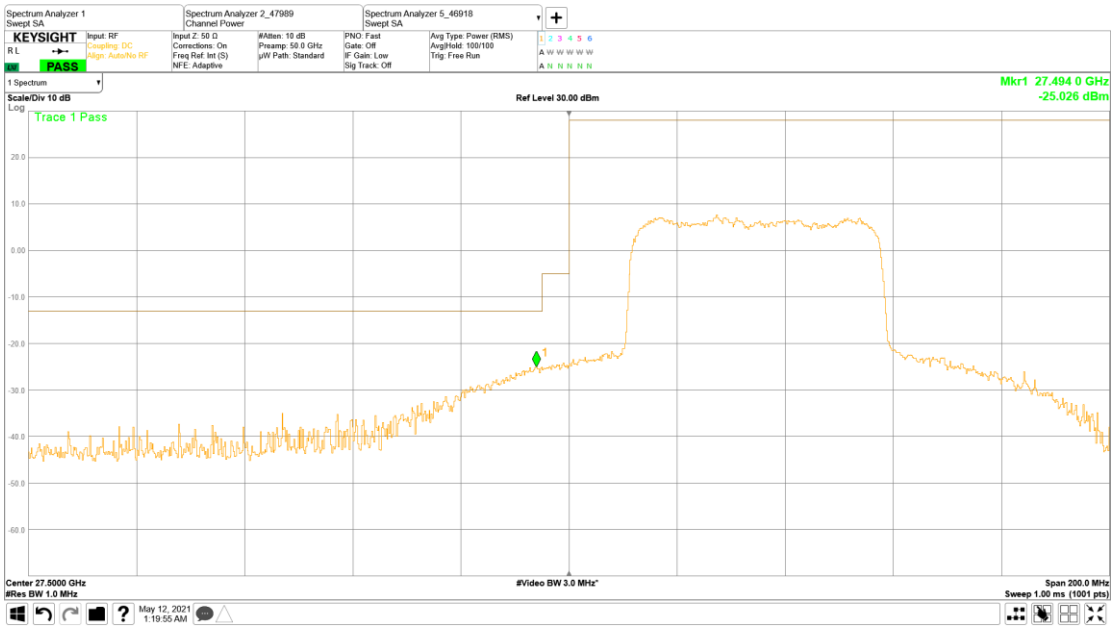
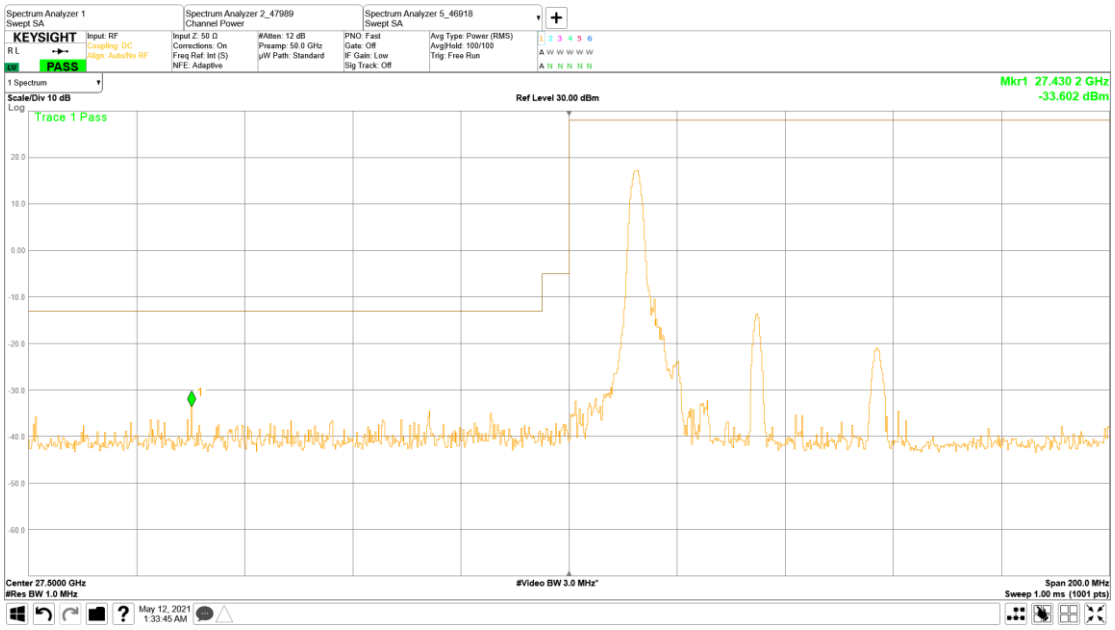
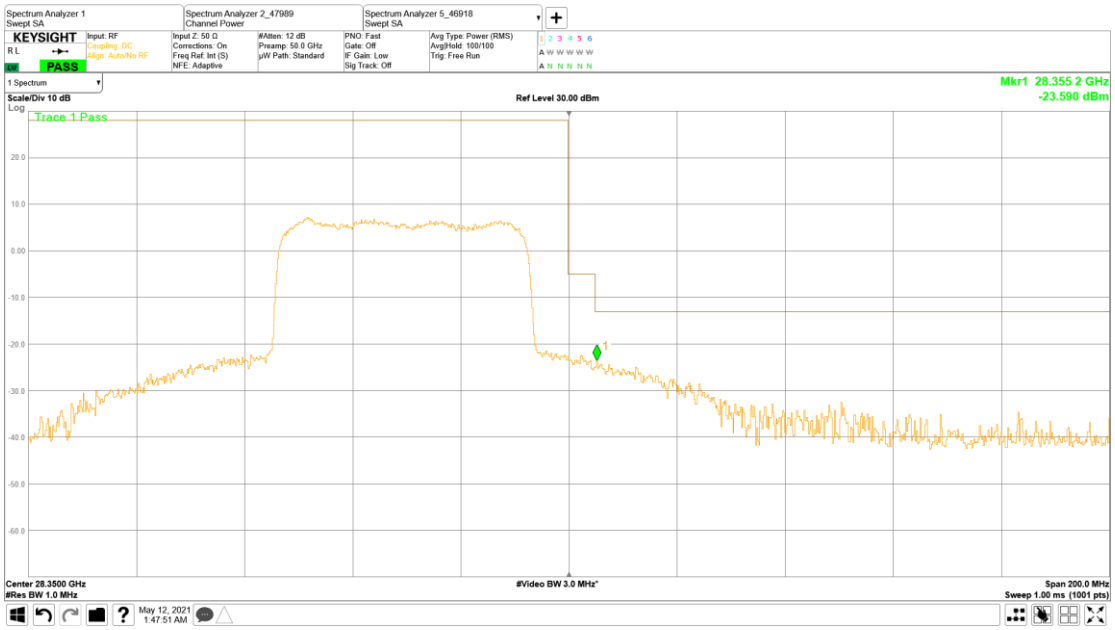
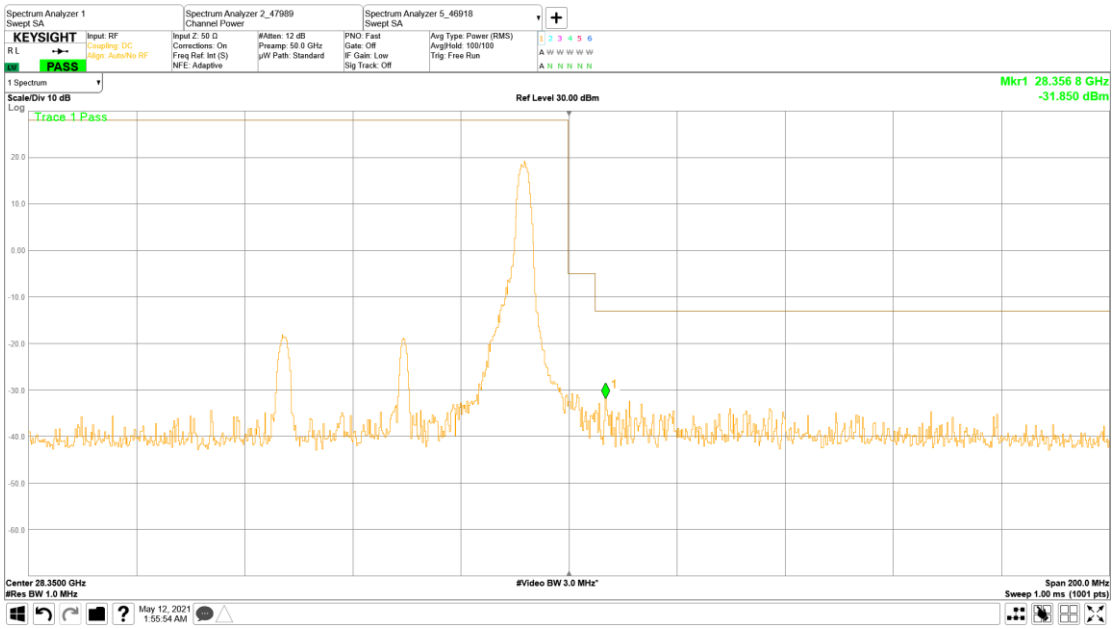
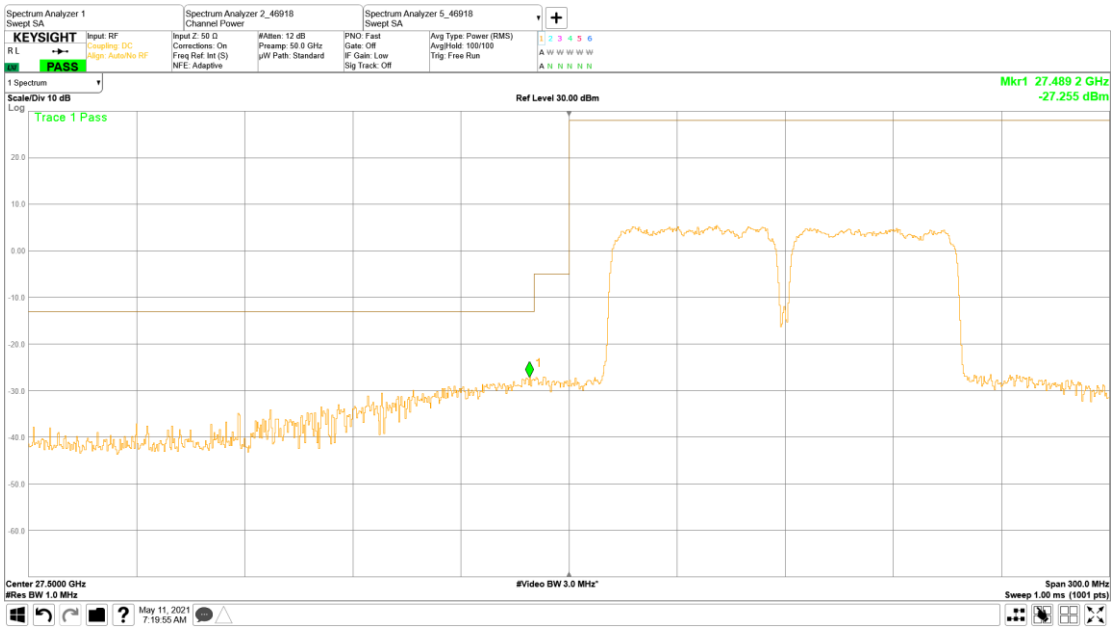
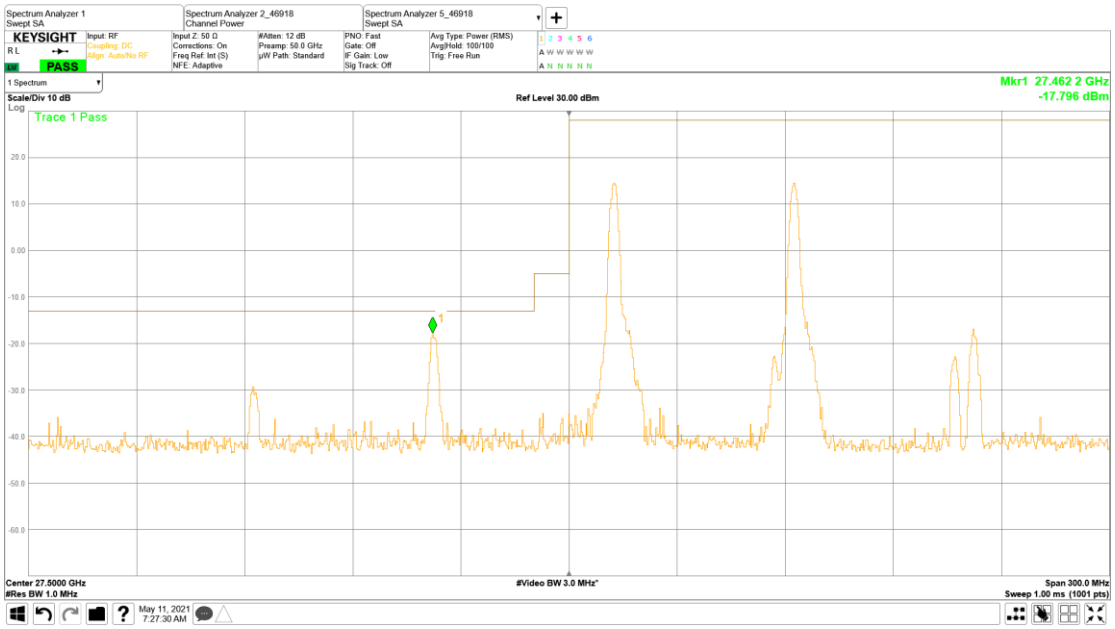
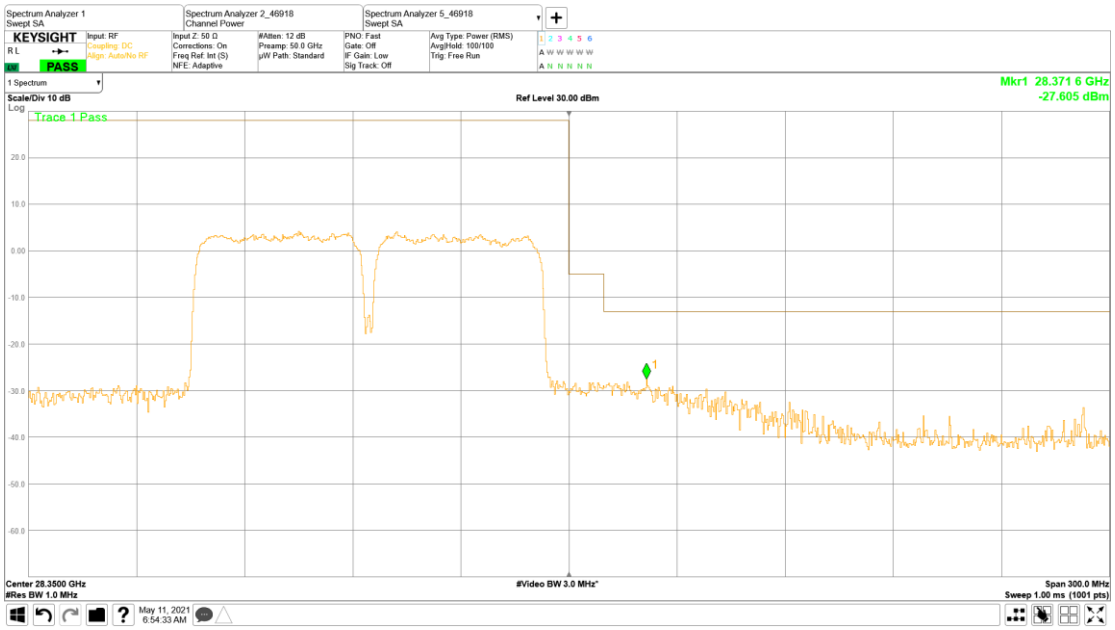
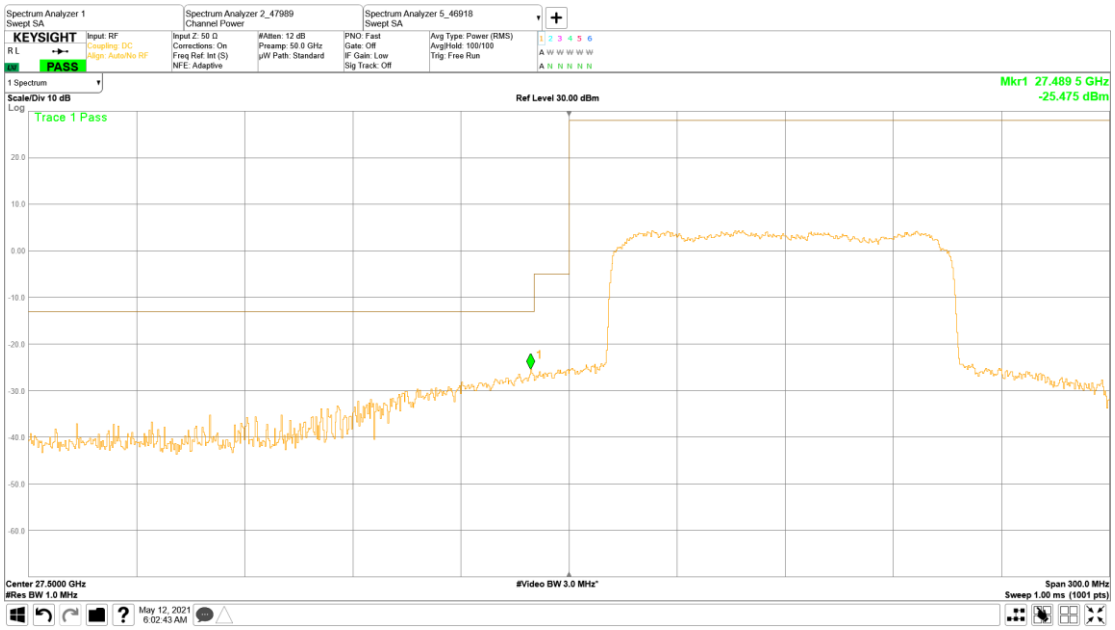
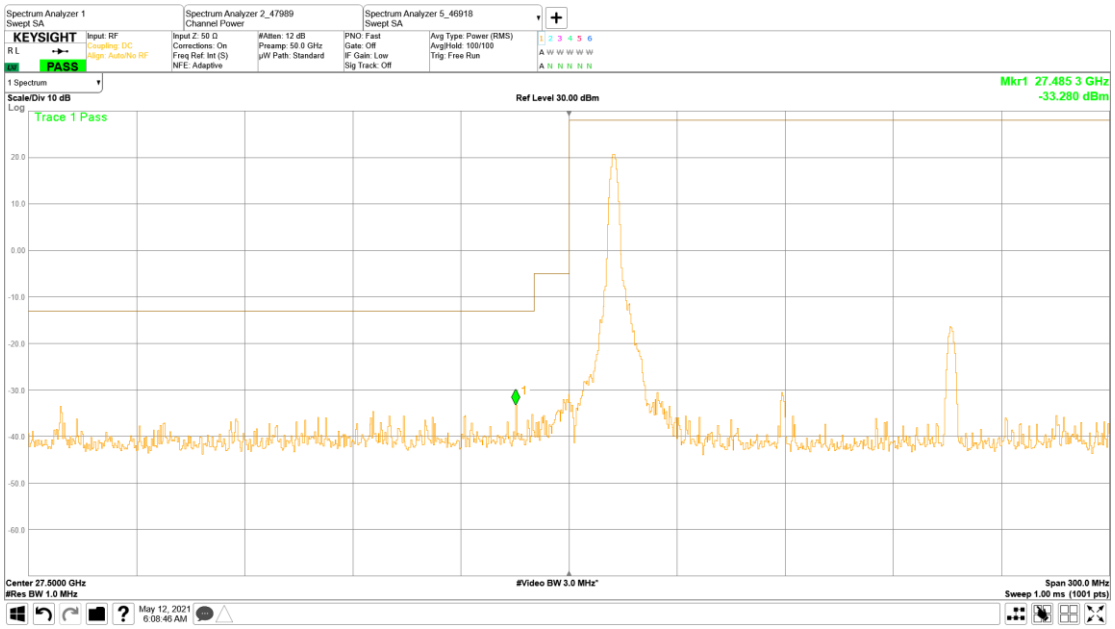
Module 1, Band n261, MIMO

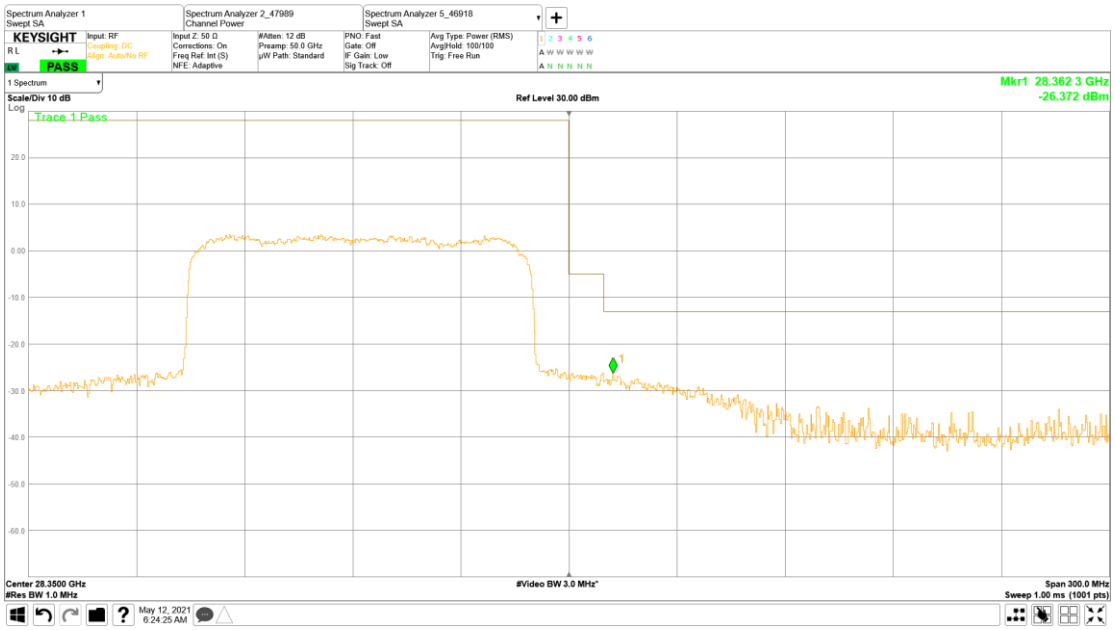
M 1 n261 MIMO BW 50MHz	 1CC / QPSK / Low channel / Full RB
M 1 n261 MIMO BW 50MHz	 1CC / BPSK / Low channel / 1 RB

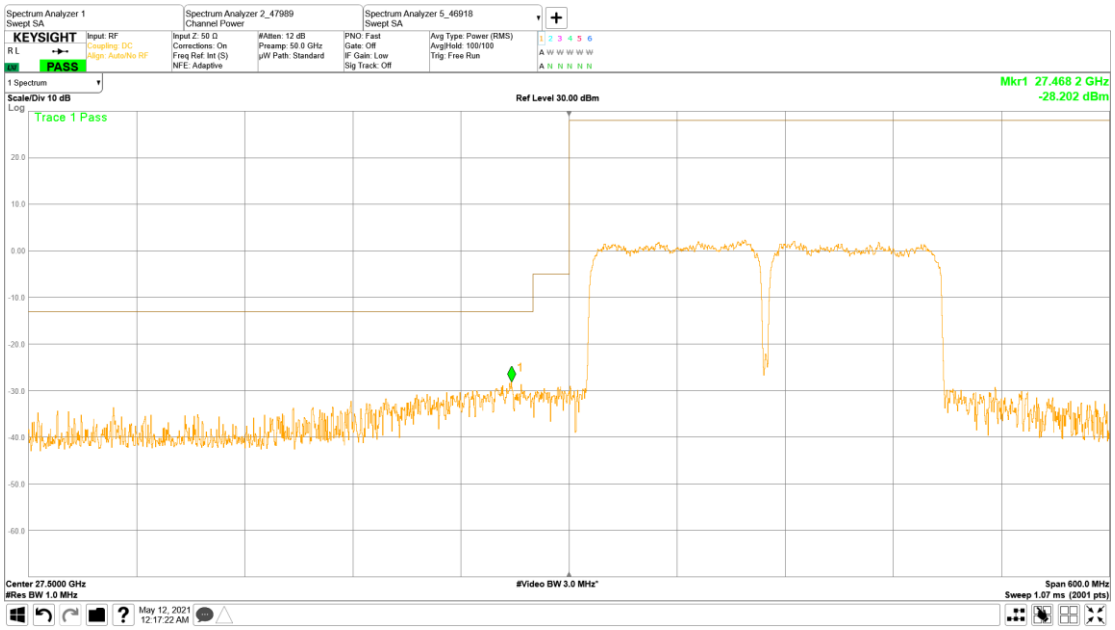
M 1 n261 MIMO BW 50MHz	 1CC / QPSK / High channel / Full RB
M 1 n261 MIMO BW 50MHz	 1CC / 16QAM / High channel / 1 RB

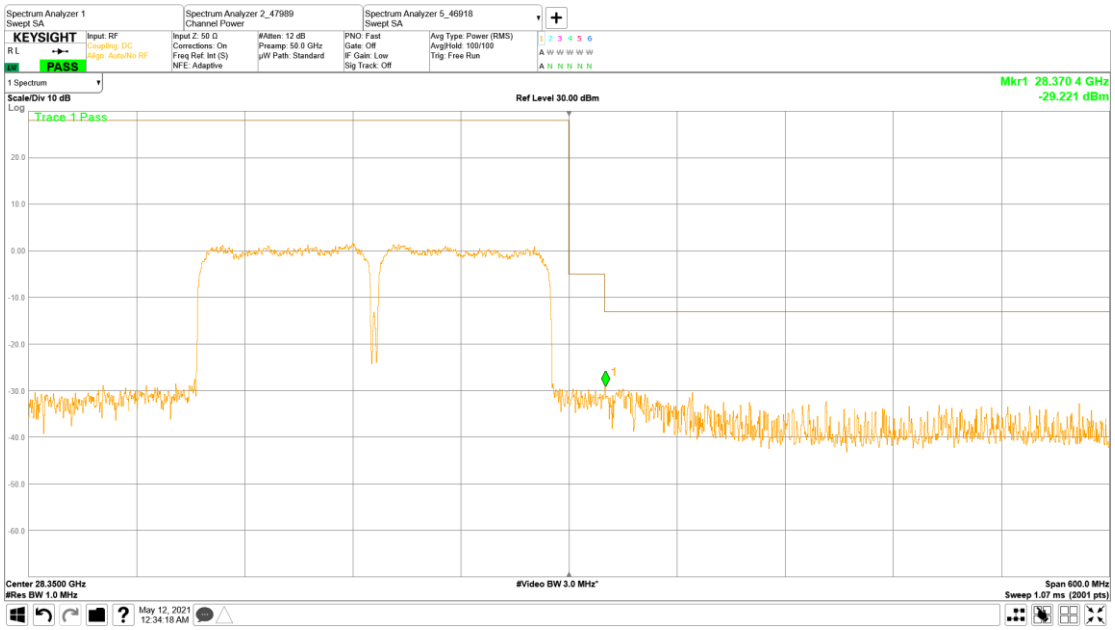
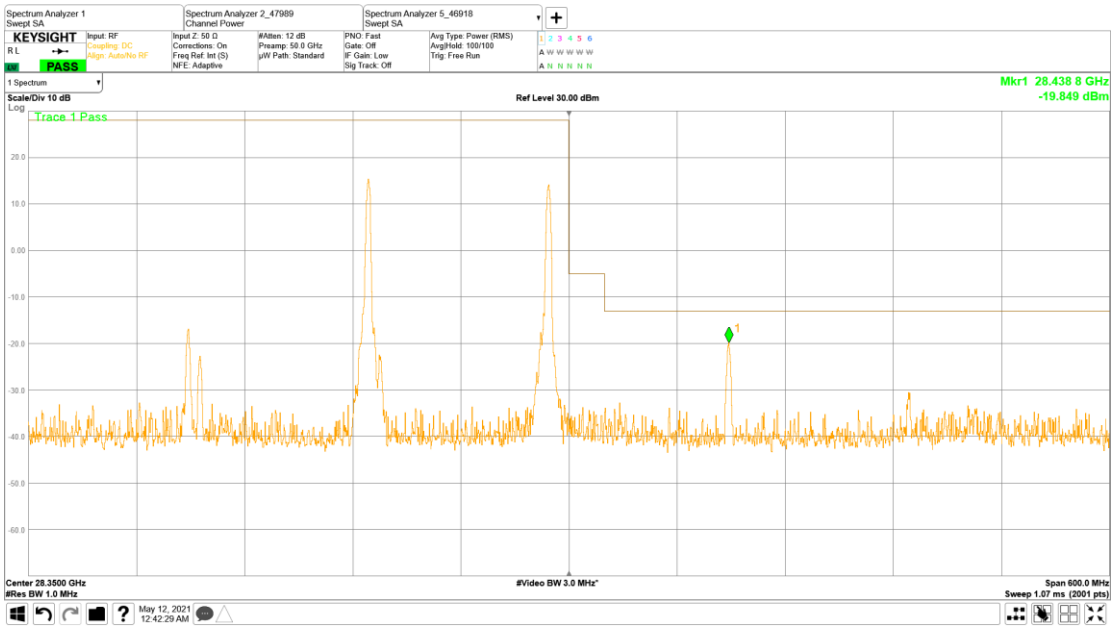
M 1 n261 MIMO BW 50MHz	 2CC / BPSK / Low channel / Full RB
M 1 n261 MIMO BW 50MHz	 2CC / 16QAM / Low channel / 1 RB

M 1 n261 MIMO BW 50MHz	 2CC / BPSK / High channel / Full RB
M 1 n261 MIMO BW 50MHz	 2CC / QPSK / High channel / 1 RB

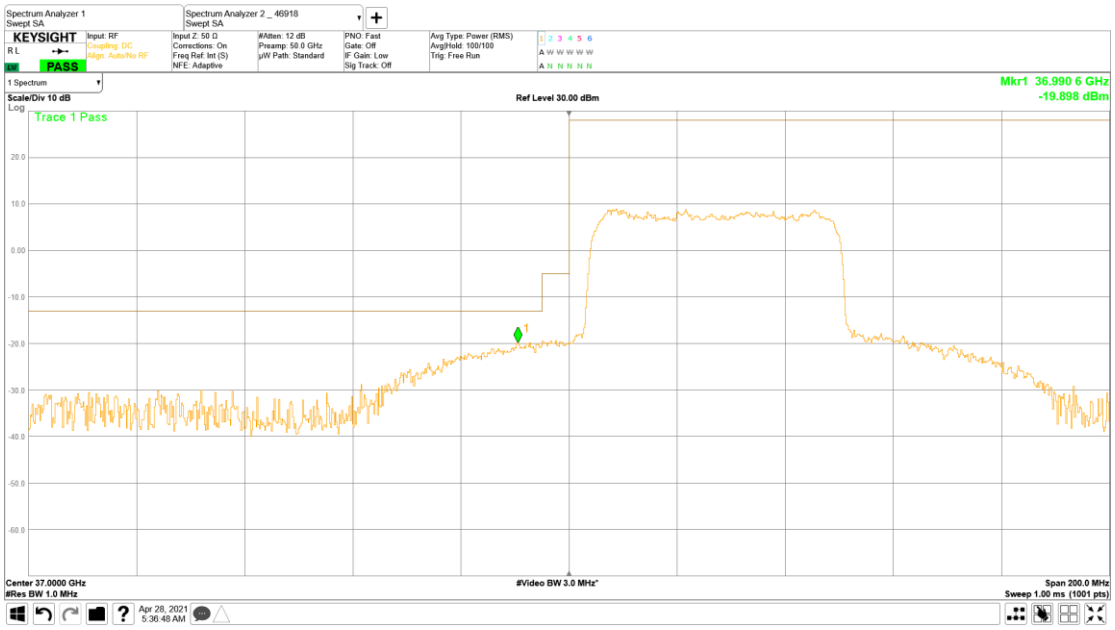
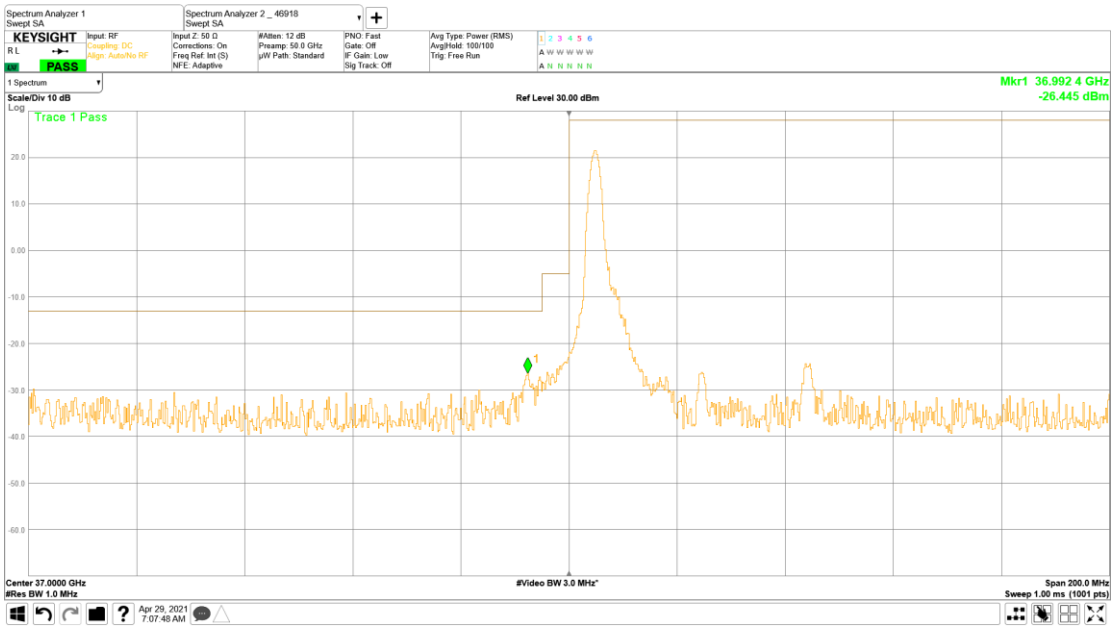
M 1 n261 MIMO BW 100MHz	 1CC / QPSK / Low channel / Full RB
M 1 n261 MIMO BW 100MHz	 1CC / QPSK / Low channel / 1 RB

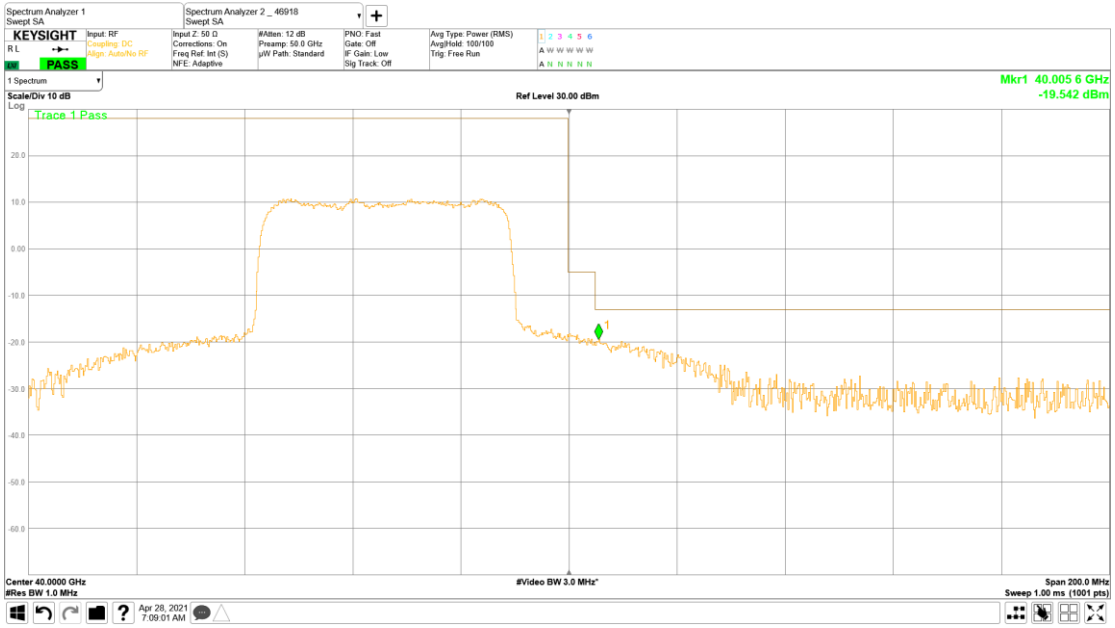
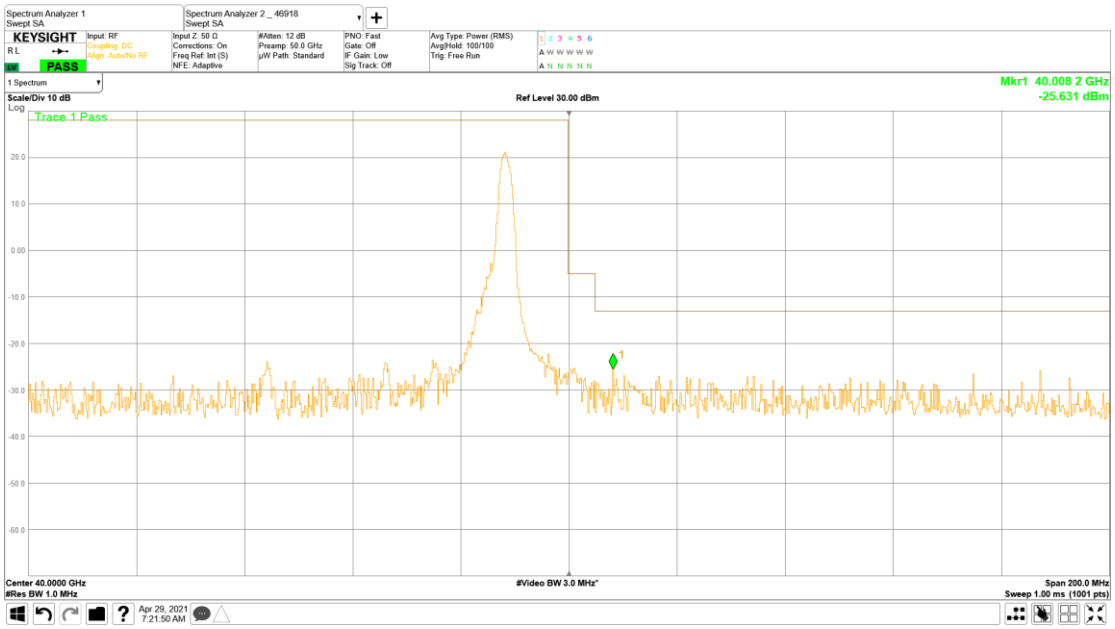
M 1 n261 MIMO BW 100MHz	 1CC / QPSK / High channel / Full RB
M 1 n261 MIMO BW 100MHz	 1CC / BPSK / High channel / 1 RB

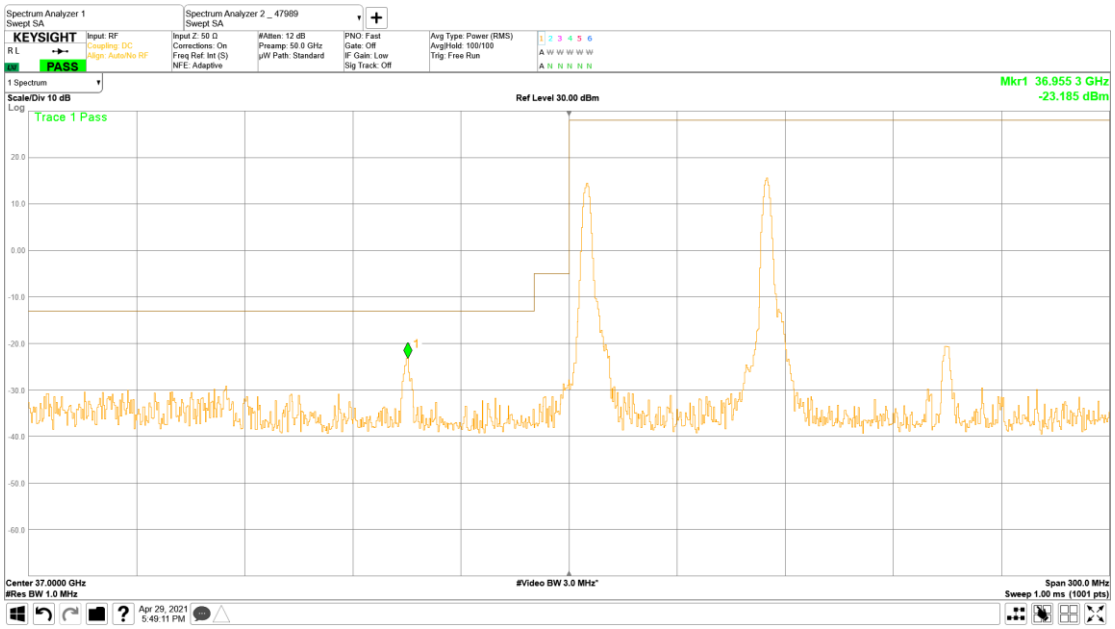
M 1 n261 MIMO BW 100MHz	 2CC / BPSK / Low channel / Full RB
M 1 n261 MIMO BW 100MHz	 2CC / 16QAM / Low channel / 1 RB

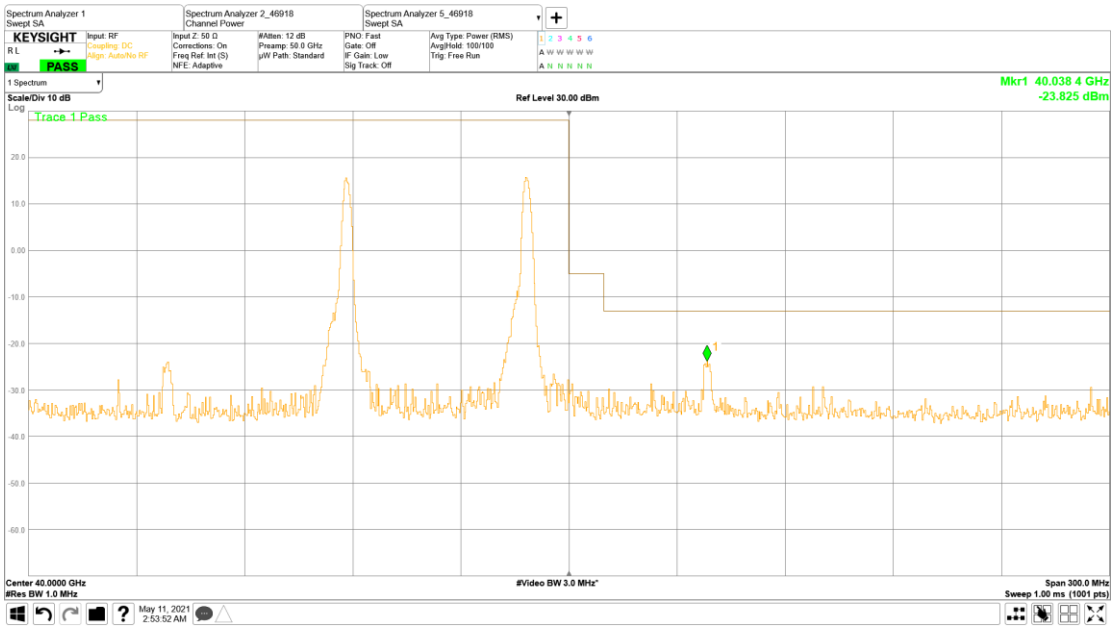
M 1 n261 MIMO BW 100MHz	 2CC / BPSK / High channel / Full RB
M 1 n261 MIMO BW 100MHz	 2CC / 16QAM / High channel / 1 RB

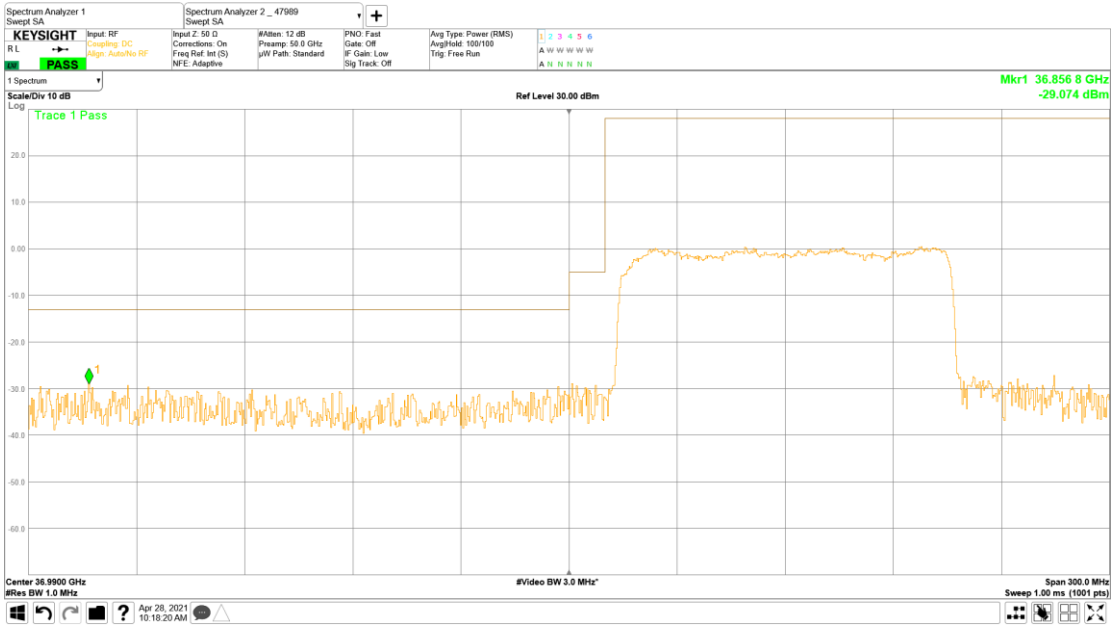
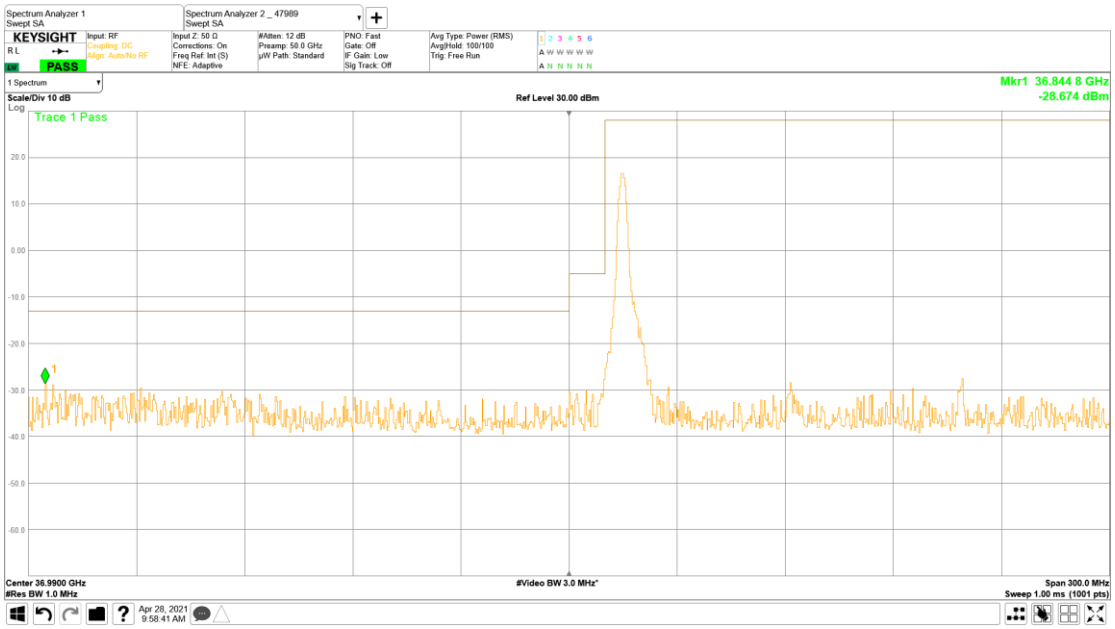
Module 1, Band n260, SISO-Dual

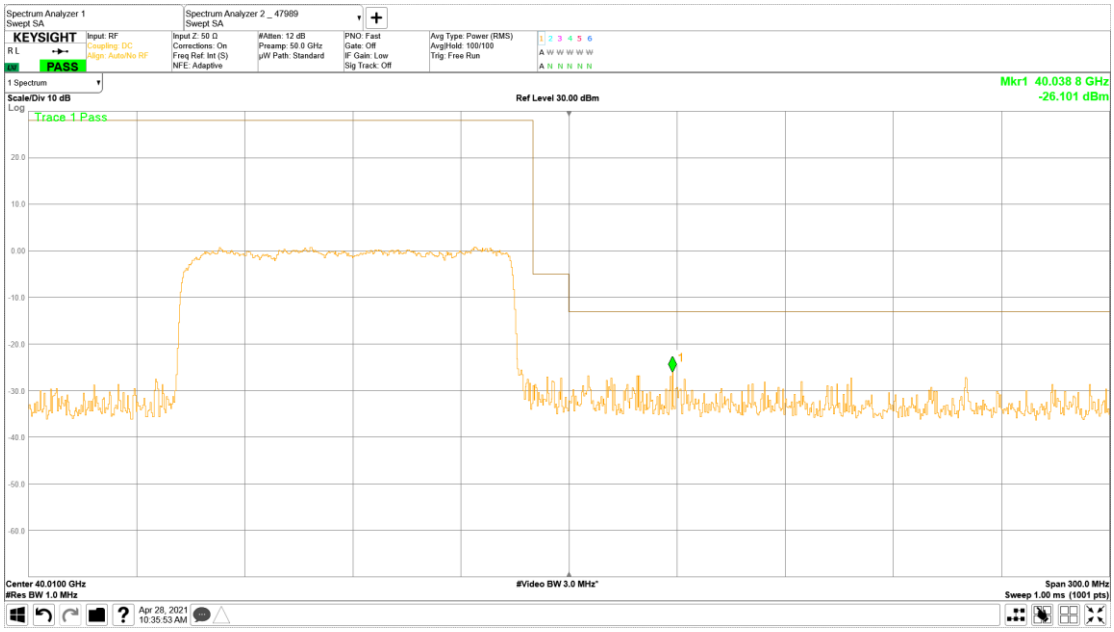
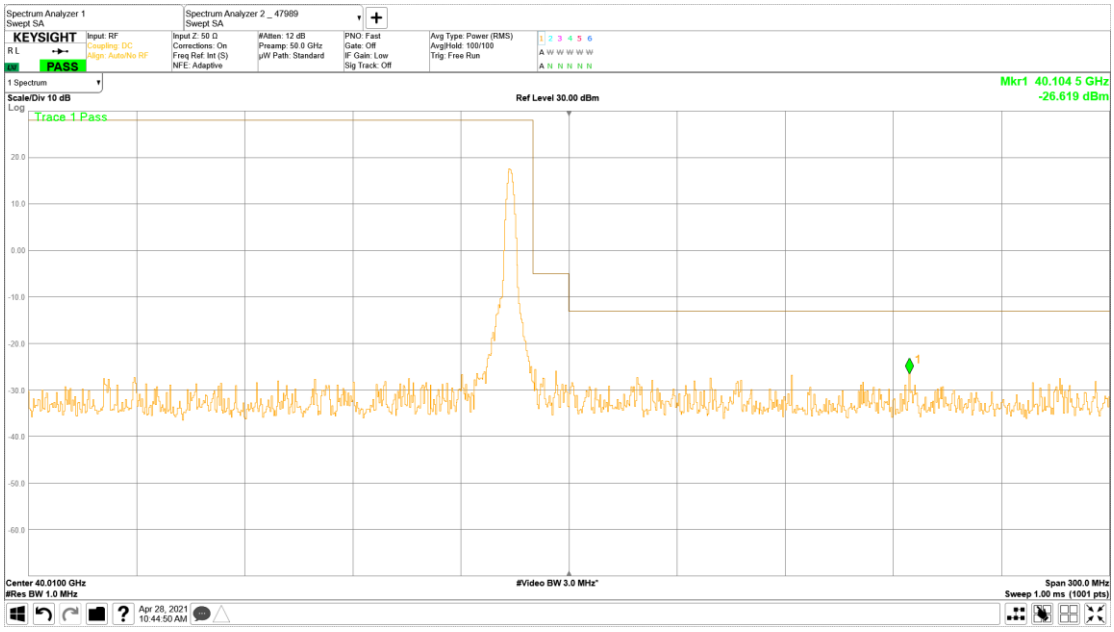
M 1 n260 SISO -Dual BW 50MHz	 1CC / QPSK / Low channel / Full RB
M 1 n260 SISO -Dual BW 50MHz	 1CC / BPSK / Low channel / 1 RB

M 1 n260 SISO -Dual BW 50MHz	 1CC / QPSK / High channel / Full RB
M 1 n260 SISO -Dual BW 50MHz	 1CC / 64QAM / High channel / 1 RB

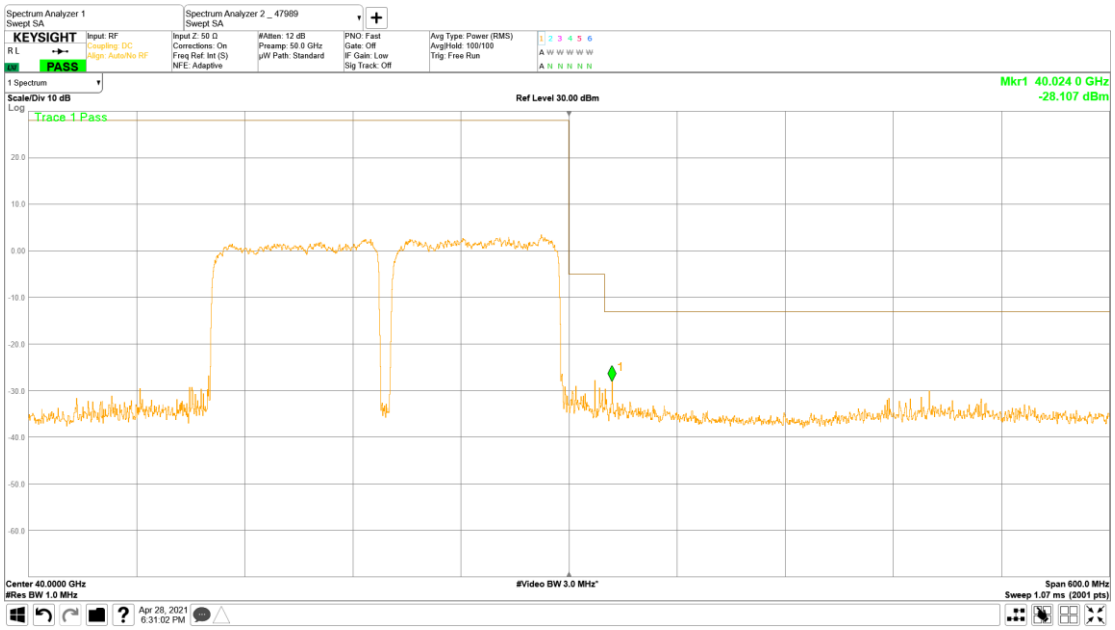
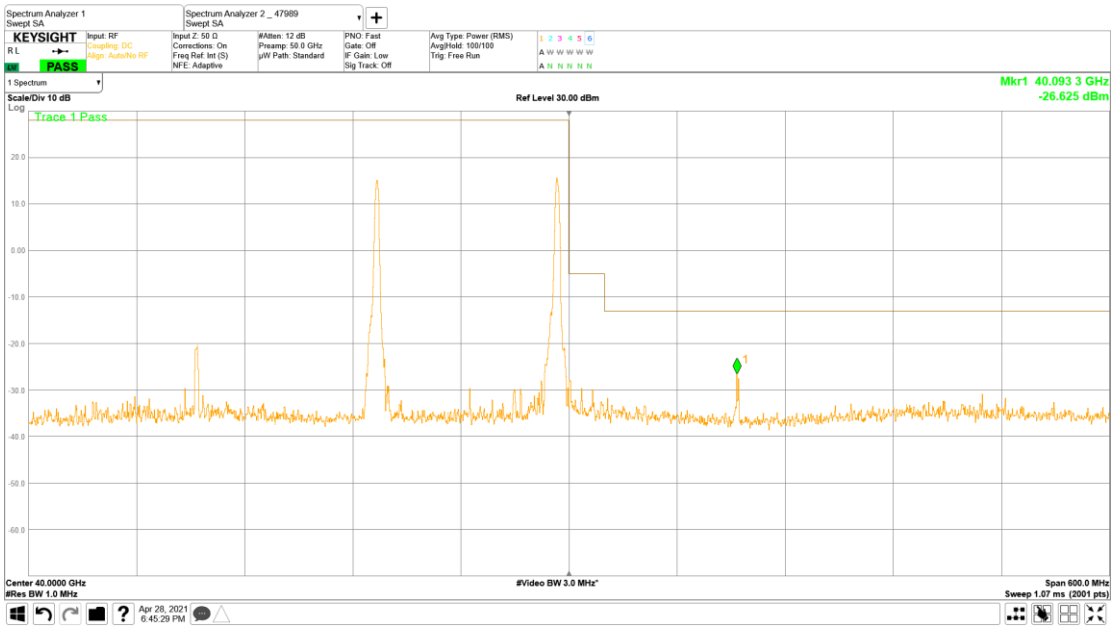
M 1 n260 SISO -Dual BW 50MHz	 2CC / QPSK / Low channel / Full RB
M 1 n260 SISO -Dual BW 50MHz	 2CC / 64QAM / Low channel / 1 RB

M 1 n260 SISO -Dual BW 50MHz	 2CC / QPSK / High channel / Full RB
M 1 n260 SISO -Dual BW 50MHz	 2CC / 64QAM / High channel / 1 RB

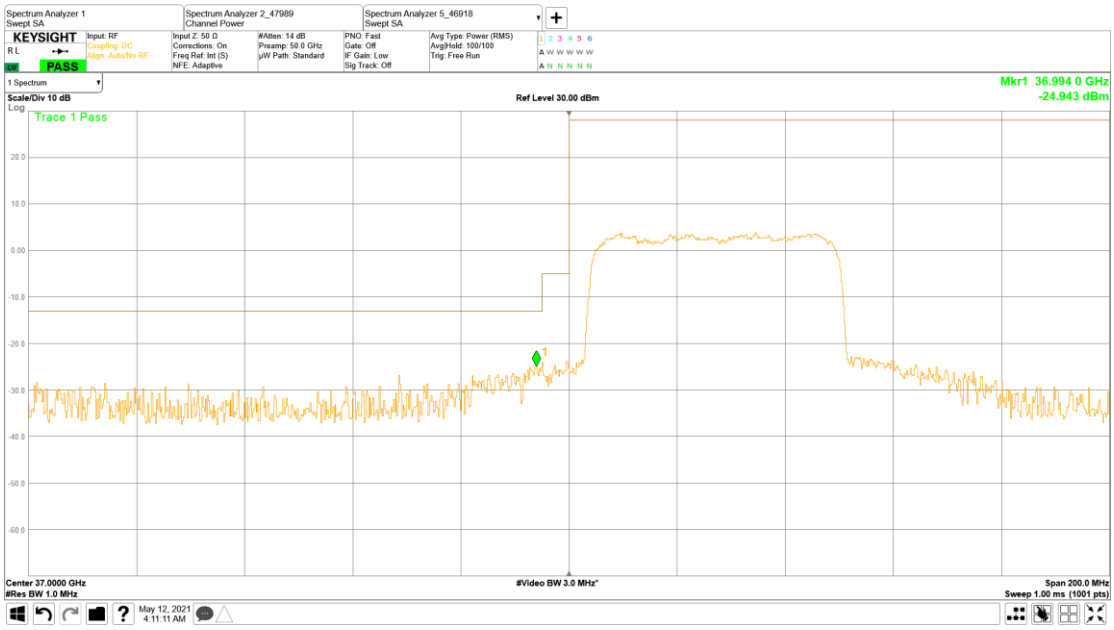
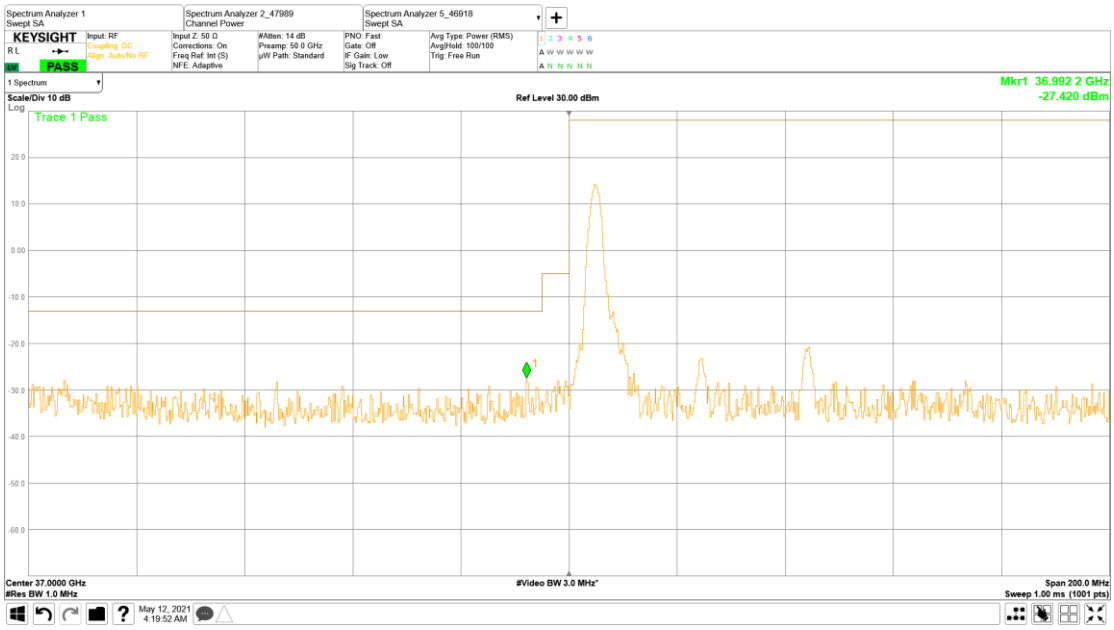
M 1 n260 SISO -Dual BW 100MHz	 1CC / QPSK / Low channel / Full RB
M 1 n260 SISO -Dual BW 100MHz	 1CC / QPSK / Low channel / 1 RB

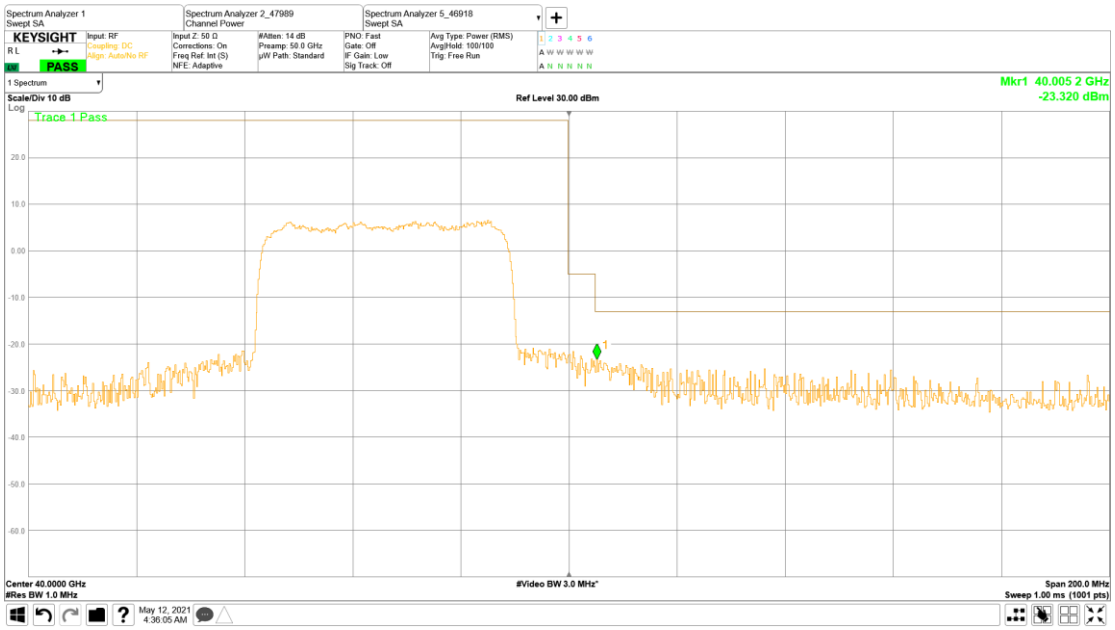
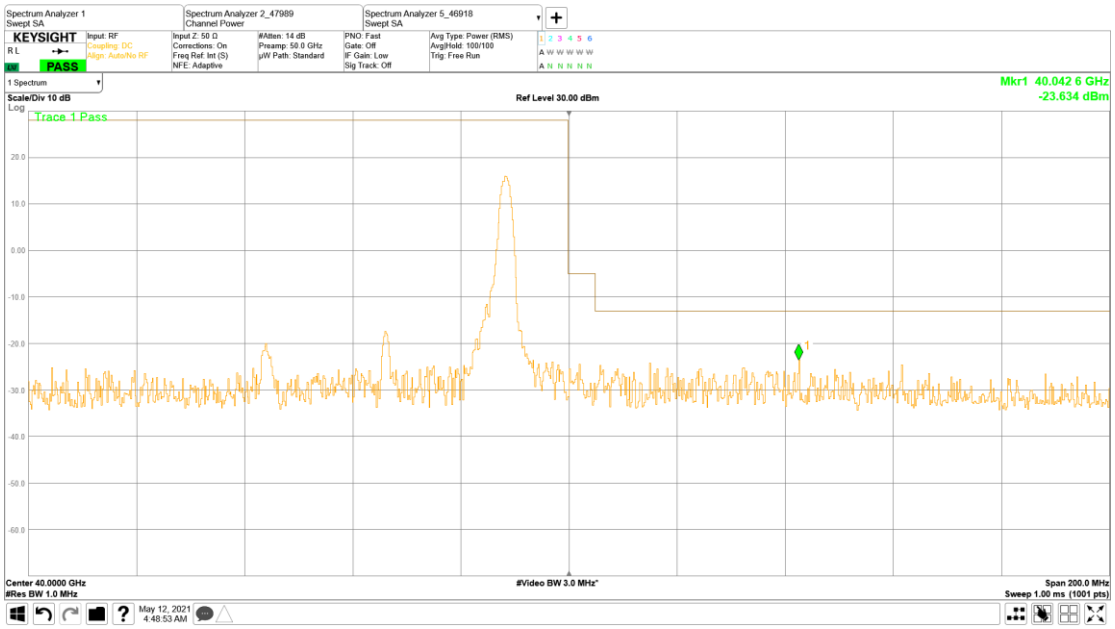
M 1 n260 SISO -Dual BW 100MHz	 1CC / 16QAM / High channel / Full RB
M 1 n260 SISO -Dual BW 100MHz	 1CC / 16QAM / High channel / 1 RB

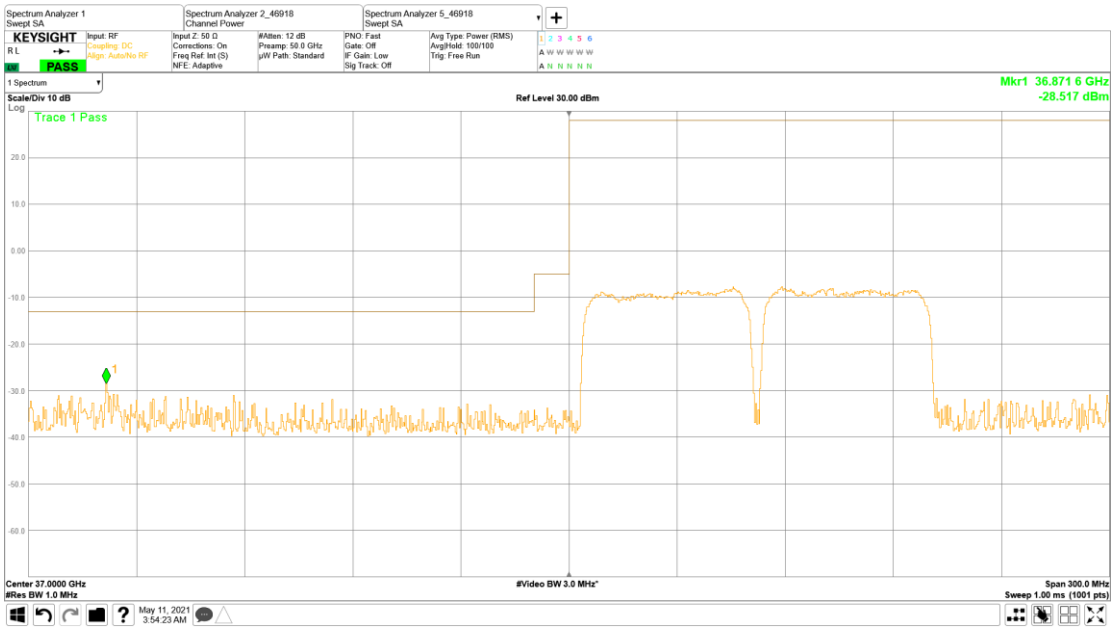
M 1 n260 SISO -Dual BW 100MHz	 2CC / BPSK / Low channel / Full RB
M 1 n260 SISO -Dual BW 100MHz	 2CC / 64QAM / Low channel / 1 RB

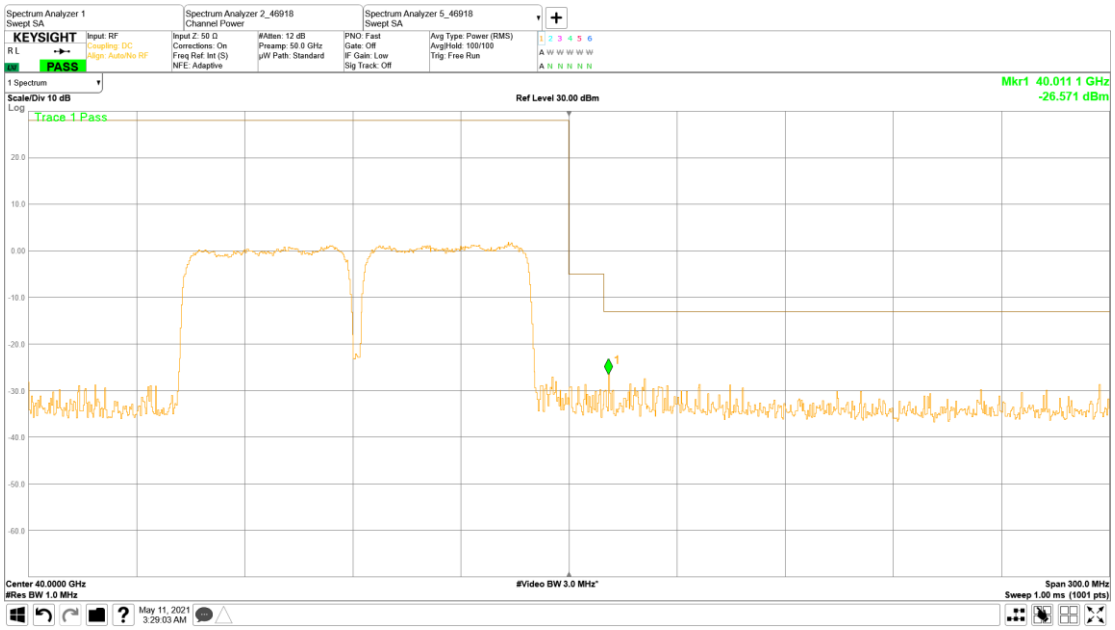
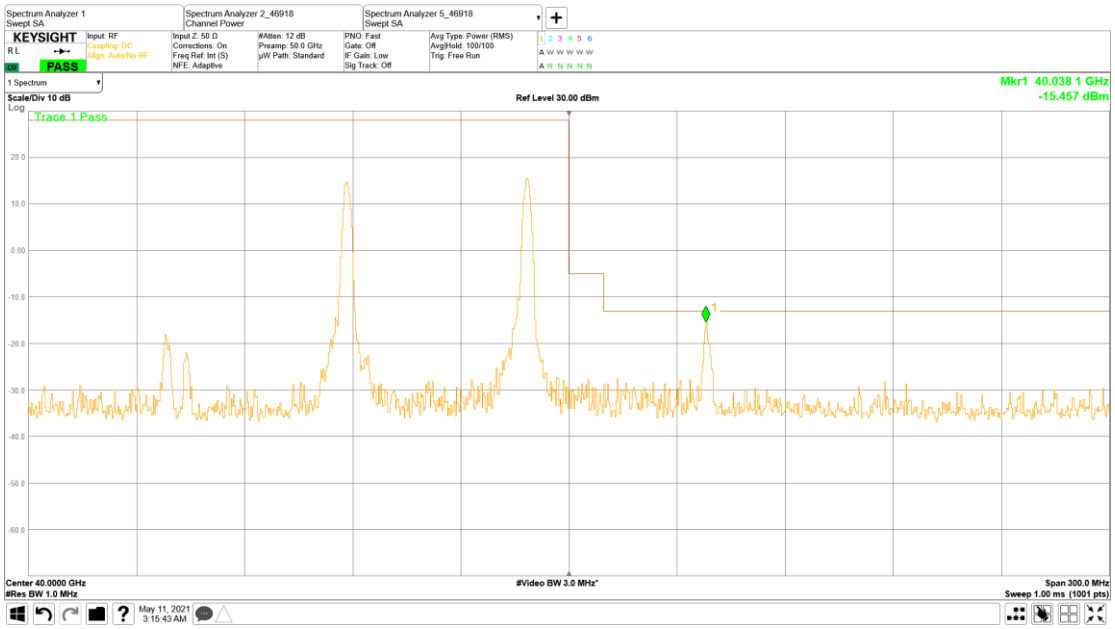
M 1 n260 SISO -Dual BW 100MHz	 2CC / QPSK / High channel / Full RB
M 1 n260 SISO -Dual BW 100MHz	 2CC / 64QAM / High channel / 1 RB

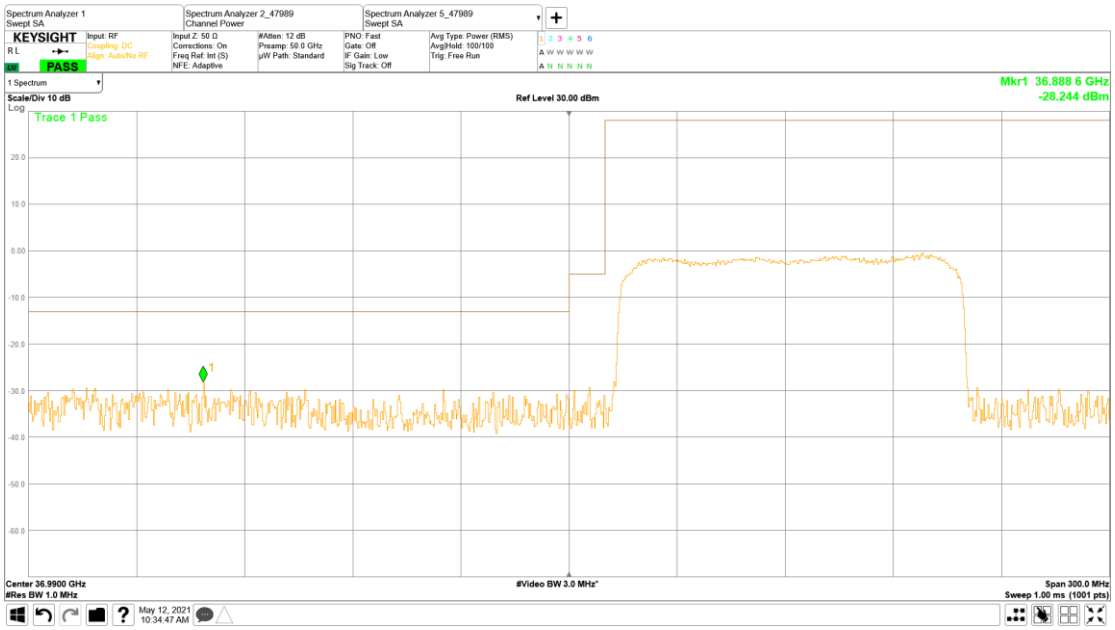
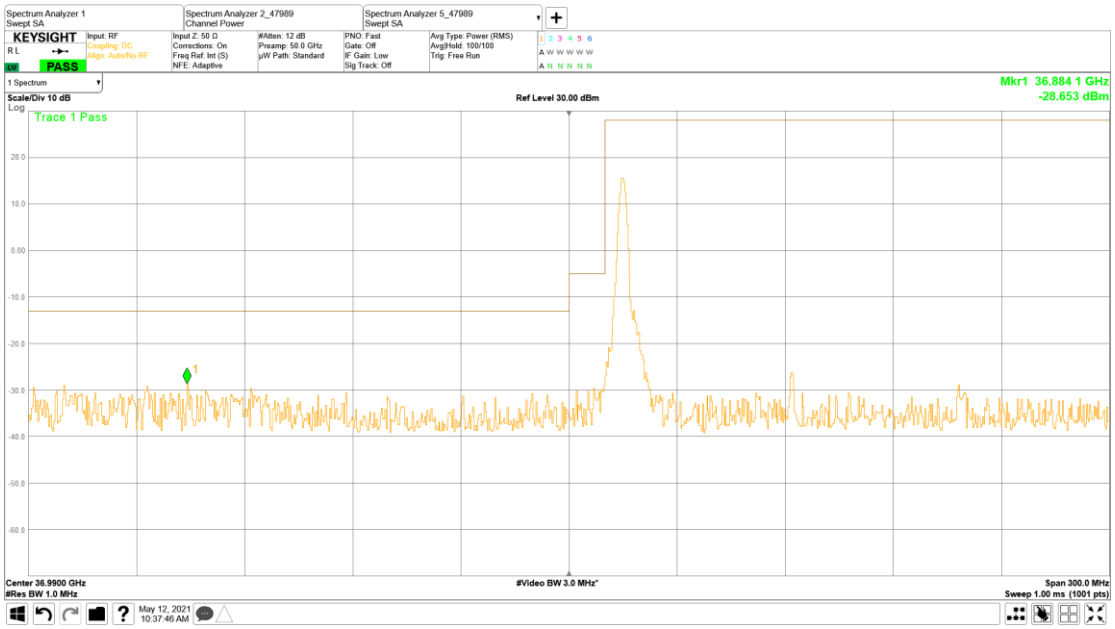
Module 1, Band n260, MIMO

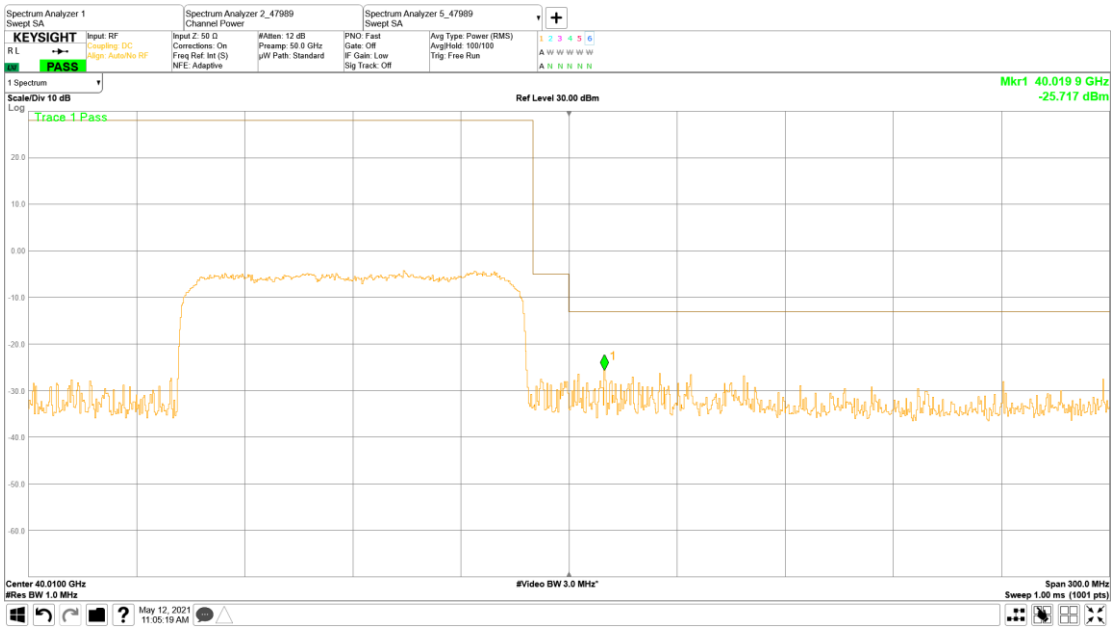
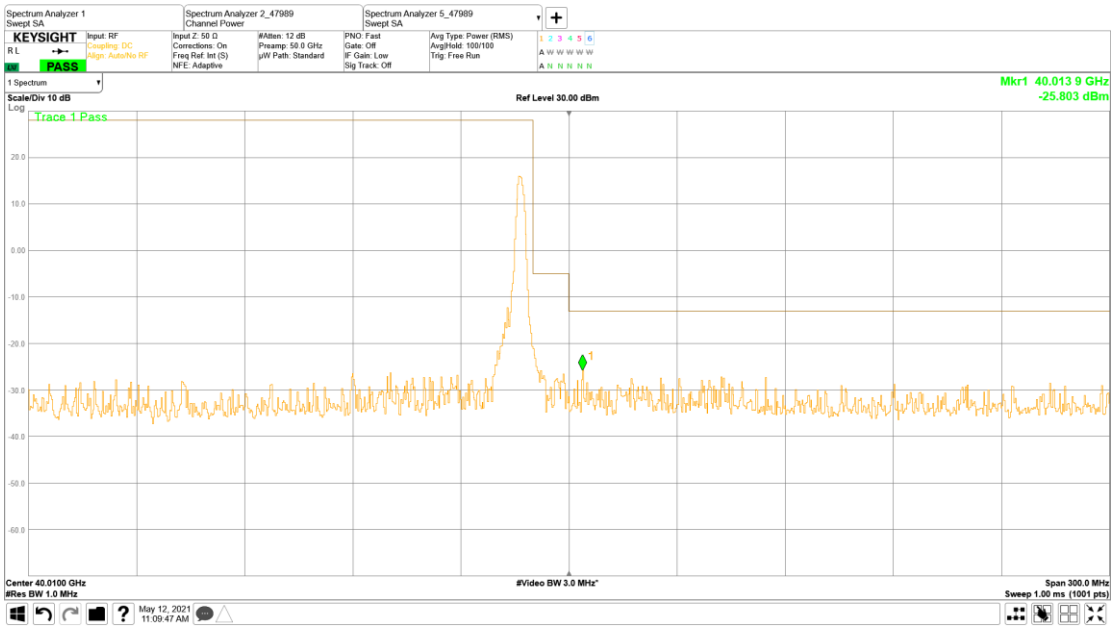
M 1 n260 MIMO BW 50MHz	 1CC / QPSK / Low channel / Full RB
M 1 n260 MIMO BW 50MHz	 1CC / 64QAM / Low channel / 1 RB

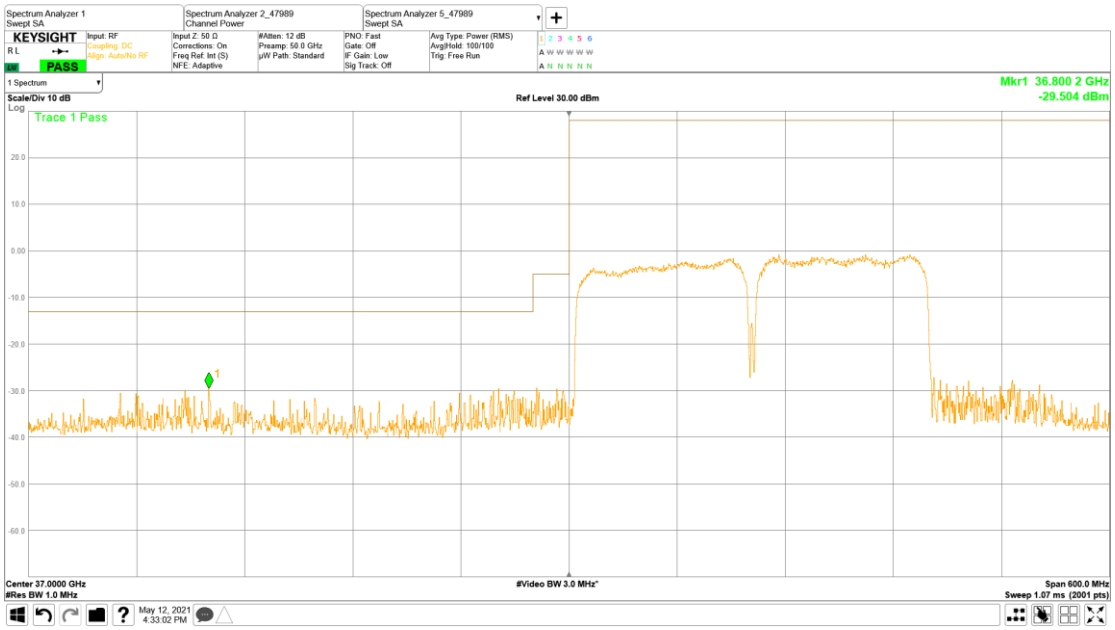
M 1 n260 MIMO BW 50MHz	 1CC / QPSK / High channel / Full RB
M 1 n260 MIMO BW 50MHz	 1CC / 64QAM / High channel / 1 RB

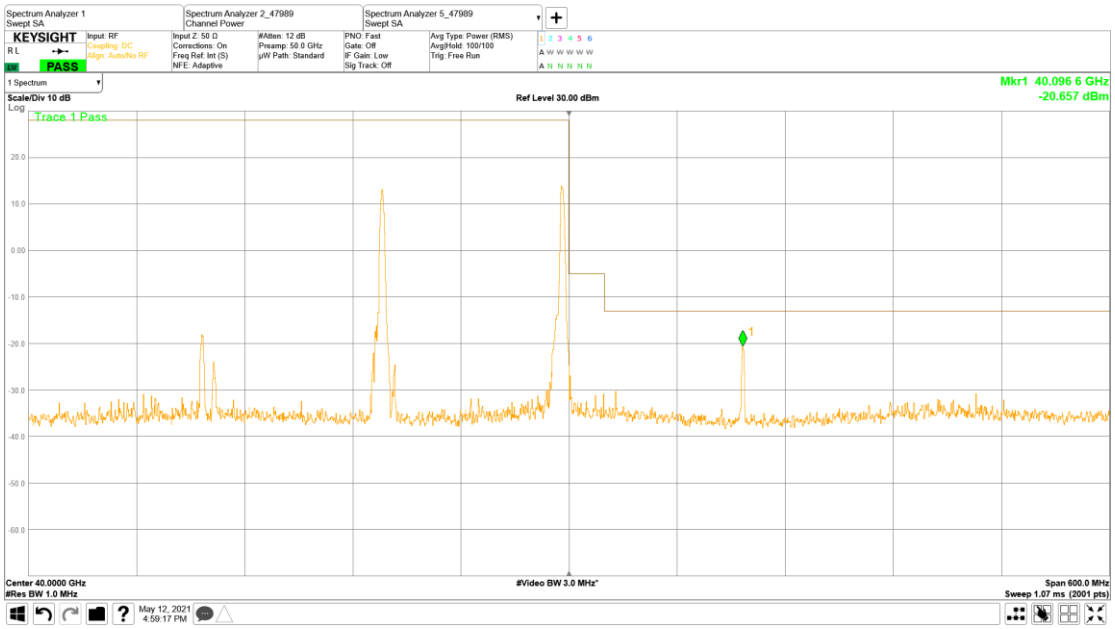
M 1 n260 MIMO BW 50MHz	 2CC / QPSK / Low channel / Full RB
M 1 n260 MIMO BW 50MHz	 2CC / 16QAM / Low channel / 1 RB

M 1 n260 MIMO BW 50MHz	 2CC / BPSK / High channel / Full RB
M 1 n260 MIMO BW 50MHz	 2CC / 16QAM / High channel / 1 RB

M 1 n260 MIMO BW 100MHz	 1CC / BPSK / Low channel / Full RB
M 1 n260 MIMO BW 100MHz	 1CC / QPSK / Low channel / 1 RB

M 1 n260 MIMO BW 100MHz	 1CC / BPSK / High channel / Full RB
M 1 n260 MIMO BW 100MHz	 1CC / 16QAM / High channel / 1 RB

M 1 n260 MIMO BW 100MHz	 2CC / BPSK / Low channel / Full RB
M 1 n260 MIMO BW 100MHz	 2CC / 16QAM / Low channel / 1 RB

M 1 n260 MIMO BW 100MHz	 2CC / QPSK / High channel / Full RB
M 1 n260 MIMO BW 100MHz	 2CC / 16QAM / High channel / 1 RB

8.4. Radiated Spurious and Harmonic Emissions

RULE PART(S)

FCC: §2.1051, §30.203

LIMITS

30.203 - (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower.

TEST PROCEDURE

a) Start frequency was set to 30MHz and stop frequency was set to 100 GHz for n261 and 200GHz for n260.
b) Set the RBW = 100kHz for emission below 1GHz and 1MHz for emissions above 1GHz
c) Set VBW ≥ 3 × RBW;
d) Detector = RMS;
e) Trace mode = trace average;
f) Sweep time = auto couple;
g) Number of sweep points ≥ 2 x Span/RBW

(KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 Section 4.4.2 and Section 4.4.3)
(ANSI C63.26-2015 Section 5.7.4)

NOTE

The EUT was tested in three orthogonal planes and in all possible test configurations and positioning.

All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.

The plots from 1-200GHz show corrected average EIRP levels. Plots below 1GHz are corrected field strength levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. For measurements > 50GHz, Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

Sample Analyzer Offset Calculation (1 - 50GHz, test distance = 1m)
EIRP (dBm) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107 + 20log(D) − 104.8
All factors except spectrum analyzer level are applied as correction factors each band in the analyzer.

Sample Analyzer Offset Calculation (50 - 200GHz, test distance = 1m)
EIRP (dBm) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107 + 20log(D) − 104.8
All factors except spectrum analyzer level are applied as correction factors each band in the analyzer.

Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: $R > 2D^2/\text{wavelength}$, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, D is the largest dimension of the measurement antenna.

Frequency Range(GHz)	Wavelength(m)	Far Field Distance(m)	Measurement Distance(m)
18-40	0.008	0.54	1.00 (EIRP and Band Edge = 3.00)
40-50	0.006	1.05	1.50
50-75	0.004	0.69	1.00
75-110	0.003	0.46	1.00
110-175	0.002	0.34	1.00
175-200	0.002	0.16	1.00

All emissions from 18GHz - 50GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions above 50GHz were measured using a harmonic mixer with the spectrum analyzer.

All RSE's were measured with 1CC. It was determined that adding more CC's causes the overall amplitude of just 1CC to decrease, therefore, 1CC is the worst case for the purposes of spurious emissions measurements.

pi/2-BPSK, QPSK, 16QAM and 64QAM modulations were all investigated in SISO, SISO-Dual and MIMO configurations. The highest spurious emissions were for the SISO-Dual antenna configuration consistent with this also being the configuration with the highest EIRP. The SISO-Dual configuration was, therefore, use for the final emission measurements.

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Band n261 RSE reported only mid channel because no emissions were detected above noise floor except 18 – 27.5 GHz, 28.35 - 40 GHz and 50 – 75 GHz.

Band n260 RSE reported only mid channel because no emissions were detected above noise floor except 50 - 75 GHz.

All RSE’s were investigated in EN-DC mode and with 802.11 chipset active. It was determined that there is no new emission introduced by EN-DC mode, or the 802.11 chipset. For EN-DC mode, n261 and n260 use LTE B2, B5, B12, B13, B14, B30, B48 and B66.

There was no discernible difference in the spurious emission levels when using different LTE anchor bands. Thus, LTE Band 66 was used as a representative anchor band for EN-DC investigations.

RESULTS

See the following pages.

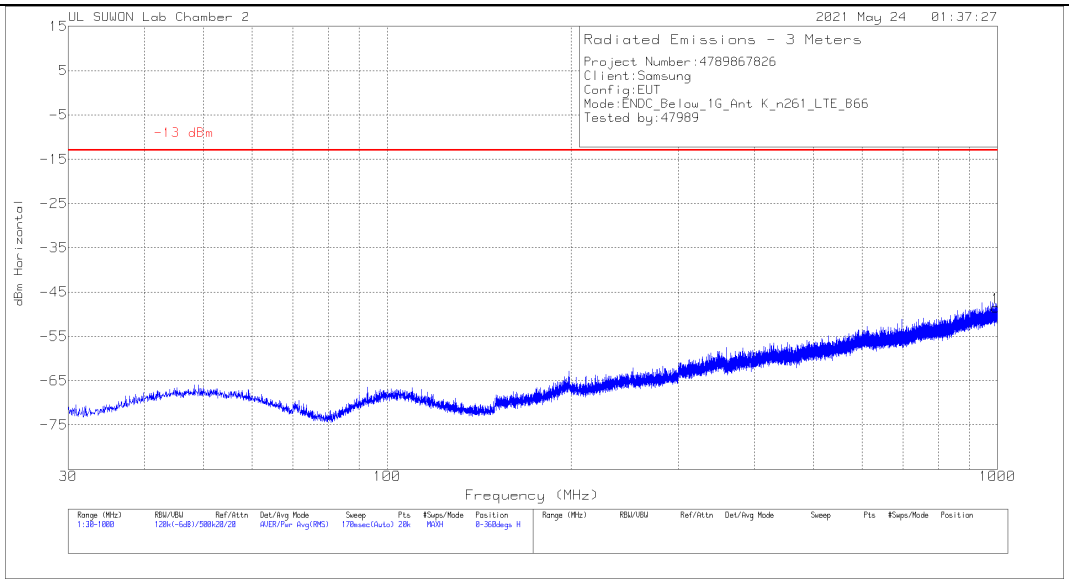
8.4.1. RADIATED SPURIOUS AND HARMONIC EMISSIONS RESULT

Module 0 / n261

30 – 1000 MHz Result

M 0

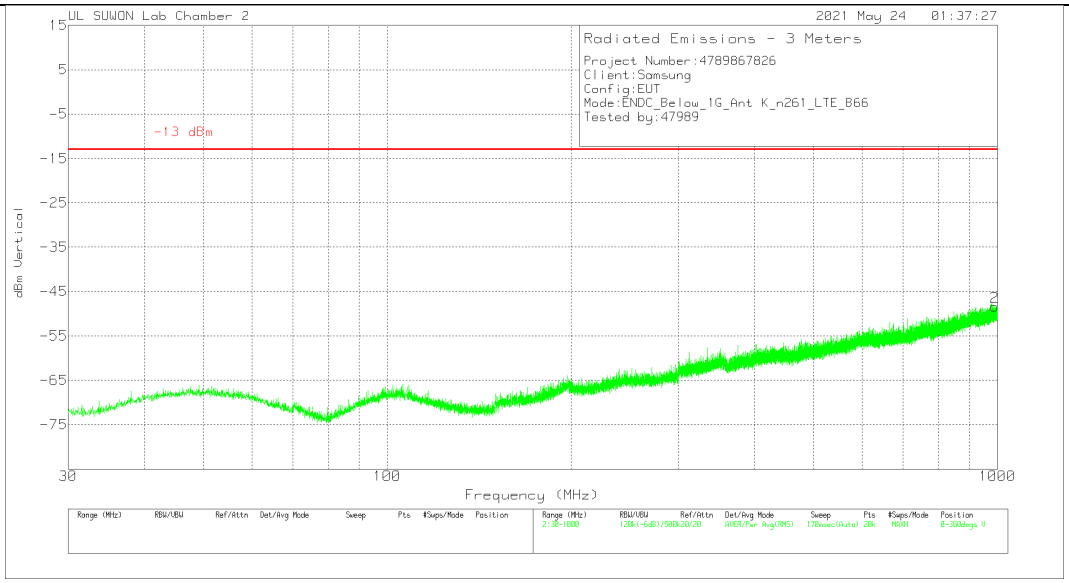
n261



Mid Channel / Horizontal

M 0

n261



Mid Channel / Vertical

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	VULB9163_749	Below 1G[dB]	Conversion Factor[dB]	Corrected Reading dBm	-13 dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	993.0733	-61.63	RMS	28.4	-27.1	11.8	-48.53	-	-	0-360	400	H
2	989.4844	-61.28	RMS	28.3	-27.2	11.8	-48.38	-	-	0-360	200	V

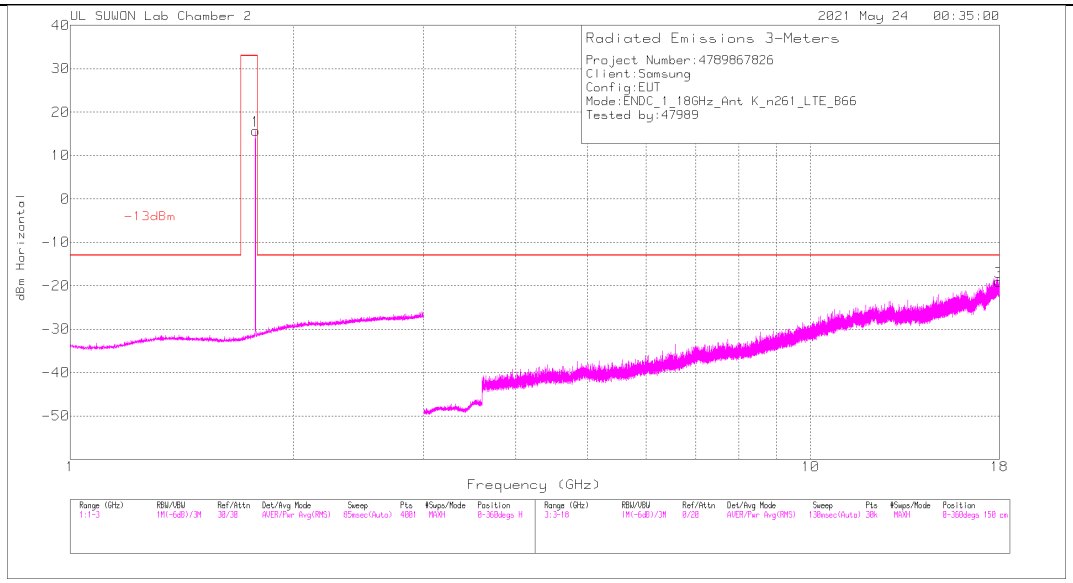
RMS - RMS detection

No emissions were detected above noise floor this antenna and band. Thus reported mid channel data.

1 – 18 GHz Result

M 0

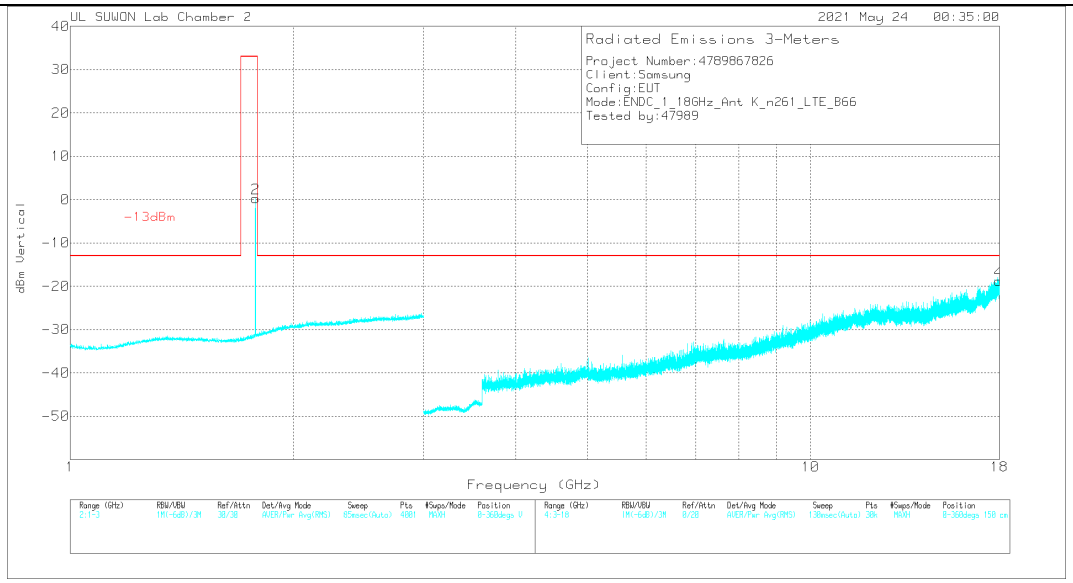
n261



Mid Channel / Horizontal

M 0

n261



Mid Channel / Vertical

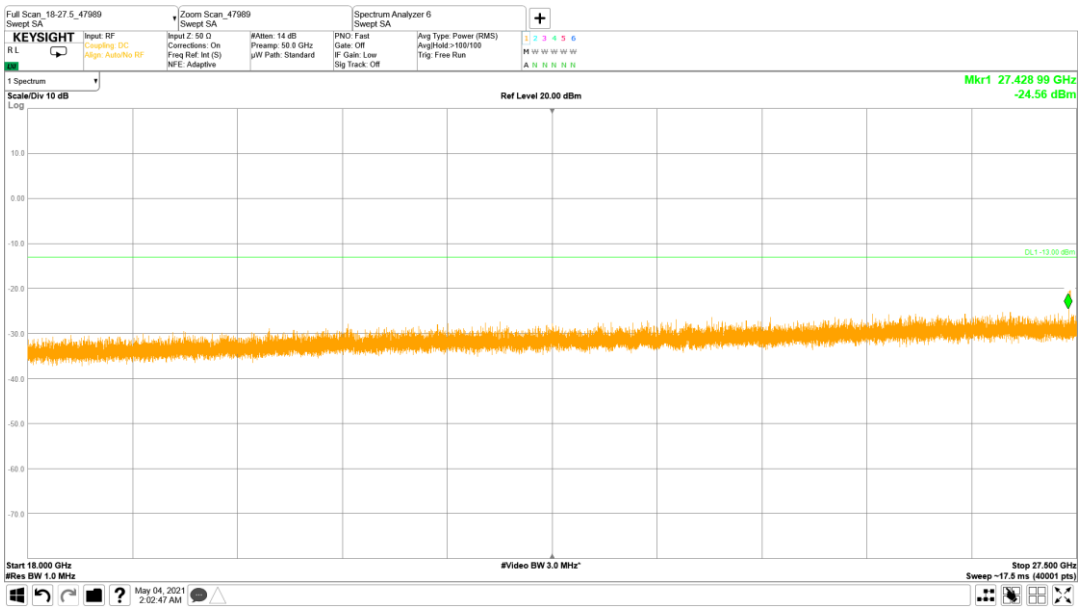
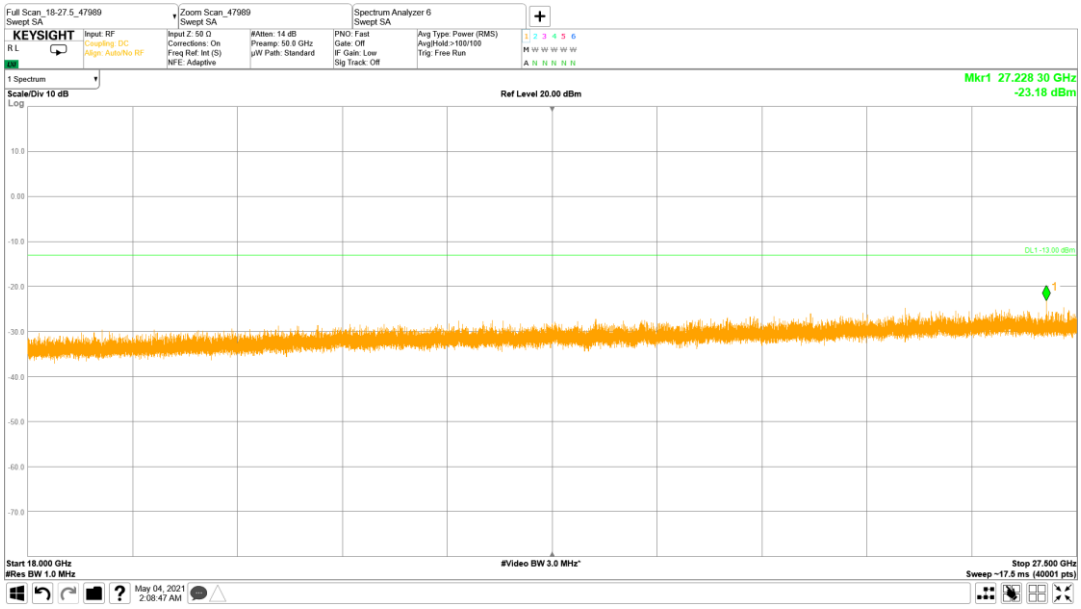
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	3117_00168724	10dB ATT[dB]	Conversion Factor[dB]	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
**1	1.779	-4.22	RMS	29.6	-21.5	11.8	15.68	33	-17.32	0-360	150	H
**2	1.779	-19.63	RMS	29.6	-21.5	11.8	.27	33	-32.73	0-360	150	V
3	17.95699	-64.21	RMS	41.7	-8.4	11.8	-19.11	-13	-6.11	0-360	150	H
4	17.97749	-63.97	RMS	41.6	-8.3	11.8	-18.87	-13	-5.87	0-360	150	V

RMS - RMS detection

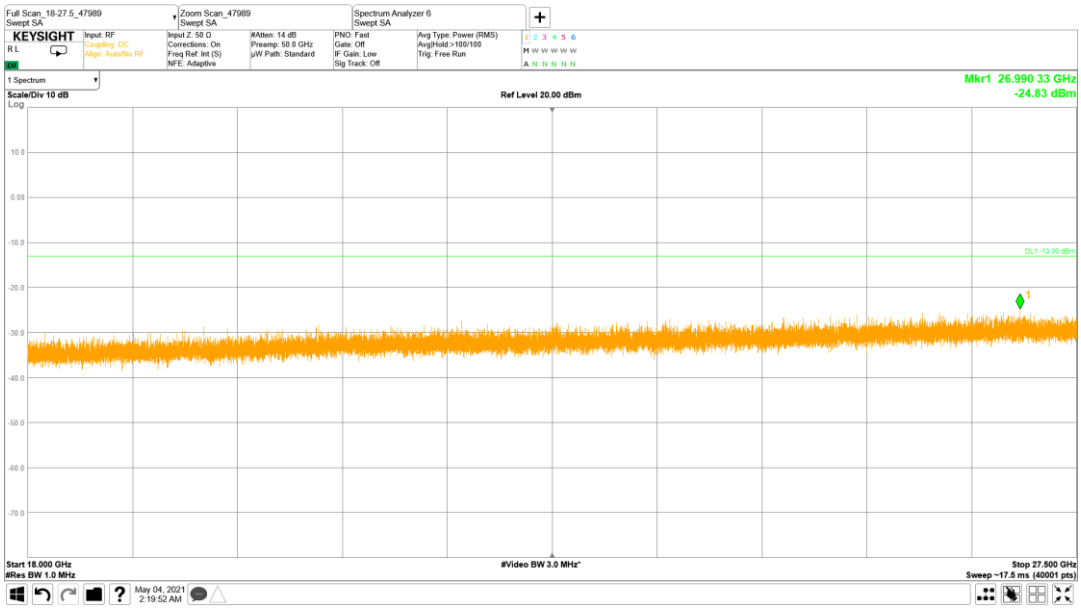
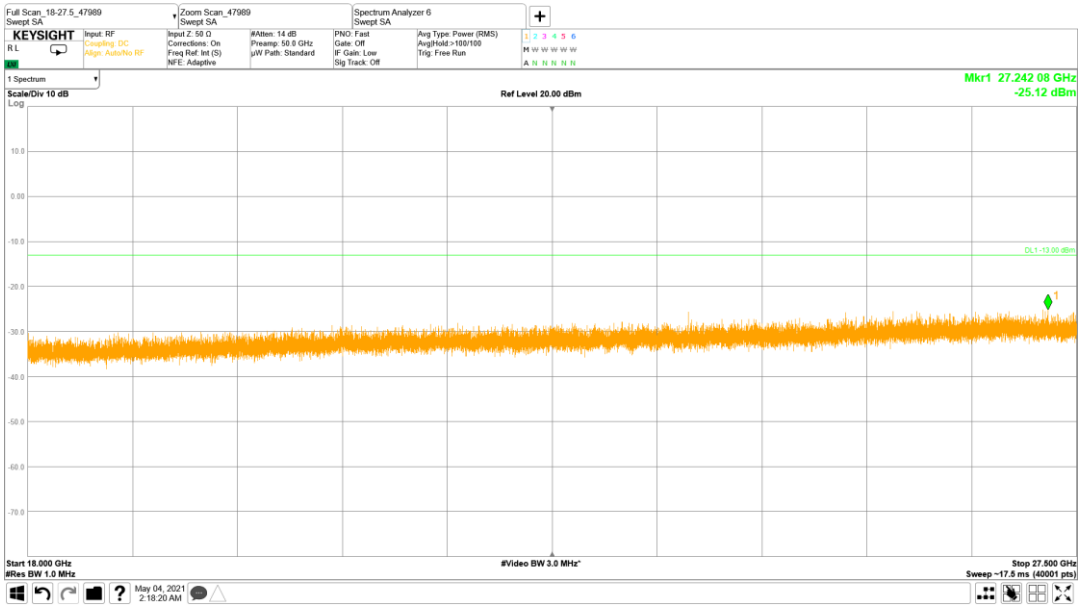
** Marker 1 and 2 were the fundamental signal of LTE Band 66 that was used as a representative anchor band for EN-DC investigations.
No emissions were detected above noise floor this antenna and band. Thus reported mid channel data.

18 – 27.5 GHz

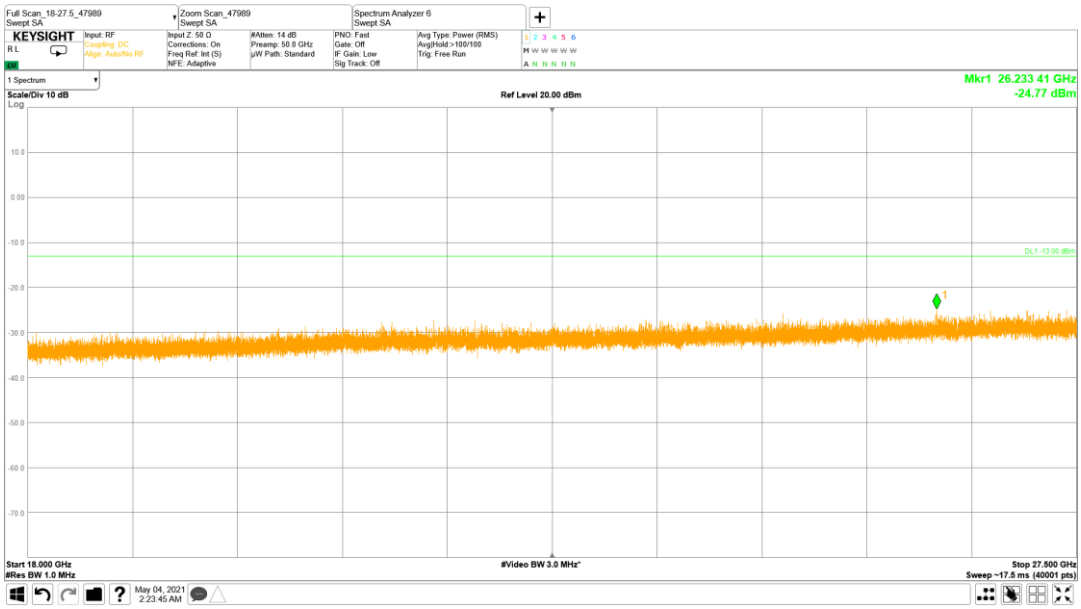
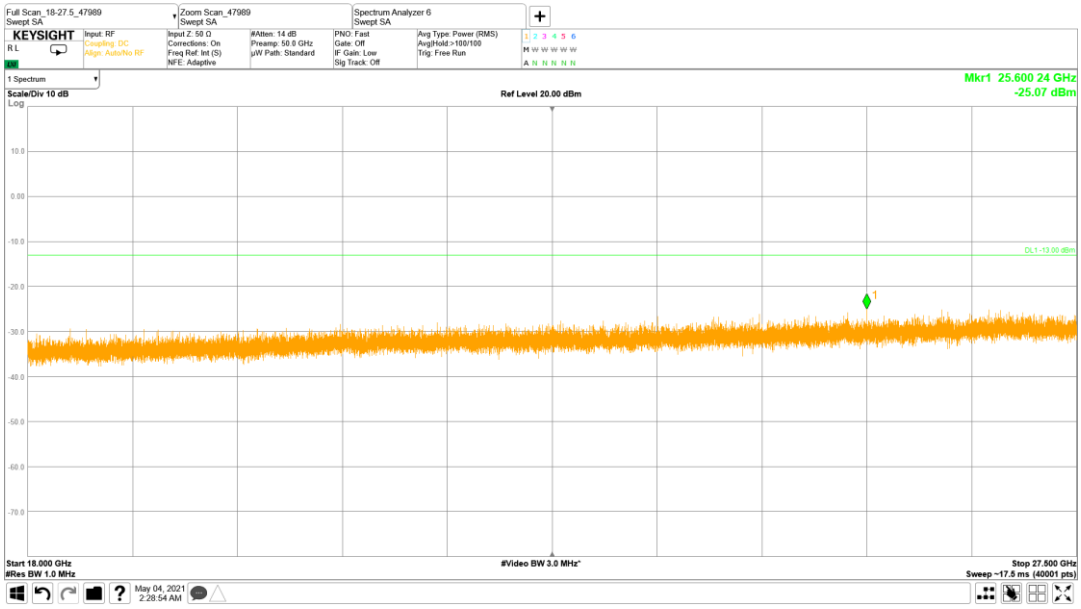
M 0 n261 BW 50MHz	 Low Channel / Horizontal
M 0 n261 BW 50MHz	 Low Channel / Vertical

Final Measurement Data Table

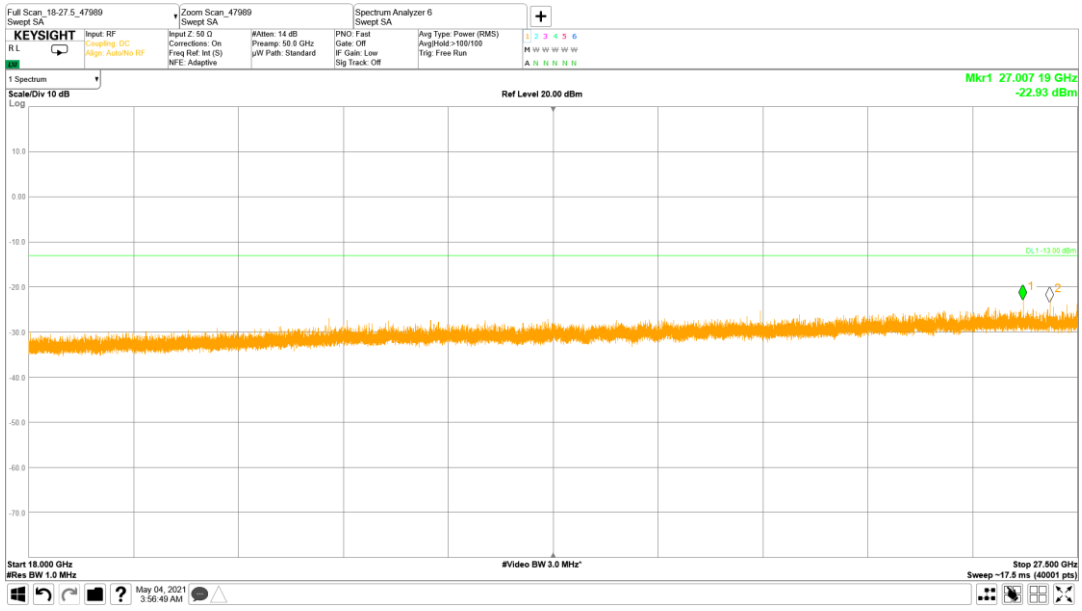
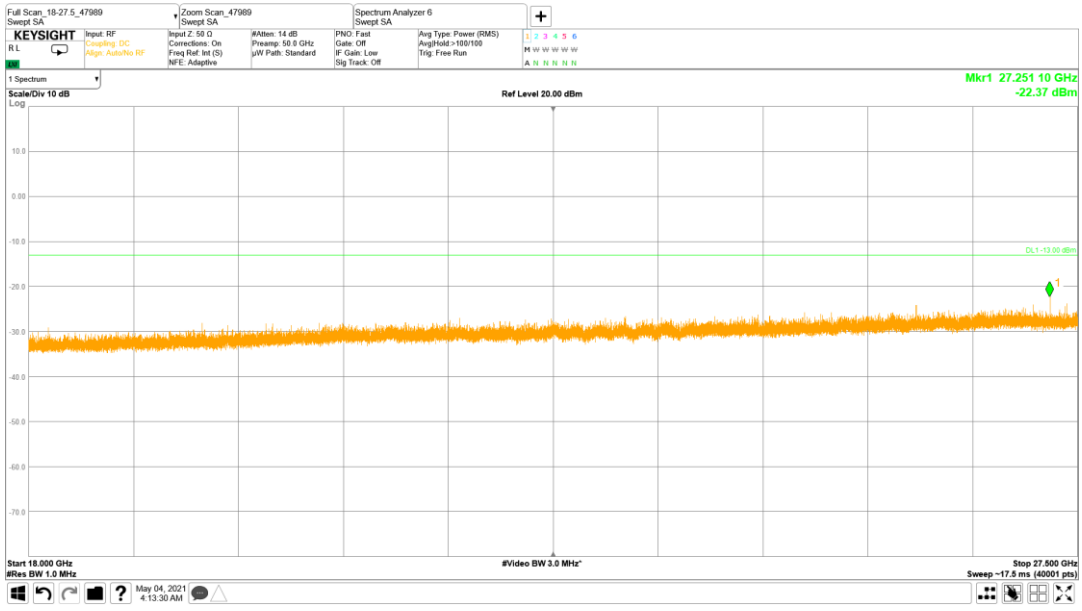
Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
27228.23	50	SISO-Dual	QPSK	V	132.1	285.0	-32.44	-13	19.44

M 0 n261 BW 50MHz	 Mid Channel / Horizontal
M 0 n261 BW 50MHz	 Mid Channel / Vertical

No emissions were detected above noise floor.

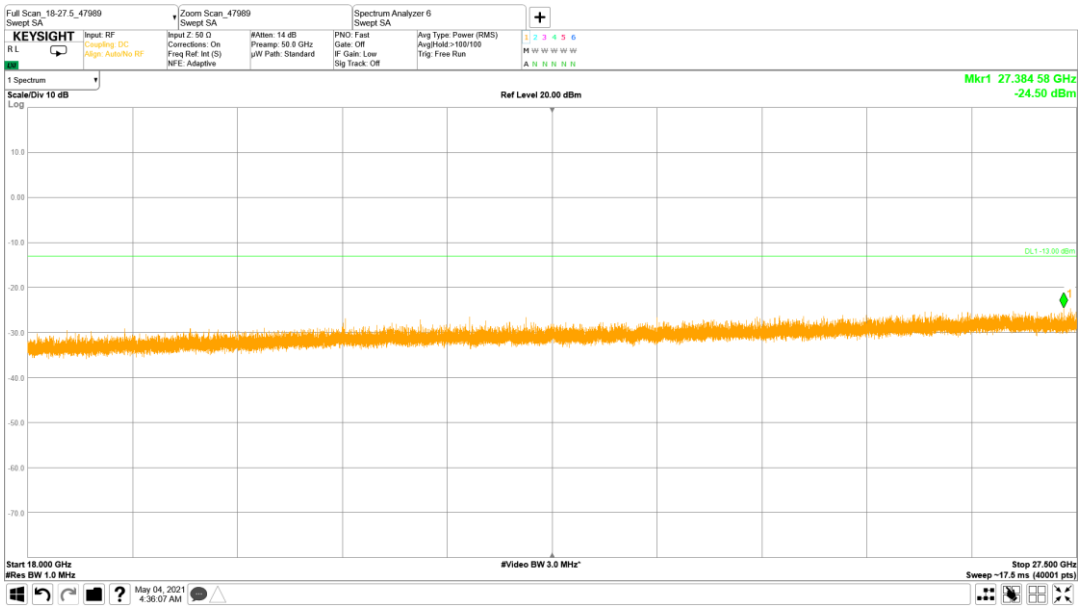
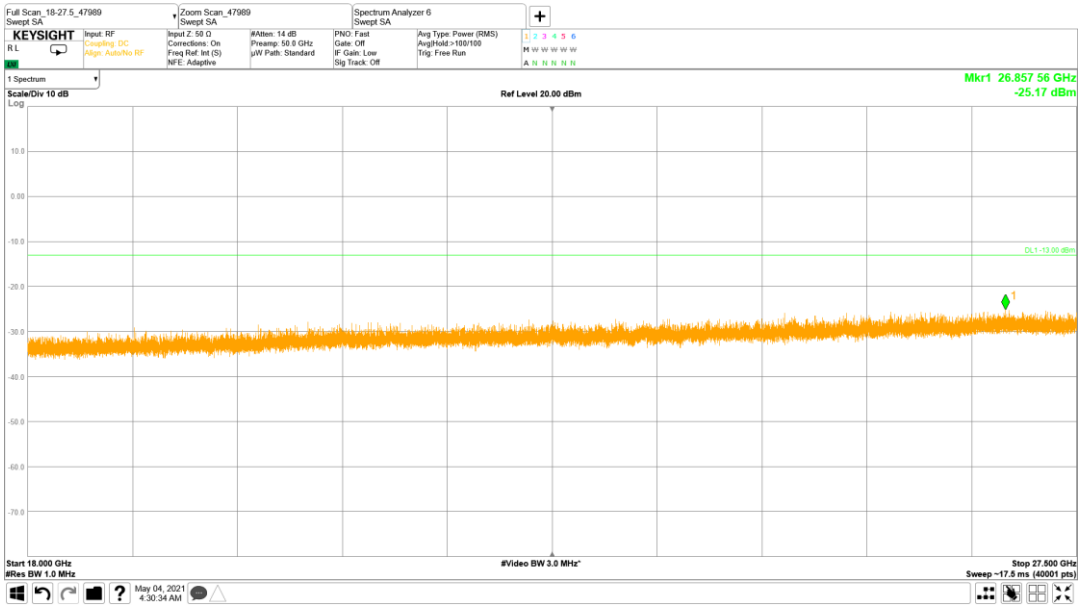
M 0 n261 BW 50MHz	 High Channel / Horizontal
M 0 n261 BW 50MHz	 High Channel / Vertical

No emissions were detected above noise floor.

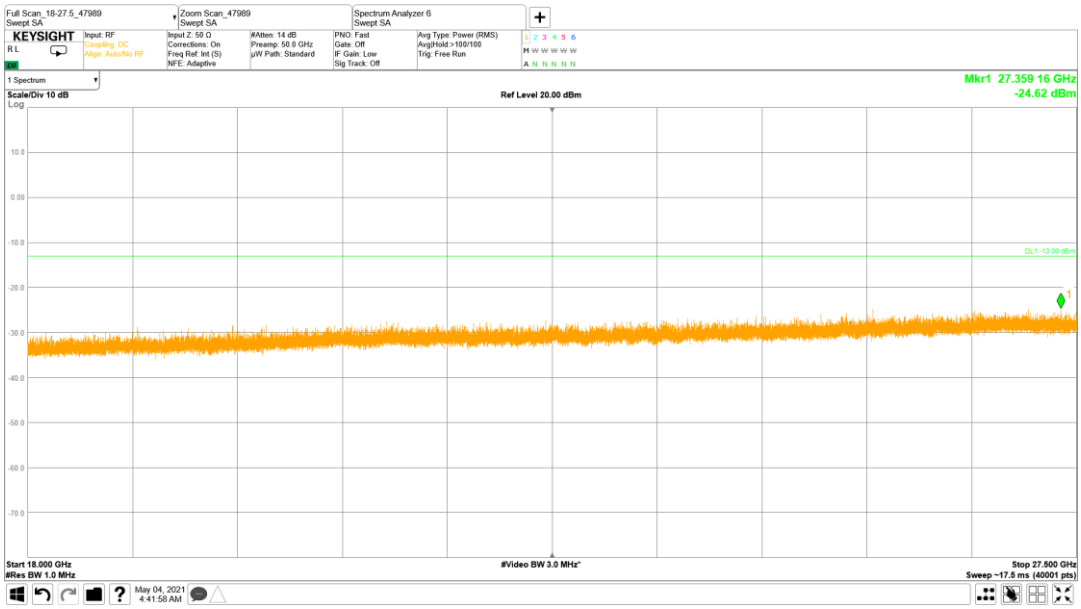
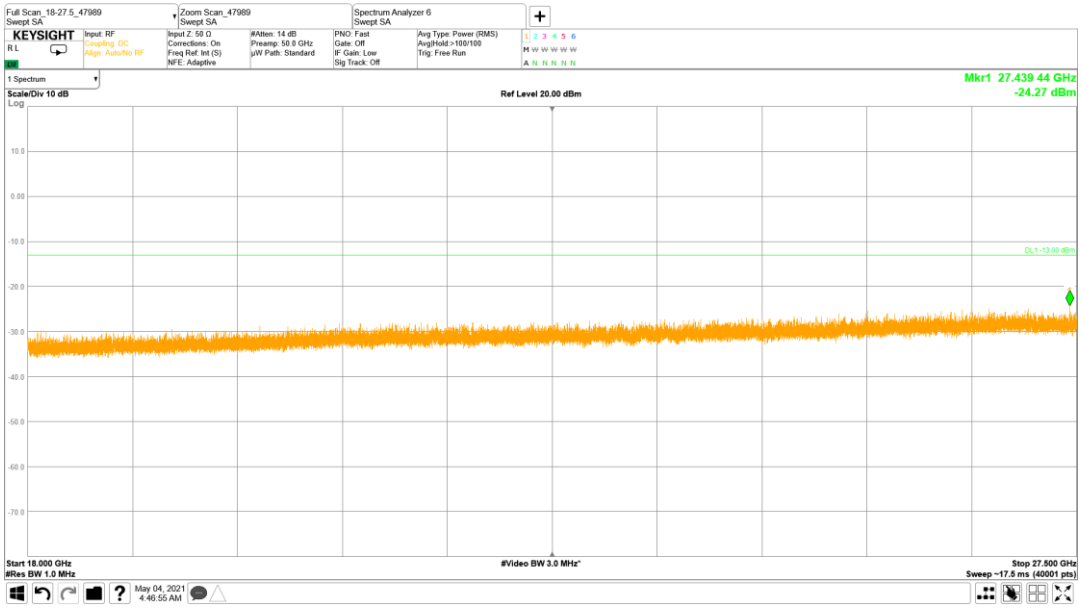
M 0 n261 BW 100MHz	 Low Channel / Horizontal
M 0 n261 BW 100MHz	 Low Channel / Vertical

Final Measurement Data Table

Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
27007.87	100	SISO-Dual	QPSK	H	323.6	98.9	-30.14	-13	17.14
27251.19	100	SISO-Dual	QPSK	H	358.7	102.5	-29.17	-13	16.17
27251.15	100	SISO-Dual	QPSK	V	220.0	269.5	-33.08	-13	20.08

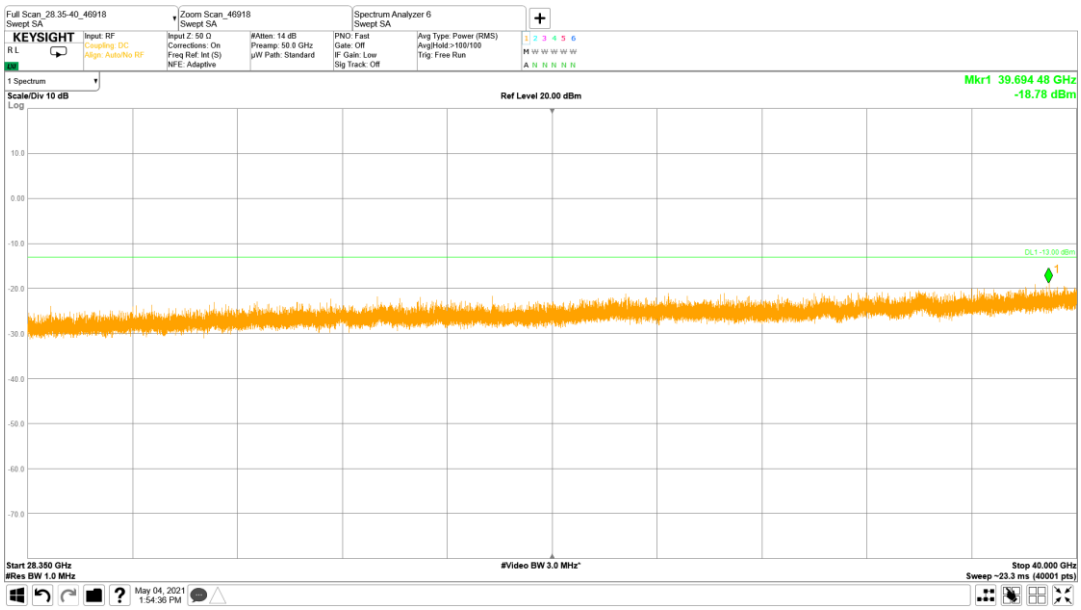
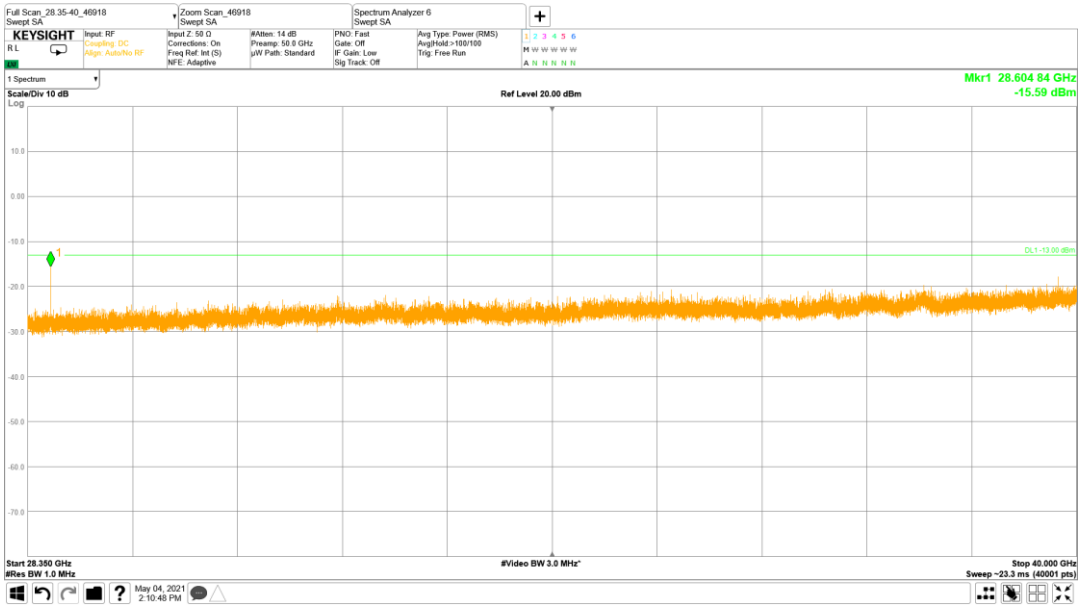
M 0 n261 BW 100MHz	 Mid Channel / Horizontal
M 0 n261 BW 100MHz	 Mid Channel / Vertical

No emissions were detected above noise floor.

M 0 n261 BW 100MHz	 High Channel / Horizontal
M 0 n261 BW 100MHz	 High Channel / Vertical

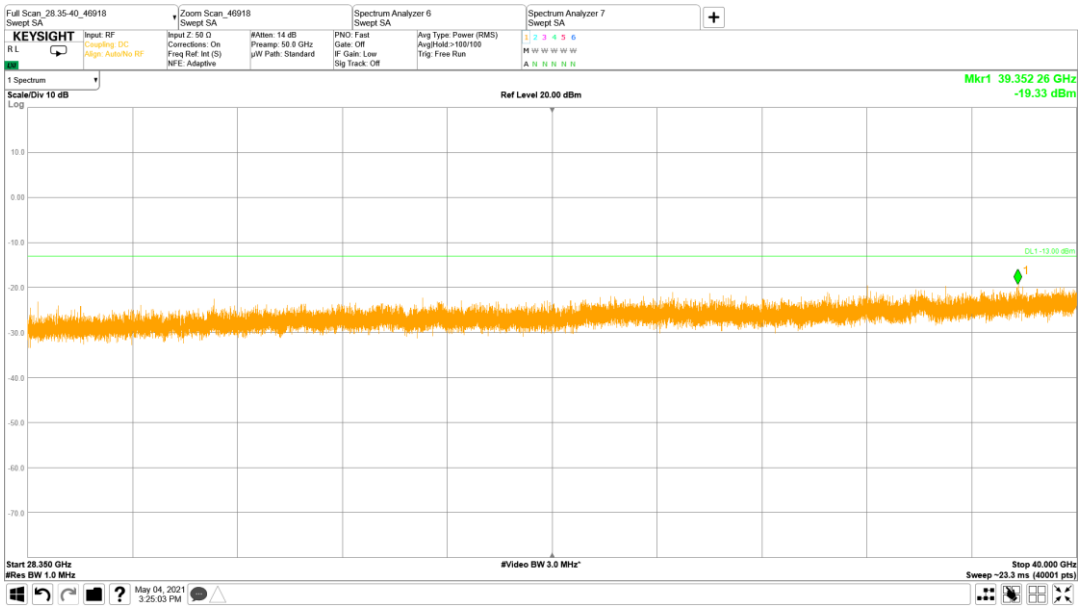
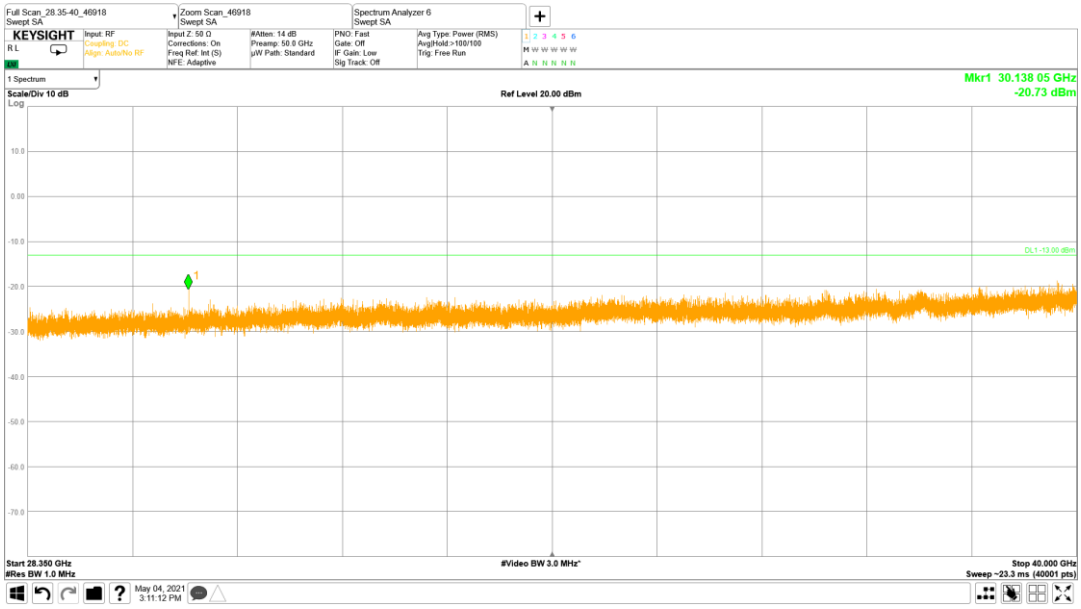
No emissions were detected above noise floor.

28.35 – 40 GHz Result

M 0 n261 BW 50MHz	 Low Channel / Horizontal
M 0 n261 BW 50MHz	 Low Channel / Vertical

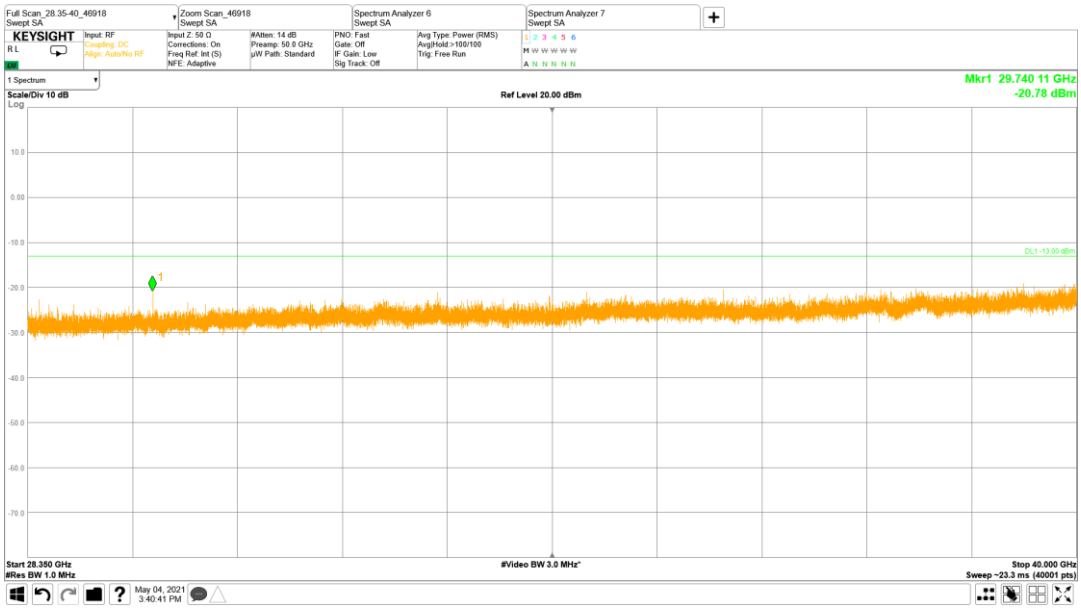
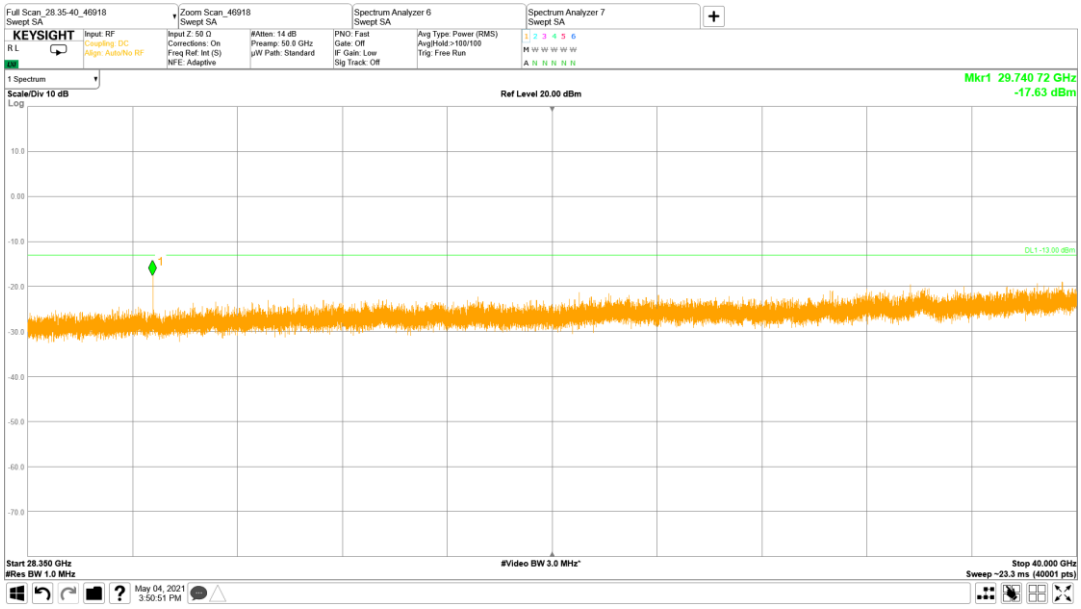
Final Measurement Data Table

Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
28605.17	50	SISO-Dual	QPSK	V	173.4	262.9	-19.24	-13	6.24

M 0 n261 BW 50MHz	 Mid Channel / Horizontal
M 0 n261 BW 50MHz	 Mid Channel / Vertical

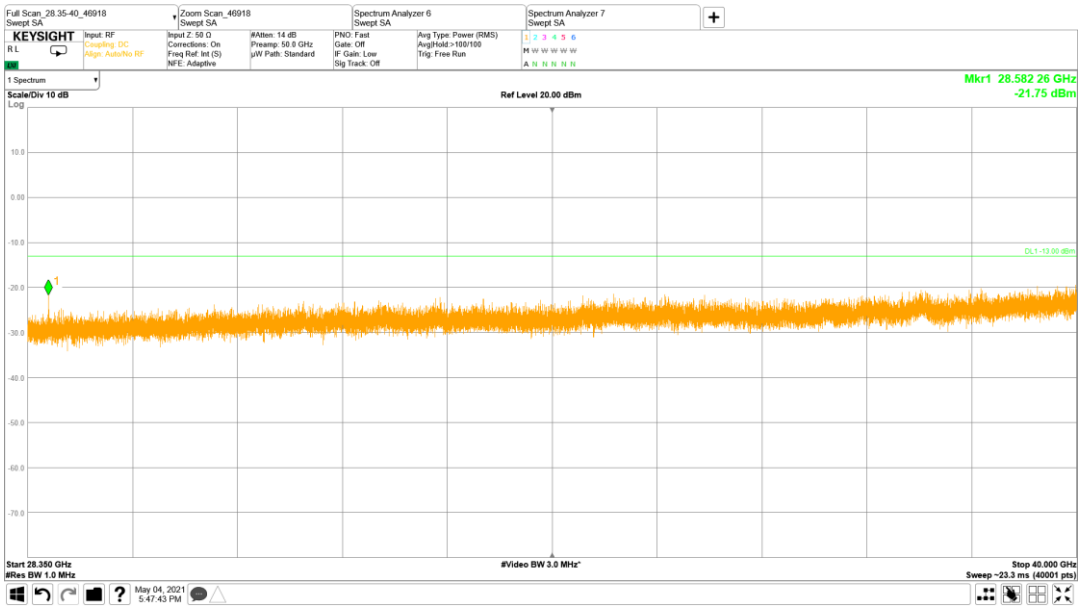
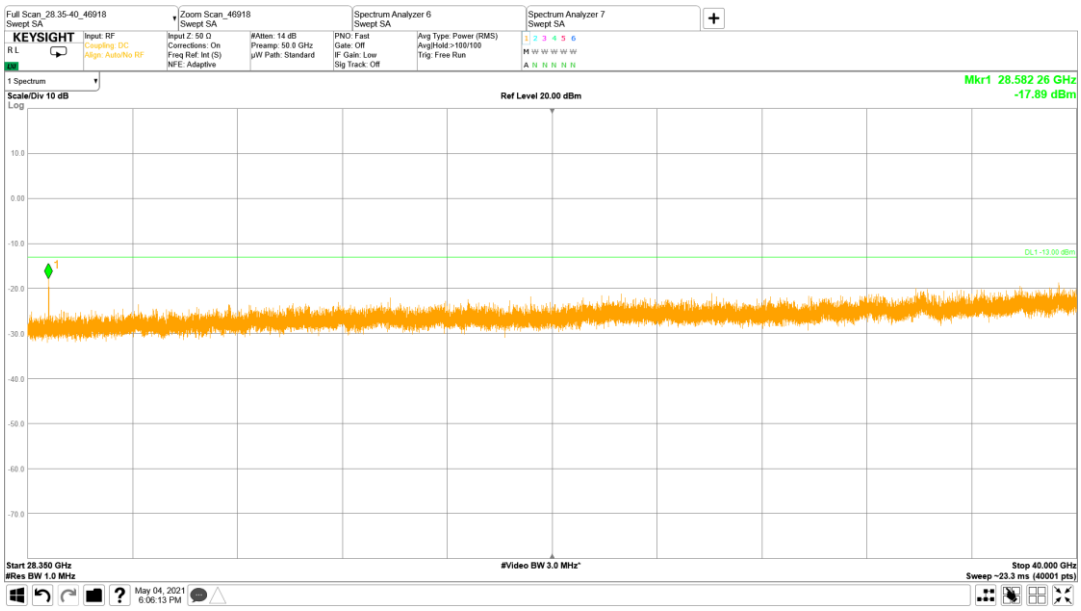
Final Measurement Data Table

Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
30137.85	50	SISO-Dual	QPSK	V	180.6	222.6	-24.91	-13	11.91

M 0 n261 BW 50MHz	 High Channel / Horizontal
M 0 n261 BW 50MHz	 High Channel / Vertical

Final Measurement Data Table

Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
29740.54	50	SISO-Dual	QPSK	H	275.7	112.5	-25.22	-13	12.22
29740.49	50	SISO-Dual	QPSK	V	9.2	65.9	-21.88	-13	8.88

M 0 n261 BW 100MHz	 Low Channel / Horizontal
M 0 n261 BW 100MHz	 Low Channel / Vertical

Final Measurement Data Table

Frequency [MHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	Result [dBm]	Limit [dBm]	Margin [dB]
28582.15	100	SISO-Dual	QPSK	H	358.2	41.4	-26.25	-13	13.25
28582.11	100	SISO-Dual	QPSK	V	357	90.8	-20.46	-13	7.46

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