
EUT Power Supply	AC 100-240V
Antenna Type	Manufacturer: Birto Type: PCB Antenna Model: WF-EM-1510-0067-A(WF0EM12-I080) Gain: 2.31 dBi
Firmware Version	DL4351_ICYH111P01_STM32F030F4P6_Y0-4
Software Version	N/A

#### **Power Adapter :**

Manufacturer	Model No.	Power Input	Power Output
GPE	GPE012T-120100-Z	100-240V~ 50/60Hz 0.5A	12Vdc 1.0A 12.0W MAX

#### Remark:

1. The sample selected for test was production product and was provided by manufacturer.

2. This submittal(s) (test report) is intended for FCC ID: API-SPINNERBT filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.

3. For more details, please refer to the User's manual of the EUT.



# 4. DESCRIPTION OF TEST MODES

The EUT had been tested under operating condition.

There are three channels have been tested as following :

Channel	Frequency (MHz)
Low	2402
Middle	2441
High	2480

#### Radiated Emission Test (Below 1 GHz):

- ☑ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Example Selected for the final test as listed below.

Normal Operation

#### Radiated Emission Test (Above 1 GHz):

- ☑ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Example Selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, Mid, High	FHSS	GFSK	DH5
Low, Mid, High	FHSS	8-DPSK	3-DH5



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#### Bandedge Measurement :

- ☑ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Example Selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, High	FHSS	GFSK	DH5
Low, High	FHSS	8-DPSK	3-DH5

#### Antenna Port Conducted Measurement :

- ☑ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

Tested Channel	Modulation Technology	Modulation Type	Packet Type
Low, Mid, High	FHSS	GFSK	DH5
Low, Mid, High	FHSS	8-DPSK	3-DH5



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# **5. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.10 : 2013 and FCC CFR 47 15.207, 15.209 and 15.247.



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# 6. FACILITIES AND ACCREDITATIONS

### 6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

No.8, Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

No. 168, Ln. 523, Sec. 3, Zhongzheng Rd., Rende Dist., Tainan City 717, Taiwan

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

## 6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

## **6.3 LABORATORY ACCREDITATIONS LISTINGS**

The test facilities used to perform radiated and conducted emissions tests are accredited by Taiwan Accreditation Foundation for the specific scope of accreditation under Lab Code: 1109 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by TAF or any agency of the Government. In addition, the test facilities are listed with Federal Communications Commission (registration no: TW1109).



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## 6.4 TABLE OF ACCREDITATIONS AND LISTINGS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Taiwan TAF

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	Industry Canada (ISED#: 2324H)
Germany	TUV NORD
Taiwan	BSMI
USA	FCC



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### 6.5 MEASUREMENT EQUIPMENT USED For §8.8.2~8.8.3

Chamber 1166 Room (Radiation Test)							
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due		
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	08/29/2022	08/28/2023		
Attenuator	MCL	BW-S15W5	0535	01/19/2023	01/18/2024		
Bilog Antenna With 6dB Attenuator	SUNOL SCIENCES & EMCI	JB1 & N-6-06	A021306 & AT-N0682	10/11/2022	10/10/2023		
Cable	EMCI	EM102-KMKM	CB1166-01	06/17/2023	06/16/2024		
Double Ridged Guide Horn Antenna	ETS-LINDGREN	3116	00078900	03/25/2023	03/24/2024		
EMI Test Receiver	R&S	ESCI 7	100856	06/15/2023	06/14/2024		
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	08/11/2022	08/10/2023		
Double Ridged Guide Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-788(98006)	04/18/2023	04/17/2024		
Notch Filter	MICRO-TRONICS	BRM50702-01	018	01/19/2023	01/18/2024		
Pre-Amplifier	EMCI	EMC012645	980098	01/19/2023	01/18/2024		
Pre-Amplifier	Com-Power	PAM-840A	461378	06/07/2023	06/06/2024		
Software		Excel(ccs	-o6-2020 v1.1) , e3(v	(6.101222)			

For §8.1~8.7 8.8.4

Chamber 1166 Room (Conducted Test)							
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due		
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	08/11/2022	08/10/2023		
SMA Cable+10dB Attenuator	CCS	SMA+10dB ATT	SMA/10dB	01/19/2023	01/18/2024		
Software	Excel(ccs-o6-2020 v1.1)						

#### For §8.9

Conducted Emission room #1							
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due		
BNC Coaxial Cable	CCS	BNC50	11	01/19/2023	01/18/2024		
EMI Test Receiver	R&S	ESCI	100960	01/11/2023	01/10/2024		
LISN	FCC	FCC-LISN-50-32-2	08009	07/15/2022	07/14/2023		
LISN	SCHWARZBECK	NNLK8130	8130124	01/18/2023	01/17/2024		
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	797	01/19/2023	01/18/2024		
Test S/W			e3(v6.101222)				



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### 6.6 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 6.7 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 9kHz~30MHz Test Site : CB1166	±2.7dB
Radiated Emission, 30 MHz ~1GHz Test Site : CB1166	±3.76dB
Radiated Emission, 1GHz ~18GHz Test Site : CB1166	±4.43dB
Radiated Emission, 18GH~26.5GHz Test Site : CB1166	±4.79dB
Radiated Emission, 26.5GH~40GHz Test Site : CB1166	±4.72dB
Power Line Conducted Emission, 9kHz~30MHz	±1.83dB
Band Width	0.025%
Peak Output Power MU	±1.9dB
Band Edge MU	±0.264dBuV
Channel Separation MU	±361.69Hz
Duty Cycle MU	±0.2%
Frequency Stability MU	±0.493Hz
Temperature	±0.5
Humidity	±3%

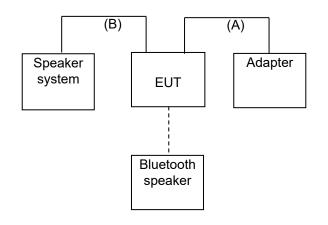
This measurement uncertainty is confidence of approximately 95%, k=2



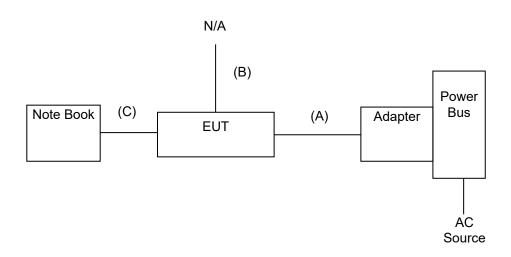
# 7. SETUP OF EQUIPMENT UNDER TEST

## 7.1 SETUP CONFIGURATION OF EUT

EMI



RF



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## 7.2 SUPPORT EQUIPMENT

#### For EMI test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable	
1	Speaker System	T.C.SATR	TCS2285	DOC	N/A	
2	Bluetooth Speaker	KINYO	BTS-672	N/A	N/A	
No.	b. Signal cable description					
	orginal sabis assori					
Α	DC Cable Power	Unshielded, 1.6	Sm 1 pcs.			

#### For RF test

No.	Product	Manufacturer	Model No.	Certify No.	Power cable		
1	Note Book	Acer	Z5WE1	N/A	Unshielded, 1.8m with 1 core.		
No.	No. Signal cable description						
А	DC Power	Unshielded, 1	Unshielded, 1.5m 1 pcs.				
В	Audio	Shielded, 1.0	Shielded, 1.0m 1 pcs.				
С	USB	Shielded, 1.8	m 1 pcs.				

#### Note:

- 1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
- 2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3) shd. = shielded; unshd. = unshielded



#### EUT OPERATING CONDITION

#### **RF Setup**

- 1. Set up all computers like the setup diagram.
- 2. The "Blue Test 3 V3.3.9.1137" software was used for testing
- 3. Choose Transport "DEBUG" and Device "USB DBG(100)"

### BT1.0 \ 3.0

### TX Mode:

PACKET TX Channel 1~5: 0,39,78 GFSK(DH1): Packet Type:DH1 > Packet Length 27 Power(0-9): (5;6;6) GFSK(DH3): Packet Type:DH3 > Packet Length 183 Power(0-9): (5;6;6) GFSK(DH5): Packet Type:DH5 > Packet Length 339 Power(0-9): (5;6;6) 8-DPSK(3DH1): Packet Type:3DH1 > Packet Length 83 Power(0-9): 6 8-DPSK(3DH3): Packet Type:3DH3 > Packet Length 552 Power(0-9): 6 8-DPSK(3DH5): Packet Type:3DH5 > Packet Length 1021 Power(0-9): 6

### RX Mode:

PACKET TX

### BT4.0 、 5.0

#### TX Mode:

BLE TEST TX Channel > 0,20,39 (0-39) Length > 37 Bit pattern > Pseudo-rdm 9 PHY > 1M (2M) Page: 16 / 120 Rev.: 02



Report No.: TMTN2305000719NR RX Mode: BLE TEST RX Channel > 0 (0-39) PHY > 1M (2M)

- 4. All of the function are under run.
- 5. Start test.

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# 8. APPLICABLE LIMITS AND TEST RESULTS

## 8.1 20dB BANDWIDTH FOR HOPPING

#### <u>LIMIT</u>

None; for reporting purposes only.

### TEST SETUP



### TEST PROCEDURE

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW)  $\ge$  3 x RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.

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



#### TEST RESULTS

Model Name	JBL SPINNER BT	Test By	Peter Chu
Temp & Humidity	23.5°C, 48%	Test Date	2023/06/19

### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Two-third of 20dB Bandwidth (MHz)	Pass / Fail
Low	2402	1121.00	0.75	PASS
Middle	2441	1120.00	0.75	PASS
High	2480	1122.00	0.75	PASS

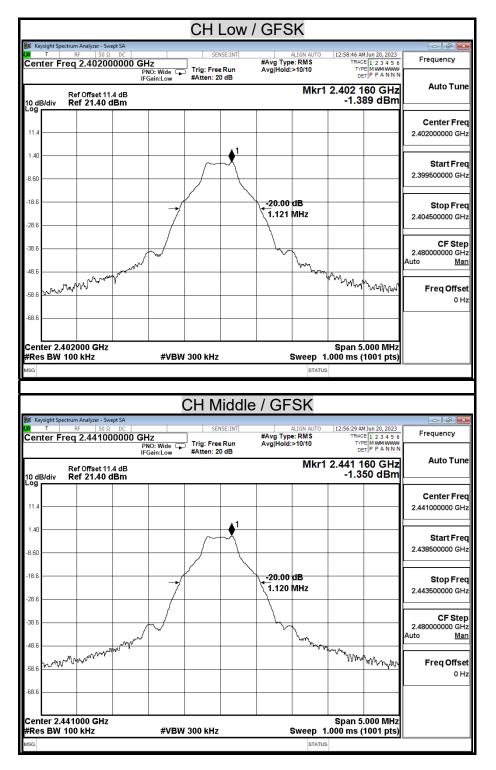
### Modulation Type: 8-DPSK / 3-DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Two-third of 20dB Bandwidth (MHz)	Pass / Fail
Low	2402	1402.00	0.93	PASS
Middle	2441	1405.00	0.93	PASS
High	2480	1403.00	0.93	PASS



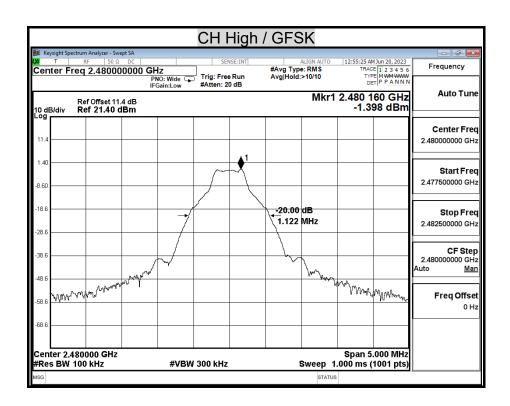
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#### 20dB BANDWIDTH



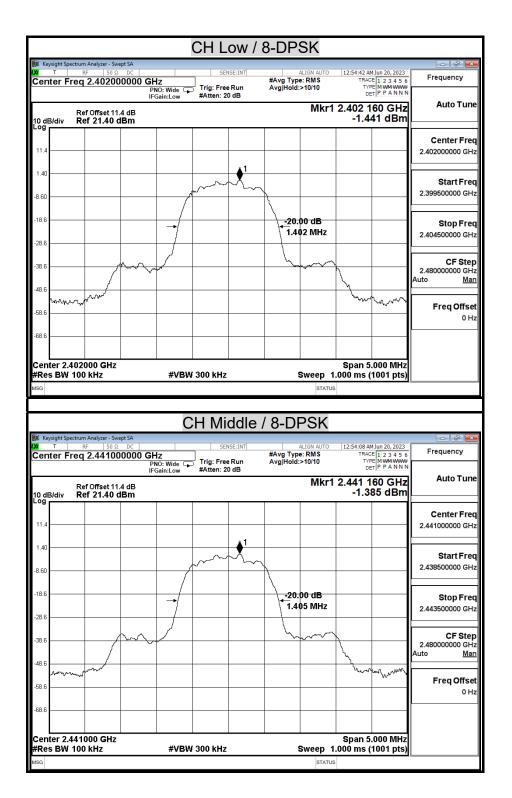


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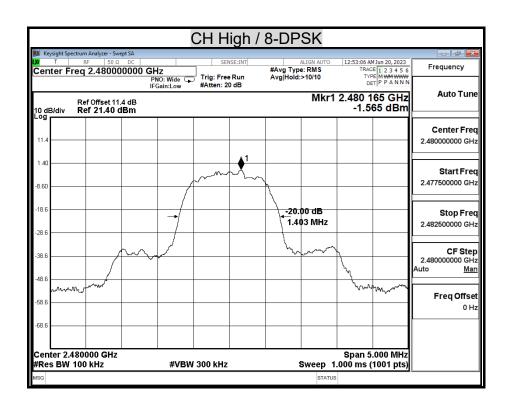


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### 8.2 MAXIMUM PEAK OUTPUT POWER

#### <u>LIMIT</u>

§15.247(b)(1) 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.

### Test Configuration



#### TEST PROCEDURE

The RF power output was measured with a Spectrum Analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

Peak Power set:

- 1. Set the RBW =  $\geq$  DTS bandwidth.
- 2. Set the VBW  $\geq$  [3 × RBW].
- 3. Set the span  $\geq$  [1.5 × DTS bandwidth].
- 4. Detector = peak.
- 5. Sweep time = auto couple.
- 6.Trace mode = max hold.
- 7. Allow trace to fully stabilize.

8. Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.



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Average power set:

- 1. Measure the duty cycle D of the transmitter output signal
- 2. Set span to at least 1.5 times the OBW.
- 3. Set the RBW =  $\geq$  DTS bandwidth
- 4. Set VBW ≥ [3 × RBW].

5. Number of points in sweep  $\geq$  [2 × span / RBW]. (This gives bin-to-bin spacing  $\leq$  RBW / 2, so that narrowband signals are not lost between frequency bins.)

6. Manually set sweep time  $\geq$  [10 × (number of points in sweep) × (total ON/OFF period of the transmitted signal)].

- 7. Set detector = RMS (power averaging).
- 8. Perform a single sweep.

9. Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW.

10. Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.



### TEST RESULTS

Model Name	JBL SPINNER BT	Test By	Peter Chu
Temp & Humidity	23.5°C, 48%	Test Date	2023/06/19

### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	-1.64	0.68		PASS
Mid	2441	-1.44	0.71	125	PASS
High	2480	-1.60	0.69		PASS

### Modulation Type: 8-DPSK / 3-DH5

Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	1.78	1.50		PASS
Mid	2441	1.77	1.50	125	PASS
High	2480	1.61	1.44		PASS



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### **Average Power Data**

#### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	Measure Power (dBm)	10 log (1 / D)	Average Power (dBm)
Low	2402	-2.925	1.10	-1.82
Middle	2441	-2.863	1.10	-1.76
High	2480	-2.959	1.10	-1.86

#### Modulation Type: 8-DPSK / 3-DH5

Channel	Channel Frequency (MHz)	Measure Power (dBm)	10 log (1 / D)	Average Power (dBm)
Low	2402	-2.759	1.10	-1.66
Middle	2441	-2.725	1.10	-1.62
High	2480	-2.943	1.10	-1.84



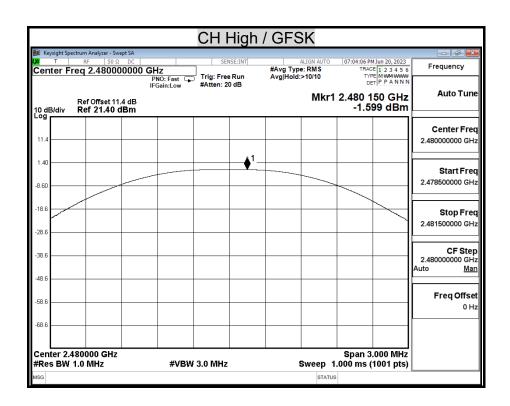
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### MAXIMUM PEAK OUTPUT POWER

				CHL	.000 /	GIG	~~~			
	pectrum Analyzer - S				an against	1		0.000		- 7
¤⊺ Center F	RF 50				SE:INT	#Avg Typ		TRA	M Jun 20, 2023	Frequency
		P	NO: Fast 😱 Gain:Low	Trig: Free #Atten: 20		Avg Hold	:>10/10	C	PE MWMWWW ET P P A N N N	
10 dB/div Log	Ref Offset 1 Ref 21.40	1.4 dB dBm					Mkr1		147 GHz 40 dBm	Auto Tune
										Center Free
11.4										2.402000000 GHz
					<b>≜</b> 1					
1.40										Start Free
-8.60										2.400500000 GH
-18.6									$\sim$	Stop Free
-28.6										2.403500000 GH
										05.01
-38.6										CF Step 2.48000000 GH:
-48.6										Auto <u>Mar</u>
										Eren Offer
-58.6										Freq Offse 0 Hi
a 93										
-68.6										
Center 2										
	402000 CH	7								
	.402000 GH: / 1.0 MHz	Z	#VBW :	3.0 MHz		:	Sweep 1		3.000 MHz (1001 pts)	
		Z	#VBW :	3.0 MHz		:	Sweep 1	.000 ms		
#Res BW		2	#VBW :	3.0 MHz				.000 ms		
#Res BW		z			iddle	e / GF	STATUS	.000 ms		
#Res BW	<b>I 1.0 MHz</b>	wept SA		CH M		e / GF	SK	.000 ms	(1001 pts)	
#Res BW IISG IIII Keysight Sj XIIII T	<b>I 1.0 MHz</b>	wept SA Ω DC   000000 GF		CH M	SE:INT	e / GF	STATUS SK ALIGN AUTO e: RMS	.000 ms	(1001 pts)	Frequency
¥Res BW ISG ISG Keysight Sj Keysight Sj	Pectrum Analyzer - S	wept SA Ω DC   000000 GF PI	C	CH M	SE:INT	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	000 ms	(1001 pts) MJun 20, 2023 CE [1 2 3 4 5 6 PE MWHWWW ET P P A N N N	Frequency
#Res BW ISG ISG ISG ISG ISG ISG ISG ISG	Pectrum Analyzer - S	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	SE:INT	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts)	Frequency
#Res BW ASG Keysight Sj X T Center F 10 dB/div Log	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	SE:INT	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE M WM WWW ET P P A N N N 156 GHz	Auto Tune
#Res BW	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	SE:INT	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE M WM WWW ET P P A N N N 156 GHz	Auto Tune
#Res BW ASG Keysight Sj X T Center F 10 dB/div Log	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	SE:INT	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE M WM WWW ET P P A N N N 156 GHz	Auto Tune
#Res BW ISG Keysight S X T Center F 10 dB/div -og 11.4	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE M WM WWW ET P P A N N N 156 GHz	Frequency Auto Tun Center Free 2.44100000 GH Start Free
Keysight S Keysight S T Center F 10 dB/div 11.4 1.40	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE M WM WWW ET P P A N N N 156 GHz	Frequency Auto Tune Center Freq 2.441000000 GH Start Freq
#Res BW           #sg           #sg           T           Center F           10 dB/div           -8.60	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency         Auto Tune         Center Freq         2.441000000 GH         Start Freq         2.439500000 GH
Keysight S Keysight S T Center F 10 dB/div 11.4 1.40	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency Auto Tune Center Free 2.44100000 GH Start Free 2.43950000 GH Stop Free
#Res BW           #sg           #sg           T           Center F           10 dB/div           -8.60	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency Auto Tune Center Free 2.44100000 GH Start Free 2.43950000 GH Stop Free
#Res BW           #ss	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH:           Start Freq           2.439500000 GH:           Stop Freq           2.442500000 GH:           CF Step
#Res BW           #sg           #sg	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH           Start Freq           2.439500000 GH           Stop Freq           2.442500000 GH           CF Step           2.48000000 GH
#Res BW           #ss	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH:           Start Freq           2.439500000 GH:           Stop Freq           2.442500000 GH:           CF Steg           2.48000000 GH:
#Res BW           #ss	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH;           Start Freq           2.439500000 GH;           Stop Freq           2.442500000 GH;           CF Step           2.48000000 GH;
#Res BW           #sg           #sg           #sg           T           Center F           10 dB/div           -28.6           -38.6	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Auto Tune           Center Free           2.441000000 GHz           Start Free           2.439500000 GHz           Stop Free           2.442500000 GHz           CF Step           2.48000000 GHz
#Res         BW           //sc         //sc	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH           Start Freq           2.439500000 GH           Stop Freq           2.442500000 GH           CF Step           2.48000000 GH           Auto           Mato           Mato           Freq Offsee
#Res BW           Iss           Iss	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	wept SA Ω DC   000000 GF IFα 1.4 dB	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	.000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH           Start Freq           2.439500000 GH           Stop Freq           2.442500000 GH           CF Step           2.48000000 GH           Auto           Mato           Mato           Freq Offsee
#Res BW           Iss           Iss	rectrum Analyzer - 3 RF   50 req 2.4410 Ref Offset 1	weet SA Ω DC   Pi If d Bm	Iz NO: Fast Q	CH M	se:INT Run dB	e / GF #Avg Typ	STATUS SK ALIGN AUTO e: RMS >10/10	000 ms	(1001 pts) MJun 20,2023 CE 1 2 3 4 5 6 PE MWHWWW ET P P A N N N 156 GHz	Frequency           Auto Tune           Center Freq           2.441000000 GH:           Start Freq           2.439500000 GH:           Stop Freq           2.442500000 GH:           2.48000000 GH:           Auto           Mar           Freq Offse
Keysight Sj           T           Center F           10 dB/div           11.4           1.40           -8.60           -38.6           -38.6           -68.6           -68.6           -68.6           Center 2	/ 1.0 MHz	weet SA Ω DC   Pi If d Bm	IZ NO: Fast	CH M	se:INT Run dB	#Avg Typ Avg Hold	SK ALIGN AUTO e: RMS >10/10 Mkr1	000 ms	(1001 pts)	Frequency           Auto Tune           Center Freq           2.441000000 GH:           Start Freq           2.439500000 GH:           Stop Freq           2.442500000 GH:           2.48000000 GH:           Auto           Mato           Mato           Freq Offse



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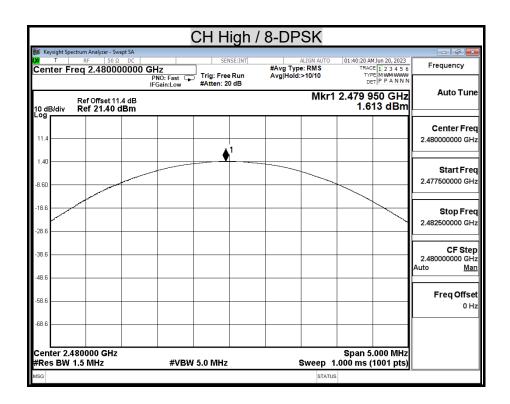


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			CHL	_ow /	8-DPS	K			
	ectrum Analyzer - Swept SA								- 6 <b>X</b>
a ⊤ Center F	RF 50 Ω DC req 2.4020000			e Run	#Avg Type: F Avg Hold:>10	RMS	TRACI	Jun 20, 2023 1 2 3 4 5 6 MWMWWW P P A N N N	Frequency
I0 dB/div	Ref Offset 11.4 dl Ref 21.40 dBn	IFGain:Lo	ow #Atten:	20 dB		Mkr1 2	2.402 0	00 GHz 75 dBm	Auto Tune
11.4				<b>▲</b> 1					Center Fred 2.402000000 GHz
8.60				<b>▼</b>					Start Fred 2.399500000 GHz
28.6									Stop Free 2.404500000 GHz
38.6									<b>CF Step</b> 2.480000000 GHz Auto <u>Mar</u>
-48.6									Freq Offset 0 Hz
-68.6	402000 GHz						Snan 5		
Doc DM		-4			<b>C</b> 11			000 MHz	
		#	VBW 5.0 MH			status			
ISG		A	СН М		/ 8-DP	status	00 ms (1	1001 pts)	[
SG Keysight Sp G T	1.5 MHz ectrum Analyzer - Swept SA	A 00 GHz PNO: Fa	CH M		/ 8-DP	STATUS STATUS SK GN AUTO RMS	00 ms ('	1001 pts)	Trace/Detector
isg Keysight Sp d T Center F	<b>1.5 MHz</b> ectrum Analyzer - Swept SA RF 50 Ω DC	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M		/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023	Trace/Detector
sg Keysight Sp Q T Center F O dB/div	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M		/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023 1 2 3 4 5 6 MWHWWW TP P A NN N 70 GHz	Trace/Detector Select Trace
sc Keysight Sp d T Center F O dB/div O dB/div O dB/div	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M	iddle ENSE:INT 20 dB	/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023 1 2 3 4 5 6 MWHWWW TP P A NN N 70 GHz	Trace/Detector Select Trace 1 Clear Write
Image: Second	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M	iddle ENSE:INT 20 dB	/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023 1 2 3 4 5 6 MWHWWW TP P A NN N 70 GHz	Trace/Detector Select Trace 1 Clear Write Trace Average
III.4 18.6 18.6 18.6 18.6 18.6 18.6	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M	iddle ENSE:INT 20 dB	/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023 1 2 3 4 5 6 MWHWWW TP P A NN N 70 GHz	Trace/Detector Select Trace, 1 Clear Write Trace Average Max Hold
Keysight Sp           Center F           10 dB/div           O'B           11.4           1.40           8.60           .18.6           .28.6           .38.6           .48.6	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M	iddle ENSE:INT 20 dB	/ 8-DP	STATUS STATUS SK GN AUTO RMS 0/10	00 ms (* 01:39:36 AM TRACI TYP DE 2.440 9	Jun 20, 2023 1 2 3 4 5 6 MWHWWW TP P A NN N 70 GHz	Trace/Detector Select Trace, 1 Clear Write Trace Average Max Hold
10         dB/div           -og         -           11.4         -           1.40         -           18.6         -           28.6         -           48.6         -           68.6         -           68.6         -	1.5 MHz	A D <b>O GH</b> Z PNO: Fa IFGain:Lo B	CH M	iddle ENSE:INT 20 dB	/ 8-DP	I.0 STATUS	00 ms (*	Jun 20, 2023 12 23 4 5 6 12 3 4 5 6 17 2	Select Trace 1 Clear Write Trace Average Max Hold Min Hold
Keysight Sp           0 dB/div           9           11.4           1.40           8.60           18.6           28.6           68.6           68.6           68.6           68.6           68.6           68.6           68.6           68.6           68.6	1.5 MHz ectrum Analyzer - Sweet SA RF 50 0 D0 req 2.4410000 Ref Offset 11.4 dl	A PNO: Fa IFGaint. B 1	CH M	iddle ENSE:INT 20 dB	/ 8-DP	I.0 STATUS	00 ms (* 01:39:36 AM TRACI TRACI DE 2.440 9 1.76	Jun 20, 2023 11 2 3 4 5 6 WMMWWWW P P A NN N 70 GHz 58 dBm	Trace/Detector Select Trace, 1 Clear Write Trace Average Max Hold Min Hold View Blank, Trace On More

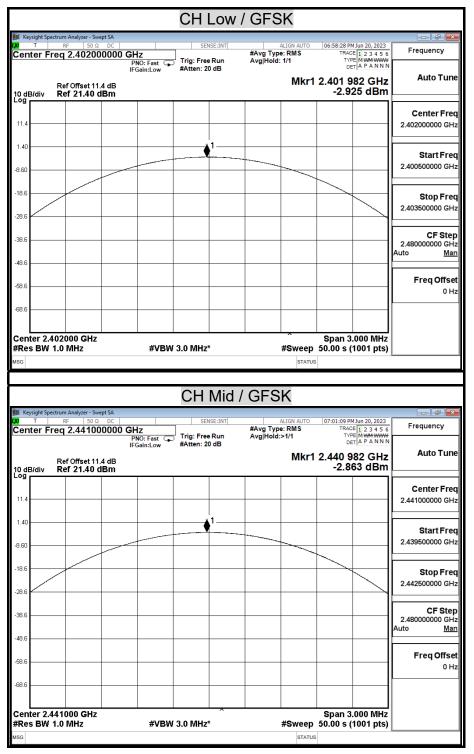


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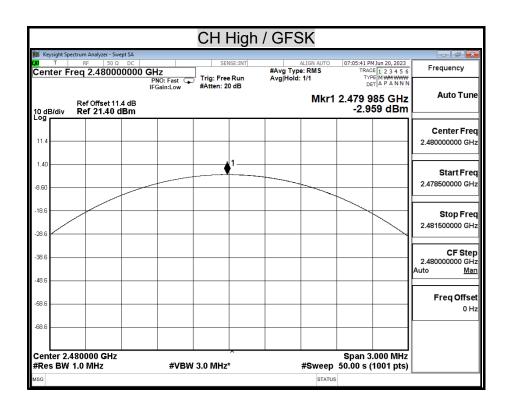


#### **AVERAGE POWER**

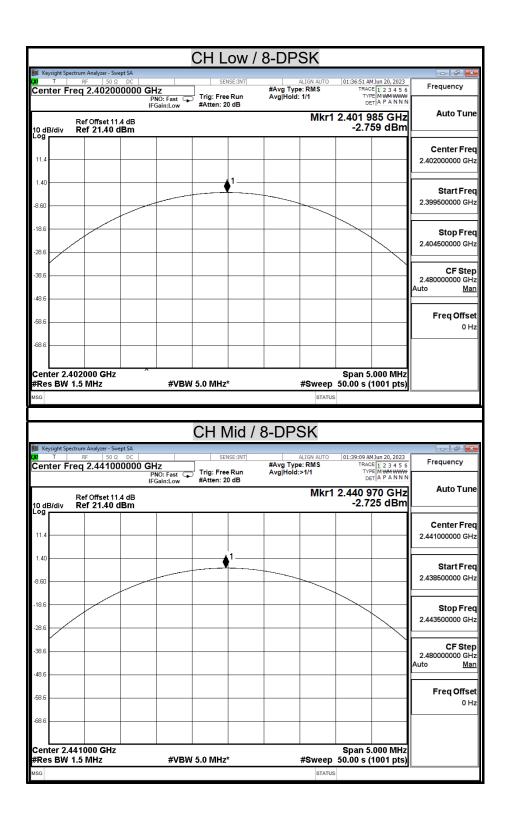




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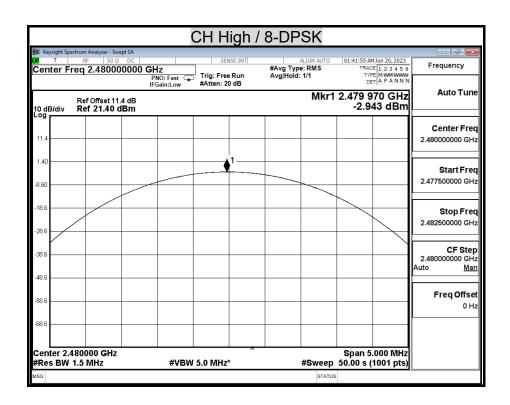








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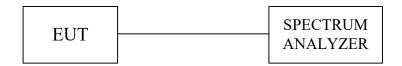
## 8.3 HOPPING CHANNEL SEPARATION

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### <u>LIMIT</u>

§15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### TEST SETUP



### TEST PROCEDURE

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- 3. By using the MaxHold function record the separation of adjacent channels.
- 4. Measure the frequency difference of these two adjacent channels by spectrum analyzer MARK function. And then plot the result on spectrum analyzer screen.
- 5. Repeat above procedures until all frequencies measured were complete.



#### Report No.: TMTN2305000719NR TEST RESULTS

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Refer to section 8.1, 20dB bandwidth measurement, the measured channel separation should be greater than two-third of 20dB bandwidth or Minimum bandwidth.

Model Name	JBL SPINNER BT	Test By	Peter Chu
Temp & Humidity	23.5°C, 48%	Test Date	2023/06/19

#### Modulation Type: GFSK / DH5

Channel	Adjacent Hopping Channel Separation (MHz)	Two –third of 20dB bandwidth (MHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.75	25	PASS
2441MHz	1.00	0.75	25	PASS
2480MHz	1.00	0.75	25	PASS

## Modulation Type: 8-DPSK / 3-DH5

Channel	Adjacent Hopping Channel Separation (MHz)	Two –third of 20dB bandwidth (MHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.93	25	PASS
2441MHz	1.00	0.93	25	PASS
2480MHz	1.00	0.93	25	PASS



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# **HOPPING CHANNEL SEPARATION**

			GFS	SK(Low	/)			
UXI T	m Analyzer - Swept SA RF 50 Ω DC <b>2.402000000</b>	GHz PNO: Wide G	SENSE:IN Trig: Free Run #Atten: 20 dB	#Avg	ALIGN AUTO Type: RMS old:>10/10	12:44:34 AM Jun 20 TRACE 1 2 3 TYPE M W DET P P 4	3 4 5 6	Frequency
10 dB/div R	ef Offset 11.4 dB ef 21.40 dBm				ΔΝ	/kr1 1.000 N 0.022		Auto Tune
11.4 1.40 -8.60			<u>2</u>			<b>↓</b> 1∆2		Center Freq 2.402000000 GHz
-18.6 -28.6 -38.6								<b>Start Freq</b> 2.400500000 GHz
-48.6								<b>Stop Freq</b> 2.403500000 GHz
Center 2.402 #Res BW 10	0 kHz	#VBW	300 kHz	FUNCTION	Sweep 1	Span 3.000 .000 ms (1001 EUNCTION VALU	pts)	<b>CF Step</b> 2.480000000 GHz uto <u>Man</u>
		1.000 MHz (Δ) 2 000 GHz	0.022 dB -2.109 dBm					Freq Offset 0 Hz
7 8 9 10 11 1							-	
MSG			III		STATUS	5	•	

				GFS	K(Mido	dle)								
💓 Keysight Sp 🗶 T	RF 50			SENSE:I		ALIGN AUTO		1 Jun 20, 2023						
Center F	req 2.4410	PN	O: Wide 🗔	Trig: Free Ru #Atten: 20 dE	n Avg	g Type: RMS  Hold:>10/10	TYP	E 1 2 3 4 5 6 E M WM WWW T P P A N N N						
10 dB/div	Ref Offset 11.4 dB													
									Center Fre					
1.40	- la	142		2	$\sim$		3∆4	<u></u>	2.441000000 GH					
-8.60								~	04+ F					
-28.6									Start Fre 2.439500000 G⊦					
-38.6														
-58.6									Stop Fre 2.442500000 GH					
-68.6														
	.441000 GH: / 100 kHz	Z	#VBW	300 kHz		Sweep 7	Span 3. 1.000 ms (′	.000 MHz 1001 pts)	2.48000000 GH					
MKR MODE T		Х		Y	FUNCTION	FUNCTION WIDTH	FUNCTIO	N VALUE	Auto <u>Ma</u>					
1 Δ2 2 F	1 f (Δ) 1 f	-1.000 2.441 000	MHz (Δ)	-0.005 dB -2.039 dBm										
3 Δ4 4 F	1 f (Δ)		) MHz (Δ)	-0.015 dB -2.039 dBm					FreqOffs					
5	1 1	2.441 000	GHZ	-2.039 dBm				E	0 F					
6														
8														
9														
11														
ISG						STATL	IS							
						01410								



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ctrum Analyzer - S	wept SA				4			- 6 2						
			SENSE:INT	#Ava Tvi	ALIGN AUTO			Frequency						
04 2.4000	PNO: Wi					TYPE DET	PPANNN PPANNN	Auto Tun						
Ref Offset 11.4 dB         ΔMkr1 -1.000 MHz           dB/div         Ref 21.40 dBm         -0.005 dB														
								Center Fre						
							[	2.480000000 GH						
								Start Fre						
								2.478500000 GH						
						- marine	Jensola	Stop Fre						
								2.481500000 GI						
	-	VBW 300	kH7		Sween 1			CF Ste						
C SCL	X	Y	FL		<u> </u>			Auto <u>Ma</u>						
f (Δ)							— I [	Freq Offs						
							=	01						
	Ref Offset 1 Ref Offset 1 Ref 21.40	req 2.48000000 GHz PNC: Wi IFGaint. Ref Offset 11.4 dB Ref 21.40 dBm 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2	ctrum Analyzer - Swept SA           RF         S0 Ω         DC         Trig           req 2.480000000 GHz         PNO: Wide C         Trig         #Att           Ref Offset 11.4 dB         Ref 21.40 dBm         #Att           1Δ2         1         1         1           100 kHz         #VBW 300         WBW 300         GHz         100 kHz         #VBW 300	ctrum Analyzer - Swept SA RF 50 Ω DC SENSE:INT req 2.48000000 GHZ PNO: Wide Trig: Free Run IFGain:Low #Atten: 20 dB Ref Offset 11.4 dB Ref 21.40 dBm 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2 1Δ2	Ctrum Analyzer - Swept SA         SENSE:INT         #Avg/Typ           req 2.48000000 GHz         Frig: Free Run         #Avg/Hole           PNO: Wide         Trig: Free Run         Avg/Hole           Ref Offset 11.4 dB         #Atten: 20 dB         14           142         7         7           142         7         7         7           140         8         7         7           140         7         7         7           140         7         7         7           140         8         7         7           140         7         7         7           140         7         7         7           140         8         7         7           140         7         7         7           1500000         7         7         7           100 kHz         #VBW 300 kHz         7         7	RF         50.0.00         GHZ         SENSE:INT         ALIGN AUTO           PRO: Wide IFGain:Low         Trig: Free Run #Atten: 20 dB         #Avg Hold:>10/10           Ref Offset 11.4 dB Ref 21.40 dBm         ΔM           1.2	ctrum Analyzer - Swept SA         SENSE:INT         ALIGN AUTO         12:46:34 AMJO           req 2.480000000 GHz         PNO: Wide Figsin: Low         Trig: Free Run #Avg Hold:>10/10         Free Run #Avg Hold:>10/10         Free Run #Avg Hold:>10/10         Free Run #Avg Hold:>10/10         Fre	ctrum Analyzer - Swept SA         SENSE:INT         ALIGN AUTO         12:46:34 AMJun 20, 2023           req 2.480000000 GHz         SENSE:INT         ALIGN AUTO         12:46:34 AMJun 20, 2023           PNO: Wide         Trig: Free Run         Avg[Hold:>10/10         Trig: P P A NNN           Ref Offset 11.4 dB         ΔMkr1 -1.000 MHz         -0.005 dB           11.42         -0.005 dB         -0.005 dB						

										8-[	DP	SK	(Lo	сw	)						
🇾 Key	sight	Spect		analyzer																	- 5 🗾
	T	Ere	RF		50 Ω 200	DC	) GH	7			ENSE:I	NT	#Avo		LIGN AUTO	)	12:49:58 TRA	AM Jun 2			Frequency
Cen		r re	<sup>7</sup> 4 4		200	0000	PN	C: Wide Sain:Lov		Trig: Fr #Atten:					>10/10		T	PE MW	M 14444	u 🛏	
10 dE	Ridiv			Offse											Δ	Mk	r1 1.( -(	000 I 0.316			Auto Tune
Log																				11	
11.4																-	<b>▲</b> 1∆2			1	Center Fred
1.40									$\sim$		₩2	$\sim$			~~~~~				$\sim$	1	2.40200000 GH
-8.60														~~~		+		+		1	
-18.6											-					+				1	Start Free
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-38.6			$\rightarrow$	~_~		, <b>~</b> ~					-					-		-		₽⊢	
-48.6											-					+		-		ł٢	Oton Ero
-58.6											-					-		-		11	Stop Free 2.403500000 GH
-68.6											_					_		-		Ł	2.405500000 GH.
Cent				~~ ~														000		╉	
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2	<u>∆2</u> F	1	f	<u>(</u> ∆)		2.40	<u>1.000</u> 02 000	) MHz ) GHz	<u>(Δ)</u>	-0.31	<u>6 dB</u> dBm			-		_			-	It	
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8-DPSK (Middle) Keysight S trum Analyzer - Swept SA 12:49:17 AM Jun 20, 2023 TRACE 1 2 3 4 5 6 TYPE MWHWWW DET P A N N N M T RF 50 Ω DC Center Freq 2.441000000 GHz PN0: Wide IFGain:Low HTrig: Free Run #Atten: 20 dB #Avg Type: RMS Avg|Hold:>10/10 Frequency ΔMkr3 1.000 MHz 0.005 dB Auto Tune Ref Offset 11.4 dB Ref 21.40 dBm 0 0 11 **Center Freq ≜**<sup>3∆4</sup>  $\sqrt{142}$ 2.441000000 GHz 1.4 12 8.60 18. Start Freq 28. 2.439500000 GHz 38.6 48. Stop Freq 58.6 2.442500000 GHz 68.E Center 2.441000 GHz #Res BW 100 kHz Span 3.000 MHz Sweep 1.000 ms (1001 pts) **CF Step** 2.480000000 GHz Auto <u>Man</u> #VBW 300 kHz MKRI MODELTROLS f (Δ) f f (Δ) f 
 -1.000 MHz
 (Δ)

 2.441 000 GHz
 (Δ)

 1.000 MHz
 (Δ)

 2.441 000 GHz
 (Δ)
 0.023 dB -2.168 dBm 0.005 dB -2.168 dBm 1 Δ2 F Δ4 F Freq Offset 0 Hz STATUS

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<mark>⊯</mark> Cent	T ter	Fre	RF eq 2	2.48	50 Ω 000	DC 000				_	Trio	SEN	Bur			ј Тур	ALIGN AL e: RMS :>10/10			TRAC TYP	1 Jun 20 E 1 2 3 E M₩	3450	-	Frequency
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10 dE	3/div				et 11 . <b>40 (</b>												4	ΔMI	kr1 -		00 N 051			Auto Tune
Log																								
11.4					▲1/	12																		Center Free
1.40	~	~	~	~~~	<b>X</b>	h	<u> </u>	-	~~	$\sim$	~	~~}	(z-	$\sim$		~								2.48000000 GH
-8.60																~								
-18.6																	$\left  \right\rangle$							Start Free
-28.6																		Luna 1	~	~	~~~~			2.478500000 GH
-38.6																				~				
-48.6																								Stop Free
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-68.6																								
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MKR M		TRC					Х				Y			FUN	CTION	FU	ICTION W	IDTH	FU	NCTIC	)n valu	E ^	Γ <sup>Α</sup>	uto <u>Mar</u>
2	∆2 F	1	f	<u>(Δ)</u>		2	-1. .480		MHz GHz	( <u></u> ( <u></u> )	-2.3	).051 ( 55 dB	dB Sm											<b>F O</b> ff ·
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Report No.: TMTN2305000719NR

# 8.4 NUMBER OF HOPPING FREQUENCY USED

#### <u>LIMIT</u>

§15.247(a)(1)(iii) For frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

## TEST SETUP



#### TEST PROCEDURE

- 1 Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
- 2 Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- 3 Set the spectrum analyzer on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- 4 Set the spectrum analyzer on View mode and then plot the result on spectrum analyzer screen.
- 5 Repeat above procedures until all frequencies measured were complete.



## TEST RESULTS

Model Name	JBL SPINNER BT	Test By	Peter Chu
Temp & Humidity	23.5°C, 48%	Test Date	2023/06/19

## Modulation Type: GFSK / DH5

Result(No.of CH)	Limit(No.of CH)	Result
79	>15	PASS

#### Modulation Type: 8-DPSK / 3-DH5

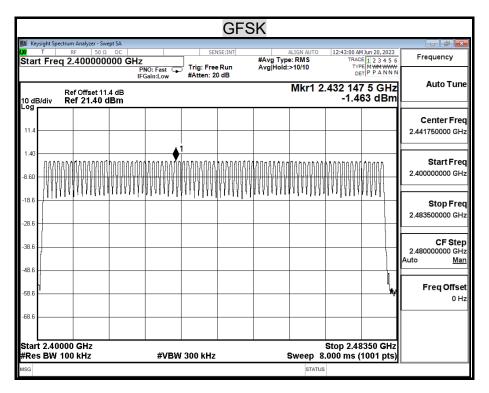
Result(No.of CH)	Limit(No.of CH)	Result
79	>15	PASS



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Report No.: TMTN2305000719NR

#### NUMBER OF HOPPING FREQUENCY USED



u í	T		n Analyze RF .4000	50 Ω		Ηz		٦.		NSE:INT	#Avg Ty		TR.	AM Jun 20,	45	6	Frequency
							D:Fast C ain:Low		rig: Free Atten: 2		Avg Hol		2.430 14				Auto Tur
0 dE	/div		ef Offse ef 21.											459 dl			
-3																	Center Fre 2.441750000 Gi
1.40 3.60	M	WW	WW	YYYY	YWW	/wl	יזיזיזי 1 1	เหน่า	NNN	WWWM	MMAN	WHANN	nnnn	MANAN			<b>Start Fr</b> 2.400000000 Gi
18.6																-	<b>Stop Fr</b> 2.483500000 G
18.6 j	4														4		<b>CF St</b> e 2.48000000 G Auto <u>M</u>
18.6 58.6																Ą	Freq Offs
58.6						+		-								╢	
			) GHz ) kHz				#\/P		0 kHz				Stop 2.4 8.000 ms				



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8.5 DWELL TIME ON EACH CHANNEL

## <u>LIMIT</u>

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

## TEST SETUP



## TEST PROCEDURE

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- 3. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrum analyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- 4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- 5. Repeat above procedures until all frequencies measured were complete.
- 6. The Bluetooth Headset has 3 type of payload, DH1, DH3, DH5. The hopping rate is 1600 per second. The longer the payload is, the slower the hopping rate is.



Report No.: TMTN2305000719NR TEST RESULTS

Time of occupancy on the TX channel in 31.6sec = time domain slot length × hop rate ÷ number of hop per channel × 31.6

Refer to the attached graph.

The hopping rates of Bluetooth devices change with different types of payload. The longer the payload is, the slower the hopping rate. The hopping rate scenario is defined in Bluetooth core specification.

Model Name	JBL SPINNER BT	Test By	Peter Chu
Temp & Humidity	23.5°C, 48%	Test Date	2023/06/19

#### Modulation Type: GFSK / DH5

Transmitting Frequency	Packet type	Dwell time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Limit for Time of occupancy on the TX channel in 31.6sec (ms)	Results
2441MHz	DH1	0.400	128.00	400.000	PASS
2441MHz	DH3	1.665	266.40	400.000	PASS
2441MHz	DH5	2.910	310.40	400.000	PASS
2441MHz	AFH	2.910	155.20	400.000	PASS
DH1 Dwell tine= DH3 Dwell tine=		s×(1600÷2)÷79×3 s×(1600÷4)÷79×3			

 DH3 Dwell tine=
 1.665
 ms×(1600÷4)÷79×31.6=
 266.40
 (ms)

 DH5 Dwell tine=
 2.910
 ms×(1600÷6)÷79×31.6=
 310.40
 (ms)

 AFH Dwell tine=
 2.910
 ms×(800÷6)÷20×8=
 155.20
 (ms)

#### Modulation Type: 8-DPSK / 3-DH5

Transmitting Frequency	Packet type	Dwell time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Limit for Time of occupancy on the TX channel in 31.6sec (ms)	Results
2441MHz	3DH1	0.400	128.00	400.000	PASS
2441MHz	3DH3	1.665	266.40	400.000	PASS
2441MHz	3DH5	2.910	310.40	400.000	PASS
2441MHz	AFH	2.910	155.20	400.000	PASS
	AFH	2.910			

3DH1 Dwell tine=0.400ms×(1600÷2)÷79×31.6=128.00 (ms)3DH3 Dwell tine=1.665ms×(1600÷4)÷79×31.6=266.40 (ms)3DH5 Dwell tine=2.910ms×(1600÷6)÷79×31.6=310.40 (ms)AFH Dwell tine=2.910ms×(800÷6)÷20×8=155.20 (ms)

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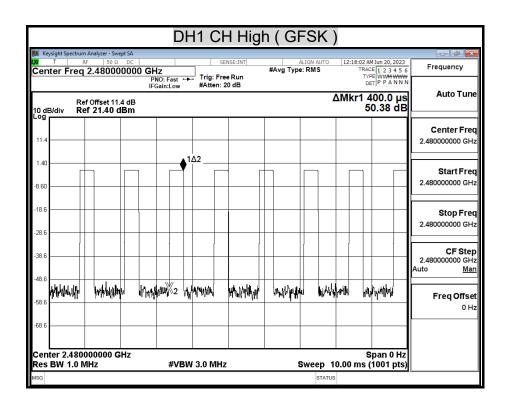
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# DWELL TIME ON EACH PAYLOAD

				DH							
Т		rum Analyzer - 1 RF 50	ΩDC		_	SENSE:INT		ALIGN AUTO	12:11:14 AM Jun		
ente	r Fre	eq 2.4020	000000 GH	NO: Fast 🔸		: Free Run en: 20 dB	#Avg Ty	pe:RMS	TRACE 1 : TYPE W DET P	23456 WMWWW PANNI	
0 dB/d	F liv <b>F</b>	Ref Offset 7 Ref 21.40	11.4 dB	Gain:Low	#Atte	en: 20 GB		Δ	Mkr1 400		Auto Tune
og 11.4											Center Free 2.402000000 GH:
1.40 — 3.60 —			∳ <sup>1∆2</sup>								Start Free 2.402000000 GH:
18.6											<b>Stop Fred</b> 2.402000000 GH;
18.6							]				CF Step 2.480000000 GH: Auto <u>Mar</u>
11.1	1404 1	hurthlynulles	X2 AMMANA	la malinina	<b>#</b> %	<b>h</b> hahayan yi	allow Ally	YUNAN	edneddydd fwrg	γµ	Freq Offse 0 H:
	r 2.40 W 1.0	2000000 MHz	GHz	#vвw			ddle ( (	STATUS	.00 ms (100	n 0 Hz 11 pts)	
es Bl	W 1.0	MHz					ddle((	STATUS	.00 ms (100	1 pts)	1
es Bi sa í Keysigi	W 1.0	rum Analyzer - 1 RF 50	5wept SA Ω DC   D00000 GF	DH′	1 C	H Mi	ddle(( #Avg Ty	STATUS GFSK ALIGN AUTO pe: RMS	) 12:12:00 AMJun TRACE [] TRACE [] TYPE WW DET P	20, 2023 2 3 4 5 6 MWWW P A N N	Frequency
Keysigi Keysigi T Center	ht Spectro r Fre	rum Analyzer - 1 RF 50	Swept SA Ω DC DC D00000 GF IF4	DH <sup>-</sup> Iz NO: Fast ++	1 C	SENSE:INT		STATUS GFSK ALIGN AUTO pe: RMS	.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MWWW P A N N	Frequency Auto Tun
Keysigh T Center	ht Spectro r Fre	MHz rum Analyzer - 1 RF 50 eq 2.4410 Ref Offset 1	Swept SA Ω DC   D00000 GF I1.4 dB 0 dBm	DH <sup>-</sup> Iz NO: Fast ++	1 C	SENSE:INT		STATUS GFSK ALIGN AUTO pe: RMS	.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MMWWP P A N N F .0 µs	Auto Tune Center Free
es Bi sa í Keysigi	ht Spectro r Fre	MHz rum Analyzer - 1 RF 50 eq 2.4410 Ref Offset 1	Swept SA Ω DC DC D00000 GF IF4	DH <sup>-</sup> Iz NO: Fast ++	1 C	SENSE:INT		STATUS GFSK ALIGN AUTO pe: RMS	.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MMWWP P A N N F .0 µs	Auto Tune Center Free 2.44100000 GH Start Free
es B) <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>6</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>7</sup> <sup>8</sup> <sup>9</sup> <sup>11,4</sup>	ht Spectro r Fre	MHz rum Analyzer - 1 RF 50 eq 2.4410 Ref Offset 1	Swept SA Ω DC   D00000 GF I1.4 dB 0 dBm	DH <sup>-</sup> Iz NO: Fast ++	1 C	SENSE:INT		STATUS GFSK ALIGN AUTO pe: RMS	.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MMWWP P A N N F .0 µs	Auto Tune Center Free 2.441000000 GH Start Free 2.441000000 GH Stop Free
Image: Several second	ht Spectrr	MHz Ref Offset 1 Ref 21.40	Swept SA	DH <sup>+</sup>	Trig: #Atte	SENSE:INT	#Avg Ty		.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MMWWP P A N N F .0 µs	Frequency           Auto Tun           Center Frequency           2.441000000 GH           Start Frequency           2.441000000 GH           Stop Frequency           2.441000000 GH           CF Steg           2.48000000 GH
0         dB/dl           0         dB/dl           111.4	ht Spectrr	MHz Ref Offset 1 Ref 21.40	Swept SA Ω DC   D00000 GF I1.4 dB 0 dBm	DH <sup>-</sup> Iz NO: Fast ++	Trig: #Atte	SENSE:INT		STATUS GFSK ALIGN AUTO pe: RMS	.00 ms (100 ) 12:12:00 AMJun TRACE [1] TYPE W DET P1 Mkr1 400	20, 2023 2 3 4 5 6 MMWWP P A N N F .0 µs	Frequency           Auto Tune           Center Freq           2.441000000 GH           Start Freq           2.441000000 GH           Stop Freq           2.441000000 GH           CF Step           2.480000000 GH           Auto           Mator           Mator           Freq Offsee
Image: sea	ht Spectra r Fre liv F	MHz <sup>RF</sup> 50 cq 2.4410 Ref Offset 7 Ref 21.40	Swept SA 2 DC 2000000 GF P If 4 dBm 1Δ2 2 multiplication 2 multiplication 3 multiplication	DH <sup>+</sup>	Trig: #Atte	SENSE:INT Free Run en: 20 dB	#Avg Ty		.00 ms (100	20,2023 2 3 4 5 6 7 2 A M M 2	Auto Tune           Center Free           2.441000000 GH:           Start Free           2.441000000 GH:           Stop Free           2.441000000 GH:           CF Step           2.48000000 GH:           Auto           Mar           Freq Offse           0 H:



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			DH3						
	ectrum Analyzer - Sv RF 50 ያ			SENSE:INT	A	LIGN AUTO	12:29:14 AM Jun	20, 2023	- 7 -
Center F	req 2.4020		: Fast ++ T	rig: Free Run	#Avg Type		TRACE 1	23456 MMWWW PANNN	Frequency
10 dB/div	Ref Offset 17 Ref 21.40	IFGai 1.4 dB		Atten: 20 dB		Δ	Mkr1 1.66		Auto Tune
11.4									Center Freq 2.402000000 GHz
8.60									<b>Start Freq</b> 2.402000000 GHz
-18.6									<b>Stop Freq</b> 2.402000000 GHz
-38.6									<b>CF Step</b> 2.480000000 GHz Auto <u>Man</u>
-40.6 M/	444 M	#U49%2	relugio	ww	WINN	rphitM	haliya	4	Freq Offset 0 Hz
Res BW 1						STATUS	ţ	,	
			DH3	сн мід	dla ( C	FOK	)		
Kausiaht Ca		week CA	DH3	CH Mid	dle(G	FSK	)		
Т	RF 50 S	Ω DC 00000 GHz		SENSE:INT	,	LIGN AUTO	12:28:38 AM Jun	23456	Frequency
0 ⊤ Center F 0 dB/div	RF 50 \$	DC 00000 GHz PNO IFGai	Fast ↔ T		Å	LIGN AUTO E: RMS	12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	23456 WHWWW PANNN	Frequency
Center F	RF 50 S req 2.4410 Ref Offset 1	DC 00000 GHz PNO IFGai	:Fast ↔ T n:Low #/	SENSE:INT	Å	LIGN AUTO E: RMS	12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	2 3 4 5 6 MMWWW P A N N N 5 ms	Auto Tune Center Free
Center F	RF 50 S req 2.4410 Ref Offset 1	DC 00000 GHz PNO IFGai	: Fast ↔ T	SENSE:INT	Å	LIGN AUTO E: RMS	12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	2 3 4 5 6 MMWWW P A N N N 5 ms	
10 dB/div	RF 50 S req 2.4410 Ref Offset 1	DC 00000 GHz PNO IFGai	:Fast ↔ T n:Low #/	SENSE:INT	Å	LIGN AUTO E: RMS	12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	2 3 4 5 6 MMWWW P A N N N 5 ms	Frequency Auto Tune Center Freq 2.44100000 GHz Start Freq
0 dB/div 0 dB/div 0 dB/div 11.4 1.40 18.6 18.6	RF   50 C	DC 00000 GHz PNO IFGai	:Fast ↔ T n:Low #/	SENSE:INT			12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	23456 WWW PANNN 5 ms 7 dB	Frequency Auto Tune Center Freq 2.44100000 GHz Start Freq 2.44100000 GHz Stop Freq
0 dB/div °9 11.4 1.40 18.6 38.6 38.6	RF 50 S req 2.4410 Ref Offset 1	DC 00000 GHz PNO IFGai	:Fast ↔ T n:Low #/	SENSE:INT	Å	LIGN AUTO E: RMS	12:28:38 AM Jun TRACE 1 TYPE W DET P 1 Mkr1 1.66	2 3 4 5 6 MMWWW P A N N N 5 ms	Frequency           Auto Tune           Center Freq           2.441000000 GHz           Start Freq           2.441000000 GHz           Center Freq           2.441000000 GHz           CF Step           2.48000000 GHz



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