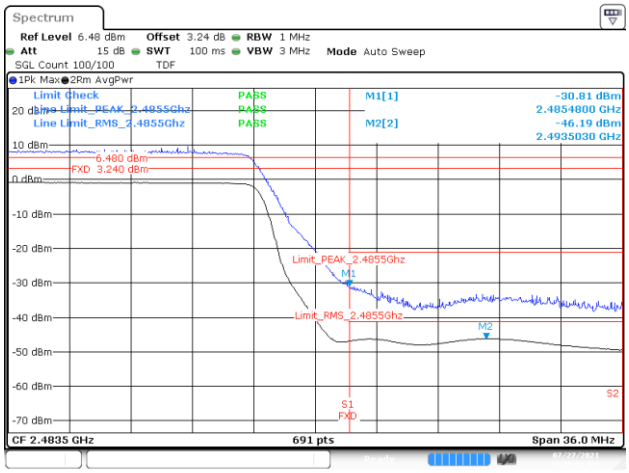
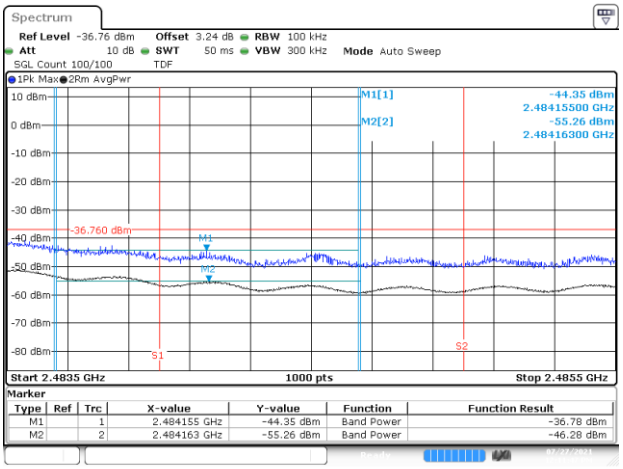
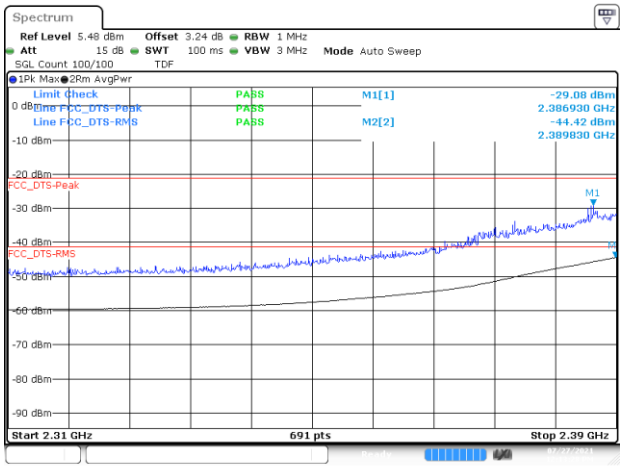


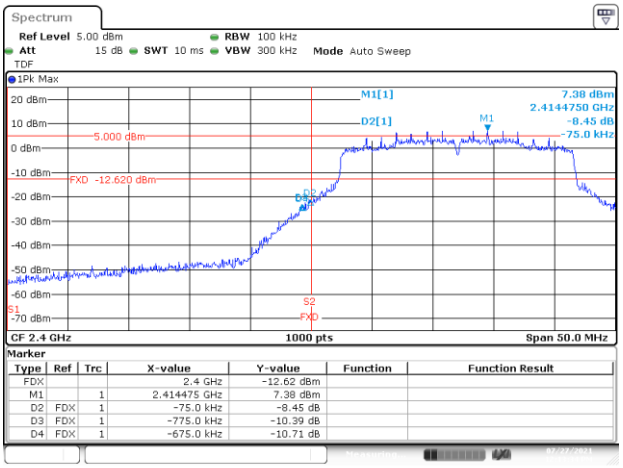
BE-R-HIGH, SISO-B, 802.11n40-HT0, Ch11



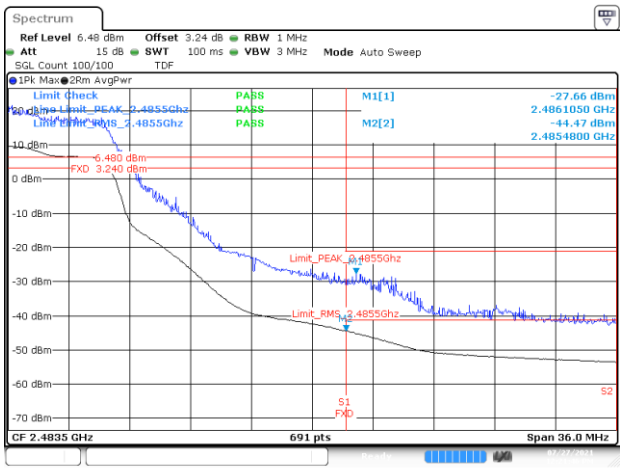
BE-R-HIGH-2MHz, SISO-B, 802.11n40-HT0, Ch11



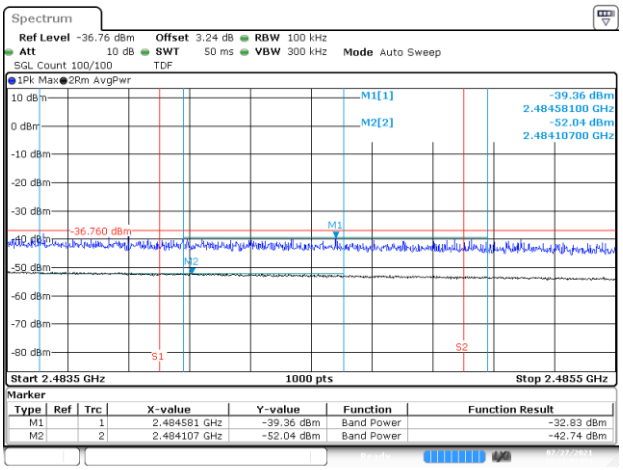
BE-R-LOW, SISO-B, 802.11ax20-HE0, Ch1



BE-NR, SISO-B, 802.11ax20-HE0, Ch1



BE-R-HIGH, SISO-B, 802.11ax20-HE0, Ch11



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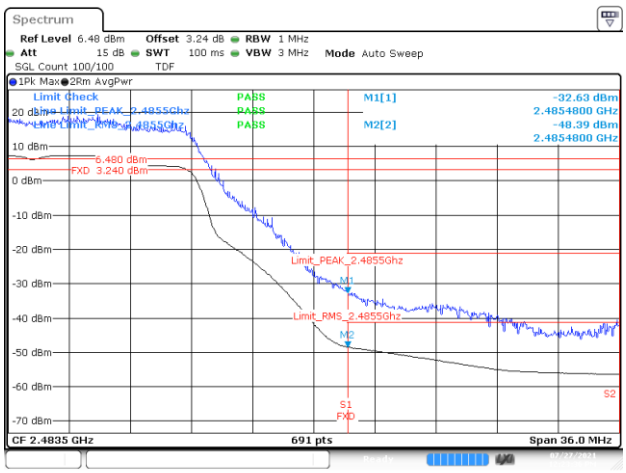
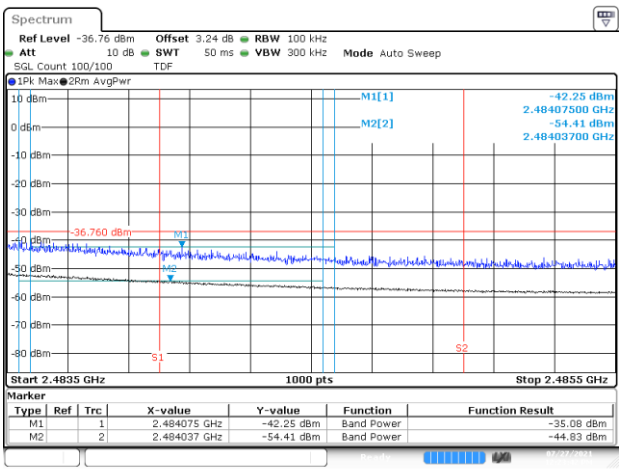
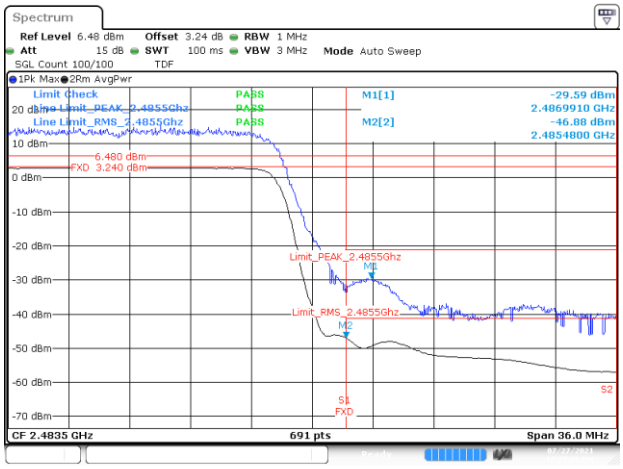


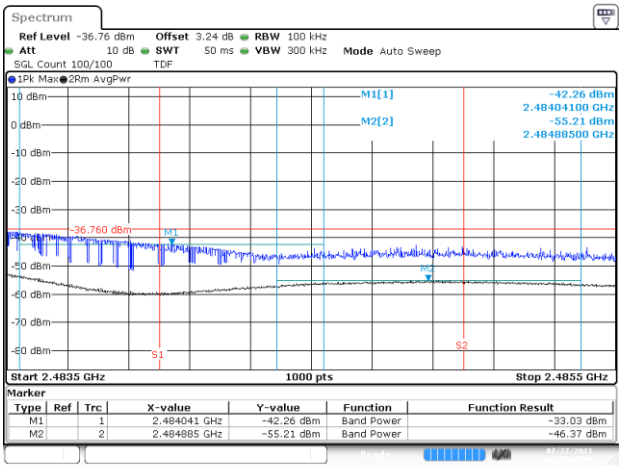
BE-R-HIGH, SISO-B, 802.11ax20-HE0, Ch12



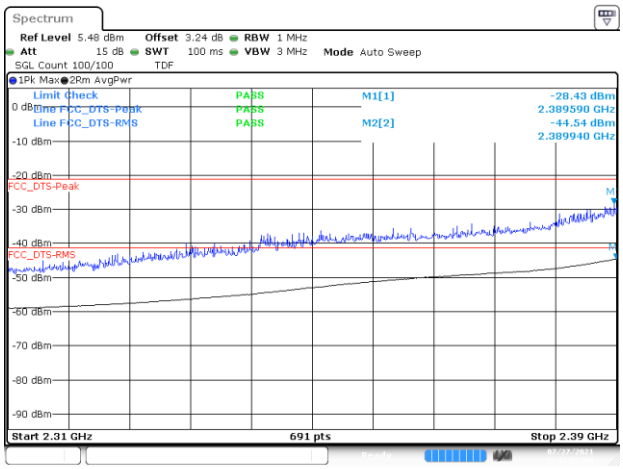
BE-R-HIGH-2MHz, SISO-B, 802.11ax20-HE0, Ch12



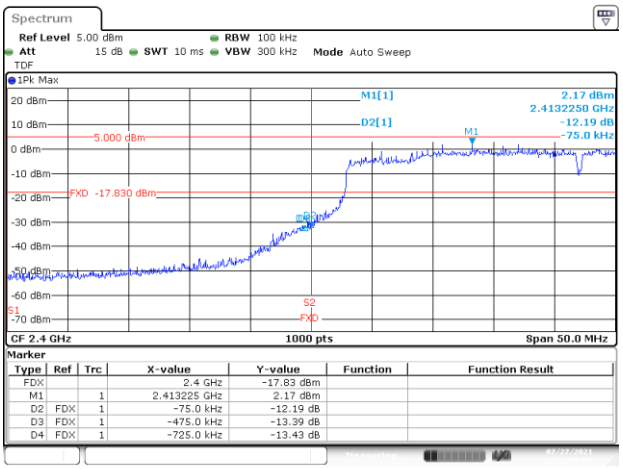
BE-R-HIGH, SISO-B, 802.11ax20-HE0, Ch13



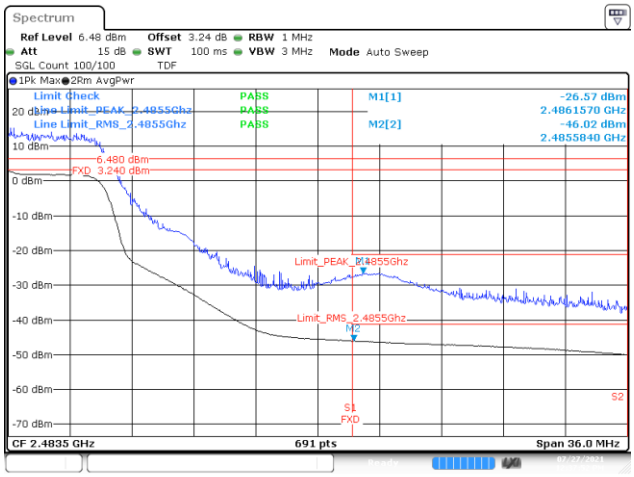
BE-R-HIGH-2MHz, SISO-B, 802.11ax20-HE0, Ch13



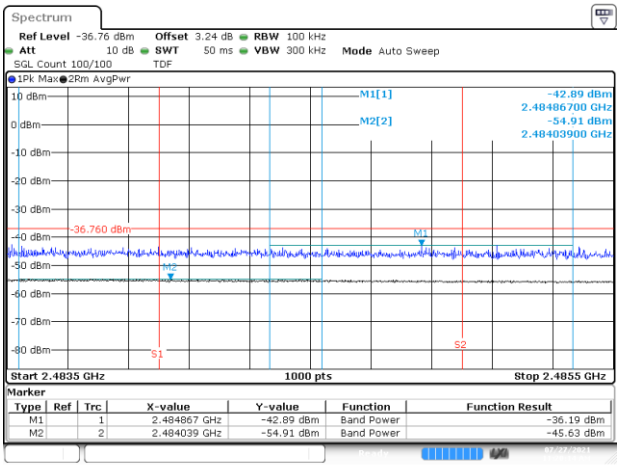
BE-R-LOW, SISO-B, 802.11ax40-HE0, Ch3



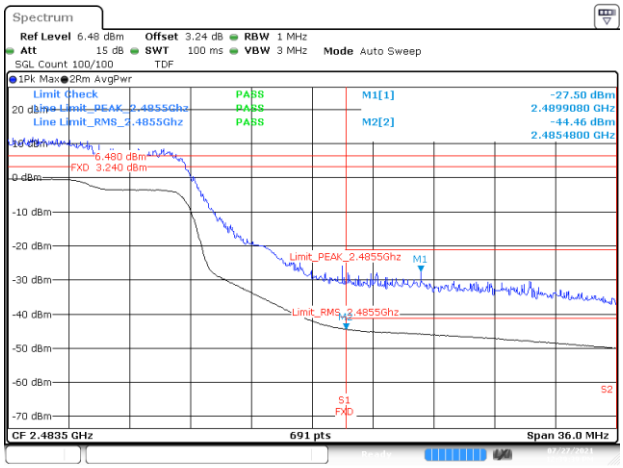
BE-NR, SISO-B, 802.11ax40-HE0, Ch3



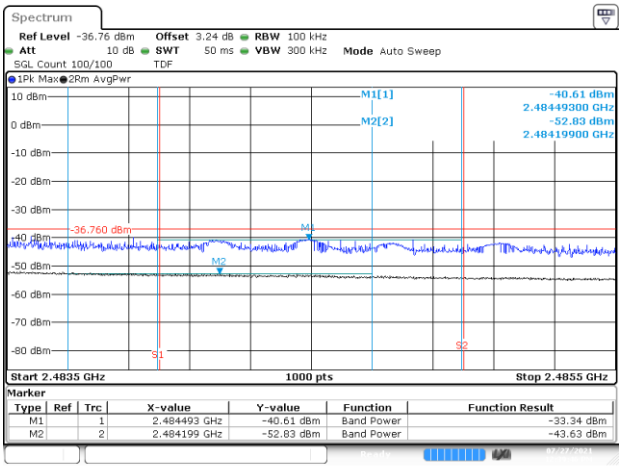
BE-R-HIGH, SISO-B, 802.11ax40-HE0, Ch9



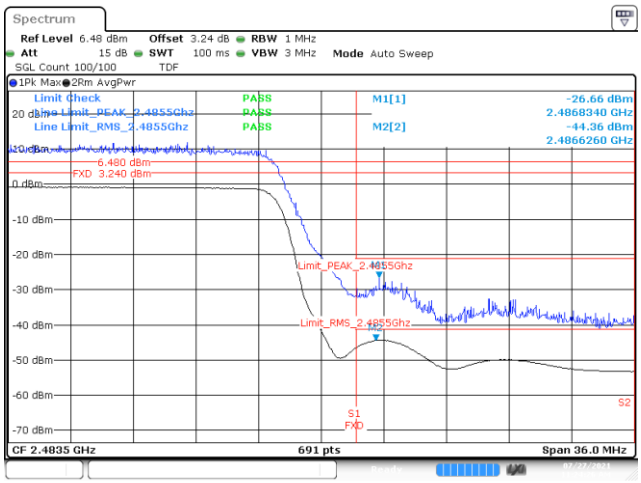
BE-R-HIGH-2MHz, SISO-B, 802.11ax40-HE0, Ch9



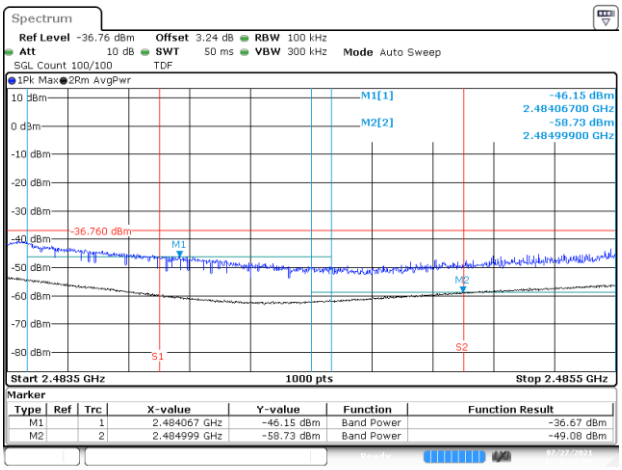
BE-R-HIGH, SISO-B, 802.11ax40-HE0, Ch10



BE-R-HIGH-2MHz, SISO-B, 802.11ax40-HE0, Ch10

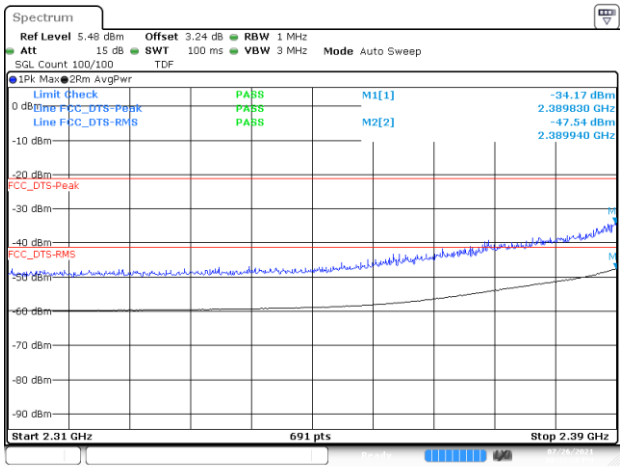


BE-R-HIGH, SISO-B, 802.11ax40-HE0, Ch11

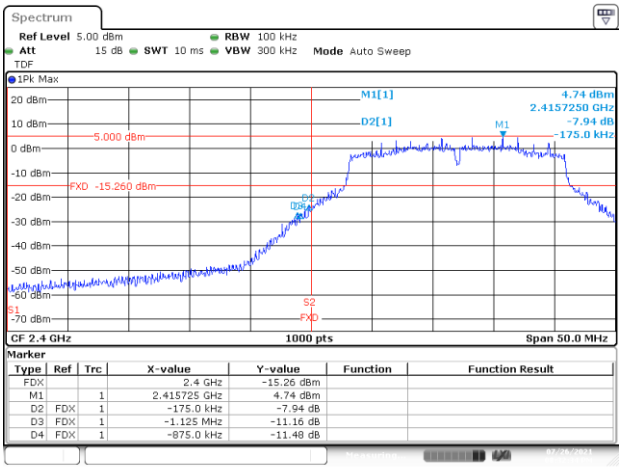


BE-R-HIGH-2MHz, SISO-B, 802.11ax40-HE0, Ch11

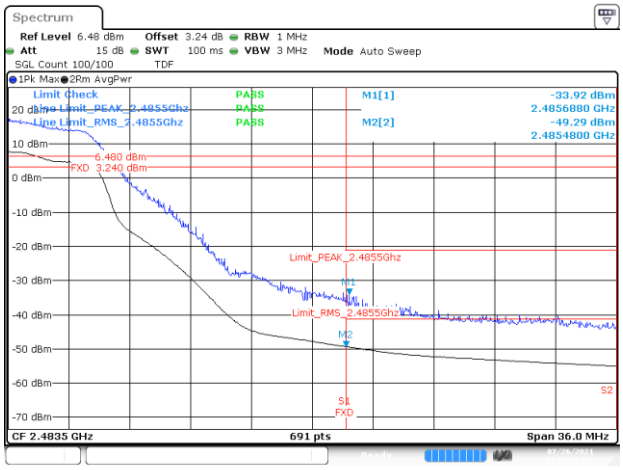
MIMO-A



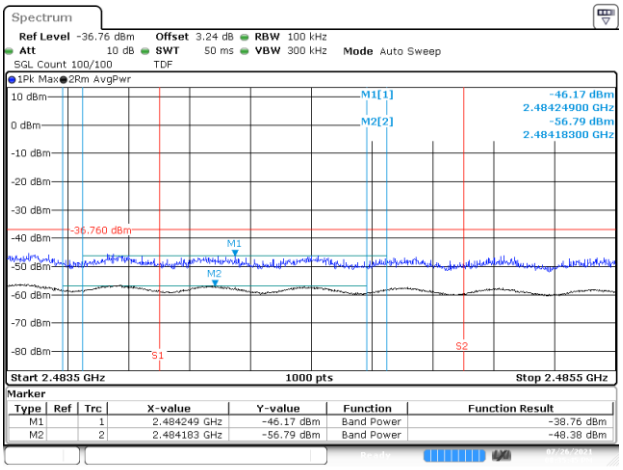
BE-R-LOW, MIMO-A, 802.11n20-HT8, Ch1



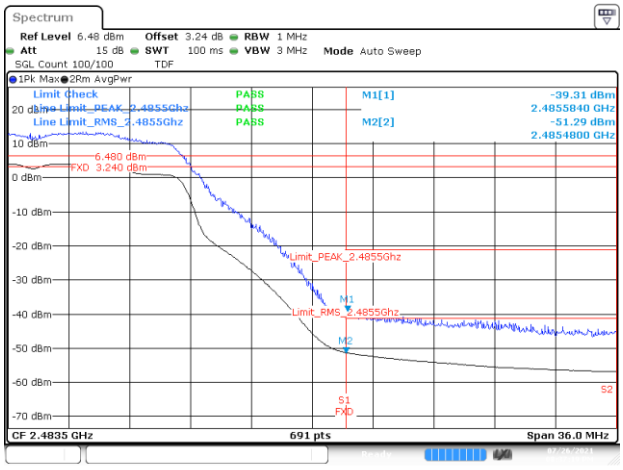
BE-NR, MIMO-A, 802.11n20-HT8 Ch1



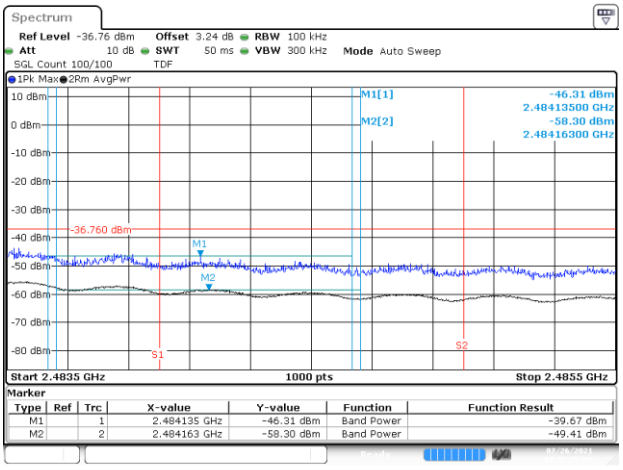
BE-R-HIGH, MIMO-A, 802.11n20-HT8, Ch11



BE-R-HIGH-2MHz, MIMO-A, 802.11n20-HT8, Ch11



BE-R-HIGH, MIMO-A, 802.11n20-HT8, Ch12



BE-R-HIGH-2MHz, MIMO-A, 802.11n20-HT8, Ch12

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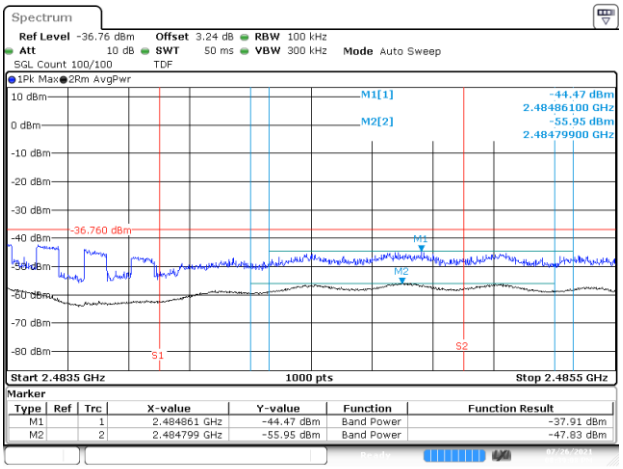
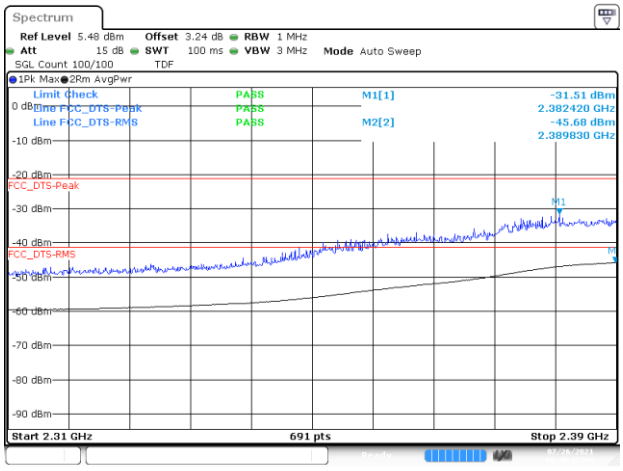
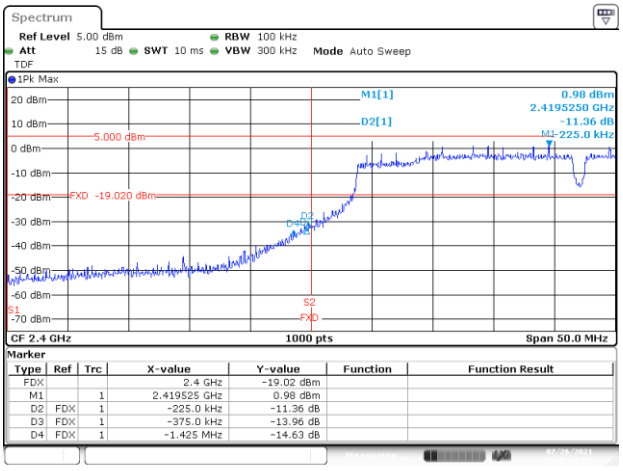
BE-R-HIGH, MIMO-A, 802.11n20-HT8, Ch13



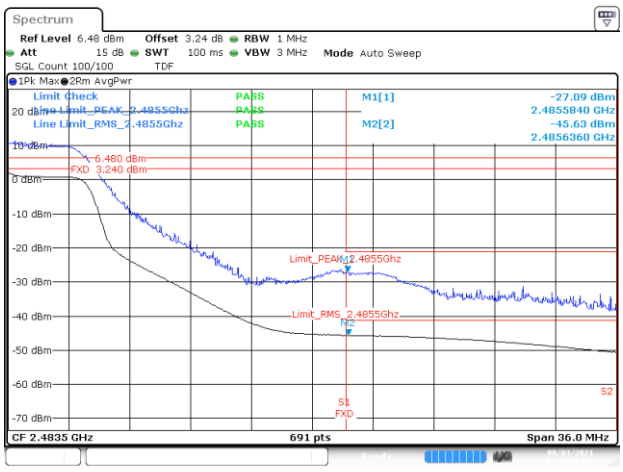
BE-R-HIGH-2MHz, MIMO-A, 802.11n20-HT8, Ch13



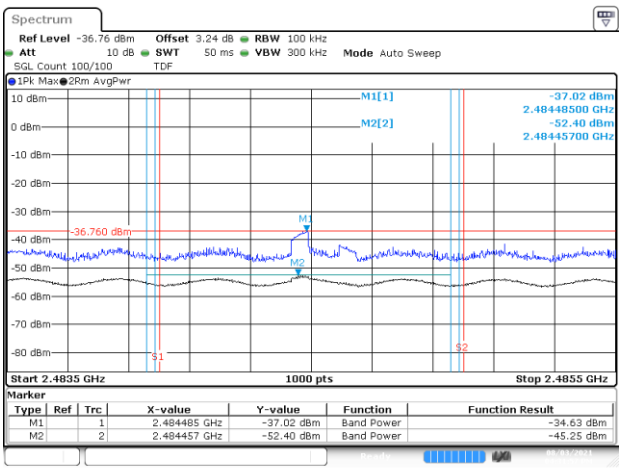
BE-R-LOW, MIMO-A, 802.11n40-HT8, Ch3



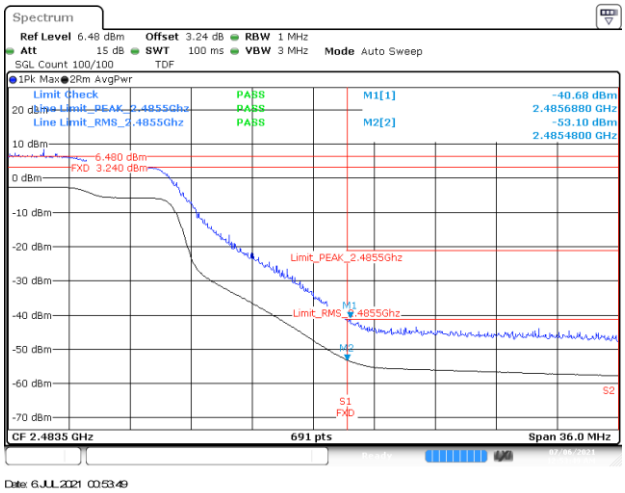
BE-NR, MIMO-A, 802.11n40-HT8, Ch3



BE-R-HIGH, MIMO-A, 802.11n40-HT8, Ch9



BE-R-HIGH-2MHz, MIMO-A, 802.11n40-HT8, Ch9



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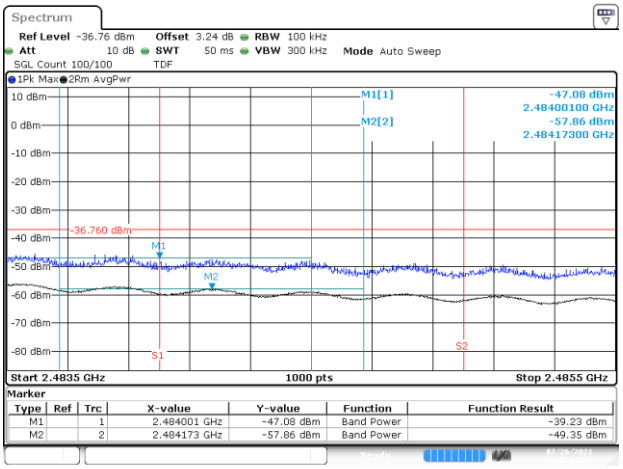
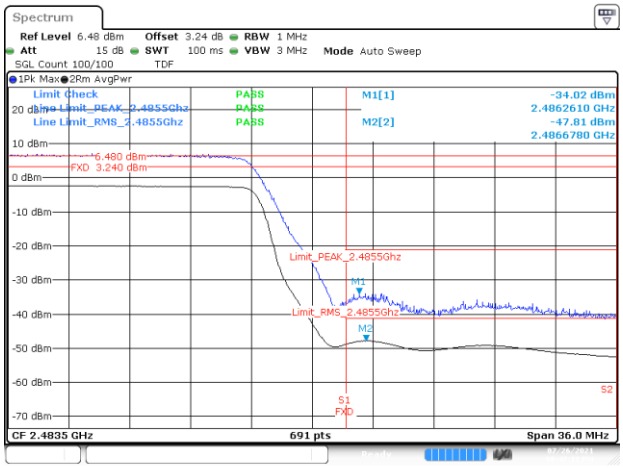
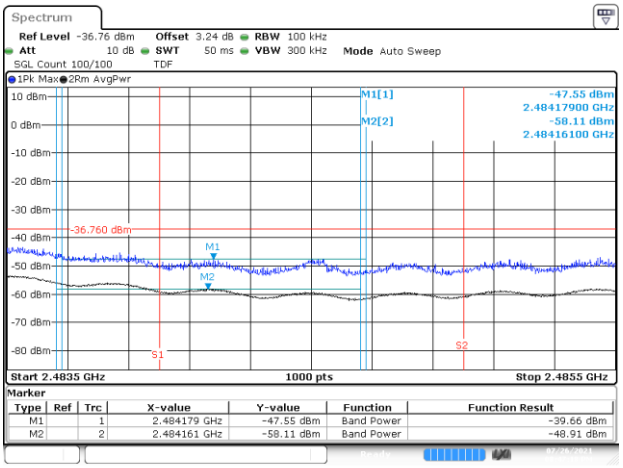
BE-R-HIGH, MIMO-A, 802.11n40-HT8, Ch10



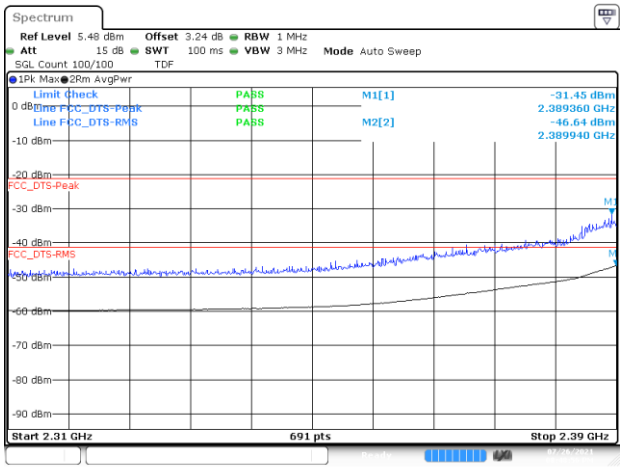
BE-R-HIGH-2MHz, MIMO-A, 802.11n40-HT8, Ch10



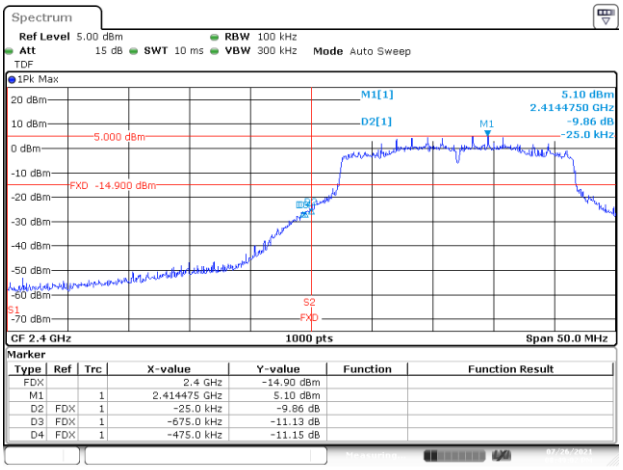
BE-R-HIGH, MIMO-A, 802.11n40-HT8, Ch11



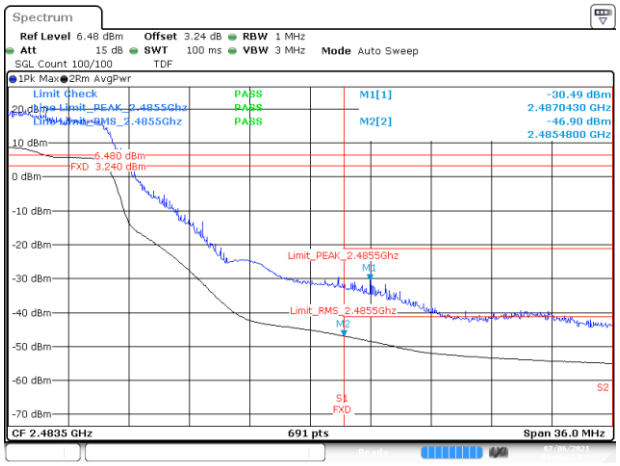
BE-R-HIGH-2MHz, MIMO-A, 802.11n40-HT8, Ch11



BE-R-LOW, MIMO-A, 802.11ax20-HE0, Ch1



BE-NR, MIMO-A, 802.11ax20-HE0, Ch1



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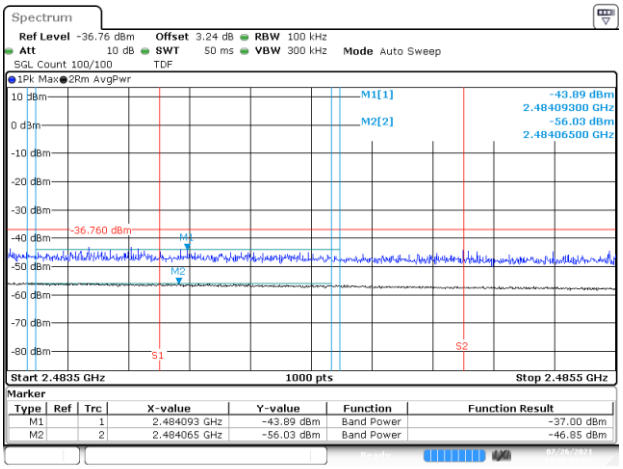
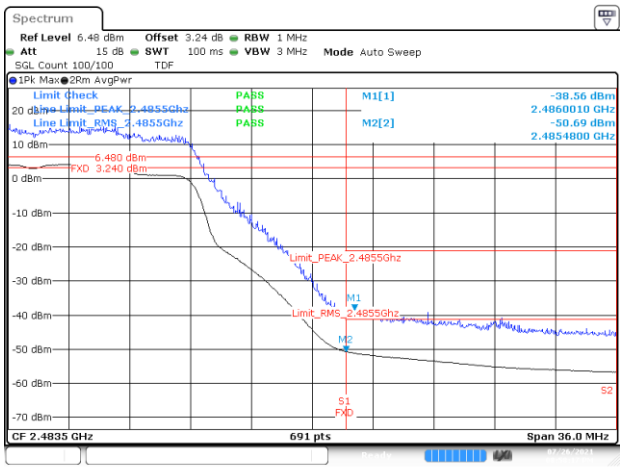
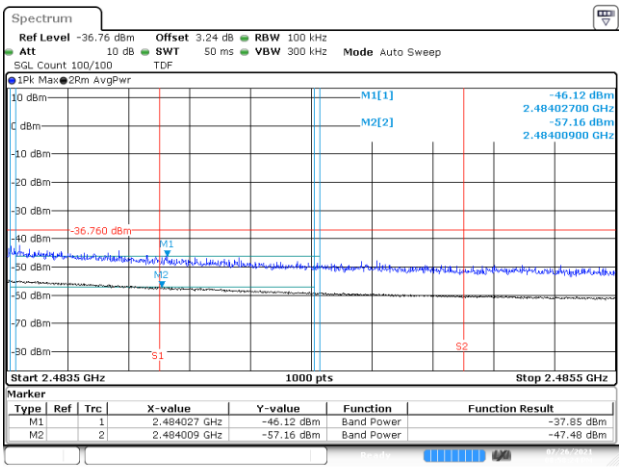
BE-R-HIGH, MIMO-A, 802.11ax20-HE0, Ch11



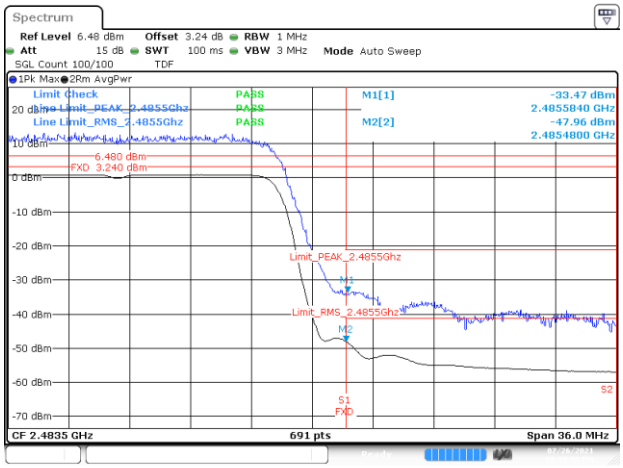
BE-R-HIGH-2MHz, MIMO-A, 802.11ax20-HE0, Ch11



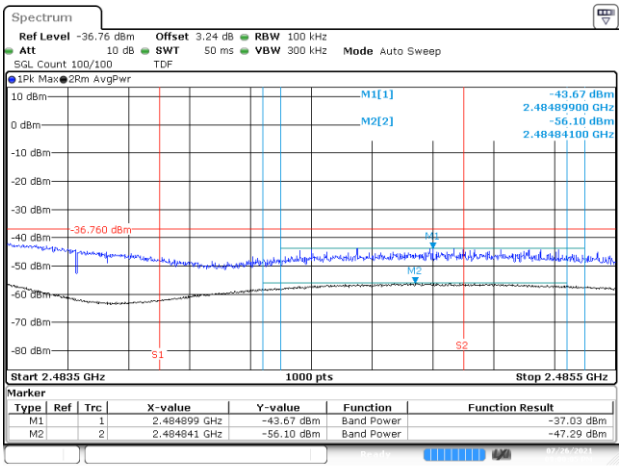
BE-R-HIGH, MIMO-A, 802.11ax20-HE0, Ch12



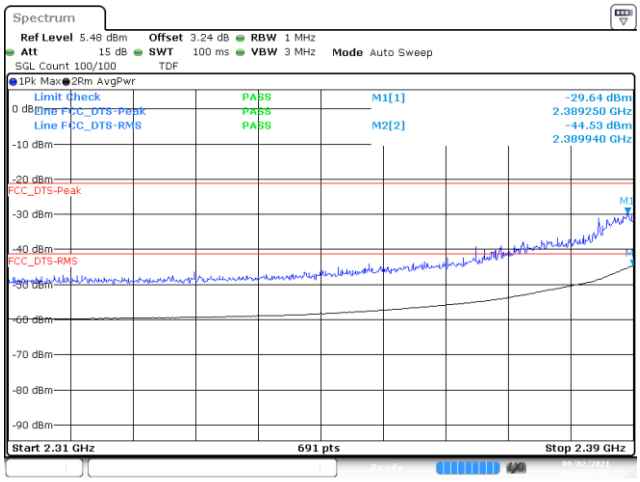
BE-R-HIGH-2MHz, MIMO-A, 802.11ax20-HE0, Ch12



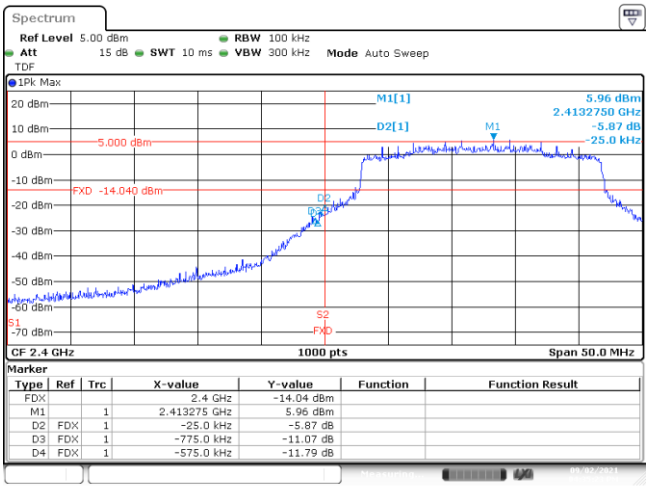
BE-R-HIGH, MIMO-A, 802.11ax20-HE0, Ch13



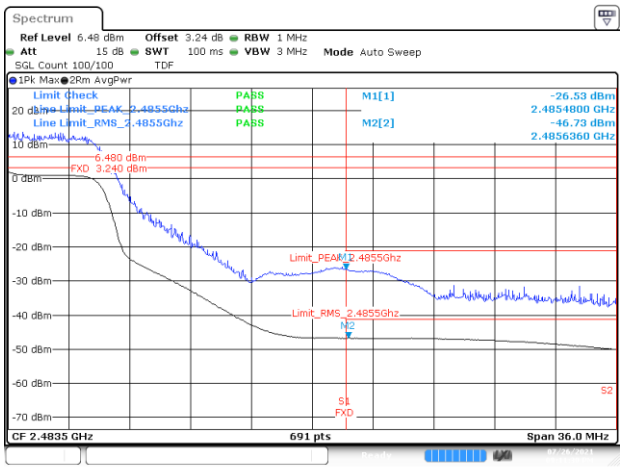
BE-R-HIGH-2MHz, MIMO-A, 802.11ax20-HE0, Ch13



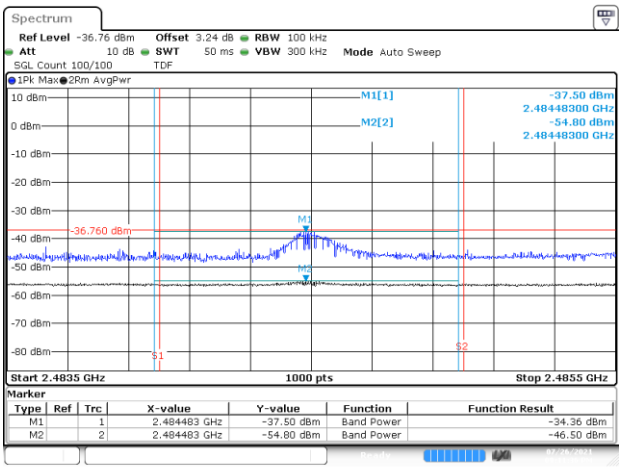
BE-R-LOW, MIMO-A, 802.11ax40-HE0, Ch3



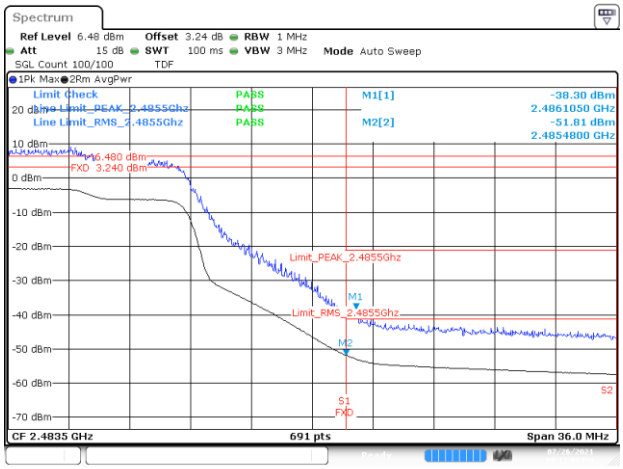
BE-NR, MIMO-A, 802.11ax40-HE0, Ch3



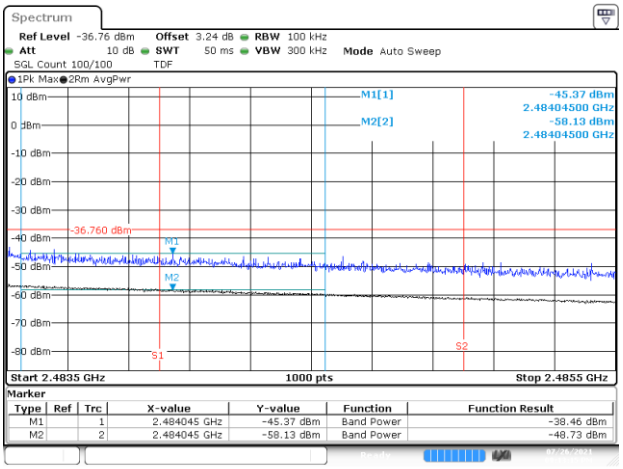
BE-R-HIGH, MIMO-A, 802.11ax40-HE0, Ch9



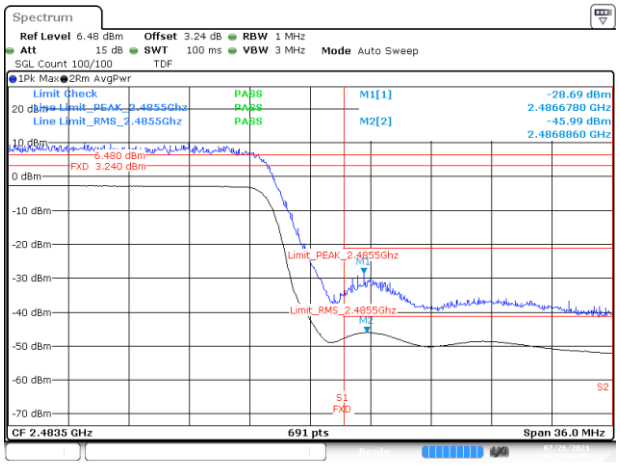
BE-R-HIGH-2MHz, MIMO-A, 802.11ax40-HE0, Ch9



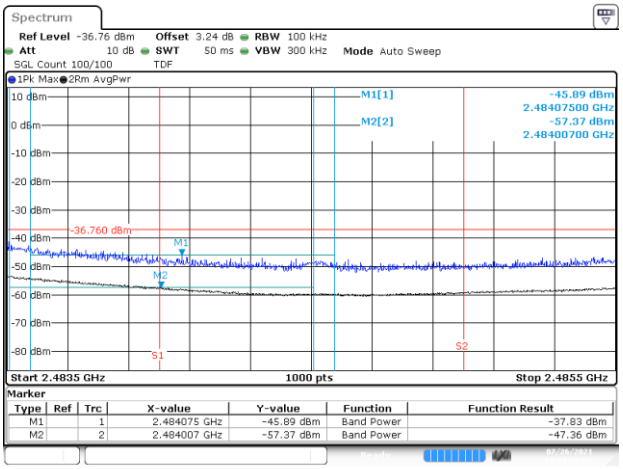
BE-R-HIGH, MIMO-A, 802.11ax40-HE0, Ch10



BE-R-HIGH-2MHz, MIMO-A, 802.11ax40-HE0, Ch10

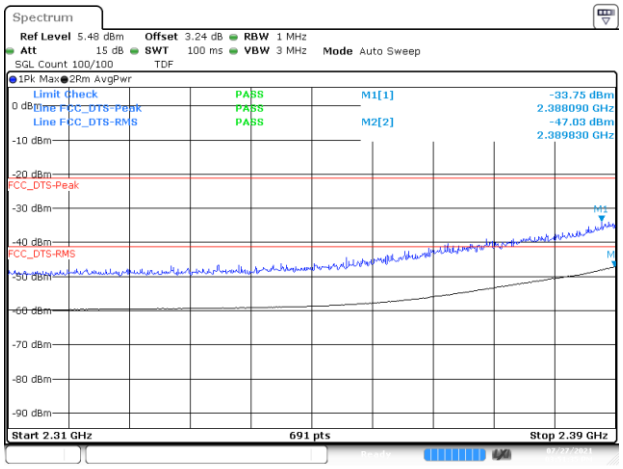


BE-R-HIGH, MIMO-A, 802.11ax40-HE0, Ch11

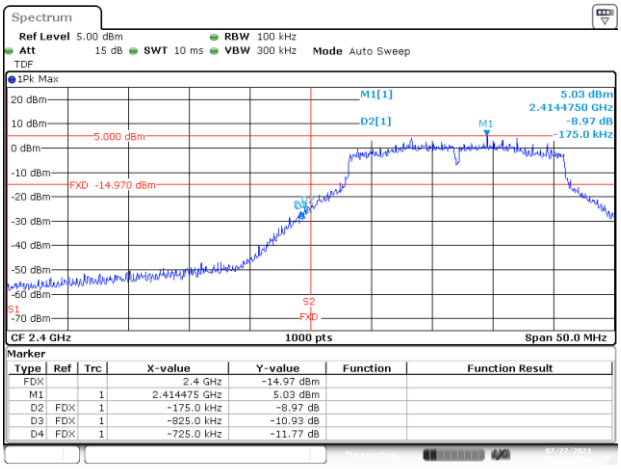


BE-R-HIGH-2MHz, MIMO-A, 802.11ax40-HE0, Ch11

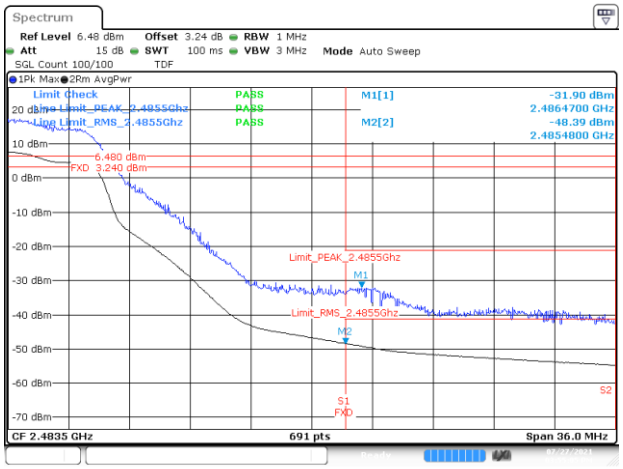
MIMO-B



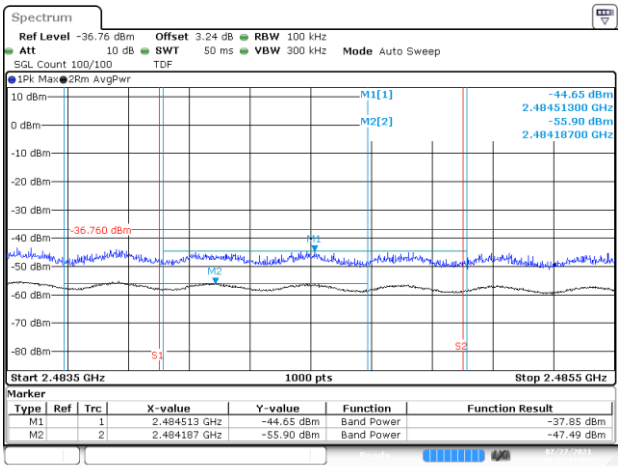
BE-R-LOW, MIMO-B, 802.11n20-HT8, Ch1



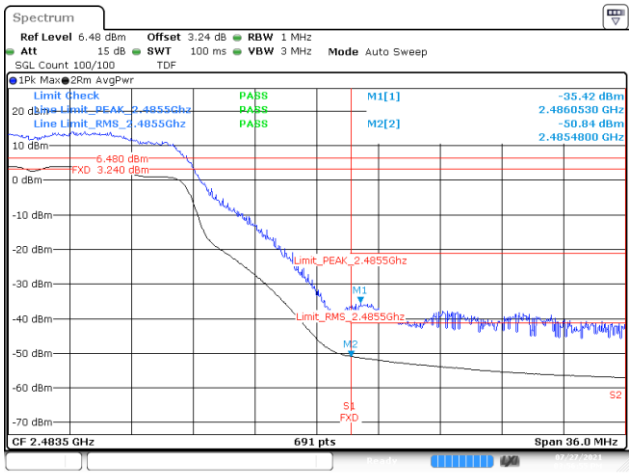
BE-NR, MIMO-B, 802.11n20-HT8 Ch1



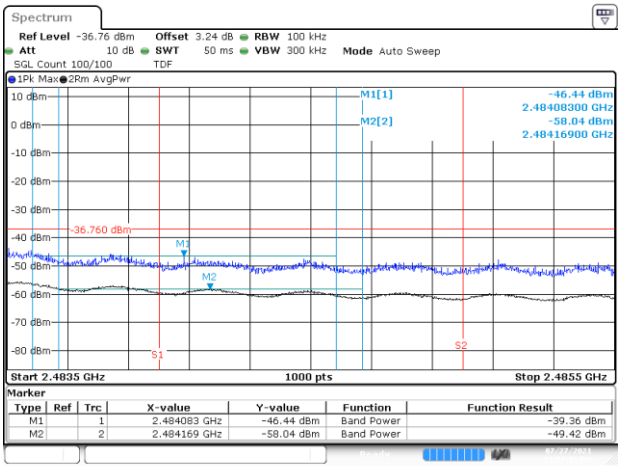
BE-R-HIGH, MIMO-B, 802.11n20-HT8, Ch11



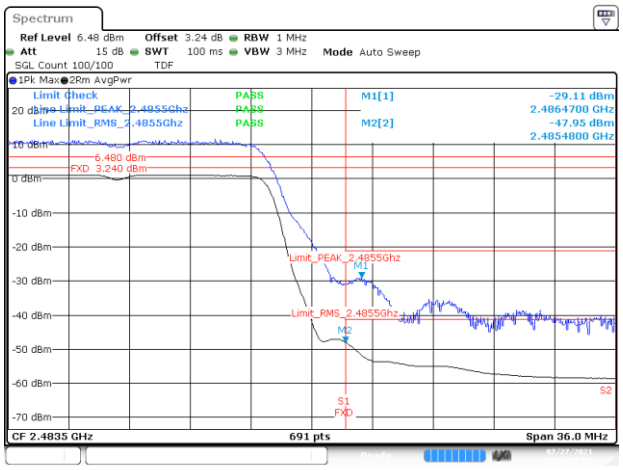
BE-R-HIGH-2MHz, MIMO-B, 802.11n20-HT8, Ch11



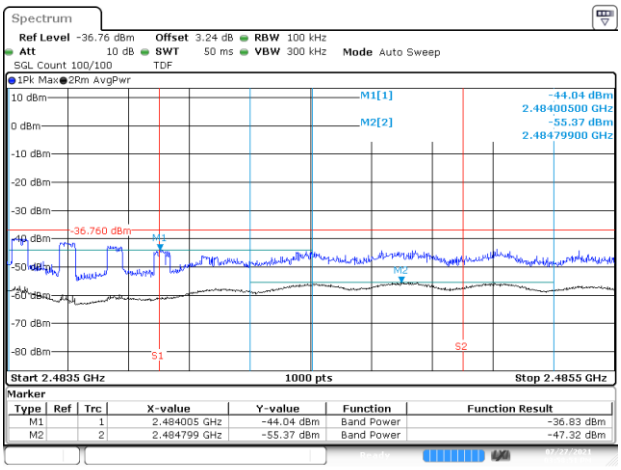
BE-R-HIGH, MIMO-B, 802.11n20-HT8, Ch12



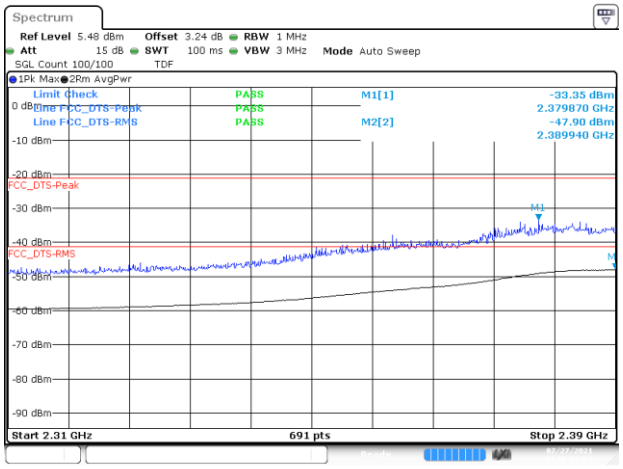
BE-R-HIGH-2MHz, MIMO-B, 802.11n20-HT8, Ch12



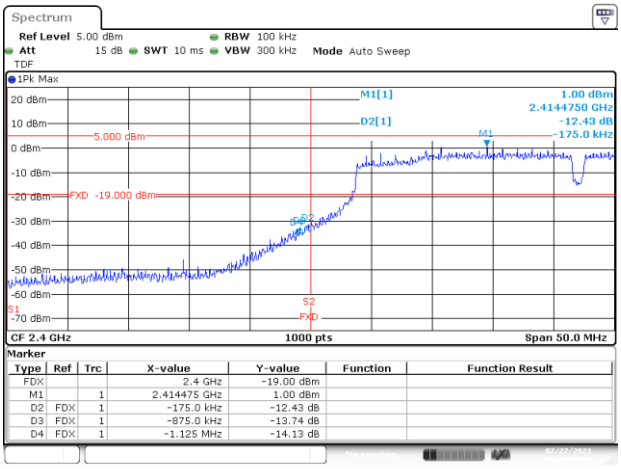
BE-R-HIGH, MIMO-B, 802.11n20-HT8, Ch13



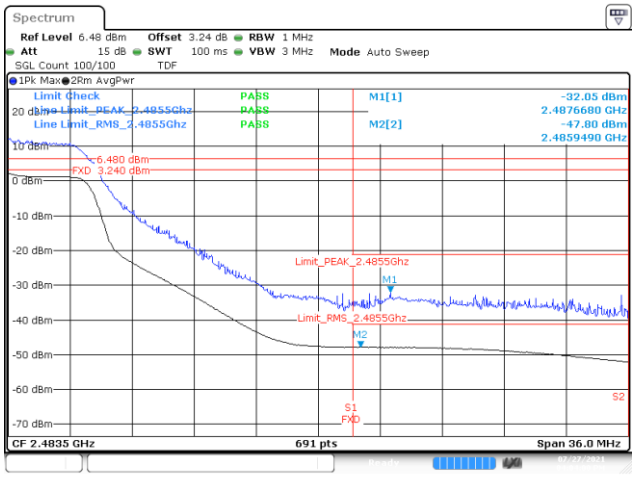
BE-R-HIGH-2MHz, MIMO-B, 802.11n20-HT8, Ch13



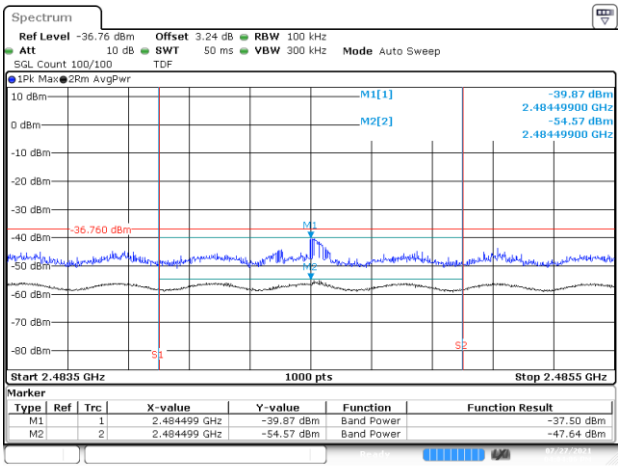
BE-R-LOW, MIMO-B, 802.11n40-HT8, Ch3



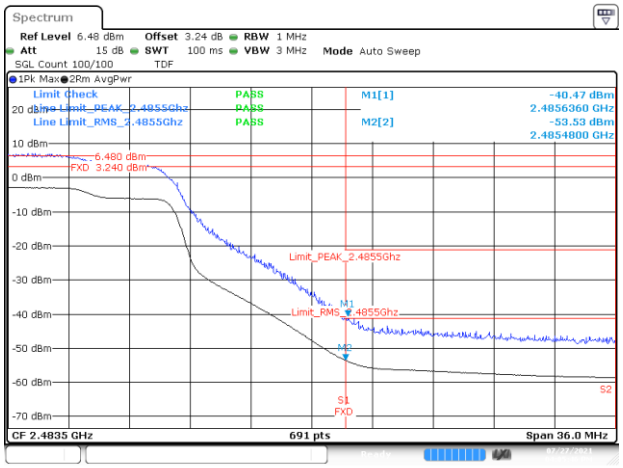
BE-NR, MIMO-B, 802.11n40-HT8, Ch3



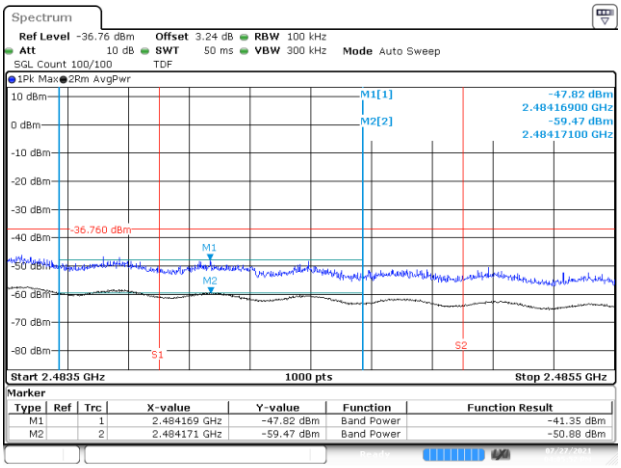
BE-R-HIGH, MIMO-B, 802.11n40-HT8, Ch9



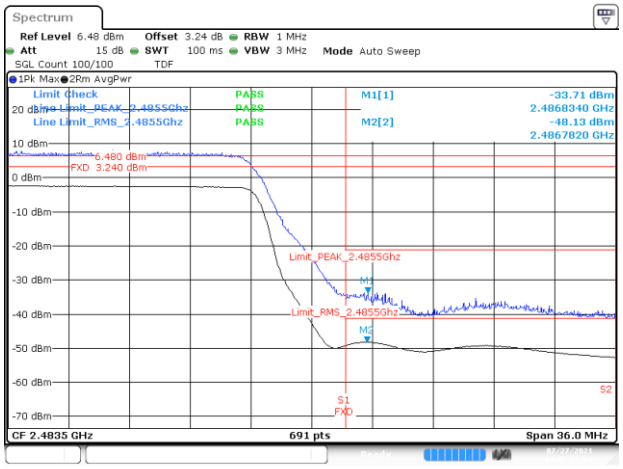
BE-R-HIGH-2MHz, MIMO-B, 802.11n40-HT8, Ch9



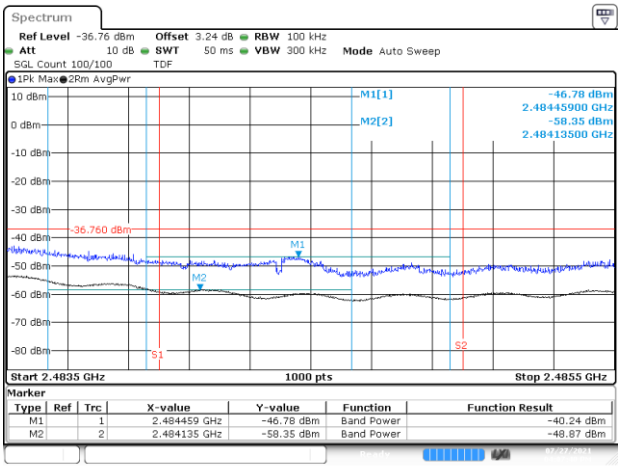
BE-R-HIGH, MIMO-B, 802.11n40-HT8, Ch10



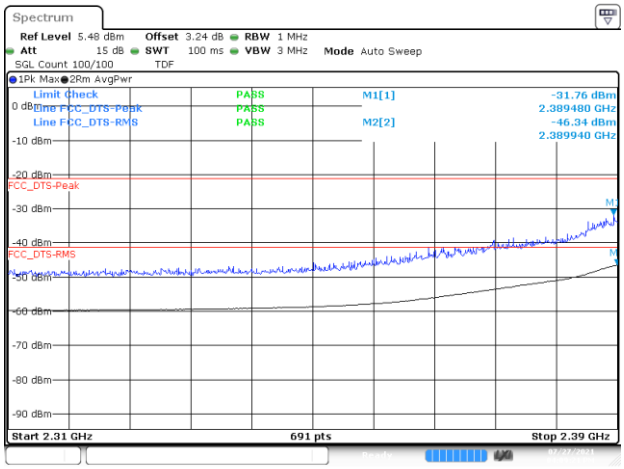
BE-R-HIGH-2MHz, MIMO-B, 802.11n40-HT8, Ch10



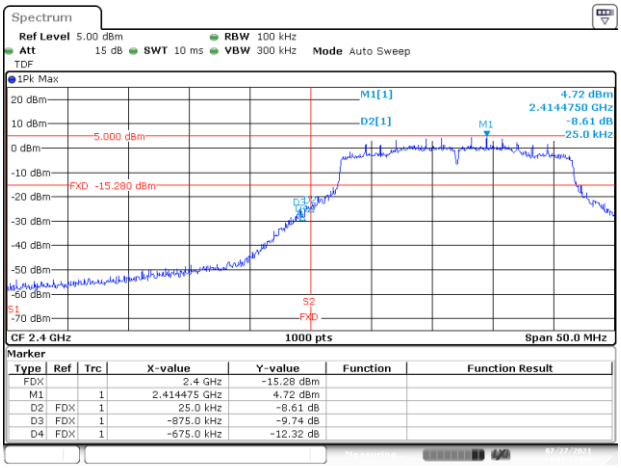
BE-R-HIGH, MIMO-B, 802.11n40-HT8, Ch11



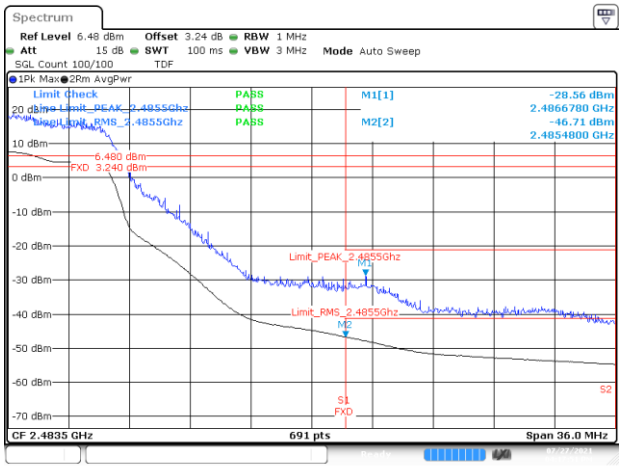
BE-R-HIGH-2MHz, MIMO-B, 802.11n40-HT8, Ch11



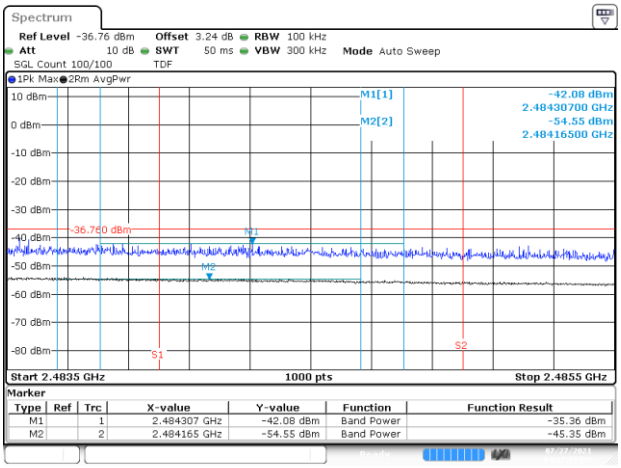
BE-R-LOW, MIMO-B, 802.11ax20-HE0, Ch1



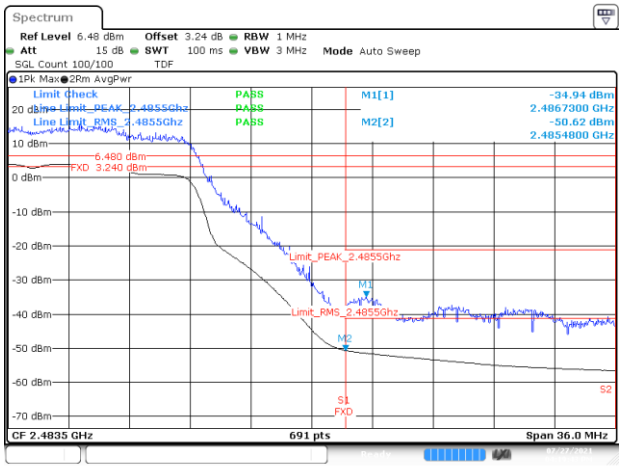
BE-NR, MIMO-B, 802.11ax20-HE0, Ch1



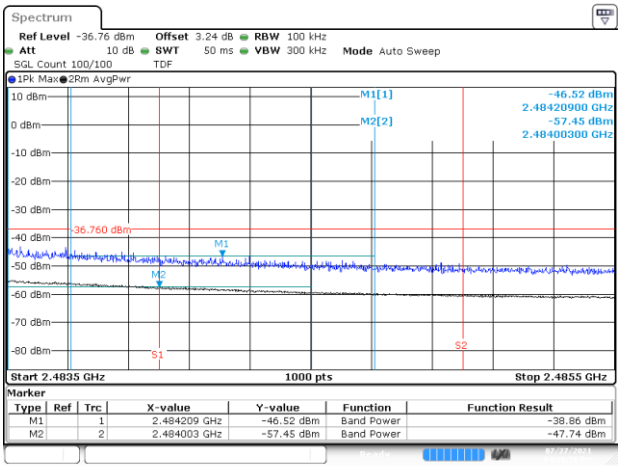
BE-R-HIGH, MIMO-B, 802.11ax20-HE0, Ch11



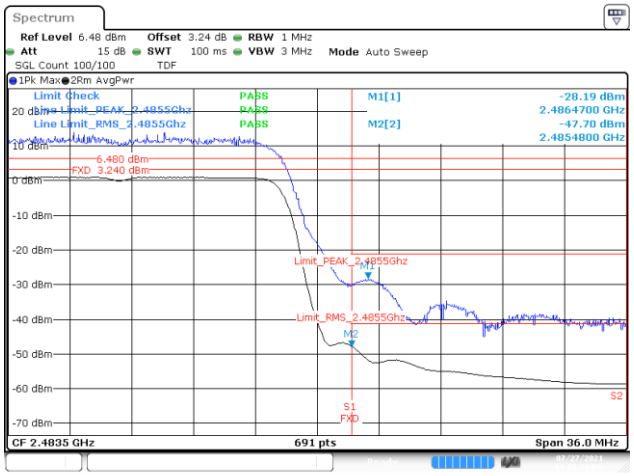
BE-R-HIGH-2MHz, MIMO-B, 802.11ax20-HE0, Ch11



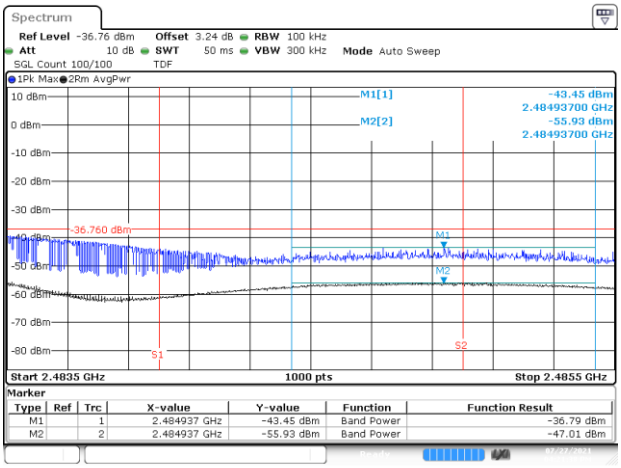
BE-R-HIGH, MIMO-B, 802.11ax20-HE0, Ch12



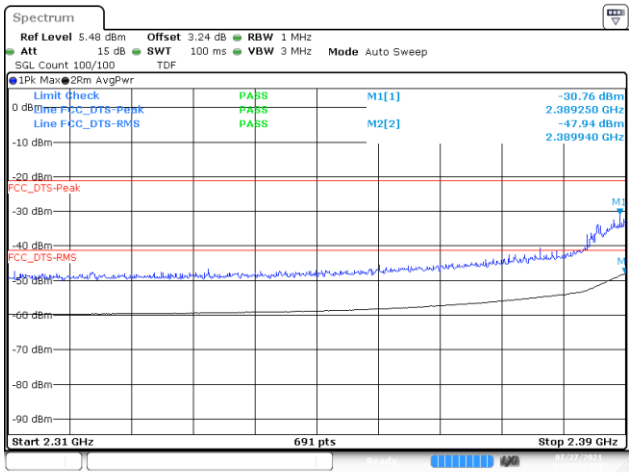
BE-R-HIGH-2MHz, MIMO-B, 802.11ax20-HE0, Ch12



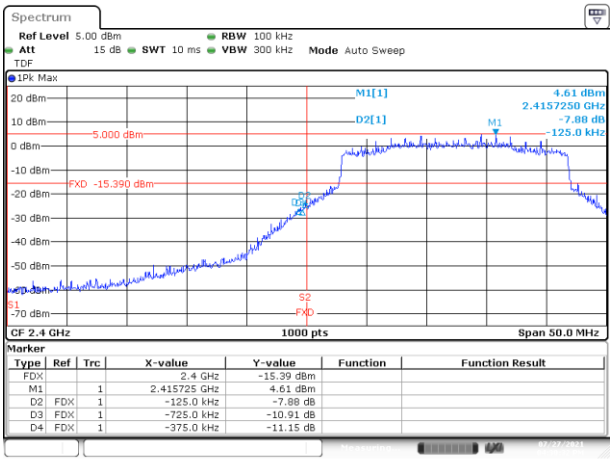
BE-R-HIGH, MIMO-B, 802.11ax20-HE0, Ch13



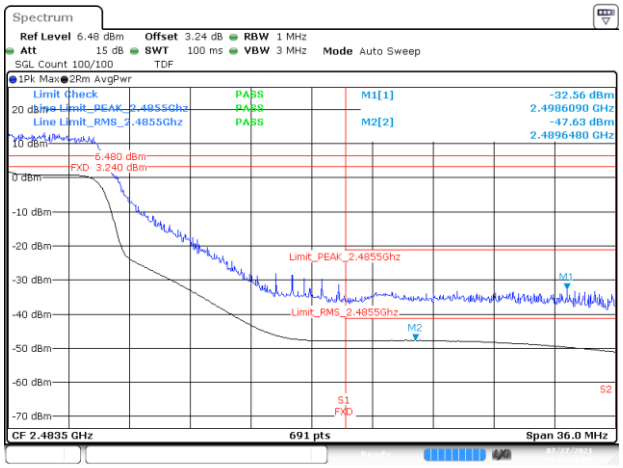
BE-R-HIGH-2MHz, MIMO-B, 802.11ax20-HE0, Ch13



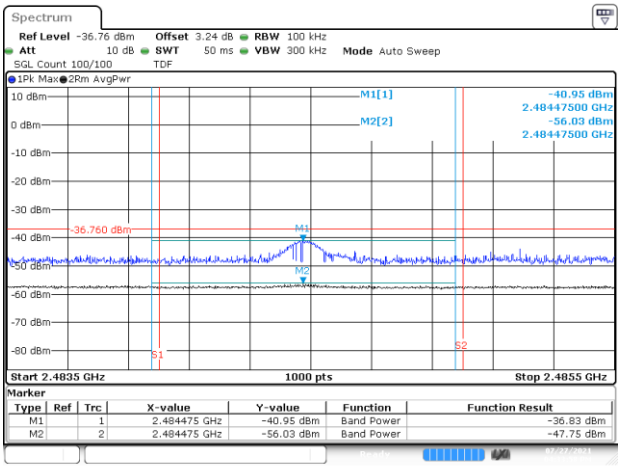
BE-R-LOW, MIMO-B, 802.11ax40-HE0, Ch3



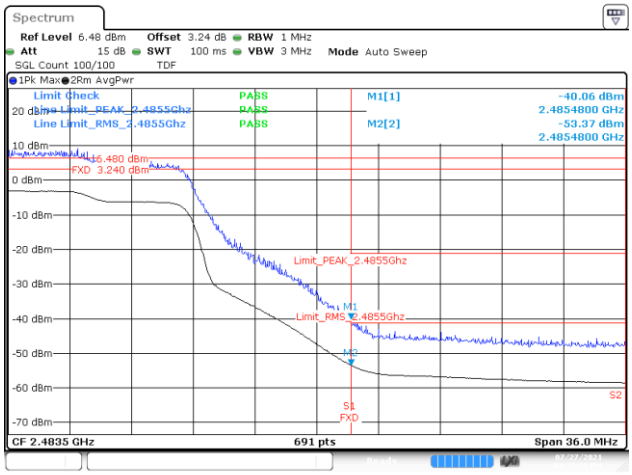
BE-NR, MIMO-B, 802.11ax40-HE0, Ch3



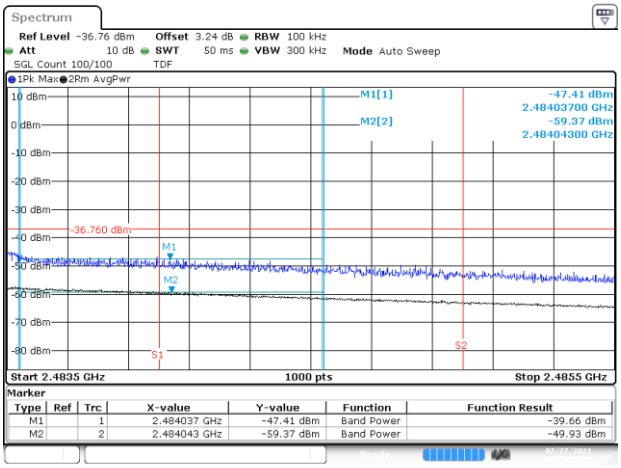
BE-R-HIGH, MIMO-B, 802.11ax40-HE0, Ch9



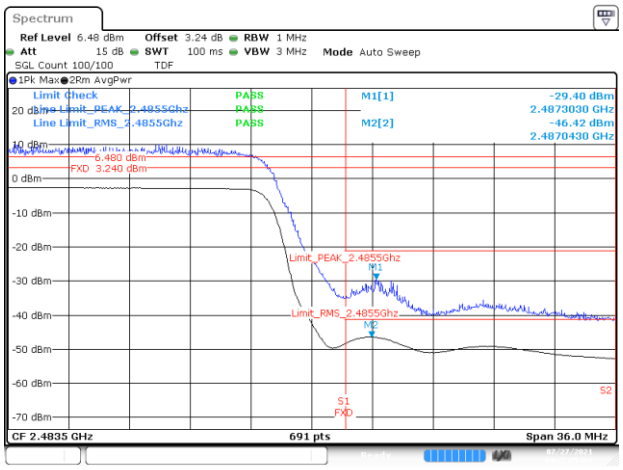
BE-R-HIGH-2MHz, MIMO-B, 802.11ax40-HE0, Ch9



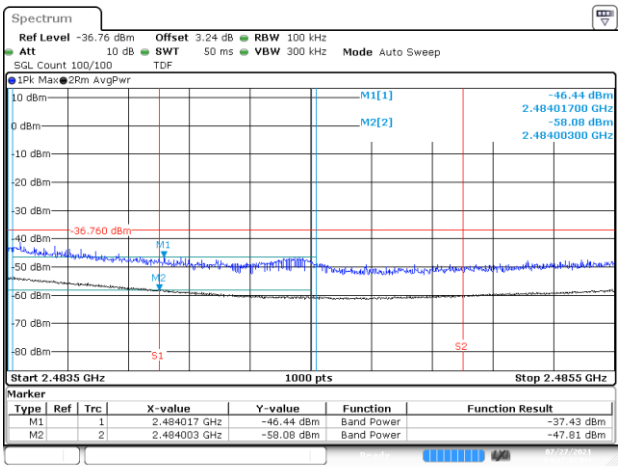
BE-R-HIGH, MIMO-B, 802.11ax40-HE0, Ch10



BE-R-HIGH-2MHz, MIMO-B, 802.11ax40-HE0, Ch10



BE-R-HIGH, MIMO-B, 802.11ax40-HE0, Ch11



BE-R-HIGH-2MHz, MIMO-B, 802.11ax40-HE0, Ch11

Annex C. Test Results BLE

C.1.1 6dB & 99% Bandwidth

Test limits

FCC part	RSS part	Limits
15.247 (a) (2)	RSS-247 Clause 5.2 (a)	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 procedure

The conducted setup shown in section *Test & System Description* was used to measure the 6dB & 99% Bandwidth. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

Results tables

Mode	Frequency [MHz]	6dB BW [MHz]	99% BW [MHz]
BLE	2402	1.116	2.094
	2440	1.125	2.088
	2480	1.134	2.094

C.1.2 Maximum Output Power and antenna gain

Test limits

	Limits
FCC Part 15.247 (b) (3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.
RSS-247 Clause 5.4 (d)	For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode

Test procedure:

The Maximum peak conducted output power was measured using the *RBW ≥ DTS bandwidth* method defined in paragraph 11.9.1.1 of ANSI C63.10-2013.

The Maximum conducted average output power was measured using the channel integration method according to Method AVGSA-2, defined in paragraph 11.9.2.2.4 of ANSI C63.10-2013.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

The conducted setup shown in section *Test & System Description* was used to measure the maximum conducted output power. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

Results tables

Mode	Meas. Duty Cycle [%]	Frequency [MHz]	Peak Power [dBm] Measured Conducted Output Power	EIRP	Peak Output Power [mW]
BLE	33.08	2402	9.62	12.86	9.17
		2440	10.06	13.30	10.15
		2480	10.39	13.63	10.94

Max Value
Min Value

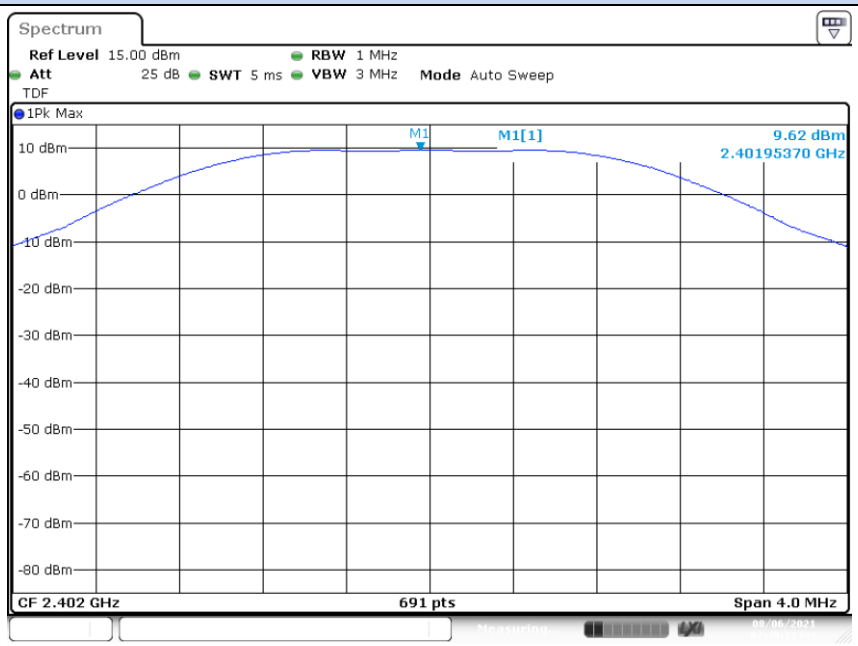
Mode	Meas. Duty Cycle [%]	Frequency [MHz]	Average Output Power* [dBm] Maximum Conducted Output Power	Maximum Conducted Output Power Duty cycle Compensated	EIRP	Average Output Power [mW]
BLE	33.08	2402	4.67	9.62	12.86	9.15
		2440	5.12	10.07	13.31	10.15
		2480	4.39	9.34	12.58	8.58

* Output Power RMS values are shown for indicative purpose only

Results screenshot

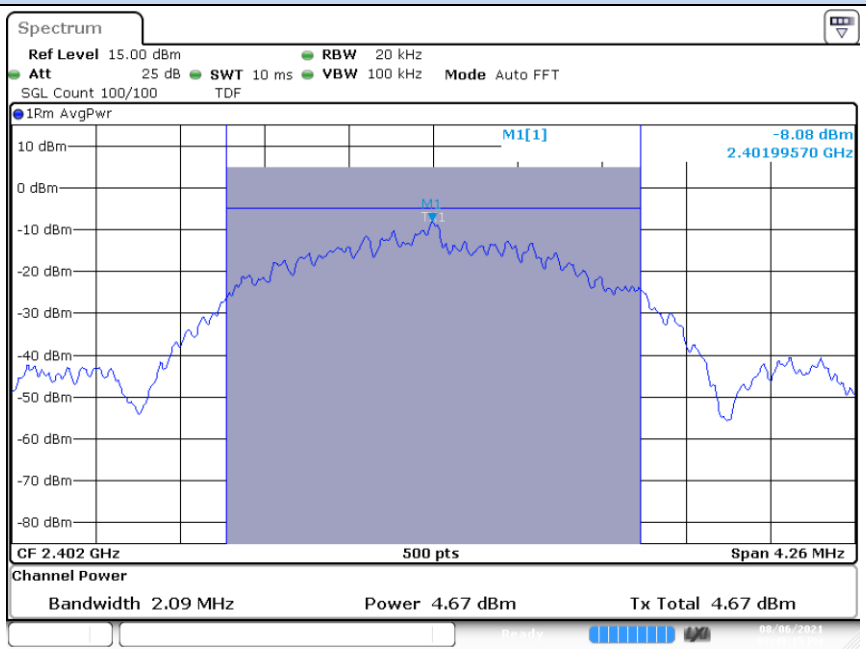
BLE

Max Power Peak – 2402 MHz



Date: 6.AUG.2021 14:49:13

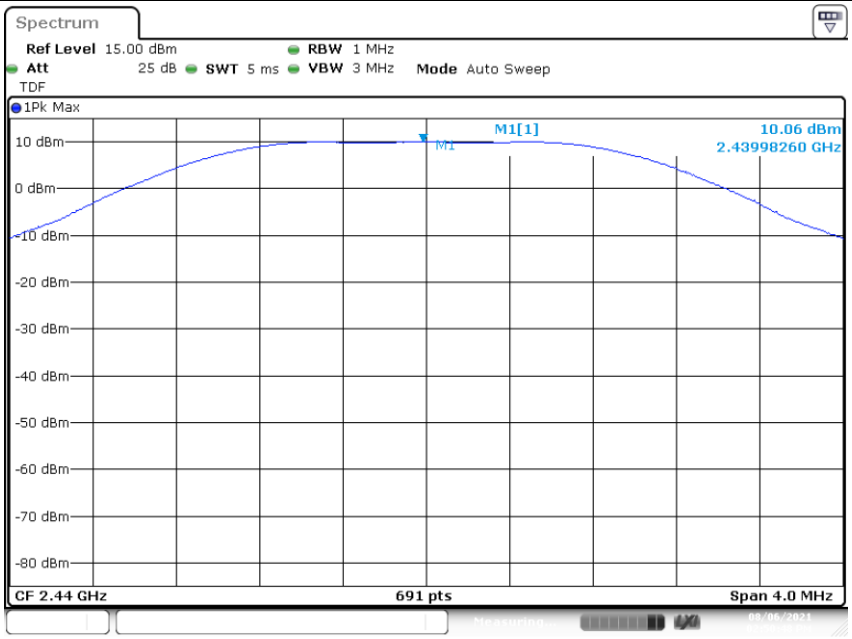
Max Power RMS – 2402 MHz



Date: 6.AUG.2021 14:49:16

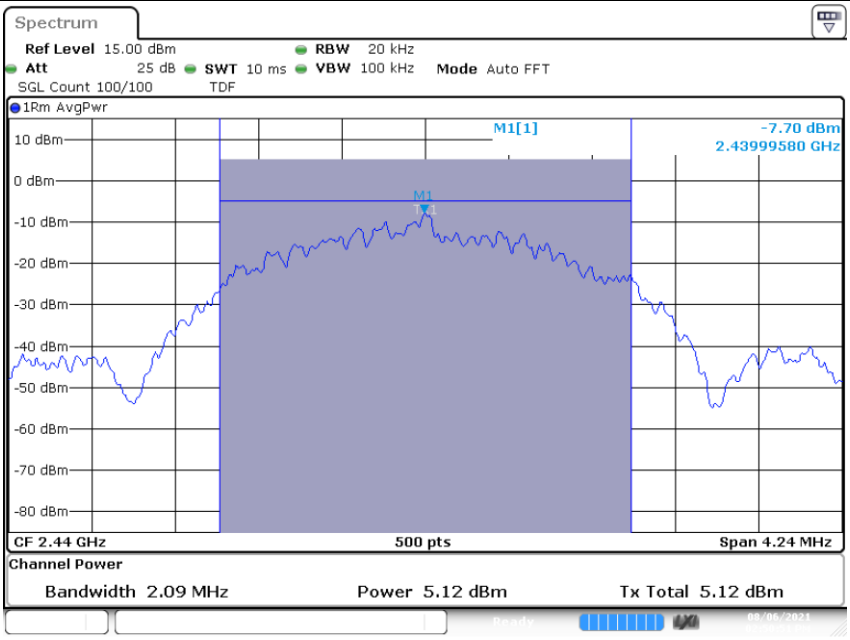
BLE

Max Power Peak – 2440 MHz



Date: 6.AUG.2021 14:50:48

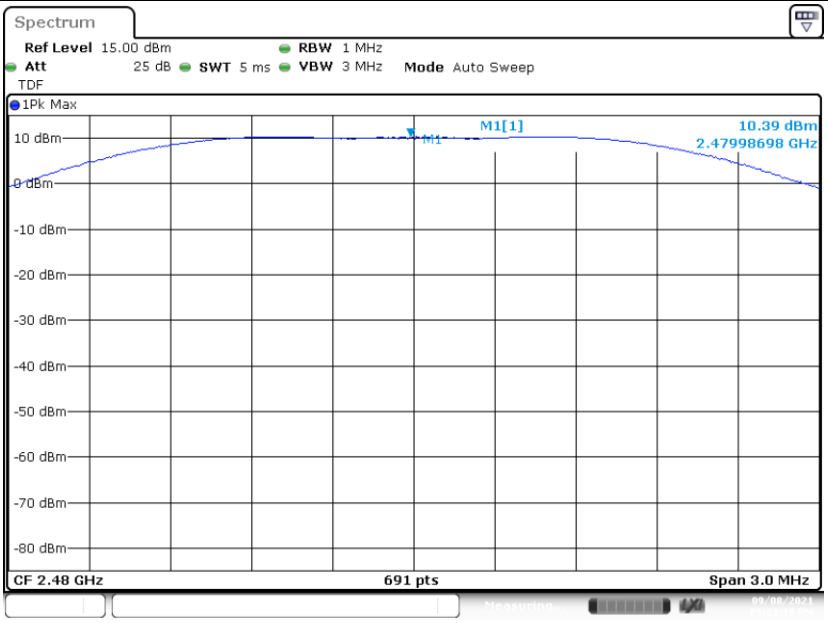
Max Power RMS – 2440 MHz



Date: 6.AUG.2021 14:50:51

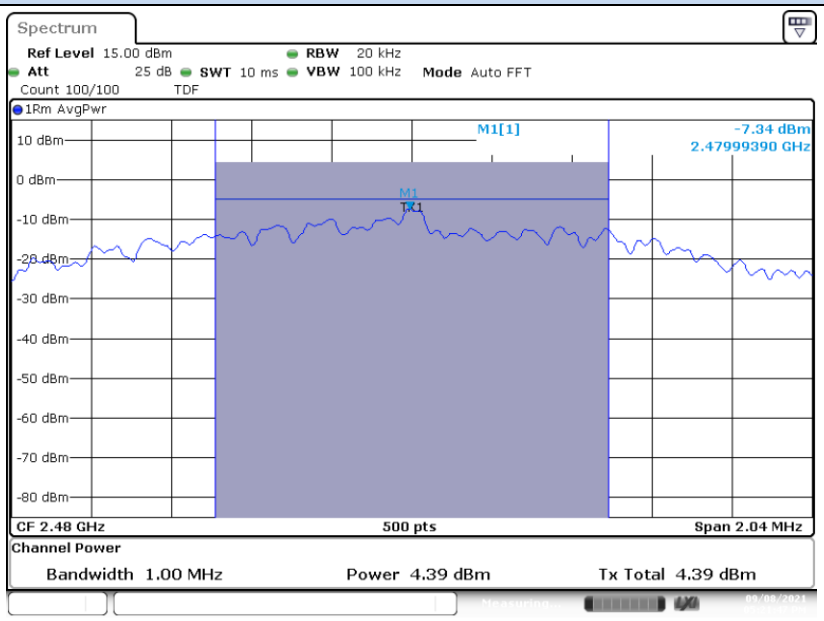
BLE

Max Power Peak – 2480 MHz



Date: 8.SEP.2021 17:23:10

Max Power RMS – 2480 MHz



Date: 8.SEP.2021 17:21:47

C.1.3 Power Spectral Density

Test limits

FCC part	RSS part	Limits
15.247 (e)	RSS-247 Clause 5.2 (b)	For digitally modulated 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 procedure

The maximum peak power spectral density level of the fundamental emission was measured using the method PKPSD, defined in paragraph 11.10.2 of ANSI C63.10-2013.

The conducted setup shown in section *Test & System Description* was used to measure the power spectral density. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

Results tables

Mode	Frequency [MHz]	PSD Peak [dBm/3kHz]
BLE	2402	-7.96
	2440	-7.69
	2480	-7.34

C.1.4 Out-of-band emission (Conducted)

Test Limits

<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.247 (d)</td><td>RSS-247
Clause 5.5</td><td>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.</td></tr>
<tr><td>15.209</td><td>RSS-Gen A1
Clause 8.9</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Stregth (µV/m)</th><th>Field Stregth (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

In case of band edge measurements falling in restricted bands, the declared Antenna Gain is also compensated in the graph.

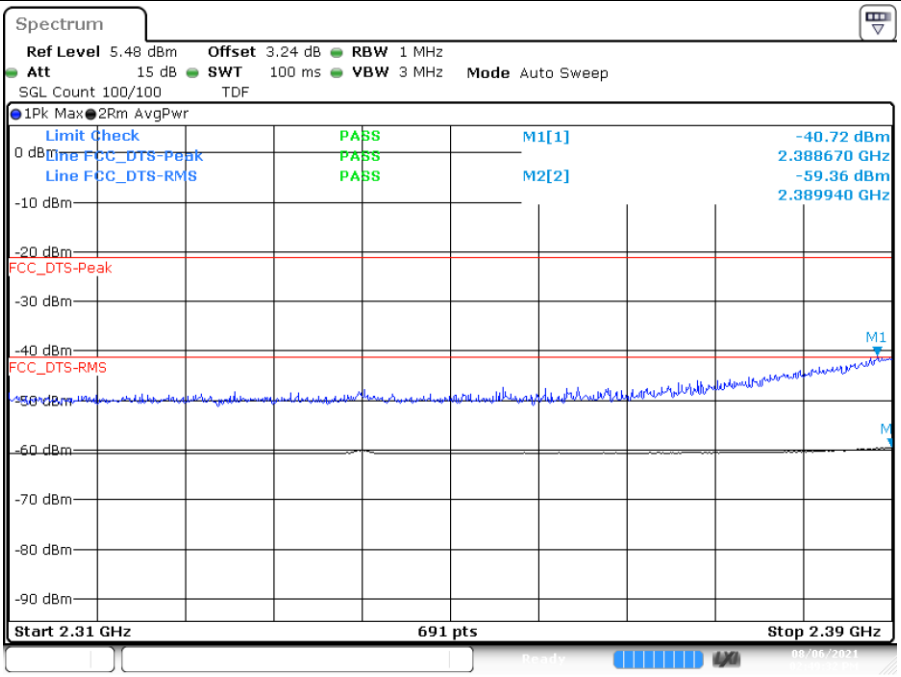
For band edge measurements falling in restricted bands, the following limits in dBm were applied for the average detector after the conversion from the limits detailed above in dBµV/m, according to FCC 47 CFR part 15 - Subpart C – §15.209(a). The limits in dBm for peak detector are 20dB above the indicated values in the table.

§15.209(a)			Converted values	
Freq Range (MHz)	Distance (m)	Field strength (microvolts/meter)	Field strength (dB microvolts/meter)	Power (dBm)
Above 960	3	500	54.0	-41.2

The conducted setup shown in section *Test & System Description* was used to measure the out-of-band emissions. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

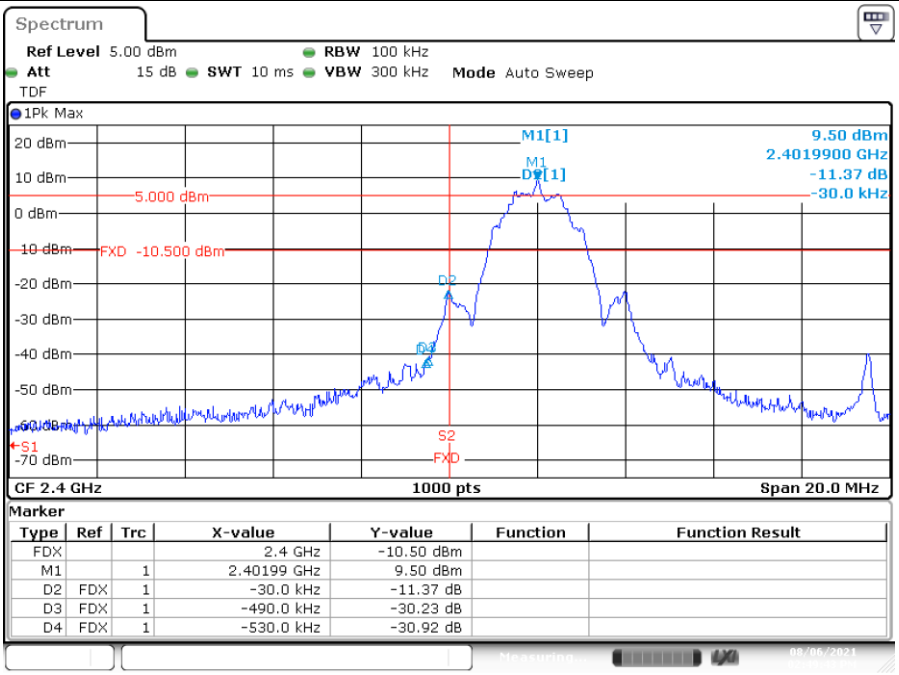
BLE

BE Low (Restricted) – 2402 MHz

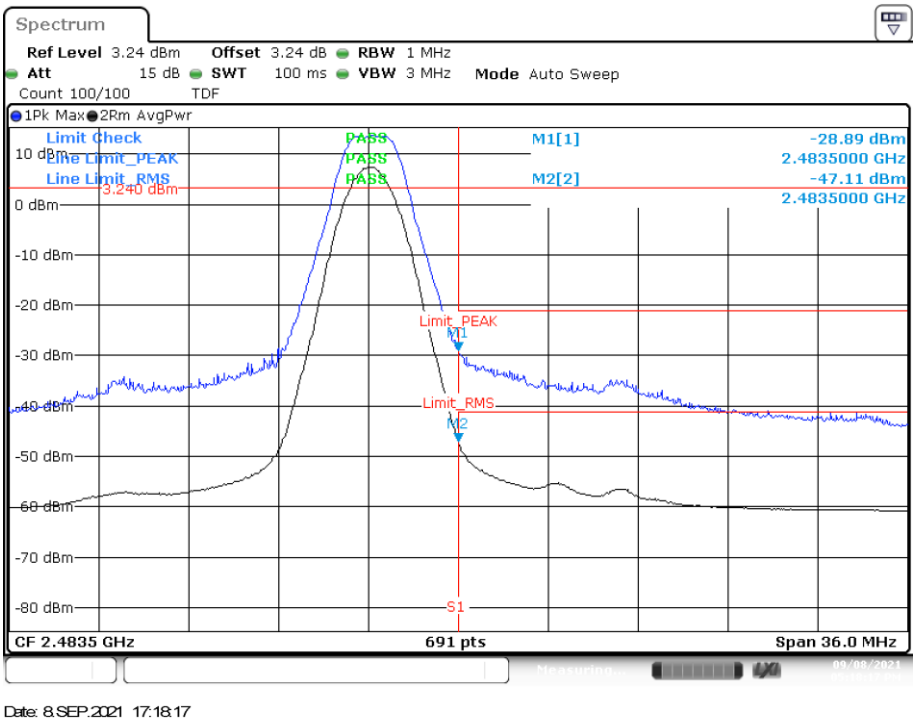


Date: 6.AUG.2021 14:49:32

BE Low (Non Restricted) – 2402 MHz



Date: 6.AUG.2021 14:49:43

BE High (Restricted) – 2480 MHz


C.1.5 Radiated spurious emission

Standards references

<table>
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</table>
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For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The radiated setups shown in section *Test & System Description* were used to measure the radiated spurious emissions. were used to measure the radiated spurious emissions.
Depending of the frequency range and bands being tested, different antennas and filters were used.
The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emissions were measured on the lowest, middle and highest channels.

Test Results

Radiated Spurious - 30 MHz – 1 GHz

Frequency	Quasi-Peak	Limit	Margin	Polarization
MHz	dBµV/m	dBµV/m	dB	---
893.5	33.5	46.0	12.5	H

Note 1: The spurious signals detected do not depend on either the operating channel or the modulation mode.

1 GHz – 26.5 GHz, BLE

Radiated Spurious – 2402 MHz

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3067.0	51.6	---	74.0	22.4	V
3068.5	---	40.3	54.0	13.7	H
16496.0	---	40.5	54.0	13.5	H
16509.0	53.3	---	74.0	20.7	H
26221.0	49.1	---	74.0	24.9	H
26254.5	---	35.9	54.0	18.1	V

Radiated Spurious – 2440 MHz

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
3111.5	---	40.1	54.0	13.9	H
3112.5	51.5	---	74.0	22.5	V
3190.5	52.5	---	74.0	21.5	H
3191.0	---	40.4	54.0	13.6	H
17800.5	---	41.7	54.0	12.3	H
17801.5	54.6	---	74.0	19.4	V
25912.0	49.0	---	74.0	25.0	H
25922.0	---	36.3	54.0	17.7	V

Radiated Spurious – 2480 MHz

Frequency	MaxPeak	Average	Limit	Margin	Polar
MHz	dBµV/m	dBµV/m	dBµV/m	dB	---
9357.0	57.5	---	74.0	16.6	H
9357.5	---	44.8	54.0	**9.2**	V
17804.5	54.0	---	74.0	20.0	H
17814.0	---	41.6	54.0	12.4	H
25235.0	48.5	---	74.0	25.6	H
25252.0	---	35.6	54.0	18.4	V