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

For

# Fully Automatic Belt-Drive Wireless Streaming Turntable

Model: PRO200BT, iT96

Data Applies To: N/A



Issued for

ION Audio, LLC 200 Scenic View Drive, Cumberland, RI 02864, U.S.A.

Issued By

**Compliance Certification Services Inc.** 

Tainan Laboratory No.8,Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.) TEL: 886-6-580-2201 FAX: 886-6-580-2202 http://www.ccsrf.com Issued Date: November 02, 2018

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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### **REVISION HISTORY**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	November 02, 2018	Initial Issue	ALL	Sunny Chang



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# **1. TEST REPORT CERTIFICATION**

Applicant	:	<b>ION Audio, LLC</b> 200 Scenic View Drive, Cumberland, RI 02864, U.S.A.
Manufacturer	:	ION Audio, LLC 200 Scenic View Drive, Cumberland, RI 02864, U.S.A.
Equipment Under Test	:	Fully Automatic Belt-Drive Wireless Streaming Turntable
Model Number	:	PRO200BT, iT96
Data Applies To	:	N/A
Brand Name	:	
Date of Test	:	October 24, 2018 ~ October 25, 2018

APPLICABLE STANDARD		
STANDARD	TEST RESULT	
FCC Part 15 Subpart C AND ANSI C63.10: 2013	PASS	

## 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:

Jeter Wu Assistant Manager

Reviewed by:

Eric Huang Section Manager



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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



# **3. EUT DESCRIPTION**

# **3.1 DESCRIPTION OF EUT & POWER**

Product	Fully Automatic Belt-Drive Wireless Streaming Turntable	
Model Number	PRO200BT, iT96	
Data Applies To	N/A	
Brand Name		
Identify Number	T180917N02	
Received Date	September 17, 2018	
Frequency Range	2402 ~ 2480 MHz	
Transmit Peak Power     GFSK : 2.476dBm / 1.76847938mW       8DPSK: 2.131dBm / 1.63342802mW		
Channel Spacing	1MHz	
Transmit Data Rate	GFSK Mode:1 Mbps 4/π DQPSK Mode:3Mbps 8DPSK Mode:24Mbps	
Modulation Type	Frequency Hopping Spread Spectrum	
Number of Channels	79 Channels	
EUT Power Supply	DC 12V, 500mA (Powered by Adapter)	
Antenna Type	Manufacturer: BRITO TECHNOLOGY Type: PIFA Antenna Model: ANT-200 Gain: 2.04 dBi	
Firmware Version	ICYH104P08	
Software Version	N/A	

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Power Adapter :

No.	Manufacturer	Model No.	Power Input	Power Output
1	GPE	GPE053A-V12005 0-1	100-240Vac, 50/60Hz, 0.2A	12Vdc, 0.5A

#### 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: 2AB3E-iT96 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. To add model(iT96) all the same of the original model(PRO200BT), design, except for different models name and is just for the marketing purpose.



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# 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).
- Following channel(s) was (were) 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).
- Following channel(s) was (were) 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).
- Solution 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



# 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.)

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
Germany	TUV NORD
Taiwan	BSMI
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http:///www.ccsrf.com



## **6.5 MEASUREMENT EQUIPMENT USED**

#### For §8.8.2~8.8.3

	Chamber 966 Room (Radiation Test)						
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due			
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	07/19/2019			
Amplifier	HP	8447F	2443A01671	01/21/2019			
Bi-Log Antenna	Sunol	JB1	A070506-2	02/08/2019			
Cable	Rosnol+Suhner	SUCOFLEX 104PEA	SN25737 /4PEA	01/26/2019			
Double Ridged Guide Horn Antenna	ETS-LINDGREN	3116	00078900	03/19/2019			
EMI Test Receiver	R&S	ESCI	100960	10/30/2018			
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	07/04/2019			
Hi-Pass Filter	MICRO-TRONIC S	BRM50702-01	018	01/21/2019			
Horn Antenna	Com-Power	AH-118	071032	04/18/2019			
Pre-Amplifier	EMCI	EMC012645	980098	01/21/2019			

### For §8.1~8.7 8.8.4

Chamber 966 Room (Conducted Test)						
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due		
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY54430216	07/04/2019		
Power Meter	Anritsu	ML2487A	6K00003888	05/01/2019		
Power Sensor	Anritsu	MA2491A	033265	05/01/2019		
SMA Cable + 10dB Attenuator	CCS	SMA + 10dB Att	O6	01/21/2019		

#### For §8.9

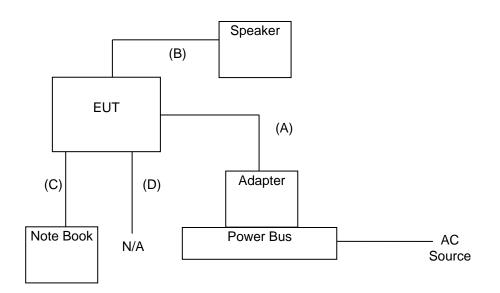
Conducted Emission room #1							
Name of Equipment	quipment Manufacturer Model Serial Number Calibration D						
BNC Coaxial Cable	CCS	BNC50	11	01/23/2019			
EMI Test Receiver	R&S	ESCS 30	100348	01/30/2019			
LISN	SCHWARZBECK	NNLK8130	8130124	11/30/2018			
LISN	FCC	FCC-LISN-50-32- 2	08009	05/23/2019			
Pulse Limiter	R&S	ESH3-Z2	100116	01/23/2019			
Test S/W	e-3 (5.04211j)						



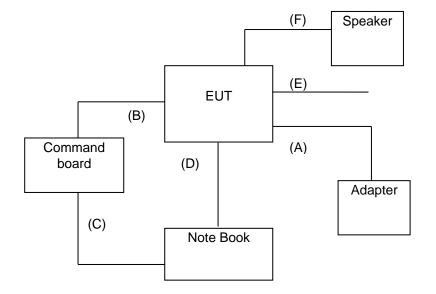
# 7. SETUP OF EQUIPMENT UNDER TEST

# 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	Genius	SP-S110	DCC	Audio cable, unshd, 1.6m
2	Note Book	TOSHIBA	PORTEGE R30-A	DCC	Power cable, unshd, 1.8m

No.	Signal cable description		
А	DC In	Unshielded, 1.5m 1 pcs.	
В	Audio	Unshielded, 1.4m 1 pcs.	
С	USB	Shielded, 1.0m 1 pcs. with one core	
D	Audio	Unshielded, 0.35m 1 pcs.	

### For RF test

No.	Product	Manufacturer	Model No.	Certify No.	Signal cable
1	Note Book	Acer	AS 3830TG	DoC	Power cable, unshd, 1.6m
2	Speaker System	T.C.SATR	TCS2285	DoC	Power cable, unshd, 1.8m

No.	Signal cable description		
А	Power	Unshielded, 1.5m 1 pcs.	
В	Command	Unshielded, 0.15m 1 pcs.	
С	USB	Shielded, 1.0m 1 pcs. with 1 core.	
D	USB	Shielded, 1.0m 1 pcs. with 1 core.	
Е	Audio	Unshielded, 0.35m 1 pcs.	
F	Audio	Unshielded, 1.4m 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

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### **EUT OPERATING CONDITION**

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### **RF Setup**

- 1. Set up all computers like the setup diagram.
- 2. The "ISRT\_V1.0.37.2841" software was used for testing
- 3.Choose Chip Number "IS1621S\_393\_SRC\_V3.1", COM "COM6" and BAUDRATE"115200".

TX Mode:

GFSK(DH1): Packet Type > DH1 BDR MAX > 0x36

GFSK(DH3): BDR MAX > 0x36

GFSK(DH5): Packet Type > DH5 BDR MAX > 0x36

8-DPSK(3DH1): Packet Type > 3DH1 BDR MAX > 0x2e

8-DPSK(3DH3): Packet Type > 3DH3 EDR MAX > 0x2e

8-DPSK(3DH5): Packet Type > 3DH5 EDR MAX > 0x2e

### **RX Mode:**

RX

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



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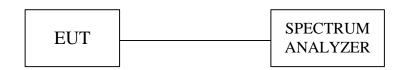
# 8. APPLICABLE LIMITS AND TEST RESULTS

## 8.1 20dB BANDWIDTH FOR HOPPING

### <u>LIMIT</u>

None; for reporting purposes only.

### TEST SETUP



### TEST PROCEDURE

The 20dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20dB band width of the emission was determined.



### **TEST RESULTS**

Model Name	PRO200BT	Test By	Ted Huang
Temp & Humidity	26.5°C, 54%	Test Date	2018/10/25

### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Pass / Fail
Low	2402	1001.00	N/A
Middle	2441	964.00	N/A
High	2480	1006.00	N/A

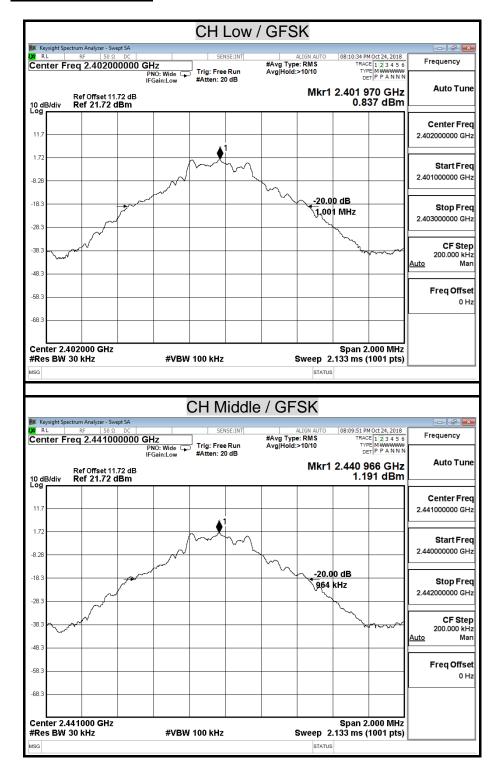
### Modulation Type: 8-DPSK / 3-DH5

Channel	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Pass / Fail
Low	2402	1290.00	N/A
Middle	2441	1293.00	N/A
High	2480	1299.00	N/A



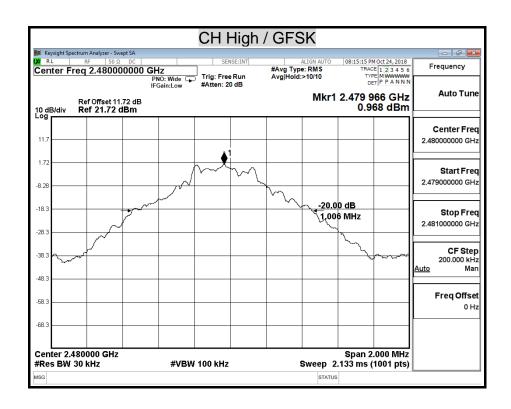
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### 20dB BANDWIDTH





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CH Low / 8-DPSK Keysight Spectrum Analyzer - Swept SA ALIGN AUTO 08:19:15 PM Oct 24, 2018 #Avg Type: RMS TRACE [12] 3 4 5 6 Avg|Hold:>10/10 TYPE M WWWWW DET [P P A N N N Center Freq 2.402000000 GHz Freq 2.402000000 GHz FRoin:Low Freq 2.402000000 GHz Trig: Free Run HGain:Low #Atten: 20 dB Frequency Auto Tune Mkr1 2.401 970 GHz Ref Offset 11.72 dB Ref 21.72 dBm -0.009 dBm 10 dB/div Log **Center Freq** 11.3 2.402000000 GHz 1.7 Start Freq 2.400500000 GHz -8.28 20.00 dB -18.3 Stop Freq 1.290 MHz 2.403500000 GHz -28.3 CF Step 300.000 kHz Man -38.3 50 ACL - - - O  $\nabla$ Auto .48 3 Freq Offset -58.3 0 Hz -68.3 Center 2.402000 GHz #Res BW 30 kHz Span 3.000 MHz Sweep 3.200 ms (1001 pts) #VBW 100 kHz STATUS CH Middle / 8-DPSK 
 Keysight Spectrum Analyzer - Swept SA

 RL
 RF
 50 Ω
 DC
 - 6 × SENSE:INT 
 ALIGN AUTO
 08:18:40 PM Oct 24, 2018

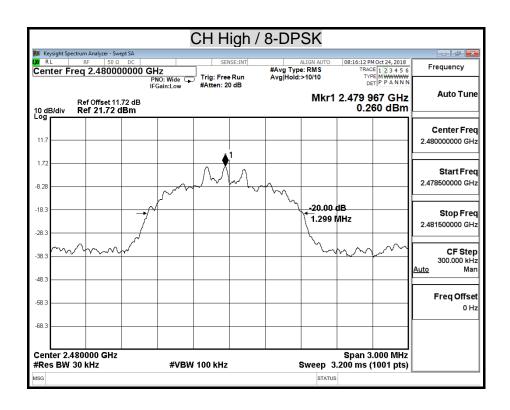
 #Avg Type: RMS
 TRACE [1:2:3 4 5 6

 Avg|Hold:>10/10
 TYPE M

 DET [P P A N N N
 Frequency Center Freq 2.441000000 GHz PNO: Wide Trig: Free Run IFGain:Low #Atten: 20 dB Auto Tune Mkr1 2.440 967 GHz 0.510 dBm Ref Offset 11.72 dB Ref 21.72 dBm 10 dB/div Log **Center Freq** 11.3 2.441000000 GHz 1.7 Start Freq 2.439500000 GHz -8.28 -20.00 dB 18. Stop Freq 1.293 MHz 2.442500000 GHz -28.3 CF Step -38.3 300.000 kHz Man Auto -48 3 Freq Offset -68.3 0 Hz -68.3 Center 2.441000 GHz #Res BW 30 kHz Span 3.000 MHz Sweep 3.200 ms (1001 pts) #VBW 100 kHz STATUS



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## 8.2 MAXIMUM PEAK OUTPUT POWER

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### <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, A power meter was used to record the shape of the transmit signal.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured  $VBW \ge RBW$ Sweep = auto Detector function = peak Trace = max hold



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### TEST RESULTS

Model Name	PRO200BT	Test By	Ted Huang	
Temp & Humidity	26.5°C, 54%	Test Date	2018/10/25	

### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	2.27	1.68616		PASS
Mid	2441	2.48	1.76848	125	PASS
High	2480	2.12	1.63042		PASS

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

Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Output (mW)	Limit (mW)	Result
Low	2402	1.74	1.49245		PASS
Mid	2441	2.13	1.63343	125	PASS
High	2480	1.95	1.56531		PASS



## **Average Power Data**

### Modulation Type: GFSK / DH5

Channel	Channel Frequency (MHz)	Average Power (dBm)
Low	2402	0.95
Middle	2441	1.24
High	2480	0.83

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

Channel	Channel Frequency (MHz)	Average Power (dBm)
Low	2402	-1.75
Middle	2441	-1.16
High	2480	-1.17

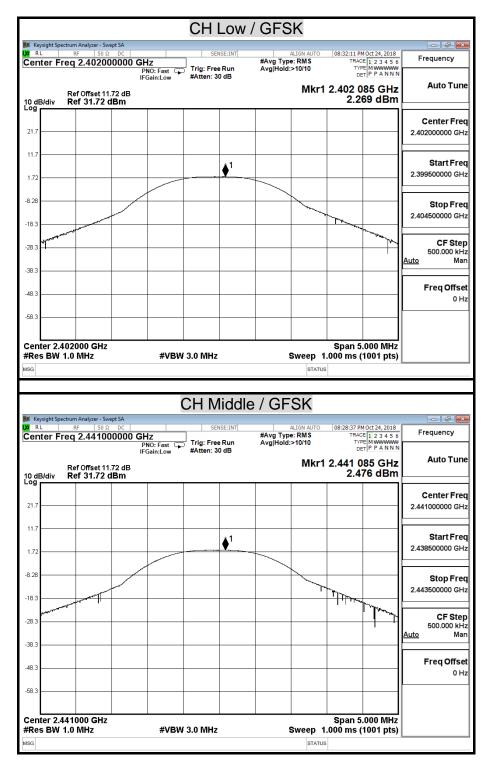
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### MAXIMUM PEAK OUTPUT POWER





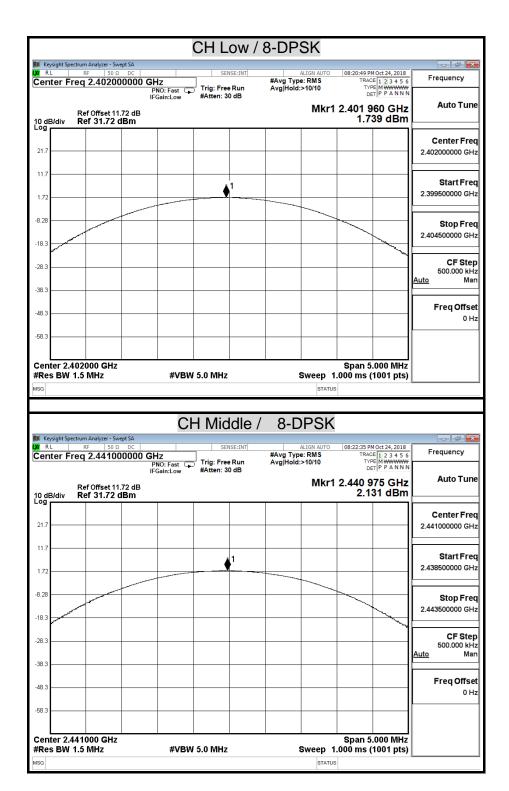
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		trum Analyzer - Sv RF 50 ያ				SE:INT		ALIGN AUTO	00-26-42.5	M Oct 24, 2018	- 5 -
		eq 2.4800	00000 G	iHz PNO: Fast	Trig: Free	Run	#Avg Typ Avg Hold	e: RMS	TRA TY	CE 1 2 3 4 5 6 PE MWWWW	Frequency
IO dE	3/div	Ref Offset 17 Ref 31.72	1.72 dB	FGain:Low	#Atten: 3	0 dB		Mkr1	2.479	ational and a second se	Auto Tun
21.7											Center Fre 2.480000000 GH
11.7 1.72					<b>∮</b> <sup>1</sup>						<b>Start Fre</b> 2.477500000 GH
-8.28											<b>Stop Fre</b> 2.482500000 GH
28.3	anger Nered Ye									and the second sec	CF Ste 500.000 kH <u>Auto</u> Ma
48.3											Freq Offse 0 H
68.3											
		80000 GHz 1.0 MHz		#\/B\A	/ 3.0 MHz			Sween 1		000 MHz (1001 pts)	



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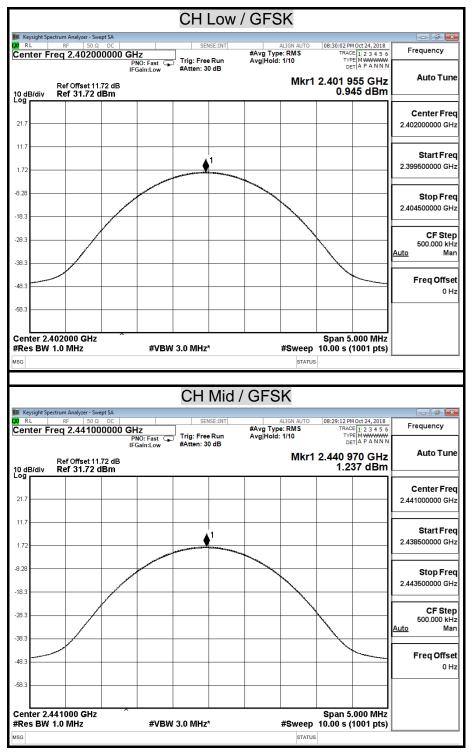
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		C	CH High /	8-DPSK		
	Spectrum Analyzer - Swept SA		Ŭ			- 7 -
XI RL Center	RF 50 Ω DC	GHz	SENSE:INT	ALIGN AUTO #Avg Type: RMS	08:23:00 PM Oct 24, 2018 TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast IFGain:Low	J Trig: Free Run #Atten: 30 dB	Avg Hold:>10/10	DET P P A N N N	
10 dB/div	Ref Offset 11.72 dB Ref 31.72 dBm			Mkr1	2.479 965 GHz 1.949 dBm	Auto Tun
						Center Free
21.7						2.480000000 GH:
11.7		_				Start Free
1.72			∳ <sup>1</sup>			2.477500000 GH
-8.28						Stop Free
-18.3	where the second s					2.482500000 GH
ſ						CF Ster
-28.3						500.000 kH <u>Auto</u> Mai
-38.3						Freq Offse
-48.3						0 H
-58.3						
	2.480000 GHz V 1.5 MHz	#VBW	( 5.0 MHz	Sweep 1	Span 5.000 MHz .000 ms (1001 pts)	
MSG				STATU		



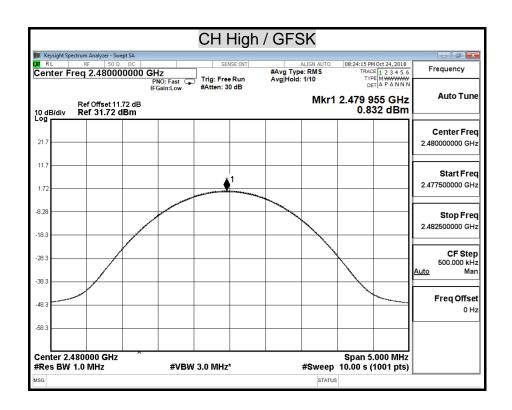
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### **AVERAGE POWER**



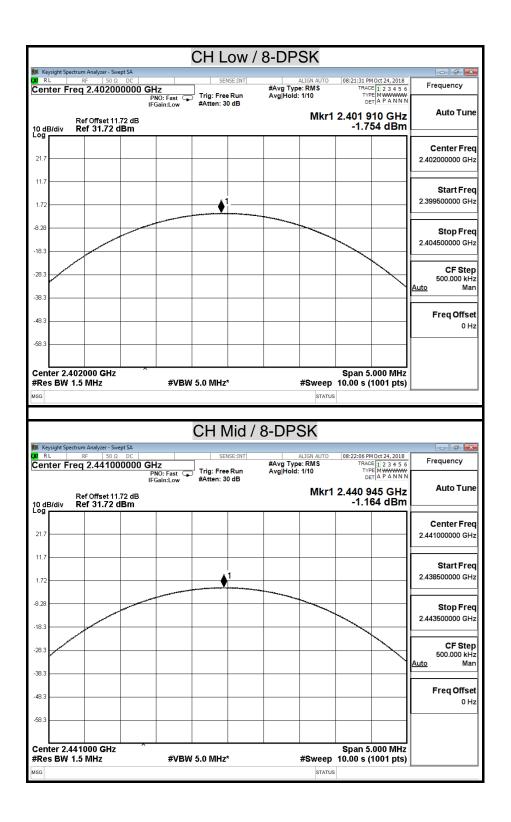


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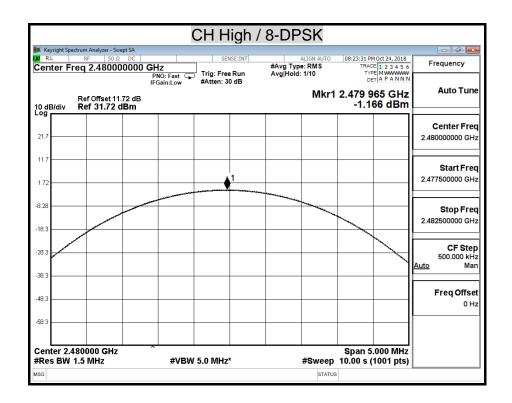


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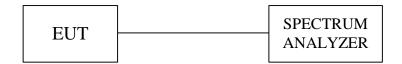


## **8.3 HOPPING CHANNEL SEPARATION**

### <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 andomly 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.

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Report No.: T180917N02-RP1 TEST RESULTS

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	PRO200BT	Test By	Ted Huang
Temp & Humidity	26.5°C, 54%	Test Date	2018/10/25

### Modulation Type: GFSK / DH5

Channel	Adjacent Hopping Channel Separation (MHz)	Two –third of 20dB bandwidth (MHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.67	25 KHz	PASS
2441MHz	1.00	0.64	25 KHz	PASS
2480MHz	1.00	0.67	25 KHz	PASS

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

Channel	Adjacent Hopping Channel Separation (kHz)	Two –third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2402MHz	1.00	0.86	25 KHz	PASS
2441MHz	1.00	0.86	25 KHz	PASS
2480MHz	1.00	0.87	25 KHz	PASS



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## **HOPPING CHANNEL SEPARATION**

		GFSK	(Low)		
Keysight Spectrum Analyzer - Swe       RL     RF     50 Ω       Center Freq 2.40200	DC 0000 GHz	SENSE:INT Trig: Free Run #Atten: 20 dB	ALIGN AUTO #Avg Type: RMS Avg Hold:>10/10	09:29:09 PM Oct 24, 2018 TRACE 1 2 3 4 5 6 TYPE M WWWW DET P P A N N N	Frequency
Ref Offset 11. 10 dB/div Ref 21.72 d			ΔΝ	/kr1 1.000 MHz -0.109 dB	Auto Tune
Log 11.7 -8.28		milan		1Δ2	Center Freq 2.402000000 GHz
-18.3	and the second s				Start Freq 2.400500000 GHz
-48.3					<b>Stop Freq</b> 2.403500000 GHz
Center 2.402000 GHz #Res BW 30 kHz	#VBW 1		•	Span 3.000 MHz .200 ms (1001 pts)	CF Step 300.000 kHz Auto Man
MKR     MODE     TRC     SCL       1     A2     1     f     (A)       2     F     1     f     3       3     -     -     4     -       4     -     -     -     6	× 1.000 MHz (Δ) 2.401 964 GHz	Y FU -0.109 dB 0.873 dBm	JNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offset
7     8       9     10       11     11					
MSG			STATUS	3	

		GFSK	(Middle)		
📕 Keysight Spectrum Analyzer - Sw 🕱 RL RF 50 Ω					
X RL RF 50 Ω Center Freq 2.44100		SENSE:INT	ALIGN AUTO #Avg Type: RMS	09:34:31 PM Oct 24, 2018 TRACE 1 2 3 4 5 6	
	PNO: Wide IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold:>10/10	DET P P A N N	
Ref Offset 11 10 dB/div Ref 21.72			Δι	0.835 dB 0.835 dB	Auto Tune
Log 11.7 1.72 -8.28		- Man		304	Center Fre 2.441000000 GH
-18.3					<b>Start Fre</b> 2.439500000 GH
-48.3					<b>Stop Fre</b> 2.442500000 GH
Center 2.441000 GHz #Res BW 30 kHz		3W 100 kHz	· · · ·	Span 3.000 MHz 3.200 ms (1001 pts)	CF Ste 300.000 kH Auto Ma
MKR MODE TRC SCL $1 \Delta 2 1 f (\Delta)$	× -1.000 MHz (,		FUNCTION FUNCTION WIDTH	FUNCTION VALUE	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2.440 967 GHz 1.000 MHz (, 2.440 967 GHz	0.498 dBm			Freq Offse 0 H
6 7 8					
9					
				<b>T</b>	
	ł		1	•	



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GFSK(High) Keysight Spectrum Analyzer - Swept SA - 6 
 ALIGN AUTO
 09:30:10 PM Oct 24, 2018

 #Avg Type: RMS
 TRACE [1 2 3 4 5 6

 Avg|Hold:>10/10
 TYPE [M WWWWW

 DET [P P A N N N
 Center Freq 2.480000000 GHz PNO: Wide IFGain:Low #Atten: 20 dB Frequency ΔMkr1 -1.000 MHz 0.060 dB Auto Tune Ref Offset 11.72 dB Ref 21.72 dBm 0 c 110 **Center Freq** \*\* 2.480000000 GHz 1.72 8.28 18. Start Freq 28. 2.478500000 GHz 38.3 mh -48. Stop Freq -58. 2.481500000 GHz -68.3 CF Step 300.000 kHz Man Span 3.000 MHz Sweep 3.200 ms (1001 pts) Center 2.480000 GHz #Res BW 30 kHz #VBW 100 kHz Auto MKR MODE T f (Δ) Δ2 2 F -1.000 MHz (Δ) 2.479 964 GHz 0.060 dB 1.043 dBm 2 Freq Offset 0 Hz 9 10 11 STATUS

							8-D	P	SK (	Ĺ	)w	)					
鱦 Keysight S																	- ē 💌
X RL Center	R Fred				17		SEI	VSE:I		#Ava	AL Type:	IGN AUTO		5 PM Oct 24,		F	requency
Center	rieq	2.402	0000	PN	IC: Wide Gain:Lov		Trig: Free #Atten: 2				lold:>				-		
10 dB/div		f Offset										ΔΝ	/kr1 1. -	.000 N 0.107			Auto Tun
Log		1 2 1.7															
11.7			-										<b>1</b> ∆2	+			Center Fre
1.72							$\sim$	2	n			M	. A. C	'n		2.40	2000000 GH
8.28					~~	$\sim$		$\sim$	-		~	~	y m	᠆᠆᠆᠆	~~~		
18.3				$\sim$	r	-									_		Start Fre
28.3				-		-								+	_	2.40	0500000 GH
38.3 ~~~	$\sim$	$\sim \sim \sim \sim$	~	/		_								-	_		
48.3			_			_								_	_		
58.3			_			_								_			Stop Fre 3500000 GH
68.3														_		2.40	3500000 GF
													_				
Center 2 Res BV			IZ		#V	вw	100 kHz				S	weep 3	Span .200 ms	3.000 I ; (1001		Auto	CF Ste 300.000 kH Ma
MKR MODE				Х			Y		FUNCTI	ON	FUNC	TION WIDTH	FUNC	TION VALUE		Auto	IVIG
1 Δ2 2 F	1 f	( <u></u> )	2	<u>1.00</u> 2.401 97	0 MHz 0 GHz	<u>(Δ)</u>	-0.107 0.105 di								-1		
3 4															_		Freq Offs
5															=		0 F
6	_							-							-1		
8																	
10															_		
11								_									
sg							511					STATUS	3				



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rum Analyzer - Sw RF 50 Ω			SENSE				3 PM Oct 24, 2018	
eq 2.44100	PN	IO: Wide 🗔		un A			RACE 1 2 3 4 5 6 TYPE M WWWW DET P P A N N N	Frequency
						ΔMkr3 1	.000 MHz 0.003 dB	Auto Tun
h	2			<u></u>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	3∆4	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Center Fre 2.441000000 G⊦
								Start Fre 2.439500000 GH
								<b>Stop Fre</b> 2.442500000 GH
0 kHz		#VBW	/ 100 kHz			ep 3.200 m	s (1001 pts)	CF Ste 300.000 kH Auto Ma
SCL f (Δ) f f (Δ) f	-1.00 2.440 96 1.00	7 GHz 0 MHz (Δ)	0.498 dBn 0.003 dB	3 1 3	FUNCTION	WDTH FUN	CTION VALUE	Freq Offs
	Ref Offset 11       Ref Offset 12       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       120       12	RF     50.0     DC       2q     2.441000000 GH     PP       P     P     IFG       Ref Offset 11.72 dB     Ref 21.72 dBm     IfG       1Δ2     1Δ2     IfG       41000 GHz     IfG     IfG       If     (Δ)     -1.00       f     (Δ)     -1.00       f     (Δ)     -1.00	RF     50.Ω     DC       2q     2.441000000 GHz     PN0: Wide GIFGain:Low       Ref Offset 11.72 dB     Ref 21.72 dB       Q     1Δ2     1       41000 GHz     #VBW       Vide GIFGain     41000 GHz       Yo kHz     #VBW       F     (Δ)       f     (Δ)       f     (Δ)	RF     50 Ω     DC     SENSE       2q 2.441000000 GHz     PNO: Wide IFGain:Low     Trig: Free R #Atten: 20 d       Ref Offset 11.72 dB Ref 21.72 dBm     1Δ2     2       1Δ2     41000 GHz     41000 GHz     2       41000 GHz     #VBW 100 kHz     2     41000 GHz       10 kHz     #VBW 100 kHz     2	RF     50.Ω     OC     SEMSE:INT       2q 2.441000000 GHz     Trig: Free Run IFGain:Low     Trig: Free Run #Atten: 20 dB     #       Ref Offset 11.72 dB Ref 21.72 dBm     102     4     4     4       102     102     4     4     4     4     4       100 GHz     #VBW 100 kHz     100 kHz     100 kHz     100 kHz     100 kHz	RF     50.0     DC     SENSE:INT     ALIGN       2q     2.441000000 GHz     Trig: Free Run IFGain:Low     Trig: Free Run #Atten: 20 dB     #Avg Type: RM Avg]Hoid:>10/1       Ref Offset 11.72 dB Ref 21.72 dBm     10/2     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0	RF     50.0     DC     SENSE:INT     ALIGN AUTO     [09:33:1]       2q 2.441000000 GHz     PNO: Wide IFGain:Low     Trig: Free Run #Atten: 20 dB     #Avg Hold>10/10     T       Ref Offset 11.72 dB Ref 21.72 dBm     ΔMkr3 1     ΔMkr3 1       1Δ2     4000     4000     4000       41000 GHz     Free Run #Atten: 20 dB     3Δ4       41000 GHz     Sweep 3.200 m     3Δ4       410000 GHz     FUNCTION WIDE FUNCTION FUNCTION FU	RF     Iso Ω DC     SENSE:INT     ALIGN AUTO ALIGN AUTO PNO: Wide IFGaint.ow     Iop33:13 PMOd 24,2018 Trig: Free Run #Atten: 20 dB     Op33:13 PMOd 24,2018 Trig: Free Run AvgIHoid:>10/10     Op33:13 PMOd 24,2018 Trig: Free Run AvgIHoid:>10/10       Ref Offset 11.72 dB Ref 21.72 dBm     AMKr3 1.000 MHz 0.003 dB     OMKr3 1.000 MHz 0.003 dB       11Δ2     3Δ4     3Δ4       41000 GHz     Span 3.000 MHz 0.003 dB     Span 3.000 MHz 0.003 dB       41000 GHz     #VBW 100 kHz     Sweep 3.200 ms (1001 pts)       Sci     X     FUNCTION MIDTH       1     0.409 8dB     FUNCTION MIDTH       1     0.409 8dB     0.003 dB

			ı)	(Higl	PS	8-D						
Frequency	M Oct 24, 2018 E 1 2 3 4 5 6 PE M WWWW T P P A N N N	TRAC		#Avg Tyj Avg Hold			IZ NO: Wide ⊂ Sain:Low	DC 0000 GI	nalyzer - Sw 50 Ω 2.48000	RF	L	XI R
Auto Tun	00 MHz .030 dB	kr1 -1.0 -0.	ΔM				Sumeon	.72 dB	Offset 11		B/div	
<b>Center Fre</b> 2.480000000 GH				~~~~	2~^	%		2		~~~		Log 11.7 1.72 -8.28
Start Fre 2.478500000 G⊦		~~~~	Langer and the second s									-18.3 -28.3 -38.3
<b>Stop Fre</b> 2.481500000 GH												-48.3 -58.3 -68.3
CF Ste 300.000 kF <u>Auto</u> Ma	.000 MHz 1001 pts)	.200 ms ('	Sweep 3			/ 100 kHz	#VB\	X	00 GHz Hz	2.4800 V 30 k	s Bl	#Re
Freq Offs 0 ⊦	E				dB	-0.030 0.400 dB	0 MHz (Δ 7 GHz		(Δ)		Δ2 F	1 2 3 4 5 6
												7 8 9 10 11
l	,		STATUS			m						۲ L



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Report No.: T180917N02-RP1

# 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.



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## TEST RESULTS

Model Name	PRO200BT	Test By	Ted Huang
Temp & Humidity	26.5°C, 54%	Test Date	2018/10/25

### Modulation Type: GFSK / DH5

Result(No.of CH)	Limit(No.of CH)	Result
79	>75	PASS

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

Result(No.of CH)	Limit(No.of CH)	Result
79	>75	PASS



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# NUMBER OF HOPPING FREQUENCY USED

						GFS	SK					
📕 Keys 🚺 R L		Analyzer - Swe									- 7	×
	Freq 2.		DC   000 GHz			ISE:INT	#Avg Typ	ALIGN AUTO e: RMS	TRAC	M Oct 24, 20 CE 1 2 3 4	5.6 Frequency	
			PI IF(	NO: Fast ⊂ ⊊ Gain:Low	Trig: Free #Atten: 2		Avg Hold:	:>10/10	D	PE MWW		
	Rei	f Offset 11.	72 dB					Mkr1 2	.431 14			un
0 dB		f 21.72 d							2.4	51 dB	m	
											Center F	re
11.7											2.441750000 0	GH
1.72				<b>∮</b>								
1.72	1	aaac I		1. JUNEAU (					unnen stit		Start F	
8.28	╷┧┧╽╽╽					<u> </u>					2.40000000 0	GH
	{											
-18.3											Stop F	
28.3											2.483500000 0	GH
	[										CFS	to
-38.3 <sup>(</sup>											8.350000 N	мн
48.3											h <u>Auto</u> M	Mai
											Freq Off	fee
-58.3												0 H
-68.3												
L Start	2.40000	GH7					<u> </u>		Stop 2.4	8350 CI		
	BW 100			#VBW	300 kHz		:	Sweep 8	3.000 ms (			
ISG								STATU	s			_

C RL		-   F	n Analyzer - S	Ω. D	C		SEM	SE:INT	#Avg Typ	ALIGN AUTO	09:25:45 Pt	4 Oct 24, 20 E 1 2 3 4		Frequency
star	t Fr	eq 2	.40000	000	PI	NO: Fast 🕞 Gain:Low	Trig: Free #Atten: 2	e Run 0 dB	#Avg Typ Avg Hold:		TYP	E MWW PE MWWW T P P A N	N N	
0 dB	3/div		of Offset 1 of 21.72							Mkr1 2	.433 149 1.7	9 5 GI 49 dB		Auto Tur
. <sup>og</sup>													Ī	Center Fre
11.7							1						┨	2.441750000 Gi
1.72 - 3.28 -	ľΨ	WW	WWW	WW	MM	www	www.	WWW	MMM	WWW.	www	WW		<b>Start Fr</b> 2.400000000 G
	ĺ												ļ	
18.3 - 28.3 -														<b>Stop Fr</b> 2.483500000 G
38.3	N												Ļ	CF Sto 8.350000 M
48.3													L L	<u>Auto</u> M
58.3													Į	Freq Offs 0
58.3				_										
			) GHz ) kHz			#VRM	/ 300 kHz		<u> </u> ,	Sween 8	Stop 2.48			



# 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.

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Report No.: T180917N02-RP1 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	PRO200BT	Test By	Ted Huang
Temp & Humidity	26.5°C, 54%	Test Date	2018/10/25

### 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	400.00	PASS
2441MHz	DH3	1.650	264.00	400.00	PASS
2441MHz	DH5	2.900	309.33	400.00	PASS
2441MHz	AFH	2.900	154.67	400.00	PASS
DH1 Dwell tine= DH3 Dwell tine= DH5 Dwell tine=	1.650 ms	s×(1600÷2)÷79×3 s×(1600÷4)÷79×3 s×(1600÷6)÷79×3	1.6= 264.00 (ms)		

AFH Dwell tine=  $2.900 \text{ msx}(1000+0)+79\times31.6= 309.33 (ms)$ AFH Dwell tine=  $2.900 \text{ msx}(800+6)+20\times8= 154.67 (ms)$ 

### 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	0.410	131.20	400.00	PASS
2441MHz	3DH3	1.660	265.60	400.00	PASS
2441MHz	3DH5	2.920	311.47	400.00	PASS
2441MHz	AFH	2.920	155.73	400.00	PASS
3DH1 Dwell tine=	0.410 ms	×(1600÷2)÷79×3	1.6= 131.20 (ms)		



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### DWELL TIME ON EACH PAYLOAD

						<i>พ</i> ( GFS					
	Spectrum Analyzer - Swept					1					- 8 2
RL enter	RF 50 Ω Freq 2.402000		lz	1	SENSE:INT	#Avg Type: R		08:41:30 PM TRACE	E 1 2 3	456	Frequency
		PI	NO: Fast ++- Gain:Low	Trig: Fi #Atten:				TYPI DE	EWWW TPPA	NNN	
	D-607						Δ	Mkr1 4	00.0	) µsl	Auto Tur
0 dB/div	Ref Offset 11.72 Ref 31.72 dE							:	3.79	dΒ	
°g											
21.7											Center Fre 2.402000000 GH
										- 1	2.40200000 GF
11.7										_	
					▲1∆2					- 1	Start Fre
.72	r	~~~		Ŵ							2.402000000 GH
				₩2						Í	
1.28											Stop Fre
8.3											2.402000000 GH
18.3						<u> </u>				+	CF Ste 1.000000 MH
											Auto Ma
8.3					- h					+	
	YAYAYAYAYAYAY	ļ	u na hina hina hina hina hina hina hina h	/thetw	W/44	<b>alehariyi.Ali 41</b> 14	MAN	₽ <b>₩₩</b> ₩	'leffyrder	(	Freq Offs
8.3											0 F
8.3											
										- 1	
	2.402000000 GH	-								0.11-	
enter 2 es BW		12							pan		
	1.U IVIMZ		#VBW	3.0 MH	Z	Swe	eep 5.0	00 ms (1	1001	pts)	
	1.0 MHZ		#VBW	3.0 MH	Z	Swe	eep 5.0	00 ms (1	1001	pts)	
SG	1.0 MHZ		#VBW	3.0 MH	Z	Swe	STATUS	00 ms (1	1001	pts)	
	1.0 MHZ						STATUS		1001	pts)	
G						swe dle ( GF	STATUS		1001	pts)	
iG [ Keysight S	Spectrum Analyzer - Swept			1 CF	l Mido	dle ( GF	STATUS				08
iG Keysight S R L		DC   0000 GH	DH'	1 CH	I Mida	dle ( GF	STATUS	08:42:12 PM TRACE	10ct 24	,2018 3 4 5 6	Frequency
iG Keysight S R L	Spectrum Analyzer - Swept RF 50 Ω	DC   1000 GH PI	DH′	1 CF	I Mide	dle ( GF	STATUS	08:42:12 PM TRACE	10ct 24	,2018 3 4 5 6	Frequency
iG Keysight S R L	Spectrum Analyzer - Swept RF 50 Ω	DC 1000 GH PI IFC	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	
G Keysight S RL enter	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	1 Oct 24, E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency
G Keysight S RL enter	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur
Keysight S RL enter	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency
G Keysight S RL enter 0 0 dB/div 99	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre
G Keysight S RL enter 0 0 dB/div 99	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE <b>VIKr1 4</b>	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.441000000 GH
G Keysight S RL RL Code A Code	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	I Mide	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre
G Keysight S RL RL Code A Code	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.441000000 GF Start Fre
Keysight S RL enter	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.441000000 GH Start Fre 2.441000000 GH
Keysight S RL enter	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.44100000 GF Start Fre 2.44100000 GF
C Keysight S RL enter 1 0 dB/div 0 g 21.7 1.7 1.72	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.441000000 GH Start Fre 2.441000000 GH
G ( Keysight S R L	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF
ic Keysight S RL enter 1 2) dB/div 29 21.7 .22 8.3	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency Auto Tur Center Fre 2.44100000 GF Start Fre 2.44100000 GF
isis     Keynight S       RL     RL       ienter     I       11.7     I       11.7     I       18.3     I       18.3     I	Spectrum Analyzer - Swept	DC 1000 GH PI IFC 2 dB	DH1 Iz NO: Fast ->	1 CH	H Midd	dle ( GF	STATUS SK) N AUTO MS	08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E 1 2 3 E WWW T P P A	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GH       Start Fre       2.441000000 GH       Stop Fre       2.441000000 GH       CF Ste
3G     Keysight S       RL     RL       RL     RL       21.7     RL       11.7     RL       8.3     RL	Spectrum Analyzer - Swept RF   50 Ω Freq 2.441000 Ref Offset 11.7 Ref 31.72 dE	DC 000 GH PI IFC 2 dB 3m	DH <sup>2</sup> NO: Fast →→ Sain:Low	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	ALIG #Avg Type: RI		08:42:12 PM TRACE TYPI DE Mkr1 4 -(	10ct 24 E1 2 3 T P P A 00.C 0.41	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF
3G     Keysight Sector       RL     RL       Renter     Sector       0 dB/div     Sector       11.7     Sector       1	Spectrum Analyzer - Swept	DC 000 GH PI IFC 2 dB 3m	DH1 Iz NO: Fast ->	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	dle ( GF		08:42:12 PM TRACE TYPI DE Wkr1 4	10ct 24 E1 2 3 T P P A 00.C 0.41	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF
IG Keysight S RL 20 dB/div 21.7 1.7 1.2 8.3 8.3	Spectrum Analyzer - Swept RF   50 Ω Freq 2.441000 Ref Offset 11.7 Ref 31.72 dE	DC 000 GH PI IFC 2 dB 3m	DH <sup>2</sup> NO: Fast →→ Sain:Low	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	ALIG #Avg Type: RI		08:42:12 PM TRACE TYPI DE Mkr1 4 -(	10ct 24 E1 2 3 T P P A 00.C 0.41	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GH       Start Fre       2.441000000 GH       Stop Fre       2.441000000 GH       CF Ste       1.000000 MH       Auto
IX Expright S RL enter 1 1.7 1.7 1.7 8.3 8.3 8.3	Spectrum Analyzer - Swept RF   50 Ω Freq 2.441000 Ref Offset 11.7 Ref 31.72 dE	DC 000 GH PI IFC 2 dB 3m	DH <sup>2</sup> NO: Fast →→ Sain:Low	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	ALIG #Avg Type: RI		08:42:12 PM TRACE TYPI DE Mkr1 4 -(	10ct 24 E1 2 3 T P P A 00.C 0.41	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF       Mato       Freq Offse
IX Expright S RL enter 1 1.7 1.7 1.7 8.3 8.3 8.3	Spectrum Analyzer - Swept RF   50 Ω Freq 2.441000 Ref Offset 11.7 Ref 31.72 dE	DC 000 GH PI IFC 2 dB 3m	DH <sup>2</sup> NO: Fast →→ Sain:Low	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	ALIG #Avg Type: RI		08:42:12 PM TRACE TYPI DE Mkr1 4 -(	10ct 24 E1 2 3 T P P A 00.C 0.41	,2018 3 4 5 6 3 4 N N N	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF       Mato       Freq Offse
IG Keysight S RL enter 1 1.7 1.7 1.7 8.3 8.3 8.3 8.3	Spectrum Analyzer - Swept RF   50 Q Freq 2.441000 Ref Offset 11.72 dE	DC    000   P   P   P( 2 dB Bm	DH <sup>2</sup> NO: Fast →→ Sain:Low	Trig: Fi #Atten:	A Midd SENSE:INT Tree Run 30 dB 1Δ2 1Δ2	ALIG #Avg Type: RI		08:42:12 РМ ткасс туре <b>МКГТ 4</b> -(	10ct 24 E 1 2 3 E WWW 000.C 0.41	,2018 4 4 5 6 4 8 5 4 8 5 7 8	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF       Mato       Freq Offse
IG Keyright S RL enter 2) dB/div 99 21.7 .22 .28 .3 .6.3 .6.3 .6.3 .6.3 .6.3 .6.3 .6.3	Spectrum Analyzer - Swept RF   50 Ω Freq 2.441000 Ref Offset 11.7 Ref 31.72 dE	DC    000   P   P   P( 2 dB Bm	DH <sup>+</sup> NO: Fast → Sain:Low	Trig: Fi #Atten:		ALIGY #Avg Type: RI		08:42:12 PM TRACE TYPE DE MKr1 4 -C	10ct 24 E 11 2 3 E WWW 00.C 0.41	2018 1456 <b>dB</b>	Frequency       Auto Tur       Center Fre       2.441000000 GF       Start Fre       2.441000000 GF       Stop Fre       2.441000000 GF       CF Ste       1.000000 MF       Mato       Freq Offse



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en				NO: Fast +++	Trig: Free #Atten: 30		#Avg T	ALIGN AUTO ype: RMS	TYPE	Oct 24, 2018 1 2 3 4 5 6 WWWWW P P A N N N	Frequency
0 dE		ef Offset ef 31.72	11.72 dB 2 dBm					L	19 19Mkr1 19	00.0 µs 0.11 dB	Auto Tur
21.7											Center Fre 2.480000000 G⊦
11.7 1.72					∳ <sup>1∠</sup>	52					<b>Start Fre</b> 2.480000000 GF
8.28 18.3				×_2							<b>Stop Fre</b> 2.48000000 GH
28.3											CF Ste 1.000000 MH <u>Auto</u> Ma
18.3 48.3	h.date.april	WHY	hhiluithyn	ppMhupph	441	, MANY MAY MA	MM	hellwithe	Khangpinga	¥#	Freq Offs
58.3											



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Frequency	12 34 5 6 PM Oct 24, 2018 TRACE 1 2 3 4 5 6 TYPE WWWWWW	RMS TR/	ALIGN AUT #Avg Type: RMS	SENSE:INT		DC 000 GHz	ctrum Analyzer - Swept SA RF 50 Ω DC eq 2.4020000	RL
	DET P P A N N N	l		Free Run n: 30 dB		PNO: Fast IFGain:Low	•	
Auto Tun	r1 1.650 ms 0.37 dB	ΔMkr1 1					Ref Offset 11.72 o Ref 31.72 dBn	dB/div
<b>Center Fre</b> 2.402000000 GH								1.7
<b>Start Fre</b> 2.402000000 GH			1∆2	2	1			.72
<b>Stop Fre</b> 2.402000000 GH								.28
<b>CF Ste</b> 1.000000 MH <u>Auto</u> Ma								8.3
Freq Offse 0 H	upy have	ų p	an phantum pa		inged give it		approval as a party	18.3
	) ms (1001 pts)	STATUS						ŝG
- 6 <b>-</b>			str	H Mida	H3 (		ctrum Analyzer - Swept SA	
Frequency	:48:53 PM Oct 24, 2018 TRACE [1 2 3 4 5 6	FSK) IGN AUTO 08:48:53 RMS TR		SENSE:INT		t SA DC	ctrum Analyzer - Swept SA RF   50 Ω DC 7 <b>eq 2.4410000</b>	Keysight S R L
Frequency	:48:53 PM Oct 24, 2018	FSK) IGN AUTO 08:48:53 RMS ТРИ ТТ ΔMkr1 1	IIe ( GFS		t 🛶 Tri	t SA DC DOOD GHZ PNO: Fast IFGain:Low 2 dB	RF 50 Ω DC	Keysight S RL enter
Frequency Auto Tun Center Fre	-48:53 PM Oct 24, 2018 TRACE I 1 2 3 4 5 6 TYPE WWWWW DET IP P A NN N cr1 1.660 ms	FSK) IGN AUTO 08:48:53 RMS ТРИ ТТ ΔMkr1 1	IIe ( GFS	SENSE:INT	t 🛶 Tri	t SA DC DOOD GHZ PNO: Fast IFGain:Low 2 dB	RF 50 Ω DC eq 2.4410000 Ref Offset 11.72 c	Keysight S RL enter ) dB/div Dg
Frequency Auto Tun Center Fre 2.44100000 GH Start Fre	-48:53 PM Oct 24, 2018 TRACE I 1 2 3 4 5 6 TYPE WWWWW DET IP P A NN N cr1 1.660 ms	FSK) IGN AUTO 08:48:53 RMS ТРИ ТТ ΔMkr1 1	IIe ( GFS	SENSE:INT	t 🛶 Tri	tSA DC GHZ PNO: Fast IFGain:Low 2 dB 3m	RF 50 Ω DC eq 2.4410000 Ref Offset 11.72 c	D dB/div 99 1.7
Frequency Auto Tun Center Fre 2.44100000 GH 2.44100000 GH	-48:53 PM Oct 24, 2018 TRACE I 1 2 3 4 5 6 TYPE WWWWW DET IP P A NN N cr1 1.660 ms	FSK) IGN AUTO 08:48:53 RMS ТРИ ТТ ΔMkr1 1	IIe ( GFS	SENSE:INT	t +++ Tri w #A	tSA DC GHZ PNO: Fast IFGain:Low 2 dB 3m	RF 50 Ω DC eq 2.4410000 Ref Offset 11.72 c	í Keysight S R L
Frequency Auto Tun Center Fre 2.44100000 GH Start Fre 2.44100000 GH Stop Fre	-48:53 PMOct 24, 2018 TRACE [1 2 3 4 5 6 TYPE WWWWWW DET /P A NN N (r1 1.660 ms -21.83 dB	FSK) IGN AUTO 08:48:53 RMS ТРИ ТТ ΔMkr1 1	ALIGN AUT #Avg Type: RMS	SENSE:INT	t → Tri w #A	tSA DC GHZ PNO: Fast IFGain:Low 2 dB 3m	RF 50 Ω DC eq 2.4410000 Ref Offset 11.72 c	Keysight S       RL       enter       0 dB/dlv       1.7       .72       .83       .83       .83

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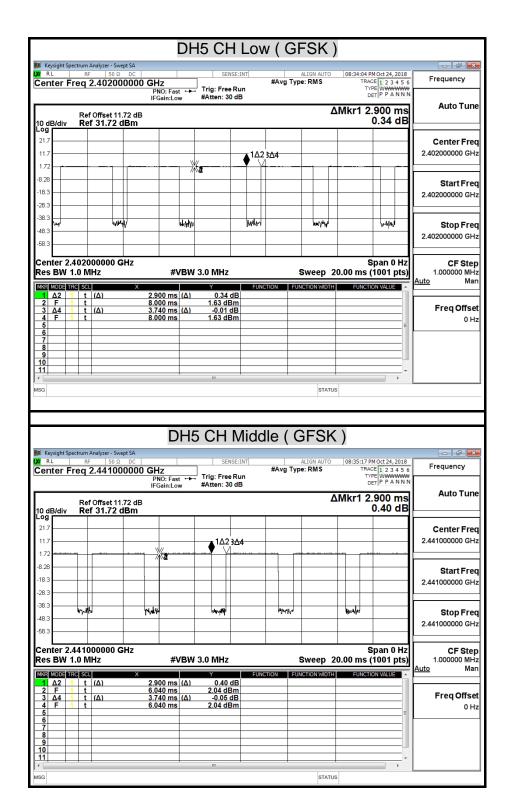
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Center Freq 2.	50 Ω DC 480000000 GHz PNO: Fast ←		Avg Type: RMS TRAC	M Oct 24, 2018 CE 1 2 3 4 5 6 PE WWWWWW ET P P A N N N	Frequency
	IFGain:Low ffset 11.72 dB 31.72 dBm	#Atten: 30 dB	ΔMkr1 1		Auto Tur
21.7					<b>Center Fre</b> 2.48000000 GF
11.7		↓1∆2			<b>Start Fre</b> 2.480000000 GH
18.3					<b>Stop Fre</b> 2.48000000 GF
28.3				A	CF Ste 1.000000 MH Luto Ma
38.3 Minite 48.3	walland	yenter of the second	hinakilin	With	Freq Offs
58.3					



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RL		DC	SENSE:INT	ALIGN AU		
enter F	req 2.480000	DOOD GHZ PNO: Fast ↔ IFGain:Low	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	TRACE 1 2 3 4 TYPE WWWW DET P P A N	INN
0 dB/div	Ref Offset 11.7 Ref 31.72 dl				ΔMkr1 2.900 n 0.30 c	
.og 21.7						Center Fr
11.7 1.72		X.2	●1 <u>∆23</u> <u>∆</u> 4			2.480000000 Gi
8.28						Start Fr 2.480000000 G
28.3						2.48000000 G
38.3 48.3	H-\$147	YACH4	freeson	wyan	antippi	Stop Fro
58.3						
	.480000000 GH 1.0 MHz		3.0 MHz	Sweep	Span 0   20.00 ms (1001 p	
IKR MODE T	1 t (Δ)	X 2.900 ms (Δ)	0.30 dB	JNCTION FUNCTION W	DTH FUNCTION VALUE	
2 F 3 Δ4 4 F 5	1 t 1 t (Δ) 1 t	6.320 ms 3.740 ms (Δ) 6.320 ms	1.82 dBm -0.34 dB 1.82 dBm			Freq Offs
6 7 8 9						



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			3DF	11 CH	l Lov	v ( 8-l	DPSł	()			
	pectrum Analyzer										
Center F		50 Ω DC 2000000 G	iHz PNO: Fast ↔	Trig: Free		#Avg Typ	ALIGN AUTO e: RMS	TRAC	M Oct 24, DE 1 2 3 DE WWW ET P P A	456	Frequency
10 dB/div	Ref Offse Ref 31.7	t 11.72 dB	FGain:Low	#Atten: 3	0 dB			\Mkr1 4		) µs	Auto Tune
21.7											Center Fred 2.402000000 GH:
11.7		rann		1∆ ~~~~	2	frews	יי			<u>م</u>	Start Fred 2.402000000 GHz
-8.28											Stop Fred 2.402000000 GH:
-28.3											CF Step 1.000000 MH Auto Mar
-38.3 -48.3	hallont	l <sub>i</sub> yhhhivy	WikiWiki	h h	on the state of th	WWU	nhhhhhhhh	urdallwu		ni <sub>pa</sub> i	Freq Offse 0 H
ISG	1.0 MHz		#VBW	3.0 MHz		;	Sweep 5	.000 ms (	1001	pts)	
📕 Keysight Sp XI R L	pectrum Analyzer RF Freq 2.44	50 Ω DC   1000000 G	3DH1	1 CH	NSE:INT	lle(8	-DPS ALIGN AUTO e: RMS	08:44:29 PI TRAC TYF DE AMkr1 4	M Oct 24, E 1 2 3 PE WWW ET P P A	,2018 4 5 6 ///////////////////////////////////	Frequency
📕 Keysight Sp XI R L	pectrum Analyzer RF Freq 2.44	50 Ω DC 1000000 G I t 11.72 dB	3DH1 Hz PNO: Fast ↔	1 CH	NSE:INT	lle(8	-DPS ALIGN AUTO e: RMS	08:44:29 PI TRAC TYF DE AMkr1 4	M Oct 24 E 1 2 3 PE WWW ET P P A	,2018 4 5 6 ///////////////////////////////////	
Keysight Sp RL Center F 10 dB/div	pectrum Analyzer RF Freq 2.44 Ref Offse	50 Ω DC 1000000 G I t 11.72 dB	3DH1 Hz PNO: Fast ↔	1 CH	NSE:INT	lle(8	-DPS ALIGN AUTO E: RMS	08:44:29 PI TRAC TYF DE SMKr1 4	M Oct 24, E 1 2 3 PE WWW ET P P A	,2018 4 5 6 ///////////////////////////////////	Auto Tune
I Keysight Sp RL Center F 10 dB/div 21.7	pectrum Analyzer RF Freq 2.44 Ref Offse	50 Ω DC   1000000 G I t 11.72 dB 72 dBm	3DH1 Hz PNO: Fast ↔	1 CH	ISE:INT	lle(8	STATUS	08:44:29 PI TRAC TYF DE SMKr1 4	M Oct 24, E 1 2 3 PE WWW ET P P A	,2018 4 5 6 ///////////////////////////////////	Frequency Auto Tun Center Free 2.44100000 GH Start Free 2.44100000 GH Stop Free
Keysight Sp RL Center F  Canter  Canter F  Canter F  Canter F  Canter F  Cant	Ref Offse Ref 31.1	50 Ω DC 1000000 G 11.72 dB 72 dBm 12.72 dBm 14.72	3DH <sup>2</sup> iHz PN0: Fast ↔ FGain:Low	1 CH		#Avg Typ		SK)  08:44:29 PI TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC TRAC	MOCt 24 = 1 2 3 = WWW TTP P A F10.C 6.62	,2018 4 5 6 ///////////////////////////////////	Frequency       Auto Tun       Center Free       2.441000000 GH       Start Free       2.441000000 GH       Stop Free       2.441000000 GH       CF Step       1.000000 MH
Keysight Sp RL Center F  Canter  Canter F  Canter F  Canter F  Canter F  Cant	pectrum Analyzer RF Freq 2.44 Ref Offse	50 Ω DC 1000000 G 11.72 dB 72 dBm 12.72 dBm 14.72	3DH1 Hz PNO: Fast ↔	1 CH		lle(8		08:44:29 PI TRAC TYF DE SMKr1 4	MOCt 24 = 1 2 3 = WWW TTP P A F10.C 6.62	,2018 4 5 6 ///////////////////////////////////	Frequency       Auto Tun       Center Fre       2.441000000 GH       Start Fre       2.441000000 GH       Stop Fre       2.441000000 GH       CF Step       1.000000 MH       Auto       Main       Freq Offsee
Keysight Sp RL Conter F	Ref Offse Ref Offse	50 Q DC 1000000 G 11.72 dB 72 dBm 10000000 C 1000000 C 1000000 C 1000000 C 1000000 C 1000000 C 1000000 C 10000000 C 1000000 C 100000 C 100000 C 10000 C	3DH <sup>-</sup>	1 CH		#Avg Typ			Moct 24 E 12 3 E WW F WW F WW F WW F WW F WW F WW F WW	2018 4 5 6 0 ) µs dB	Frequency       Auto Turn       Center Freq       2.441000000 GH       Start Freq       2.441000000 GH       Stop Freq       2.441000000 GH       CF Steg       1.000000 MH