









RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS 9

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	ТХ
Test Mode (Final Test)	ТХ
Tester	Eason
Temperature	25 ℃
Humidity	60%

9.1 LIMITS

9.1 LIMITS		
Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



9.2 BLOCK DIAGRAM OF TEST SETUP



9.3 PROCEDURE

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.



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h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



9.4 TEST DATA

During the test, pre-scan the GFSK, Pi/4QPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.

[TestMode:	[TestMode: TX]						
		Tes	st channel:low	vest			
	1		Peak value:		1	1	
Frequency	Read Level	Correct	Level	Limit Line	Over Limit	Polarizatio	
(MHz)	(dBuV)	factor	(dBuV/m)	(dBuV/m)	(dB)	n	
2310	57.77	-4.2	53.57	74	-20.43	Horizontal	
2390	58.19	-3.88	54.31	74	-19.69	Horizontal	
2310	53.9	-4.49	49.41	74	-24.59	Vertical	
2390	55.19	-4.21	50.98	74	-23.02	Vertical	
	1	ļ	Average value	:		1	
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB/ m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarizatio n	
2310	46.83	-4.2	42.63	54	-11.37	Horizontal	
2390	47.55	-3.88	43.67	54	-10.33	Horizontal	
2310	44.24	-4.49	39.75	54	-14.25	Vertical	
2390	44.27	-4.21	40.06	54	-13.94	Vertical	
		Tes	t channel:Higl	nest			
			Peak value:		I	I	
Frequency	Read Level	Correct	Level	Limit Line	Over Limit	Polarizatio	
(MHz)	(dBuV)	factor	(dBuV/m)	(dBuV/m)	(dB)	n	
2483.5	52.58	-3.39	49.19	74	-24.81	Horizontal	
2500	73.02	-3.3	69.72	74	-4.28	Horizontal	
2483.5	49.73	-3.78	45.95	74	-28.05	Vertical	
2500	67.08	-3.7	63.38	74	-10.62	Vertical	
		ļ	Average value		I	I	
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB/ m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarizatio n	
2483.5	40.8	-3.39	37.41	54	-16.59	Horizontal	
2500	40.64	-3.3	37.34	54	-16.66	Horizontal	
2483.5	37.86	-3.78	34.08	54	-19.92	Vertical	
2500	38.02	-3.7	34.32	54	-19.68	Vertical	

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Test Result: Pass

10 CONDUCTED SPURIOUS EMISSIONS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11
Test Mode (Pre-Scan)	ТХ
Test Mode (Final Test)	ТХ
Tester	Eason
Temperature	25℃
Humidity	60%

10.1 LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.209(a) (see §15.205(c)).

10.2 BLOCK DIAGRAM OF TEST SETUP



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10.3 TEST DATA

Pass: Please Refer To Appendix: For Details



Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2
Test Mode (Pre-Scan)	ТХ
Test Mode (Final Test)	ТХ
Tester	Eason
Temperature	25 ℃
Humidity	60%

11 CONDUCTED BAND EDGES MEASUREMENT

11.1 LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.209(a) (see §15.205(c)).

11.2 BLOCK DIAGRAM OF TEST SETUP





11.3 TEST DATA

Pass: Please Refer To Appendix: For Details



12 APPENDIX

12.1 APPENDIX :20DB EMISSION BANDWIDTH

Test Result

TestMode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
		2402	1.116	2401.436	2402.552		PASS
DH1	Ant1	2441	1.119	2440.433	2441.552		PASS
		2480	1.116	2479.436	2480.552		PASS
		2402	1.107	2401.442	2402.549		PASS
2DH1	Ant1	2441	1.107	2440.439	2441.546		PASS
		2480	1.101	2479.445	2480.546		PASS
		2402	1.107	2401.442	2402.549		PASS
3DH1	Ant1	2441	1.107	2440.442	2441.549		PASS
		2480	1.107	2479.442	2480.549		PASS



Test Graphs



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12.2 APPENDIX : MAXIMUM CONDUCTED OUTPUT POWER

Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
		2402	1.38	<=20.97	PASS
DH1	Ant1	2441	0.02	<=20.97	PASS
		2480	-0.76	<=20.97	PASS
		2402	1.35	<=20.97	PASS
2DH1	Ant1	2441	-0.01	<=20.97	PASS
		2480	-0.76	<=20.97	PASS
		2402	1.34	<=20.97	PASS
3DH1	Ant1	2441	-0.02	<=20.97	PASS
		2480	-0.76	<=20.97	PASS



Test Graphs



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12.3 APPENDIX : CARRIER FREQUENCY SEPARATION

Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
DH1	Ant1	Нор	1.176	>=1.119	PASS
2DH1	Ant1	Нор	1.162	>=1.107	PASS
3DH1	Ant1	Нор	1.002	>=0.738	PASS

Test Graphs





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	3DH1_A	nt1_Hop			
Agilent Spectrum Analyzer - Swept SA Agilent Spectrum Analyzer - Swept SA Center Freq 2.44150000	DO GHz PNO: Wide +++ Trig: Free Run	ALIGNAUTO #Avg Type: RMS Avg Hold: 100/100	01:16:25 AM May 22, 2020 TRACE 1 2 3 4 5 6 TYPE M WANNAWAY	Frequency	
Ref Offset 1.92 dB 10 dB/div Ref 30.00 dBm	IFGain:Low #Atten: 40 dB	ΔM	Ikr2 1.002 MHz -0.018 dB	Auto Tune	
20.0				Center Freq 2.441500000 GHz	
10.0 0.00	Q1	<u>2</u> Δ1		Start Freq 2.440500000 GHz	
-10.0	- Monte Monte -	Normer of the second	. Norrall Dr	Stop Freq 2.442500000 GHz	
-30.0				CF Step 200.000 kHz <u>Auto</u> Man	
-40.0				Freq Offset 0 Hz	
-60.0					
Start 2.440500 GHz #Res BW 100 kHz	#VBW 300 kHz	S Sweep 1.	top 2.442500 GHz .000 ms (1001 pts)		
MSG		STATUS			*



12.4 APPENDIX : TIME OF OCCUPANCY

Test Result

TestMode	Antenna	Channel	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Нор	0.38	330	0.126	<=0.4	PASS
DH3	Ant1	Нор	1.28	170	0.217	<=0.4	PASS
DH5	Ant1	Нор	2.89	110	0.317	<=0.4	PASS



Test Graphs





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12.5 APPENDIX : NUMBER OF HOPPING CHANNELS

Test Result

TestMode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Нор	79	>=15	PASS
2DH1	Ant1	Нор	79	>=15	PASS
3DH1	Ant1	Нор	79	>=15	PASS

Test Graphs





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	3DH1 Ar	nt1 Hop		
Agilent Spectrum Analyzer - Swept M RL RF 50 Ω Center Freq 2.441750	AC SENSE:INT 000 GHZ PN0: Fast Trig: Free Run	ALIGNAUTO 01:20:17 AM May 22, 2 #Avg Type: RMS TRACE 23 4 Avg Hold>1000/1000 TYPE MMMM	Frequency	
Ref Offset 1.89 10 dB/div Ref 30.00 dB	IFGain:Low #Atten: 40 dB dB Sm	DETIFFF	Auto Tune	
20.0			Center Freq 2.441750000 GHz	
10.0 0.00	นกกลังไม้ก็ส่งมีหังกลังไปเรื่องการและการ	ANNATEANNATELIURAAA INEEAAA MAAAA	Start Freq 2.400000000 GHz	
-10.0	, 414 4 - 814 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	laheanaadharaahkaahkahhkanhkahhkahh	Stop Freq 2.483500000 GHz	
-30.0			CF Step 8.350000 MHz Auto Man	
-50.0			Freq Offset 0 Hz	
-60.0			-	
Start 2.40000 GHz #Res BW 100 kHz	#VBW 300 kHz	Stop 2.48350 G Sweep 8.000 ms (1001 p	tz ts)	
MSG		STATUS		



12.6 APPENDIX : BAND EDGE MEASUREMENTS

Test Result

TestMode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
DH1	Ant1	Low	2402	0.46	-56.49	<=-19.55	PASS
		High	2480	-1.04	-55.72	<=-21.04	PASS
		Low	Hop_2402	0.61	-56.6	-19.39	PASS
		High	Hop_2480	-0.27	-54.69	-20.27	PASS
2DH1	Ant1	Low	2402	1.10	-56.1	<=-18.9	PASS
		High	2480	-0.92	-55.75	<=-20.92	PASS
		Low	Hop_2402	0.91	-56.33	-19.09	PASS
		High	Hop_2480	-0.54	-55.39	-20.54	PASS
3DH1	Ant1	Low	2402	1.18	-55.92	<=-18.82	PASS
		High	2480	-0.96	-55.12	<=-20.96	PASS
		Low	Hop_2402	1.19	-53.87	-18.82	PASS
		High	Hop_2480	-0.74	-55.53	-20.74	PASS



Test Graphs





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DH1_Ant1_Lo	w_Hop_2402		
Agilent Spectrum Analyzer - Swept SA U RL 9€ 509 AC SPISEENT Center Freq 2.3525000000 GHz PR0: Fast □ Trig: Free Run	ALIGNAUTO 12:52:31 AM May 22, 2020 #Avg Type: RMS TRACE 12:34 5 6 Avg Hold>300/300 TYPE IM HAMANAN	Frequency	
IFGain:Low #Atten: 30 dB Ref Offset 1.87 dB 10 dB/div Ref 20.00 dBm	Mkr5 2.376 650 GHz -56.595 dBm	Auto Tune	
10.0 0.00 -10.0		Center Freq 2.352500000 GHz	
-20.0	-1935 den	Start Freq 2.300000000 GHz	
50.0 60.0 70.0		Stop Freq 2.40500000 GHz	
Start 2.30000 GHz #VBW 300 kHz	Stop 2.40500 GHz #Sweep 100.0 ms (1001 pts)	CF Step 10.500000 MHz Auto Man	
N 1 f 2.402 900 GHz 0.653 dBm 2 N 1 f 2.402 900 GHz 0.653 dBm 3 N 1 f 2.400 900 GHz 5.858 dBm 4 N 1 f 2.390 000 GHz 5.856 dBm 5 N 1 f 2.376 650 GHz 5.558 dBm		Freq Offset 0 Hz	
6 7 8 9 10			
III €	STATUS		
DH1_Ant1_Hig	gh_Hop_2480		
RL RF 50 Q AC SENSE:INT Center Freq 2.510000000 GHz PN0: East Trig: Free Run	ALIGN AUTO 12:49:03 AM May 22, 2020 #Avg Type: RMS IRACE 12:3 4 5 6 Avg Hold>300/300 TYPE M WARNAW	Frequency	
IFGain:Low #Atten: 30 dB Ref Offset 1.92 dB 10 dB/div Ref 20.00 dBm	Mkr4 2.526 96 GHz -54.691 dBm	Auto Tune	
		Center Freq 2.510000000 GHz	
20.0 30.0 40.0	-20.27 dBn	Start Freq 2.470000000 GHz	
50.0 60.0 70.0	4 caratratigeter de la construction de	Stop Freq 2.550000000 GHz	
Start 2.47000 GHz #Res BW 100 kHz #VBW 300 kHz	Stop 2.55000 GHz #Sweep 100.0 ms (1001 pts)	CF Step 8.000000 MHz <u>Auto</u> Man	
1 N 1 f 2.471 84 GHz 0.267 48m 2 N f 2.483 50 GHz 56.659 48m 3 N f 2.500 00 GHz 56.741 48m 5 f 2.526 96 GHz 54.691 48m		Freq Offset 0 Hz	
6 7 8 9 10			



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	2DH1_Ant1	_Low_2402		
	Agilent Spectrum Analyzer - Swept SA 20 RL RF 50 Ω AC SENSE:INT	ALIGN AUTO 08:03:00 PM May 20, 2020		
(Center Freq 2.352500000 GHz PN0: Fast Trig: Free Run	#Avg Type: RMS Avg Hold: 300/300 Det IP P P P P	Frequency	
	IFGain:Low #Atten:30 dB	Mkr5 2.317 745 GHz	Auto Tune	
	10 dB/div Ref 20.00 dBm	-56.103 dBm		
	10.0	¹	Center Freq 2.352500000 GHz	
	-10.0	-18.90.dBn		
	-20.0		Start Freq	
	-40.0			
	-50.0 Atlastation and a state of the state o	land mine and an a man and and the	Stop Freq	
	-70.0		2.405000000 GH2	
	Start 2.30000 GHz #Res BW 100 kHz #VBW 300 kHz	Stop 2.40500 GHz #Sweep 100.0 ms (1001 pts)	CF Step 10.500000 MHz	
	MKR MODE TRC SCL X Y 7 1 N 1 f 2,401 955 GHz 1,103 dRm	UNCTION FUNCTION WIDTH FUNCTION VALUE	<u>Auto</u> Man	
	2 N 1 f 2.400 000 GHz -28.744 dBm 3 N 1 f 2.390 000 GHz -57.847 dBm		Freq Offset	
	4 N 1 F 2.310 000 GHz -58.100 dBm 5 N 1 f 2.317 745 GHz -56.103 dBm 6		0 Hz	
	7 8 9			
	10	~		
L.	s MSG	STATUS		~
	2DH1_Ant1	_High_2480		
	Agilent Spectrum Analyzer - Swept SA	ALIGNAUTO 08:07:50 PM May 20, 2020	Frequency	
<u>(</u>	Center Freq 2.510000000 GHz PN0: Fast Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Hold: 300/300 TYPE MWWWW DET P P P P P		
	Ref Offset 1.92 dB	Mkr4 2.535 44 GHz	Auto Tune	
			Contor From	
			2.51000000 GHz	
	-10.0	-20.92 dBn		
	-30.0		Start Freq 2.470000000 GHz	
	-40.0	4		
	-60.0 Martine and a second sec		Stop Freq 2.55000000 GHz	
	-////	Stop 2 55000 CHa		
	#Res BW 100 kHz #VBW 300 kHz	#Sweep 100.0 ms (1001 pts)	CF Step 8.000000 MHz	
	NKE MODE TAB SEL X Y T 1 N 1 f 2.480 00 GHz -0.920 dBm 2 N 1 f 2.482 50 CHz 50.309 dBm	FUNCTION FUNCTION WIDTH FUNCTION VALUE		
	2 N 1 7 2.453 50 GHz -36.309 GBm 3 N 1 f 2.500 00 GHz -57.581 dBm 4 N 1 f 2.535 44 GHz -55.745 dBm		Freq Offset	
	6 7			
	8 9			
	11	×		
A	MSG	STATUS		