

7.8 Conducted Spurious Emissions §15.247 (d); RSS-247 [5.5]

Test Overview and Limit

Conducted out-of-band spurious emissions were investigated from 30MHz up to 25GHz to include the 10th harmonic of the fundamental transmit frequency. *The maximum permissible out-of-band emission level is* 20 dBc.

Test Procedure Used

ANSI C63.10-2013 - Section 7.8.8

Test Settings

- 1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
- 2. RBW = 1MHz* (See note below)
- 3. VBW = 3MHz
- 4. Detector = Peak
- 5. Trace mode = max hold
- 6. Sweep time = auto couple
- 7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-7. Test Instrument & Measurement Setup

Test Notes

- 1. Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at 1Mbps. The display line shown in the following plots is the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, the traces in the following plots are measured with a 1MHz RBW to reduce test time, so the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.
- 2. The unit was tested with all possible mode and power schemes and only the highest emission is reported.

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🔤 Ke	ysight Sp	ectrum Anal	yzer - Swep	t SA										×
lxi R	L	RF	50 Ω	AC	CORREC		SEN	NSE:INT	#Ava Tvp	e: RMS	07:43:00 PI	M Mar 29, 2023	Fr	equency
					PNO: Fas IFGain:Lo	t 🖵 w	Trig: Free Atten: 40	e Run) dB	0 ,1	N	Akr1 3.03			Auto Tune
10 dE Log	B/div	Ref 3	0.00 dE	3m							-24.	93 aBM		
20.0													C 5.01	Center Freq 5000000 GHz
10.0														
0.00												DL1 -1.54 dDm	30	Start Freq
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-50.0	L												l	Freq Offset
														UHZ
-60.0														Scale Type
Star	t 30 N	IHz									Stop 10	.000 GHz	Log	Lin
#Re	s BW	1.0 MH	Z		#\	/BW	3.0 MHz		S	weep	18.00 ms (3	0001 pts)		
MSG										STAT	TUS			

Plot 7-67. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA - Ch.0)



Plot 7-68. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA - Ch.0)

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🔤 Keysight Spe	ctrum Analyzer - Swept SA						
LX/ RL	RF 50 Ω AC	CORREC	SENSE:INT	#Avg Type: RM	07:46:32 PM S TRACE	Mar 29, 2023	Frequency
		PNO: Fast 🖵 IFGain:Low	Trig: Free Run Atten: 40 dB	"a.)period	TYPE DET	PNNNN	
10 dB/div Log	Ref 30.00 dBm				Mkr1 3.568 -24.9	4 GHz 9 dBm	Auto Tune
20.0							Center Freq
10.0							0.010000000000112
0.00						DL1-1-23-dBm	Start Freq 30.000000 MHz
-10.0							Stop Fred
-20.0		1_					10.000000000 GHz
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-40.0							Auto Man
-50.0							Freq Offset
-60.0							0 112
							Scale Type
Start 30 N #Res BW	1Hz 1.0 MHz	#VBW	3.0 MHz	Swee	Stop 10. p 18.00 ms (30	000 GHz 0001 pts)	Log <u>Lin</u>
MSG					STATUS		

Plot 7-69. Conducted Spurious Plot Ant1 ((Bluetooth, GFSK, ePA – Ch.39)
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Plot 7-70. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA Ch.39)

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🔤 Keysight Sp	ectrum Analyzer - Swept SA					
(X/RL	RF 50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	07:48:31 PM Mar 29, 2023 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref 30.00 dBm	PNO: Fast 🖵 IFGain:Low	Trig: Free Run Atten: 40 dB	М	kr1 3.471 3 GHz -24.74 dBm	Auto Tune
20.0						Center Freq 5.015000000 GHz
0.00						Start Freq 30.000000 MHz
-10.0		1_				Stop Freq 10.000000000 GHz
-30.0				a di bana ya ku ya di ku ya d Ya di bana ya ku ya ku ya ku ya di ku y Ya di bana ya ku	fant birt na fyn llyngroegon fan die gyn die henrin fan die New die namen fan die die gegene die die die die die New die namen fan die die die gegene die die die die die die	CF Step 997.000000 MHz Auto Man
-50.0						Freq Offset 0 Hz
-60.0					Stop 10 000 CHr	Scale Type
#Res BW	1.0 MHz	#VBW	3.0 MHz	Sweep 1	8.00 ms (30001 pts)	
MSG				STAT	JS	



Plot 7-72. Conducted Spurious Plot Ant1 (Bluetooth, GFSK, ePA - Ch.78)

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🔤 Keysight Sp	ectrum Analyzer - Swep	it SA									
LXI RL	RF 50 Ω	AC COF	RREC	SEI	NSE:INT	#Avg Typ	e: RMS	10:24:56 PI TRAC	Mar 29, 2023	F	requency
10 dB/div	Ref 30.00 dB	Pi IFC 3m	NO: Fast 🖵 Gain:Low	Atten: 40) dB		M	kr1 3.16 -25.	7 9 GHz 18 dBm		Auto Tune
20.0										5.01	Center Freq 5000000 GHz
0.00									_DL1_1.05 dBm	30	Start Freq 0.000000 MHz
-10.0			_1							10.00	Stop Freq
-30.0 Hoofiles -40.0						in the constant		at alle suites de societées y	hen sy ny staat Afrik fan de skaar de s New skaar de	99 <u>Auto</u>	CF Step 7.000000 MHz Man
-50.0											Freq Offset 0 Hz
-60.0								Stop 10	000 CH2	Log	Scale Type
#Res BW	1.0 MHz		#VBW	3.0 MHz		s	weep 1	8.00 ms (3	0001 pts)		
MSG							STATU	IS			





Plot 7-74. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA - Ch.0)

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🔤 Ke	ysight Spec	trum Analyzer - S	Swept SA									
l,XI R	L	RF 50	Ω ΑC	CORREC	SEI	NSE:INT	#Ava Tvp	e: RMS	10:28:14 P	M Mar 29, 2023	F	requency
10 4	2 diu	Pof 30.00	dBm	PNO: Fast G IFGain:Low	Trig: Free Atten: 40	e Run) dB		N	۲۷ Ikr1 3.17 -25.	4 5 GHz		Auto Tune
20.0											5.01	Center Freq 5000000 GHz
10.0 0.00										DL1 - 1.20 dBm	31	Start Freq 0.000000 MHz
-10.0 -20.0				1							10.00	Stop Freq 0000000 GHz
-30.0	Baylan Dark						Materipacytesiper Tombuses, mendul		n (Leaguer a Leaguer a Star agus Star agus agus a tha agus a tha an	a la parte de la company de la company a de la company de la comp	99' <u>Auto</u>	CF Step 7.000000 MHz Man
-50.0												Freq Offset 0 Hz
-60.0											Log	Scale Type
star #Re	t 30 M sBW/1	HZ I.0 MHZ		#VB\	V 3.0 MHz		s	weep	stop 10 18.00 ms (3	.000 GHz 0001 pts)	LUg	<u></u>
MSG								STAT	rus			

Plot 7-75. Conducted Spurious Plot Ant2 (B	Bluetooth, GFSK, ePA – Ch.39)
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Plot 7-76. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA Ch.39)

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Keysight Spectrun	n Analyzer - Swept SA								
lxu RL F	RF 50 Ω AC	CORREC	SENS	SE:INT	#Avg Type	:RMS	10:29:52 PM TRAC	4 Mar 29, 2023 E 1 2 3 4 5 6	Frequency
10 dB/div R	ef 30.00 dBm	PNO: Fast 🖵 IFGain:Low	Atten: 40	Run dB		М	kr1 6.92	7 2 GHz 22 dBm	Auto Tune
20.0									Center Freq 5.015000000 GHz
0.00								_DL1_1.19 dBm	Start Freq 30.000000 MHz
-10.0						1			Stop Freq 10.000000000 GHz
-30.0						an an tha an tha tha an that an t		a paga <mark>kasi, bay pakyak</mark> Ana ang kasi kasi kasi kasi kasi kasi kasi kasi	CF Step 997.000000 MHz <u>Auto</u> Man
-50.0									Freq Offset 0 Hz
-60.0							6 4 40		Scale Type
#Res BW 1.0	MHz	#VBW	3.0 MHz		S	weep 1	Stop 10 8.00 ms (3	.000 GHz 0001 pts)	
MSG						STATU	s	pro/	

Plot 7-77. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA - Ch.78)



Plot 7-78. Conducted Spurious Plot Ant2 (Bluetooth, GFSK, ePA – Ch.78)

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NB UNII_L

🔤 Keysight Sp	ectrum Analyzer - Swe	ept SA									
LXI RL	RF 50 Ω	AC COF	RREC	SEI	NSE:INT	#Avg Typ	e: RMS	12:14:22 A	M Mar 30, 2023	F	requency
10 dB/div	Ref 30.00 c	Pi IF¢ 1Bm	NO:Fast 🕞 Gain:Low	Atten: 40) dB		M	lkr1 3.14 -25.	4 3 GHz 42 dBm		Auto Tune
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0.00										3(Start Freq 0.000000 MHz
-10.0			1						DL1 -10.85.dBm	10.00	Stop Freq 0000000 GHz
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-50.0											Freq Offset 0 Hz
-60.0											Scale Type
Start 30 M #Res BW	/Hz 1.0 MHz		#VBW	3.0 MHz		s	weep 1	Stop 10 8.00 ms (3	.000 GHz 30001 pts)	Log	Lin
MSG							STAT	US			

Plot 7-79. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA - Ch.0)



Plot 7-80. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA - Ch.0)

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🔤 Keysig	ght Spect	rum Ar	nalyzer - Swe	ept SA										
LXI RL		RF	50 Ω	AC	CORREC		SEN	ISE:INT			12:16:1	2 AM Mar 30, 2023	En	equency
					DNO F		Trig: Free	Run	#Avg Typ	e: RIVIS	1	TYPE MWWWWW		squonoy
					IFGain:L	ast 🖵	Atten: 40	dB				DET P NNNN		
											Mkr1 3 0			Auto Tune
			~~ ~~								-2	5 33 dBm		
10 dB/c	div	Ref	30.00 C	IBM							-2	0.00 abm		
								í					-	
													C	enter Freq
20.0													5.015	5000000 GHz
10.0														
														Start Freq
													30	.000000 MHz
0.00														
												DI 1 10.07 dBm		
-10.0												DET-10.07 GBm		Stop Freg
													10 000	000000 GHz
-20.0					<u> </u>								10.000	
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	م الم		and the state										<u>Auto</u>	Man
-40.0														
-50.0													F	-req Offset
														0 Hz
-60.0														_
														Scale Type
													Log	Lin
Start :	30 MI	Z									Stop	10.000 GHz	Log	
#Res	BW 1	.0 M	Hz		7	ABM 3	5.0 MHz		S	weep	18.00 ms	(30001 pts)		
MSG										ST	ATUS			

Plot 7-81. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA - Ch. 39)



Plot 7-82. Conducted Spurious Plot NB UNII_L (Bluetooth, GFSK, iPA Ch. 39)

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🔤 Ke	ysight Spe	trum A	nalyzer - Sw	ept SA									-	
l XI R	L	RF	50 Ω	AC	CORREC		SEN	ISE:INT			12:17:36	AM Mar 30, 2023	Fred	uency
							Tria: Free	Run	#Avg Typ	e: RMS	16	ACE 1 2 3 4 5 6		uonoy
					PNO: Fa IFGain:L	st ⊆ _⊃ ow	Atten: 40	dB				DET P NNNN		
													A	uto Tune
												24 d GHZ		
10 dE	3/div	Ref	30.00 d	звт							-21	.54 UBIII		
													-	
													Ce	nter Freq
20.0													5.0150	00000 GHz
10.0	<u> </u>													
													:	Start Freq
0.00													30.0	00000 MHz
0.00														
-10.0				\models								DL1 -10.90 dBm		Stop Freg
													10 0000	00000 GHz
-20.0									1 ———				10.0000	00000 0112
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						WRITE DAY	an alatan	in a standard in the standard in the	والملج والمحمد والمته	hill a group of the	المراجب والمراجع	a successive to be available to be		CF Step
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-40.0	———													
													_	
-50.0													FI	eq Offset
00.0														0 Hz
-60.0													-	
													S	cale Type
-											-		Log	Lin
star	T 30 IV	HZ							_		Stop 1	0.000 GHz	Log	<u>L</u>
#Re	SBW	1.U IV	IHZ		71	VBW 3	.U WHZ		S	weep	18.00 ms	(30001 pts)		
MSG										STA	ATUS			





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7.9 Radiated Spurious Emissions – Above 1GHz §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-16 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [µV/m]	Measured Distance [Meters]		
Above 960.0 MHz	500	3		

Table 7-16. Radiated Limits

Test Procedure Used

ANSI C63.10-2013 - Section 6.6.4.3

Test Settings

Peak Field Strength Measurements

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 1MHz
- 3. VBW = 3MHz
- 4. Detector = peak
- 5. Sweep time = auto couple
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

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The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-8. Radiated Test Setup >1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-16.

- 2. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
- 3. This unit was tested with its standard battery.
- 4. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.

5. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.

6. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

- 7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
- 8. All supported modulation, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.
- 9. Average emissions were not reported since the duty cycle correction factor was greater than 20dB.

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Sample Calculation

- \circ Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- o AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB] Preamplifier Gain [dB]
- $\circ \quad \text{Margin}_{[dB]} = \text{Field Strength Level}_{[dB\mu V/m]} \text{Limit}_{[dB\mu V/m]}$

Duty Cycle Correction Factor Calculation

- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50×20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms

Duty cycle correction factor = $20\log_{10}(7.5\text{ms}/100\text{ms}) = -22.5 \text{ dB}$

Average Emission Calculation

Average Emission = Measured Peak Emissions [dBµV/m] – Duty Cycle Correction Factor [dB]

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Radiated Spurious Emission Measurements (1 – 18GHz) §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Peak	V	160	194	-66.78	4.00	44.22	73.98	-29.76
12010.00	Peak	-	-	-	-68.88	12.75	50.87	73.98	-23.11

Table 7-17. Radiated Measurements Ant1

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Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Peak	V	235	191	-66.88	4.23	44.35	73.98	-29.63
7323.00	Peak	V	282	157	-67.91	8.72	47.81	73.98	-26.17
12205.00	Peak	V	-	-	-70.51	13.63	50.12	73.98	-23.86

Table 7-18. Radiated Measurements Ant1

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Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Peak	V	267	162	-66.85	4.42	44.57	73.98	-29.41
7440.00	Peak	V	221	124	-67.74	8.60	47.86	73.98	-26.12
12400.00	Peak	-	-	-	-69.93	13.30	50.37	73.98	-23.61

Table 7-19. Radiated Measurements Ant1

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 91 of 109
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Radiated Spurious Emission Measurements (1 – 18GHz) §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Peak	Н	264	200	-68.72	5.88	44.16	73.98	-29.82
12010.00	Peak	-	-	-	-72.63	14.68	49.05	73.98	-24.92

Table 7-20. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dogo 92 of 109
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Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Peak	-	-	-	-69.19	6.23	44.04	73.98	-29.94
7323.00	Peak	н	305	252	-67.60	9.95	49.35	73.98	-24.63
12205.00	Peak	-	-	-	-73.69	14.84	48.15	73.98	-25.83

Table 7-21. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dogo 92 of 109
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GFSK
1Mbps
ePA
3 Meters
2480MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Peak	-	-	-	-69.17	6.45	44.28	73.98	-29.70
7440.00	Peak	Н	195	200	-68.12	9.93	48.81	73.98	-25.17
12400.00	Peak	-	-	-	-73.50	15.14	48.64	73.98	-25.34

Table 7-22. Radiated Measurements Ant2

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 84 of 108
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Radiated Spurious Emission Measurements (1 – 18GHz) §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

NB UNII_L





Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Peak	Н	-	-	-68.48	5.88	44.40	73.98	-29.58
12010.00	Peak	Н	-	-	-72.80	14.68	48.88	73.98	-25.09

Table 7-23. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dana 05 at 400
1C2302130007-01.BCG	2/10/2023 - 5/5/2023	Head Mounted Device	Page 85 of 108
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Plot 7-92. Radiated Spurious Emissions above 1GHz NB UNII_L (BT GFSK iPA - Ch.39)

Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Peak	Н	-	-	-68.47	6.23	44.76	73.98	-29.22
7323.00	Peak	Н	-	-	-69.04	9.95	47.91	73.98	-26.07
12205.00	Peak	Н	-	-	-73.48	14.84	48.36	73.98	-25.62

Table 7-24. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dege 96 of 109
1C2302130007-01.BCG	2/10/2023 - 5/5/2023	Head Mounted Device	Page 80 01 108
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Plot 7-93. Radiated Spurious Emissions above 1GHz NB UNII_L (BT GFSK iPA - Ch.78)

Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	iPA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Peak	Н	-	-	-69.64	6.45	43.81	73.98	-30.17
7440.00	Peak	Н	-	-	-69.62	9.93	47.31	73.98	-26.67
12400.00	Peak	Н	-	-	-74.29	15.14	47.85	73.98	-26.13

Table 7-25. Radiated Measurements NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dege 97 of 109
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Radiated Spurious Emission Measurements (1 – 18GHz) §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

TxBF

Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2402MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Peak	Н	-	-	-68.83	5.88	44.05	73.98	-29.93
12010.00	Peak	Н	-	-	-72.72	14.68	48.96	73.98	-25.01

Table 7-26. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage 80 of 100	
1C2302130007-01.BCG	2/10/2023 - 5/5/2023	Head Mounted Device	Page 88 of 108	
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Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2441MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Peak	Н	152	252	-68.69	6.23	44.54	73.98	-29.44
7323.00	Peak	Н	278	253	-62.23	9.95	54.72	73.98	-19.26
12205.00	Peak	Н	-	-	-73.43	14.84	48.41	73.98	-25.57

Table 7-27. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 89 of 108
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Bluetooth Mode:	GFSK
Data Rate:	1Mbps
Power Scheme	ePA
Distance of Measurements:	3 Meters
Operating Frequency:	2480MHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Peak	Н	215	214	-68.78	6.45	44.67	73.98	-29.31
7440.00	Peak	Н	305	248	-64.08	9.93	52.85	73.98	-21.13
12400.00	Peak	Н	368	74	-74.56	15.14	47.58	73.98	-26.40

Table 7-28. Radiated Measurements TxBF

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 00 of 100
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MultiView	Prescan	×	Maximize	×	Avg	×	Peak	×						•
Ref Level 107 Att TDF "CA_ATM_	7.00 dBµV/r 0 dl Horn_Ant_4	n B = SWT 3 40GHz_T058	 RBW 1 36 ms VBW 3 3601-03","CA_TS 	I MHz 3 MHz -PR1840	Mode Auto C00568_18-4	Sweep ЮGHz_u	pdate","3M TC	D 1M DISTAR	VCE CORRECTION","Field Stre	ngth Dimension"			Count 100/100	O 104 Mars
Limit Line	Check CC PART 15	C PEAK							PASS PASS					M1[1] 43.20 dBμV/m 21.970 530 GHz
00 -10-1//														
90 dBµV/m														
80 dBµV/m														
70 dBµV/m														
60 dBµV/m														
50 dBµV/m														
40 dBuV/m	واجأط أراده والا				(and the second	ei grieche	an a	Angla Mili	a di kana kara da ini kana di kana da si kana		and the design of the Lagrandian distances	in a start of the st		
30 dBµV/m														
20 dBµV/m														
10 dBµV/m														
18.0 GHz								18001 pts			900.0 MHz/			27.0 GHz
	~												✓ Measuring	24.03.2023 16:53:50

16:53:50 24.03.2023

Plot 7-97. Radiated Spurious Emissions above 18GHz TxBF (BT GFSK ePA – Ch.39, Pol H)

15:54:49 24.03.2023

FCC ID: BCGA2117 IC: 579C-A2117	element	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage 01 of 100
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Ant1

Plot 7-99. Radiated Restricted Lower Band Edge Measurement Ant1

Plot 7-100. Radiated Restricted Lower Band Edge Measurement Ant1

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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Plot 7-101. Radiated Restricted Upper Band Edge Measurement Ant1

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dega 02 of 100
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Ant2

Plot 7-103. Radiated Restricted Lower Band Edge Measurement Ant2

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 04 of 109
1C2302130007-01.BCG	2/10/2023 - 5/5/2023	Head Mounted Device	Fage 94 01 100
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Plot 7-105. Radiated Restricted Upper Band Edge Measurement Ant2

Plot 7-106. Radiated Restricted Upper Band Edge Measurement Ant2

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dege 05 of 100
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NB UNII_L

Plot 7-107. Radiated Restricted Lower Band Edge Measurement NB UNII_L

Plot 7-108. Radiated Restricted Lower Band Edge Measurement NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	element	Approved by: Technical Manager	
Test Report S/N:	Test Dates:	EUT Type:	Dage OC of 100
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Plot 7-109. Radiated Restricted Upper Band Edge Measurement NB UNII_L

Plot 7-110. Radiated Restricted Upper Band Edge Measurement NB UNII_L

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 07 of 109
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TxBF

Plot 7-111. Radiated Restricted Lower Band Edge Measurement TxBF

FCC ID: BCGA2117 IC: 579C-A2117	element 🤤	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dogo 09 of 109
1C2302130007-01.BCG	2/10/2023 - 5/5/2023	Head Mounted Device	Fage 90 01 100
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Plot 7-113. Radiated Restricted Upper Band Edge Measurement TxBF

Plot 7-114. Radiated Restricted Upper Band Edge Measurement TxBF

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 00 of 100
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7.10 Radiated Spurious Emissions – Below 1GHz §15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-29 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-29. Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Quasi-Peak Field Strength Measurements

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 120kHz (for emissions from 30MHz 1GHz)
- 3. Detector = quasi-peak
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

Peak Field Strength Measurements

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 120kHz (for emissions from 30MHz 1GHz)
- 3. VBW = 300kHz
- 4. Detector = peak
- 5. Sweep time = auto couple
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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The EUT and measurement equipment were set up as shown in the diagrams below.

Figure 7-9. Radiated Test Setup < 30MHz

IC: 579C-A2117		Technical Manager	
Test Report S/N: T	Test Dates:	EUT Type:	Page 101 of 108
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Test Notes

- 1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-29.
- The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes. For below 30MHz the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
- 3. This unit was tested with its standard battery.
- 4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR guasi peak detector on emissions that were within 6dB of the limit.
- 5. Emissions were measured at a 3 meter test distance.
- 6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
- 7. No spurious emissions were detected within 20dB of the limit below 30MHz.
- 8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
- 9. All supported modulation, antenna (including TxBF mode) and power schemes have been tested on the unit and only worst case configuration is reported.
- 10. Both configurations below were investigated, and the worst case has been reported.
 - a. EUT powered by AC/DC adaptor to USB-C Power Pack to Magnetic Charging Cable
 - b. EUT powered by host PC via USB-C Power Pack to Magnetic Charging Cable

Sample Calculations

Determining Spurious Emissions Levels

- ο Field Strength Level [dB_μV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB] Preamplifier Gain [dB]
- $\circ \quad \text{Margin}_{[dB]} = \text{Field Strength Level}_{[dB\mu V/m]} \text{Limit}_{[dB\mu V/m]}$

FCC ID: BCGA2117 IC: 579C-A2117	element MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 102 of 108
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Radiated Spurious Emissions Measurements (Below 1GHz) §15.209; RSS-Gen [8.9]

TxBF

Plot 7-115. Radiated Spurious Emissions Below 1GHz TxBF (GFSK ePA – Ch.39, with AC/DC Adapter)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
35.72	Max Peak	Н	100	17	-65.56	-11.72	29.72	40.00	-10.28
54.83	Max Peak	Н	100	300	-67.07	-18.18	21.75	40.00	-18.25
94.46	Max Peak	Н	200	243	-68.26	-17.08	21.66	43.52	-21.86
202.85	Max Peak	V	100	288	-66.66	-12.74	27.60	43.52	-15.92
405.63	Max Peak	V	100	151	-76.22	-5.52	25.26	46.02	-20.76
680.14	Max Peak	V	100	281	-73.13	0.87	34.74	46.02	-11.28

Table 7-30. Radiated Spurious Emissions Below 1GHz TxBF (GFSK ePA – Ch.39, with AC/DC Adapter)

FCC ID: BCGA2117 IC: 579C-A2117	element	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Technical Manager
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7.11 AC Line-Conducted Emissions Measurement §15.207; RSS-Gen [8.8]

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for AC Line conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission	Conducted Limit (dBµV)			
(11112)	Quasi-peak	Average		
0.15 – 0.5	66 to 56*	56 to 46*		
0.5 – 5	56	46		
5 – 30	60	50		

Table 7-31. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = quasi-peak
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

Average Measurements

- 1. Analyzer center frequency was set to the frequency of the spurious emission of interest
- 2. RBW = 9kHz (for emissions from 150kHz 30MHz)
- 3. Detector = RMS
- 4. Sweep time = auto couple
- 5. Trace mode = max hold
- 6. Trace was allowed to stabilize

FCC ID: BCGA2117 IC: 579C-A2117	element	element MEASUREMENT REPORT (CERTIFICATION)	
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The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-11. Test Instrument & Measurement Setup

Test Notes

- 1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
- 2. Both configurations below were investigated, and the worst case has been reported.
 - a. EUT powered by AC/DC adaptor to USB-C Power Pack to Magnetic Charging Cable
 - b. EUT powered by host PC via USB-C Power Pack to Magnetic Charging Cable
- 3. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen (8.8).
- 4. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
- 5. QP/AV Level (dB μ V) = QP/AV Analyzer/Receiver Level (dB μ V) + Correction Factor (dB)
- 6. Margin (dB) = QP/AV Level (dB μ V) QP/AV Limit (dB μ V)
- 7. Traces shown in plot are made using a quasi peak and average detectors.
- 8. Deviations to the Specifications: None.

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Frequency [MHz]	Process State	QuasiPeak [dBµV]	Averaqe [dBµV]	Limit [dB µ ∨]	Marqin [dB]	Line	PE
0.152	FINAL		17.25	55.88	-38.63	L1	GND
0.152	FINAL	43.6		65.88	-22.24	L1	GND
0.472	FINAL		20.24	46.48	-26.24	L1	GND
0.472	FINAL	35.0		56.48	-21.44	L1	GND
0.796	FINAL	21.7		56.00	-34.27	L1	GND
0.798	FINAL		14.09	46.00	-31.91	L1	GND
3.937	FINAL		6.34	46.00	-39.66	L1	GND
3.941	FINAL	14.4		56.00	-41.56	L1	GND
16.208	FINAL	13.8		60.00	-46.20	L1	GND
16.208	FINAL		9.10	50.00	-40.90	L1	GND
24.311	FINAL		4.72	50.00	-45.28	L1	GND
24.311	FINAL	11.4		60.00	-48.65	L1	GND

Table 7-32. AC Line-Conducted Test Data TxBF (L1, GFSK ePA – Ch.39, with AC/DC Adapter)

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Plot 7-117. AC Line-Conducted Test Plot TxBF (N, GFSK ePA – Ch.39, with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Averaqe [dBµV]	Limit [dB µ V]	Marqin [dB]	Line	PE
0.152	FINAL		17.27	55.88	-38.61	N	GND
0.152	FINAL	41.9		65.88	-23.95	N	GND
0.249	FINAL		19.37	51.79	-32.42	N	GND
0.249	FINAL	38.0		61.79	-23.76	N	GND
0.539	FINAL		21.04	46.00	-24.96	N	GND
0.539	FINAL	31.5		56.00	-24.50	N	GND
3.928	FINAL		7.48	46.00	-38.52	N	GND
3.944	FINAL	15.9		56.00	-40.14	N	GND
8.711	FINAL	10.0		60.00	-50.02	N	GND
8.711	FINAL		2.94	50.00	-47.06	N	GND
16.211	FINAL		5.52	50.00	-44.48	N	GND
16.211	FINAL	11.7		60.00	-48.30	N	GND

Table 7-33. AC Line-Conducted Test Data TxBF (N, GFSK ePA – Ch.39, with AC/DC Adapter)

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Apple Head Mounted Device FCC ID: BCGA2117 and IC: 579C-A2117** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules and RSS-247 of the Innovation, Science and Economic Development Canada Rules.

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