

TEST REPORT

FCC Standards : FCC 47 CFR part 15 subpart C

Test Report No.	:	CTK-2017-00126		
Date of Issue	:	2017-01-09		
FCC ID	:	V2R-BT150NC		
Model/Type No.	:	BT 150 NC		
Kind of Product	:	NECKBAND BTNC EARPHONE		
Applicant	:	Cresyn Co., Ltd.		
Applicant Address	:	5 Gangnam-dearo 107-gil, Seocho-gu, Seoul, Korea		
Manufacturer	:	Cresyn Co., Ltd.		
Manufacturer Address	:	5 Gangnam-dearo 107-gil, Seocho-gu, Seoul, Korea		
Contact Person	:	Jung Jaesoo / Research Engine	eer	
Telephone	:	+81-2-2041-2646		
Received Date	:	2016-12-15		
Test period	:	Start : 2016-12-26	End : 2017-01-05	
Test Results	:	In Compliance	Not in Compliance	

The test results presented in this report relate only to the object tested.

Tested by

Won-Jae, Hwang Test Engineer Date: 2017-01-09 Reviewed by

J. Park

Young-Joon, Park Technical Manager Date: 2017-01-09

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REPORT REVISION HISTORY

Date	Revision	Page No
2017-01-09	Issued (CTK-2017-00126)	All

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1.0 General Product Description

Basic Model/Type No.	BT 150 NC
Serial number	Prototype
EUT condition	Pre-production, not damaged
Antenna type	PCB antenna Gain 1.4 dBi
Frequency Range	2402 MHz - 2480 MHz
RF power	-1.349 dBm Peak Conducted (GFSK) 1.103 dBm Peak Conducted (DQPSK)
Number of channels	79
Channel Spacing	1 MHz
Channel Access Protocol	Frequency Hopping
Type of Modulation	GFSK(1 Mbps), DQPSK(2 Mbps)
Power Source	DC 3.7 V
Hardware Rev	V1.0
Software Rev	V1.0
Firmware Rev	V1.0

1.1 Tested Frequency

	LOW	MID	HIGH
Frequency (MHz)	2402	2441	2480

1.2 **Tested Mode**

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

Tested Ch	Modulation Technology	Modulation Type	Packet Type	
Low, Mid, High	FHSS	GFSK	DH 5	
Low, Mid, High	FHSS	DQPSK	2DH 5	



1.3 EUT Operation Test Setup

For Bluetooth function, the engineering test program was provided and enabled to make EUT continuous transmit/receive.

1.4 EUT Exercise of Software

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

1.5 Device Modifications

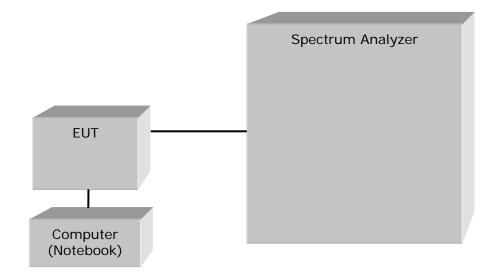
The following modifications was applied by the applicant:

Not applicable

1.6 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	ProBook 650 G1	5CG5114KD2
AC ADAPTER	HP	PPP012D-S	-

1.7 Configuration of System under Test





1.8 Calibration Details of Equipment Used for Measurement

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

1.9 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.10 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	FC
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	V ©I
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	



2.0 Summary of tests

FCC Part Section(s)	Parameter	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation		С
15.247(a)	Number of Hopping Frequencies		С
15.247(a)	20 dB Bandwidth	Conducted	С
15.247	Dwell Time		С
15.247(b)	Transmitter Output Power		С
15.247(d)	Conducted Spurious emission		С
15.247(d)	Band Edge		С
15.209	Field Strength of Harmonics	Radiated	С
15.207	AC Conducted Emissions	Line Conducted	С

The sample was tested according to the following specification:

- FCC Part 15.247

The tests were performed according to the method of measurements prescribed in DA 00-705 and ANSI C63.10-2013.



2.1 Transmitter Requirements

2.1.1 Carrier Frequency Separation

Test Location

RF Test Room

Test Procedures

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

The spectrum analyzer is set to:

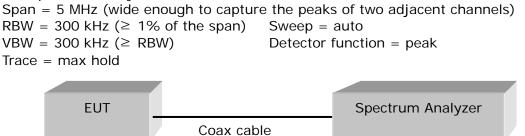


Figure 1 : Measurement setup for the carrier frequency separation

Limit

§15.247(a)(1) Frequency hopping system operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Results

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Channel	Adjacent Hopping Channel Separation (kHz)	Two-third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2441MHz	985	626.7	25	Complies

Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

Channel	Adjacent Hopping Channel Separation (kHz)	Two-third of 20dB bandwidth (kHz)	Minimum Bandwidth (kHz)	Result
2441MHz	1015	819.3	25	Complies

See next pages for actual measured spectrum plots.



Carrier Frequency Separation



Data Rate : GFSK

Data Rate : DQPSK

gilent Spectrum Analyzer - Swept SA		SENSE:INT	ALIGNAUTO	01:00:48 PM Dec 26, 2016	
arker 1 1.015000000 N		Trig: Free Run	Avg Type: Log-Pwr Avg Hold>100/100	TRACE 123456 TYPE MWWWWW DET PPPPP	Peak Search
	PNO: Fast 🕞 IFGain:Low	#Atten: 20 dB	Ext Gain: -0.80 dB	DET PPPPP	
dB/div Ref 10.00 dBm			ΔN	/kr1 1.015 MHz -0.183 dB	NextPea
			1Δ2		Next Pk Righ
	- market and the second	~~~~X2~~~	man and and and and and and and and and a	war and a second	J
20.0					Next Pk Le
0.0					
10.0					Marker Del
i0.0					
50.0					Mkr→C
70.0					Mkr→RefL
0.0					
				Onon 5 000 Miles	Moi 1 of
enter 2.441000 GHz Res BW 300 kHz	#VBW	300 kHz	Sweep 1	Span 5.000 MHz .000 ms (1001 pts)	
6G			STATUS		

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2.1.2 Number of Hopping Frequencies

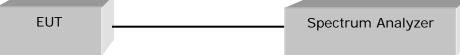
Test Location RF Test Room

Test Procedures

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

The spectrum analyzer is set to:

Frequency range	1: Start = 2389.5 MHz 2: Start = 2439.5 MHz	•
Span = 50 MHz RBW = 300 kHz (\geq 1% VBW = 300 kHz (\geq RB Trace = max hold	-	Sweep = auto Detector function = peak



Limit

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

Test Results

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Total number of Hopping Channels	Result
79	Complies

Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

Total number of Hopping Channels	Result
79	Complies

See next pages for actual measured spectrum plots.

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11:07:40 AM Dec 26, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P SENSE:INT Peak Search Avg Type: Log-Pwr Avg|Hold>100/100 Ext Gain: -0.80 dB Marker 1 36.927000000 MHz PNO: Fast Trig: Free Run IFGain:Low #Atten: 20 dB Next Peak ΔMkr1 36.927 0 MHz 0.227 dB 10 dB/div Ref 10.00 dBm 142 Next Pk Right Next Pk Left Marker Delta Mkr→CF Mkr→RefLvl More 1 of 2 Start 2.39000 GHz #Res BW 300 kHz Stop 2.43950 GHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz STATUS

Number of Hopping Frequencies(GFSK)

	Spectrum A																	
<mark>x</mark> RL Mark	er 1 39.		Ω AC					NSE:INT			Туре	ALIGNA	Pwr	11:07	TRA	M Dec 26, 2016 CE 123456 PE M 444444	Peak Search	h
				PNC IFGa): Fast ⊂ iin:Low		rig: Fre Atten: 2					>100/1 -0.80 c	B		D	ET <mark>PPPPP</mark>		
10 dB/	div Re	ef 10.00	dBm										ΔN	/lkr1	39. -0	95 MHz .119 dB	NextPe	еак
														<u>_</u> 1∆2	2		Next Pk Rig	aht
-10.0	ANN	MAN	nnn	M	M	Ŵ	MM	M	M	nnr	m	M		Ň				J
-20.0	1011				1 4 4 1				4 1	i I		ĨĨ	ų v				Next Pk L	_ef
-30.0																	MarkerDe	elta
40.0																		
50.0 -															Ŵ		Mkr→	→CF
60.0															Ý	VLANNA		
-70.0																	Mkr→Ref	Lv
-80.0																		ore
	2.43950 BW 300				#VB	W 30	0 kHz					Swee	ep 1	Stop .000 i	2.4 ns (8950 GHz (1001 pts)	10	of 2
MSG												4	STATUS	5				



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Swept SA 01:04:01 PM Dec 26, 2016 Peak Search Avg Type: Log-Pwr Avg|Hold>100/100 Ext Gain: -0.80 dB Marker 1 37.054500000 MHz PNO: Fast Free Run IFGain:Low #Atten: 20 dB TYPE **Next Peak** ΔMkr1 37.054 5 MHz -0.109 dB Ref 10.00 dBm 10 dB/div Log 1<u>4</u>2 Next Pk Right ᠕᠕ Next Pk Left Marker Delta Mkr→CF MAN Mkr→RefLvi More Start 2.39000 GHz #Res BW 300 kHz 1 of 2 Stop 2.43950 GHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz







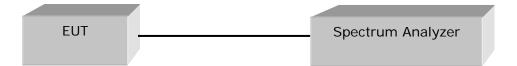
2.1.3 20 dB bandwidth

Test Location RF Test Room

Test Procedures

The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels. After the trace being stable, Use the marker-to peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to:Center frequency = the highest, middle and the lowest channelsSpan = 3 MHz (approximately 2 or 3 times of the 20 dB bandwidth)RBW = 30 kHz (\geq 1% of the span)VBW = 100 kHz (\geq RBW)Trace = max hold



Limit

Limit : N/A



Test Results (20 dB bandwidth)

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2402	0	0.943	Complies
2441	39	0.940	Complies
2480	78	0.945	Complies

Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2402	0	1.227	Complies
2441	39	1.229	Complies
2480	78	1.228	Complies

Test Results (Occupied Bandwidth)

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2402	0	0.860	Complies
2441	39	0.855	Complies
2480	78	0.856	Complies

Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

Frequency (MHz)	Channel Number.	Measured Bandwidth (MHz)	Result
2402	0	1.168	Complies
2441	39	1.162	Complies
2480	78	1.161	Complies

See next pages for actual measured spectrum plots.



20 dB Bandwidth, Occupied Bandwidth (GFSK)

RL 10:51:22 AM Dec 26, 2016 ALIGN AUTO Frequency Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold: 10/10 #Atten: 20 dB Ext Gain: -0.80 dB Radio Std: None #IEGain:Low Radio Device: BTS Ref 10.00 dBm 0 dB/div .og **Center Freq** 2.402000000 GHz Span 3 MHz Sweep 3.2 ms Center 2.402 GHz #Res BW 30 kHz CF Step 300.000 kHz #VBW 91 kHz Man Auto **Occupied Bandwidth Total Power** 5.37 dBm 859.93 kHz Freq Offset Transmit Freq Error 14.716 kHz **OBW Power** 99.00 % 0 Hz x dB Bandwidth 942.8 kHz x dB -20.00 dB STATUS





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20 dB Bandwidth, Occupied Bandwidth (DQPSK)

RL 11:12:41 AM Dec 26, 2016 ALIGN AUTO Frequency Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold: 10/10 #Atten: 20 dB Ext Gain: -0.80 dB Radio Std: None #IEGain:Low Radio Device: BTS Ref 10.00 dBm 0 dB/div .og **Center Freq** NA 2.402000000 GHz Span 3 MHz Sweep 3.2 ms Center 2.402 GHz #Res BW 30 kHz CF Step 300.000 kHz #VBW 91 kHz Man Auto **Occupied Bandwidth Total Power** 5.89 dBm 1.1680 MHz Freq Offset Transmit Freq Error -3.073 kHz **OBW Power** 99.00 % 0 Hz x dB Bandwidth 1.227 MHz x dB -20.00 dB STATUS





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2.1.4 Time of Occupancy (Dwell Time)

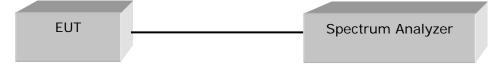
Test Location RF Test Room

Test Procedures

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

- 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 BT 150 NC has 3 type of payload, DH1, DH3, DH5. The hopping rate is 1600 per second.

The spectrum analyzer is set to:



Limit

§15.247(a)(1)(iii) For frequency hopping system operating in 2400-2483.5 MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Test Results

Time of occupancy on the TX channel in 31.6 sec = time domain slot length \times hop rate \div number of hop per channel \times 31.6

Test mode : GFSK

Channel Frequency (MHz)			Test Results			
	Packet Type	Dwell Time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Result		
	DH 1	0.418	133.8	Complies		
2441	DH 3	1.689	270.2	Complies		
	DH 5	2.947	314.3	Complies		

DH1 Dwell time = $0.418 \text{ ms} \times (1600 \div 2) \div 79 \times 31.6 = 133.8 \text{ ms}$ DH3 Dwell time = $1.689 \text{ ms} \times (1600 \div 4) \div 79 \times 31.6 = 270.2 \text{ ms}$ DH5 Dwell time = $2.947 \text{ ms} \times (1600 \div 6) \div 79 \times 31.6 = 314.3 \text{ ms}$

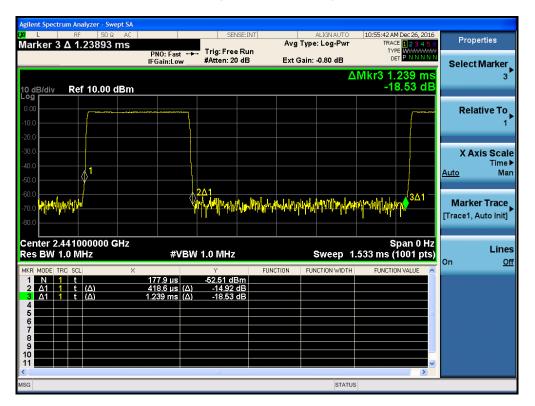
Test mode : DQPSK

Channel Frequency (MHz)			Test Results			
	Packet Type	Dwell Time (ms)	Time of occupancy on the TX channel in 31.6sec (ms)	Result		
	2DH 1	0.435	139.2	Complies		
2441	2DH 3	1.690	270.4	Complies		
	2DH 5	2.935	313.1	Complies		

2DH1 Dwell time = $0.435 \text{ ms} \times (1600 \div 2) \div 79 \times 31.6 = 139.2 \text{ ms}$ 2DH3 Dwell time = $1.690 \text{ ms} \times (1600 \div 4) \div 79 \times 31.6 = 270.4 \text{ ms}$ 2DH5 Dwell time = $2.935 \text{ ms} \times (1600 \div 6) \div 79 \times 31.6 = 313.1 \text{ ms}$

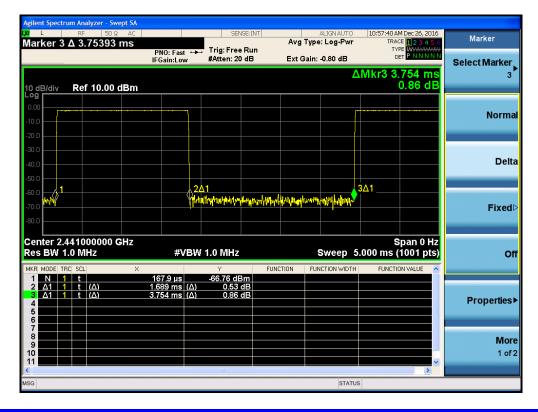
See next pages for actual measured spectrum plots.





Time of Occupancy for PACKET Type DH1(GFSK)

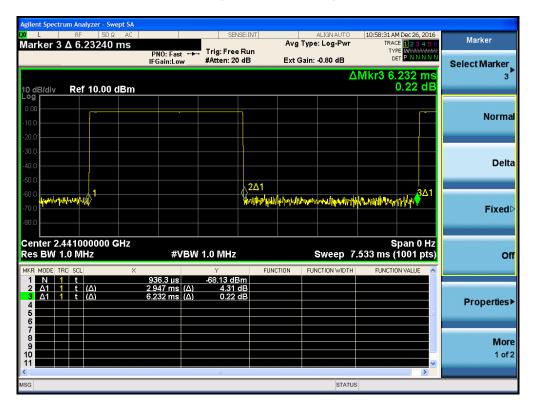
Time of Occupancy for PACKET Type DH3(GFSK)



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Time of Occupancy for PACKET Type DH5(GFSK)

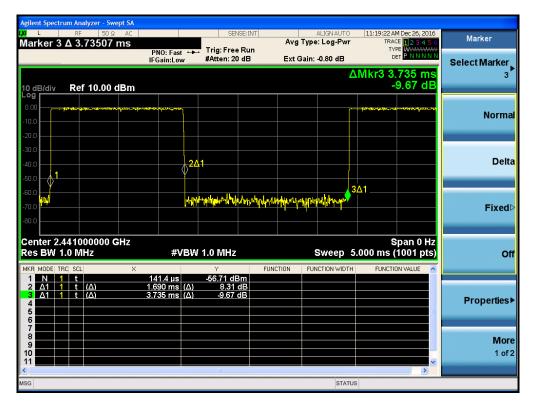


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11:18:33 AM Dec 26, 2016 TRACE 12345 Properties Marker 3 Δ 1.24507 ms Ava Type: Loa-Pwr Trig: Free Run TYPE PNO: Fast IFGain:Low #Atten: 20 dB Ext Gain: -0.80 dB DET Select Marker ΔMkr3 1.245 m 3 -8.81 dE Ref 10.00 dBm 0 dB/div Relative To X Axis Scale Time ► Man <u>2Δ1</u> Auto 3∆1 nexternellering and the state of the Marker Trace (hyd) [Trace1. Auto Init] Center 2.441000000 GHz Span 0 Hz Lines Res BW 1.0 MHz #VBW 1.0 MHz Sweep 1.533 ms (1001 pts) On Off FUNCTION FUNCTION WIDTH -61.56 dBm 12.63 dB -8.81 dB N 1 t Δ1 1 t (Δ) Δ1 1 t (Δ) 156.4 μs 435.5 μs (Δ) 1.245 ms (Δ)

Time of Occupancy for PACKET Type 2DH1(DQPSK)

Time of Occupancy for PACKET Type 2DH3(DQPSK)



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11:20:36 AM Dec 26, 2016 TRACE 1 2 3 4 5 6 TYPE DET P N N N N SENSE:INT Marker Marker 3 Δ 12.4651 ms Avg Type: Log-Pwr Trig: Free Run #Atten: 20 dB PNO: Fast ↔↔ IFGain:Low Ext Gain: -0.80 dB Select Marker ΔMkr3 12.47 ms -53.84 dB 3 Ref 10.00 dBm 10 dB/div Normal Delta <u>2Δ1</u> <u>3∆1</u> n happy whaterperture at the second white **Fixed** Center 2.441000000 GHz Res BW 1.0 MHz Span 0 Hz Sweep 15.00 ms (1001 pts) #VBW 1.0 MHz Off FUNCTION FUNCTION WIDTH FUNCTION VALUE 2.031 ms 2.935 ms (Δ) 12.47 ms (Δ) -51.20 dB -53.84 dB Δ1 t (Δ) **Properties**► More 1 of 2 STATUS

Time of Occupancy for PACKET Type 2DH5(DQPSK)



2.1.5 Maximum peak Conducted Output Power

Test Location

RF Test Room

Test Procedures

The maximum peak conducted output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

The spectrum analyzer is set to:Center frequency = the highest, middle, and the lowest channelsSpan = 5 MHz (approximately 5 times of the 20 dB bandwidth)RBW = 3 MHz (greater than the 20 dB bandwidth of the emission being measured)VBW = 3 MHz (\geq RBW)Detector function = peakTrace = max holdSweep = autoEUTSpectrum Analyzer

Limit

§5.247(b)(1) The Maximum Peak Output Power Measurement is 0.125 Watts for frequency hopping system operating in 2400-2483.5 MHz employing at least 15 Hopping channels.

Test Results

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

Frequency (MHz)	Channel No.	Peak output power(dBm)	Peak output power(mW)	Result
2402	0	-2.063	0.622	Complies
2441	39	-1.349	0.733	Complies
2480	78	-1.675	0.680	Complies

Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

Frequency (MHz)	Channel No.	Peak output power(dBm)	Peak output power(mW)	Result				
2402	0	0.537	1.132	Complies				
2441	39	1.103	1.289	Complies				
2480	78	0.877	1.224	Complies				

See next pages for actual measured spectrum plots.



X/RL RF 50Ω AC		SEN	ISE:INT		ALIGN AUTO		1Dec 26, 2016	Ε.	
Center Freq 2.402000000	GHz PNO: Fast 🖵 IFGain:Low	Trig: Free #Atten: 20		Avg Type Avg Hold> Ext Gain: -	≻10/Ī0	TRAC TYP DE	E 1 2 3 4 5 6 E MWWWWW T P P P P P P	Fr	equency
10 dB/div Ref 10.00 dBm					Mkr1	2.402 0 -2.0	85 GHz 63 dBm		Auto Tun
0.00			♦ ¹						Center Free 2000000 GH
-10.0								2.39	Start Fre
30.0									Stop Fre
40.0								2.40	4500000 G⊦ CF Ste
60.0								<u>Auto</u>	500.000 kH Ma
70.0									Freq Offs 0 H
80.0									
Center 2.402000 GHz #Res BW 3.0 MHz	40 (D) (A)	3.0 MHz		_		Span 5. .000 ms (000 MHz		

Maximum peak Conducted Output Power - GFSK

X RL RF 50Ω A Center Freq 2.4410000		SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	10:53:23 AM Dec 26, 2016 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast 😱 IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold>10/10 Ext Gain: -0.80 dB	TYPE MWWWWW DET PPPPP	
10 dB/div Ref 10.00 dB	m		Mkr1	2.440 770 GHz -1.349 dBm	Auto Tun
0.00		▲1			Center Fre
					2.441000000 GH
10.0					Start Fre 2.438500000 GF
20.0					2.438500000 GF
30.0					Stop Fre 2.443500000 GH
40.0					2.443300000 GI
50.0					CF Ste 500.000 kH
60.0					<u>Auto</u> Ma
70.0					Freq Offs 0 F
80.0					
				Spop 5 000 Mile	
Center 2.441000 GHz #Res BW 3.0 MHz	#VBW	3.0 MHz	Sweep 1	Span 5.000 MHz .000 ms (1001 pts)	



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	ectrum Analyzer - Swept SA									
Cente	RF 50 Ω AC r Freq 2.480000000	PNO: Fast 😱	Trig: Free		Avg Type Avg Hold:		TRAC	M Dec 26, 2016 CE 1 2 3 4 5 6 PE M 4444 ET P P P P P P	Fr	equency
10 dB/di	iv Ref 10.00 dBm	IFGain:Low	#Atten: 20	dB	Ext Gain:		2.479 7			Auto Tune
Log			∳ 1							Center Freq 0000000 GHz
-10.0									2.47	Start Freq 7500000 GHz
-30.0									2.482	Stop Freq 2500000 GHz
-50.0									<u>Auto</u>	CF Step 500.000 kHz Man
-70.0 —									I	F req Offset 0 Hz
-80.0	2.480000 GHz						Enon 5	000 MHz		
	2.480000 GHZ SW 3.0 MHz	#VBW	3.0 MHz			Sweep ′		.000 MHz 1001 pts)		
MSG						STATU	S			



Maximum peak Conducted Output Power – DQPSK

Swept SA 11:12:33 AM Dec 26, 2016 TRACE 1 2 3 4 5 6 TYPE M WWWW DET P P P P P .IGN / SENSE:INT ALIGNAUTO Avg Type: Log-Pwr Avg|Hold:>10/10 Ext Gain: -0.80 dB Frequency Center Freq 2.402000000 GHz GHZ PNO: Fast Free Run IFGain:Low #Atten: 20 dB Auto Tune Mkr1 2.401 865 GHz 0.537 dBm 10 dB/div Log Ref 10.00 dBm ▲1 **Center Freq** 2.402000000 GHz Start Freq 2.399500000 GHz Stop Freq 2.404500000 GHz CF Step 500.000 kHz Auto Man Freq Offset 0 Hz Center 2.402000 GHz #Res BW 3.0 MHz Span 5.000 MHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz

Agilent Spec	c <mark>trum Analyzer - Swept SA</mark> RF 50 Ω AC		071.00				
	RF 50 Ω AC Freq 2.44100000	0 GHz PN0: Fast	SENSE	Av Run Avg	ALIGN AUTO g Type: Log-Pwr g Hold:>10/10	11:17:12 AM Dec 26, 2016 TRACE 1 2 3 4 5 6 TYPE M	Frequency
	_	IFGain:Low	#Atten: 20 c	IB Ext	Gain: -0.80 dB	DET P P P P P P P	Auto Tune
10 dB/div Log	Ref 10.00 dBm					1.103 dBm	
			♦ ¹				Center Freq
0.00							2.441000000 GHz
-10.0							Start Freq
-20.0							2.438500000 GHz
-30.0							
00.0							Stop Freq 2.443500000 GHz
-40.0							
-50.0							CF Step 500.000 kHz
-60.0							<u>Auto</u> Mar
70.0							Freq Offset
-70.0							0 Hz
-80.0							
Center 2	2.441000 GHz					Span 5.000 MHz	
	V 3.0 MHz	#VBW	3.0 MHz		Sweep	1.000 ms (1001 pts)	
MSG					STATU	S	



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Agilent Spectrum Analyzer - Swept SA				
Center Freq 2.480000000	GHz PNO: East Trig: Free	Avg Type Run Avg Hold:	:Log-Pwr TRA	M Dec 26, 2016 CE 1 2 3 4 5 6 PE M WWWWW
	IFGain:Low #Atten: 20) dB Ext Gain:	-0.00 40	ET P P P P P P
10 dB/div Ref 10.00 dBm			Mkr1 2.479 8 0.8	77 dBm
	↓ 1			Center Freq 2.480000000 GHz
-10.0				Start Freq 2.477500000 GHz
-30.0				Stop Freq 2.482500000 GHz
-50.0				CF Step 500.000 kHz <u>Auto</u> Man
-60.0				Freq Offset 0 Hz
-80.0				
Center 2.480000 GHz #Res BW 3.0 MHz	#VBW 3.0 MHz		Span s Sweep 1.000 ms	5.000 MHz (1001 pts)
MSG			STATUS	



2.1.6 Band-edge

Test Location RF Test Room

Test Procedures

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

```
The spectrum analyzer is set to:Center frequency = the highest, middle, and the lowest channelsRBW = 100 \text{ kHz}VBW = 300 kHz (\geq RBW)Span = 10 MHzDetector function = peakTrace = max holdSweep = autoEUTSpectrum Analyzer
```

Limit

> 20 dBc

Test Results

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

See next pages for actual measured spectrum plots.





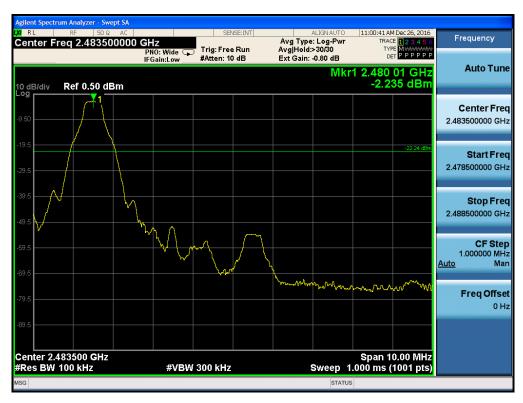
Band - edge (with Hopping) - GFSK





Center Freq 2.400000000 GHz PNO: Wide IFGain:Low SENSE:INT 10:51:34 AM Dec 26, 2016 Frequency Avg Type: Log-Pwr Avg|Hold:>30/30 TRACE 2 3 4 5 6 TYPE M Trig: Free Run #Atten: 10 dB Ext Gain: -0.80 dB Auto Tune Mkr1 2.402 17 GHz -2.130 dBm 10 dB/div Ref 0.50 dBm **Center Freq** 2.40000000 GHz Start Freq 2.395000000 GHz Stop Freq 2.405000000 GHz ١., CF Step 1.000000 MHz Man <u>Auto</u> ... www ~~~~~ Freq Offset 0 Hz Center 2.400000 GHz #Res BW 100 kHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz STATUS

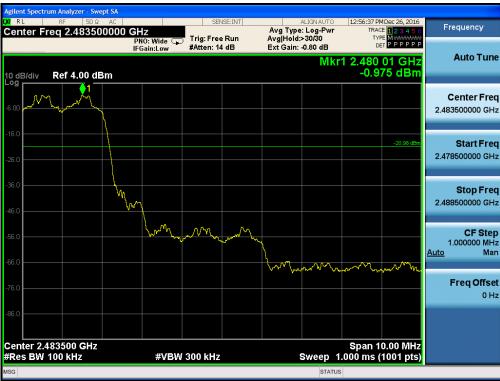
Band – edge (without Hopping) - GFSK







Band – edge (with Hopping) – DQPSK





11:14:51 AM Dec 26, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P RL SENSE:INT Center Freq 2.400000000 GHz PN0: Wide IFGain:Low #Atten: 14 dB Frequency Avg Type: Log-Pwr Avg|Hold:>30/30 Ext Gain: -0.80 dB Auto Tune Mkr1 2.402 01 GHz -1.022 dBm 10 dB/div Ref 4.00 dBm **Ö**1 **Center Freq** 2.40000000 GHz Start Freq 2.395000000 GHz Stop Freq 2.405000000 GHz CF Step 1.000000 MHz Man <u>Auto</u> Freq Offset 0 Hz Center 2.400000 GHz #Res BW 100 kHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz STATUS







Band – edge (at 20 dB blow) – Low channel Frequency Range = 30 MHz ~ 10th harmonic (GFSK : Worst-Case)



RL RF 50Ω AC enter Freq 20.00000000	GH7	ALIGNAUTO Avg Type: Log-Pwr	10:53:03 AM Dec 26, 2016 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast IFGain:Low #Atten: 10 dB	Avg Hold:>30/30 Ext Gain: -0.80 dB		Auto Tun
dB/div Ref 0.70 dBm		IV.	1kr1 24.98 GHz -68.080 dBm	Auto Tu
30				Center Fre 20.000000000 GF
9.3			-22.79 dBm	Start Fr 15.00000000 G
9.3				Stop Fr 25.00000000 G
9.3			1	CF St 1.000000000 G <u>Auto</u> M
9.3	white here the second state of the second	internet and the second second	monther and the following of	Freq Offs 0
2.3		<u>^</u>	Stop 35 000 GH-	
Res BW 100 kHz	#VBW 300 kHz	Sweep 9	Stop 25.000 GHz 55.7 ms (1001 pts)	

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Band – edge (at 20 dB blow) – Mid channel Frequency Range = 30 MHz ~ 10th harmonic (GFSK : Worst-Case)



KI RL	rum Analyzer - Swept SA RF 50 Ω AC		SENSE:INT	A	LIGNAUTO	10:59:59 AM	1 Dec 26, 2016	
Center F	req 20.00000000	OGHz PNO: Fast		Avg Type: Avg Hold> Ext Gain: -	Log-Pwr 30/30	TRAC	E 123456 E M WWWWWW T P P P P P P	Frequency
I0 dB/div	Ref 0.70 dBm	II Gam.Low				/lkr1 24. -68.00	99 GHz 03 dBm	Auto Tun
- og .9.30								Center Fre 20.000000000 GH
29.3							-22.91 dBm	Start Fre 15.000000000 G⊦
39.3 49.3								Stop Fre 25.00000000 GF
69.3								CF Ste 1.00000000 GH <u>Auto</u> Ma
79.3	n sealar and a faile and in the second of th	wither worth particular	NyelvongoustatikleNetenik	whether the shapethe	ah Managar Make	waat the of galacter land		Freq Offs 0 H
89.3 Start 15.0 #Res BW	100 GHz 100 kHz	#VBW	300 kHz		Sweep 9	Stop 25. 55.7 ms (.000 GHz 1001 pts)	
	<krc.png> saved</krc.png>				STATUS			

Test Report No.: CTK-2017-00126 Date: 2017-01-09

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Band – edge (at 20 dB blow) – High channel Frequency Range = 30 MHz ~ 10th harmonic (GFSK : Worst-Case)





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Band – edge (at 20 dB blow) – Low channel Frequency Range = 30 MHz ~ 10th harmonic (DQPSK : Worst-Case)





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Band – edge (at 20 dB blow) – Mid channel Frequency Range = 30 MHz ~ 10th harmonic (DQPSK : Worst-Case)



XI RL	rum Analyzer - Swept SA RF 50 Ω AC		SEN	ISE:INT		ALIGNAUTO		4 Dec 26, 2016 E 1 2 3 4 5 6	Frequency
Center F	req 20.0000000	PNO: Fast IFGain:Low	Trig: Free #Atten: 14		Avg Hold: Ext Gain:	>30/30 -0.80 dB	TYF De	95 GHz	Auto Tune
10 dB/div Log	Ref 4.00 dBm							09 dBm	
-6.00									Center Fre 20.000000000 GH
-16.0								-22.93 dBm	Start Fre 15.000000000 GH
-36.0									Stop Fre 25.000000000 GH
-56.0								1	CF Ste 1.000000000 GH <u>Auto</u> Ma
-66.0	Here Bill Harris Martin Constant of the State of the Stat	ann frid Arachi de Allan A	and the second	illeder of the second	ne _{te} ntr _{instalan} na	udat ^{ana} nsha ^{nan} ah	and a strange of the second	<mark>pel of the shelp street</mark>	Freq Offse 0 H
-86.0									
Start 15.0 #Res BW		#VBW	/ 300 kHz			Sweep 9	Stop 25 55.7 ms (.000 GHz 1001 pts)	
	<krc.png> saved</krc.png>					STATUS			

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Band – edge (at 20 dB blow) – High channel Frequency Range = 30 MHz ~ 10th harmonic (DQPSK : Worst-Case)





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2.1.7 Field Strength of Emissions

Test Location

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

Test Procedures

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

The spectrum analyzer is set to:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10^{th} harmonic) RBW = 1 MHz for f \geq 1 GHz, 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz VBW \geq RBW Sweep = auto

Limit

- 15.209(a)

Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
2400/F(kHz)	-	300
24000/F(kHz)	-	30
30	-	30
100**	40	3
150**	43.5	3
200**	46	3
500	54	3
	uV/m@3m 2400/F(kHz) 24000/F(kHz) 30 100** 150** 200**	uV/m@3m dBuV/m@3m 2400/F(kHz) - 24000/F(kHz) - 30 - 100** 40 150** 43.5 200** 46

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

Note :

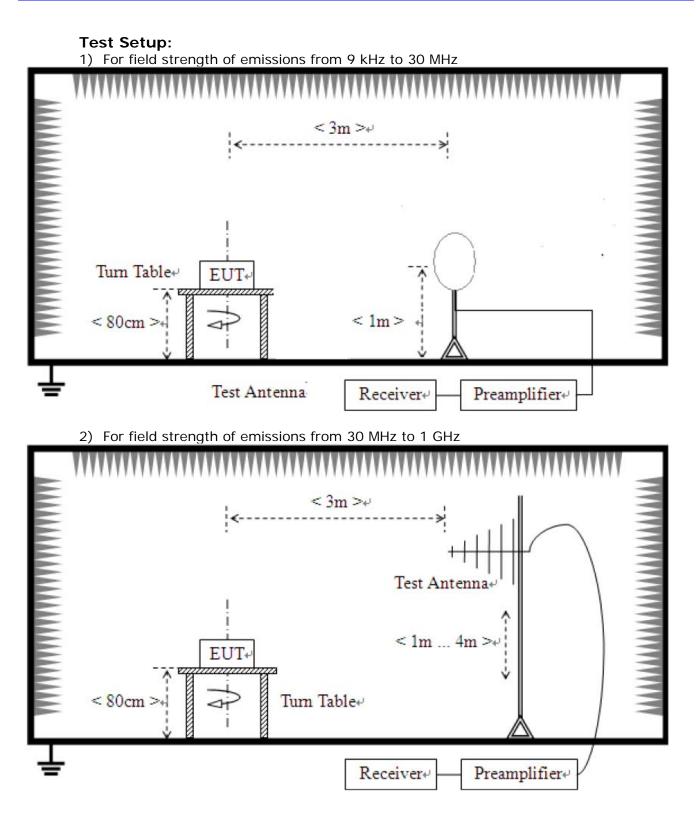
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)



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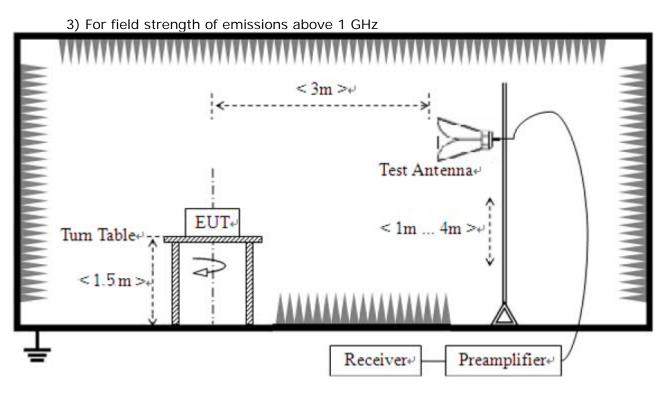




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Test Results

1) 9 kHz to 30 MHz

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5) Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

EUT	NECKBAND BTNC EARPHONE	Measurement Detail			
Model	BT 150 NC	Frequency Range	9 kHz – 30 MHz		
Test mode	GFSK, DQPSK	Detector function	Quasi-Peak		

The requirements are:

 \boxtimes Complies

Frequency	Measured Data	Margin	Remark	
(MHz)	(dBuV/m)	(dB)		
-	-	-	See note	

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB)

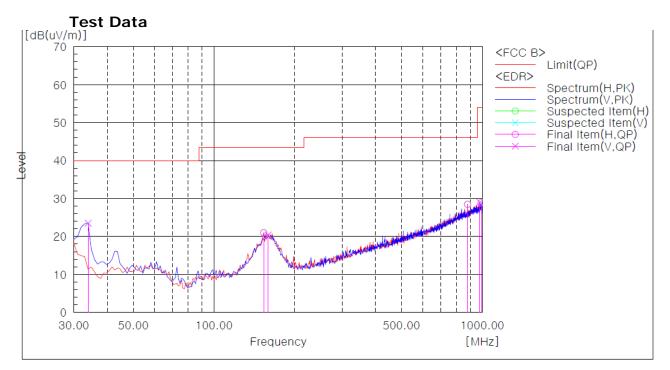


2) 30 MHz to 1 GHz

EUT	NECKBAND BTNC EARPHONE	Measurement Detail	
Model	BT 150 NC	Frequency Range	Below 1000MHz
Test mode	DQPSK Hopping	Detector function	Quasi-Peak / Peak

The requirements are:

Complies			
Frequency	Measured Data	Margin	Domork
(MHz)	(dBuV/m)	(dB)	Remark
33.880	23.5	16.5	Quasi-Peak



Final Result

No.	Frequency	(P)	Reading QP	c.f	Result QP	Limit QP	Margin QP	Angle
	[MHz]		[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[deg]
1	33.880	V	40.9	-17.4	23.5	40.0	16.5	56.1
2	153.190	Н	27.9	-6.9	21.0	43.5	22.5	243.6
3	159.010	V	26.6	-6.2	20.4	43.5	23.1	117.0
4	880.690	Н	29.7	-1.2	28.5	46.0	17.5	129.0
5	978.660	V	28.3	0.7	29.0	54.0	25.0	80.3
6	989.330	Н	28.1	0.8	28.9	54.0	25.1	301.2

Remark :

1. The field strength of spurious emission was measured in the following position: EUT standup position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.

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3) above 1 GHz

Test mode : GFSK, CFG PKT Packet Type : 15 Packet Size : 339(DH5)

EUT	NECKBAND BTNC EARPHONE	Measurement Detail	
Madal	DT 160 NC	Frequency Range	1-25GHz
Model	BT 150 NC	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

 \boxtimes Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
4882.00	40.01	13.99	Average

Test Data

Ch.0(Low Channel)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
4804.00	Н	54.00	74.00	39.47	51.49	14.53	22.51
4804.00	V	54.00	74.00	39.53	50.95	14.47	23.06

Ch.39(Mid Channel)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
4882.00	Н	54.00	74.00	40.01	51.22	13.99	22.78
4882.00	V	54.00	74.00	39.03	50.28	14.97	23.72
2597.00	Н	54.00	74.00	34.45	46.39	19.55	27.61

Ch.78(High Channel)

Frequency	(P)	Limit AV	Limit PK	Level AV	Level PK	Margin AV	Margin PK
[MHz]		[dB(uV/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[dB]
4960.00	Н	54.00	74.00	39.90	50.71	14.11	23.29
4960.00	V	54.00	74.00	39.16	50.29	14.84	23.71
2636.00	Н	54.00	74.00	35.27	47.16	18.73	26.84



Test mode : DQPSK, CFG PKT Packet Type : 30 Packet Size : 679(2DH5)

EUT	NECKBAND BTNC EARPHONE	Measurement Detail	
Madal	BT 150 NC	Frequency Range	1-25GHz
Model	BITSONC	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark	
4882.00	36.21	17.79	Peak	

Test Data

Ch.0(Low Channel)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
4804.00	Н	54.00	74.00	36.15	52.04	17.85	21.96
4804.00	V	54.00	74.00	34.89	49.37	19.11	24.64

Ch.39(Mid Channel)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
4882.00	Н	54.00	74.00	36.21	51.78	17.79	22.22
4882.00	V	54.00	74.00	34.75	48.85	19.25	25.16

Ch.78(High Channel)

Frequency [MHz]	(P)	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]
4960.00	Н	54.00	74.00	36.14	51.53	17.86	22.48
4960.00	V	54.00	74.00	35.14	49.01	18.86	24.99



2.1.8 AC Conducted Emissions

Test Location

Shielded Room

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

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

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

Limit

- 15.207(a)

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

* Decreases with the logarithm of the frequency.

Test Results

The requirements are:

 \boxtimes Complies

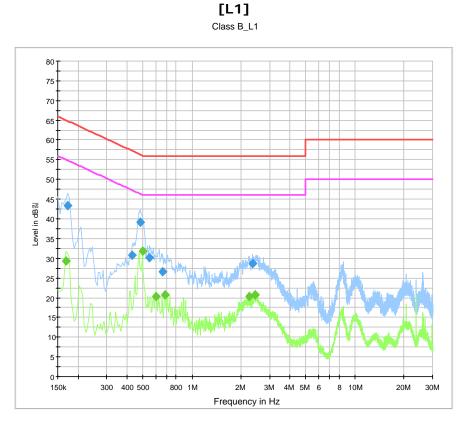
Test mode : USB Charge

Frequency	Measured Data	Margin	Remark	
(MHz)	(dBuV/m)	(dB)		
0.496 500	31.8	14.2	Average	



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Test Data



Final Result 1

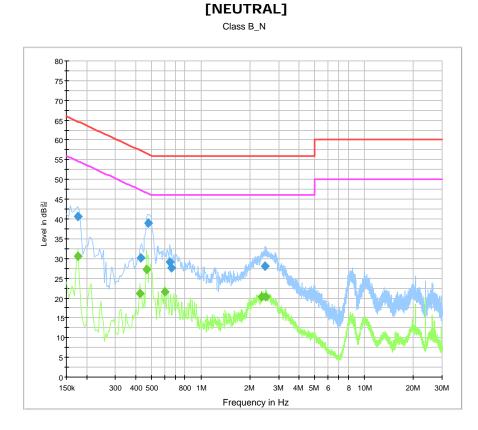
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.172500	43.3	1000.0	9.000	On	L1	9.8	21.6	64.8
0.429000	30.8	1000.0	9.000	On	L1	9.9	26.5	57.3
0.483000	39.1	1000.0	9.000	On	L1	9.9	17.2	56.3
0.550500	30.2	1000.0	9.000	On	L1	9.9	25.8	56.0
0.663000	26.6	1000.0	9.000	On	L1	9.9	29.4	56.0
2.355000	28.6	1000.0	9.000	On	L1	9.7	27.4	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.168000	29.3	1000.0	9.000	On	L1	9.8	25.7	55.1
0.496500	31.8	1000.0	9.000	On	L1	9.9	14.2	46.1
0.604500	20.3	1000.0	9.000	On	L1	9.9	25.7	46.0
0.681000	20.6	1000.0	9.000	On	L1	9.8	25.4	46.0
2.247000	20.3	1000.0	9.000	On	L1	9.7	25.7	46.0
2.431500	20.6	1000.0	9.000	On	L1	9.7	25.4	46.0

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Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.177000	40.6	1000.0	9.000	On	Ν	9.8	24.0	64.6
0.429000	30.2	1000.0	9.000	On	Ν	9.9	27.1	57.3
0.478500	38.9	1000.0	9.000	On	Ν	9.9	17.5	56.4
0.645000	29.1	1000.0	9.000	On	Ν	9.9	26.9	56.0
0.663000	27.7	1000.0	9.000	On	Ν	9.9	28.3	56.0
2.481000	28.0	1000.0	9.000	On	Ν	9.7	28.0	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.177000	30.5	1000.0	9.000	On	Ν	9.8	24.1	54.6
0.424500	21.2	1000.0	9.000	On	Ν	9.9	26.1	47.4
0.465000	27.3	1000.0	9.000	On	Ν	9.9	19.3	46.6
0.600000	21.6	1000.0	9.000	On	Ν	9.9	24.4	46.0
2.350500	20.4	1000.0	9.000	On	Ν	9.7	25.6	46.0
2.499000	20.3	1000.0	9.000	On	Ν	9.7	25.7	46.0

Test Report No.: CTK-2017-00126 Date: 2017-01-09



APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY50510324	2016-03-11	2017-03-11
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2016-11-01	2017-11-01
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100816	2016-10-31	2017-10-31
4	LISN	Rohde & Schwarz	ENV216	101760	2016-02-05	2017-02-05
5	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2016-11-01	2017-11-01
6	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-13	2017-05-13
7	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2016-05-16	2018-05-16
8	6dB Attenuator	R&S	DNF	272.4110.50-2	2016-11-01	2017-11-01
9	AMPLIFIER	SONOMA	310	291721	2016-02-02	2017-02-02
10	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2015-05-14	2017-05-14
11	Preamplifier	Agilent	8449B	3008A02011	2016-12-01	2017-12-01
12	Horn Antenna	ETS-Lindgren	3115	00078894	2015-09-02	2017-09-02
13	Horn Antenna	ETS-Lindgren	3116	00062504	2015-09-04	2017-09-04
14	Horn Antenna	ETS-Lindgren	3116	00062916	2015-04-30	2017-04-30
15	Horn Antenna	ETS-Lindgren	3117	00154525	2015-09-02	2017-09-02