







Plot 7-90. Average Conducted Power (3Mbps – Ch. 78) Antenna 2 iPA

FCC ID: A3LSMS908E	PCTEST Proud to be part of (® element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager
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Dual Antenna

Frequency	quency Data Rate Modulation	Power C	Channel	Peak Conducted Power ANT 1		Peak Conducted Power ANT 2		Peak Conducted Power Dual		
[MHZ]	[Mbps]		Scheme	NO.	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	iPA	0	13.07	20.272	10.65	11.614	15.04	31.915
2441	1.0	GFSK	iPA	39	13.28	21.267	11.47	14.028	15.48	35.318
2480	1.0	GFSK	iPA	78	12.32	17.065	10.48	11.179	14.51	28.249
2402	2.0	π/4-DQPSK	iPA	0	12.46	17.620	9.80	9.552	14.34	27.164
2441	2.0	π/4-DQPSK	iPA	39	12.87	19.382	10.61	11.497	14.90	30.903
2480	2.0	π/4-DQPSK	iPA	78	11.75	14.966	9.56	9.026	13.80	23.988
2402	3.0	8DPSK	iPA	0	12.79	19.002	9.98	9.963	14.62	28.973
2441	3.0	8DPSK	iPA	39	13.09	20.347	10.87	12.226	15.13	32.584
2480	3.0	8DPSK	iPA	78	12.13	16.315	9.94	9.870	14.18	26.182

Table 7-6. Dual Bluetooth Conducted Output Power – Peak Measurements

Frequency Data Rate		Modulation	Power Char	Channel	Avg Cor Power	nducted ANT 1	Avg Cor Power	nducted ANT 2	Avg Cond	ucted Power Dual
[MHz]	[Mbps]		Scheme	No.	[dBm]	[mW]	[dBm]	[mW]	[dBm]	[mW]
2402	1.0	GFSK	iPA	0	12.33	17.096	9.96	9.920	14.32	27.040
2441	1.0	GFSK	iPA	39	12.44	17.535	10.08	10.186	14.43	27.733
2480	1.0	GFSK	iPA	78	12.10	16.214	9.65	9.224	14.05	25.410
2402	2.0	π/4-DQPSK	iPA	0	10.24	10.575	8.09	6.435	12.31	17.022
2441	2.0	π/4-DQPSK	iPA	39	10.63	11.553	9.00	7.935	12.90	19.498
2480	2.0	π/4-DQPSK	iPA	78	10.26	10.624	8.05	6.378	12.31	17.022
2402	3.0	8DPSK	iPA	0	10.55	11.340	7.58	5.724	12.32	17.061
2441	3.0	8DPSK	iPA	39	10.75	11.890	8.50	7.084	12.78	18.967
2480	3.0	8DPSK	iPA	78	10.18	10.411	7.52	5.649	12.06	16.069

Table 7-7. Dual Bluetooth Conducted Output Power – Average Measurements

Note:

This device can operate simultaneously on two antennas. The directional gains are shown in Table 2-2 in Section 2.3 of this report. The directional gain from the operation of two antennas is shown to operate at less than 6dBi per the calculation below:

Directional gain = $10 \log[(10^{G_{1/20}} + 10^{G_{2/20}} + ... + 10^{G_{N/20}})^2 / N_{ANT}] dBi$ = $10 \log[(10^{-6.82/20} + 10^{-6.12/20})^2 / 2] dBi$ = -3.45dBi

where G_N is the gain of the nth antenna and N_{ANT} is the total number of antennas used.

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Plot 7-92. Dual Bluetooth Peak Conducted Power (1Mbps - Ch. 39) Antenna 1 iPA

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Plot 7-94. Dual Bluetooth Peak Conducted Power (2Mbps – Ch. 0) Antenna 1 iPA

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Plot 7-96. Dual Bluetooth Peak Conducted Power (2Mbps - Ch. 78) Antenna 1 iPA

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Plot 7-98. Dual Bluetooth Peak Conducted Power (3Mbps - Ch. 39) Antenna 1 iPA

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Plot 7-99. Dual Bluetooth Peak Conducted Power (3Mbps - Ch. 78) Antenna 1 iPA



Plot 7-100. Dual Bluetooth Average Conducted Power (1Mbps – Ch. 0) Antenna 1 iPA

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Keysight Spectrum Analyzer - Burst Power				
μα RF 50 Ω AC CORF	REC SENSE:INT Center Freq: 2.4410000 Trig: RF Burst ain:Low #Atten: 40 dB	000 GHz Avg Hold: 100/100	12:02:09 PM Oct 10, 2021 Radio Std: None	Frequency
10 dB/div Ref 30.00 dBm				
20.0				Center Freq 2.441000000 GHz
-10.0				
-30.0				
-50.0				
0.00 s ResBw 3.00 MHz		Sweep 4.00 ms	4.00 ms (60001 pt)	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl) 12.439 dBm	Abs Amplitude Rel Amplitude Current Data	Threshold -1 Threshold -3	6.34 dBm 0.00 dB	Freq Offset
Above Threshold Pts 44083	Output Pwr 12.431 dBm	Max Pt 13.660 dBm	Min Pt -79.102 dBm	0 Hz
MSG		STATUS		

Plot 7-101. Dual Bluetooth Average Conducted Power (1Mbps - Ch. 39) Antenna 1 iPA



Plot 7-102. Dual Bluetooth Average Conducted Power (1Mbps - Ch. 78) Antenna 1 iPA

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Keysight Spectrum Analyzer - Burst Power			
KF 50 Ω AC CORREC	SENSE:INT	11:57:31 AM Oct 10, 2021	Frequency
	Center Freq: 2.402000000 GHz	Radio Std: None	
IFGain:Low	#Atten: 40 dB		
10 JB/JU Bof 30,00 dBm			
Log			
20.0			Center Freq
		<u> </u>	2.402000000 GHz
n na sean an a	<u>h syntych da anallia dy b haly thaday nightlar madria yn y baly bath ynitych ar mailia dy b hale</u>	<mark>s lk</mark>	
400			
-10.0			
-20.0			
-30.0			
-40.0			
-50.0			
-60.0			
0.00 s		4.00 ms	CE Step
ResBw 3.00 MHz	Sweep 4.0	00 ms (60001 pt)	3.000000 MHz
Output Bower	Abo Amplitudo Throshold	47.04 JDm	<u>Auto</u> Man
(Above Threshold Lvl)	Rel Amplitude Threshold	-17.31 dBm	
10.243 dBm		-30.00 dB	Fred Offset
	Current Data		
	Output Pwr Max Pt	Min Pt	0 H2
Above Threshold Pts 44120	10.245 dBm 12.685 dBm -74.821 dBm		
Above Threshold Fis 44129			
MSG	S	TATUS	

Plot 7-103. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 0) Antenna 1 iPA



Plot 7-104. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 39) Antenna 1 iPA

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Keysight Spectrum Analyzer - Burst Power			
DZ RF 50Ω AC CORREC IFGain:Low	SENSE:INT Center Freq: 2.480000000 GHz Trig: RF Burst Avg Hold: 100/1 #Atten: 40 dB	11:53:31 AM Oct 10, 2021 Radio Std: None 00	Frequency
10 dB/div Ref 30.00 dBm Log			
			Center Freq 2.480000000 GHz
	atiinii waxatati kankiinii waxati yaanii kuu waxata		
-30.0			
-50.0			
0.00 s ResBw 3.00 MHz	Sweep 4.0	4.00 ms 00 ms (60001 pt)	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl) 10 263 dBm	Abs Amplitude Threshold Rel Amplitude Threshold	-17.23 dBm -30.00 dB	<u>Auto</u> Man
	Current Data Output Pwr Max Pt	Min Pt	0 Hz
Above Threshold Pts 44130	10.274 dBm 12.768 d	dBm -78.299 dBm	
MSG	2	STATUS	

Plot 7-105. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 78) Antenna 1 iPA



Plot 7-106. Dual Bluetooth Average Conducted Power (3Mbps - Ch. 0) Antenna 1 iPA

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Keysight Spectrum Analyzer - Burst Power		
Lα RF 50Ω AC CORREC IFGain:Low	SENSE:INT Center Freq: 2.441000000 GHz Trig: RF Burst Avg Hold: 100/100 #Atten: 40 dB	11:45:52 AM Oct 10, 2021 Radio Std: None Frequency
10 dB/div Ref 30.00 dBm		
		Center Freq 2.441000000 GHz
-20.0		
-40.0		
		4.00 mg
ResBw 3.00 MHz	Sweep 4.00 r	ns (60001 pt)
Output Power (Above Threshold Lvl)	Abs Amplitude Threshold Rel Amplitude Threshold	-16.35 dBm -30.00 dB
10.752 dBm	Current Data Output Pwr Max Pt	Min Pt
Above Threshold Pts 44144	10.754 dBm 13.648 dBn	n -77.341 dBm
MSG	STAT	

Plot 7-107. Dual Bluetooth Average Conducted Power (3Mbps - Ch. 39) Antenna 1 iPA



Plot 7-108. Dual Bluetooth Average Conducted Power (3Mbps - Ch. 78) Antenna 1 iPA

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Plot 7-109. Dual Bluetooth Peak Conducted Power (1Mbps - Ch. 0) Antenna 2 iPA



Plot 7-110. Dual Bluetooth Peak Conducted Power (1Mbps - Ch. 39) Antenna 2 iPA

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🔤 Kej	ysight Spee	trum Analyzer - Swe	ept SA									
L <mark>XI</mark>		RF 50 Ω	AC	CORREC	SEN	ISE:INT	#Avg Typ	e: RMS	12:09:37 PI TRAC	4 Oct 10, 2021	F	requency
				PNO: Fast ++- IFGain:Low	Atten: 30	dB	Avginoid	100/100	DE	PNNNN		
								Mk	r1 2.479	92 GHz		Auto Tune
10 dE Log	B/div	Ref 20.00 c	lBm						10.4	84 dBm		
						1						Center Freq
10.0	<u> </u>				- V		- Andrew Area				2.48	80000000 GHz
0.00												
0.00												Start Freq
-10.0											2.47	'5000000 GHz
	/											
-20.0	/									- Ya		Stop Freq
-30.0											2.48	35000000 GHz
-40.0												CF Step 1.000000 MHz
50.0											<u>Auto</u>	Man
-50.0												
-60.0												Freq Offset
												0 HZ
-70.0												
												scale Type
Cen	ter 2.4	80000 GHz	_					_	Span 1	0.00 MHz	Log	Lin
#Re	s BW :	5.0 MHz		#VBW	8.0 MHz			sweep	1.000 ms (1001 pts)		
MSG								STATU	JS			

Plot 7-111. Dual Bluetooth Peak Conducted Power (1Mbps - Ch. 78) Antenna 2 iPA



Plot 7-112. Dual Bluetooth Peak Conducted Power (2Mbps - Ch. 0) Antenna 2 iPA

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Plot 7-113. Dual Bluetooth Peak Conducted Power (2Mbps - Ch. 39) Antenna 2 iPA



Plot 7-114. Dual Bluetooth Peak Conducted Power (2Mbps - Ch. 78) Antenna 2 iPA

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Plot 7-116. Dual Bluetooth Peak Conducted Power (3Mbps – Ch. 39) Antenna 2 iPA

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Plot 7-117. Dual Bluetooth Peak Conducted Power (3Mbps - Ch. 78) Antenna 2 iPA



Plot 7-118. Dual Bluetooth Average Conducted Power (1Mbps – Ch. 0) Antenna 2 iPA

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Keysight Spectrum Analyzer - Burst Power			
CM RF 50Ω AC CORREC →→ IFGain:Low	SENSE:INT Center Freq: 2.441000000 GHz → Trig: RF Burst Avg Hol #Atten: 40 dB	11:24:49 AM Oct 10, 2021 Radio Std: None d: 100/100	Frequency
10 dB/div Ref 30.00 dBm			
20.0			Center Freq 2.441000000 GHz
-10.0			
-30.0			
-50.0			
0.00 s ResBw 3.00 MHz	Sw	4.00 ms eep 4.00 ms (60001 pt)	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl)	Abs Amplitude Thresh Rel Amplitude Thresh	old -18.67 dBm old -30.00 dB	<u>Auto</u> Man
10.080 dBm	Current Data		Freq Offset
Above Threshold Pts 44080	Output Pwr M 10.070 dBm 1	ax Pt Min Pt 1.328 dBm -76.986 dBm	0112
MSG		STATUS	

Plot 7-119. Dual Bluetooth Average Conducted Power (1Mbps - Ch. 39) Antenna 2 iPA



Plot 7-120. Dual Bluetooth Average Conducted Power (1Mbps - Ch. 78) Antenna 2 iPA

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Keysight Spectrum Analyzer - Burst Power		
IM2 RF 50Ω AC CORREC → IFGain:Low	SENSE:INT Center Freq: 2.402000000 GHz Trig: RF Burst Avg Hold: 100/100 #Atten: 40 dB	11:28:41 AM Oct 10, 2021 Radio Std: None Frequency
10 dB/div Ref 30.00 dBm		
		Center Freq 2.402000000 GHz
	a filmiter i fatt e den antimiter i state de la constanti de la constanti de la constanti de la constanti de la Antimiter i constanti de la cons	
-200 -30.0		
-50.0		
0.00 s ResBw 3.00 MHz	Sweep 4.00 r	4.00 ms ns (60001 pt) 3.00000 MHz
Output Power (Above Threshold Lvl) 8 0854 dBm	Abs Amplitude Threshold Rel Amplitude Threshold	-19.32 dBm -30.00 dB
0.0004 (15)	Current Data	0 Hz
Above Threshold Pts 44131	8.0816 dBm 10.684 dBn	n -81.071 dBm
MSG	STAT	JS

Plot 7-121. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 0) Antenna 2 iPA



Plot 7-122. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 39) Antenna 2 iPA

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Keysight Spectrum Analyzer - Burst Power			
Und RF 50Ω AC CORREC → Figure 1 IFGain:Low	SENSE:INT Center Freq: 2.48000000 GHz Trig: RF Burst Avg Hold: 100/100 #Atten: 40 dB	11:51:31 AM Oct 10, 2021 Radio Std: None	Frequency
10 dB/div Ref 30.00 dBm			
			Center Freq 2.480000000 GHz
	nelin nelin a da a da a da anti a da anti a da anti a da anti a da a da a da anti. Nelin da anti a da a da anti a da a da a da a da a da a da a		
-20.0			
-50.0			
0.00 s ResBw 3.00 MHz	Sweep 4.00	4.00 ms ms (60001 pt)	CF Step 3.000000 MHz
Output Power (Above Threshold Lvl)	Abs Amplitude Threshold Rel Amplitude Threshold	-19.35 dBm -30.00 dB	<u>Auto</u> Man
0.0408 UBIII	Current Data	Min Bt	Freq Oπset 0 Hz
Above Threshold Pts 44129	8.0567 dBm 10.647 dB	m -78.335 dBm	
MSG	STA	ius	

Plot 7-123. Dual Bluetooth Average Conducted Power (2Mbps - Ch. 78) Antenna 2 iPA



Plot 7-124. Dual Bluetooth Average Conducted Power (3Mbps - Ch. 0) Antenna 2 iPA

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Plot 7-125. Dual Bluetooth Average Conducted Power (3Mbps - Ch. 39) Antenna 2 iPA



Plot 7-126. Dual Bluetooth Average Conducted Power (3Mbps – Ch. 79) Antenna 2 iPA

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7.4 Conducted Authorized Band Edge §15.247 (d); RSS-247 [5.5]

Test Overview and Limits

EUT operates in hopping and non-hopping transmission mode. Measurement is taken at the highest point located outside of the emission bandwidth. *The maximum permissible out-of-band emission level is 20 dBc.*

Test Procedure Used

ANSI C63.10-2013 – Section 6.10.4

Test Settings

- 1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
- 2. Span was set large enough so as to capture all out of band emissions near the band edge
- 3. RBW = 100kHz
- 4. VBW = 300kHz
- 5. Detector = Peak
- 6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
- 7. Trace mode = max hold
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

Test Setup

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



Figure 7-3. Test Instrument & Measurement Setup

Test Notes

Out of band conducted spurious emissions at the band edge were investigated for all data rates in hopping and non-hopping modes. The worst case emissions were found with the EUT transmitting at 3Mbps. Band edge emissions were also investigated with the EUT transmitting in all data rates. Plots of the worst case emissions are shown below.

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Plot 7-127. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps- Ch. 0) Antenna 1



Plot 7-128. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps- Ch. 78) Antenna 1

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Plot 7-129. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps- Ch. 0) Antenna 1



Plot 7-130. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps- Ch. 78) Antenna 1

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Plot 7-131. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps- Ch. 0) Antenna 2



Plot 7-132. Band Edge Plot (Bluetooth with Hopping Disabled, 3Mbps- Ch. 78) Antenna 2

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Plot 7-133. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps- Ch. 0) Antenna 2



Plot 7-134. Band Edge Plot (Bluetooth with Hopping Enabled, 3Mbps- Ch. 78) Antenna 2

FCC ID: A3LSMS908E	PCTEST Proud to be part of the element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager
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7.5 Carrier Frequency Separation §15.247(a)(1); RSS-247 [5.1(b)]

Test Overview and Limit

Measurement is made with EUT operating in hopping mode. The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

Test Procedure Used

ANSI C63.10-2013 - Section 7.8.2

Test Settings

- 1. Span = Wide enough to capture peaks of two adjacent channels
- 2. RBW = 30% of channel spacing. Adjust as necessary to best identify center of each individual channel
- 3. VBW ≥ RBW
- 4. Sweep = Auto
- 5. Detector = Peak
- 6. Trace mode = max hold
- 7. The trace was allowed to stabilize.
- 8. Marker-delta function used to determine separation between peaks of the adjacent channels

Test Setup

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

Figure 7-4. Test Instrument & Measurement Setup

Test Notes

- 1. The EUT complies with the minimum channel separation requirement when it is operating in 1x/EDR mode using 79 channels and when operating in AFH mode using 20 channels.
- 2. All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported.

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Frequency [MHz]	Data Rate [Mbps]	Modulation	Power Scheme	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	ePA	0	0.663
2441	1.0	GFSK	ePA	39	0.627
2480	1.0	GFSK	ePA	78	0.625
2402	2.0	π/4-DQPSK	ePA	0	0.895
2441	2.0	π/4-DQPSK	ePA	39	0.881
2480	2.0	π/4-DQPSK	ePA	78	0.886
2402	3.0	8DPSK	ePA	0	0.868
2441	3.0	8DPSK	ePA	39	0.873
2480	3.0	8DPSK	ePA	78	0.865

Table 7-8. Minimum Channel Separation – Antenna 1

Plot 7-135. Channel Spacing Plot (Bluetooth) – Antenna 1

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Frequency [MHz]	Data Rate [Mbps]	Modulation	Power Scheme	Channel No.	Min. Channel Separation [MHz]
2402	1.0	GFSK	ePA	0	0.681
2441	1.0	GFSK	ePA	39	0.668
2480	1.0	GFSK	ePA	78	0.662
2402	2.0	π/4-DQPSK	ePA	0	0.881
2441	2.0	π/4-DQPSK	ePA	39	0.882
2480	2.0	π/4-DQPSK	ePA	78	0.891
2402	3.0	8DPSK	ePA	0	0.874
2441	3.0	8DPSK	ePA	39	0.881
2480	3.0	8DPSK	ePA	78	0.872

Table 7-9. Minimum Channel Separation – Antenna 2

Plot 7-136. Channel Spacing Plot (Bluetooth) – Antenna 2

FCC ID: A3LSMS908E	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager	
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7.6 Time of Occupancy §15.247(a)(1)(iii); RSS-247 [5.1(d)]

Test Overview and Limit

Measurement is made while EUT is operating in hopping mode with the spectrum analyzer set to zero span. *The maximum permissible time of occupancy is 400 ms within a period of 400ms multiplied by the number of hopping channels employed.*

Test Procedure Used

ANSI C63.10-2013 - Section 7.8.4

Test Settings

- 1. Span = zero span, centered on a hopping channel
- 2. RBW \leq channel spacing and >> 1/T, where T is expected dwell time per channel
- 3. Sweep = as necessary to capture entire dwell time. Second plot may be required to demonstrate two successive hops on a channel
- 4. Trigger is set with appropriate trigger delay to place pulse near the center of the plot
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. Marker-delta function used to determine transmit time per hop

Test Setup

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

Figure 7-5. Test Instrument & Measurement Setup

Test Notes

All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported

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🔤 Keysight Sp	ectrum Analyzer - Swept SA					
LXI L	RF 50 Ω AC	CORREC	SENSE:INT Trig Delay3.397 ms Trig: Video	#Avg Type: RMS	11:49:49 AM Oct 08, 2021 TRACE 1 2 3 4 5 6 TYPE WWWWW	Frequency
10 dB/div	Ref 25.00 dBm	IFGain:Low	Atten: 36 dB		∆Mkr1 2.887 ms -0.71 dB	Auto Tune
15.0		X ₂		1Δ2	TRIG LVL	Center Freq 2.441000000 GHz
-5.00						Start Freq 2.441000000 GHz
-15.0						Stop Freq 2.441000000 GHz
-35.0	Alephanether and the second	hutum h		phalm-abyth	nu dhaaraanaa ahaanaa a	CF Step 1.000000 MHz <u>Auto</u> Man
-55.0						Freq Offset 0 Hz
-65.0						Scale Type
Center 2. Res BW 1	441000000 GHz 1.0 MHz	#VBW 3	0 MHz	Sweep 3	Span 0 Hz 3,467 ms (1001 pts)	Log <u>Lin</u>
MSG				STATU	s	

Plot 7-137. Time of Occupancy Plot (Bluetooth) -Antenna 1

Bluetooth time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/BDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.887 ms/channel = 307.96 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- o 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- o 53.34 hops x 2.887 ms/channel = 153.99 ms (worst case dwell time for one channel in AFH mode)

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🔤 Keysight Sp	ectrum Analyzer - Swept SA								
LXI L	RF 50 Ω AC	CORREC Trig D	SENSE:INT elay-2.539 ms /ideo	Avg Type	: Log-Pwr	06:52:59 PI TRAC	4 Oct 08, 2021 E 1 2 3 4 5 6 E WWWWWW	Fr	equency
10 dB/div	Ref 30.00 dBm	IFGain:Low Atten	: 40 dB		Δ	Mkr1 2	.887 ms 0.72 dB		Auto Tune
20.0		-X3		1Δ3				(2.44	Center Freq 1000000 GHz
0.00								2.44	Start Freq 1000000 GHz
-10.0							TRIG LVL	2.44	Stop Freq 1000000 GHz
-30.0 4 4 4	ond Antol Alfred Antol	\$* µ !		hthrith	ny (Likky whi	nninnini	iddydd yn arlan yn a Canar yn arlan yn arl	1 <u>Auto</u>	CF Step .000000 MHz Man
-50.0									F req Offset 0 Hz
-30.0									Scale Type
Center 2.	441000000 GHz	4V/DW/ 2 0 M			Dura an O	S	pan 0 Hz	Log	Lin
Res BW	I.U MHZ	#VBW 3.0 W	12		sweep 8	.407 ms (TOUT pts)		
MSG					STATUS	3			

Plot 7-138. Time of Occupancy Plot (Bluetooth) - Antenna 2

Bluetooth time of Occupancy Calculation

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/BDR modes use 5 transmit and 1 receive slot, for a total of 6 slots, the Bluetooth transmitter is actually hopping at a rate of 1600 / 6 = 266.67 hops/s/slot

- 400ms x 79 hopping channels = 31.6 sec (Time of Occupancy Limit)
- Worst case BT has 266.67 hops/second (for 1x/EDR modes with DH5 operation)
- 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.887 ms/channel = 307.96 ms (worst case dwell time for one channel in 1x/EDR modes)

With AFH, the number of channels is reduced to a minimum of 20 channels and the channel hopping rate is reduced by 50% to 800 hops/s. AFH mode also uses 6 total slots so the Bluetooth transmitter hops at a rate of 800 / 6 = 133.3 hops/s/slot

- 400ms x 20 hopping channels = 8 sec (Time of Occupancy Limit)
- Worst case BT has 133.3 hops/second/slot (for AFH mode with DH5 operation)
- o 133.3 hops/s / 20 channels = 6.67 hops/second (# of hops/second on one channel)
- 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- o 53.34 hops x 2.887 ms/channel = 153.99 ms (worst case dwell time for one channel in AFH mode)

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7.7 Number of Hopping Channels §15.247 (a.1.iii); RSS-247 [5.1(d)]

Test Overview and Limit

Measurement is made while EUT is operating in hopping mode. *This frequency hopping system must employ a minimum of 15 hopping channels.*

Test Procedure Used

ANSI C63.10-2013 - Section 7.8.3

Test Settings

- 1. Span = frequency of band of operation (divided into two plots)
- 2. RBW < 30% of channel spacing or 20dB bandwidth, whichever is smaller.
- 3. VBW ≥ RBW
- 4. Sweep = auto
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

Test Setup

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

Figure 7-6. Test Instrument & Measurement Setup

Test Notes

- 1. The frequency spectrum was broken up into two sub-ranges to clearly show all of the hopping frequencies. In AFH mode, this device operates using 20 channels so the requirement for minimum number of hopping channels is satisfied.
- 2. All supported modulation and power schemes have been tested on the unit and only worst case configuration is reported.

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Plot 7-139. Low End Spectrum Channel Hopping Plot (Bluetooth) Antenna 1

Plot 7-140. High End Spectrum Channel Hopping Plot (Bluetooth) Antenna 1

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Plot 7-142. High End Spectrum Channel Hopping Plot (Bluetooth) Antenna 2

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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

- Out-of-band conducted spurious emissions were investigated for all data rates and the worst case emissions were found with the EUT transmitting at N/AMbps. 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. All supported modulation and power schemes have been tested on the unit and only worst-case configuration is reported

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🦲 Keysight Sp	ectrum Analyzer - Swept SA					
LXI L	RF 50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	06:17:40 PM Oct 08, 2021 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref 30.00 dBm	PNO: Fast IFGain:Low	Atten: 40 dB	Avginola.>100/100	Mkr1 3.053 2 GHz -22.395 dBm	Auto Tune
20.0						Center Freq 5.015000000 GHz
0.00					DL1 -5.01 dBm	Start Freq 30.000000 MHz
-10.0		1		الر الدور ومراقع المارين ومرود الدور ومرود الم	and a second	Stop Freq 10.000000000 GHz
-30.0 -40.0						CF Step 997.000000 MHz <u>Auto</u> Man
-50.0						Freq Offset 0 Hz
Stort 20.					Stop 10 000 CH	Scale Type
#Res BW	1.0 MHz	#VBW	3.0 MHz	Sweep	18.00 ms (30001 pts)	
MSG				STA	TUS	

Plot 7-144. Conducted Spurious Plot (Bluetooth, 1Mbps- Ch. 0) Antenna 1

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Keysight 3	Spectrum Analyzer - Swept SA	4				
lXI L	RF 50 Ω A0	C CORREC	SENSE:INT	#Avg Type: RMS	06:21:01 PM Oct 08, 2021 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref 30.00 dBn	PNO: Fast 😱 IFGain:Low	Atten: 40 dB	Avg Hold:>100/100	lkr1 3.259 3 GHz -22.334 dBm	Auto Tune
20.0						Center Freq 5.015000000 GHz
0.00					DL1 -4.77 dBm	Start Freq 30.000000 MHz
-10.0		1		all	han a san da anteni	Stop Freq 10.000000000 GHz
-30.0						CF Step 997.000000 MHz <u>Auto</u> Man
-50.0						Freq Offset 0 Hz
Stort 20					Stop 10 000 CHr	Scale Type
#Res BV	V 1.0 MHz	#VBW	3.0 MHz	Sweep 1	8.00 ms (30001 pts)	
MSG				STAT	US	

Plot 7-146. Conducted Spurious Plot (Bluetooth, 1MbpsCh. 39) Antenna 1

FCC ID: A3LSMS908E	PCTEST Proud to be part of (® element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager
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Keysight Spectrum Analyzer - Swept SA					
L RF 50 Ω AC	CORREC	SENSE:INT	#Avg Type: RMS	06:23:22 PM Oct 08, 2021 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 30.00 dBm	PNO: Fast +++ IFGain:Low	rig: Free Kun Atten: 40 dB		kr1 2.990 4 GHz -23.076 dBm	Auto Tune
20.0					Center Freq 5.015000000 GHz
0.00				DL1 -4.91 dBm	Start Freq 30.000000 MHz
-10.0	1		and the state		Stop Freq 10.000000000 GHz
-30.0			n ng kang pang kang dina pang bina ng kang pang kang pang bina ng kang bina ng kang pang bina ng kang pang pan Kang pang pang pang bina pang bina ng kang pang pang pang pang pang pang pang p	A for fair fair fair an ann an Anna ann an Anna Anna Anna A	CF Step 997.000000 MHz <u>Auto</u> Man
-50.0					Freq Offset 0 Hz
-60.0					Scale Type
Start 30 MHz	#\/B\// 2		Swoon 1	Stop 10.000 GHz	
MSG	#VDVV J.	0 10112	Sweep to	si s	

Plot 7-148. Conducted Spurious Plot (Bluetooth, 1Mbps- Ch. 78) Antenna 1

FCC ID: A3LSMS908E	PCTEST Proud to be part of @ element	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Technical Manager
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🔤 Keysight Sp	ectrum Analyzer - Swept SA								
lxi L	RF 50 Ω AC	CORREC	SEN	ISE:INT	#Avg Type	RMS	06:16:27 PI TRAC	M Oct 08, 2021	Frequency
10 dB/div	Ref 30.00 dBm	PNO: Fast 😱 IFGain:Low	Atten: 40	dB	Avginoid.	N	lkr1 3.48 -22.5	7 9 GHz 61 dBm	Auto Tune
20.0									Center Freq 5.015000000 GHz
0.00								DL1 -4.78 dBm	Start Freq 30.000000 MHz
-10.0		1		a and and the	in the second	terel ⁴) is provide	det meilen verb state -	الروابية والمتراربين	Stop Freq 10.000000000 GHz
-30.0 -40.0						n Štalj Mena se k roja je se			CF Step 997.000000 MHz <u>Auto</u> Man
-50.0									Freq Offset 0 Hz
									Scale Type
Start 30 M #Res BW	MHz 1.0 MHz	#VBW	3.0 MHz		S	weep	Stop 10 18.00 ms (3	.000 GHz 0001 pts)	Log <u>Lin</u>
MSG						STAT	US		

Plot 7-150. Conducted Spurious Plot (Bluetooth, 1Mbps- Ch. 0) Antenna 2

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🔤 Keysig	jht Spectrum	Analyzer - Sw	ept SA								- d -
L <mark>XI</mark> L	R	50 Ω	AC	CORREC	SEI	ISE:INT	#Avg Typ	e: RMS	06:22:00 PI TRAC	^E 1 2 3 4 5 6	Frequency
10 dB/d	liv Re	f 30.00 d	dBm	PNO: Fast ↔ IFGain:Low	Atten: 40	dB	Avg Hold:	M	kr1 3.18 -23.3	4 8 GHz 23 dBm	Auto Tune
20.0											Center Free 5.015000000 GH
10.0										DL1 -4.69 dBm	Start Free 30.000000 MH
-10.0				1			at. untaild	ana malataka ara tu		a a li diat	Stop Free 10.000000000 GH
-30.0											CF Step 997.000000 MH <u>Auto</u> Mar
-50.0											Freq Offse 0 H
-00,0											Scale Type
Start 3 #Res I	30 MHz BW 1.0	MHz		#VBV	v 3.0 MHz		s	weep 1	Stop 10 8.00 ms (3	.000 GHz 0001 pts)	Log <u>Lir</u>
MSG								STATU	US		

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Keysight S	Spectrum Analyzer - Swept SA								
l,XI L	RF 50 Ω AC	CORREC	SEN	ISE:INT	#Avg Typ	e: RMS	06:22:42 PI TRAC	^E 1 2 3 4 5 6	Frequency
10 dB/div	Ref 30.00 dBm	PNO: Fast ↔ IFGain:Low	Atten: 40	dB	Avg Hold:	M	kr1 3.050 -23.2	3 2 GHz 21 dBm	Auto Tune
20.0									Center Freq 5.015000000 GHz
0.00								DL1 -5.10 dBm	Start Freq 30.000000 MHz
-10.0		1				ahaan dar muu		I to sub-l	Stop Freq 10.000000000 GHz
-30.0					A longer og den som forste forste forste som	na des ^{im} ten de la constance.	n het iv fan het in Hang <mark>it genere efter ditter</mark>	an a	CF Step 997.000000 MHz <u>Auto</u> Man
-50.0									Freq Offset 0 Hz
-50.0									Scale Type
Start 30 #Res BV	MHz V 1.0 MHz	#VBW	3.0 MHz		s	weep 1	Stop 10 8.00 ms (3	.000 GHz 0001 pts)	Log <u>Lin</u>
MSG						STATU	s		

Plot 7-154. Conducted Spurious Plot (Bluetooth, 1Mbps- Ch. 78) Antenna 2

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7.9 Radiated Spurious Emissions Measurements – 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 7-10 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-10. 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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Test Setup

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 7-10.

- 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. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

7. Average emissions were not reported since the duty cycle correction factor was greater than 20dB.

8. 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.

9. All supported modulation and power schemes have been tested on the unit and only the worst-case configuration is reported

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Sample Calculation

- ο 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]
- Margin [dB] = Field Strength Level $[dB\mu V/m]$ 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 = 20log10(7.5ms/100ms) = -22.5 dB

Average Emission Calculation

o 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]

Plot 7-157. Radiated Spurious Emissions above 1GHz (Bluetooth, 1Mbps– Ch. 78) Antenna 1

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Radiated Spurious Emissions Measurements (Above 18GHz) §15.209; RSS-Gen [8.9]

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Plot 7-164. Radiated Spurious Emissions above 18GHz (Bluetooth, 1Mbps- Ch. 0) Antenna 1 - Pol. H

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