

# BAND EDGE COMPLIANCE



XMit 2019.09.05

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-19	19-Mar-20

## TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in the available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet. For Multiband operation, measurements were taken at the lower band edge of the lower band and the upper band edge of the upper band.

The spectrum was scanned below the lower band edge and above the higher band edge.

All limits were adjusted by a factor of  $[-10 \cdot \log(N)]$  to account for the device operation as a N port MIMO transmitter, as per FCC KDB 622911.

For Bands 12 and 14, the adjustment factor is  $-10 \cdot \log(4) = -6$  dB. The Bands 12 and 14 adjusted limit is -19 dBm.  
For Band 29, the adjustment factor is  $-10 \cdot \log(2) = -3$  dB. The Band 29 adjusted limit is -16 dBm.

For Band 14 band edge measurements from 769MHz-775MHz and 799MHz-807MHz, reference level offset corrections were applied to the spectrum analyzer, according to the following table:

Frequency (MHz)	769	769.05	769.1	769.15	769.2	769.25	769.3	769.35	769.4
Correction Factor (dB)	50.1	49.2	48.4	47.8	47.3	46.9	46.5	46.2	45.9
Frequency (MHz)	769.45	769.5	769.55	769.6	769.65	769.7	769.75	769.8	769.85
Correction Factor (dB)	45.7	45.4	45.2	45.1	44.9	44.7	44.6	44.5	44.4
Frequency (MHz)	769.9	769.95	770	770.5	771	775	776	798	805
Correction Factor (dB)	44.3	4.2	44.1	43.3	42.9	41.9	41.8	41.1	41.1

Per FCC section 27.53(g), the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm  $[-13 \text{ dBm} -10 \log(4)]$  per FCC KDB 662911D01 v02r01 because the RRH may operate as a 4 port MIMO transmitter for Band 12.

FCC 27.53(g) requires a >100 kHz measurement bandwidth for emissions 100 kHz outside of the RRH operating frequency range. FCC 27.53(g) requires a >30 kHz measurement bandwidth for emissions between 100 kHz outside of the RRH operating frequency range and band edge of the operating frequency range.

Per section 90.543(e)(3), the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm  $[-13 \text{ dBm} -10 \log(4)]$  per FCC KDB 662911D01 v02r01 because the RRH may operate as a 4 port MIMO transmitter for Band 14.

FCC 90.543(e)(5) requires a >100 kHz measurement bandwidth for emissions 100 kHz outside of the RRH operating frequency range. FCC 90.543(e)(5) requires a >30 kHz measurement bandwidth for emissions between 100 kHz outside of the RRH operating frequency range and band edge of the operating frequency range.

# BAND EDGE COMPLIANCE



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EUT: AHLBBA RRH		Work Order: NOKI0004	
Serial Number: K9193514835		Date: 19-Nov-19	
Customer: Nokia Solutions and Networks		Temperature: 23 °C	
Attendees: John Rattanavong		Humidity: 30.7% RH	
Project: None		Barometric Pres.: 1017 mbar	
Tested by: Jonathan Kiefer		Power: 54VDC	
		Job Site: TX09	
TEST SPECIFICATIONS			
FCC 27:2019		Test Method	
FCC 901:2019		ANSI C63.26:2015	
ANSI C63.26:2015			
COMMENTS			
Band 12-14 Multicarrier band edge measurements. Tested on highest power antenna port (Port 1). EUT is operated at 100% duty cycle.			
DEVIATIONS FROM TEST STANDARD			
None			
Configuration #	2, 3	Signature <i>Jonathan Kiefer</i>	
		Value (dBm)	Limit (dBm) Result
Band 12-14			
QPSK Modulation			
Lower Band Edge			
	Measurement 1	-27.407	-19 Pass
	Measurement 2	-24.856	-19 Pass
Upper Band Edge			
	Measurement 1	-28.295	-19 Pass
	Measurement 2	-25.699	-19 Pass
	Measurement 3	-54.844	-52 Pass
	Measurement 4	-69.914	-52 Pass
16QAM Modulation			
Lower Band Edge			
	Measurement 1	-27.776	-19 Pass
	Measurement 2	-25.349	-19 Pass
Upper Band Edge			
	Measurement 1	-28.684	-19 Pass
	Measurement 2	-25.543	-19 Pass
	Measurement 3	-54.426	-52 Pass
	Measurement 4	-70.017	-52 Pass
64QAM Modulation			
Lower Band Edge			
	Measurement 1	-27.665	-19 Pass
	Measurement 2	-25.088	-19 Pass
Upper Band Edge			
	Measurement 1	-28.205	-19 Pass
	Measurement 2	-25.218	-19 Pass
	Measurement 3	-54.71	-52 Pass
	Measurement 4	-69.984	-52 Pass
256QAM Modulation			
Lower Band Edge			
	Measurement 1	-27.622	-19 Pass
	Measurement 2	-24.595	-19 Pass
Upper Band Edge			
	Measurement 1	-28.29	-19 Pass
	Measurement 2	-25.489	-19 Pass
	Measurement 3	-54.45	-52 Pass
	Measurement 4	-69.873	-52 Pass

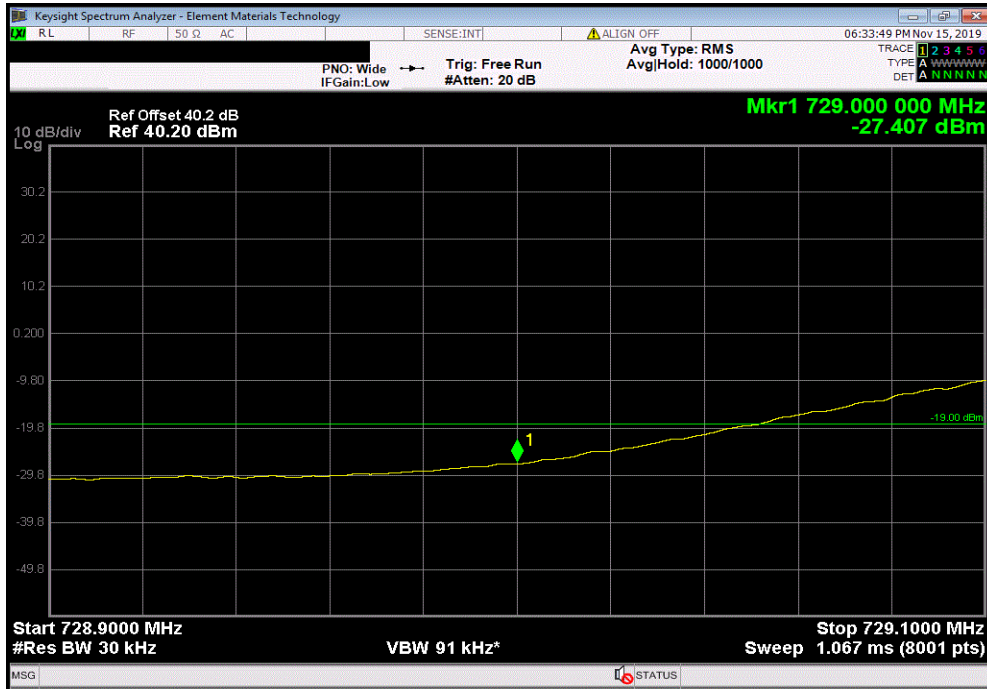
# BAND EDGE COMPLIANCE



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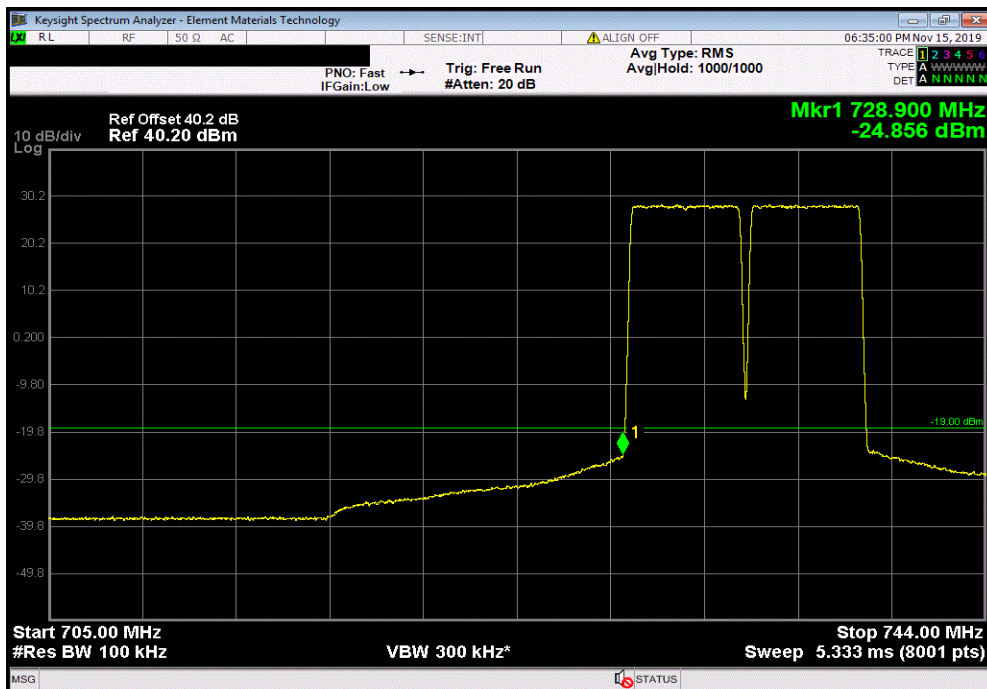
Band 12-14, QPSK Modulation, Lower Band Edge, Measurement 1

				Value (dBm)	Limit (dBm)	Result
				-27.407	-19	Pass



Band 12-14, QPSK Modulation, Lower Band Edge, Measurement 2

				Value (dBm)	Limit (dBm)	Result
				-24.856	-19	Pass

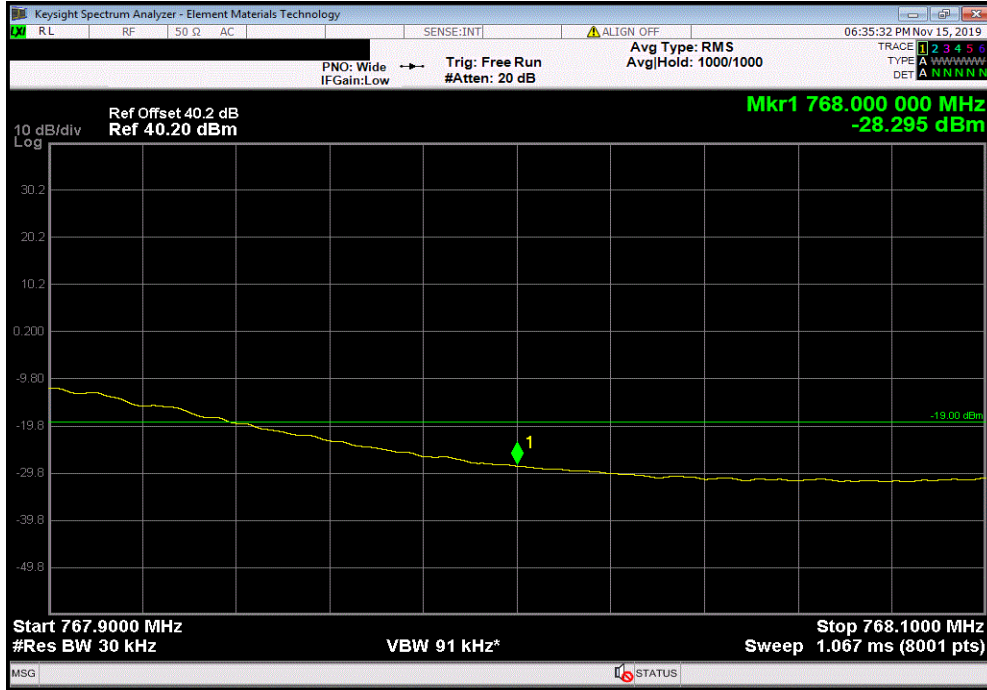


# BAND EDGE COMPLIANCE

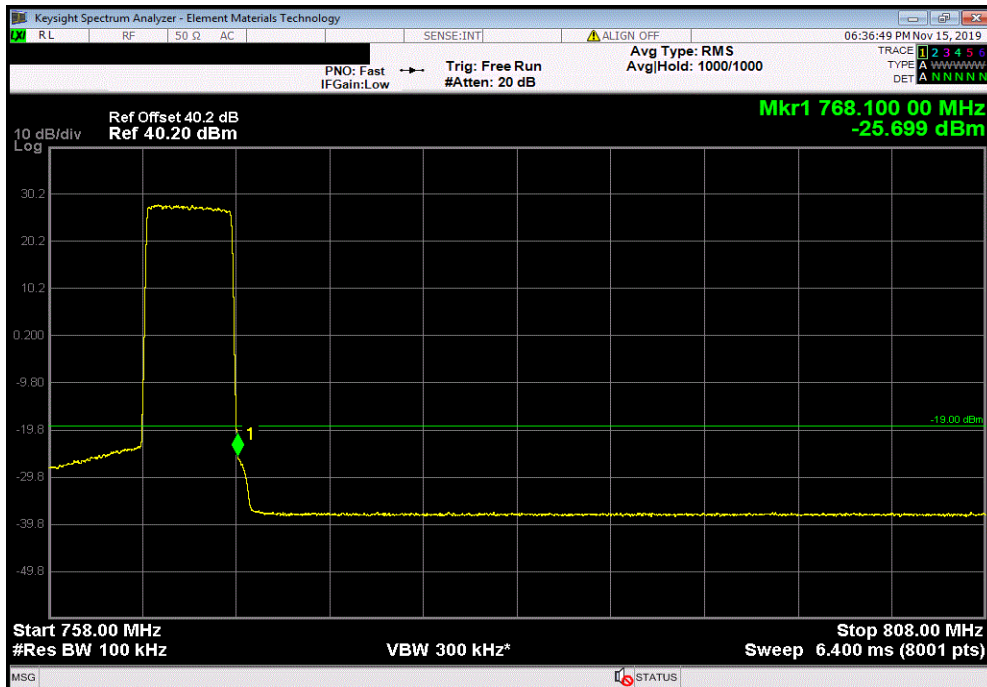


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Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-28.295	-19	Pass



Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-25.699	-19	Pass



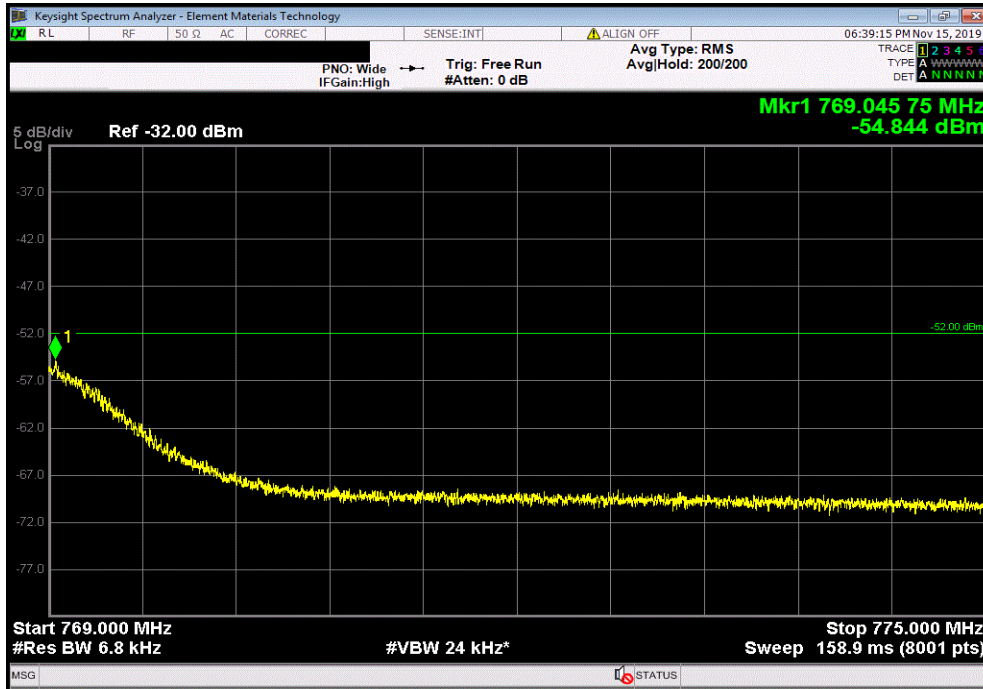
# BAND EDGE COMPLIANCE



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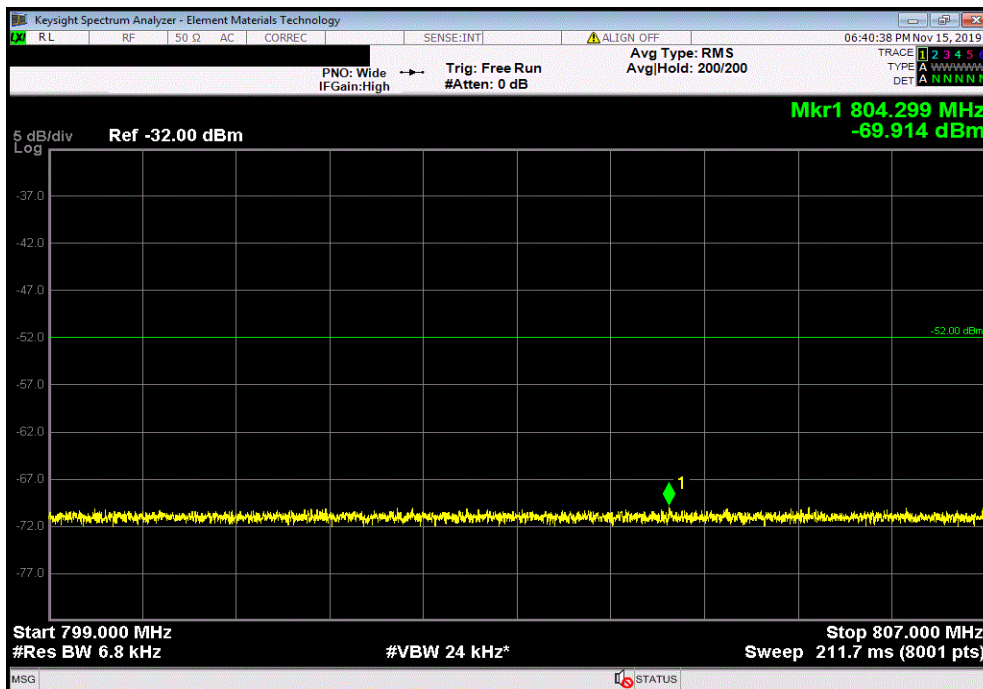
Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 3

				Value (dBm)	Limit (dBm)	Result
				-54.844	-52	Pass



Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 4

				Value (dBm)	Limit (dBm)	Result
				-69.914	-52	Pass

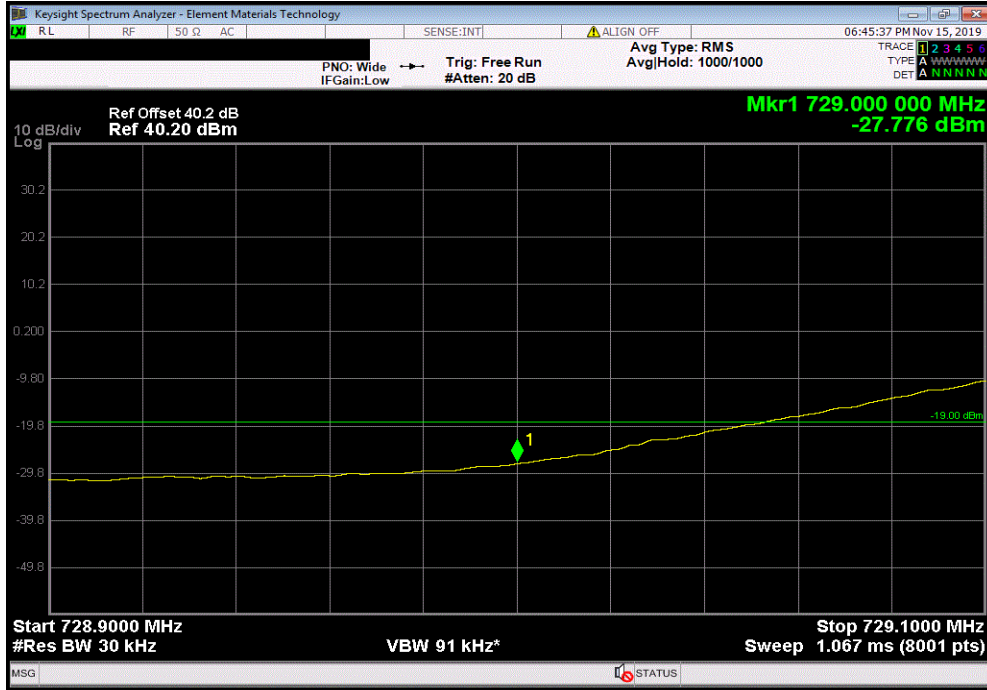


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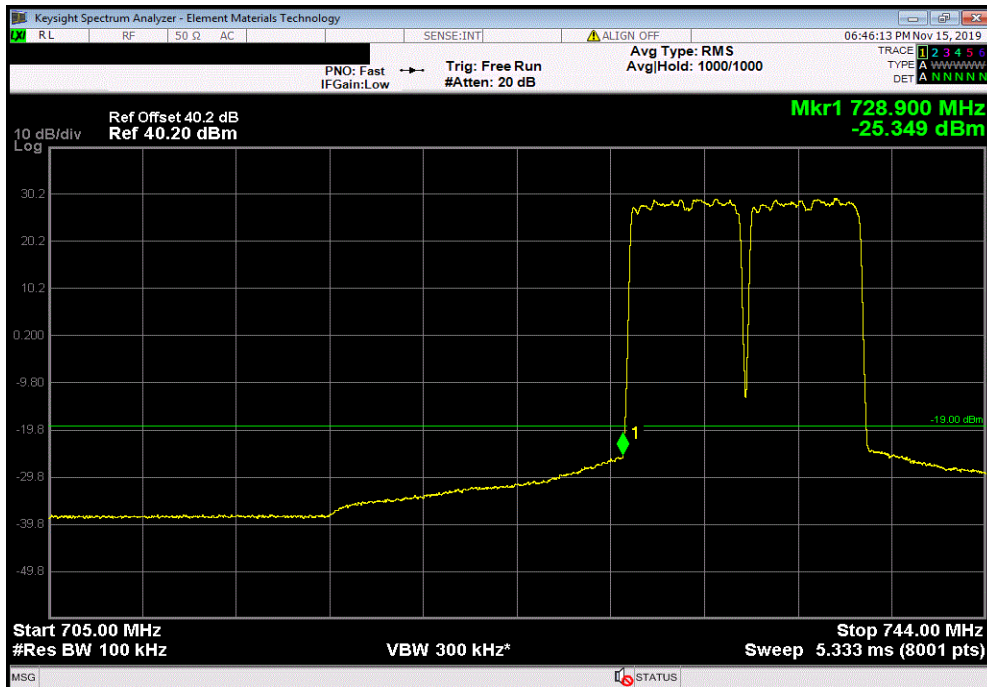


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Band 12-14, 16QAM Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-27.776	-19	Pass



Band 12-14, 16QAM Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-25.349	-19	Pass

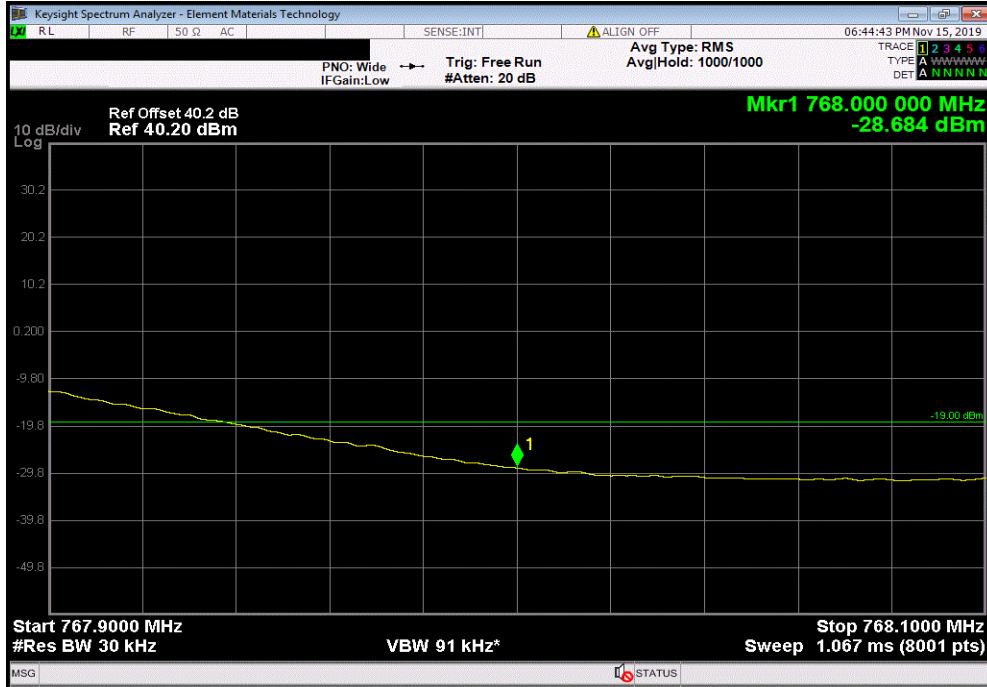


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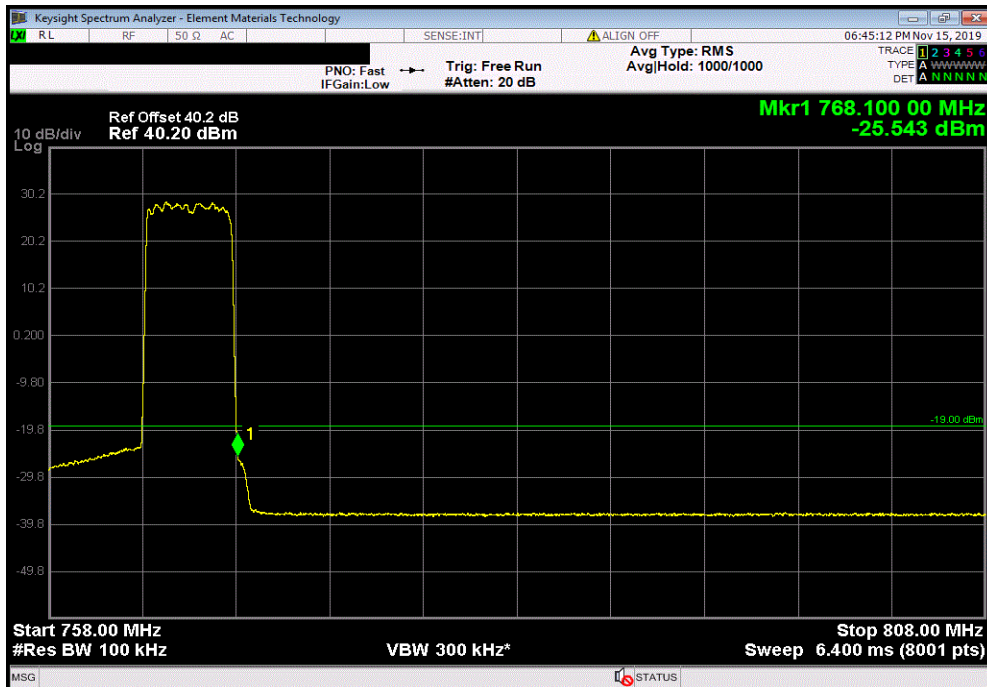


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Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-28.684	-19	Pass



Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-25.543	-19	Pass

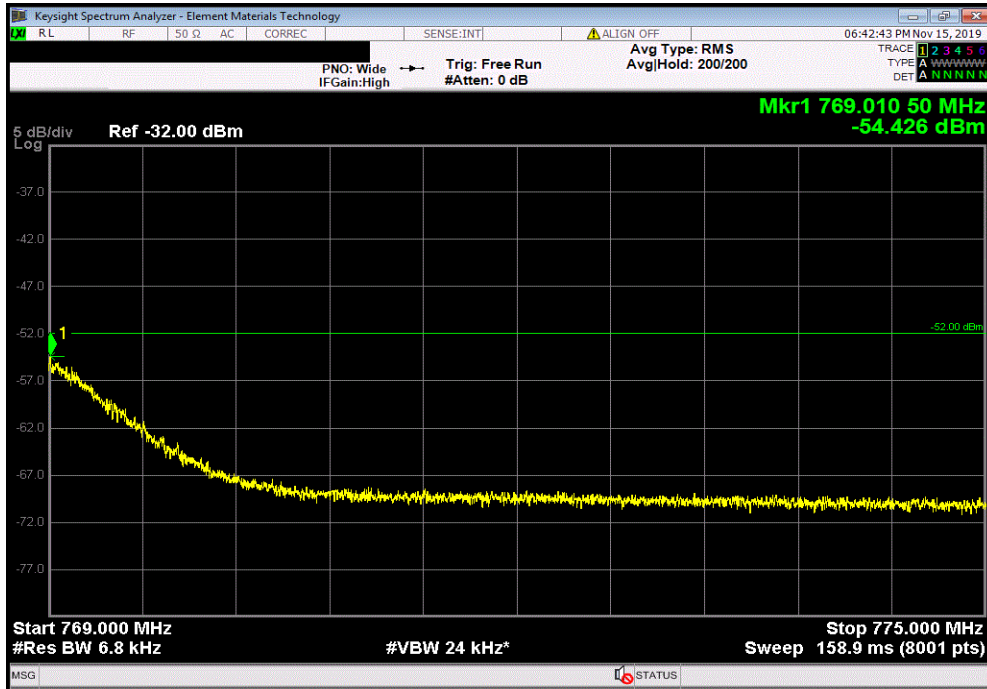


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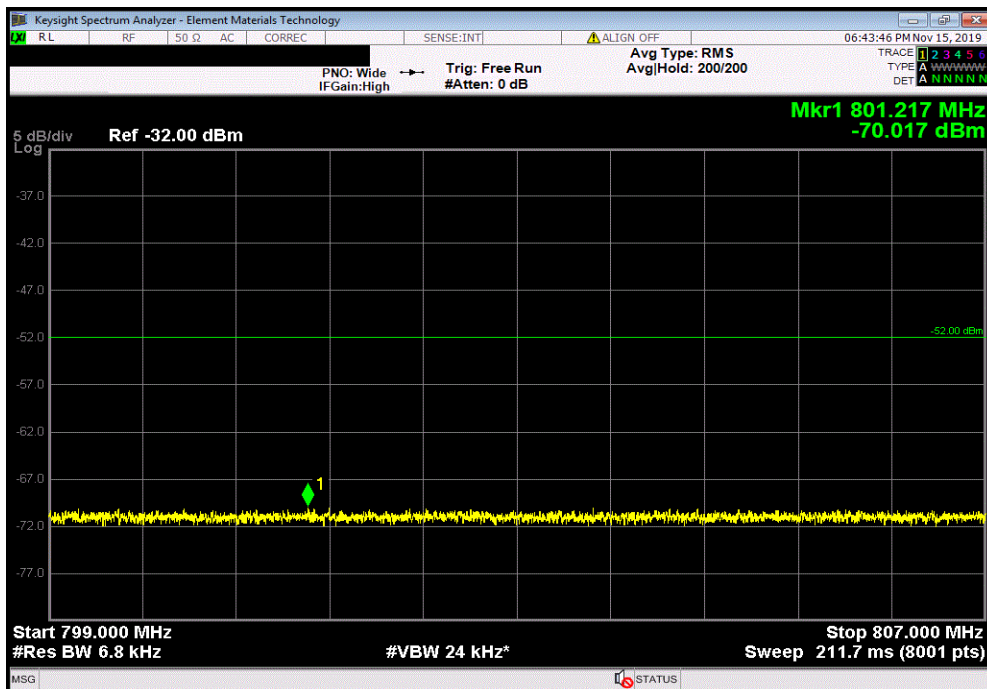


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Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.426	-52	Pass



Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-70.017	-52	Pass



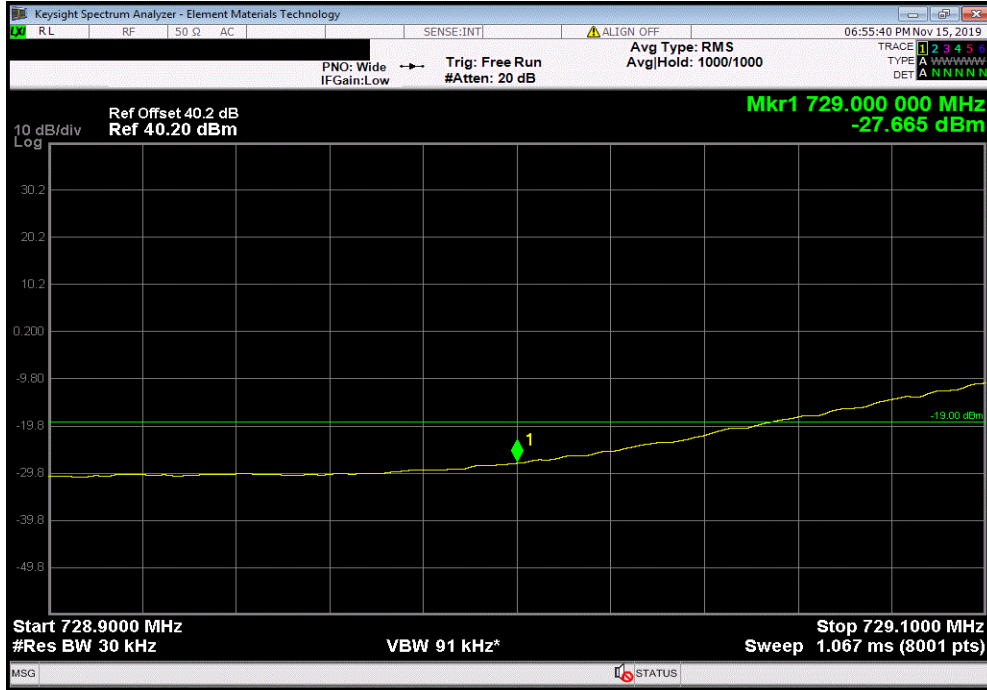


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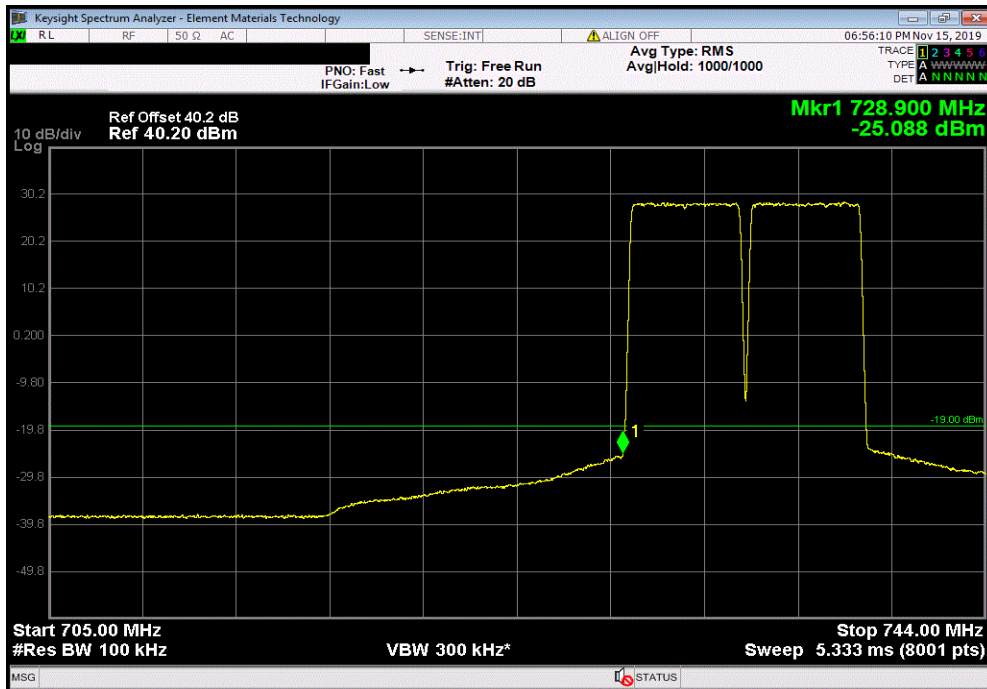


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Band 12-14, 64QAM Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-27.665	-19	Pass



Band 12-14, 64QAM Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-25.088	-19	Pass



# BAND EDGE COMPLIANCE

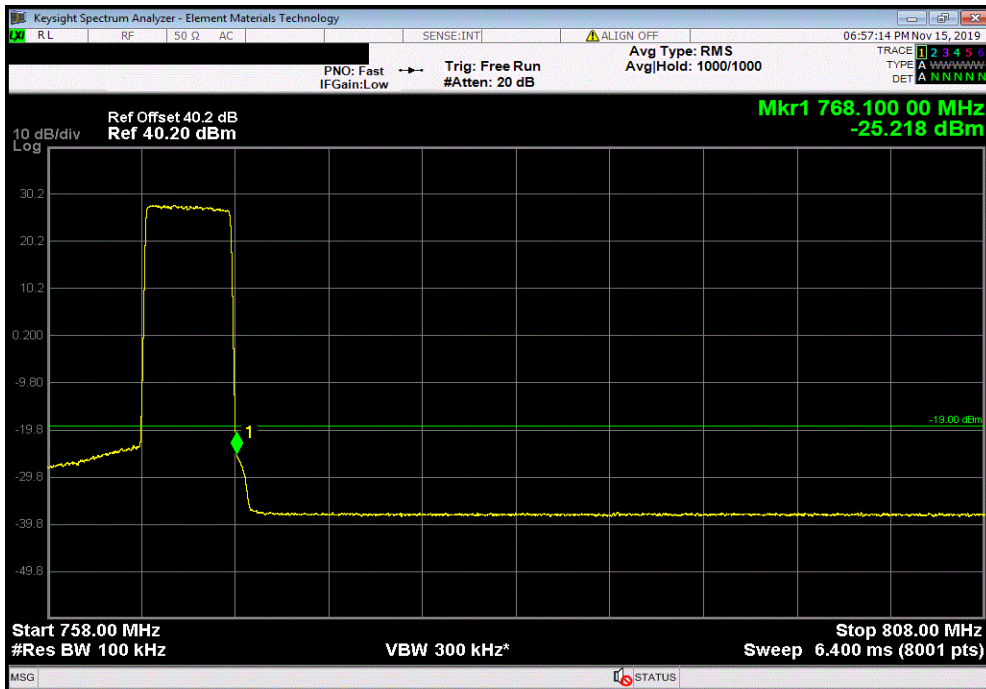


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Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-28.205	-19	Pass



Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-25.218	-19	Pass

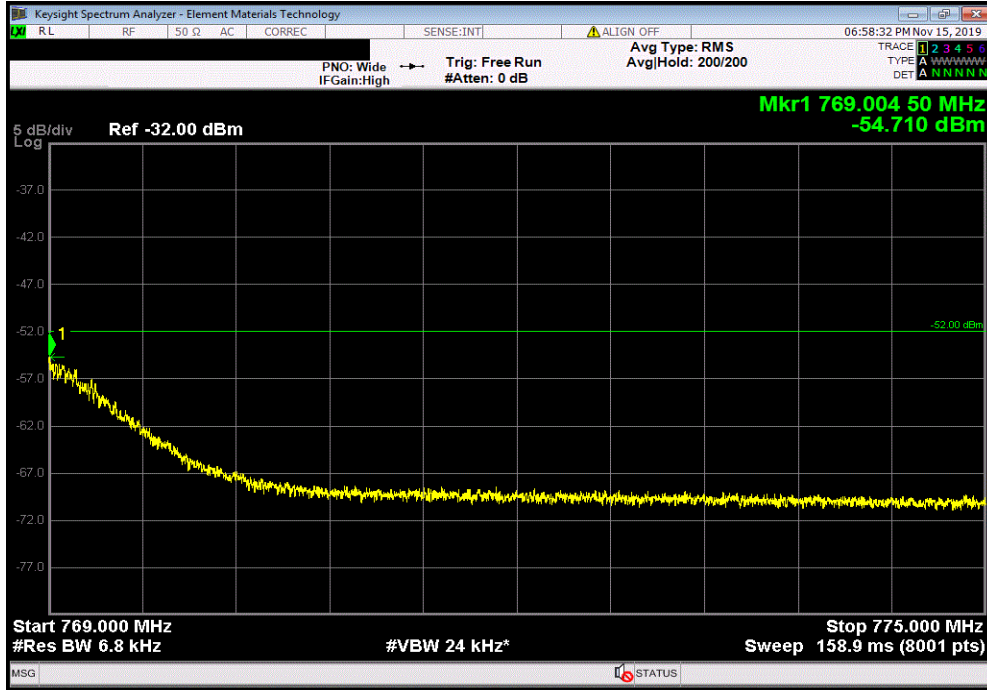


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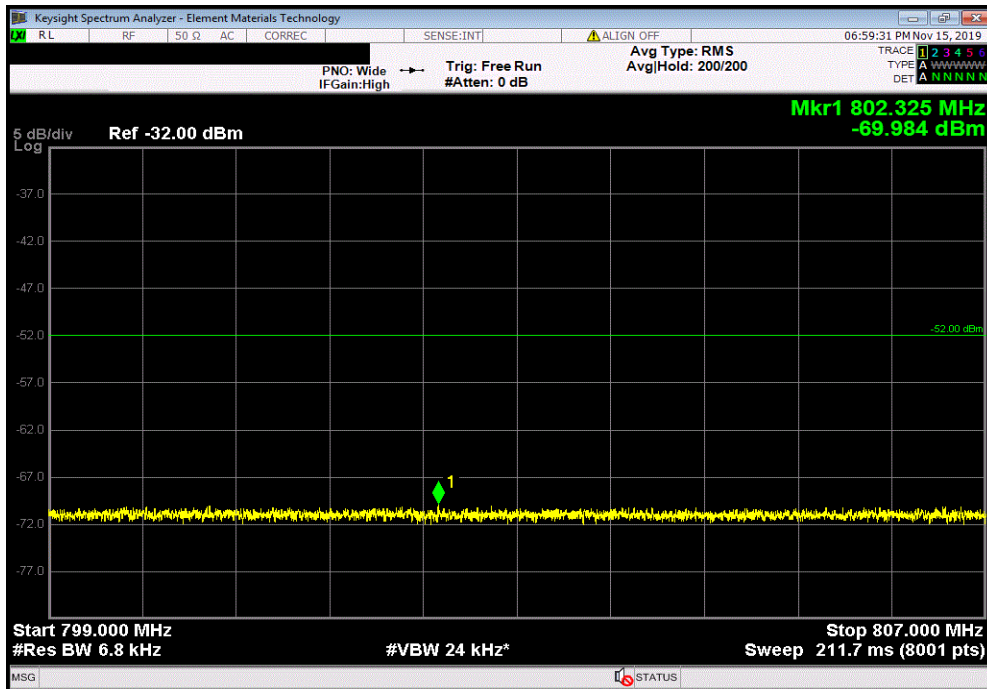


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Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.71	-52	Pass



Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.984	-52	Pass

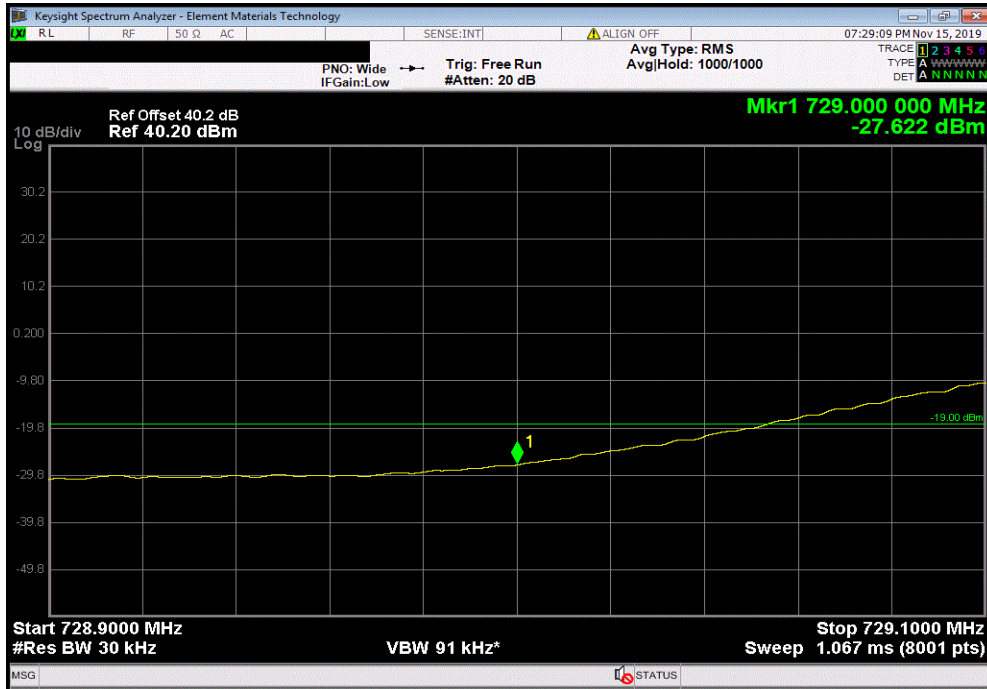


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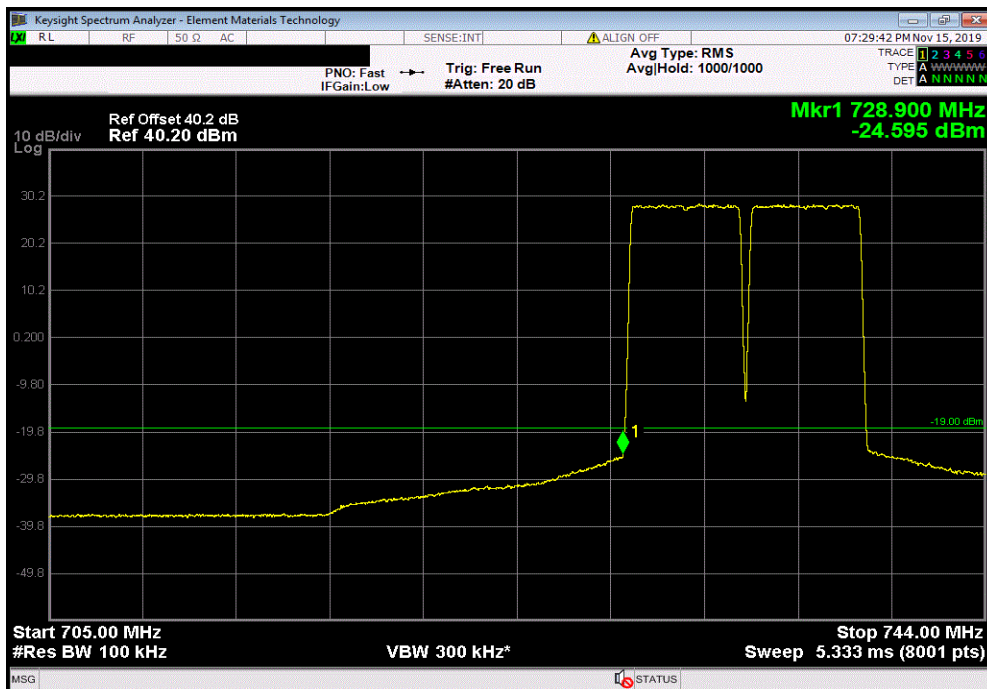


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Band 12-14, 256QAM Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-27.622	-19	Pass



Band 12-14, 256QAM Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-24.595	-19	Pass

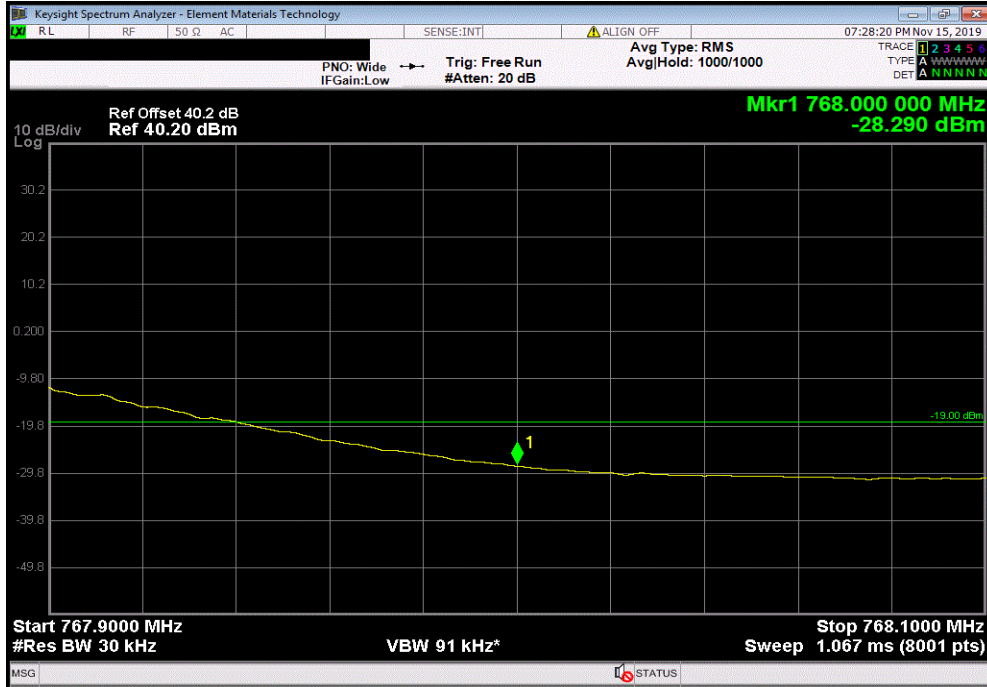


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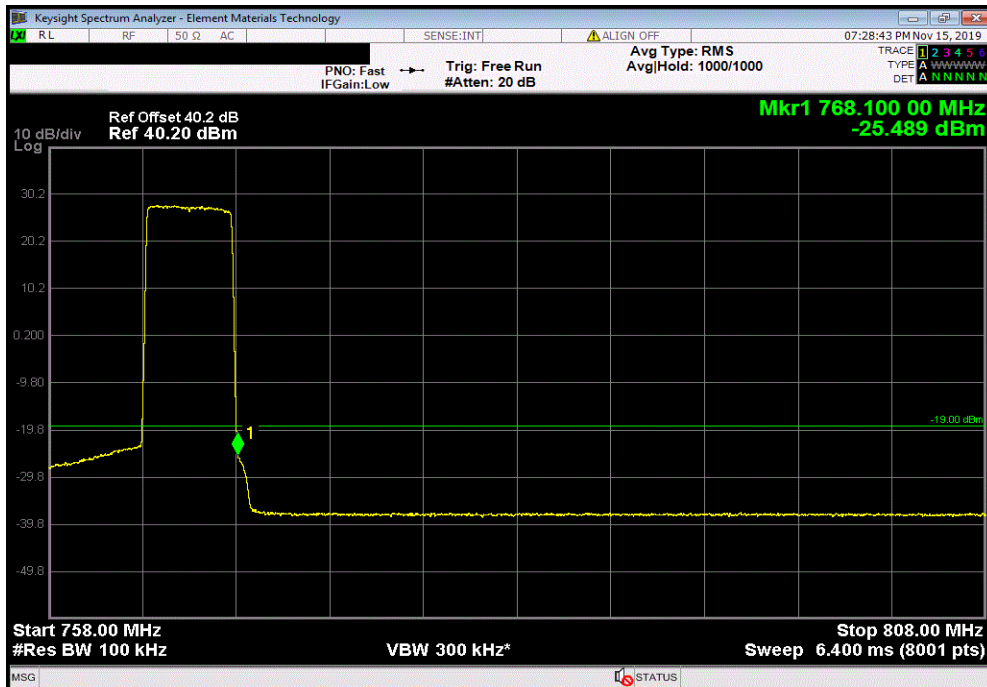


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Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 1						
	Value (dBm)	Limit (dBm)	Result			
	-28.29	-19	Pass			



Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 2						
	Value (dBm)	Limit (dBm)	Result			
	-25.489	-19	Pass			

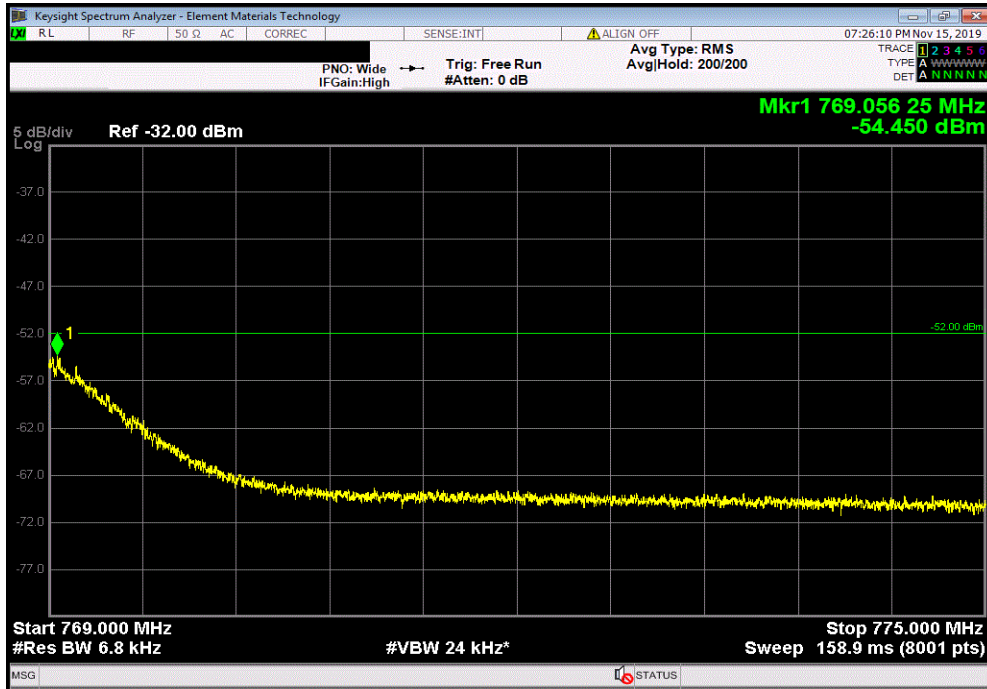


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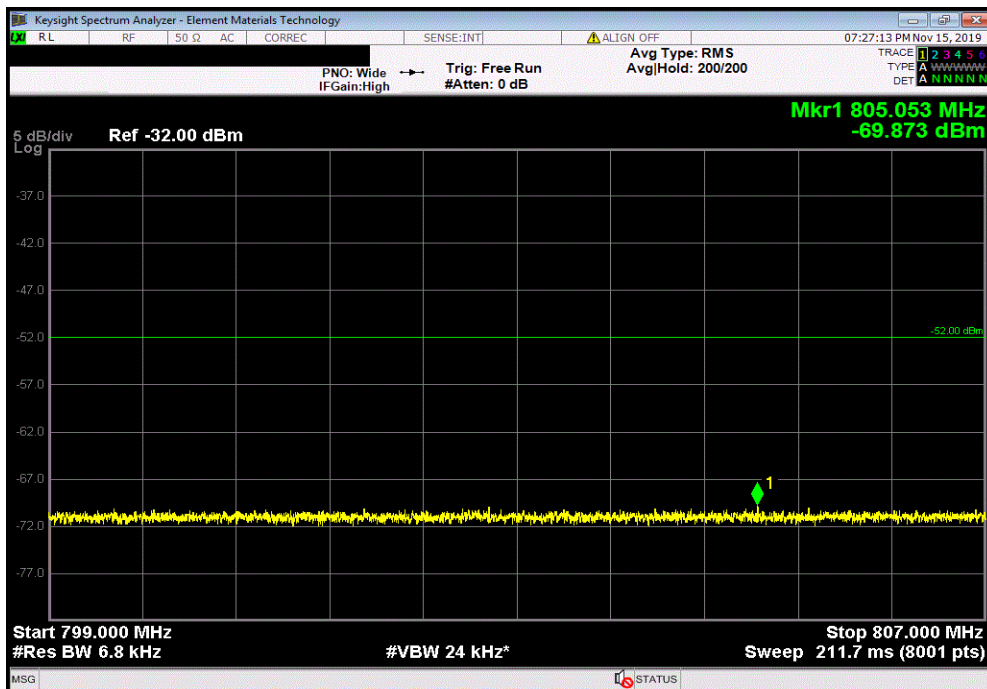


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Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.45	-52	Pass



Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.873	-52	Pass



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Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

## TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-19	19-Mar-20

## TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in the available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet. For Multiband operation, measurements were taken at the lower band edge of the lower band and the upper band edge of the upper band.

The spectrum was scanned below the lower band edge and above the higher band edge.

All limits were adjusted by a factor of  $[-10 \cdot \log(N)]$  to account for the device operation as a N port MIMO transmitter, as per FCC KDB 622911.

For Bands 12 and 14, the adjustment factor is  $-10 \cdot \log(4) = -6$  dB. The Bands 12 and 14 adjusted limit is -19 dBm.

For Band 29, the adjustment factor is  $-10 \cdot \log(2) = -3$  dB. The Band 29 adjusted limit is -16 dBm.

For Band 14 band edge measurements from 769MHz-775MHz and 799MHz-807MHz, reference level offset corrections were applied to the spectrum analyzer, according to the following table:

Frequency (MHz)	769	769.05	769.1	769.15	769.2	769.25	769.3	769.35	769.4
Correction Factor (dB)	50.1	49.2	48.4	47.8	47.3	46.9	46.5	46.2	45.9
Frequency (MHz)	769.45	769.5	769.55	769.6	769.65	769.7	769.75	769.8	769.85
Correction Factor (dB)	45.7	45.4	45.2	45.1	44.9	44.7	44.6	44.5	44.4
Frequency (MHz)	769.9	769.95	770	770.5	771	775	776	798	805
Correction Factor (dB)	44.3	4.2	44.1	43.3	42.9	41.9	41.8	41.1	41.1

Per FCC section 27.53(g), the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm  $[-13 \text{ dBm} - 10 \log(4)]$  per FCC KDB 662911D01 v02r01 because the RRH may operate as a 4 port MIMO transmitter for Band 12.

FCC 27.53(g) requires a >100 kHz measurement bandwidth for emissions 100 kHz outside of the RRH operating frequency range. FCC 27.53(g) requires a >30 kHz measurement bandwidth for emissions between 100 kHz outside of the RRH operating frequency range and band edge of the operating frequency range.

Per section 90.543(e)(3), the power of any emission outside of the authorized operating frequency range cannot exceed -13 dBm. The limit is adjusted to -19 dBm  $[-13 \text{ dBm} - 10 \log(4)]$  per FCC KDB 662911D01 v02r01 because the RRH may operate as a 4 port MIMO transmitter for Band 14.

FCC 90.543(e)(5) requires a >100 kHz measurement bandwidth for emissions 100 kHz outside of the RRH operating frequency range. FCC 90.543(e)(5) requires a >30 kHz measurement bandwidth for emissions between 100 kHz outside of the RRH operating frequency range and band edge of the operating frequency range.

FCC 90.543(e)(1) requires an emission limit of -46dBm for any 6.25 kHz bandwidth between frequency bands 769-775 MHz and 799-805 MHz. The limit is adjusted to -52 dBm per 6.25kHz bandwidth  $[-46 \text{ dBm} - 10 \log(4)]$  per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

# BAND EDGE COMPLIANCE



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EUT: AHLBBA RRH		Work Order: NOKI0004
Serial Number: K9193514835		Date: 19-Nov-19
Customer: Nokia Solutions and Networks		Temperature: 23 °C
Attendees: John Rattanavong		Humidity: 30.7% RH
Project: None		Barometric Pres.: 1017 mbar
Tested by: Jonathan Kiefer	Power: 54VDC	Job Site: TX09
TEST SPECIFICATIONS		
FCC 27:2019		Test Method
FCC 90:2019		ANSI C63.26:2015
ANSI C63.26:2015		
COMMENTS		
Band 12-14 Multicarrier band edge measurements. Tested on highest power antenna port (Port 2). EUT is operated at 100% duty cycle.		
DEVIATIONS FROM TEST STANDARD		
None		
Configuration #	2, 3	Signature <i>Jonathan Kiefer</i>

	Value (dBm)	Limit (dBm)	Result
Band 12-14			
QPSK Modulation			
Lower Band Edge			
Measurement 1	-25.003	-19	Pass
Measurement 2	-21.94	-19	Pass
Upper Band Edge			
Measurement 1	-23.504	-19	Pass
Measurement 2	-21.154	-19	Pass
Measurement 3	-54.753	-52	Pass
Measurement 4	-69.859	-52	Pass
16QAM Modulation			
Lower Band Edge			
Measurement 1	-24.591	-19	Pass
Measurement 2	-22.289	-19	Pass
Upper Band Edge			
Measurement 1	-24.03	-19	Pass
Measurement 2	-21.738	-19	Pass
Measurement 3	-54.726	-52	Pass
Measurement 4	-69.849	-52	Pass
64QAM Modulation			
Lower Band Edge			
Measurement 1	-24.311	-19	Pass
Measurement 2	-21.337	-19	Pass
Upper Band Edge			
Measurement 1	-23.922	-19	Pass
Measurement 2	-21.203	-19	Pass
Measurement 3	-54.877	-52	Pass
Measurement 4	-69.901	-52	Pass
256QAM Modulation			
Lower Band Edge			
Measurement 1	-24.93	-19	Pass
Measurement 2	-22.074	-19	Pass
Upper Band Edge			
Measurement 1	-23.869	-19	Pass
Measurement 2	-21.129	-19	Pass
Measurement 3	-54.303	-52	Pass
Measurement 4	-69.82	-52	Pass

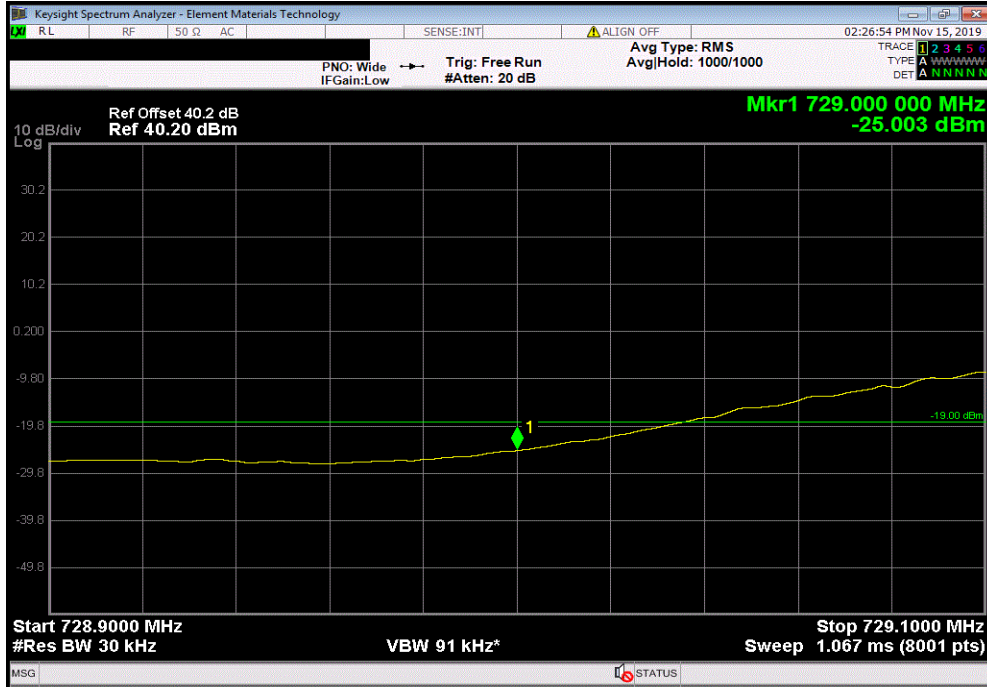


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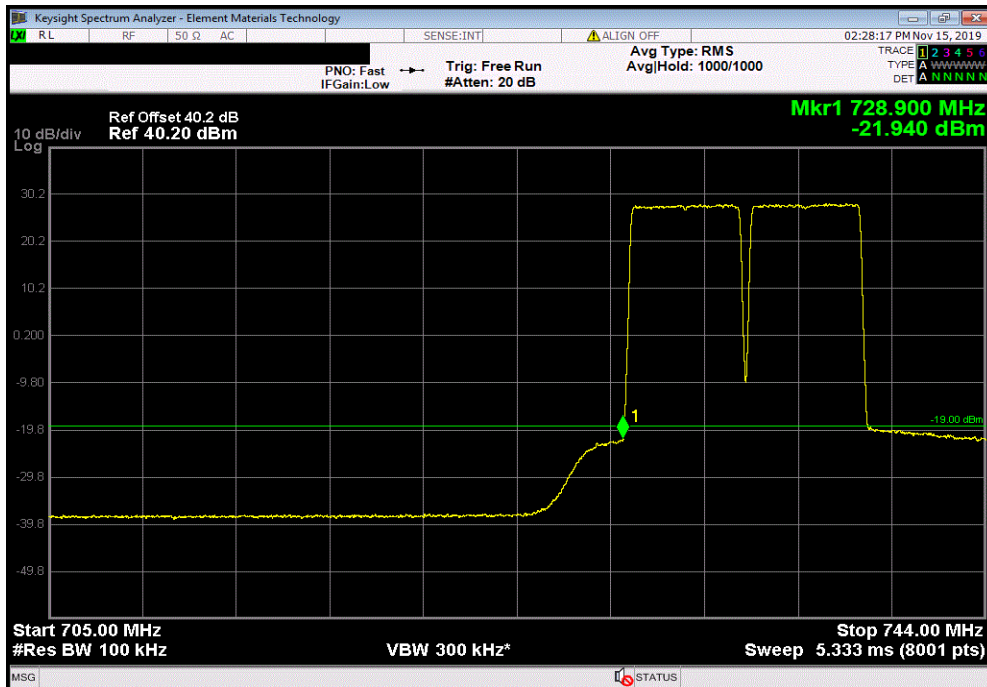


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Band 12-14, QPSK Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-25.003	-19	Pass



Band 12-14, QPSK Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-21.94	-19	Pass



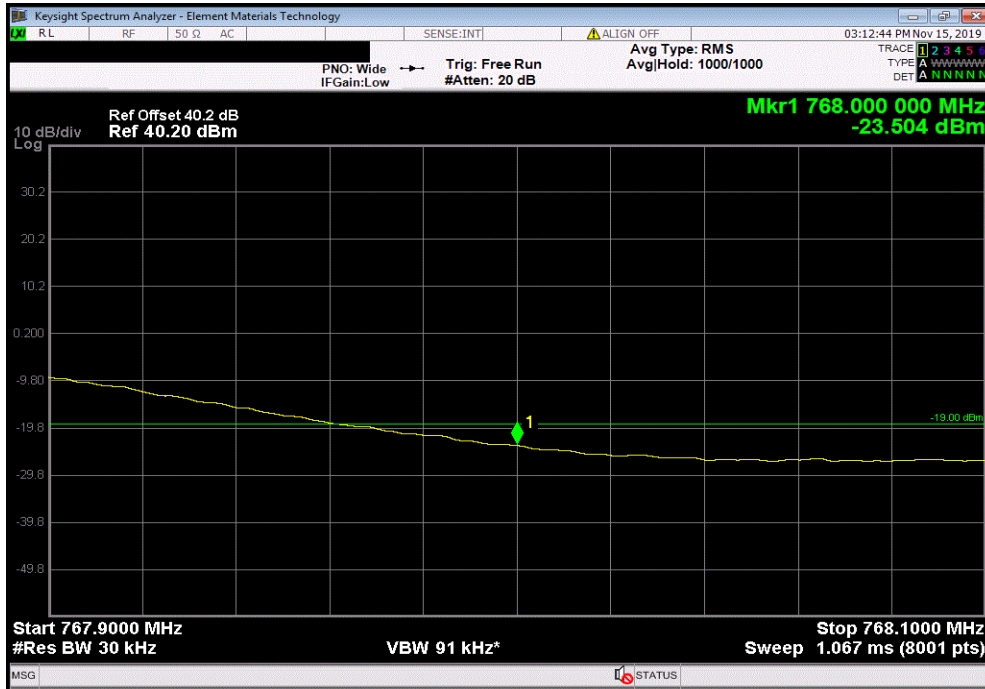
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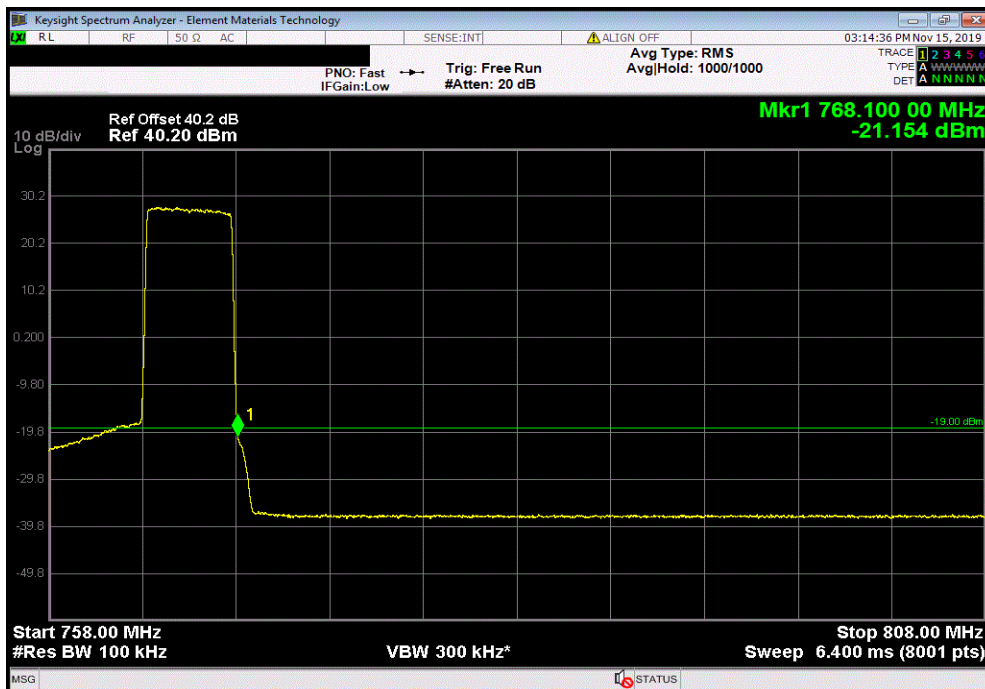
Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 1

Value (dBm)	Limit (dBm)	Result
-23.504	-19	Pass



Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 2

Value (dBm)	Limit (dBm)	Result
-21.154	-19	Pass

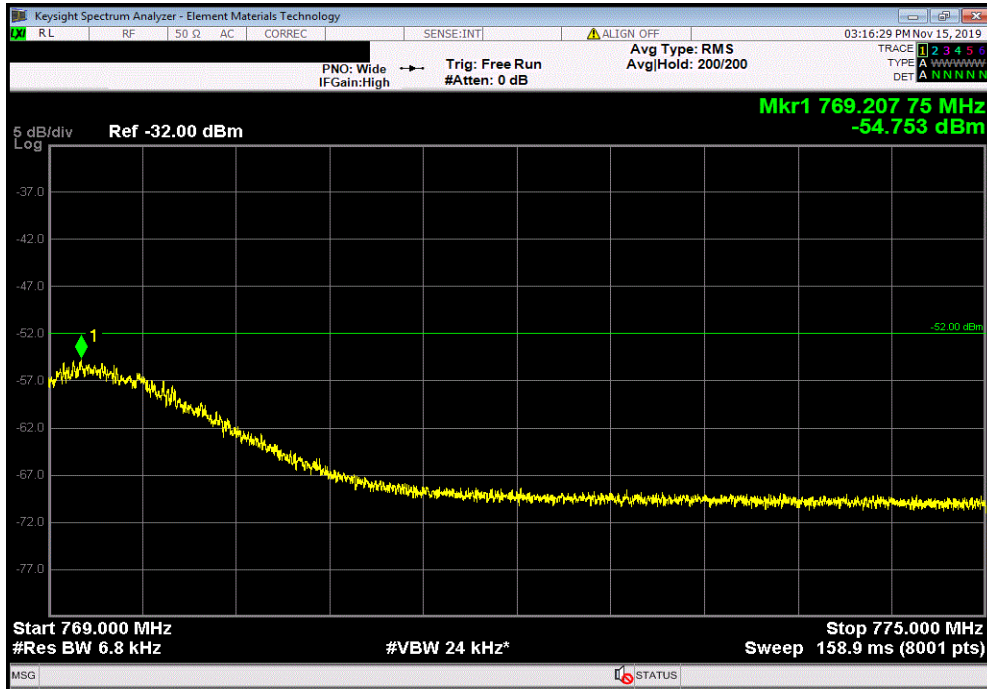


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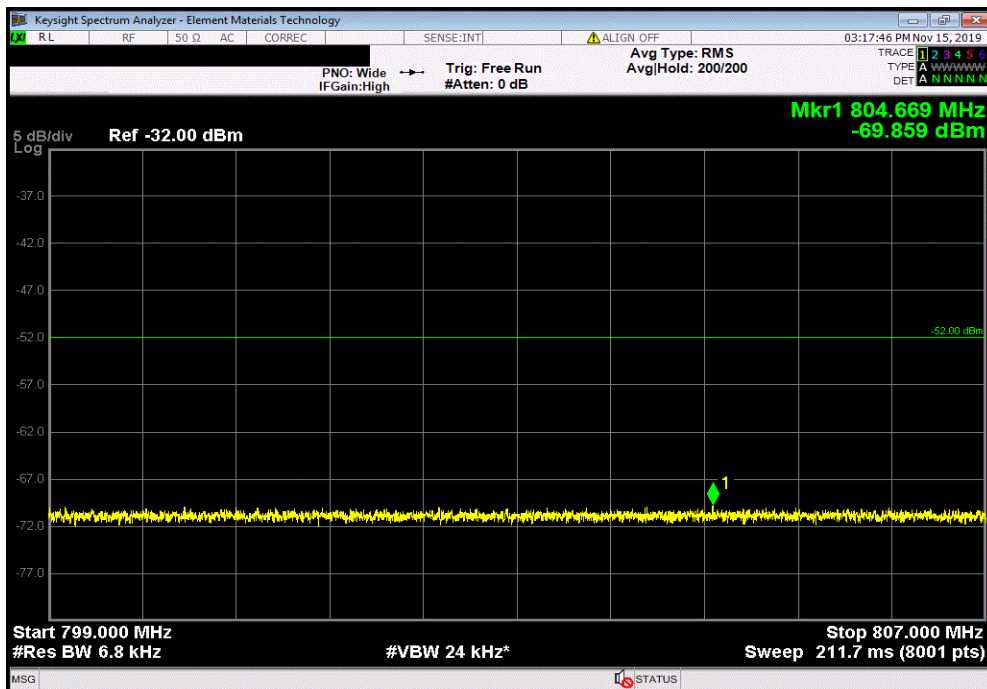


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Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.753	-52	Pass



Band 12-14, QPSK Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.859	-52	Pass



# BAND EDGE COMPLIANCE

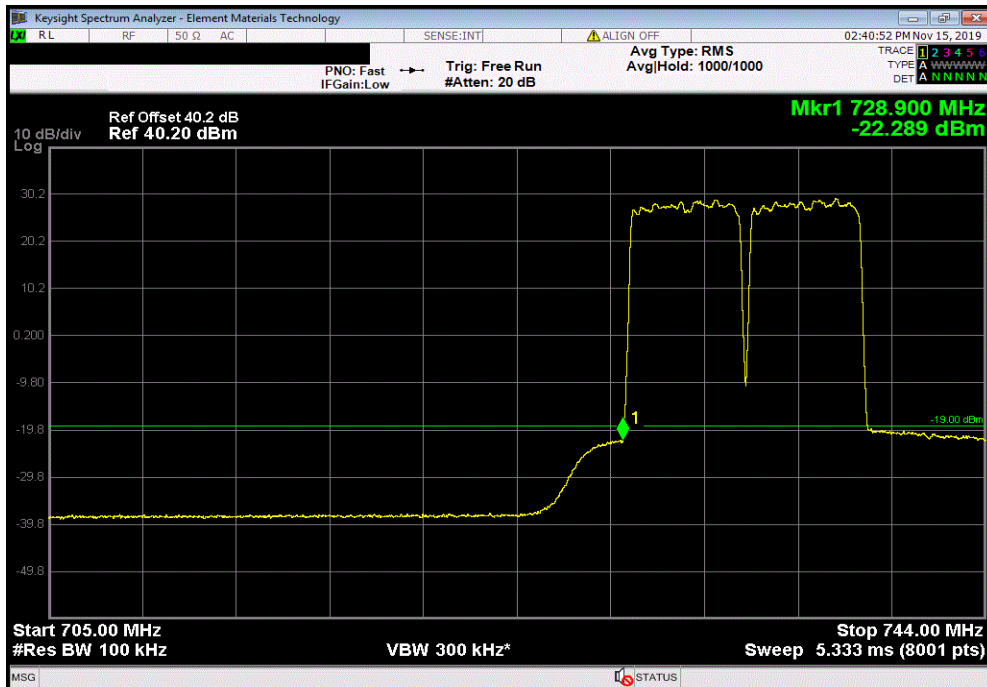


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Band 12-14, 16QAM Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-24.591	-19	Pass



Band 12-14, 16QAM Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-22.289	-19	Pass

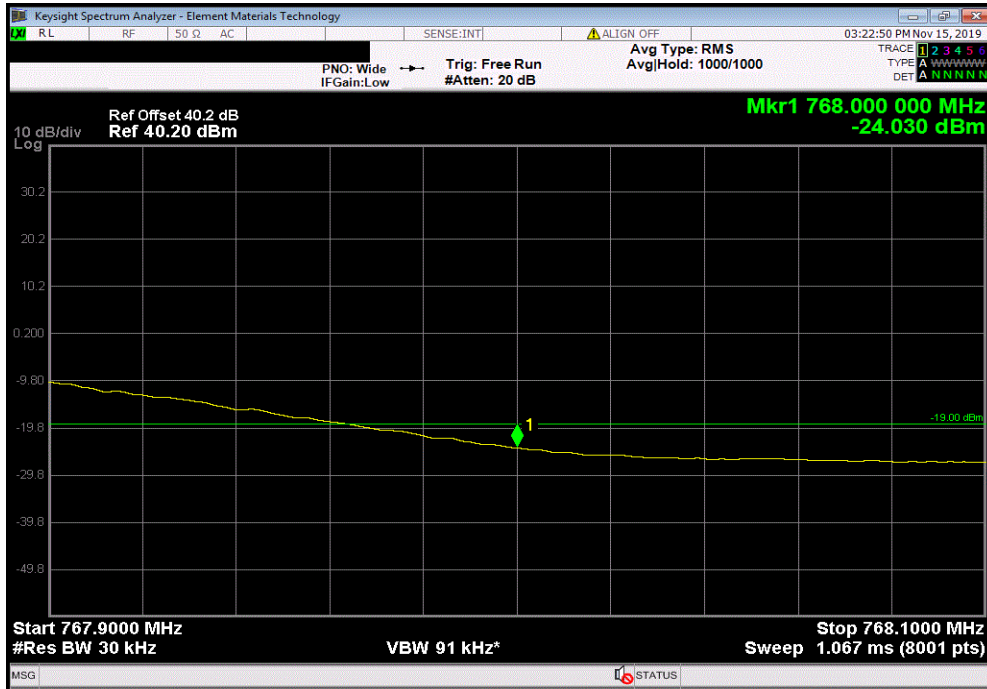


# BAND EDGE COMPLIANCE

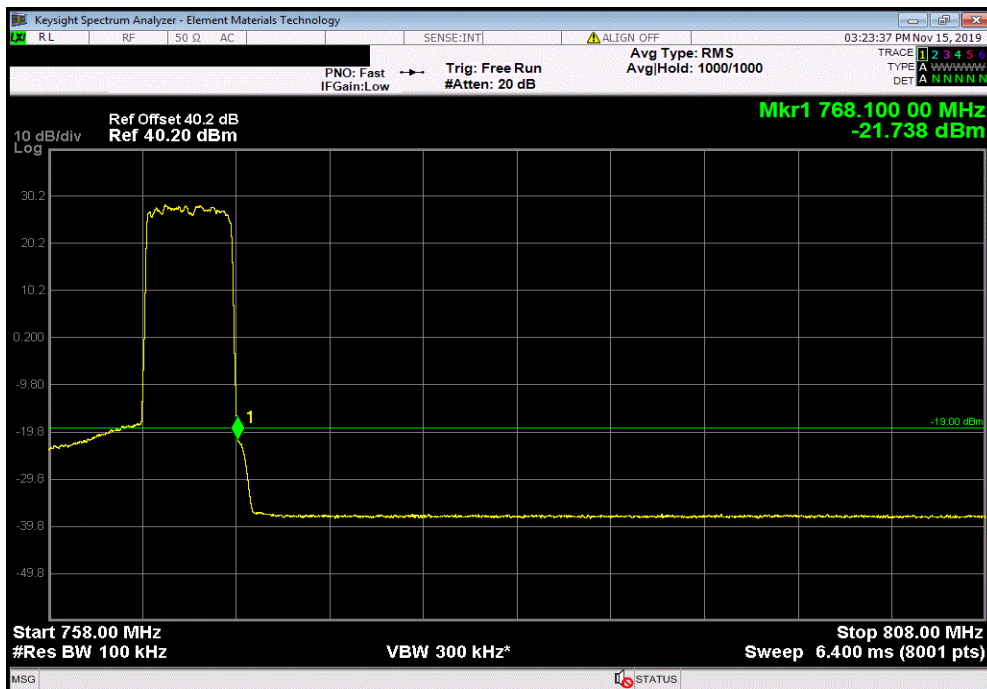


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Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-24.03	-19	Pass



Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-21.738	-19	Pass

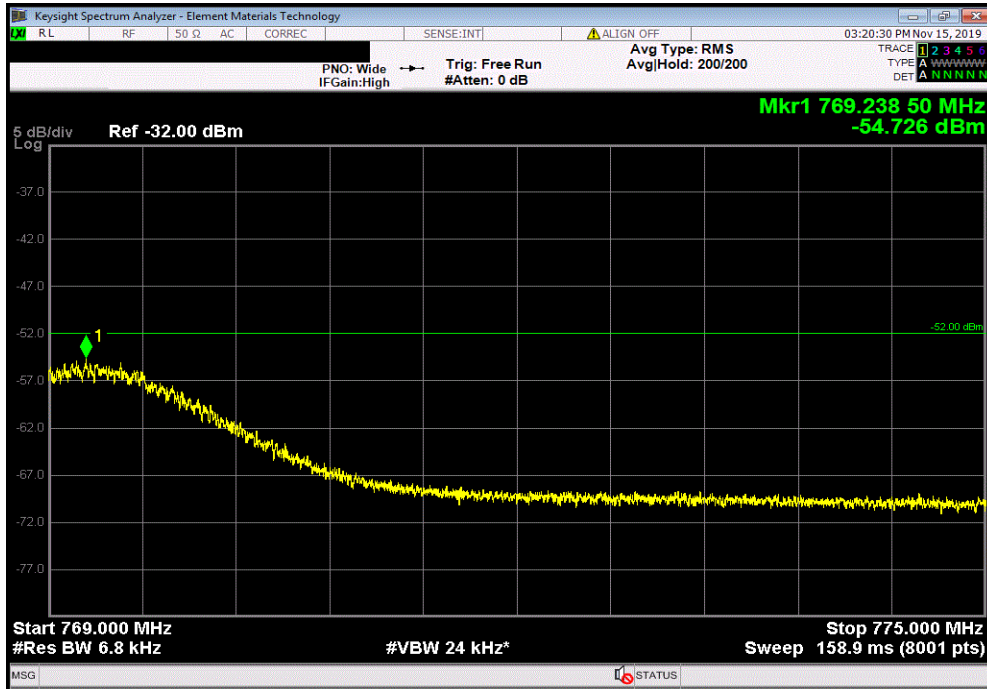


# BAND EDGE COMPLIANCE

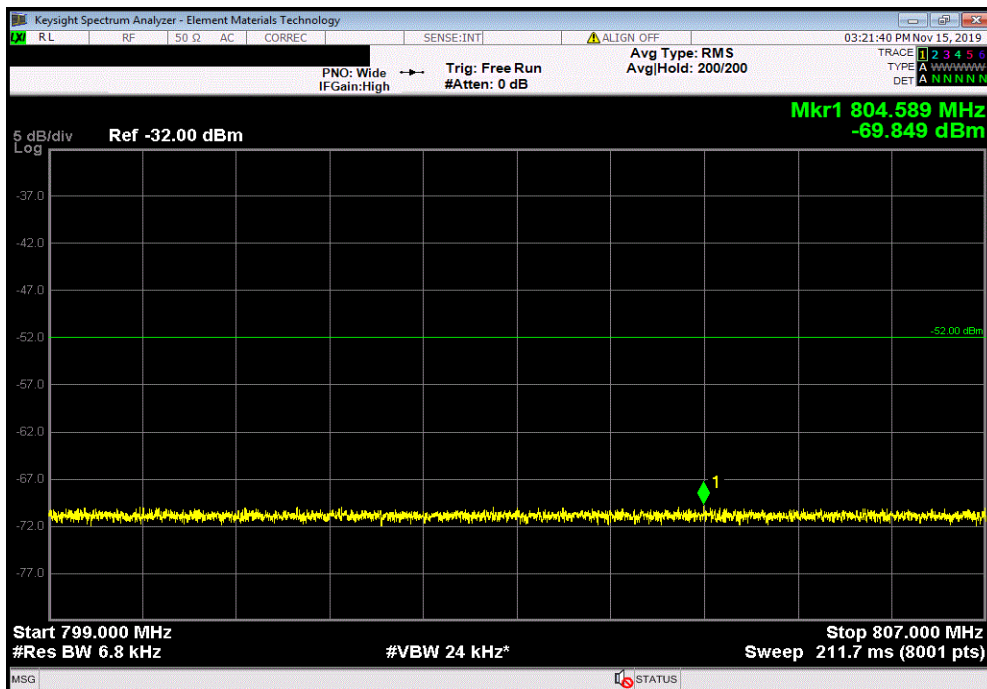


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Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.726	-52	Pass



Band 12-14, 16QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.849	-52	Pass

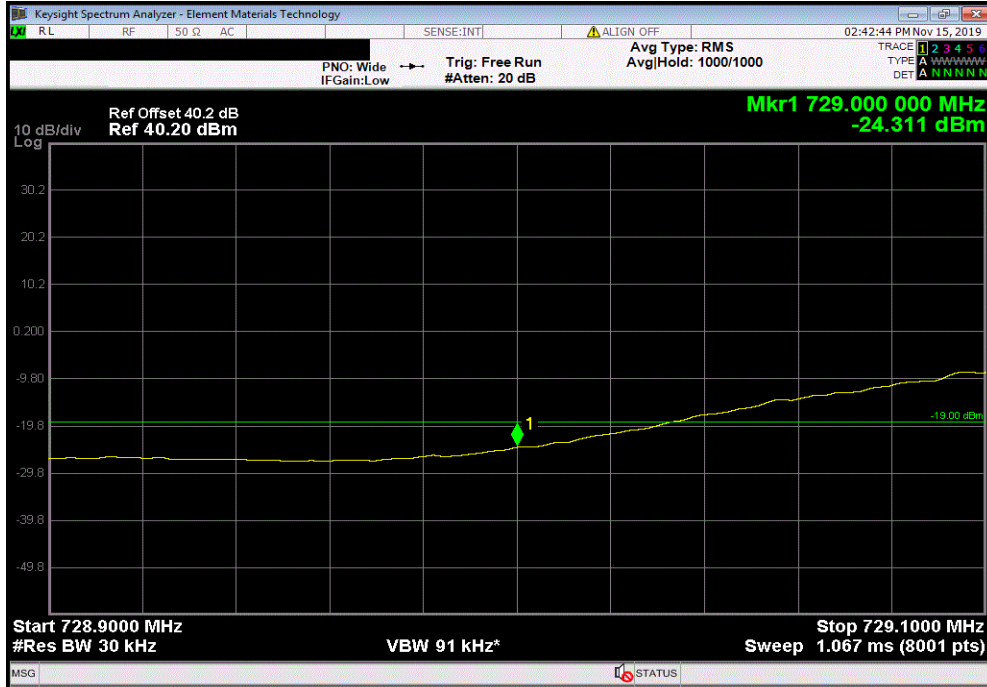


# BAND EDGE COMPLIANCE

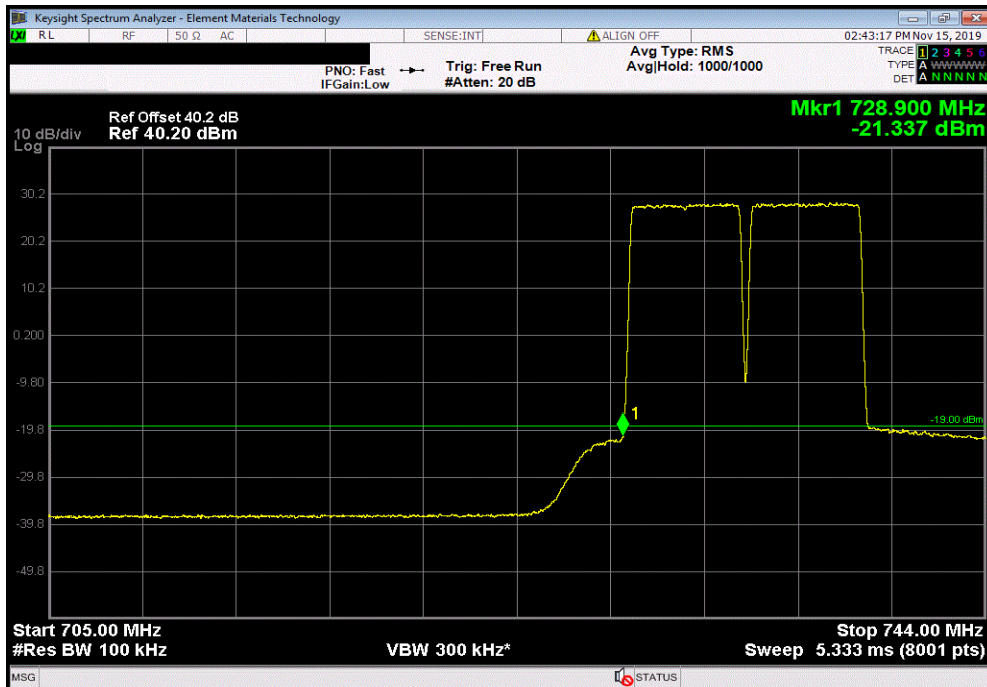


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Band 12-14, 64QAM Modulation, Lower Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-24.311	-19	Pass



Band 12-14, 64QAM Modulation, Lower Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-21.337	-19	Pass

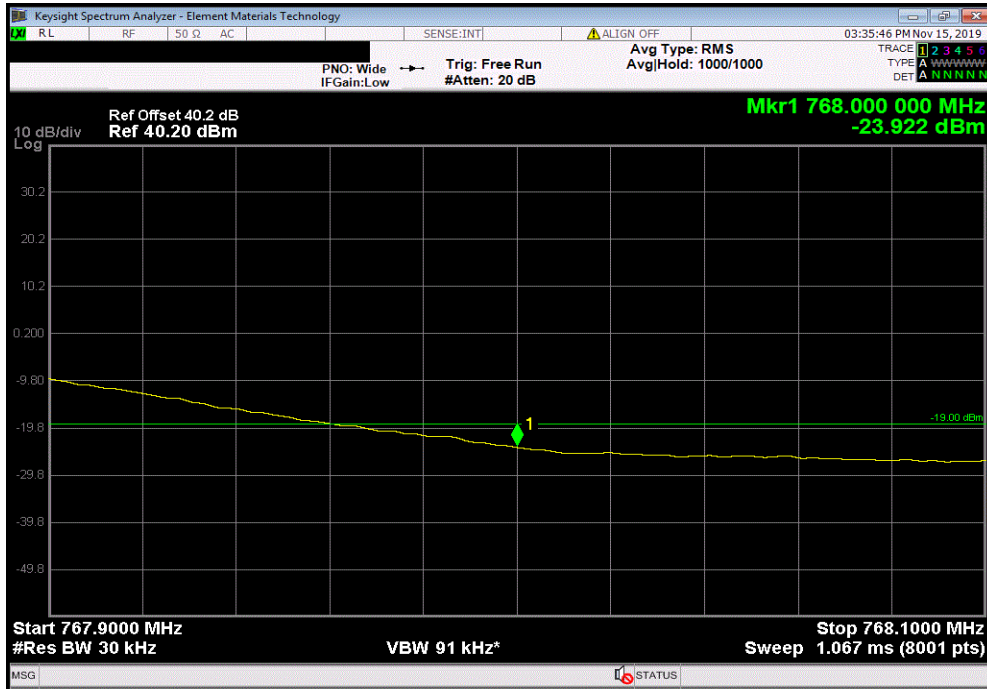


# BAND EDGE COMPLIANCE

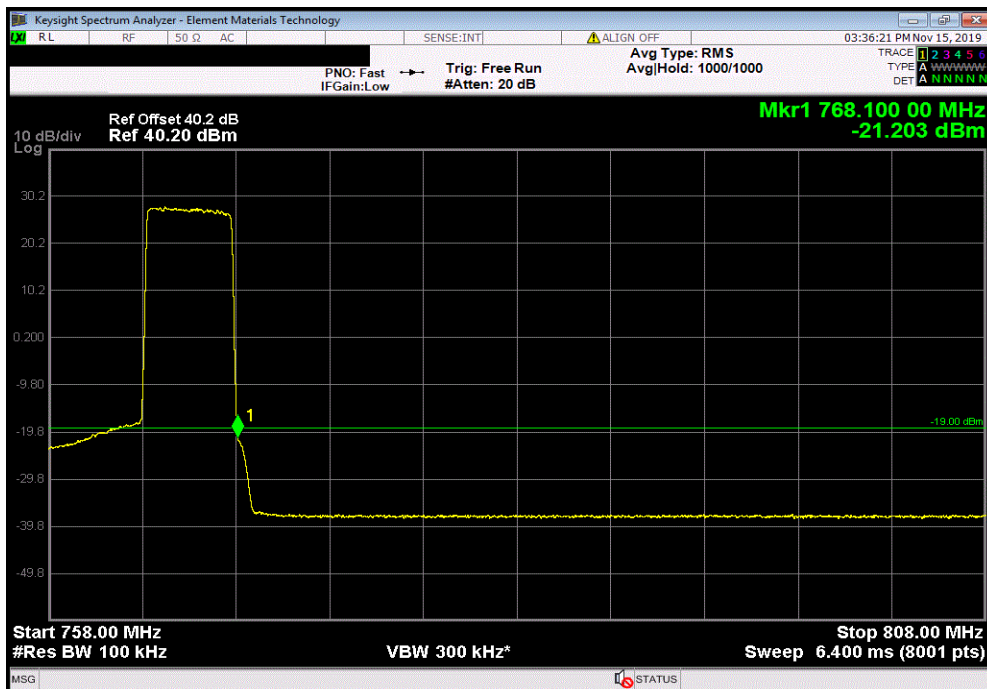


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Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-23.922	-19	Pass



Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-21.203	-19	Pass



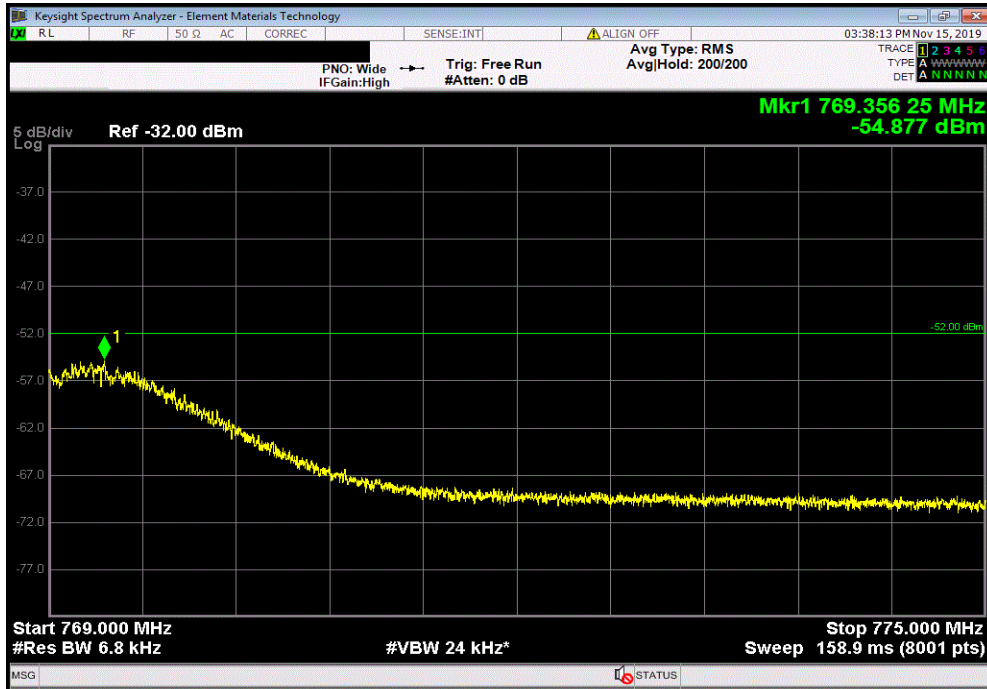


# BAND EDGE COMPLIANCE

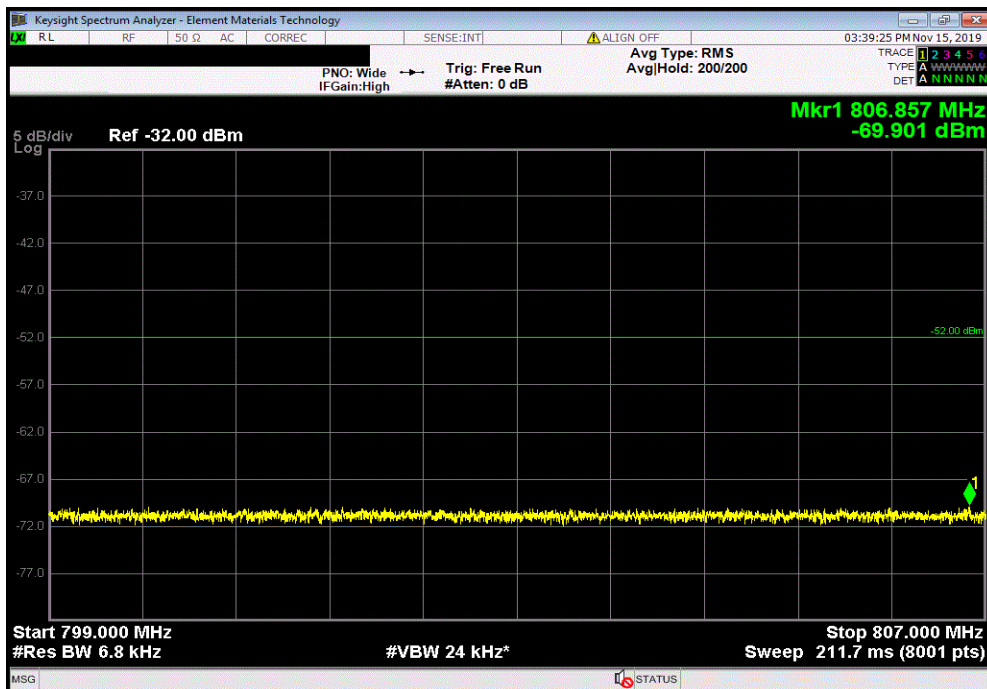


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Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.877	-52	Pass



Band 12-14, 64QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.901	-52	Pass



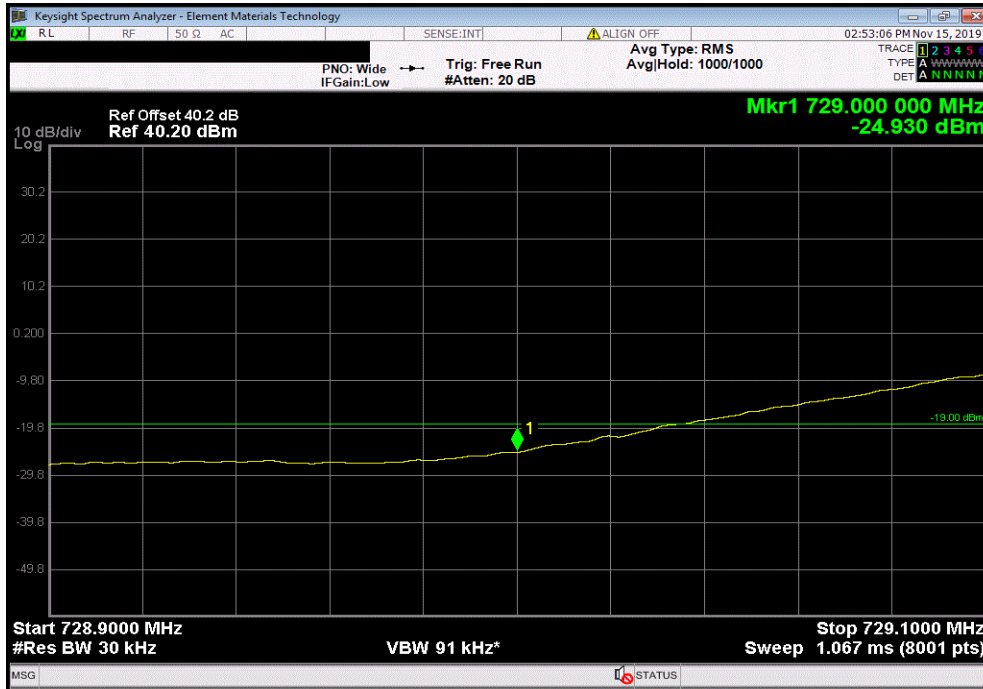
# BAND EDGE COMPLIANCE



XMI 2019.09.05

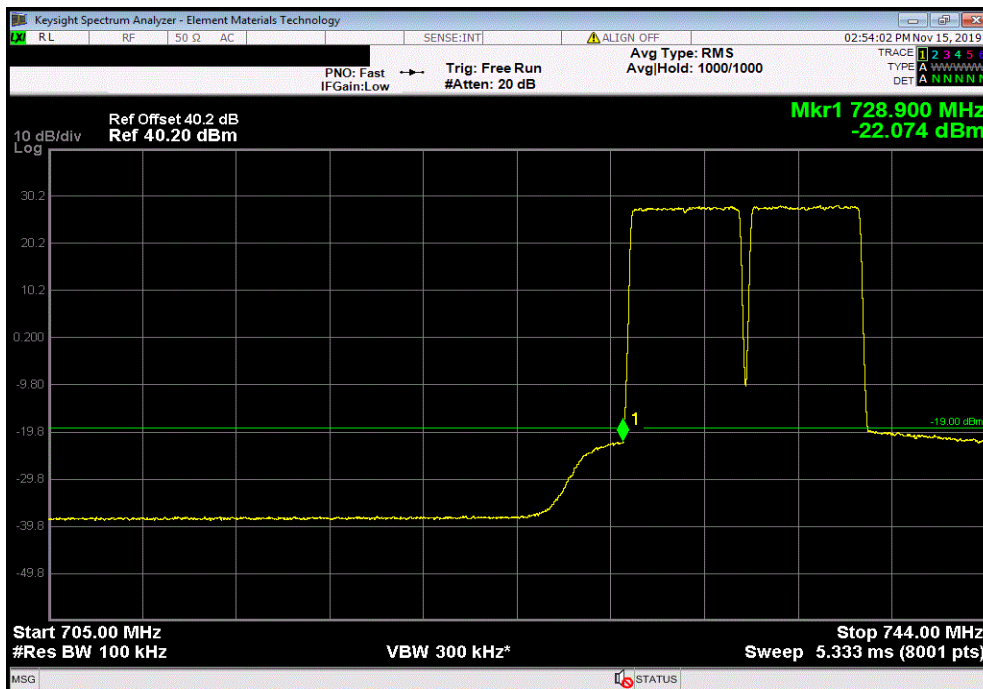
Band 12-14, 256QAM Modulation, Lower Band Edge, Measurement 1

	Value (dBm)	Limit (dBm)	Result
	-24.93	-19	Pass



Band 12-14, 256QAM Modulation, Lower Band Edge, Measurement 2

	Value (dBm)	Limit (dBm)	Result
	-22.074	-19	Pass

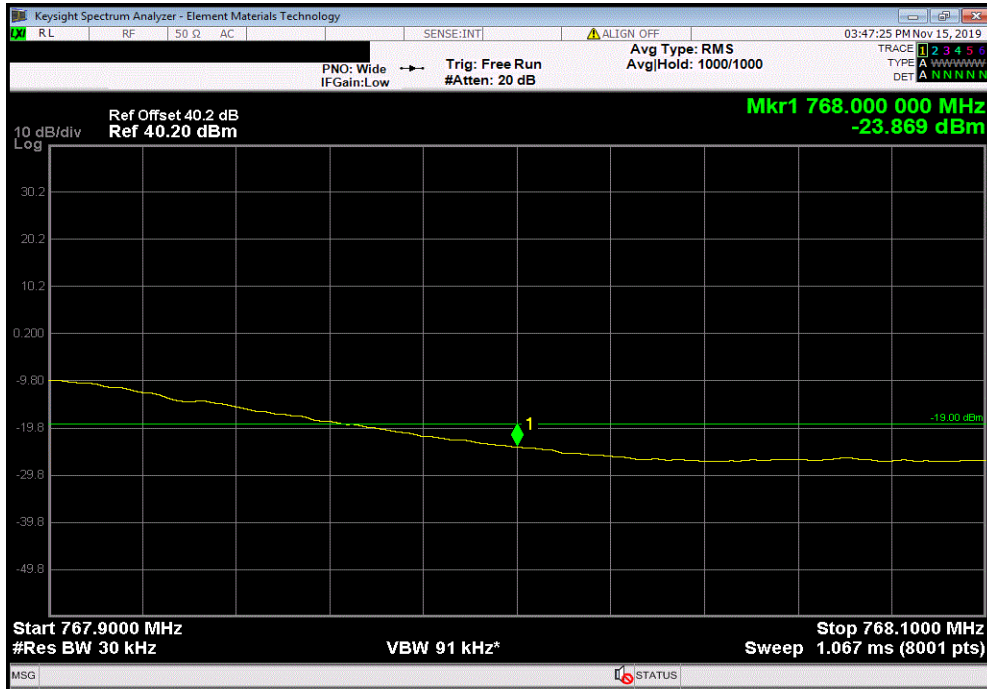


# BAND EDGE COMPLIANCE

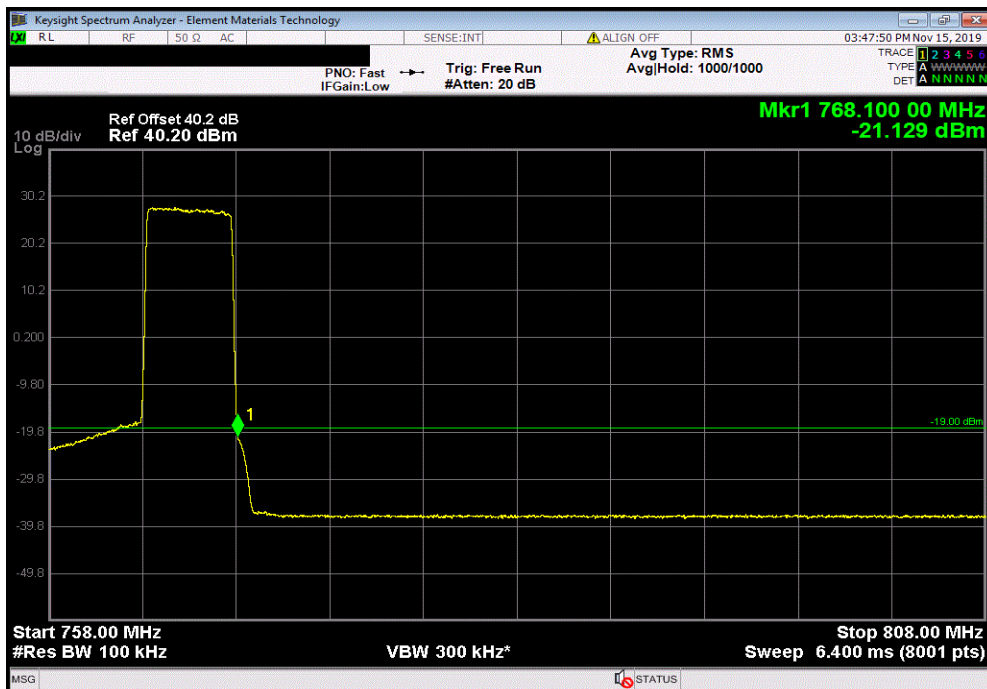


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Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 1						
				Value (dBm)	Limit (dBm)	Result
				-23.869	-19	Pass



Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 2						
				Value (dBm)	Limit (dBm)	Result
				-21.129	-19	Pass

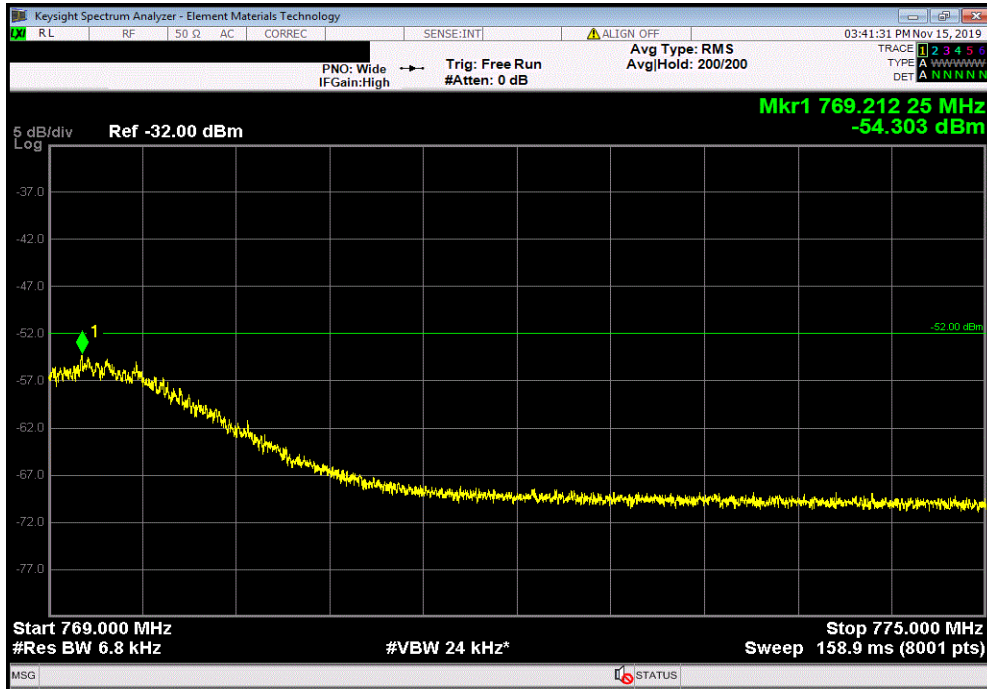


# BAND EDGE COMPLIANCE



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Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 3						
				Value (dBm)	Limit (dBm)	Result
				-54.303	-52	Pass



Band 12-14, 256QAM Modulation, Upper Band Edge, Measurement 4						
				Value (dBm)	Limit (dBm)	Result
				-69.82	-52	Pass

