

Keysight Spectrum Analyzer	- Swept SA						
<b>LXI</b> RL RF !	50 Ω DC	CORREC	SENSE:INT Trig Delay-999.0 µs	#Avg Type: RMS	12:15:29 A	M May 22, 2020	Frequency
10 dB/div Ref 25 (	NFE	PNO: Wide ↔→ IFGain:Low	Atten: 36 dB		ΔMkr1 2	890 ms	Auto Tune
		<u>nu-4</u> wn/ne	Kennandia (sulta Minika da Pa			TRIG LVL	Center Freq 2.441000000 GHz
-5.00	X <sub>2</sub>				1Δ2		Start Freq 2.441000000 GHz
-15.0							<b>Stop Freq</b> 2.441000000 GHz
-35.0	ANY				1	di <mark>llan</mark> iyiyi	CF Step 1.000000 MHz <u>Auto</u> Man
-55.0					4 4		<b>Freq Offset</b> 0 Hz
							Scale Type
Center 2.44100000 Res BW 1.0 MHz	0 GHz	#VBW 3	8.0 MHz	Sweep	S 5.000 ms (	pan 0 Hz 1001 pts)	Log <u>Lin</u>
MSG				STA	TUS		

Plot 7-81. Time of Occupancy Plot (Bluetooth) - ANTO



Plot 7-82. Time of Occupancy Plot (Bluetooth) - ANT1

FCC ID: A3LSMF707U	The for the part of the second	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 61 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 01 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# **Bluetooth Time of Occupancy Calculation**

Typically, Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s. Since 1x/EDR 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)
- o 266.67 hops/second / 79 channels = 3.38 hops/second (# of hops/second on one channel)
- o 3.38 hops/second/channel x 31.6 seconds = 106.67 hops (# hops over a 31.6 second period)
- 106.67 hops x 2.890 ms/channel = 308.27 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)
- o 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)
- o 6.67 hops/s / channel x 8 seconds = 53.34 hops (# hops over a 8 second period)
- o 53.34 hops x 2.890 ms/channel = 154.15 ms (worst case dwell time for one channel in AFH mode)

FCC ID: A3LSMF707U	PCTEST Traud to be performed	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N: Test Dates:		EUT Type:	Page 62 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 02 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# 7.7 Number of Hopping Channels §15.247 (a.1.iii); RSS-247 [5.1(4)]

### **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**

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.

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 62 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 03 01 94
© 2020 PCTEST				V 9.0 02/01/2019





Plot 7-83. Low End Spectrum Channel Hopping Plot (Bluetooth) - ANTO



Plot 7-84. High End Spectrum Channel Hopping Plot (Bluetooth) - ANTO

FCC ID: A3LSMF707U	PCTEST Tead to be performed	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 64 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 04 01 94
© 2020 PCTEST			V 9.0 02/01/2019



🔤 Key	sight Spe	ectrum A	nalyzer - Sw	ept SA															
LXI RI		RF	50 Ω	DC	CORREC			SEI	NSE:IN	Г					11	:37:11 P	M May 21, 2020	-	requency
									. n		#A	vg Ty	pe: RN	IS		TRA			requeitcy
				NFE	PNO: W	/ide ↔	. I TIQ	p: Free en: 30	e Run )dB		A	ginoi	a: 100/	100		D			
					IFGain:	Low	7.1	en. oc											
																			Auto Tune
10 dE	3/div	Ref	20.00 d	lBm															
Log								,	V										
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10.0		$\{1\}$	ANN	UIII	$\{V,V\}$		HШ	$\{ 1\rangle$	111	111		HH.	V   P			ЦЦ		2.4	
10.0	- 11			ITAL	)	1711	ITUI	1111			11 11	11.17	11 M		(/ \} \	1414	I ()	2.4.	20500000 GHZ
	- 74	111		M V I		11	V V I	1	11	V U	V V	1	U V	¥ ¥ -	V U I		V V V V		
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40.0																		2.4	00000000 GHz
-10.0																			
-20.0																			Oton From
																			StopFred
	1																	2.4	41000000 GHz
-30.0																			
	14																		
-40.0	)																		CF Step
																			4.100000 MHz
	1																	<u>Auto</u>	Man
-50.0																			
60.0																			Freq Offset
-00.01																			0 Hz
-70.0																			
																			Scale Type
Star	2 40	000.0	GHz												Sto	n 24	4100 GHz	Log	Lin
#Pec	BIA	200 1	(Hz			#\/R\A	110	MHZ					Swe	en	1 000	me	(1001 nte)		
wittes		2001						WIII 12						- P	1.000		(Toor pts)		
MSG														STATU	IS				

Plot 7-85. Low End Spectrum Channel Hopping Plot (Bluetooth) – ANT1



Plot 7-86. High End Spectrum Channel Hopping Plot (Bluetooth) – ANT1

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 65 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 05 01 94
© 2020 PCTEST			V 9.0 02/01/2019



## 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 10<sup>th</sup> 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 Mbps. 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.

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 66 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 00 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# ANT0



Plot 7-87. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 0)



Plot 7-88. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 0)

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N: Test Dates:		EUT Type:		Page 67 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 07 01 94
© 2020 PCTEST				V 9 0 02/01/2019



🔤 Keysight Spectrum A	Analyzer - Swept SA						
KL RF	50Ω DC 0	CORREC	SENSE:INT	#Avg Type: RI	12:10:14 AM MS TRACE	May 22, 2020	Frequency
	NFE	PNO: Fast 🖵 Tri IFGain:Low At	ig: Free Run iten: 36 dB		Mkr1 8.369	P NNNNN 2 GHz	Auto Tune
10 dB/div Ref	25.00 dBm				-30.8	30 dBm	
15.0							Center Freq 5.015000000 GHz
-5.00						DL1 -6.30 dBm	Start Freq 30.000000 MHz
-15.0							<b>Stop Freq</b> 10.00000000 GHz
-35.0	a have blocked and the stand of the stand					na (haya kurwa), Mana Anta kurwa ya Mana	CF Step 997.000000 MHz <u>Auto</u> Man
-45.0							Freq Offset 0 Hz
-65.0							Scale Type
Start 30 MHz #Res BW 1.0 N	ЛНz	#VBW 3.0	MHz	Swe	Stop 10. ep 18.00 ms (30	000 GHz 0001 pts)	Log <u>Lin</u>
MSG					STATUS		

Plot 7-89. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 39)



Plot 7-90. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 39)

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 68 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 00 01 94
© 2020 PCTEST			V 9.0 02/01/2019



Keysight Spectrum Analyzer - Swept SA				🗗 💌
🗶 RL RF 50Ω DC	CORREC SE	INSE:INT #Avg Type	12:13:23 AM May 22, 20 <b>E: RMS</b> TRACE <b>1 2 3 4</b>	Frequency
NFE 10 dB/div Ref 25.00 dBm	PNO: Fast Trig: Fre IFGain:Low Atten: 3	e Run 6 dB	Mkr1 6.042 2 GF -31.46 dB	Auto Tune m
15.0				Center Freq 5.015000000 GHz
-5.00			DL1 -8 60 a	Start Freq 30.000000 MHz
-15.0		1		<b>Stop Freq</b> 10.000000000 GHz
-35.0				CF Step 997.000000 MHz <u>Auto</u> Man
-55.0				<b>Freq Offset</b> 0 Hz
-65.0				Scale Type
Start 30 MHz #Res BW 1.0 MHz	#VBW 3.0 MHz	z Si	Stop 10.000 GH weep 18.00 ms (30001 p	
MSG			STATUS	

Plot 7-91. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 78)



Plot 7-92. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 78)

FCC ID: A3LSMF707U	PCTEST	MEASUREMENT REPORT (CERTIFICATION)	MSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 60 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 09 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# ANT1



Plot 7-93. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 0)



Plot 7-94. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 0)

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 70 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 70 01 94
© 2020 PCTEST	•	•		V 9 0 02/01/2019



🔤 Ke	ysight Spectrur	n Analyzer - Swep	ot SA									
<b>l,XI</b> R		RF 50 Ω	DC O	ORREC	SE	NSE:INT	#Avg Tvp	e: RMS	11:30:11 P	M May 21, 2020	F	requency
		N	IFE I	PNO:Fast ↔ FGain:Low	Trig: Free Atten: 30	e Run ) dB			TY D			Auto Tune
10 dE Loa	3/div R	ef 20.00 di	Вm						4 wkr1 9.16 -37.	6 8 GHZ 24 dBm		Auto Func
10.0											5.04	Center Freq
0.00											5.01	500000 GHZ
0.00										DL1 -6.52 dBm	3	Start Freq
-10.0												
-20.0											10.00	Stop Freq
-30.0												CE Stop
-40.0	الله ا	trees and the second second	Aller of the little pro-		n <sup>19</sup> nde inste die nee <sup>41</sup>			ang ang ang ang	an a	, ngananganggarang Kinganggarang	99 <sup>.</sup> <u>Auto</u>	7.000000 MHz Man
-50.0	Charles and and the	An Annual States and a state of the little sta	p. <b>v</b> .									
-60.0												Freq Offset 0 Hz
-70.0												
												Scale Type
Star #Re:	t 30 MHz s BW 1.0	MHz		#VB\	V 3.0 MHz		s	weep	Stop 10	.000 GHz	Log	Lin
MSG								STA	TUS			

Plot 7-95. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 39)



Plot 7-96. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 39)

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 71 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage / 10194
© 2020 PCTEST			V 9.0 02/01/2019



🔤 Ke	ysight Spec	trum Analyzer	- Swept SA									x
l <b>xi</b> R	L	RF	50Ω DC	CORREC	SEI	NSE:INT	#Ava Tvp	e: RMS	11:31:23 P TRAC	M May 21, 2020	Frequency	
			NFE	PNO: Fast • IFGain:Low	Trig: Free Atten: 30	e Run ) dB			Mkr1 8.63		Auto Tu	ne
10 di Log	B/div	Ref 20.0	00 dBm						-36.	43 dBm		
10.0											<b>Center Fr</b> 5.015000000 G	eq Hz
0.00 -10.0										DL1 -9.11 dBm	Start Fr 30.000000 M	eq Hz
-20.0											<b>Stop Fr</b> 10.000000000 G	eq Hz
-40.0	البلادية .	Martin Landar Malastr							and the state of the second state of the secon	liganig pine wikke wini kasilwalike	CF Sto 997.000000 M <u>Auto</u> M	ep Hz lan
-50.0 -60.0	-AND A CONTRACT										Freq Offs 0	i <b>et</b> Hz
-70.0											Scale Ty	ре
Star #Re	t 30 M s BW 1	Hz .0 MHz		#VB	W 3.0 MHz		s	weep	Stop 10 18.00 ms (3	.000 GHz 0001 pts)	Log <u>l</u>	<u>.in</u>
MSG								ST/	ATUS			

Plot 7-97. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 78)



Plot 7-98. Conducted Spurious Plot (Bluetooth, Mbps - Ch. 78)

FCC ID: A3LSMF707U	PCTEST Head to be pet to @	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 72 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 72 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# 7.9 Radiated Spurious Emission 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 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-8 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-8. Radiated Limits

## Test Procedure Used

ANSI C63.10-2013 – Section 6.6.4.3

### Test Settings Average Field Strength Measurements per Section 4.1.4.2.3 of ANSI C63.10-2013

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW = 1MHz
- 3. VBW =  $1kHz \ge 1/\tau$  Hz, where  $\tau$  = pulse width in seconds
- 4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
- 5. Detector = peak
- 6. Sweep time = auto
- 7. Trace mode = max hold
- 8. Trace was allowed to stabilize

### Peak Field Strength Measurements per Section 4.1.4.2.2 of ANSI C63.10-2013

- 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
- 2. RBW is set depending on measurement frequency, as specified in Table 7-9 below
- 3. VBW = 3MHz
- 4. Detector = peak
- 5. Sweep time = auto couple
- 6. Trace mode = max hold
- 7. Trace was allowed to stabilize

FCC ID: A3LSMF707U	PCTEST Head table performed	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 73 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 73 01 94
© 2020 PCTEST			V 9.0 02/01/2019



Frequency	RBW				
9 – 150kHz	200 – 300Hz				
0.15 – 30MHz	9 – 10kHz				
30 – 1000MHz	100 – 120kHz				
> 1000MHz	1MHz				
Table 7.0 BBW as a Eurotian of Fraguenov					

#### Table 7-9. RBW as a Function of Frequency

# 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 7-8.
- 2. No significant radiated emissions were found in the 2310 2390MHz restricted band.
- 3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
- 4. This unit was tested with its standard battery.
- 5. The spectrum is measured from 9kHz to the 10<sup>th</sup> harmonic and the worst-case emissions are reported.
- 6. The duty cycle correction factor was not applied to noise floor measurements.
- 7. 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.
- 8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 74 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 74 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# Sample Calculation

- ο Field Strength Level [dB<sub>μ</sub>V/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [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 (Mode)
- Adjusted channel hop rate for DH5 mode = 133.3 hops/second
- Time per channel hop = 1 / 133.3 hops/second = 7.50 ms
- Time to cycle through all channels =  $7.50 \times 20$  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 = 20log<sub>10</sub>(7.5ms/100ms) = -22.5 dB

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 75 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage / 5 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# Radiated Spurious Emission Measurements ANT0 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENTREPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 76 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 70 01 94
© 2020 PCTEST				V 9 0 02/01/2019



# Radiated Spurious Emissions Measurements (Above 18GHz) ANT0 §15.209; RSS-Gen [8.9]



Plot 7-102. Radiated Spurious Plot above 18GHz

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Page 77 of 04	
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 77 01 94	
© 2020 PCTEST				V 9.0 02/01/2019	



# Radiated Spurious Emission Measurements ANT1 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]







FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 78 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 700194
© 2020 PCTEST			V 9 0 02/01/2019



# Radiated Spurious Emissions Measurements (Above 18GHz) ANT1 §15.209; RSS-Gen [8.9]



Plot 7-106. Radiated Spurious Plot above 18GHz

FCC ID: A3LSMF707U	PCTEST	MEASUREMENT REPORT (CERTIFICATION)	MSUNG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Page 70 of 04	
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage / 9 01 94	
© 2020 PCTEST				V 9.0 02/01/2019	



# **Radiated Spurious Emission Measurements ANT0** §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	н	399	5	-78.95	6.48	-22.50	12.03	53.98	-41.95
4804.00	Peak	н	399	5	-66.13	6.48	0.00	47.35	73.98	-26.63
12010.00	Avg	н	-	-	-80.60	16.92	0.00	43.32	53.98	-10.66
12010.00	Peak	н	-	-	-69.06	16.92	0.00	54.86	73.98	-19.12

Table 7-10. Radiated Measurements

Worst Case Mode: Worst Case Data Rate: Measurement Distance: **Operating Frequency:** Channel:

Bluetooth	
1 Mbps	
3 Meters	
2441MHz	
39	

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	Н	375	343	-79.25	7.07	-22.50	12.32	53.98	-41.66
4882.00	Peak	н	375	343	-67.05	7.07	0.00	47.02	73.98	-26.96
7323.00	Avg	Н	-	-	-79.72	11.13	0.00	38.41	53.98	-15.57
7323.00	Peak	н	-	-	-67.92	11.13	0.00	50.21	73.98	-23.77
12205.00	Avg	н	-	-	-80.71	17.32	0.00	43.61	53.98	-10.37
12205.00	Peak	Н	-	-	-68.79	17.32	0.00	55.53	73.98	-18.45

Table 7-11. Radiated Measurements

FCC ID: A3LSMF707U	Head to be part of @	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 80 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 00 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# Radiated Spurious Emission Measurements ANT0 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth		
Worst Case Data Rate:	1 Mbps		
Measurement Distance:	3 Meters		
Operating Frequency:	2480MHz		
Channel:	78		

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	Н	378	129	-79.02	6.39	-22.50	11.87	53.98	-42.11
4960.00	Peak	н	378	129	-66.93	6.39	0.00	46.46	73.98	-27.52
7440.00	Avg	н	-	-	-79.94	11.48	0.00	38.54	53.98	-15.44
7440.00	Peak	н	-	-	-68.02	11.48	0.00	50.46	73.98	-23.52
12400.00	Avg	Н	-	-	-81.10	17.45	0.00	43.35	53.98	-10.63
12400.00	Peak	Н	-	-	-68.63	17.45	0.00	55.82	73.98	-18.16

Table 7-12. Radiated Measurements

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Page 81 of 94	
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 01 01 94	
© 2020 PCTEST				V 9.0 02/01/2019	



# Radiated Spurious Emission Measurements ANT1 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2402MHz
Channel:	0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	н	360	39	-78.93	6.48	-22.50	12.05	53.98	-41.93
4804.00	Peak	Н	360	39	-67.09	6.48	0.00	46.39	73.98	-27.59
12010.00	Avg	Н	-	-	-80.66	16.92	0.00	43.26	53.98	-10.72
12010.00	Peak	Н	-	-	-68.61	16.92	0.00	55.31	73.98	-18.67

# Table 7-13. Radiated Measurements

Worst Case Mode: Worst Case Data Rate: Measurement Distance: Operating Frequency: Channel:

Bluetooth
1 Mbps
3 Meters
2441MHz
39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4882.00	Avg	н	149	86	-79.20	7.05	-22.50	12.35	53.98	-41.63
4882.00	Peak	н	149	86	-67.55	7.05	0.00	46.50	73.98	-27.48
7323.00	Avg	н	-	-	-79.75	11.30	0.00	38.55	53.98	-15.43
7323.00	Peak	Н	-	-	-66.88	11.30	0.00	51.42	73.98	-22.56
12205.00	Avg	н	-	-	-80.73	17.23	0.00	43.50	53.98	-10.48
12205.00	Peak	н	-	-	-68.11	17.23	0.00	56.12	73.98	-17.86

Table 7-14. Radiated Measurements

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 82 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 02 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# Radiated Spurious Emission Measurements ANT1 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

Worst Case Mode:	Bluetooth	
Worst Case Data Rate:	1 Mbps	
Measurement Distance:	3 Meters	
Operating Frequency:	2480MHz	
Channel:	78	

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	Н	100	310	-78.49	6.39	-22.50	12.40	53.98	-41.58
4960.00	Peak	Н	100	310	-66.41	6.39	0.00	46.98	73.98	-27.00
7440.00	Avg	Н	-	-	-79.90	11.48	0.00	38.58	53.98	-15.40
7440.00	Peak	Н	-	-	-67.43	11.48	0.00	51.05	73.98	-22.93
12400.00	Avg	Н	-	-	-81.40	17.45	0.00	43.05	53.98	-10.93
12400.00	Peak	Н	-	-	-68.83	17.45	0.00	55.62	73.98	-18.36

Table 7-15. Radiated Measurements

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 83 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 03 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# 7.10 Radiated Restricted Band Edge Measurements ANT0 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction factor (DCCF).

The amplitude offset shown in the following plots for average measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) - Preamplifier Gain + DCCF

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



Plot 7-107. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-108. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: A3LSMF707U	PCTEST Vessel to be part of @	MEASUREMENT REPORT (CERTIFICATION)	UNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 84 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 04 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# 7.11 Radiated Restricted Band Edge Measurements ANT1 §15.205 §15.209 §15.247 (d); RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting. Two different amplitude offsets were used depending on whether peak or average measurements were measured. The average measurements use a duty cycle correction factor (DCCF).

The amplitude offset shown in the following plots for average measurements was calculated using the formula:

Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) - Preamplifier Gain + DCCF

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



Plot 7-109. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-110. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: A3LSMF707U	PCTEST Vessel to be part of @	MEASUREMENT REPORT (CERTIFICATION)	UNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 85 of 0/
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 05 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# 7.12 Radiated Spurious Emissions Measurements – 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 6 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]
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 7-16. 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

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 86 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 00 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# Test Setup

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







FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 87 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 87 01 94
© 2020 PCTEST			V 9.0 02/01/2019



# 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 7-16.
- 2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
- 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 quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
- 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.
- The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

FCC ID: A3LSMF707U	PCTEST Vessel to be part of @	MEASUREMENT REPORT (CERTIFICATION)	SUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 88 of 94
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 00 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# Radiated Spurious Emissions Measurements (Below 1GHz) §15.209; RSS-Gen [8.9]







Plot 7-112. Radiated Spurious Plot below 1GHz - ANT1

FCC ID: A3LSMF707U		MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 80 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 09 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# 7.13 Line Conducted Measurement Data §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 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)		
	Quasi-peak	Average	
0.15 – 0.5	66 to 56*	56 to 46*	
0.5 - 5	56	46	
5 – 30	60	50	

Table 7-17. Conducted Limits

\*Decreases with the logarithm of the frequency.

## **Test Procedures Used**

ANSI C63.10-2013, Section 6.2

### Test Settings

### **Quasi-Peak Field Strength 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 Field Strength 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: A3LSMF707U	PCTEST	MEASUREMENT REPORT (CERTIFICATION)		<b>Approved by:</b> Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 00 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	ſ	- age 50 01 54
© 2020 PCTEST				V 9.0 02/01/2019



# Test Setup

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 using mid channel. The emissions found were not affected by the choice of channel used during testing.
- 2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
- 3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
- 4. QP/AV Level (dB $\mu$ V) = QP/AV Analyzer/Receiver Level (dB $\mu$ V) + Corr. (dB)
- 5. Margin (dB) = QP/AV Limit (dB $\mu$ V) QP/AV Level (dB $\mu$ V)
- 6. Traces shown in plot are made using a peak detector.
- 7. Deviations to the Specifications: None.

FCC ID: A3LSMF707U	The for the period	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 01 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 91 01 94
© 2020 PCTEST			V 9.0 02/01/2019











FCC ID: A3LSMF707U	PCTEST	MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Page 02 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset	Fage 52 01 54
© 2020 PCTEST			V 9.0 02/01/2019





Plot 7-115. Line-Conducted Test Plot (L1) - ANT1





FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	MSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 03 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 95 01 94
© 2020 PCTEST				V 9.0 02/01/2019



# 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMF707U** 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.

FCC ID: A3LSMF707U	PCTEST Yead to be part of @	MEASUREMENT REPORT (CERTIFICATION)	SAMSUNG	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 04 of 04
1M2005040080-12.A3L	05/04 - 07/06/2020	Portable Handset		Fage 54 01 54
© 2020 PCTEST				V 9.0 02/01/2019