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Test procedure and test data

2.1 Occupied Bandwidth (99%)

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.



Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 6.9

- RBW: 1 to 5 % of OBW - $VBW > 3 \times RBW$ - Span: OBW x 1.5 to 5 - Trace: Max hold

Limitation

There are no limitations.

The measurement value is used for the emission designator.

Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

Test Date

Tested Date: 20 deg.C July 2, 2018 Temperature: Humidity: 50 % Atmos. Press: 1015 hPa







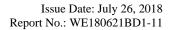
Test results

SAPPHIRE-680FSG

Operating Mode	Frequency	99% Occupied Bandwidth
	[MHz]	[MHz]
LE, 1Mbps	2402	1.029
LE, 1Mbps	2440	1.042
LE, 1Mbps	2480	1.030
LE, 2Mbps	2402	2.043
LE, 2Mbps	2440	2.040
LE, 2Mbps	2480	2.038

SAPPHIRE-681FSG

Operating Mode	Frequency [MHz]	99% Occupied Bandwidth [MHz]
LE, 1Mbps	2402	1.041
LE, 1Mbps	2440	1.038
LE, 1Mbps	2480	1.046
LE, 2Mbps	2402	2.040
LE, 2Mbps	2440	2.050
LE, 2Mbps	2480	2.050



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[SAPPHIRE-680FSG]





LE, 2440 MHz, 1Mbps



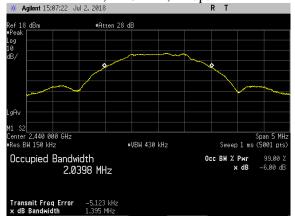
LE, 2480 MHz, 1Mbps



LE, 2402 MHz, 2Mbps

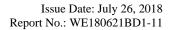


LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps





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[SAPPHIRE-681FSG]





LE, 2440 MHz, 1Mbps



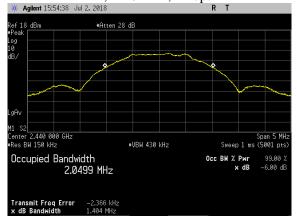
LE, 2480 MHz, 1Mbps



LE, 2402 MHz, 2Mbps



LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps





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2.2 Occupied Bandwidth (6 dB)

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

EUT	Antenna Port	Spectrum Analyzor
EUI		Spectrum Analyzer

Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 6.9

- RBW: 100 kHz - VBW: 300 kHz - Detector: Peak - Trace: Max hold

Applicable rule and limitation

15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

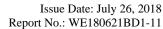
Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

Test Date

Tested Date: 20 deg.C July 2, 2018 Temperature: 1015 hPa Atmos. Press: Humidity: 50 %

Test results - Complied with requirement







Test Data

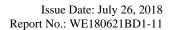
SAPPHIRE-680FSG

Operation Mode	Frequency [MHz]	6 dB Occupied Bandwidth [MHz]
LE, 1Mbps	2402	0.672
LE, 1Mbps	2440	0.713
LE, 1Mbps	2480	0.672
LE, 2Mbps	2402	1.362
LE, 2Mbps	2440	1.346
LE, 2Mbps	2480	1.337

SAPPHIRE-681FSG

Operation Mode	Frequency [MHz]	6 dB Occupied Bandwidth [MHz]
LE, 1Mbps	2402	0.697
LE, 1Mbps	2440	0.710
LE, 1Mbps	2480	0.716
LE, 2Mbps	2402	1.354
LE, 2Mbps	2440	1.362
LE, 2Mbps	2480	1.371

URL: www.jp.sgs.com

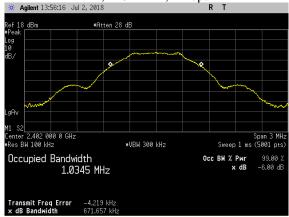


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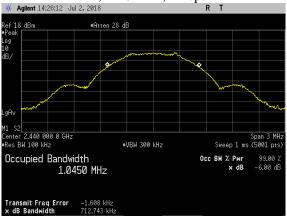


[SAPPHIRE-680FSG]

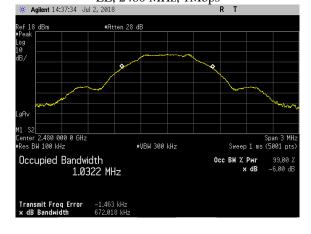




LE, 2440 MHz, 1Mbps



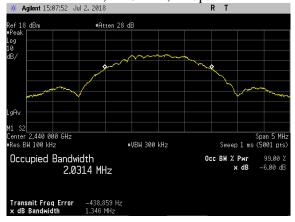
LE, 2480 MHz, 1Mbps



LE, 2402 MHz, 2Mbps

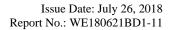


LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps





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[SAPPHIRE-681FSG]





LE, 2440 MHz, 1Mbps



LE, 2480 MHz, 1Mbps



LE, 2402 MHz, 2Mbps



LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps





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2.3 Power Spectral Density

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

DUT	Antenna Port	Cmaatmum Amaluzan	ĺ
EUI		Spectrum Analyzer	

Test procedure

Test procedure is set as below according to KDB 550874 D01 DTS Meas Guidance v04

OBW x 1.5 Span: RBW: 3 kHz VBW: 9 kHz Detector: Peak Trace: Max Hold

Applicable rule and limitation

15.247 (e) For digitally modulation systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		

Test Date

Tested Date: July 2, 2018 Temperature: 20 deg.C 50 % Atmos. Press: 1015 hPa Humidity:



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Test results - Complied with requirement

Test Data

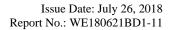
SAPPHIRE-680ESC

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Operation	Frequency	Reading	Cable Loss	Attenuator	Result Power Sp	ectral Density
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
LE, 1Mbps	2402	-19.457	1.00	9.89	-8.567	0.139
LE, 1Mbps	2440	-19.832	1.00	9.89	-8.942	0.128
LE, 1Mbps	2480	-19.006	1.00	9.89	-8.116	0.154
LE, 2Mbps	2402	-24.552	1.00	9.89	-13.662	0.043
LE, 2Mbps	2440	-24.394	1.00	9.89	-13.504	0.045
LE, 2Mbps	2480	-24.210	1.00	9.89	-13.320	0.047

SAPPHIRE-681FSG

DIN TIME	5/4 / I IIICE-0011 5G					
Operation	Frequency	Reading	Cable Loss	Attenuator	Result Power Sp	ectral Density
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
LE, 1Mbps	2402	-19.434	1.00	9.89	-8.544	0.140
LE, 1Mbps	2440	-19.155	1.00	9.89	-8.265	0.149
LE, 1Mbps	2480	-19.257	1.00	9.89	-8.367	0.146
LE, 2Mbps	2402	-24.063	1.00	9.89	-13.173	0.048
LE, 2Mbps	2440	-24.471	1.00	9.89	-13.581	0.044
LE, 2Mbps	2480	-24.523	1.00	9.89	-13.633	0.043

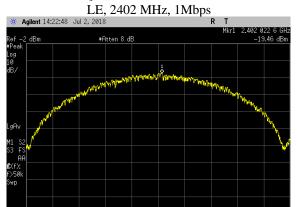
^{*} Sample calculation: Result [dBm] = Reading [dBm] + Cable Loss [dB] + Attenuator [dB]



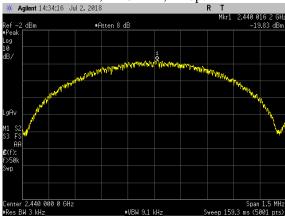




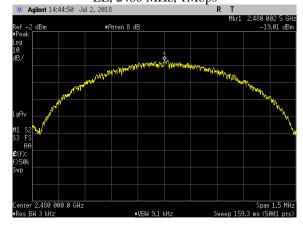
2.402 000 0 GHz







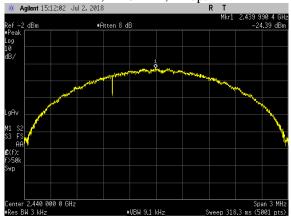
LE, 2480 MHz, 1Mbps



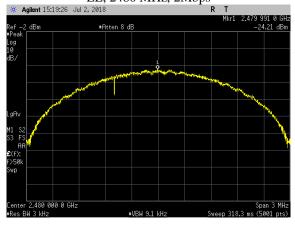
LE, 2402 MHz, 2Mbps

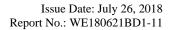


LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps

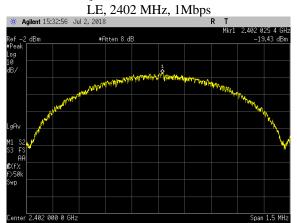


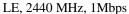


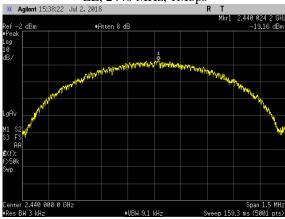
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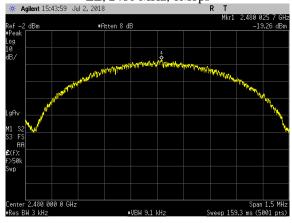
[SAPPHIRE-681FSG]



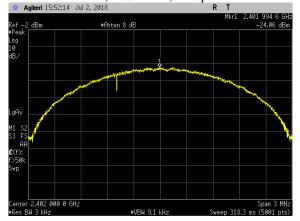




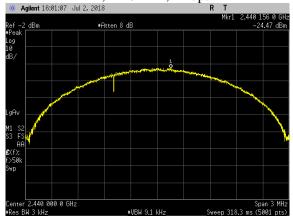
LE, 2480 MHz, 1Mbps



LE, 2402 MHz, 2Mbps



LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps





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2.4 Peak Output Power

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

Antenna Port **EUT** Spectrum Analyzer

Test procedure

Test procedure is set as below according to KDB 550874 D01 DTS Meas Guidance v04

Span: RBW x 3 RBW: **OBW** VBW: RBW x 3 Detector: Peak Trace: Max Hold

Applicable rule and limitation

15.247(a) (2) Systems using digital modulation techniques may operate in the 902 – 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. (3) For systems using digital modulation in the 902 – 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands: 1 Watt (30 dBm).

Test equipment used (refer to List of utilized test equipment)

$\mathbf{V}\Delta \mathbf{I}\mathbf{O}$	CL31 AT33			
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Test Date

Tested Date: July 2, 2018 Temperature: 20 degC 50 % Atmos. Press: 1015 hPa Humidity:

Test results - **Complied with requirement**





Test Data

SAPPHIRE-680FSG

Operating	Frequency	Reading	Cable Loss	Attenuator	Result Peak Output Power	
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
LE, 1Mbps	2402	-3.433	1.00	9.89	7.457	5.568
LE, 1Mbps	2440	-3.370	1.00	9.89	7.520	5.649
LE, 1Mbps	2480	-3.450	1.00	9.89	7.440	5.546
LE, 2Mbps	2402	-3.277	1.00	9.89	7.613	5.772
LE, 2Mbps	2440	-3.228	1.00	9.89	7.662	5.837
LE, 2Mbps	2480	-3.341	1.00	9.89	7.549	5.687

SAPPHIRE-681FSG

574 THIRE COLLEGE						
Operating	Frequency	Reading	Cable Loss	Attenuator	Result Peak Output Power	
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
LE, 1Mbps	2402	-3.436	1.00	9.89	7.454	5.564
LE, 1Mbps	2440	-3.390	1.00	9.89	7.500	5.623
LE, 1Mbps	2480	-3.485	1.00	9.89	7.405	5.502
LE, 2Mbps	2402	-3.323	1.00	9.89	7.567	5.711
LE, 2Mbps	2440	-3.310	1.00	9.89	7.580	5.728
LE, 2Mbps	2480	-3.394	1.00	9.89	7.496	5.618

^{*} Sample calculation: Result [dBm] = Reading [dBm] + Cable Loss [dB] + Attenuator [dB]

*For reference

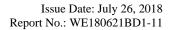
SAPPHIRE-680FSG

5/11 / I III C 0001 5 C							
Operating	Frequency	Reading	Cable Loss	Attenuator	Result Average Output Power		
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	
LE, 1Mbps	2402	-3.410	1.00	9.89	7.480	5.597	
LE, 1Mbps	2440	-3.334	1.00	9.89	7.556	5.697	
LE, 1Mbps	2480	-3.456	1.00	9.89	7.434	5.539	
LE, 2Mbps	2402	-3.304	1.00	9.89	7.586	5.737	
LE, 2Mbps	2440	-3.236	1.00	9.89	7.654	5.827	
LE, 2Mbps	2480	-3.352	1.00	9.89	7.538	5.672	

SAPPHIRE-681FSG

Operating	Frequency	Reading	Cable Loss	Attenuator	Result Average	Output Power
Mode	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]
LE, 1Mbps	2402	-3.453	1.00	9.89	7.437	5.542
LE, 1Mbps	2440	-3.373	1.00	9.89	7.517	5.645
LE, 1Mbps	2480	-3.500	1.00	9.89	7.390	5.482
LE, 2Mbps	2402	-3.363	1.00	9.89	7.527	5.658
LE, 2Mbps	2440	-3.338	1.00	9.89	7.552	5.691
LE, 2Mbps	2480	-3.434	1.00	9.89	7.456	5.567

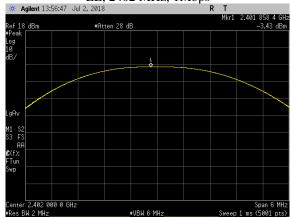
^{*} Sample calculation: Result [dBm] = Reading [dBm] + Cable Loss [dB] + Attenuator [dB]



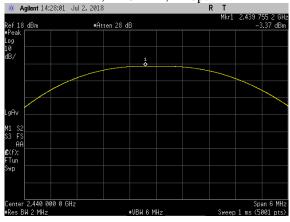




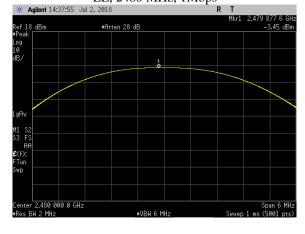




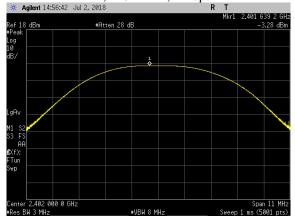
LE, 2440 MHz, 1Mbps



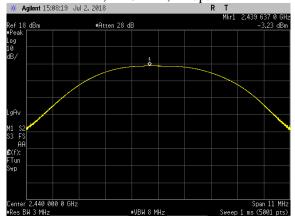
LE, 2480 MHz, 1Mbps



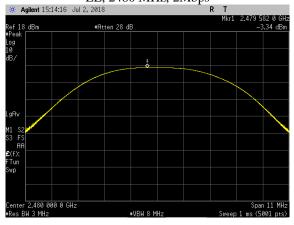
LE, 2402 MHz, 2Mbps

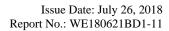


LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps

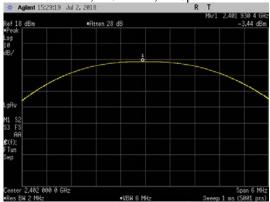




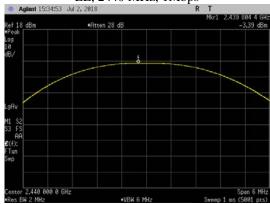




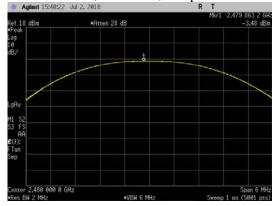




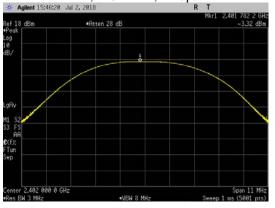
LE, 2440 MHz, 1Mbps



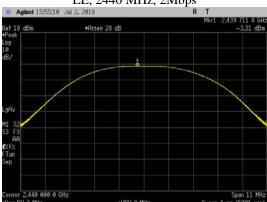
LE, 2480 MHz, 1Mbps



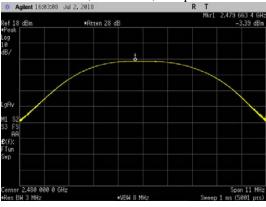
LE, 2402 MHz, 2Mbps

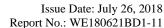


LE, 2440 MHz, 2Mbps



LE, 2480 MHz, 2Mbps









2.5 Conducted Spurious Emissions

Test setup

Test setup is the following drawing. The antenna port of EUT was connected to the spectrum analyzer.

EUT Spectrum Analyzer

Test procedure

Spectrum analyzer is set as below according to ANSI C63.10 clause 7.8.8

RBW: 100 kHz VBW: 300 kHz Peak Detector: Trace: Max Hold

Limitation

15.247(d); 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.

Test equipment used (refer to List of utilized test equipment)

SA10	CL31	AT33		
57110	CLSI	11133		

Test Date

Tested Date: Temperature: 20 degC July 2, 2018 Humidity: 50 % Atmos. Press: 1015 hPa

Test results - Complied with requirement

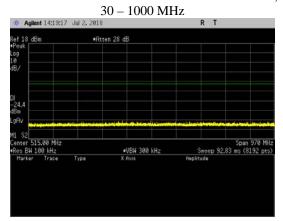
Test Data

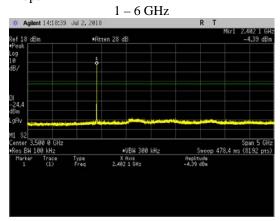
Refer to chart.

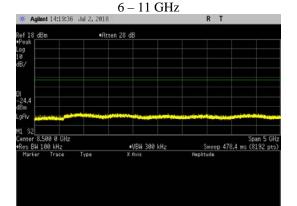


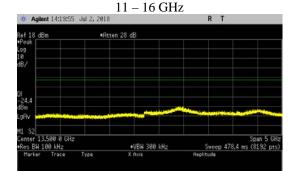


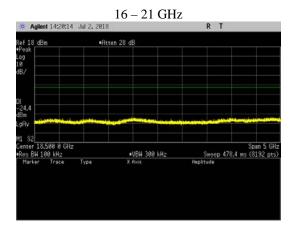
LE, 2402 MHz, 1Mbps

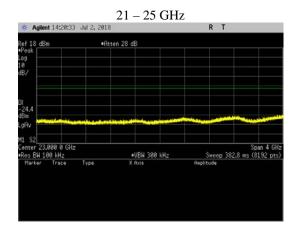


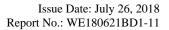








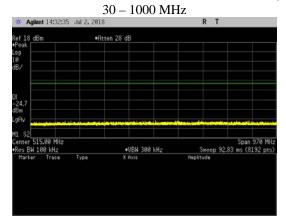


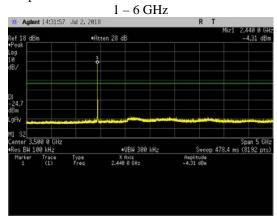


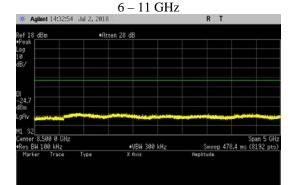


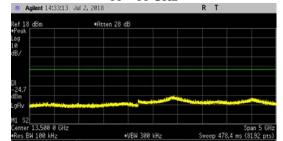


LE, 2440 MHz, 1Mbps

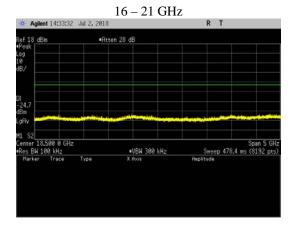


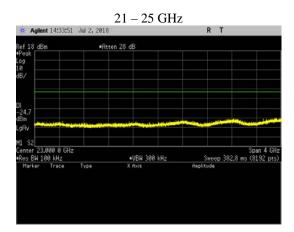


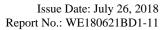




11 - 16 GHz



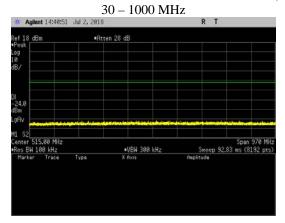


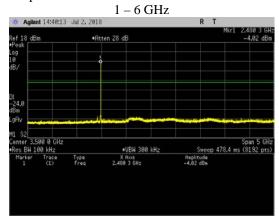




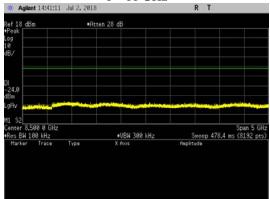


LE, 2480 MHz, 1Mbps

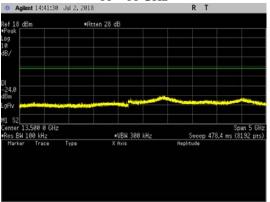




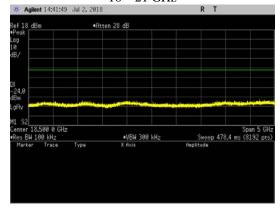




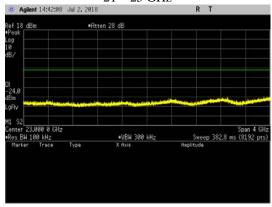


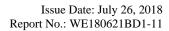


16 - 21 GHz



21 - 25 GHz



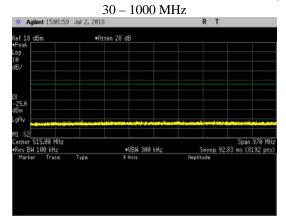


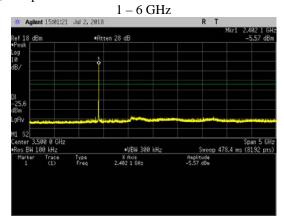
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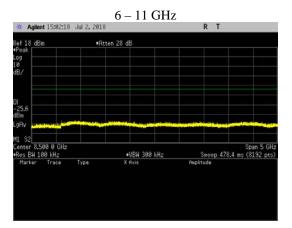


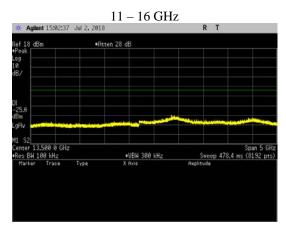
[SAPPHIRE-680FSG]

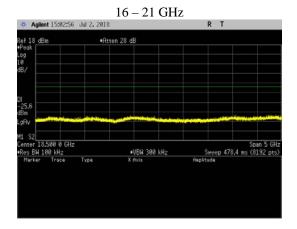
LE, 2402 MHz, 2Mbps

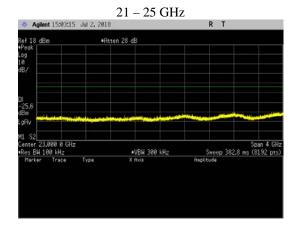


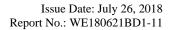








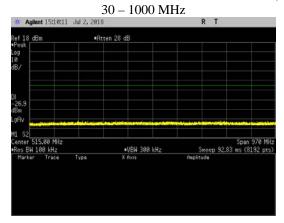


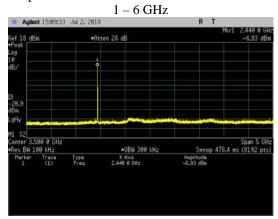




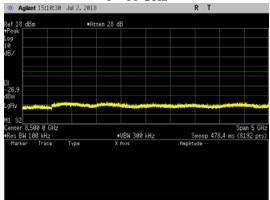


LE, 2440 MHz, 2Mbps

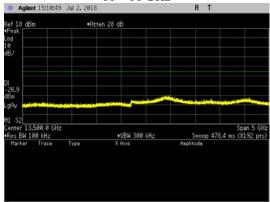




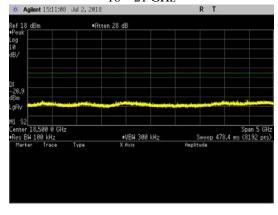




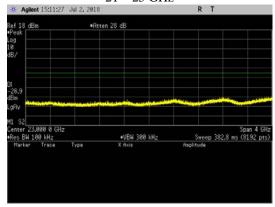


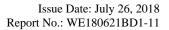


16 - 21 GHz



21 - 25 GHz

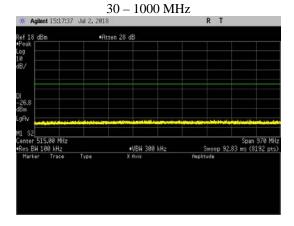


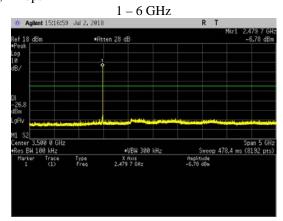


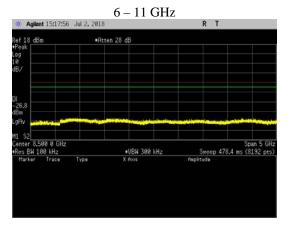


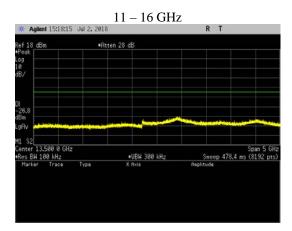


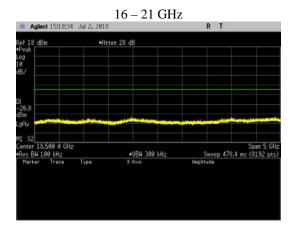
LE, 2480 MHz, 2Mbps

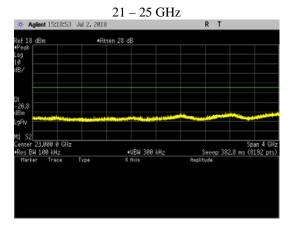


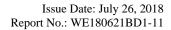










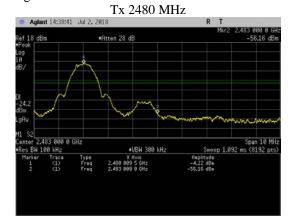






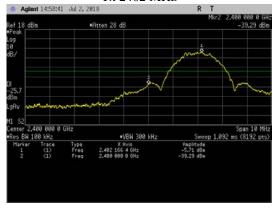
LE, 1Mbps Bandedge

Tx 2402 MHz Atten 28 dB Speep 1.892 ms (8192 pts) Replitude -4.15 dBa -53.05 dBa

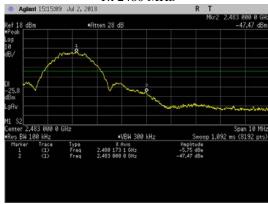


LE, 2Mbps Bandedge

Tx 2402 MHz



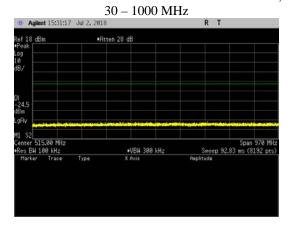
Tx 2480 MHz

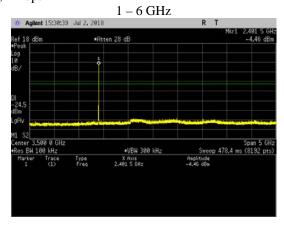


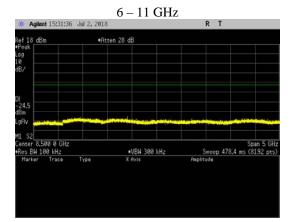


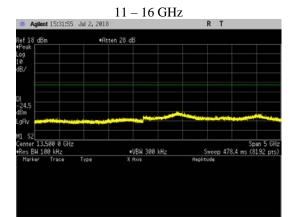


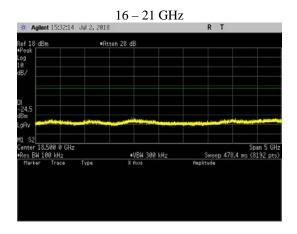
LE, 2402 MHz, 1Mbps

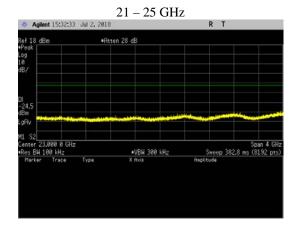


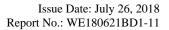








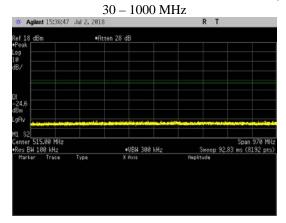


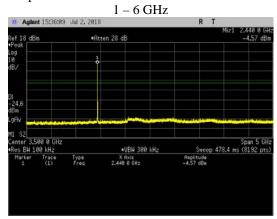


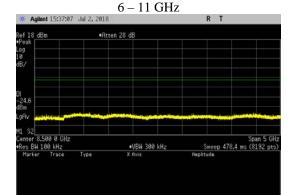


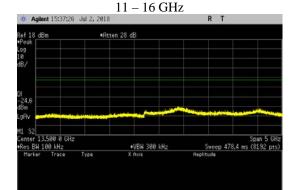


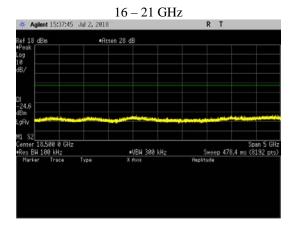
LE, 2440 MHz, 1Mbps

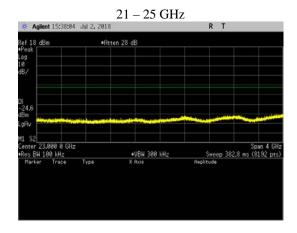








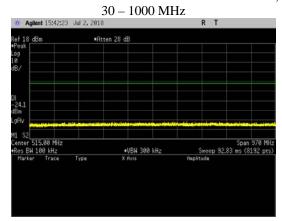


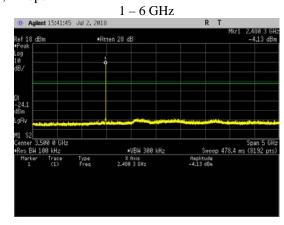


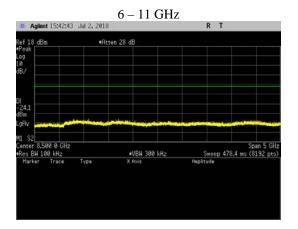


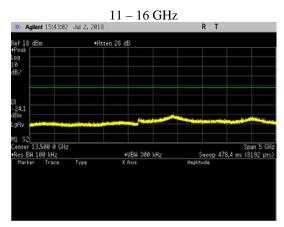


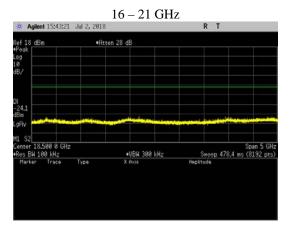
LE, 2480 MHz, 1Mbps

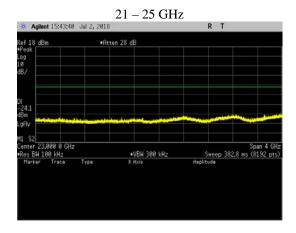


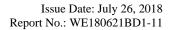








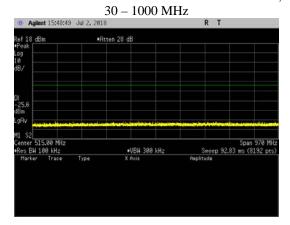


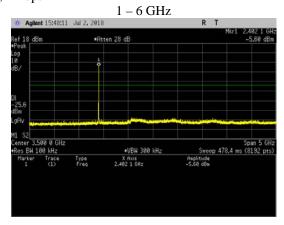


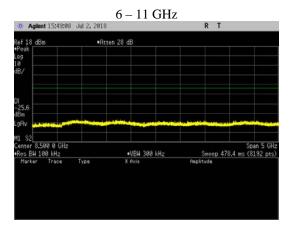


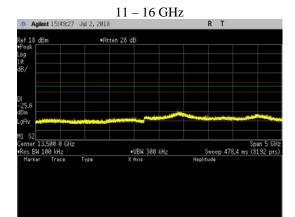


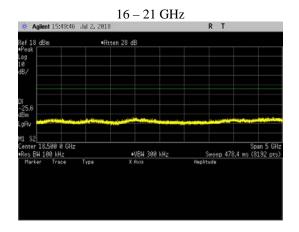
LE, 2402 MHz, 2Mbps

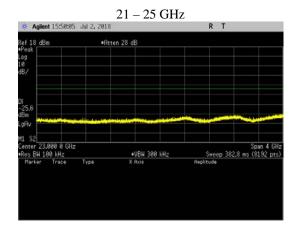


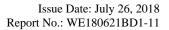








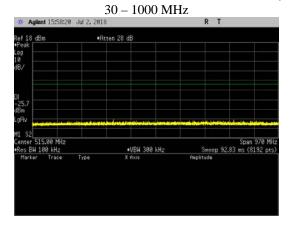


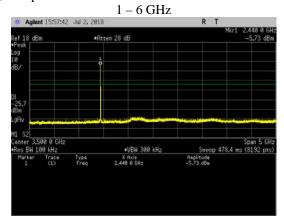


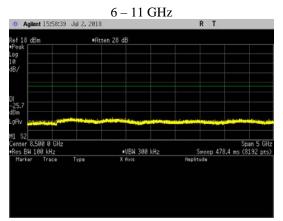


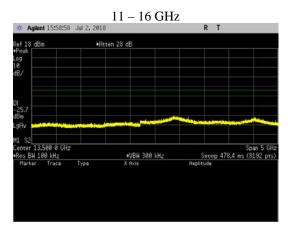


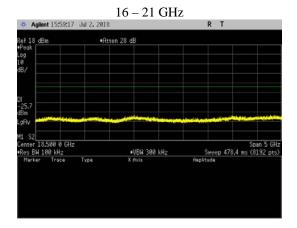
LE, 2440 MHz, 2Mbps

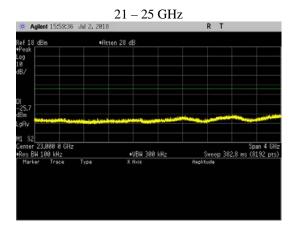


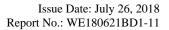








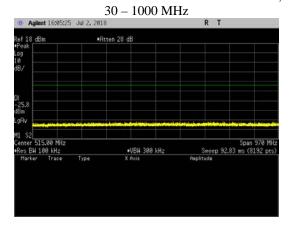


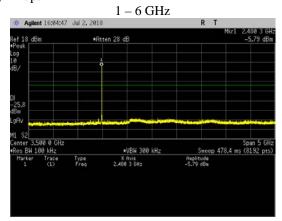


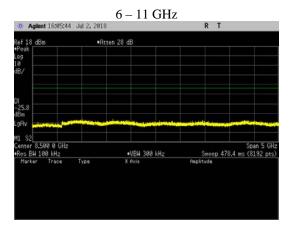


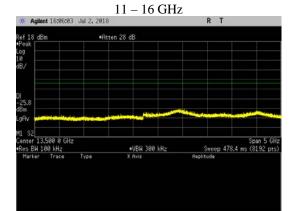


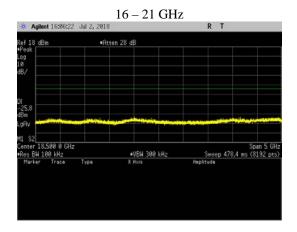
LE, 2480 MHz, 2Mbps

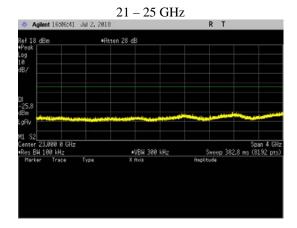


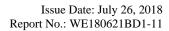








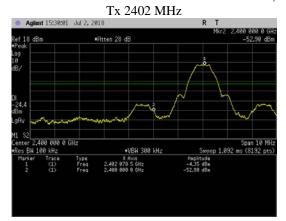


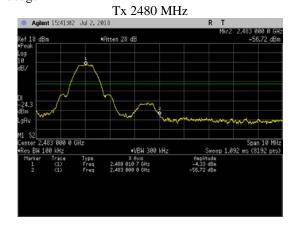






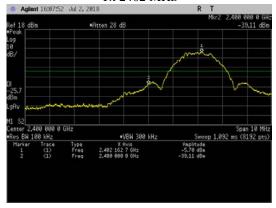
LE, 1Mbps Bandedge



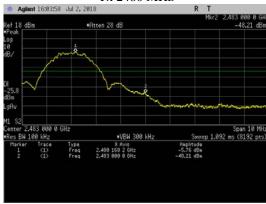


LE, 2Mbps Bandedge

Tx 2402 MHz



Tx 2480 MHz



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