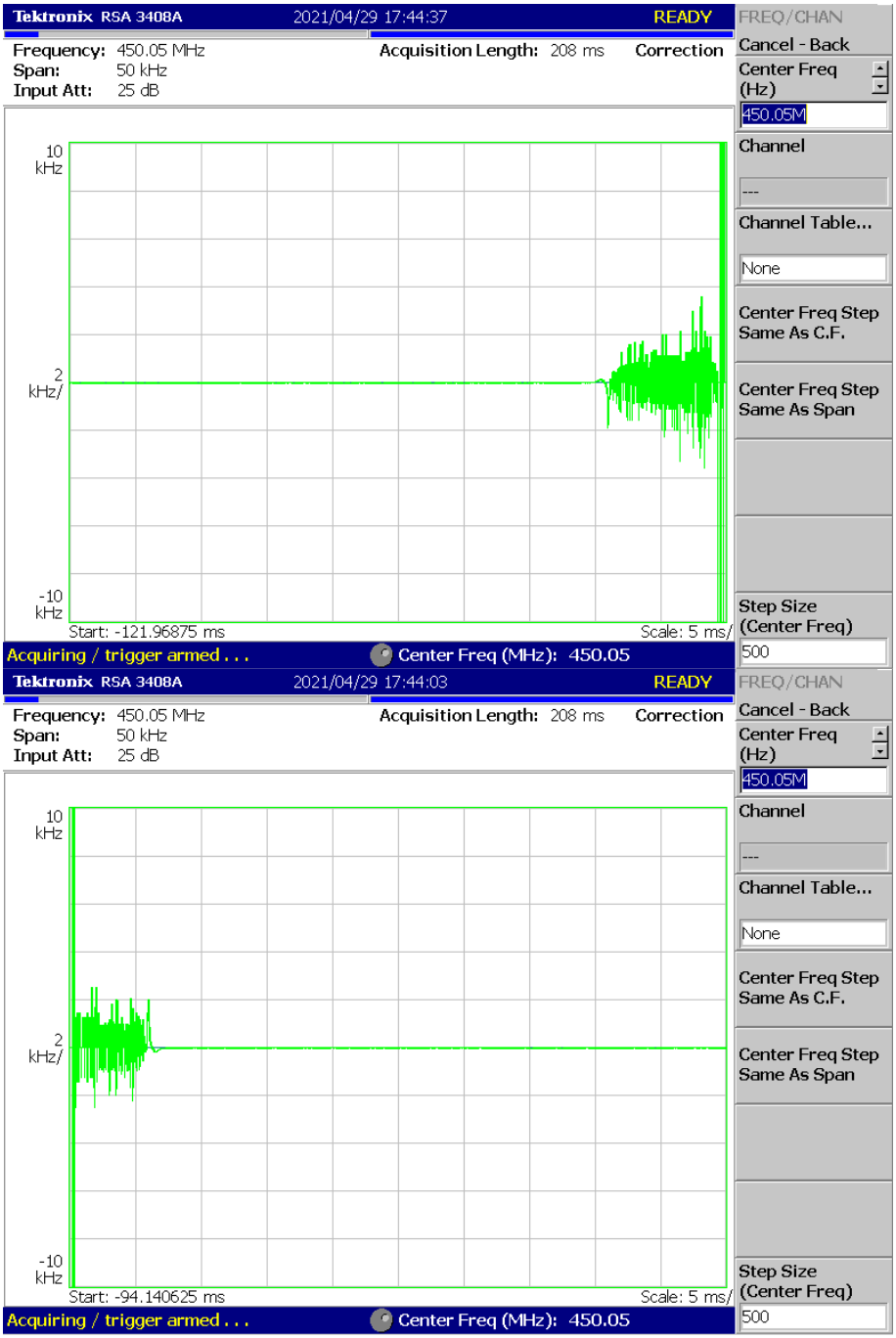
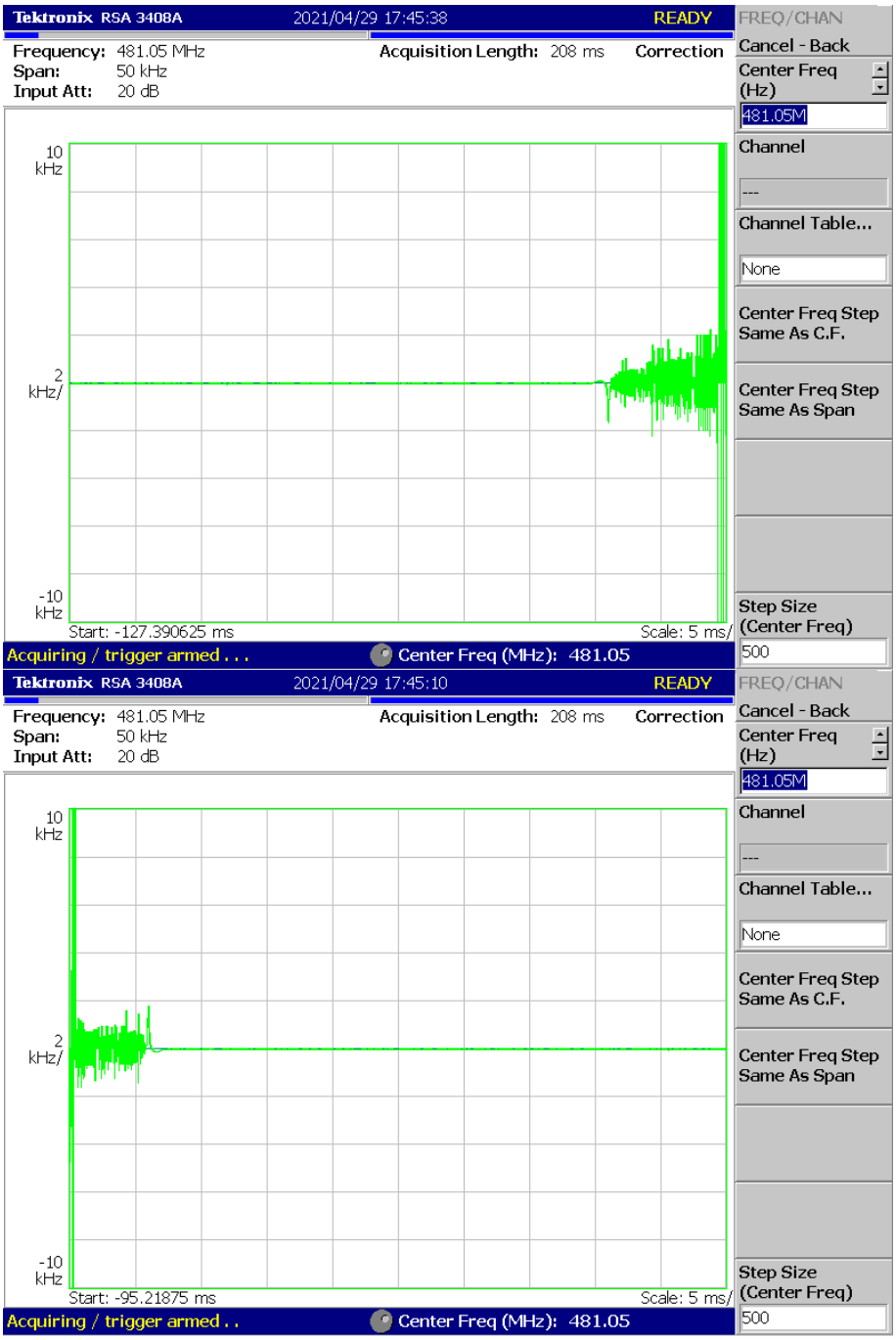
11K0F3E

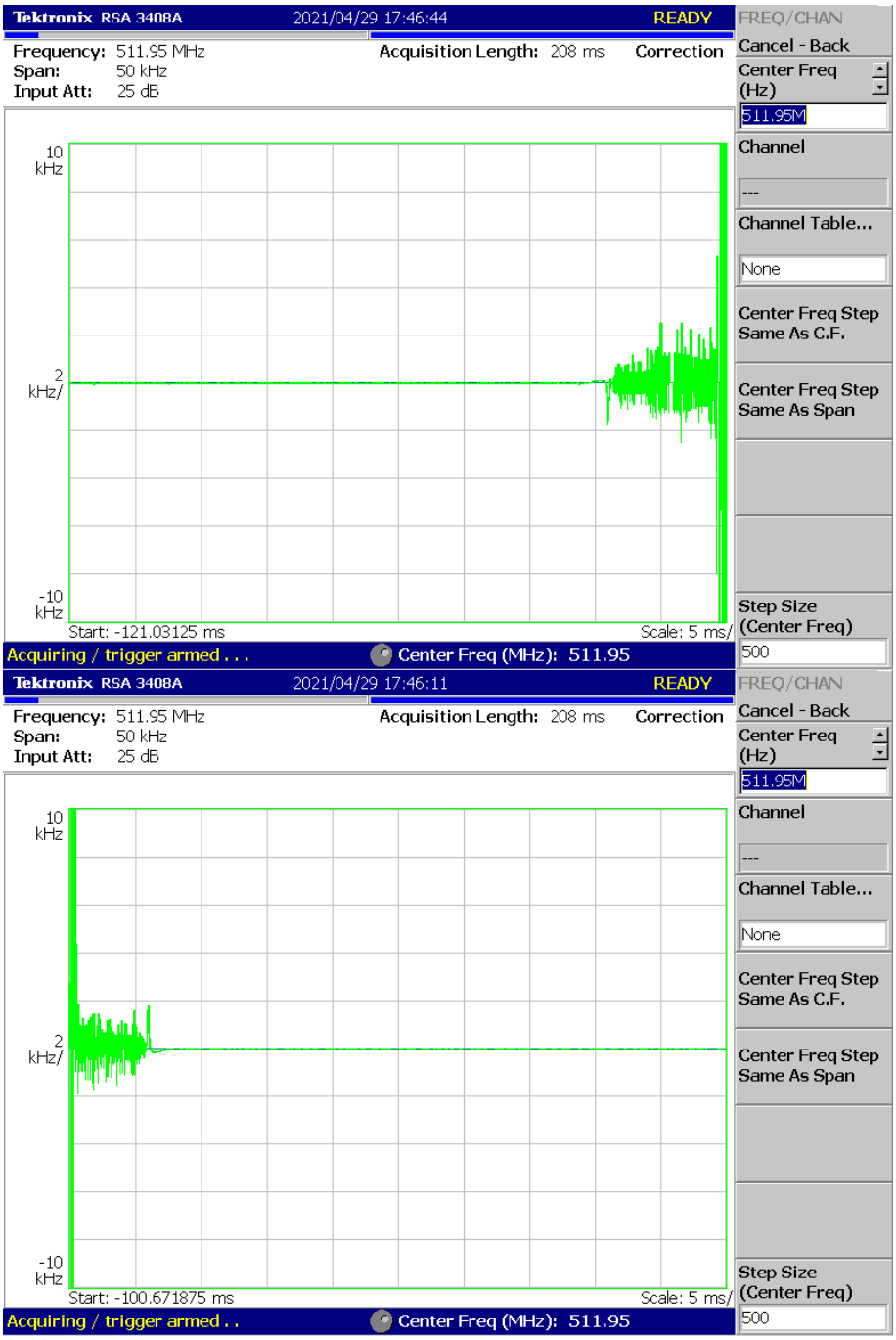
(450.05 MHz)_High



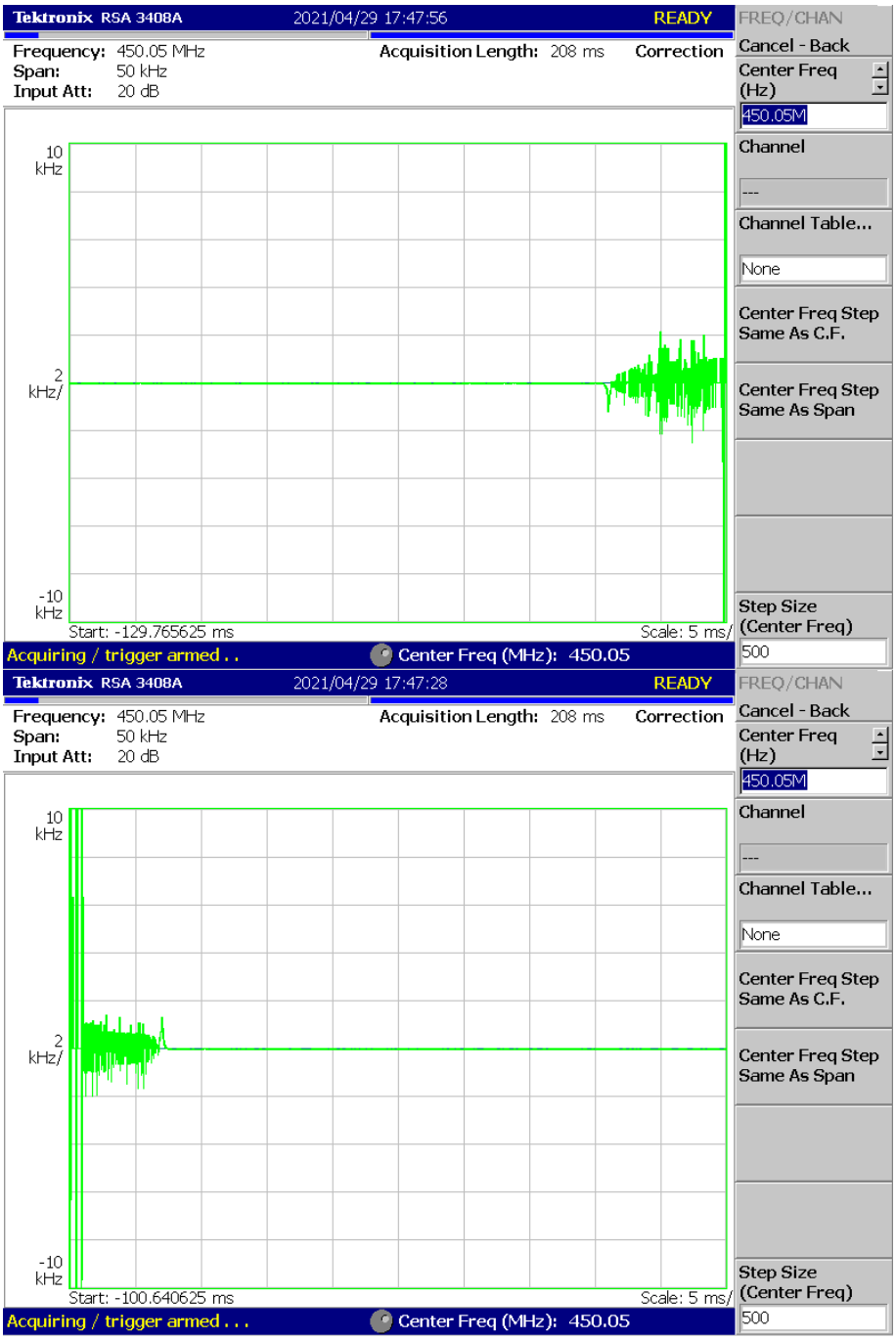
(481.05 MHz)_High



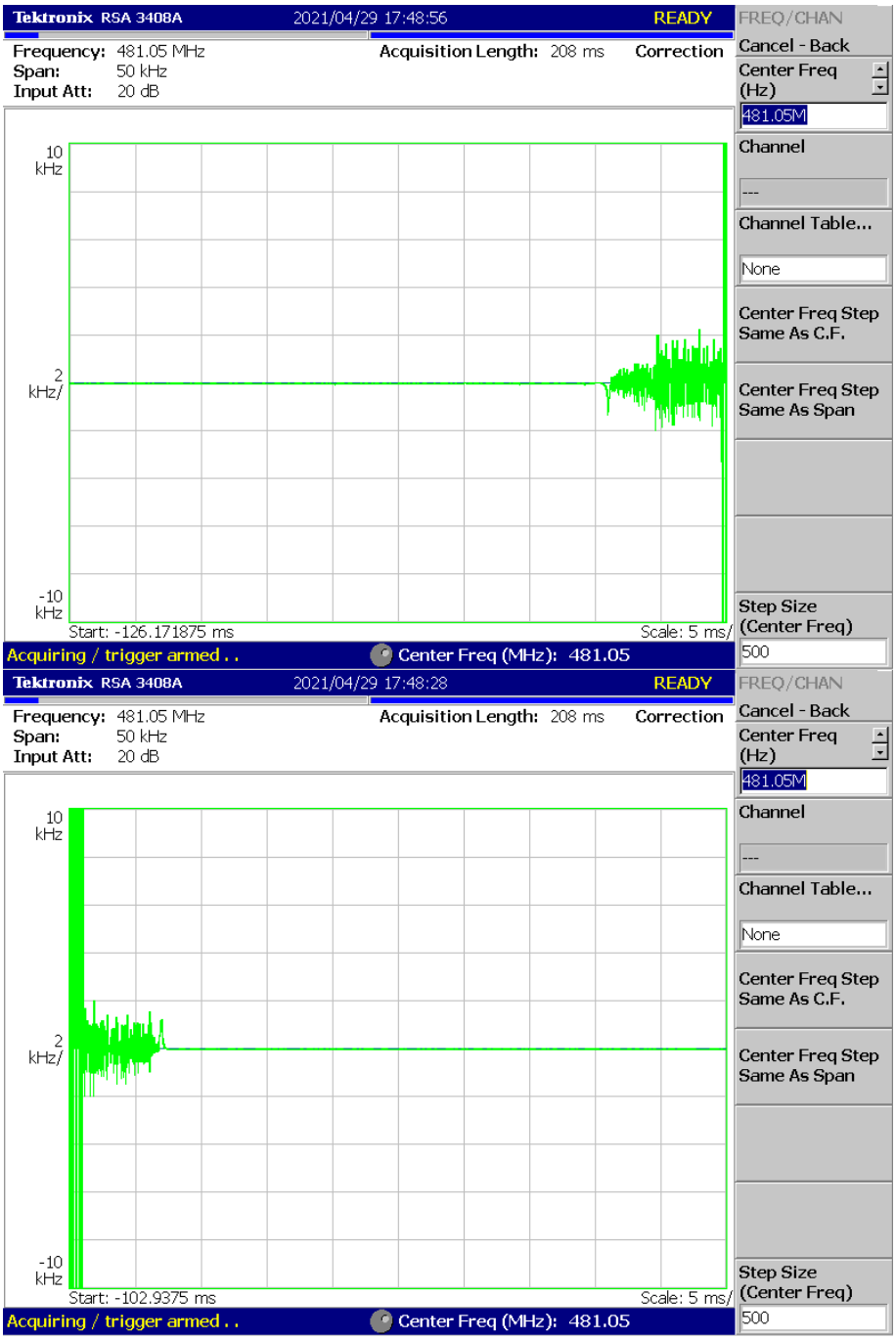
(511.95 MHz)_High



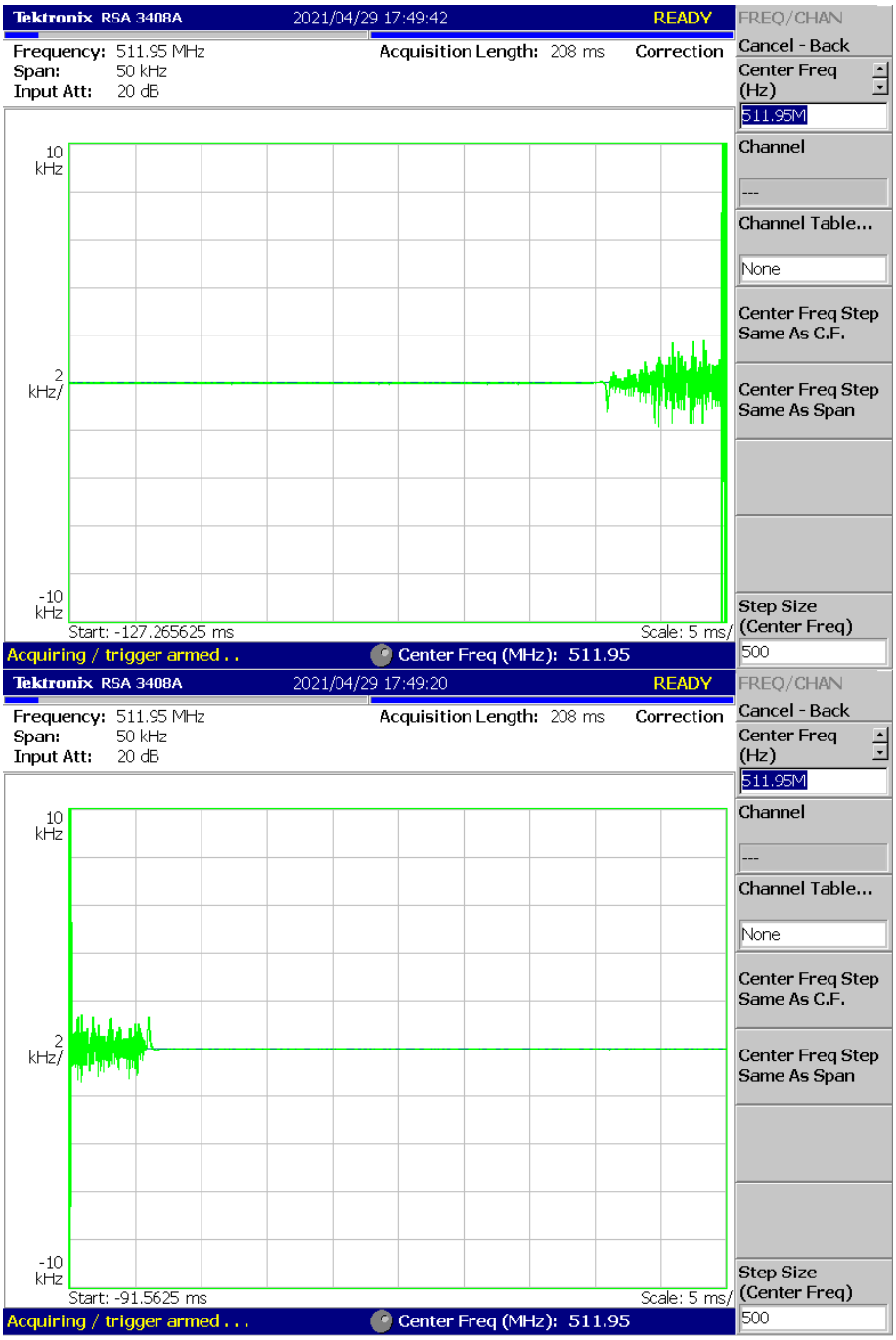
(450.05 MHz)_Low



(481.05 MHz)_ Low

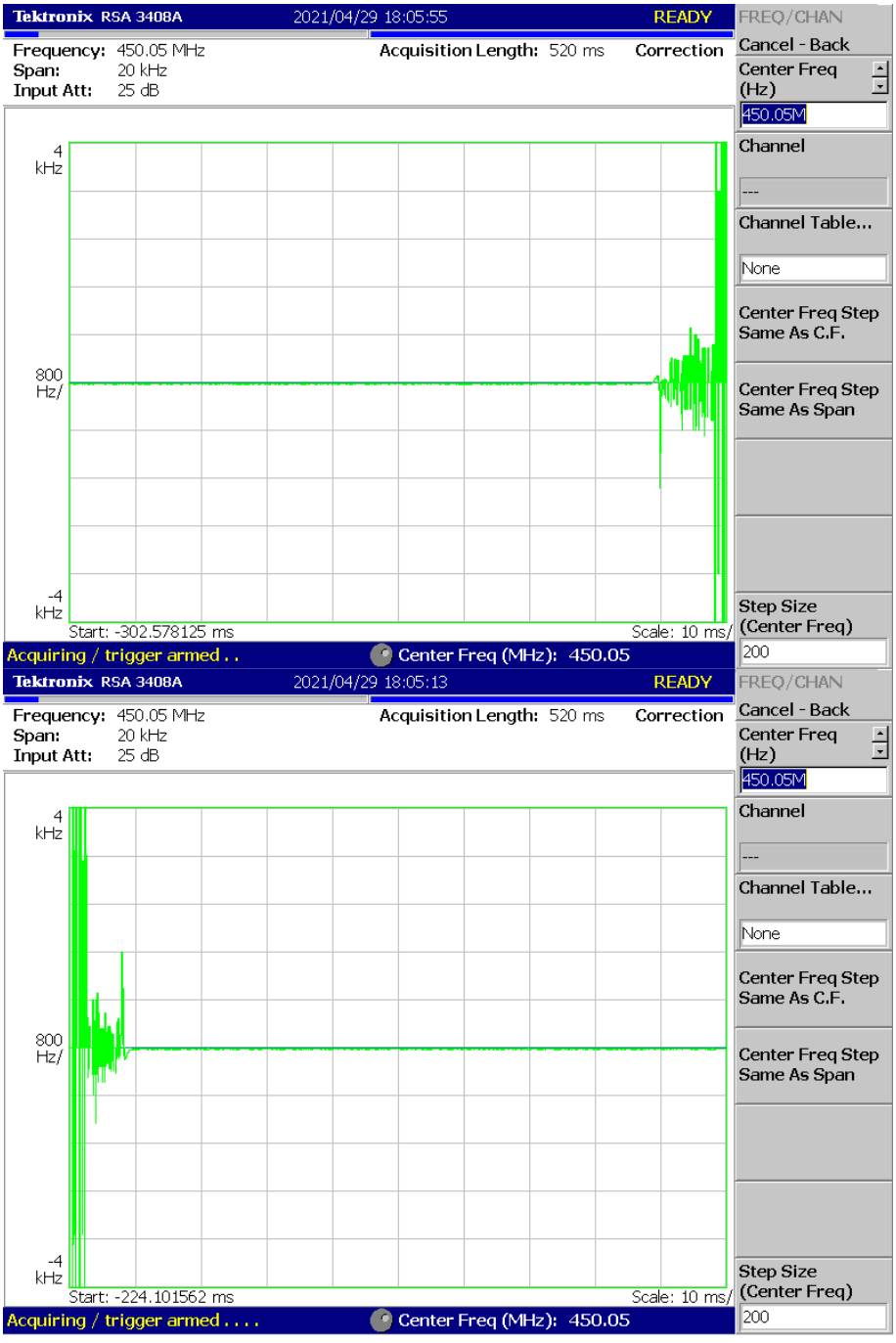


(511.95 MHz)_ Low

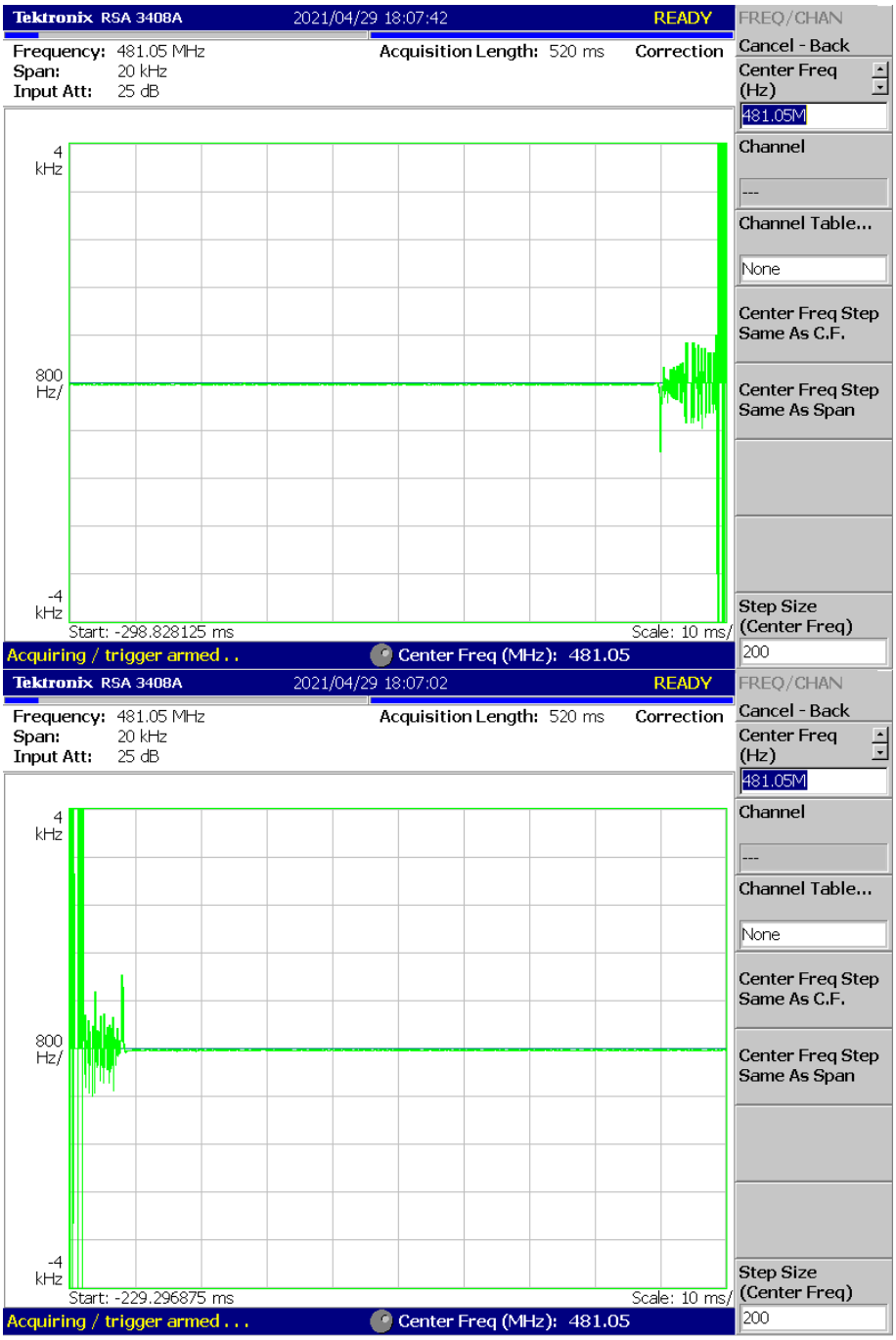


4K00F1E

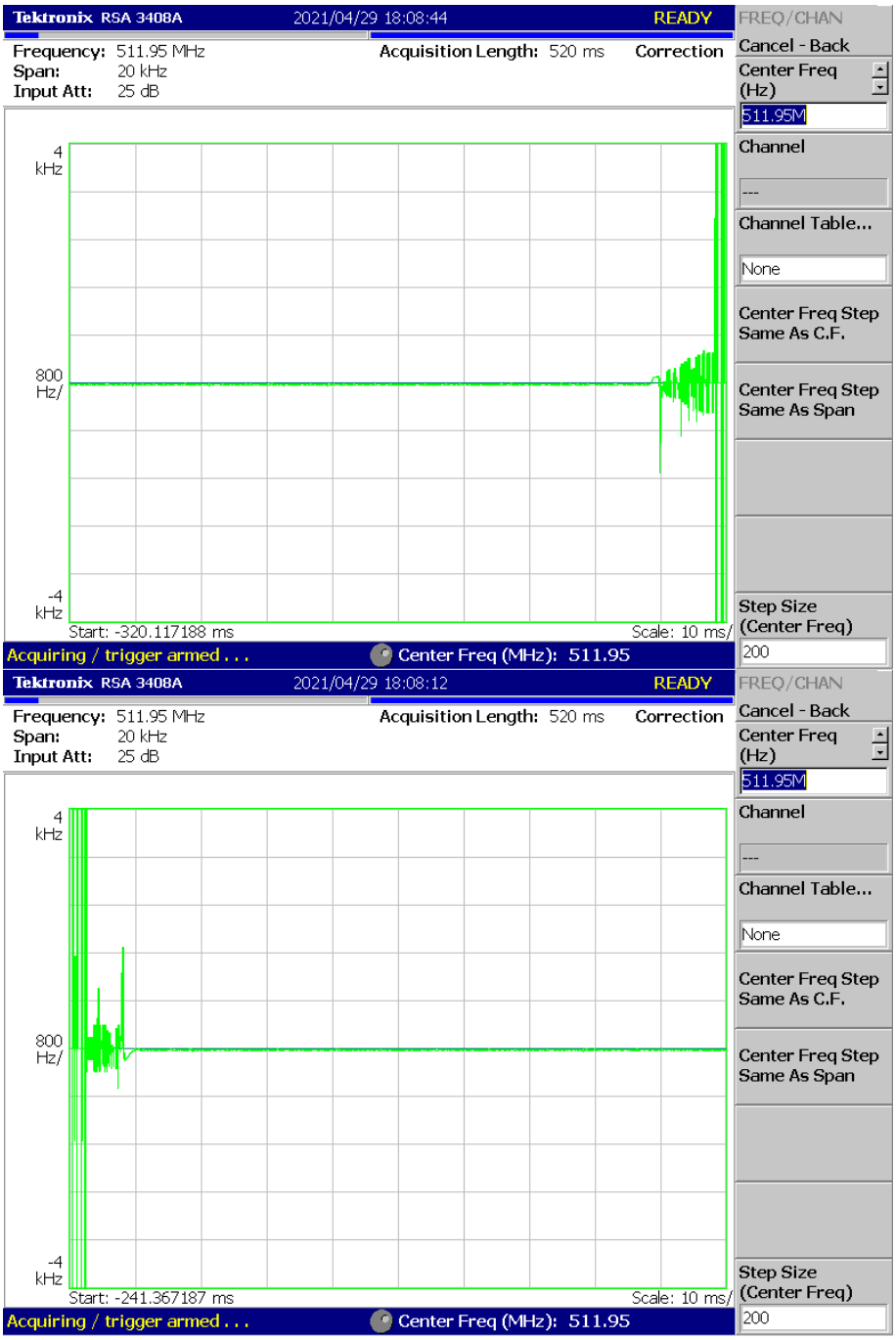
(450.05 MHz)_High



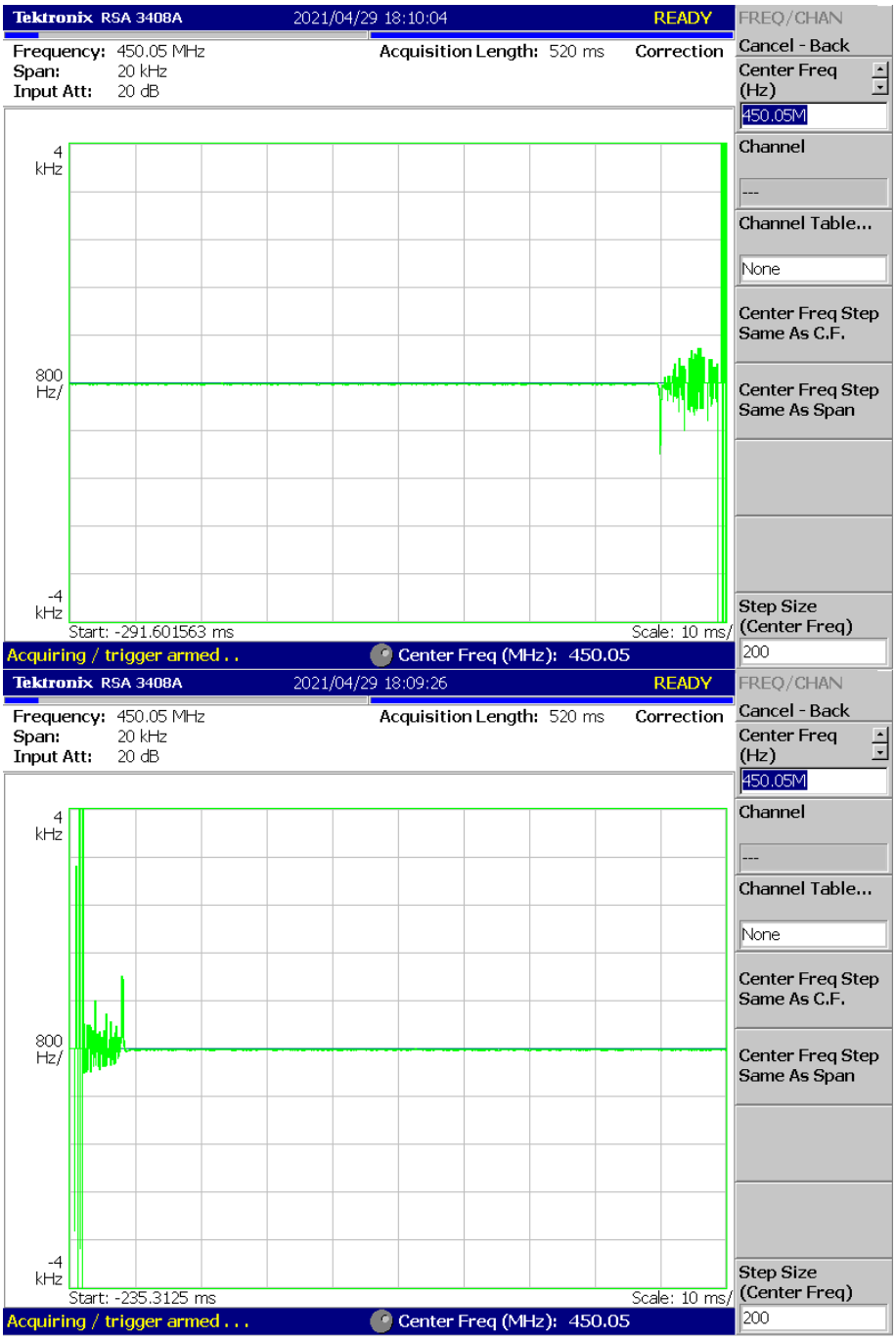
(481.05 MHz)_High



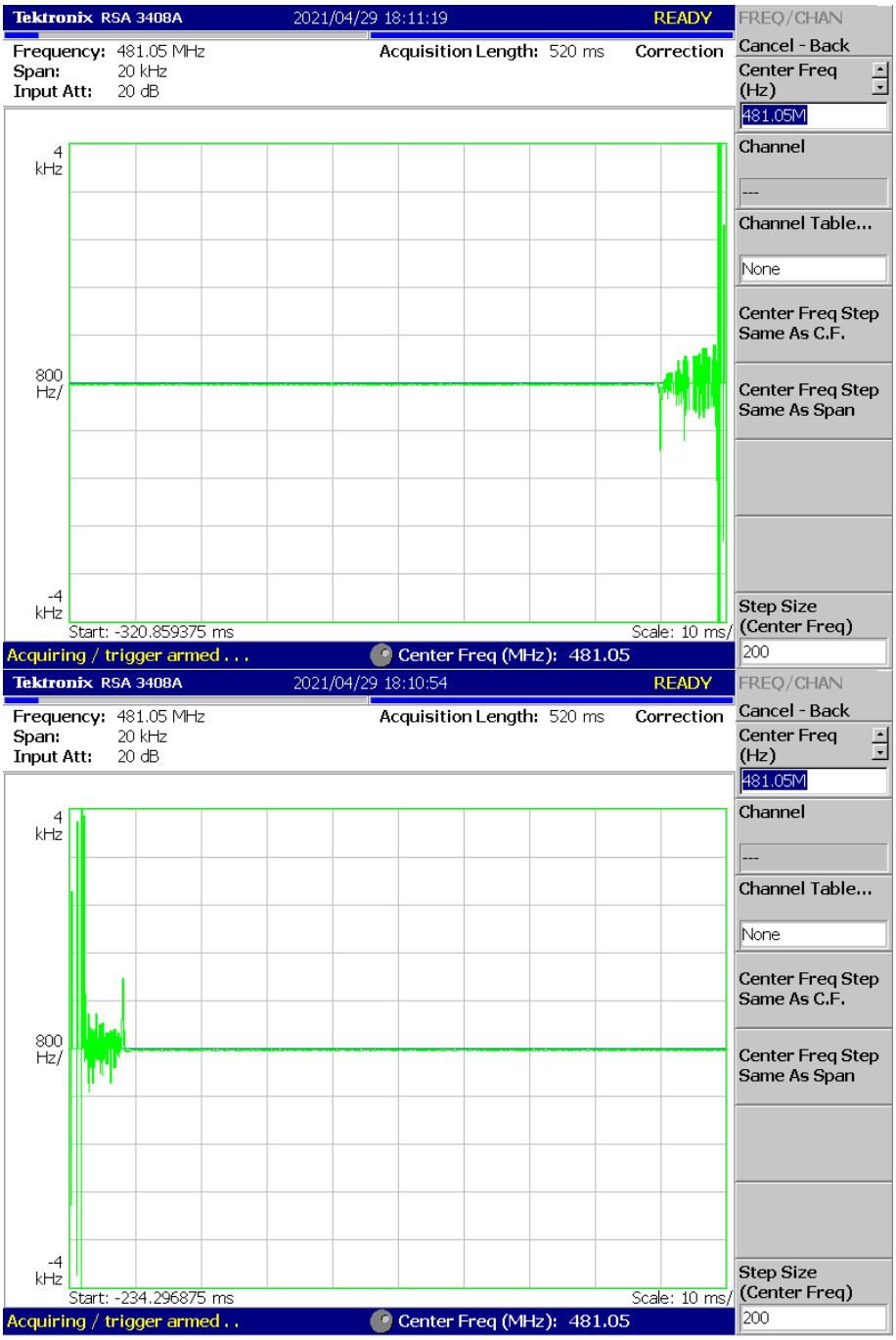
(511.95 MHz)_High



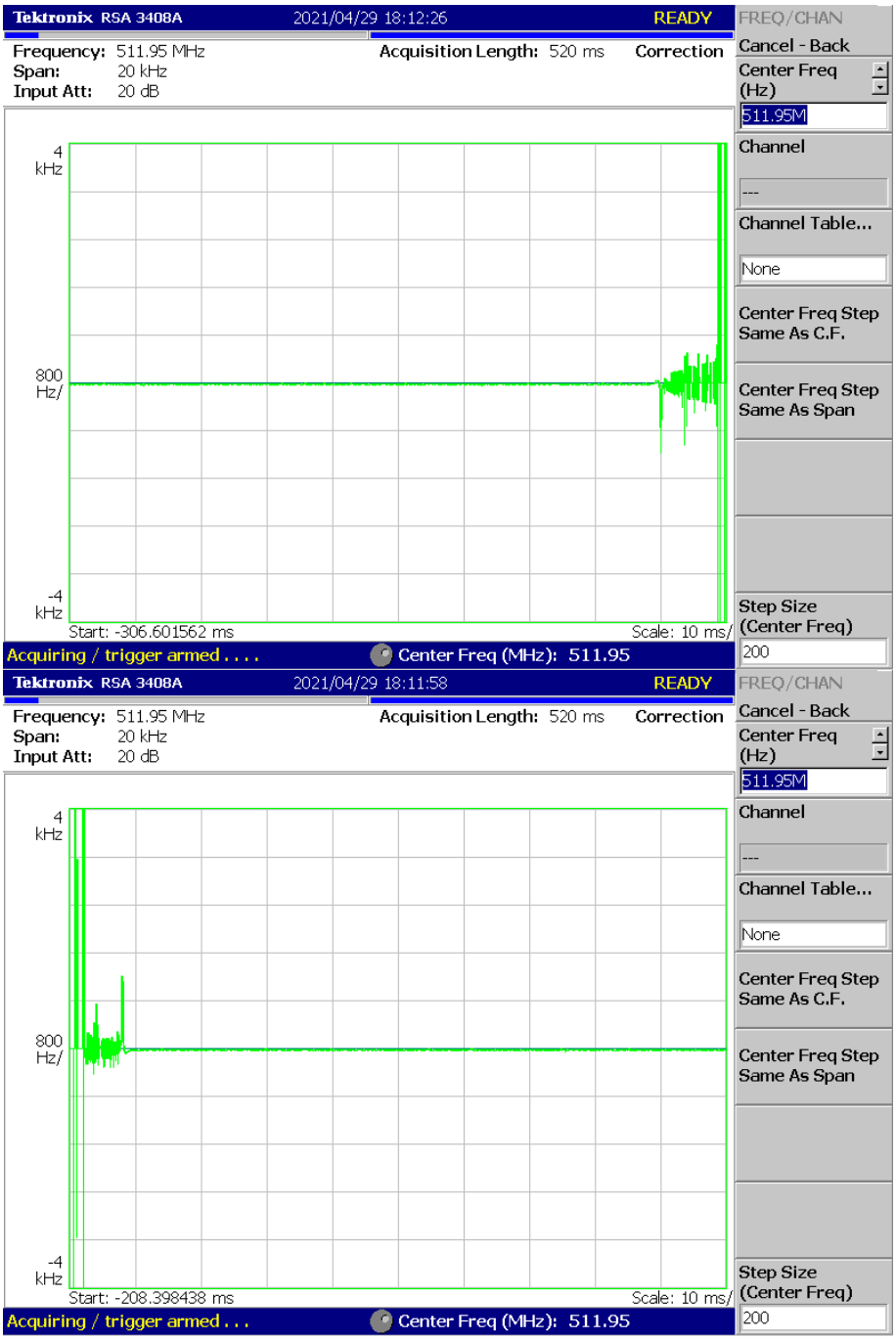
(450.05 MHz)_Low



(481.05 MHz)_ Low



(511.95 MHz)_ Low

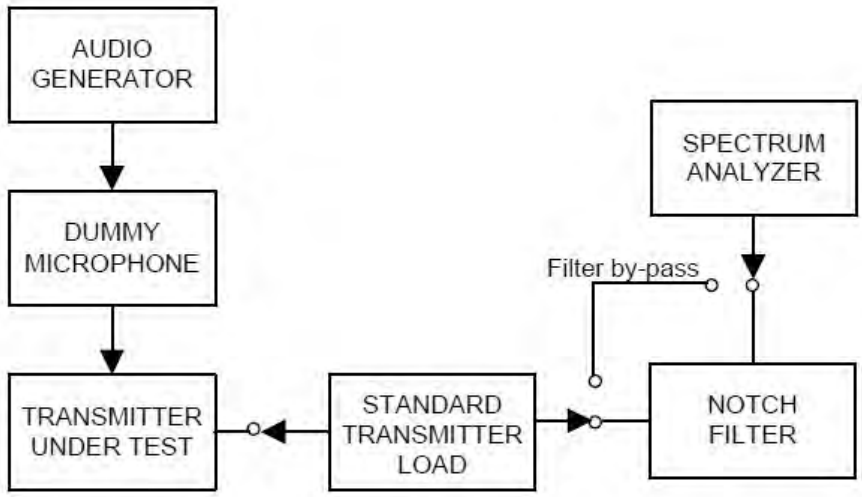


8.8 Unwanted Emissions : Conducted Spurious Emission

▣ Definition

Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

According to 2.2.13 in TIA-603-E Standard.

e) Connect the equipment as illustrated, with the notch filter by-passed.

f) Set the center frequency of the spectrum analyzer to the assigned transmitter frequency, key the transmitter, and set the level of the carrier to the full scale reference line.

g) Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation. The input level shall be established at the frequency of maximum response of the audio modulation circuit.

h) Adjust the spectrum analyzer for the following settings:

1) Resolution Bandwidth = 10 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.

2) Video Bandwidth ≥3 times the resolution bandwidth.

3) Sweep Speed ≤2000 Hz per second.

4) Detector Mode = mean or average power.

e) Adjust the center frequency of the spectrum analyzer for incremental coverage of the range from:

1) The lowest radio frequency generated in the equipment to the carrier frequency minus the test bandwidth (see 1.3.4.4).

2) The carrier frequency plus the test bandwidth to a frequency less than 2 times the carrier frequency.

f) Record the frequencies and levels of spurious emissions from step e).

g) Unkey the transmitter. Replace the transmitter under test with the signal generator and adjust the signal level to reproduce the frequencies and levels of every spurious emission recorded in step f). Record the signal generator levels in dBm.

h) Insert the notch filter.

i) Adjust the spectrum analyzer for the following settings:

1) Resolution Bandwidth = 10 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.

2) Video Bandwidth ≥3 times the resolution bandwidth.

3) Sweep Speed ≤2000 Hz per second.

4) Detector Mode = mean or average power.

j) Key the transmitter. Adjust the center frequency of the spectrum analyzer for incremental coverage of the range from a frequency equal to 2 times the carrier frequency and to the tenth harmonic of the carrier frequency.

▣ TEST RESULTS

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
16K0F3E	High Power (2W)	450.05	0.130	-50.10	-13.000	37.101
			0.260	-53.83	-13.000	40.828
			900.080	-39.14	-13.000	26.138
			4907.545	-29.97	-13.000	16.970
		481.05	0.129	-49.55	-13.000	36.550
			0.260	-52.97	-13.000	39.971
			962.069	-41.35	-13.000	28.346
			9956.798	-31.01	-13.000	18.011
		511.95	0.125	-50.15	-13.000	37.150
			0.250	-52.93	-13.000	39.926
			870.395	-42.13	-13.000	29.132
			6043.852	-30.44	-13.000	17.444

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
16K0F3E	High Power (5W)	470.05	0.011	-36.185	-13.000	23.185
			0.155	-37.621	-13.000	24.621
			940.145	-39.205	-13.000	26.205
			1410.871	-28.500	-13.000	15.500
		491.05	0.013	-34.632	-13.000	21.632
			0.180	-36.595	-13.000	23.595
			982.150	-35.195	-13.000	22.195
			1473.874	-27.505	-13.000	14.505
		511.95	0.010	-33.338	-13.000	20.338
			0.150	-35.622	-13.000	22.622
			459.074	-41.299	-13.000	28.299
			1024.751	-30.243	-13.000	17.243

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
11K0F3E	High Power (5W)	450.05	0.013	-36.107	-20.000	16.107
			0.155	-38.016	-20.000	18.016
			810.928	-42.330	-20.000	22.330
			2653.833	-31.944	-20.000	11.944
		481.05	0.009	-34.658	-20.000	14.658
			0.150	-37.452	-20.000	17.452
			962.069	-37.083	-20.000	17.083
			1443.722	-28.007	-20.000	8.007
		511.95	0.010	-34.939	-20.000	14.939
			0.150	-36.050	-20.000	16.050
			539.107	-41.113	-20.000	21.113
			1024.301	-30.901	-20.000	10.901

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
8K30F1E, 8K30F1D, 8K30F7W	High Power (5W)	450.05	0.031	-63.754	-20.000	43.754
			27.090	-54.454	-20.000	34.454
			980.307	-41.056	-20.000	21.056
			3611.031	-32.652	-20.000	12.652
		481.05	0.024	-64.270	-20.000	44.270
			3.536	-55.249	-20.000	35.249
			971.479	-42.320	-20.000	22.320
			1442.822	-30.002	-20.000	10.002
		511.95	0.018	-63.691	-20.000	43.691
			0.165	-55.082	-20.000	35.082
			744.379	-42.932	-20.000	22.932
			3623.631	-33.375	-20.000	13.375

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
7K60FXD, 7K60FXE	High Power (5W)	450.05	0.035	-63.214	-20.000	43.214
			28.645	-53.979	-20.000	33.979
			900.177	-41.689	-20.000	21.689
			6810.241	-32.493	-20.000	12.493
		481.05	0.016	-62.811	-20.000	42.811
			16.723	-54.787	-20.000	34.787
			903.184	-42.730	-20.000	22.730
			1442.822	-30.004	-20.000	10.004
		511.95	0.012	-64.413	-20.000	44.413
			0.315	-54.861	-20.000	34.861
			945.869	-42.205	-20.000	22.205
			3578.629	-33.708	-20.000	13.708

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
4K00F1E, 4K00F1D, 4K00F7W	High Power (5W)	450.05	0.017	-63.634	-25.000	38.634
			23.944	-55.027	-25.000	30.027
			900.080	-42.287	-25.000	17.287
			7281.864	-33.417	-25.000	8.417
		481.05	0.014	-62.590	-25.000	37.590
			21.444	-55.067	-25.000	30.067
			747.678	-42.792	-25.000	17.792
			1442.822	-29.451	-25.000	4.451
		511.95	0.124	-62.192	-25.000	37.192
			21.109	-55.283	-25.000	30.283
			566.076	-43.208	-25.000	18.208
			3694.735	-33.225	-25.000	8.225

Type of Emission	Power	Test Frequency (MHz)	Measured Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
4K00F2D	High Power (5W)	450.05	0.123	-49.36	-25.000	24.356
			0.255	-51.41	-25.000	26.410
			900.080	-38.96	-25.000	13.957
			3983.199	-35.05	-25.000	10.045
		481.05	0.129	-49.40	-25.000	24.401
			0.860	-51.24	-25.000	26.240
			782.504	-41.01	-25.000	16.013
			9701.185	-35.75	-25.000	10.747
		511.95	0.129	-48.94	-25.000	23.943
			0.245	-51.54	-25.000	26.543
			903.281	-41.19	-25.000	16.187
			8034.302	-35.65	-25.000	10.650

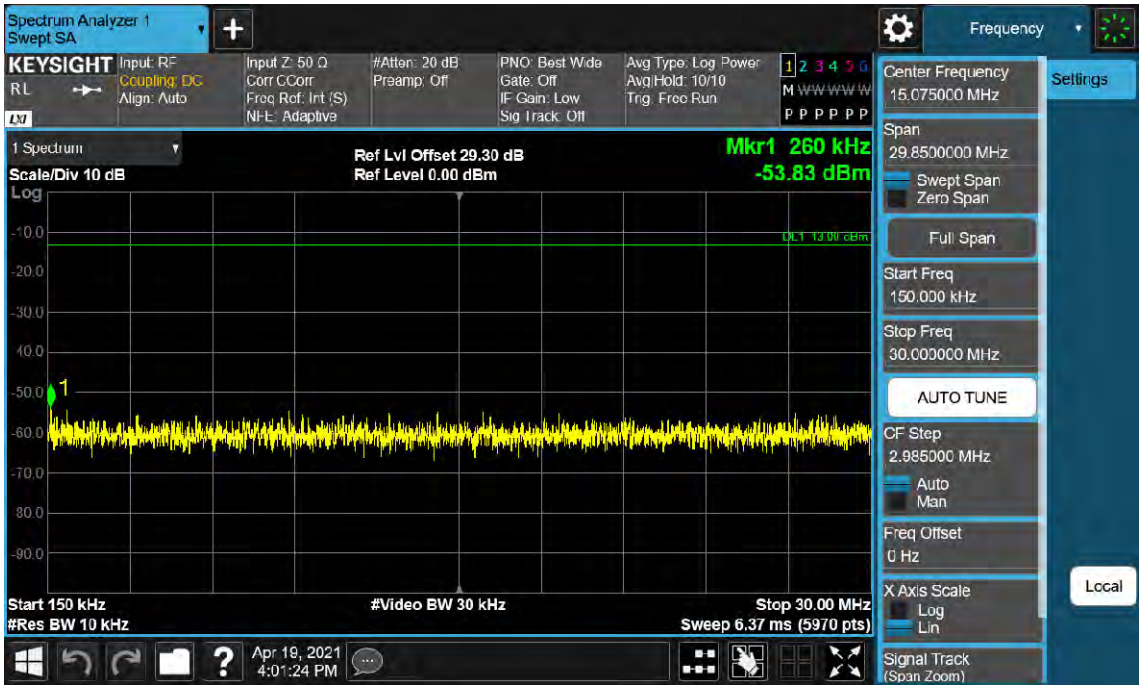
▣ Plots of Unwanted Emissions : Conducted Spurious Emission

16K0F3E_FCC

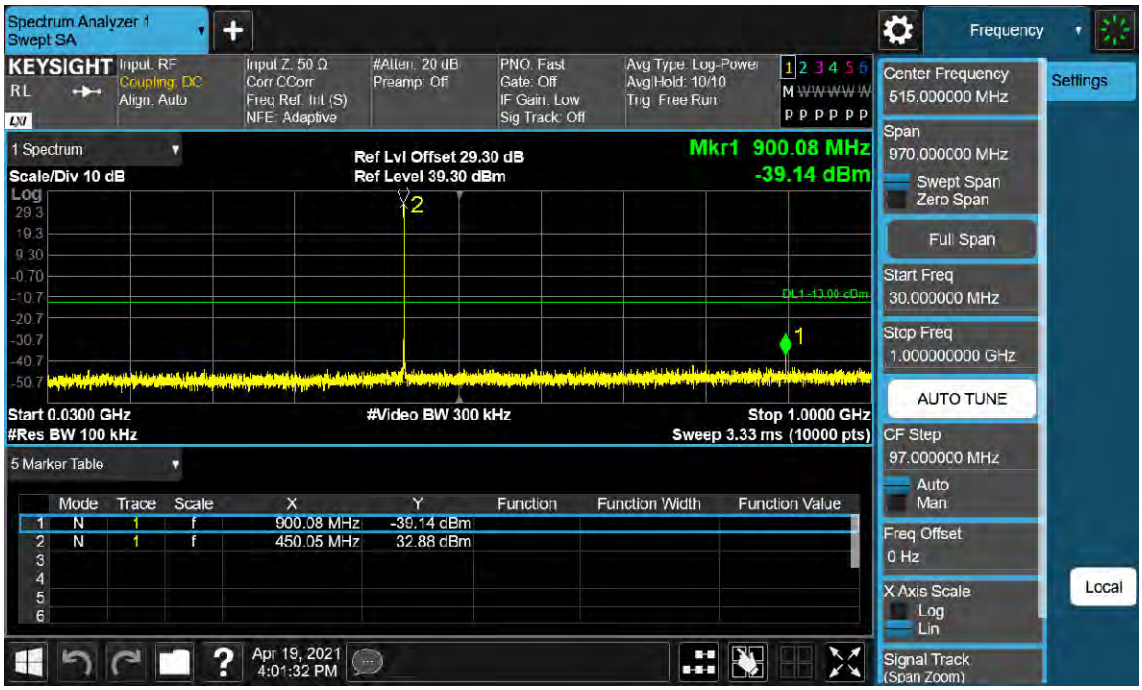
(450.05 MHz)_High_2W

9 kHz~150 kHz

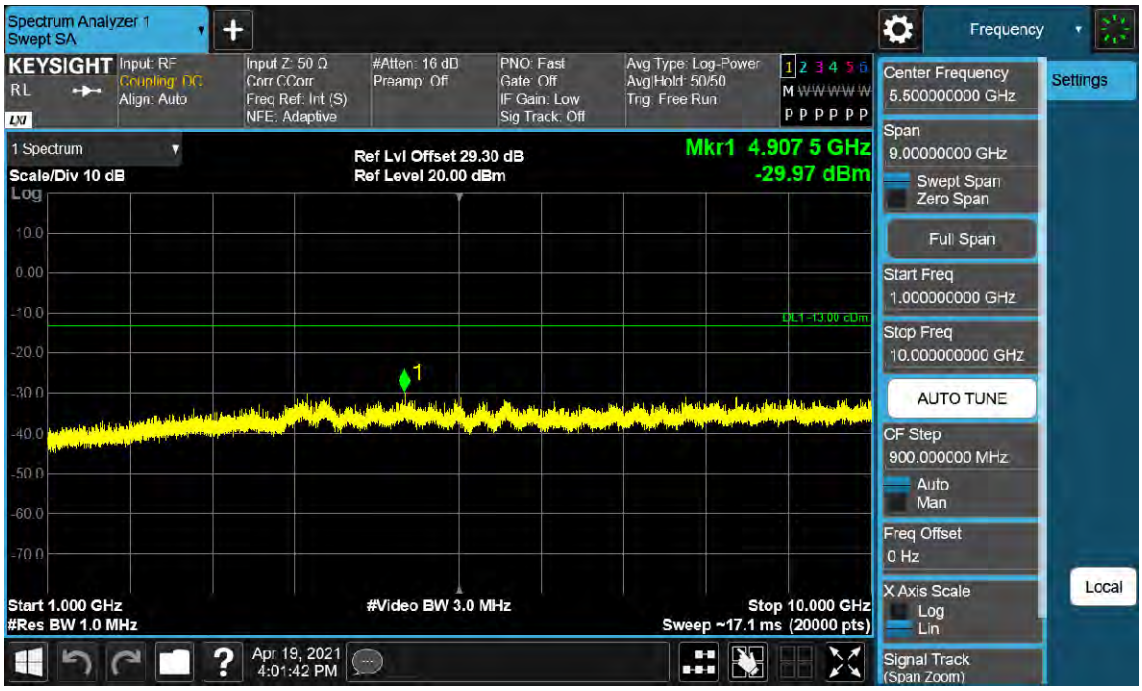
150 kHz~30 MHz



30 MHz~1 GHz



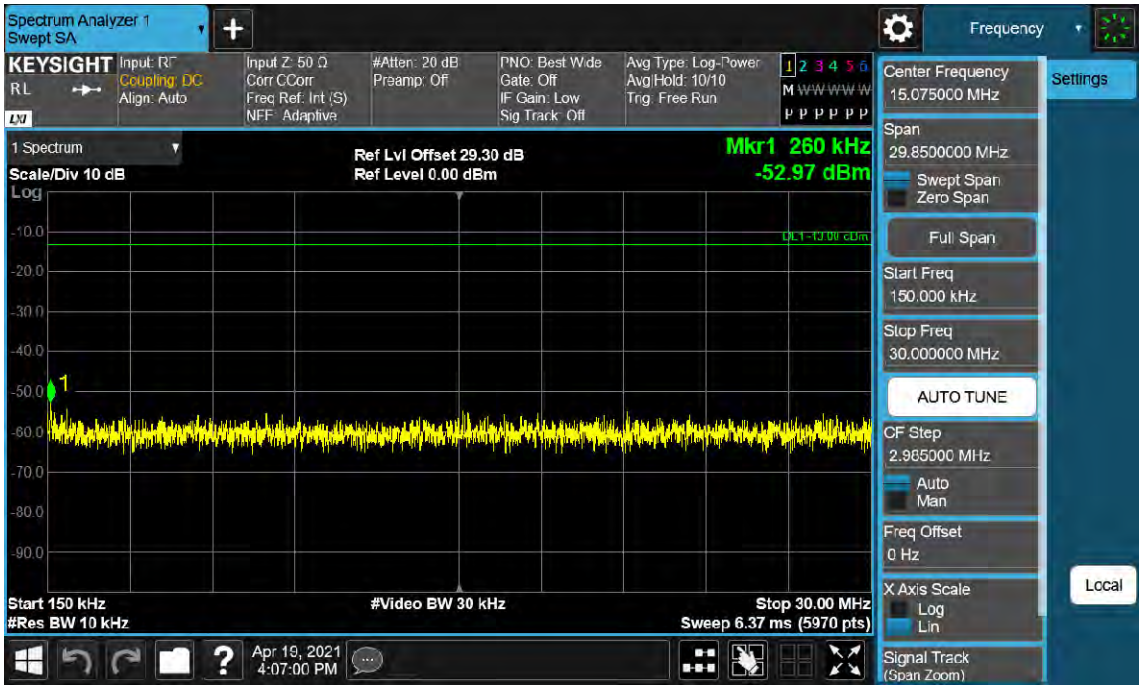
1 GHz~10 GHz



(481.05 MHz)_High_2W

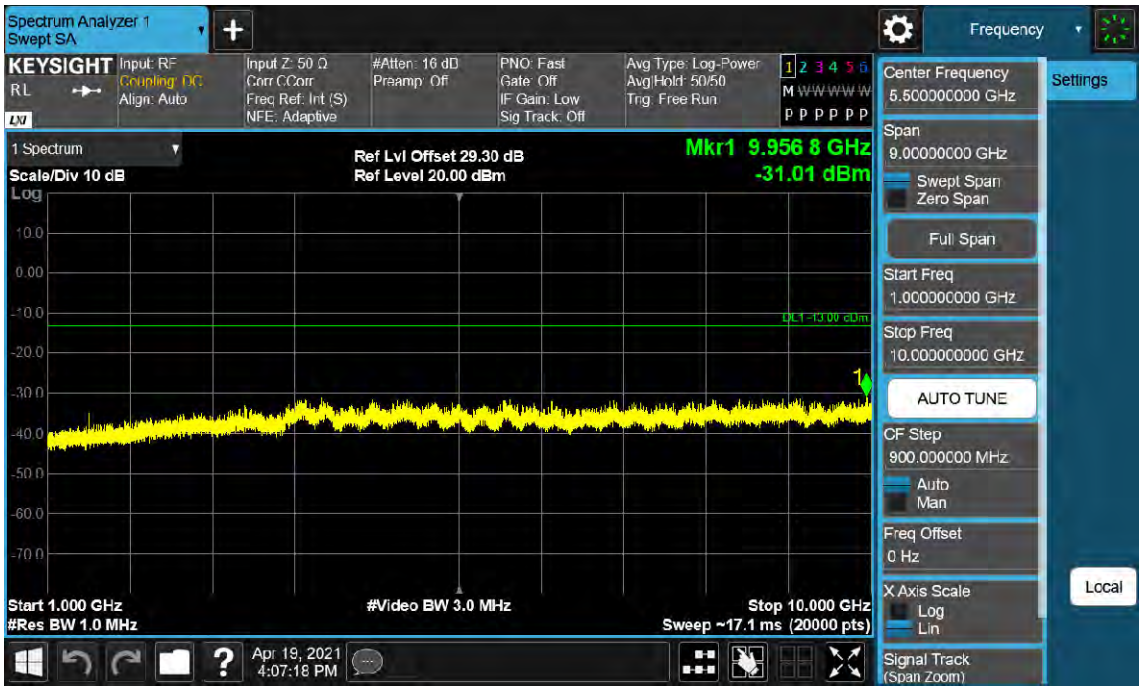
9 kHz~150 kHz

150 kHz~30 MHz



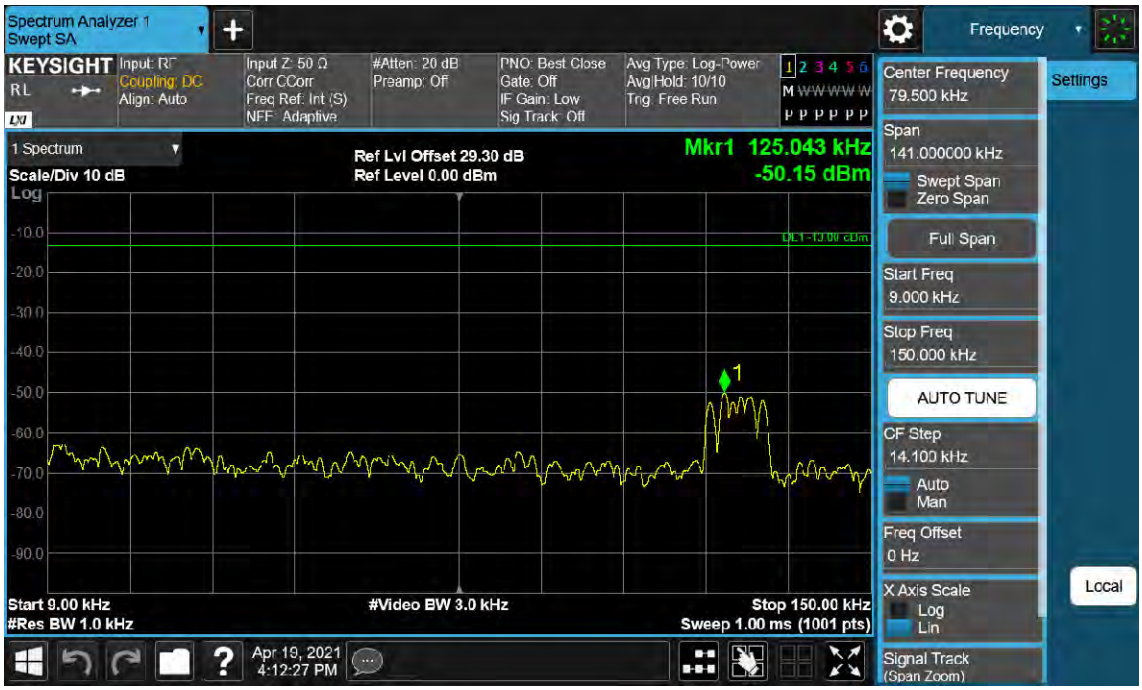
30 MHz~1 GHz

1 GHz~10 GHz

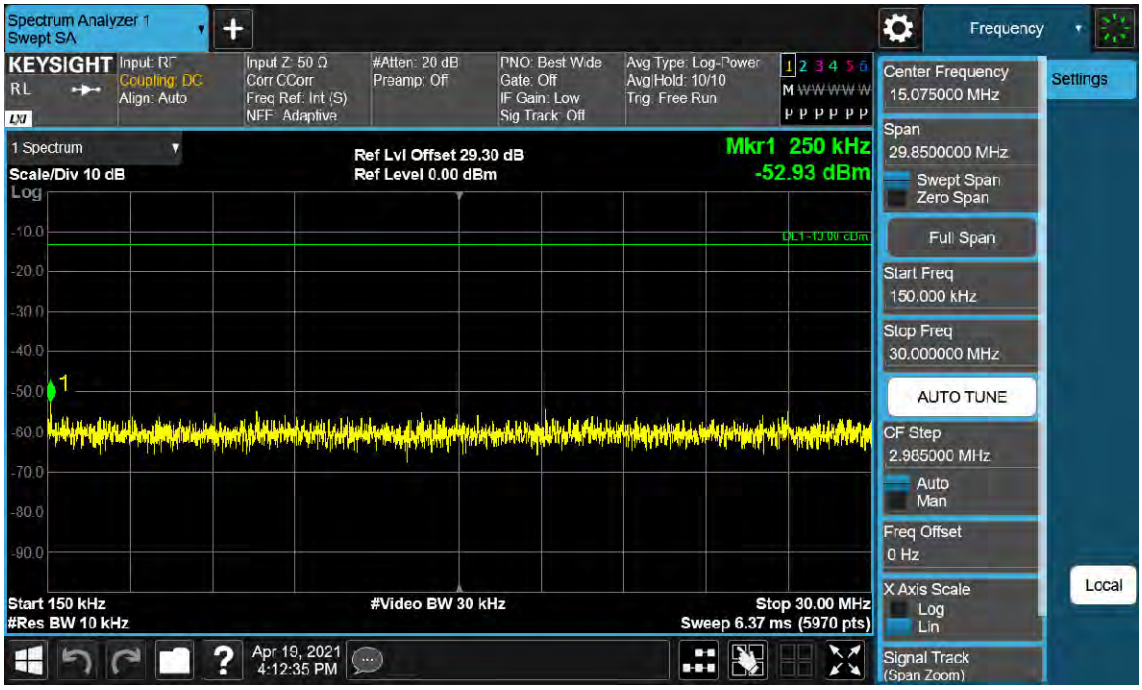


(511.95 MHz)_High_2W

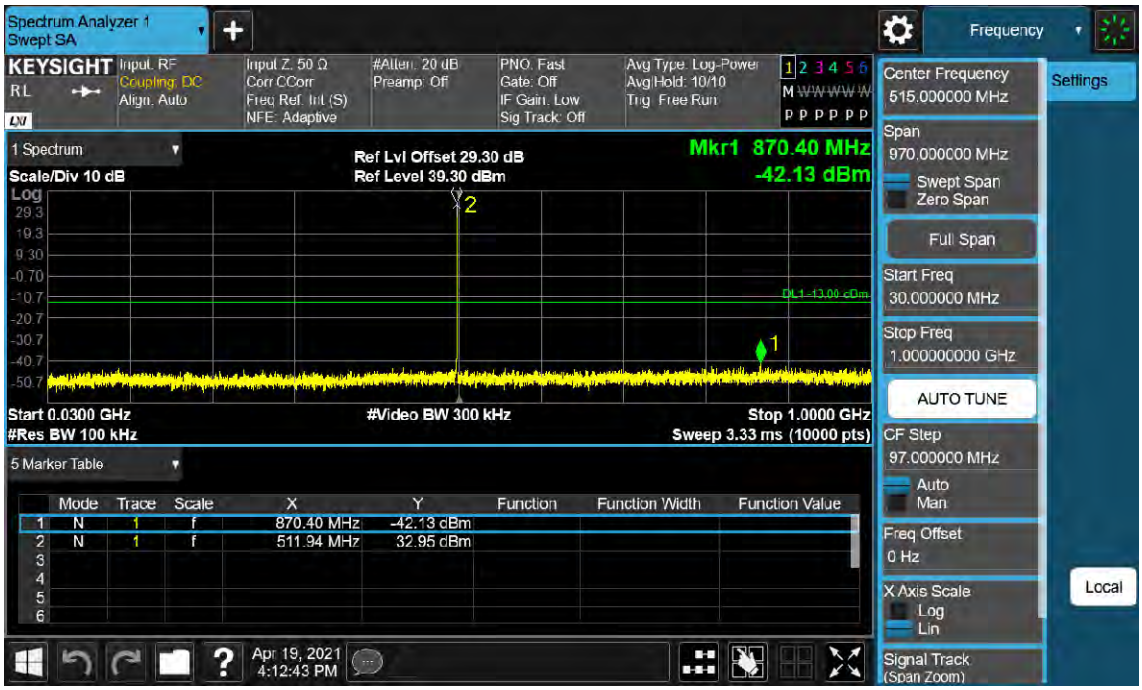
9 kHz~150 kHz



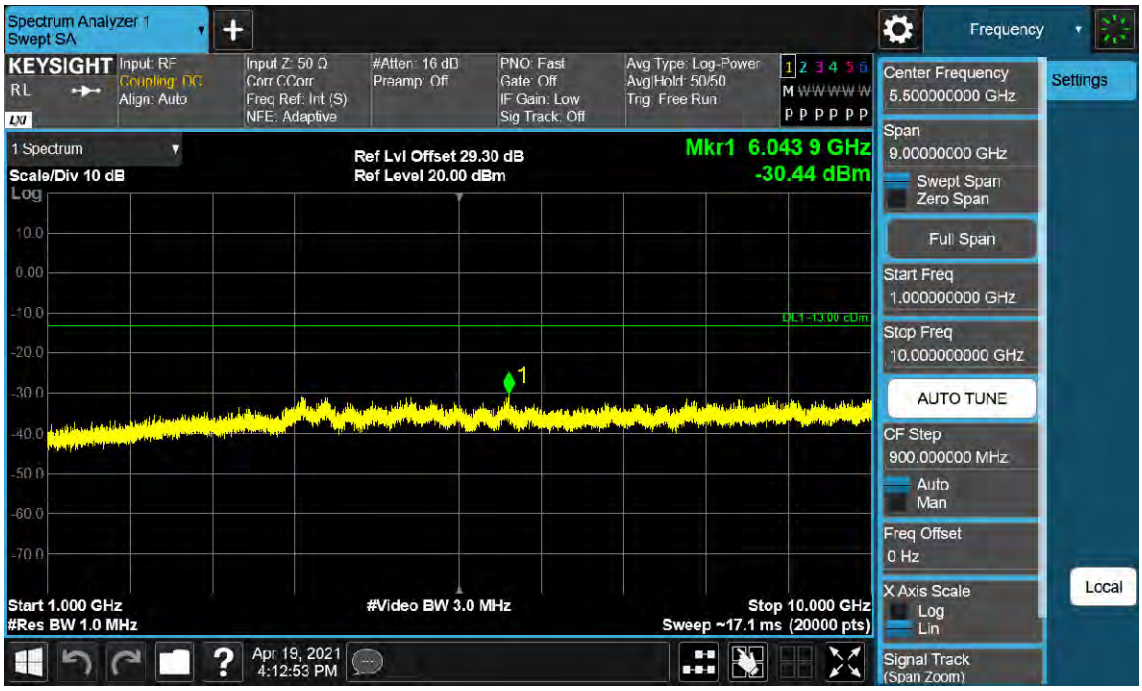
150 kHz~30 MHz



30 MHz~1 GHz

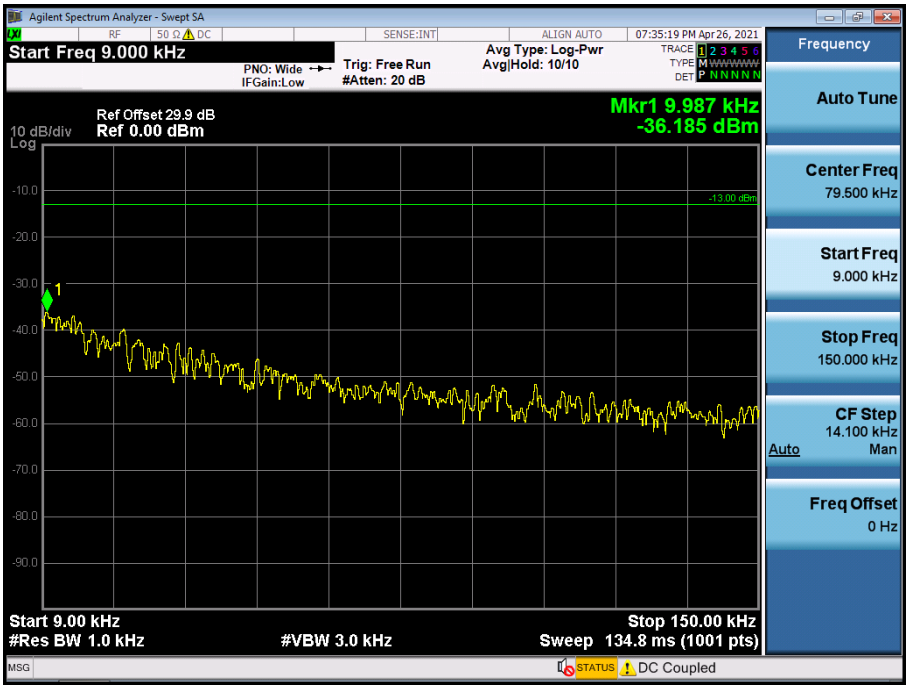


1 GHz~10 GHz

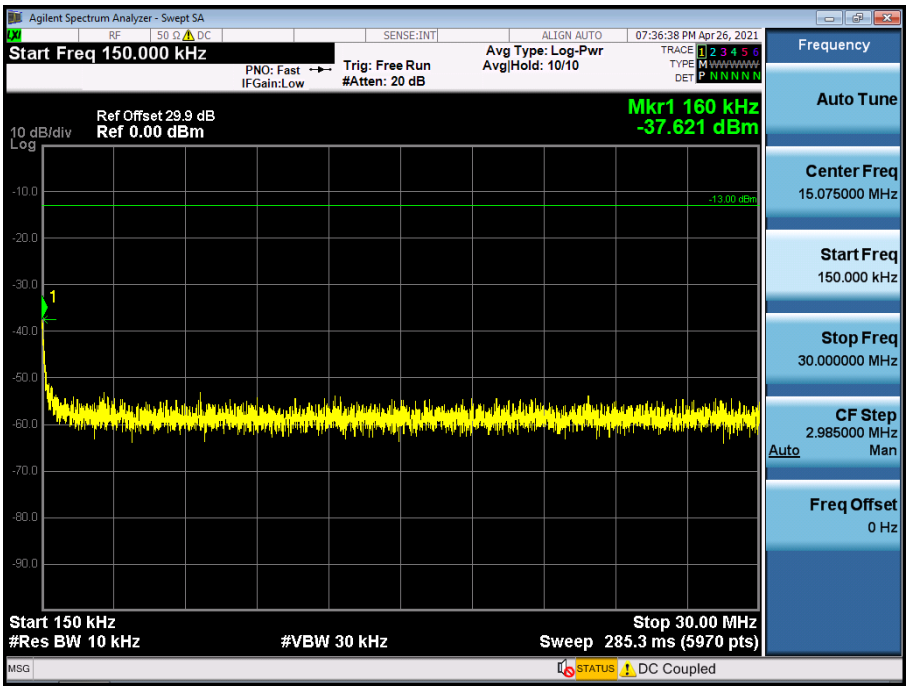


(470.05 MHz)_High_5W

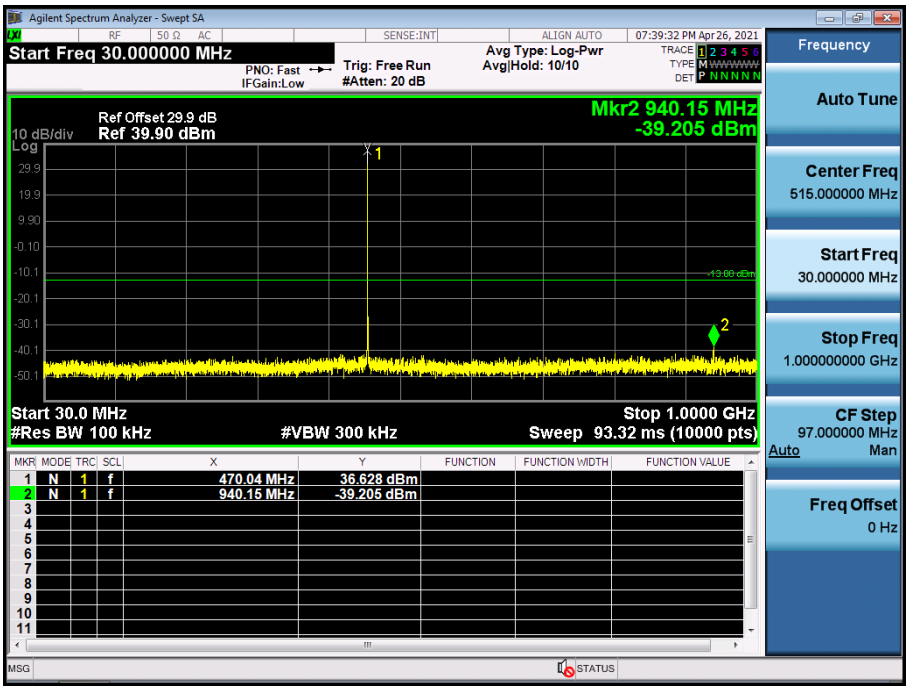
9 kHz~150 kHz



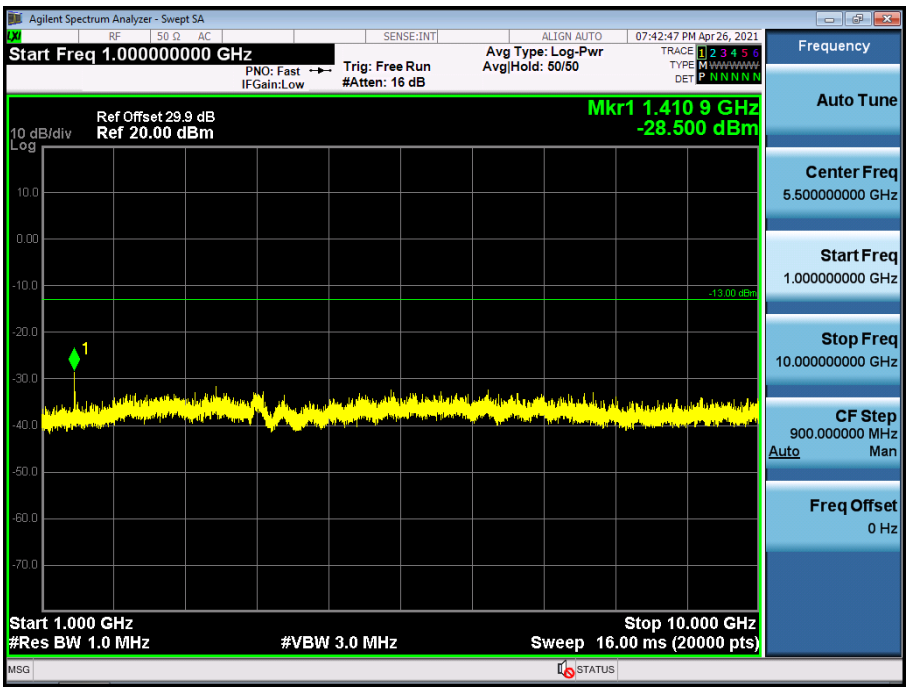
150 kHz~30 MHz



30 MHz~1 GHz



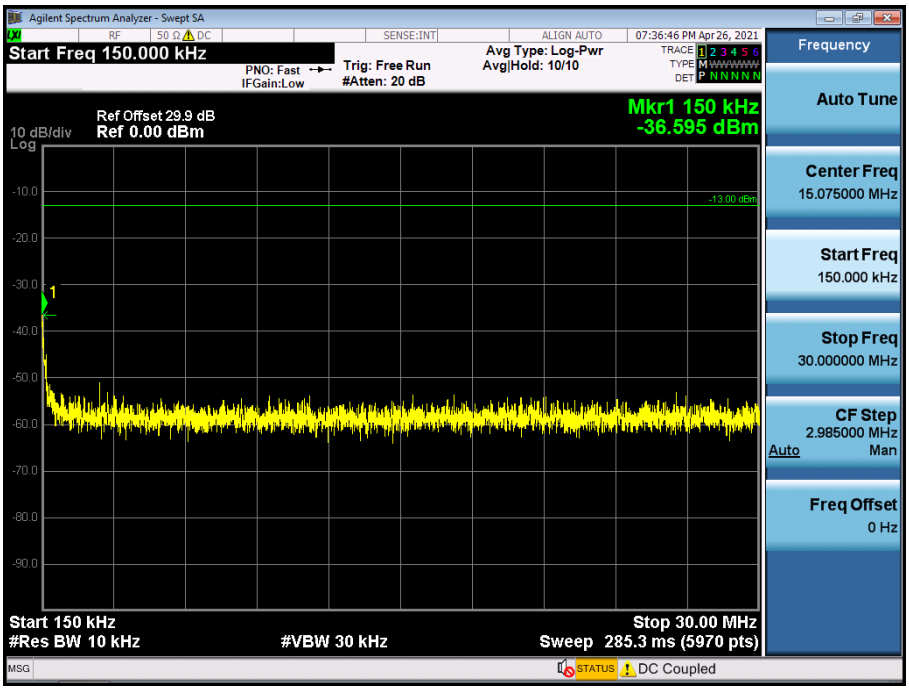
1 GHz~10 GHz



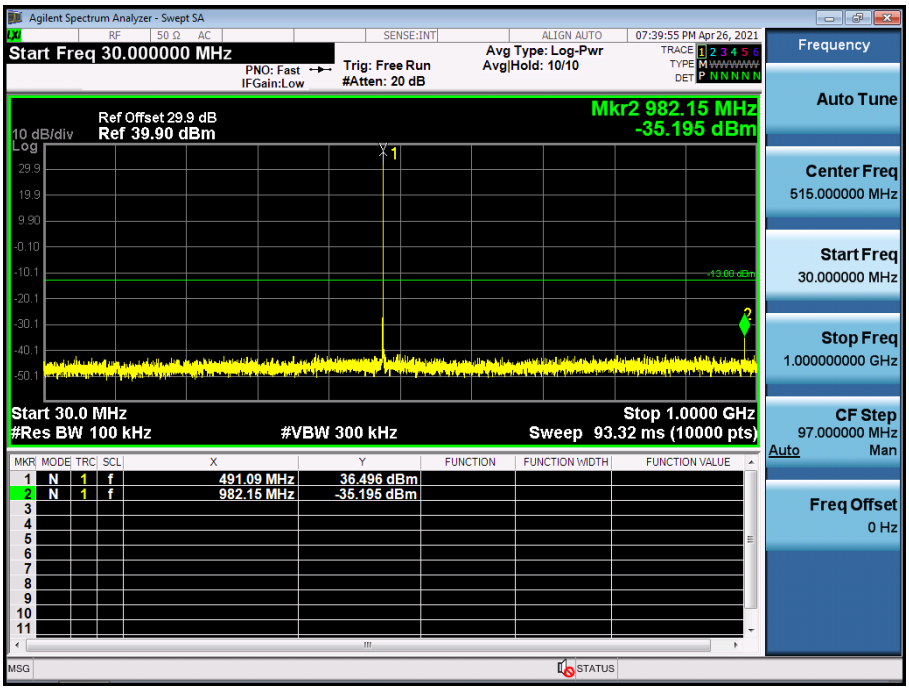
(491.05 MHz)_High_5W

9 kHz~150 kHz

150 kHz~30 MHz



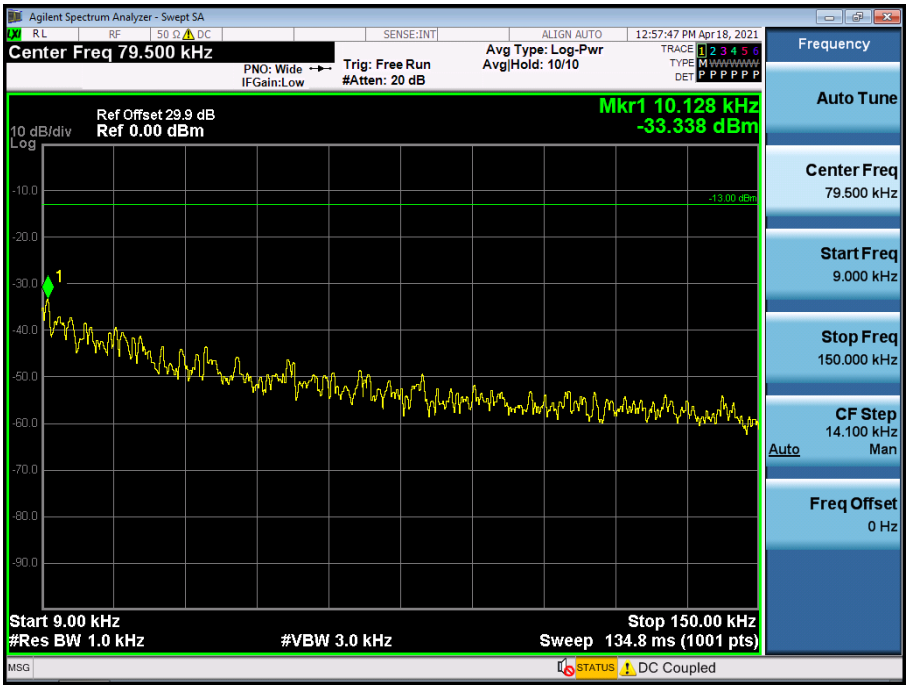
30 MHz~1 GHz



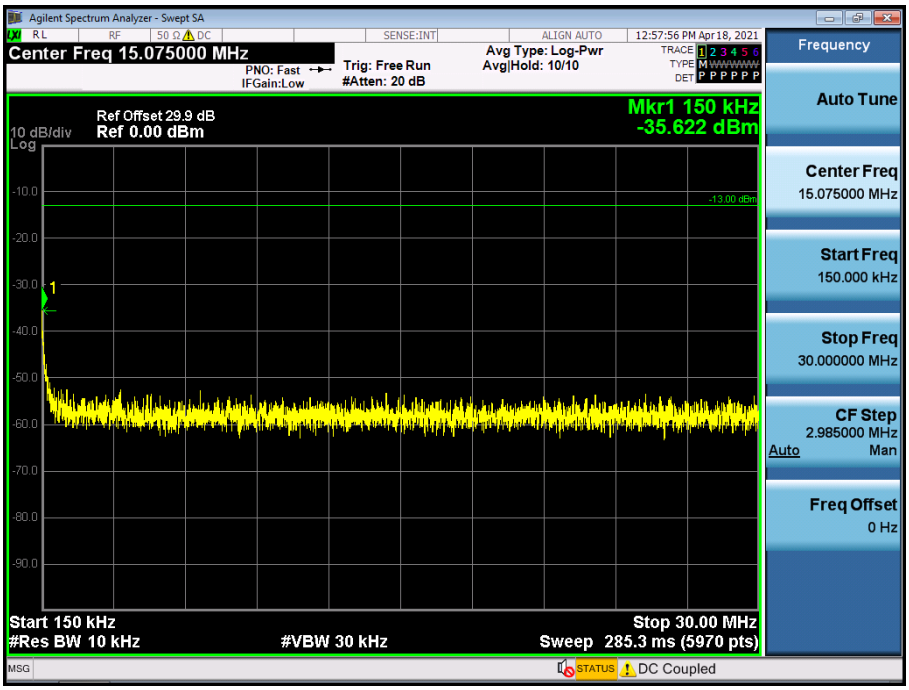
1 GHz~10 GHz

(511.95 MHz)_High_5W

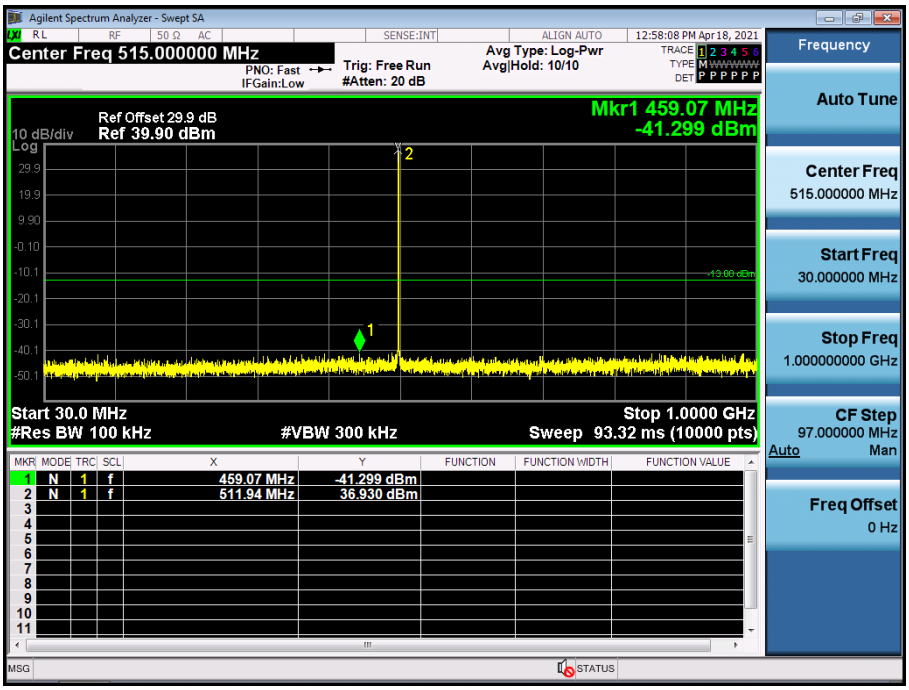
9 kHz~150 kHz



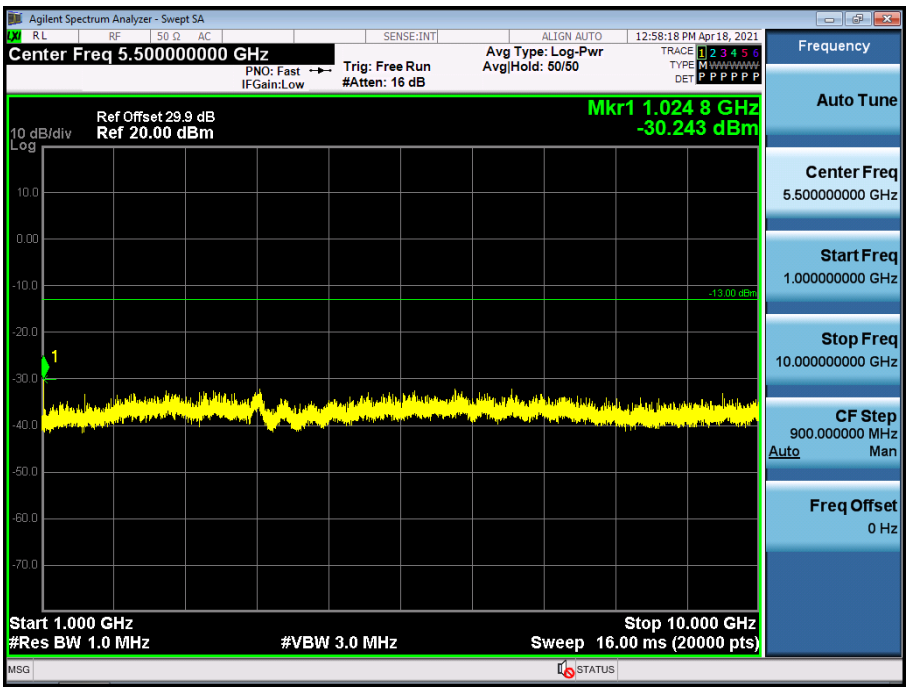
150 kHz~30 MHz



30 MHz~1 GHz



1 GHz~10 GHz

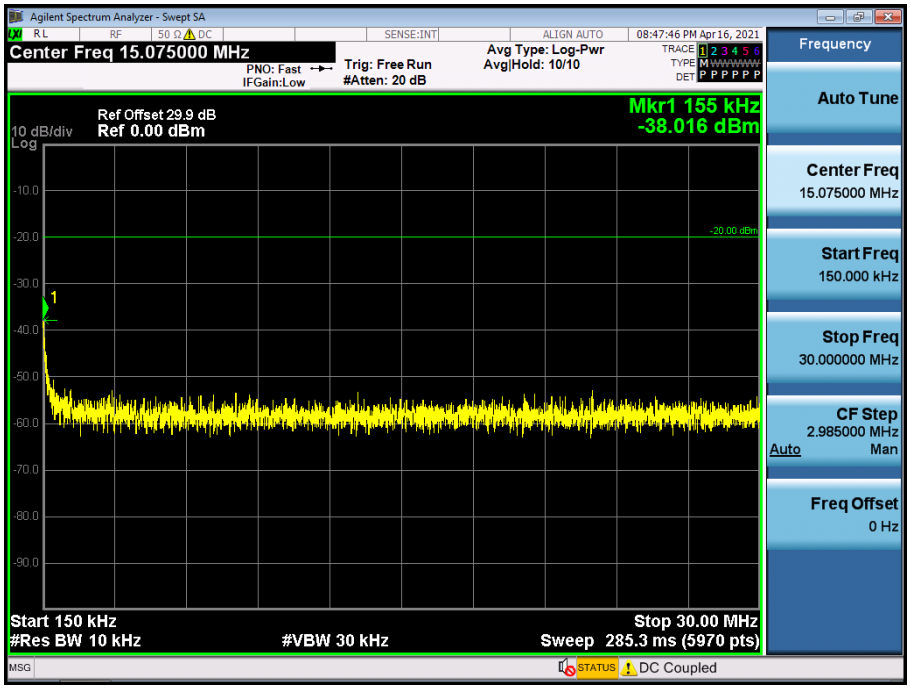


11K0F3E_FCC

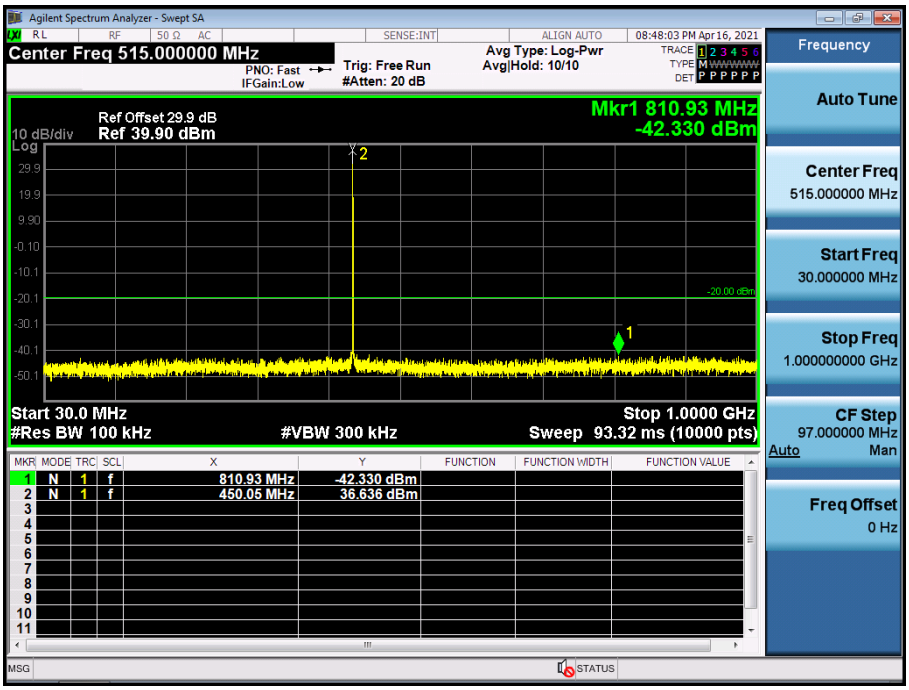
(450.05 MHz)_High

9 kHz~150 kHz

150 kHz~30 MHz



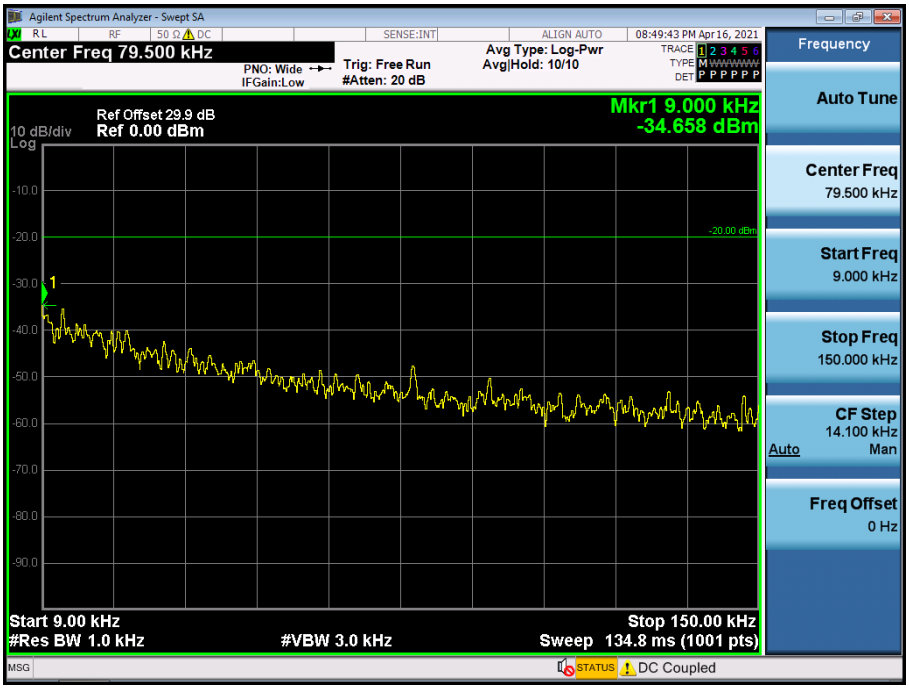
30 MHz~1 GHz



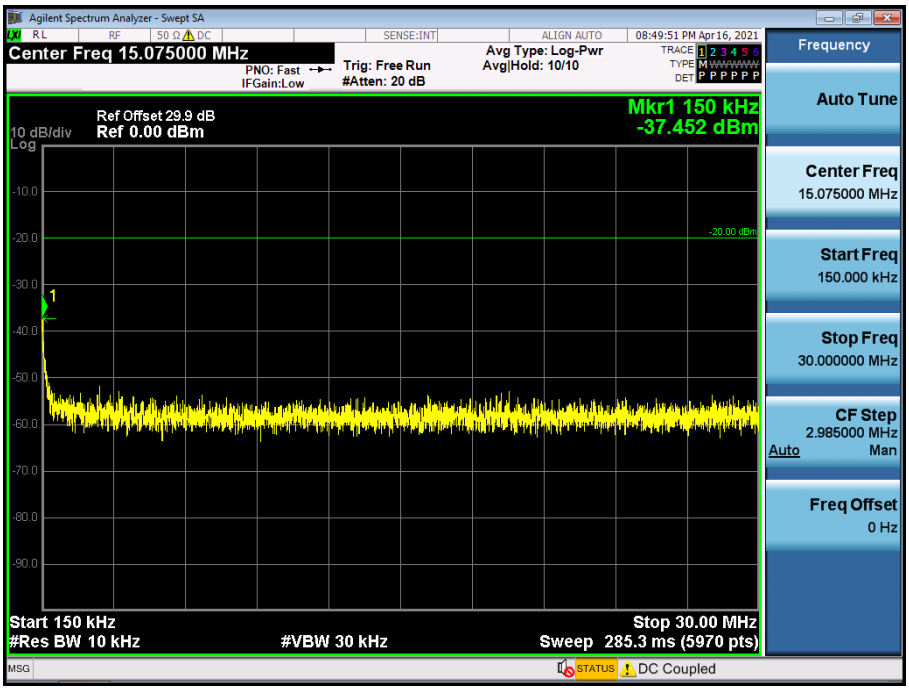
1 GHz~10 GHz

(481.05 MHz)_High

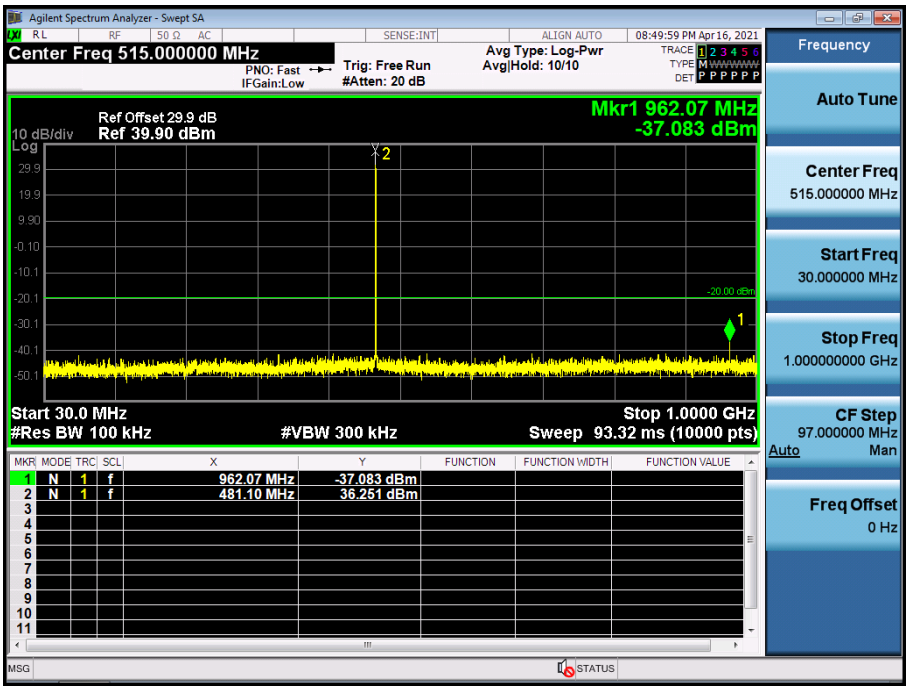
9 kHz~150 kHz



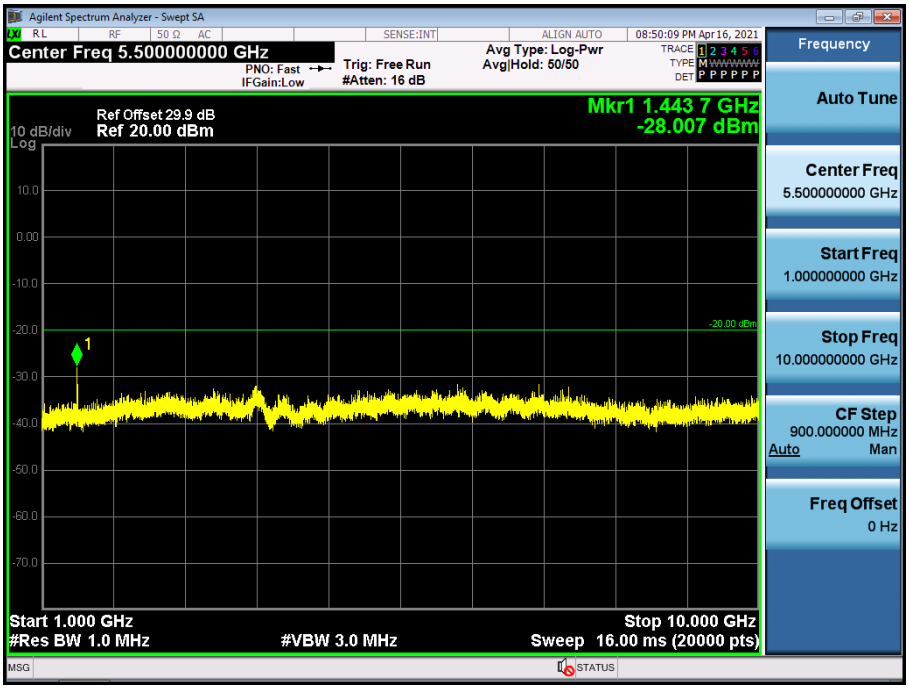
150 kHz~30 MHz



30 MHz~1 GHz

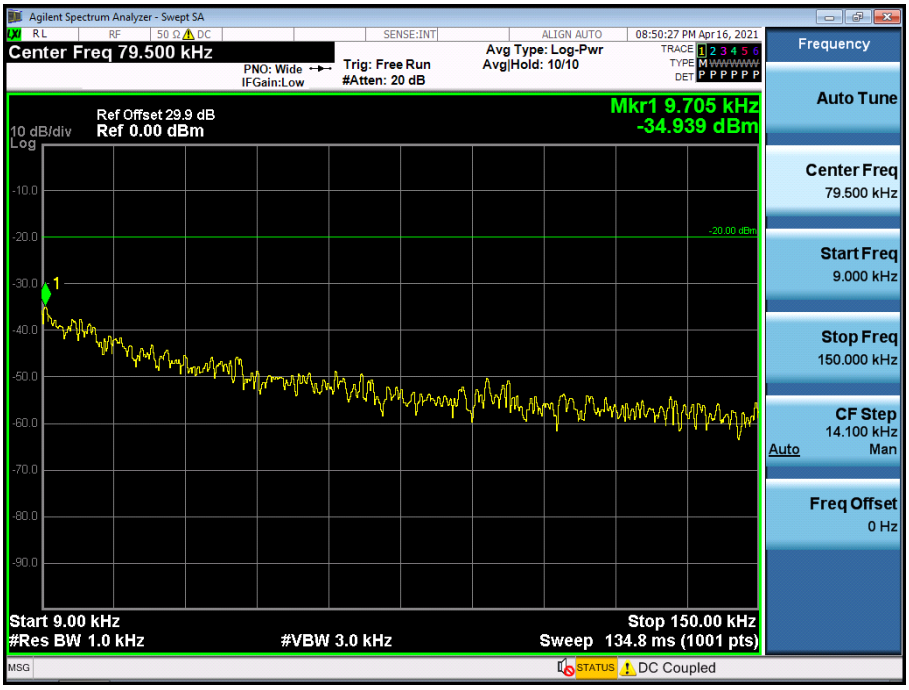


1 GHz~10 GHz

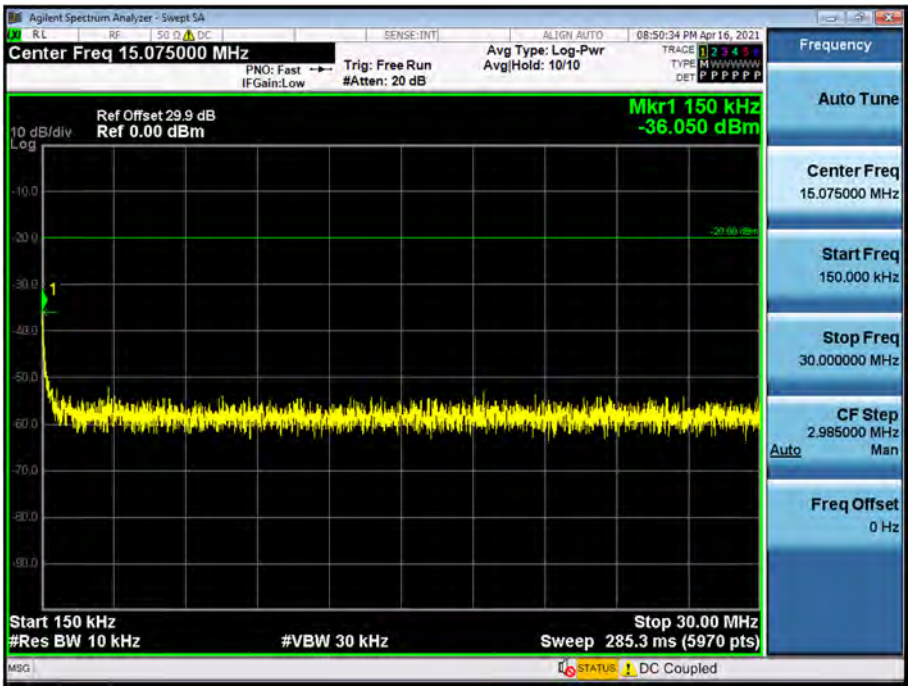


(511.95 MHz)_High

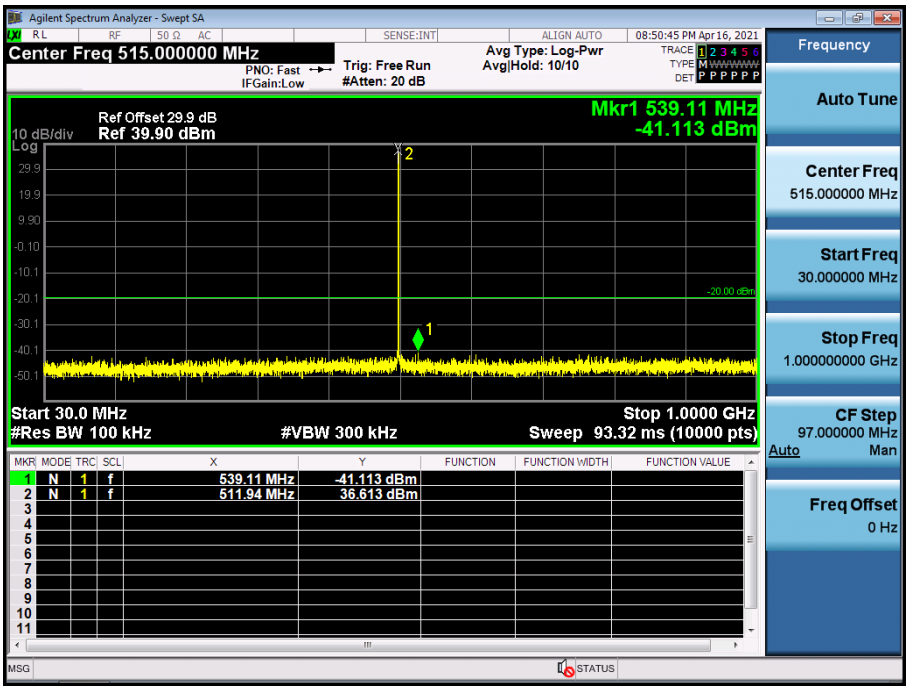
9 kHz~150 kHz



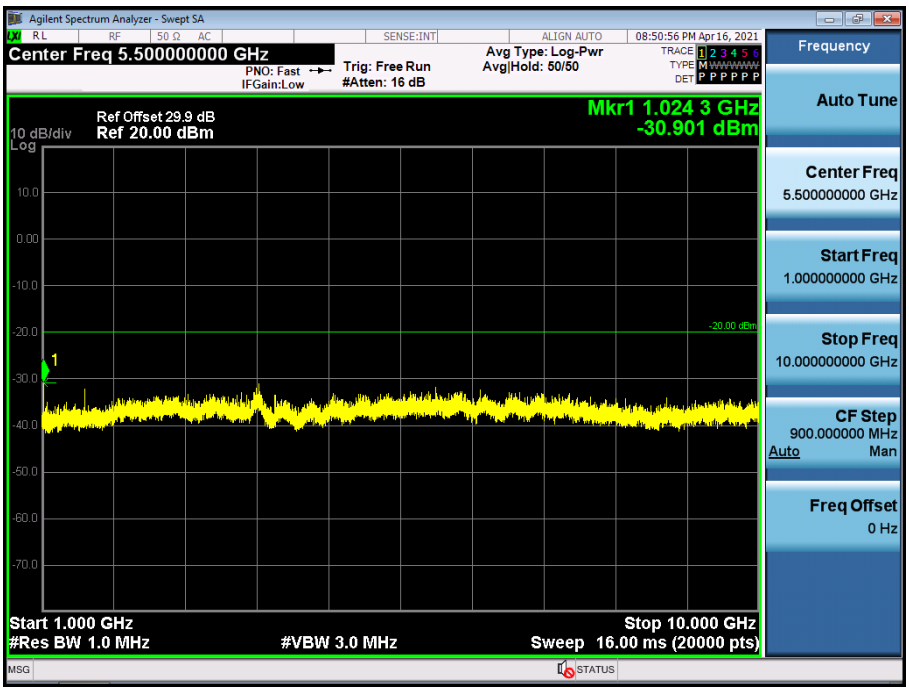
150 kHz~30 MHz



30 MHz~1 GHz



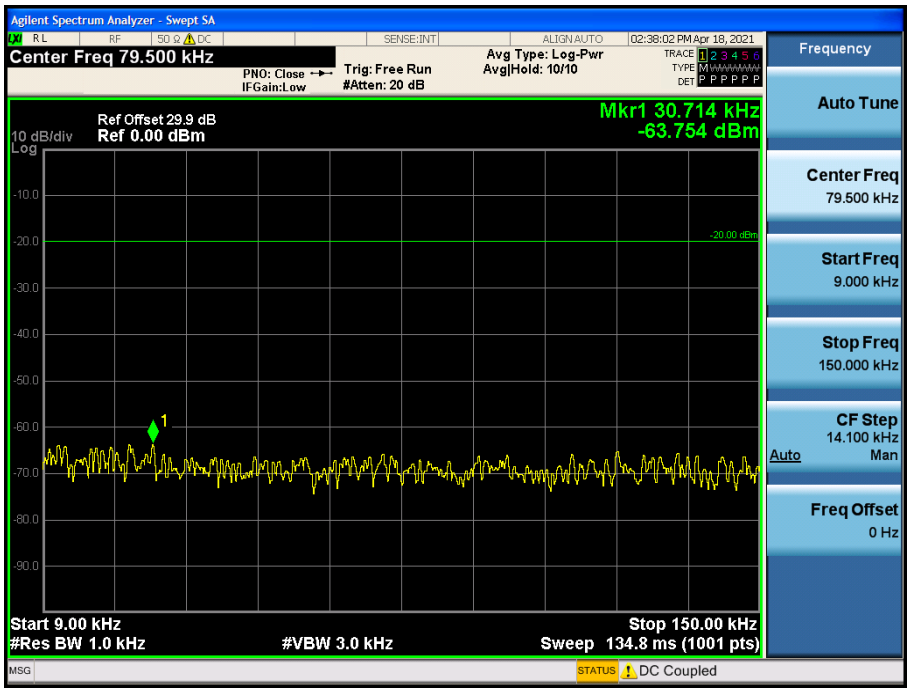
1 GHz~10 GHz



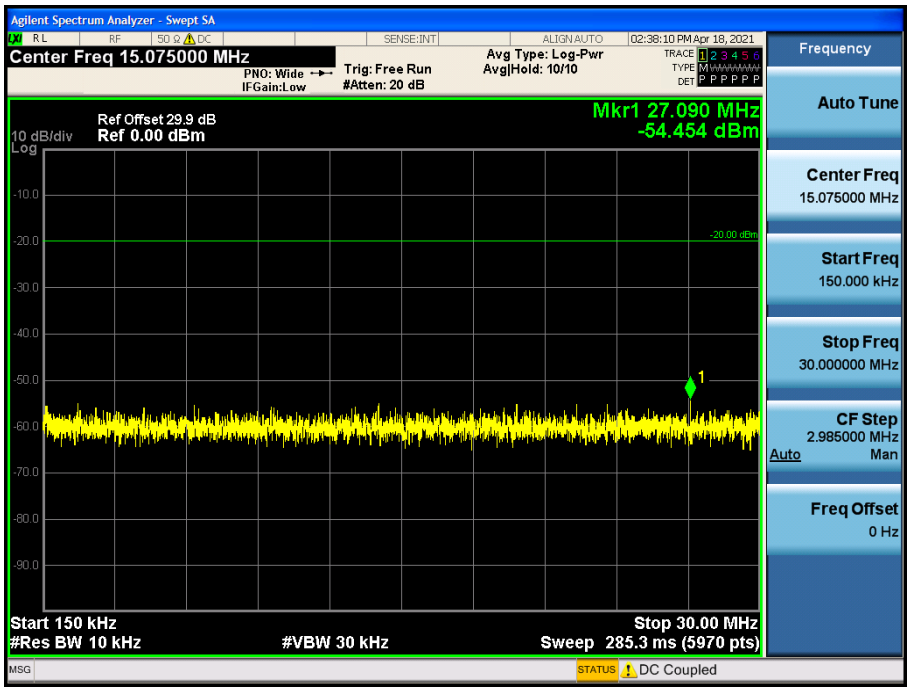
8K30F1E, 8K30F1D, 8K30F7W_FCC

(450.05 MHz)_High

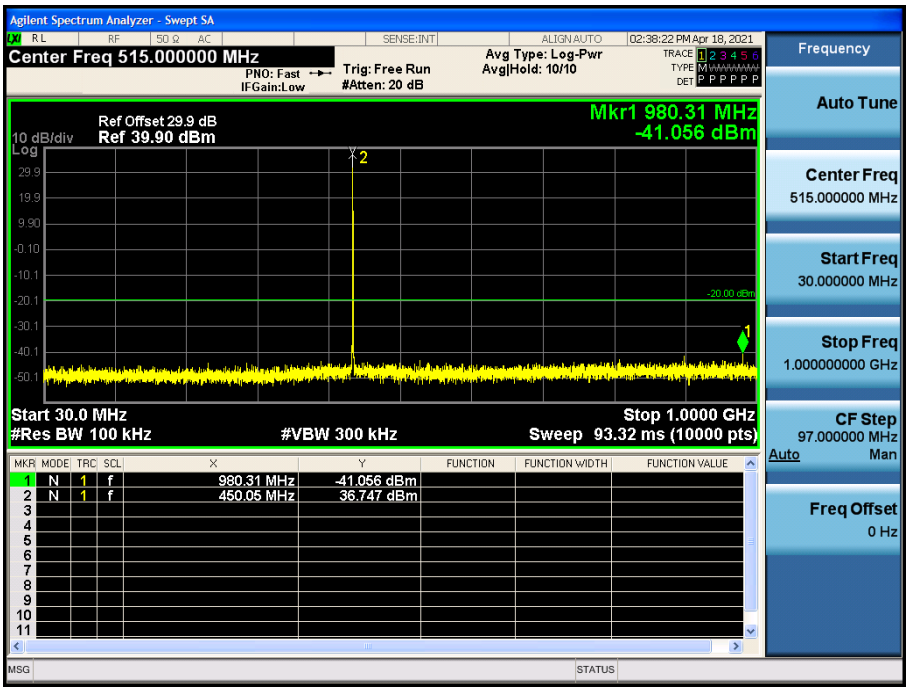
9 kHz~150 kHz



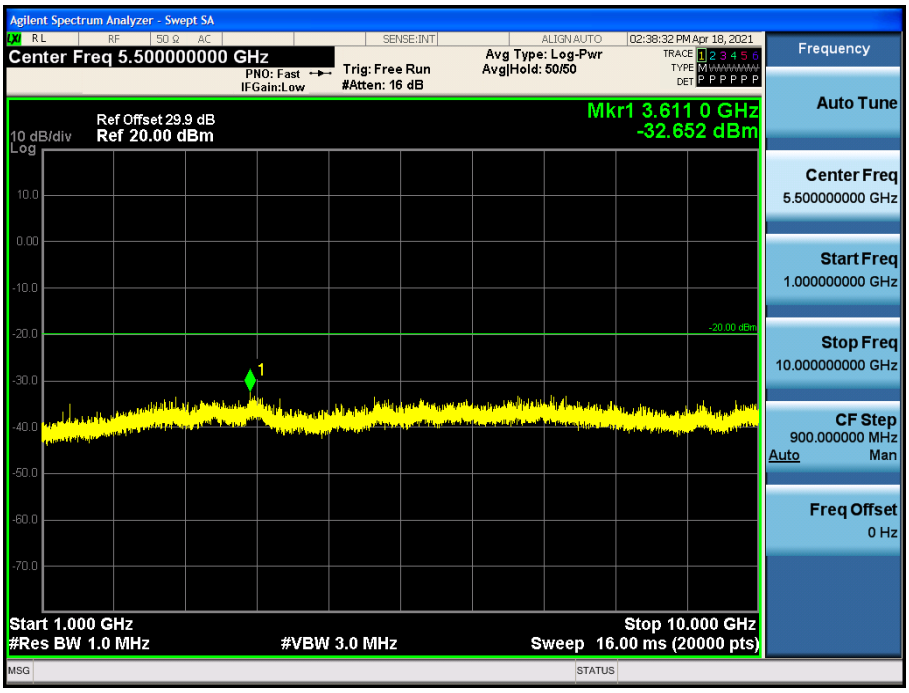
150 kHz~30 MHz



30 MHz~1 GHz

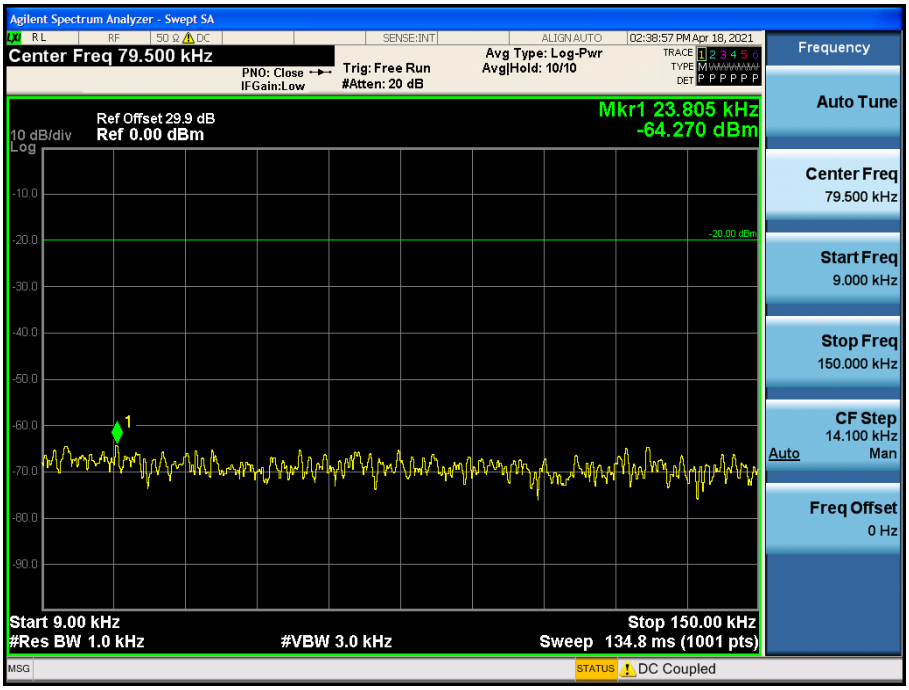


1 GHz~10 GHz

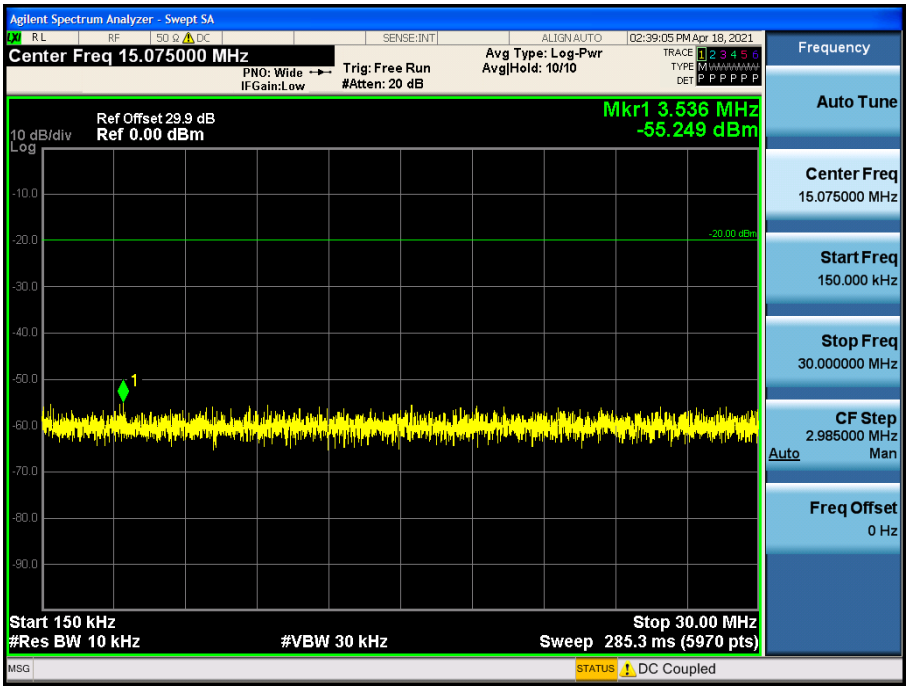


(481.05 MHz)_High

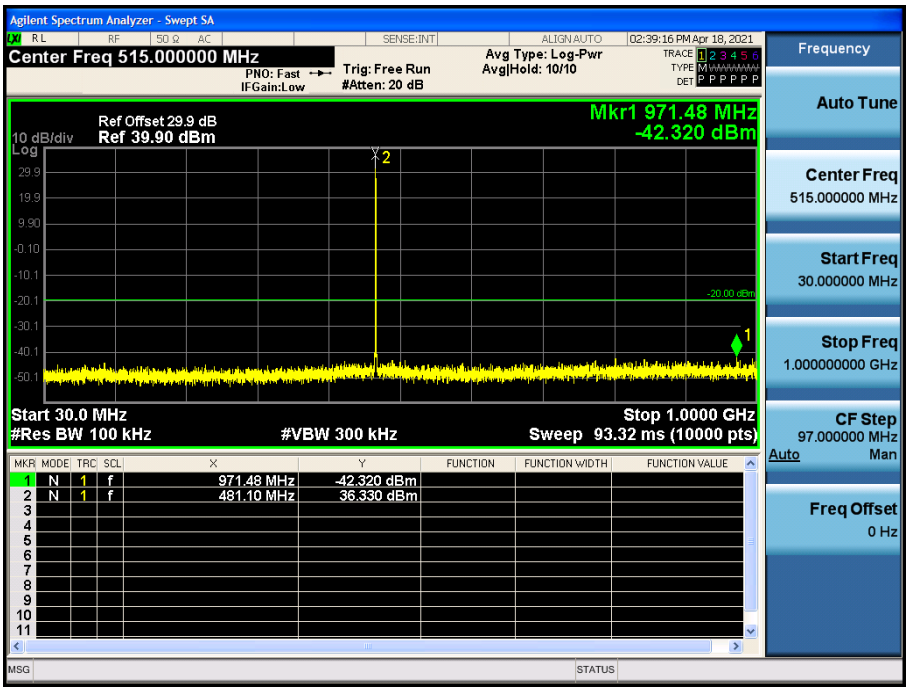
9 kHz~150 kHz



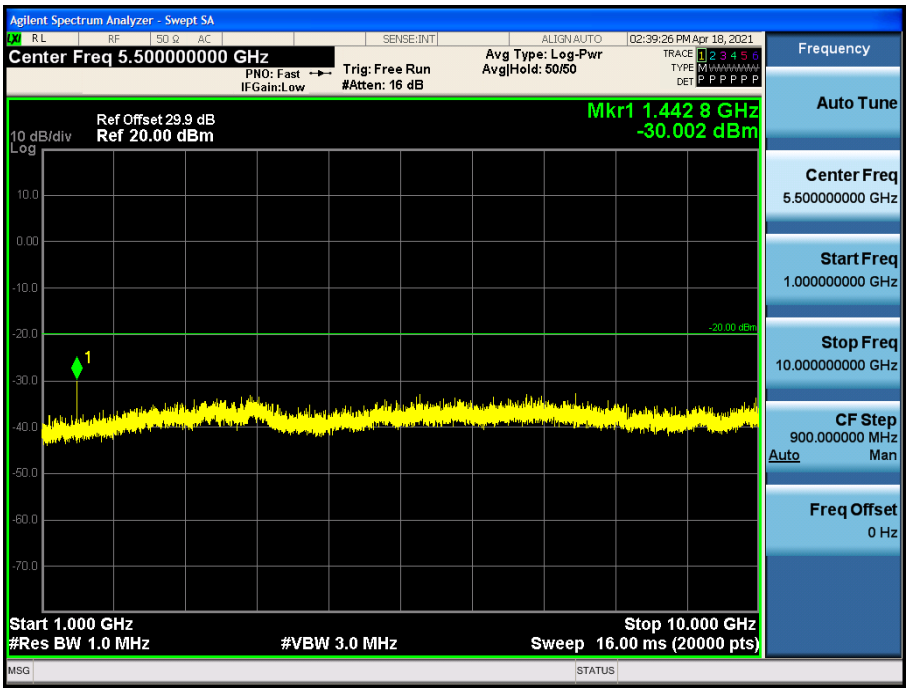
150 kHz~30 MHz



30 MHz~1 GHz

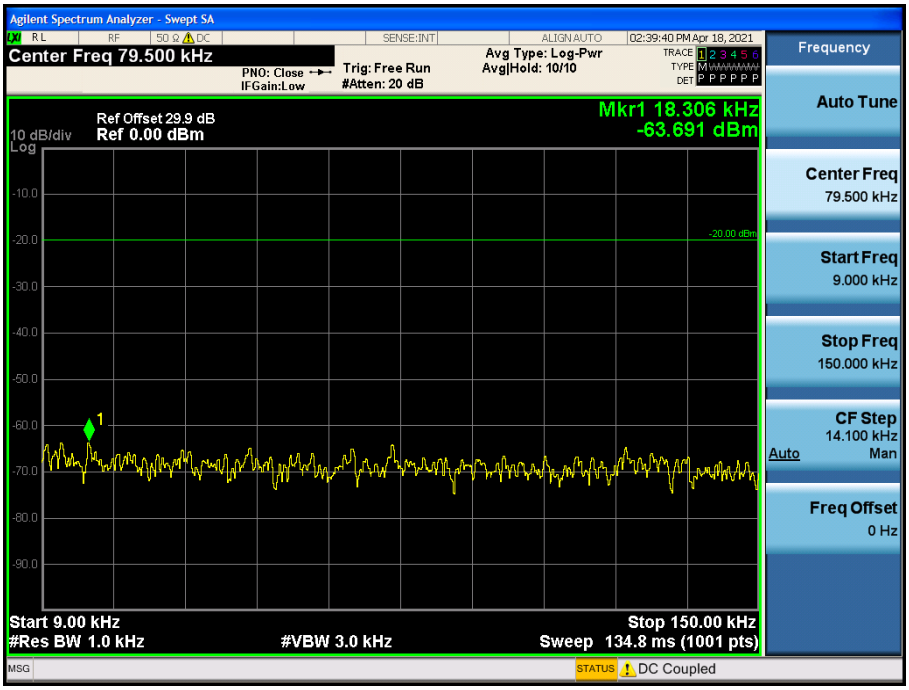


1 GHz~10 GHz

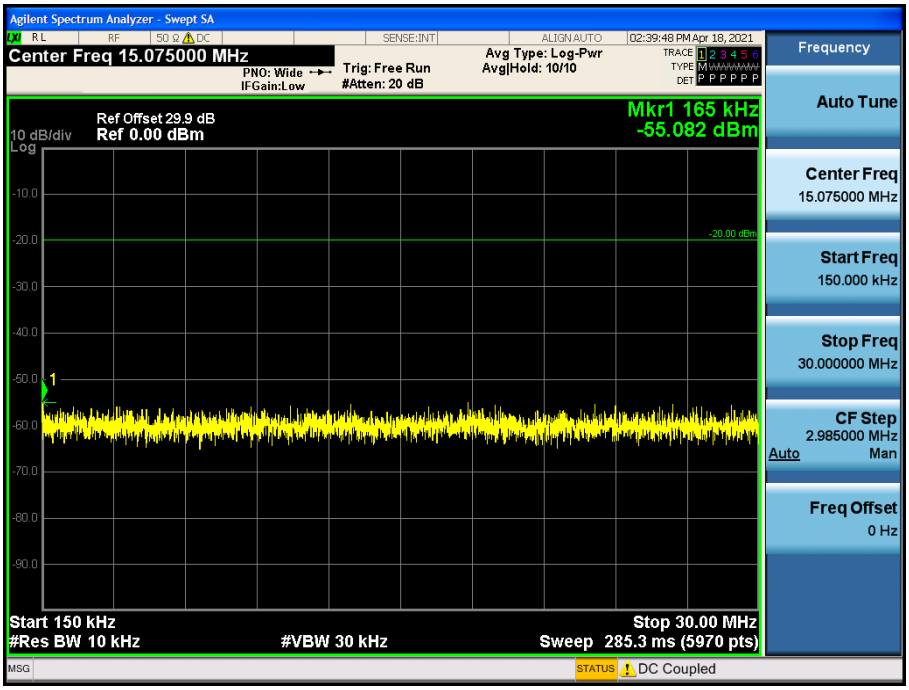


(511.95 MHz)_High

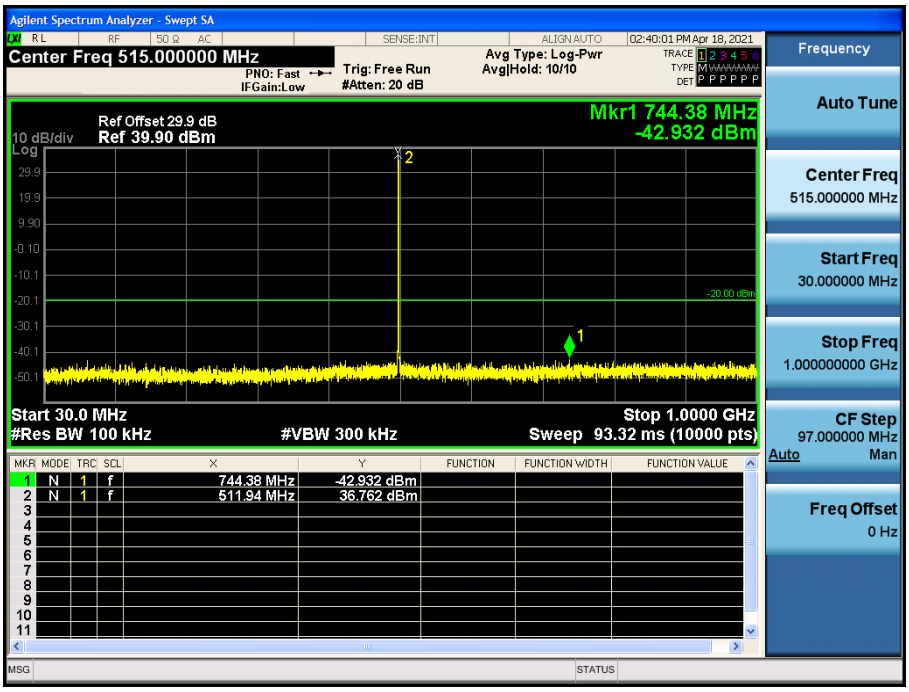
9 kHz~150 kHz



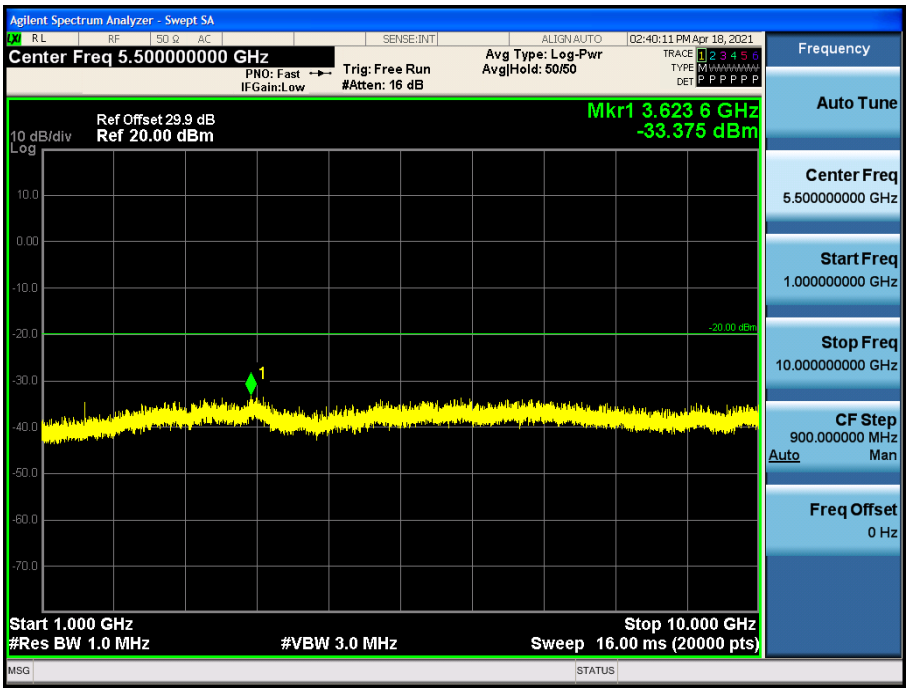
150 kHz~30 MHz



30 MHz~1 GHz



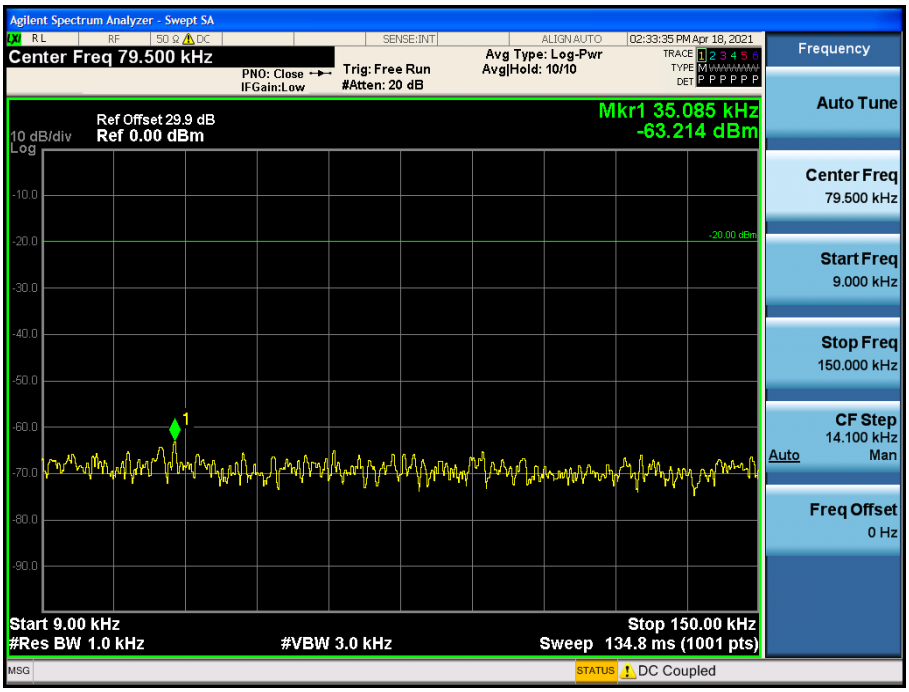
1 GHz~10 GHz



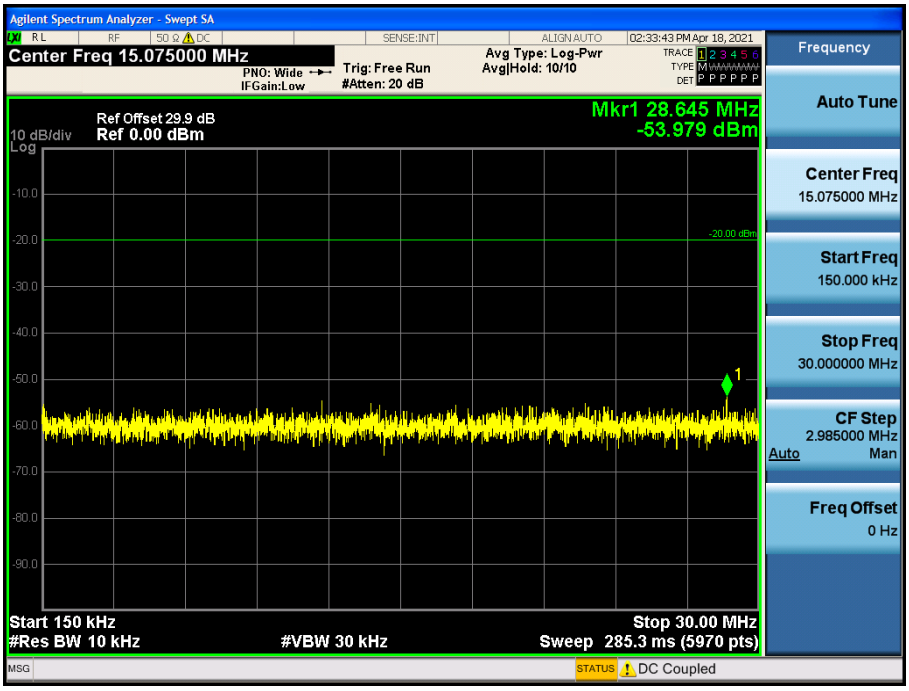
7K60FXD, 7K60FXE_FCC

(450.05 MHz)_High

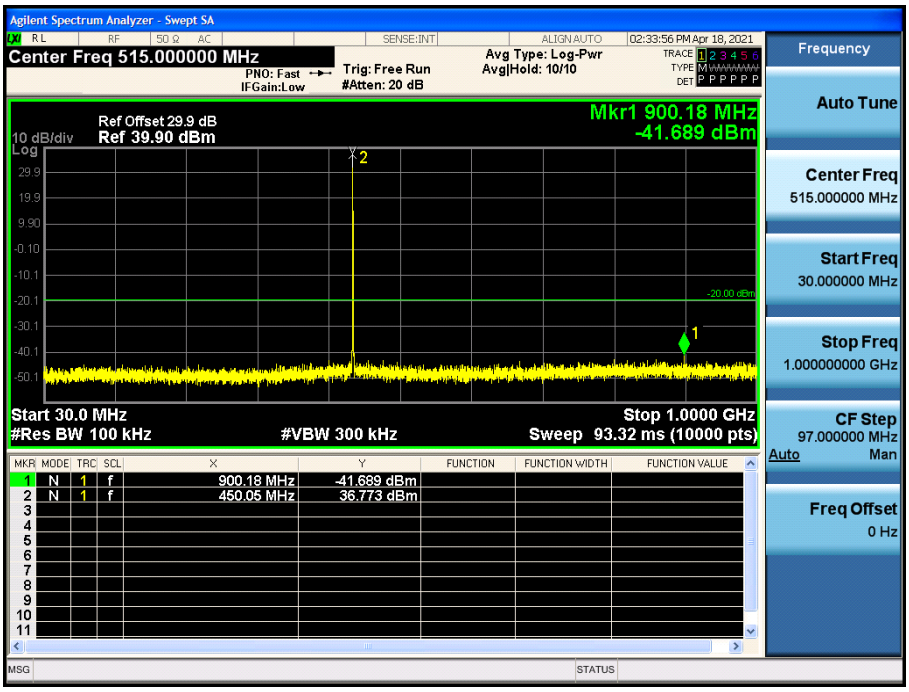
9 kHz~150 kHz



150 kHz~30 MHz



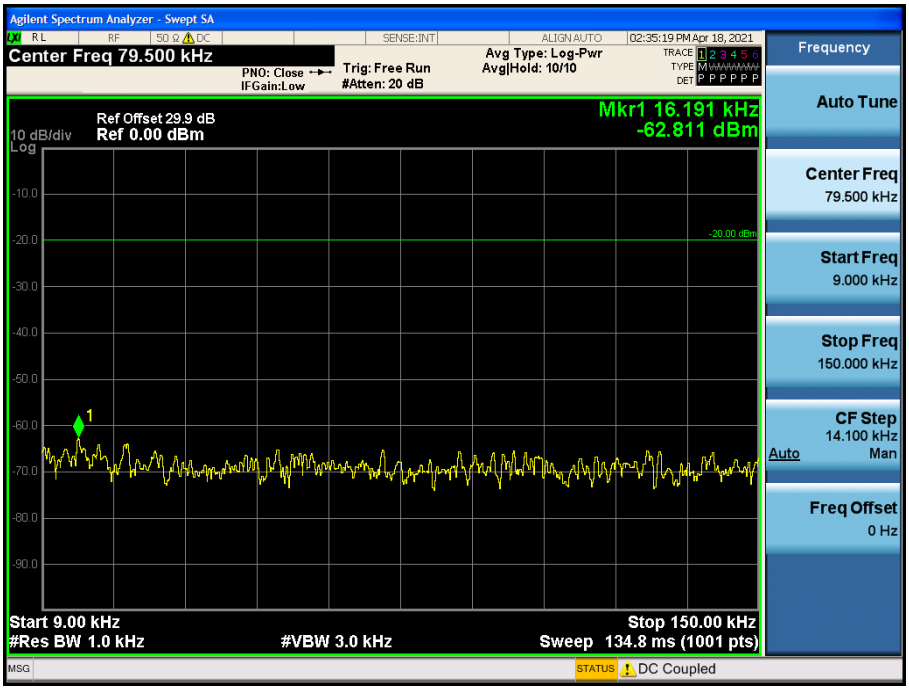
30 MHz~1 GHz



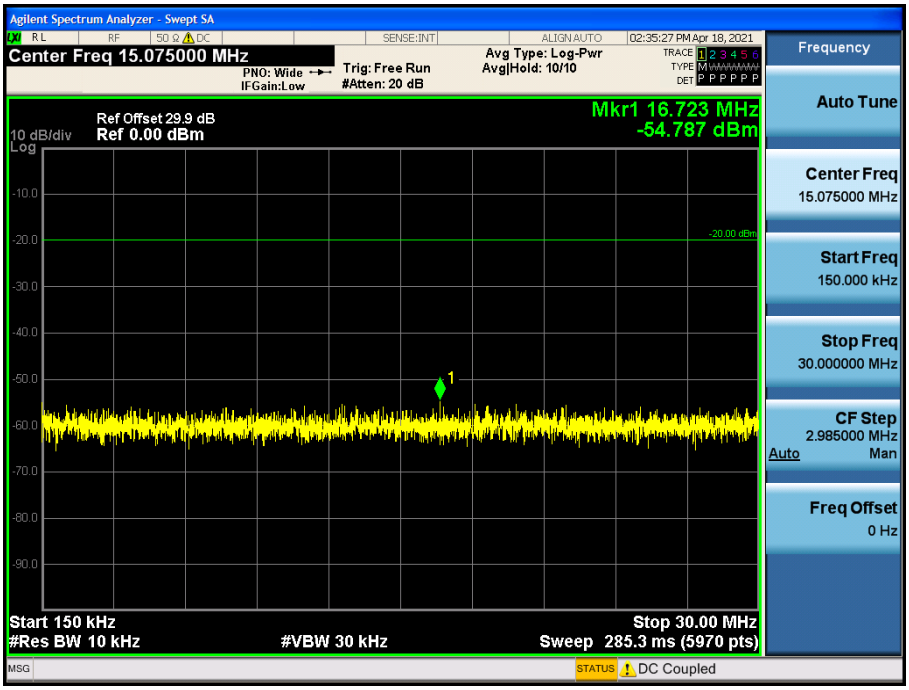
1 GHz~10 GHz

(481.05 MHz)_High

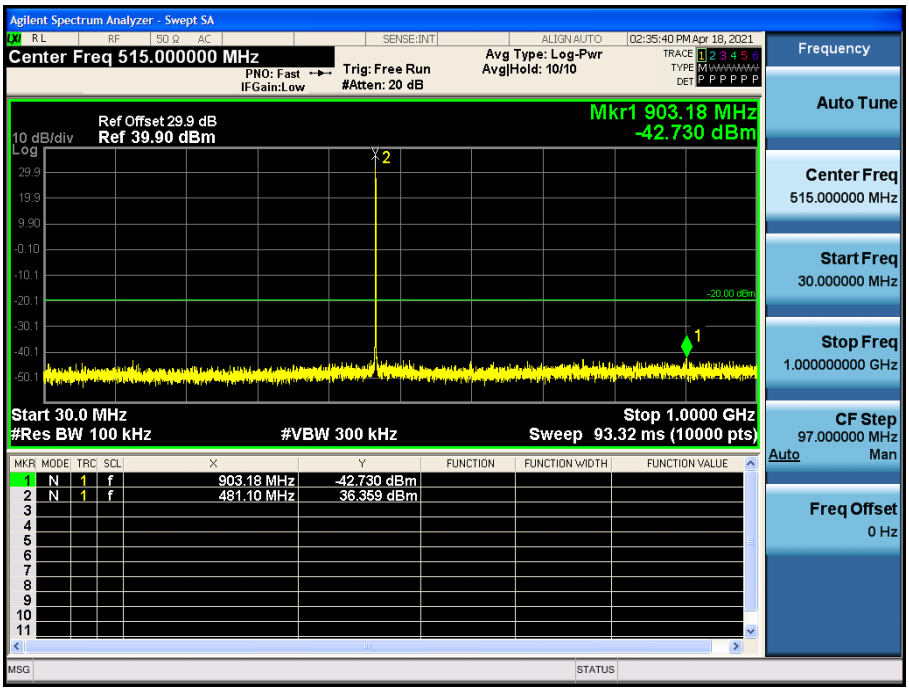
9 kHz~150 kHz



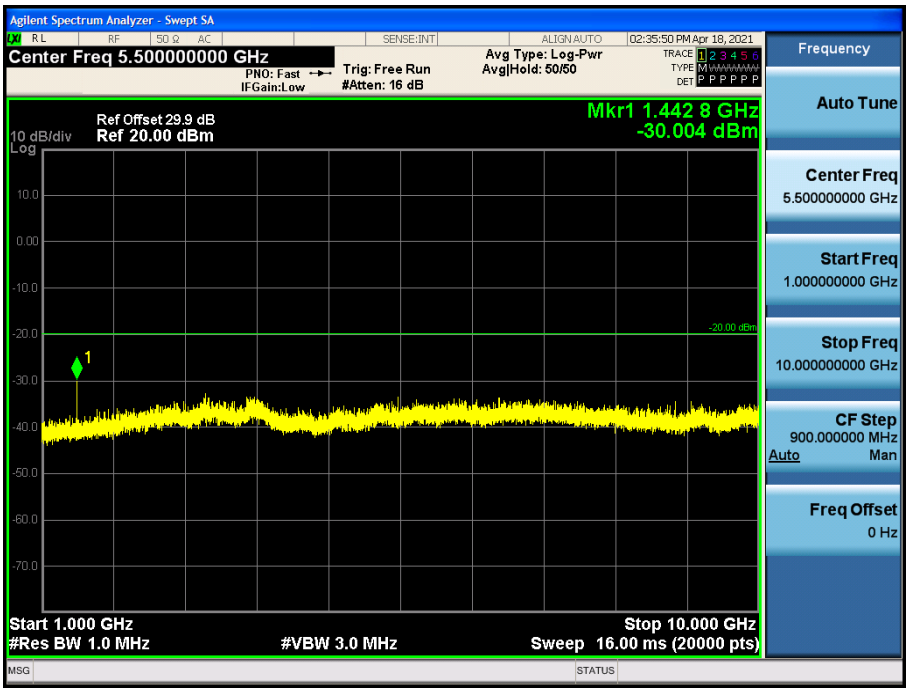
150 kHz~30 MHz



30 MHz~1 GHz

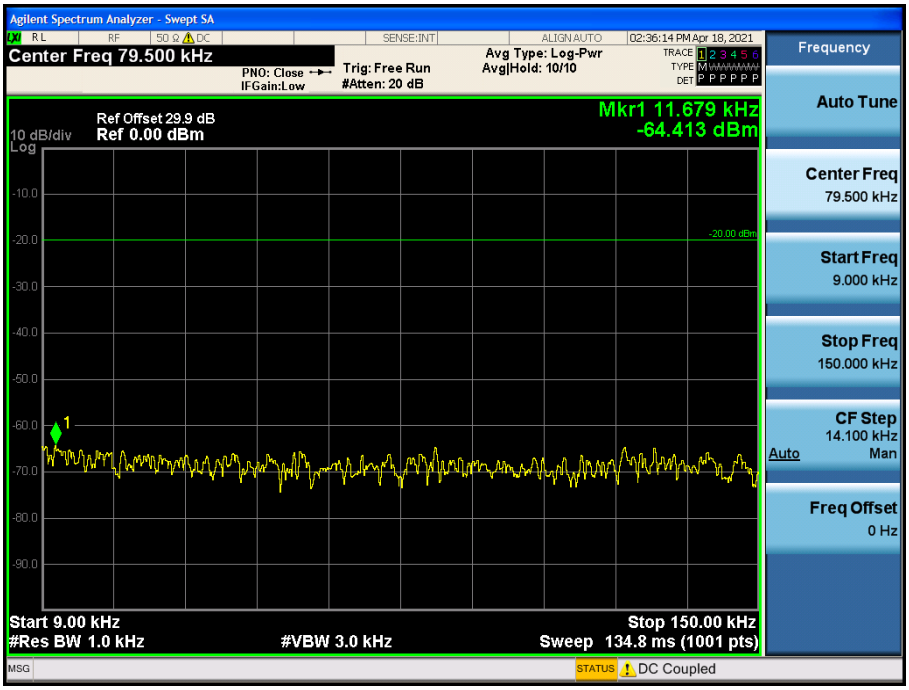


1 GHz~10 GHz

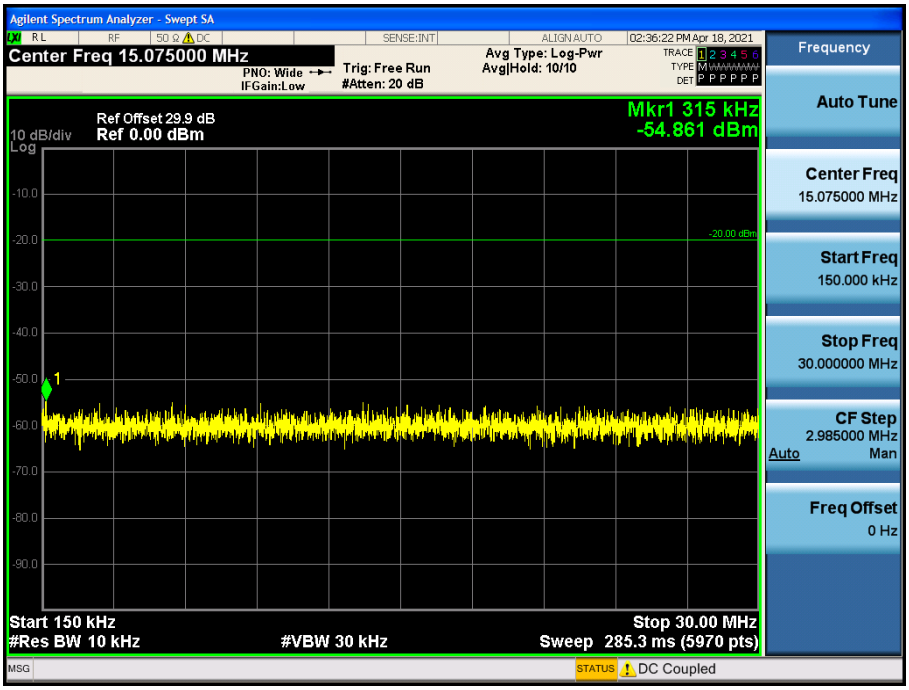


(511.95 MHz)_High

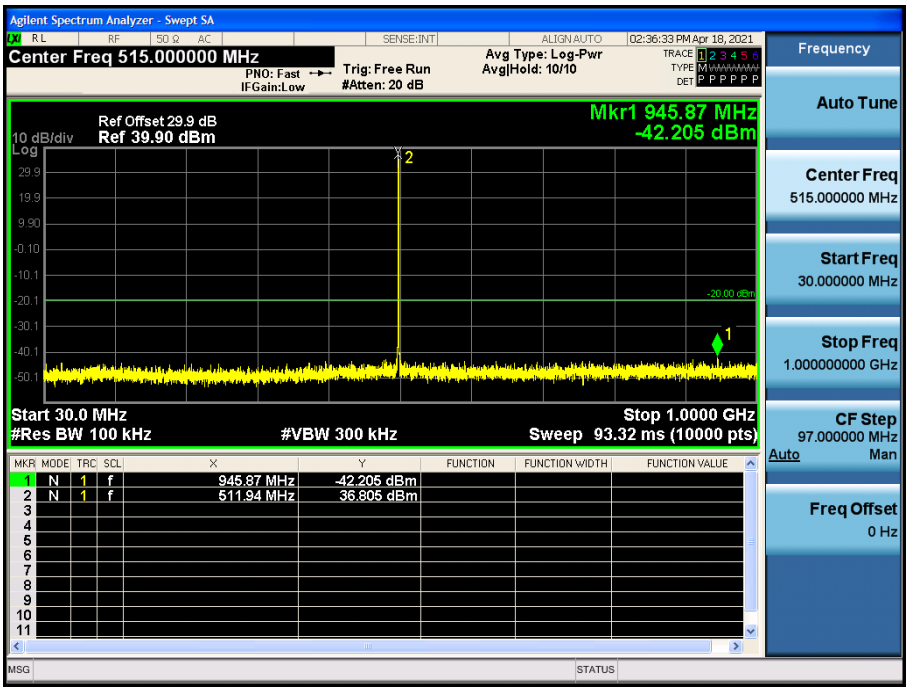
9 kHz~150 kHz



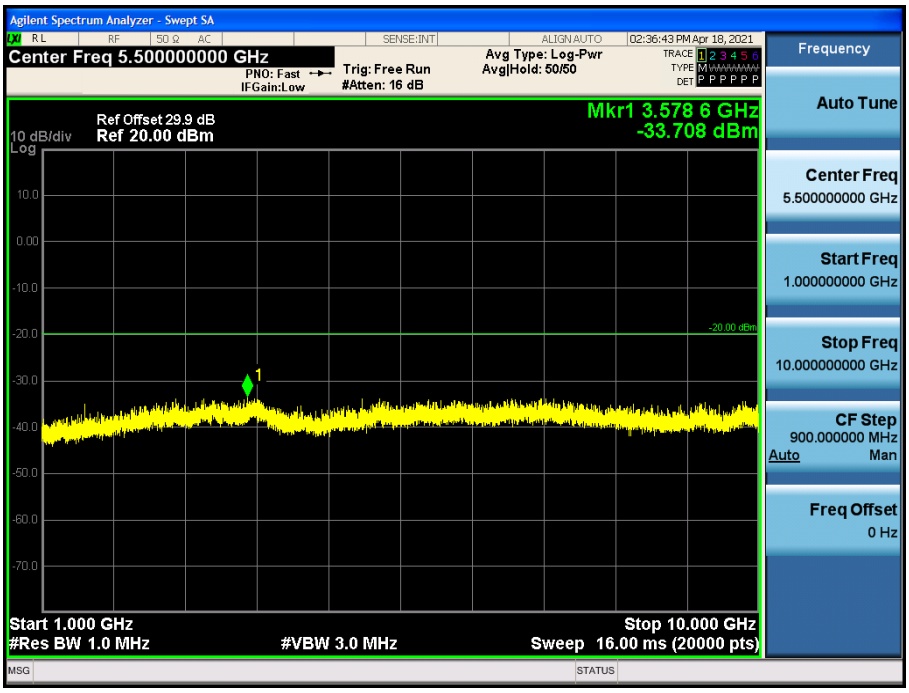
150 kHz~30 MHz



30 MHz~1 GHz



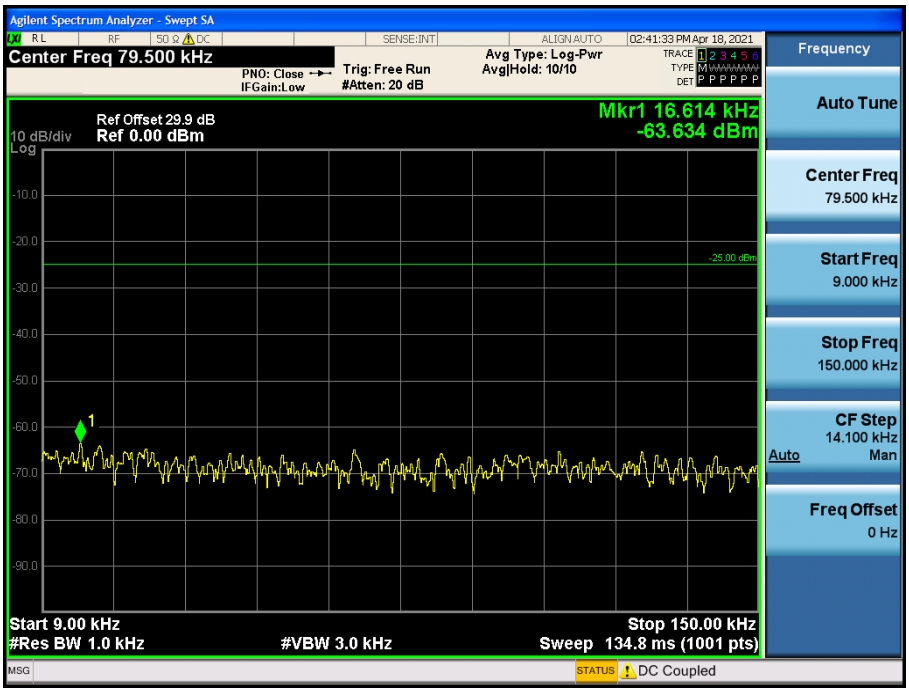
1 GHz~10 GHz



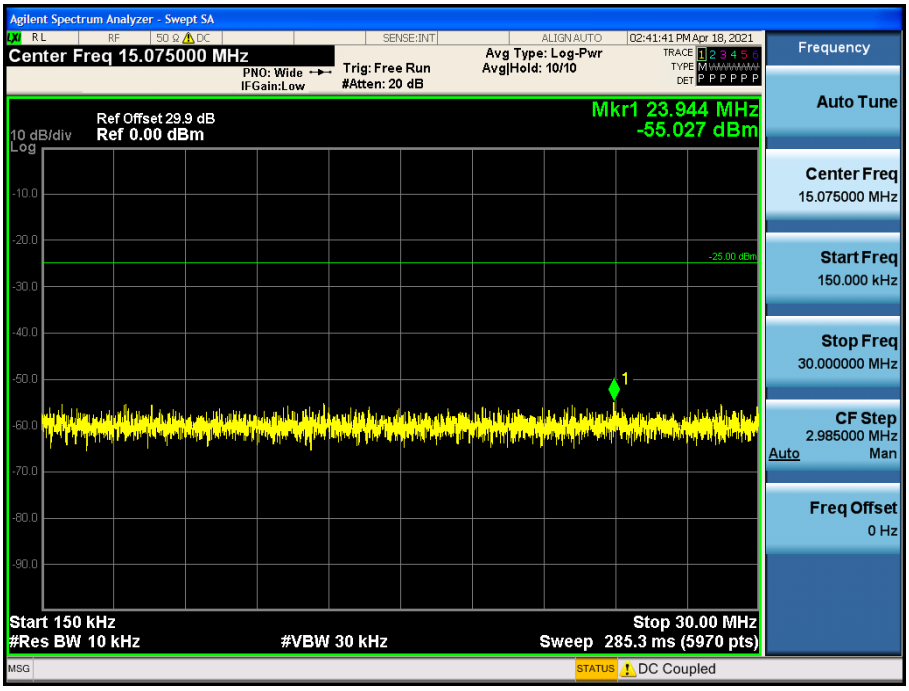
4K00F1E, 4K00F1D, 4K00F7W_FCC

(450.05 MHz)_High

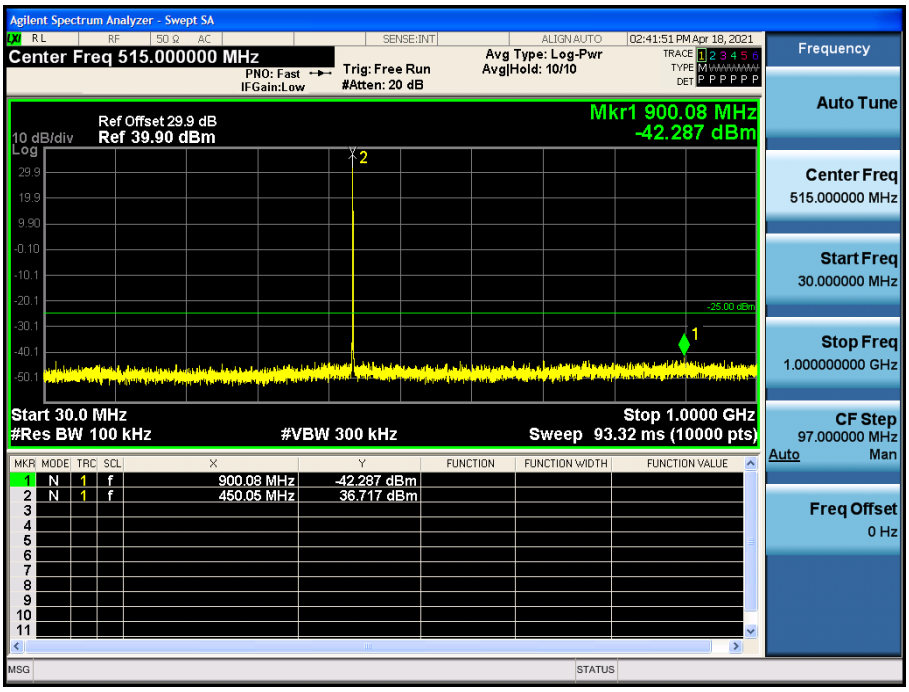
9 kHz~150 kHz



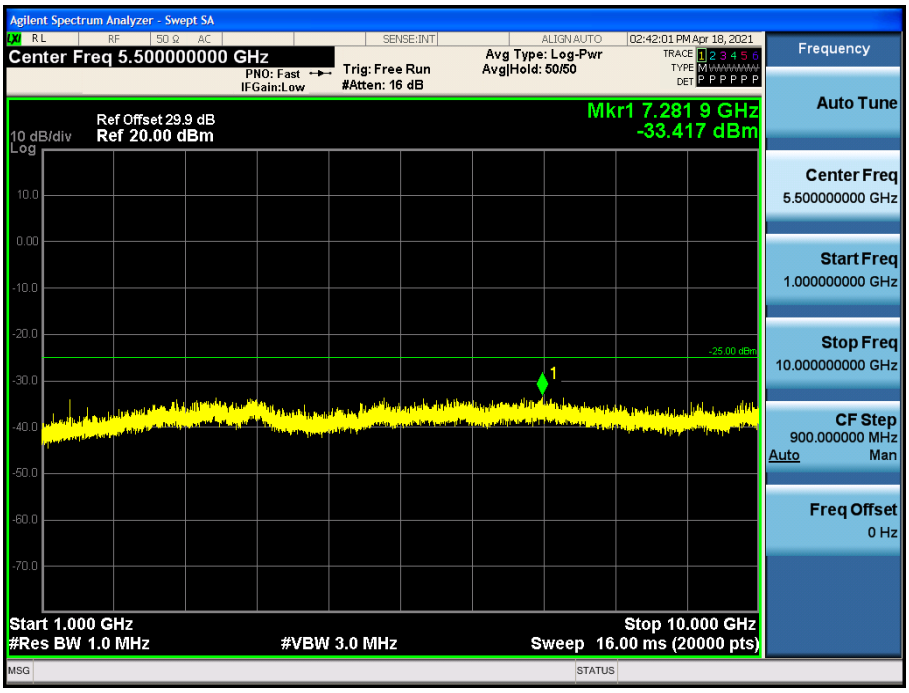
150 kHz~30 MHz



30 MHz~1 GHz

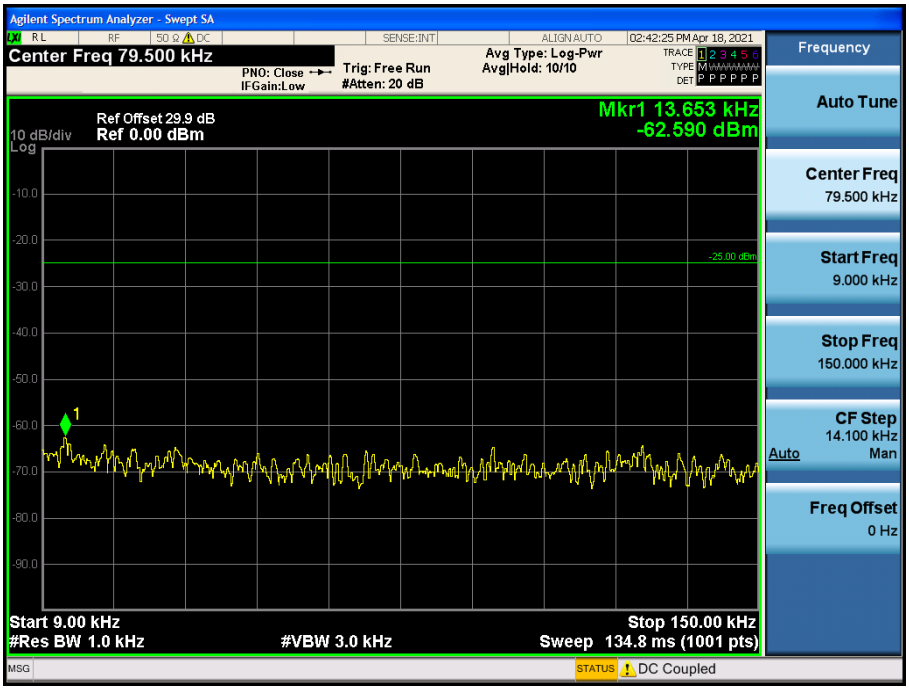


1 GHz~10 GHz

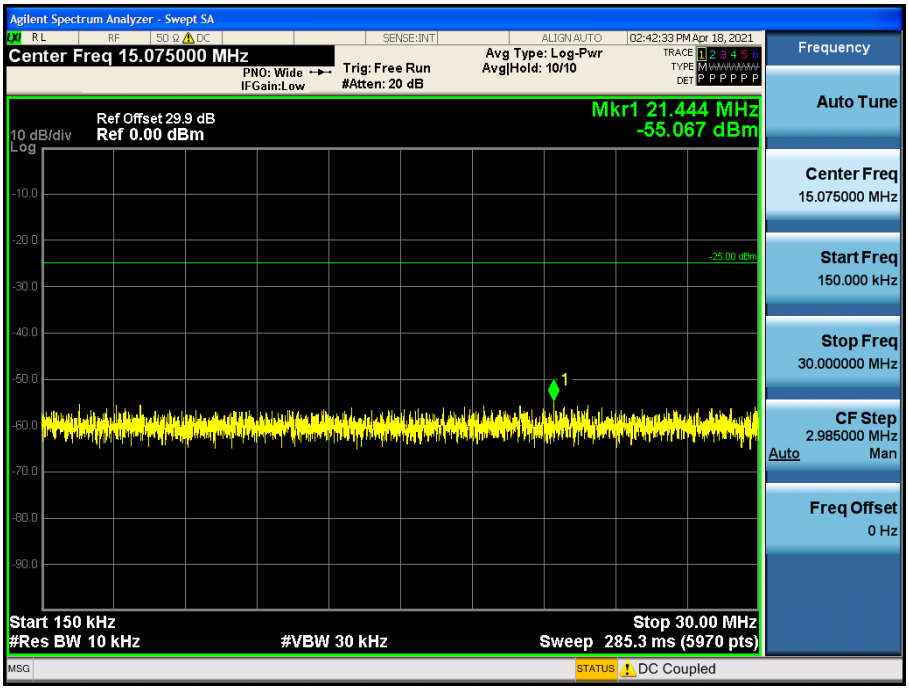


(481.05 MHz)_High

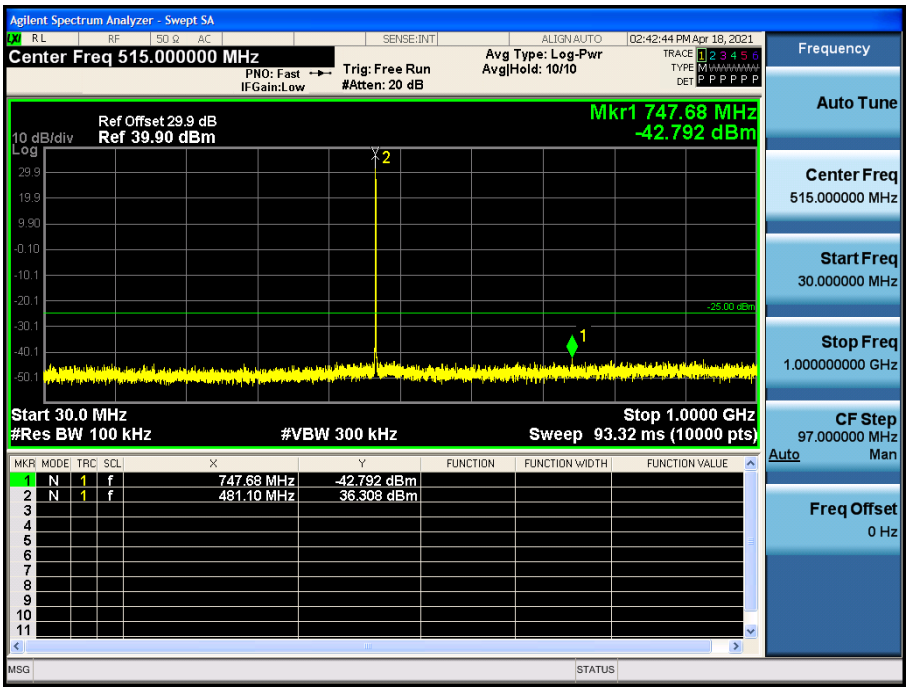
9 kHz~150 kHz



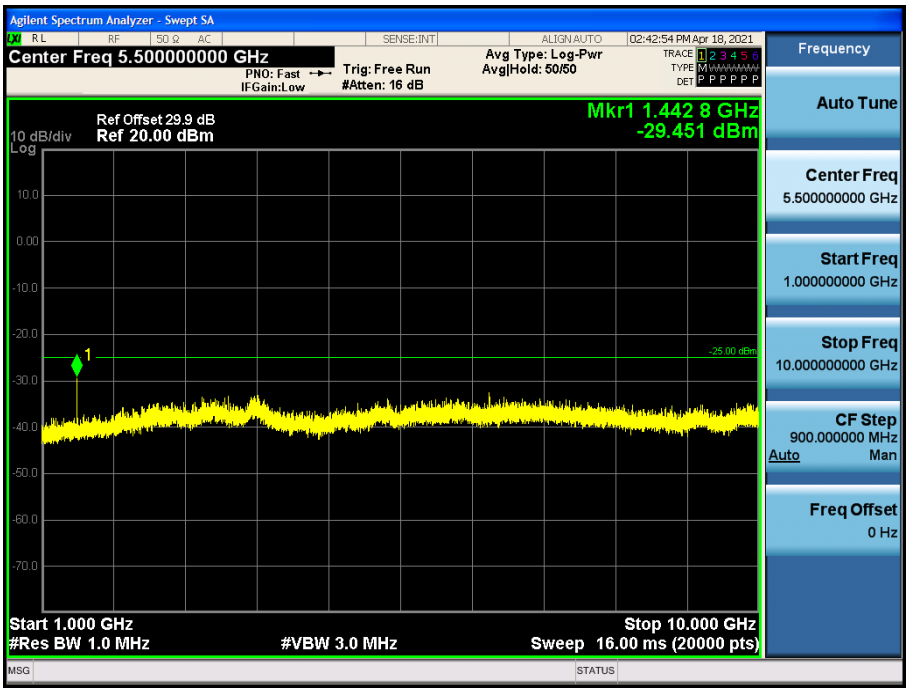
150 kHz~30 MHz



30 MHz~1 GHz

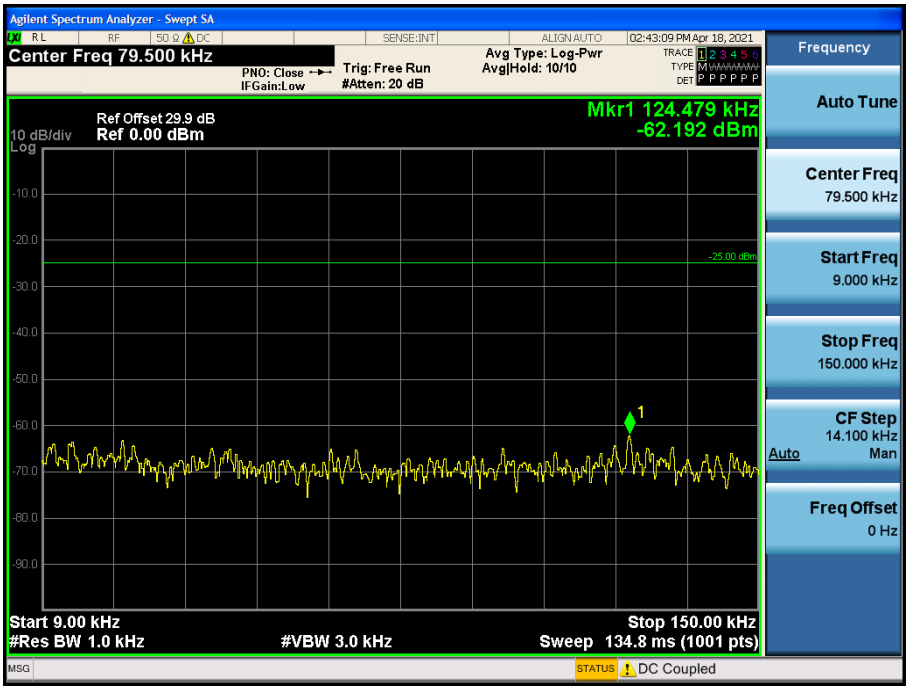


1 GHz~10 GHz

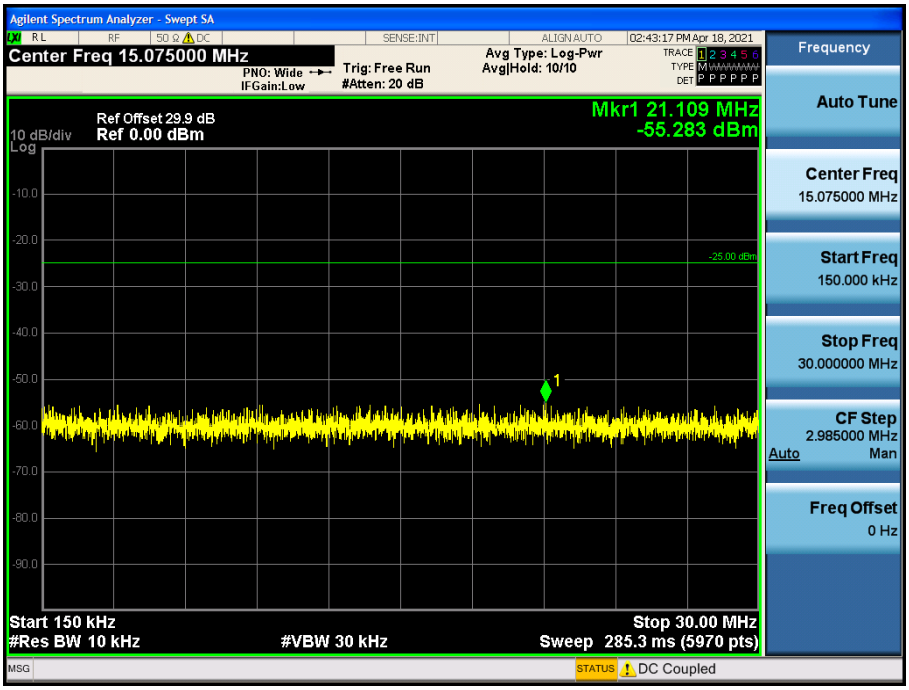


(511.95 MHz)_High

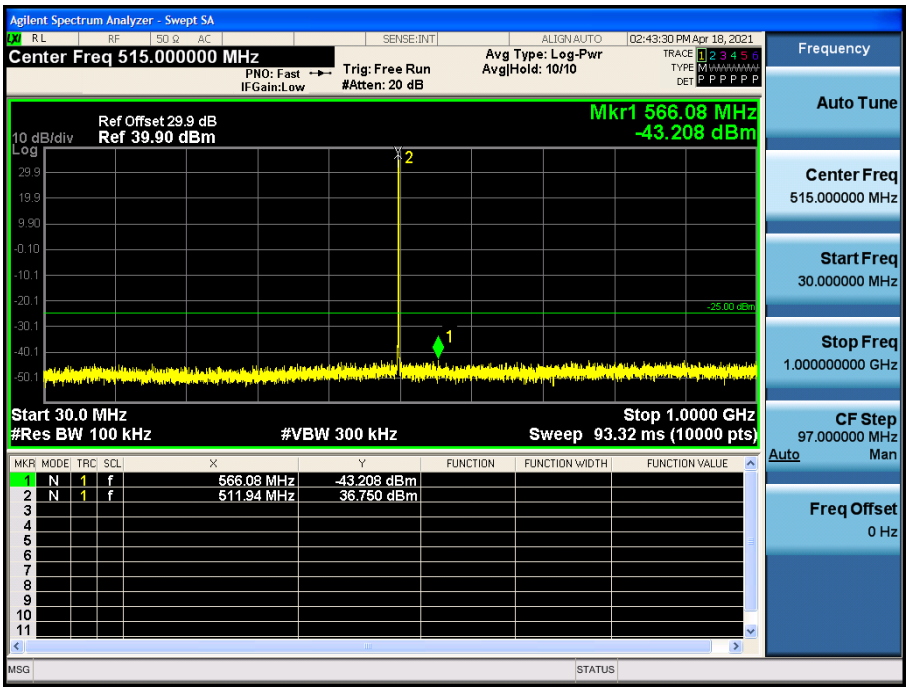
9 kHz~150 kHz



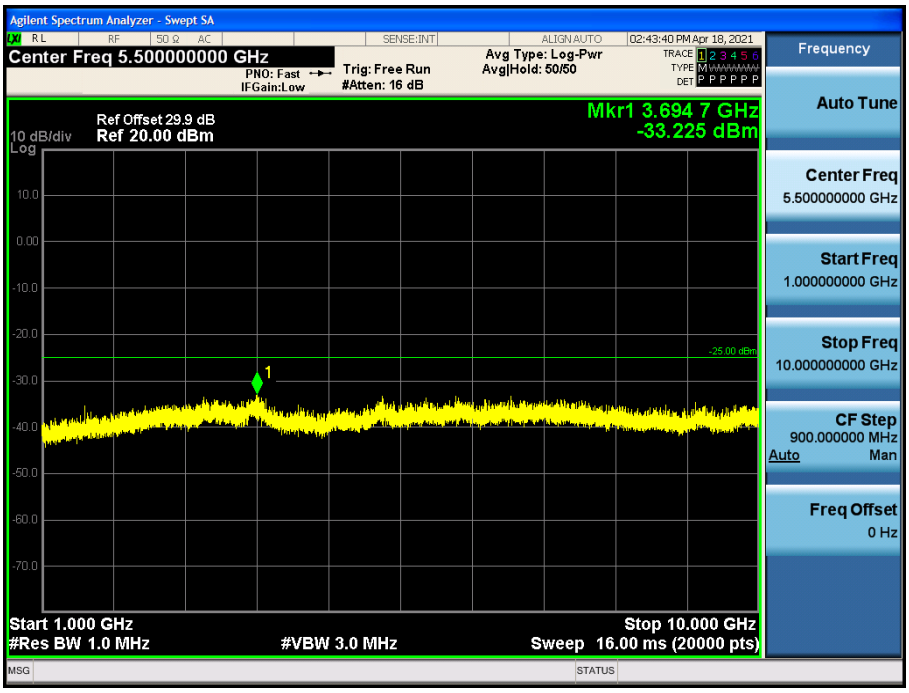
150 kHz~30 MHz



30 MHz~1 GHz



1 GHz~10 GHz



4K00F2D_FCC

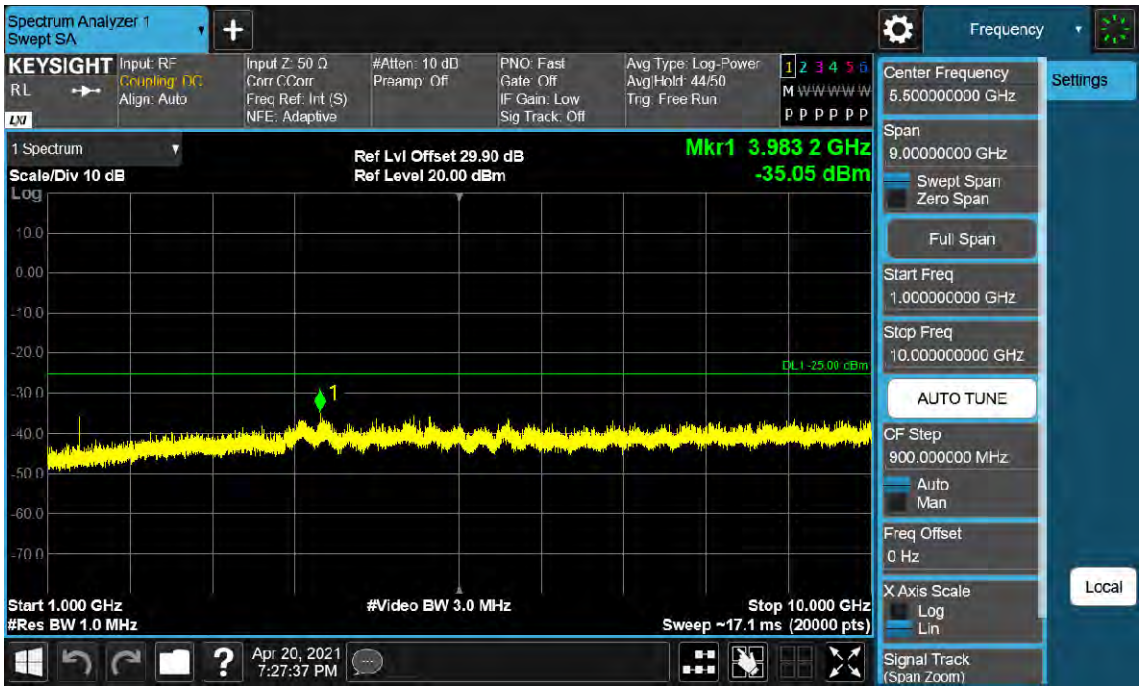
(450.05 MHz)_High

9 kHz~150 kHz

150 kHz~30 MHz

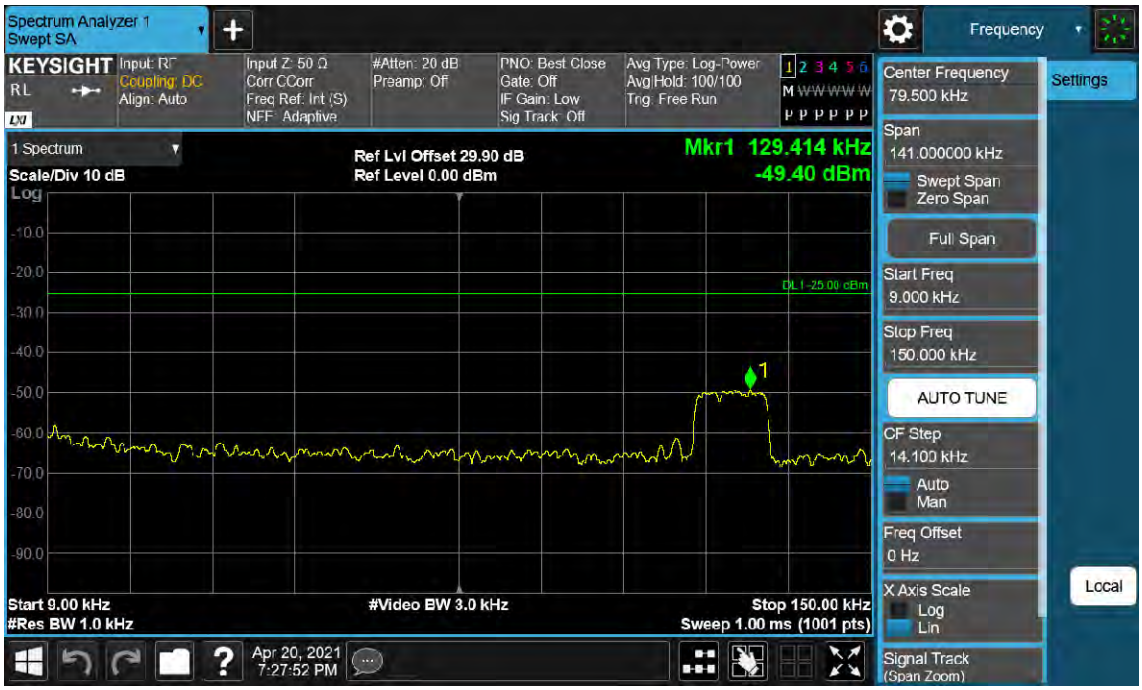
30 MHz~1 GHz

1 GHz~10 GHz



(481.05 MHz)_High

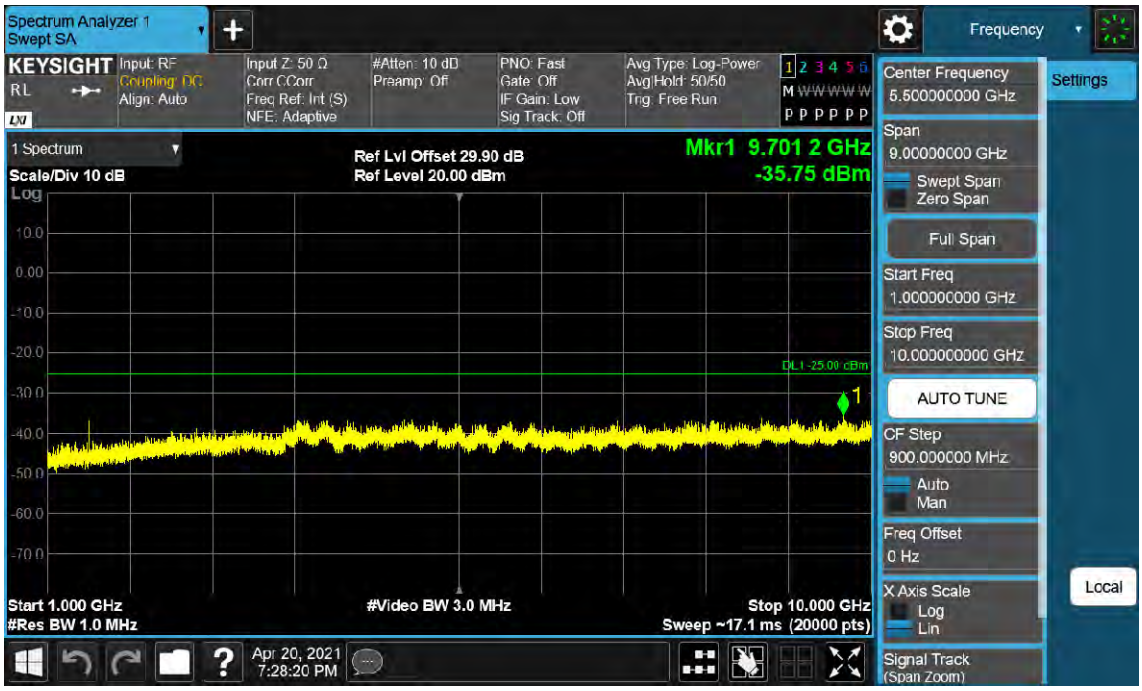
9 kHz~150 kHz



150 kHz~30 MHz

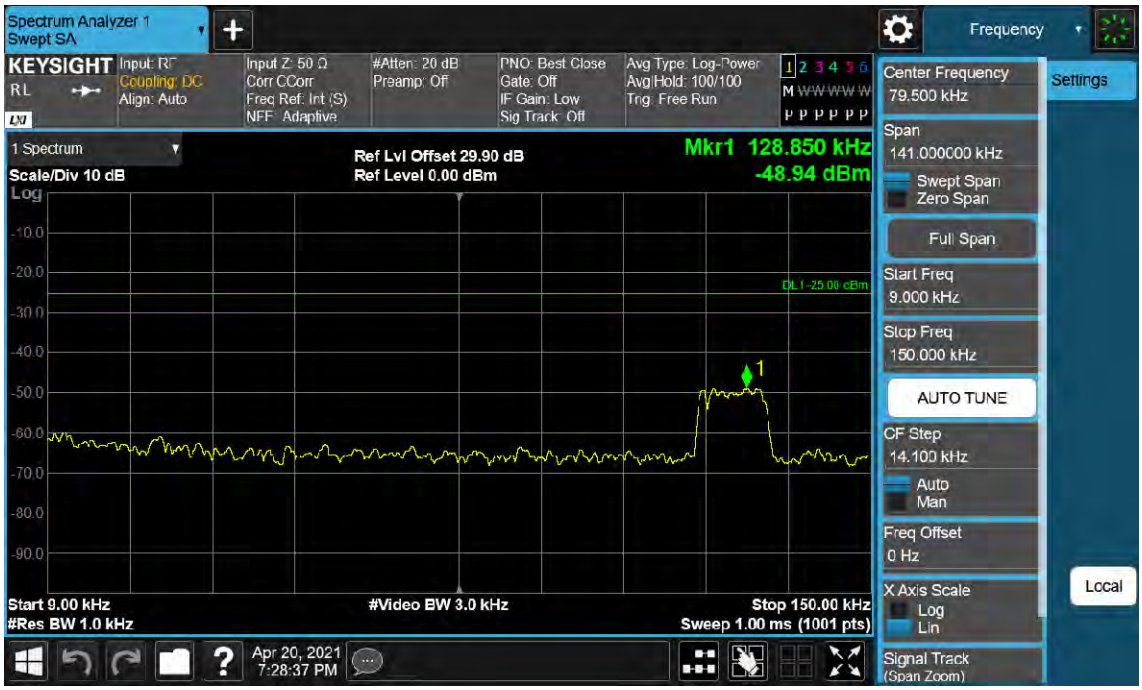
30 MHz~1 GHz

1 GHz~10 GHz

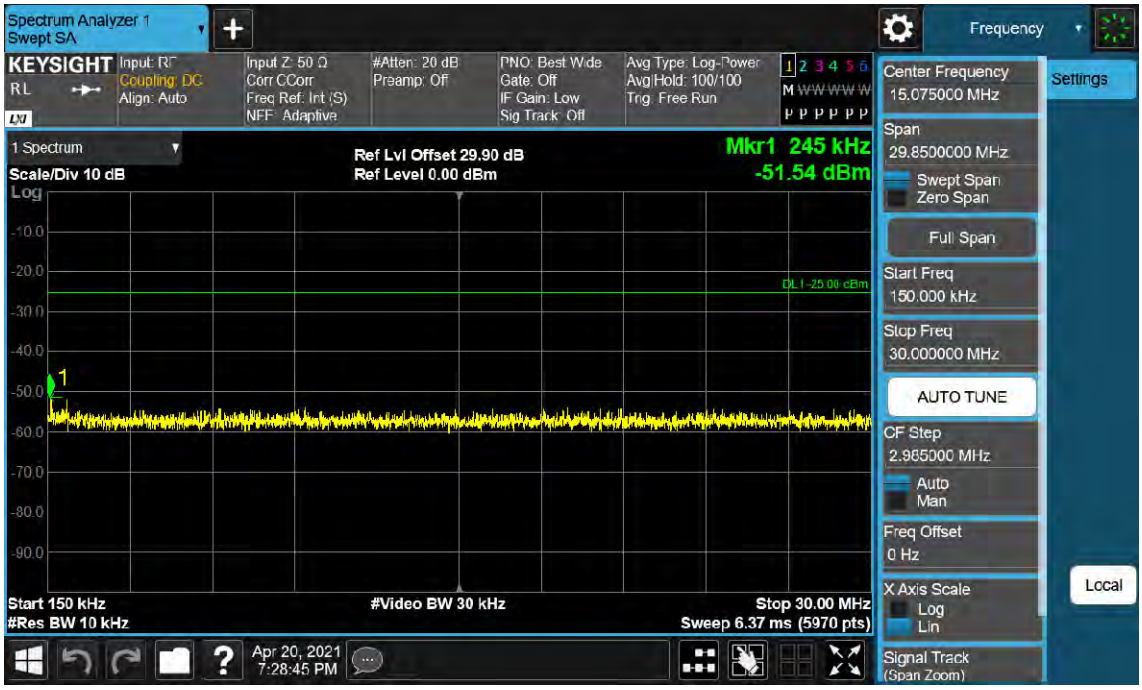


(511.95 MHz)_High

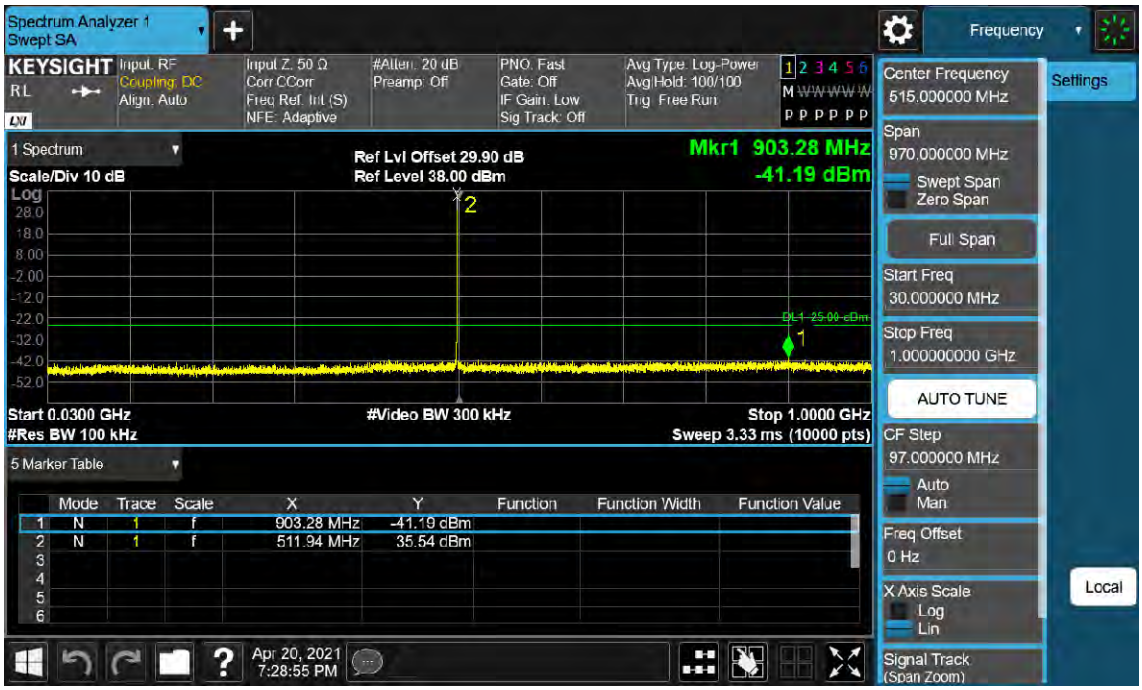
9 kHz~150 kHz



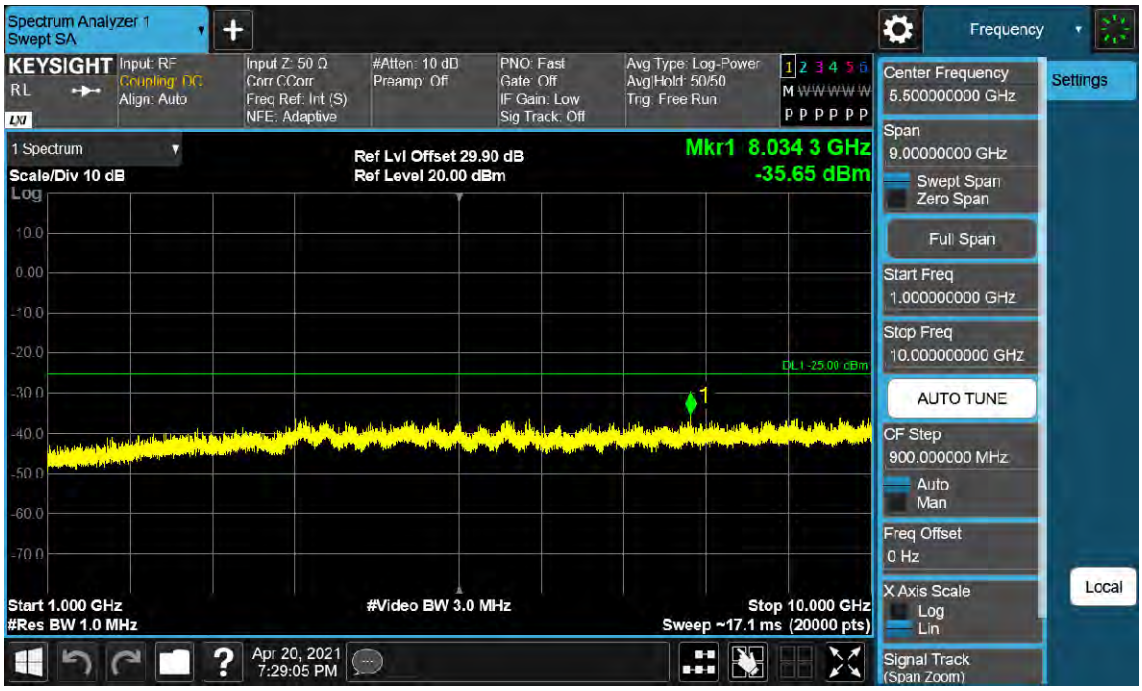
150 kHz~30 MHz



30 MHz~1 GHz



1 GHz~10 GHz

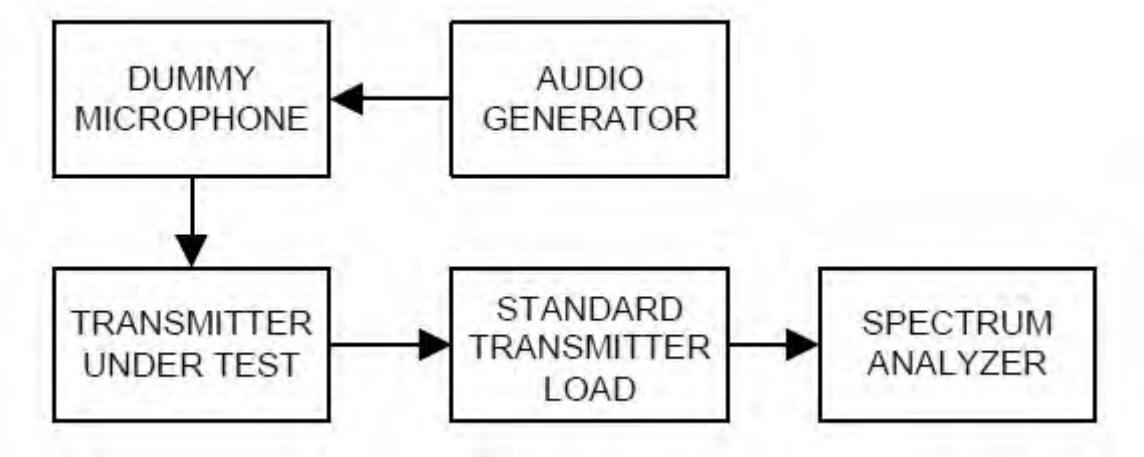


8.9 Adjacent Channel Power

▣ Definition

For 450 MHz – 470 MHz, operating using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power(ACP) limits. A measurement bandwidth is 18 kHz.

▣ TEST CONFIGURATION

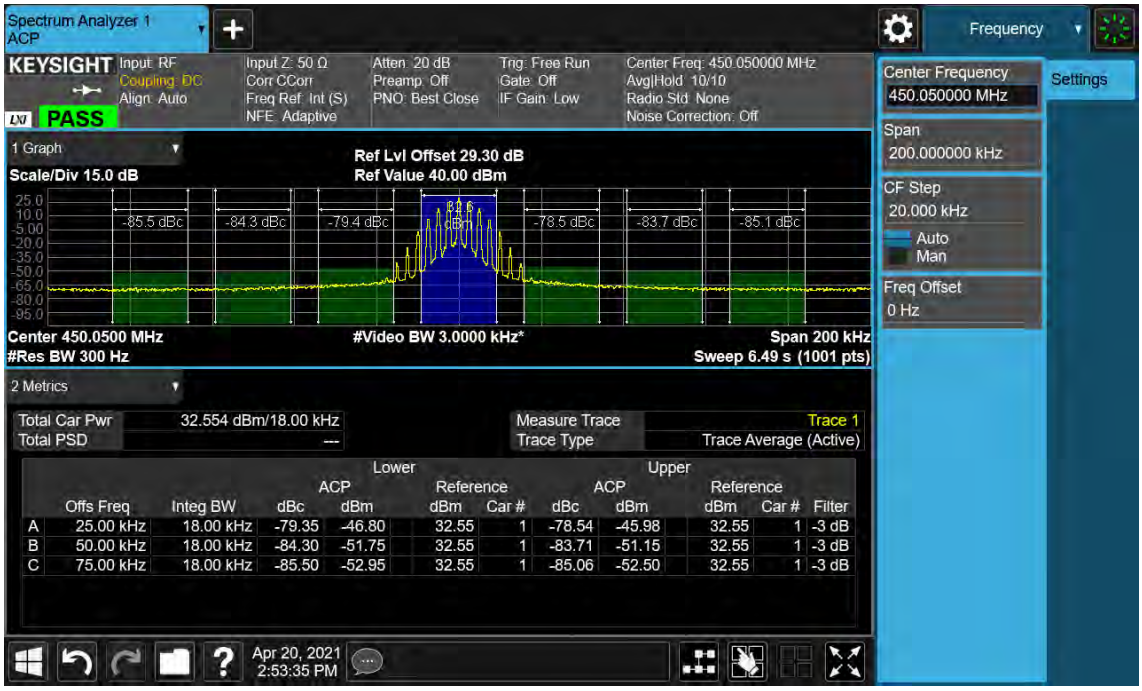


▣ TEST RESULTS

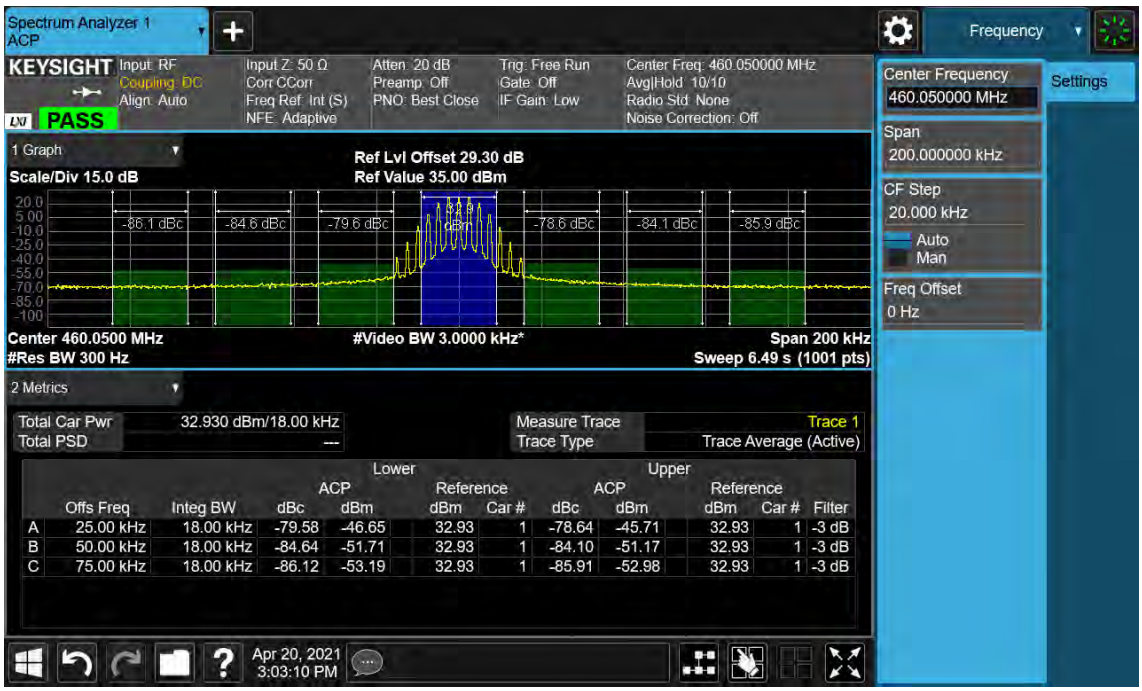
Frequency(MHz)	Frequency offset(kHz)	Lower(dBc)	Upper(dBc)	Limit(dBc)
450.05 (High Power)	25	-79.35	-78.54	-60.00
	50	-84.30	-83.71	-70.00
	75	-85.50	-85.06	-70.00
460.05 (High Power)	25	-79.58	-78.64	-60.00
	50	-84.64	-84.10	-70.00
	75	-86.12	-85.91	-70.00
469.95 (High Power)	25	-79.36	-78.57	-60.00
	50	-84.80	-84.37	-70.00
	75	-86.29	-85.89	-70.00
450.05 (Low Power)	25	-77.70	-77.08	-55.00
	50	-82.42	-82.20	-70.00
	75	-84.34	-83.99	-70.00
460.05 (Low Power)	25	-78.00	-77.38	-55.00
	50	-83.01	-82.73	-70.00
	75	-84.67	-84.61	-70.00
469.95 (Low Power)	25	-77.98	-77.30	-55.00
	50	-83.02	-82.69	-70.00
	75	-84.88	-84.57	-70.00

▣ Plots of Adjacent Channel Power

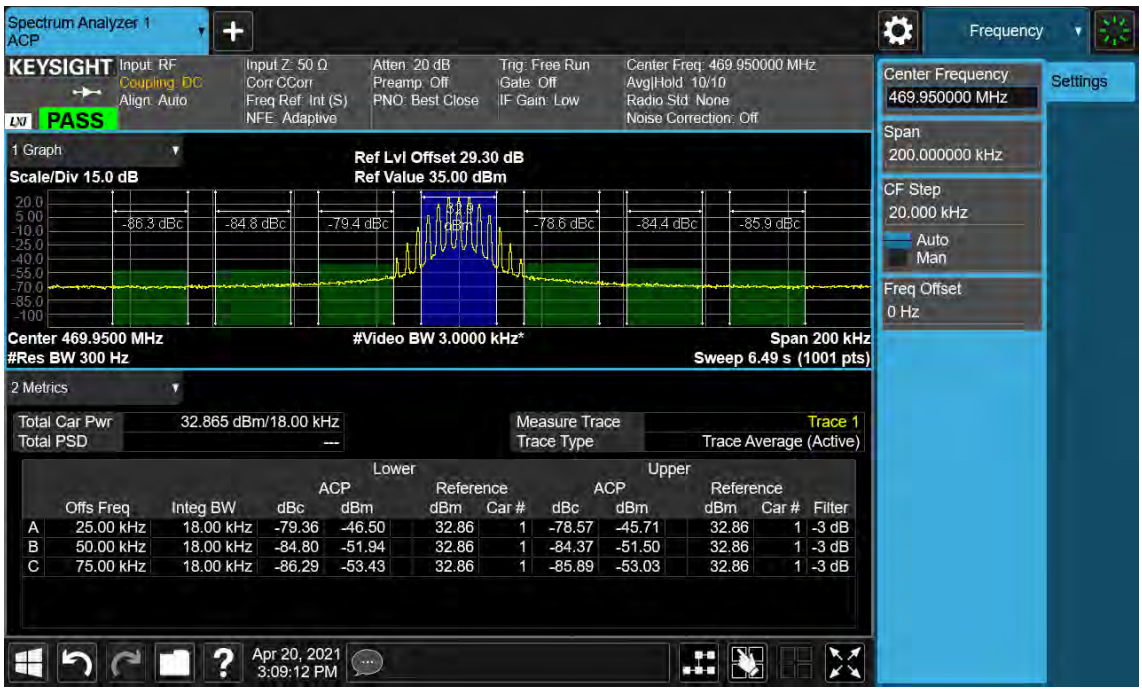
16K0F3E_ 450.05 MHz_High Power



16K0F3E_ 460.05 MHz_High Power



16K0F3E_ 469.95 MHz_High Power



16K0F3E_ 450.05 MHz_Low Power

16K0F3E_ 460.05 MHz_Low Power

16K0F3E_ 469.95 MHz_Low Power

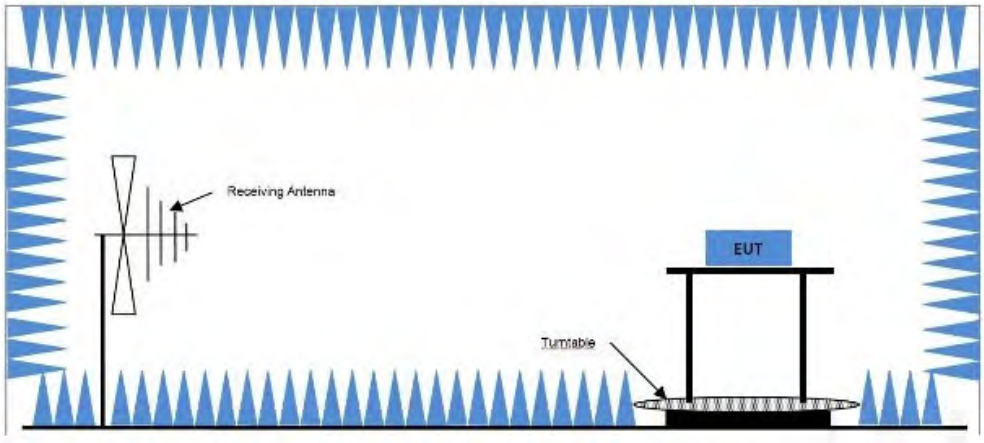
8.10 Unwanted Emissions : Radiated Spurious Emission

▣ Definition

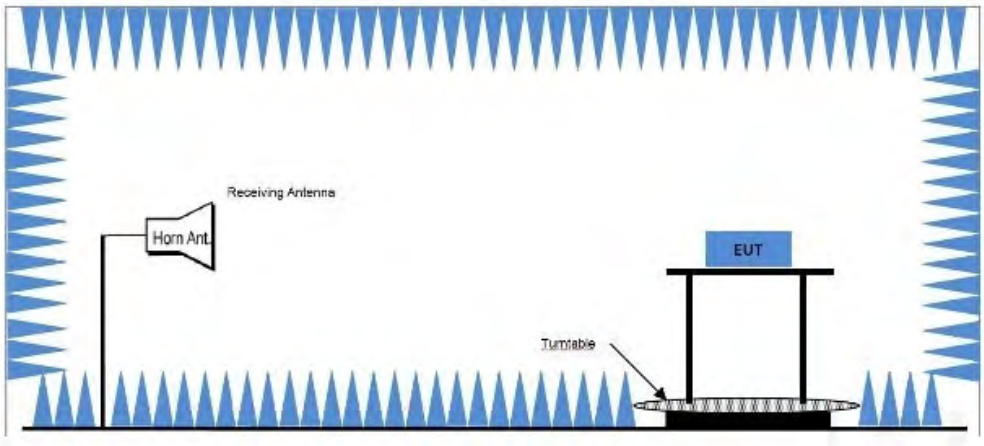
Radiated spurious emissions are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies that are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

▣ TEST CONFIGURATION

Below 30 MHz



Above 1 GHz



TEST PROCEDURE USED

Radiated tests are performed in the Fully-anechoic chamber.
Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA-603E-2016.

a) The Resolution Bandwidth for scanning Radiated Emission below 1 GHz is 100 kHz with Video Bandwidth = 300 kHz and Resolution Bandwidth for above 1 GHz is 1 MHz with Video Bandwidth = 3 MHz.
b) Detector mode is peak.
c) In the fully-anechoic chamber, setup as illustrated above the DUT placed on the 2.5m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization.
The “Read Value” is the spectrum reading the maximum power value.
d) The substitution antenna is substituted for DUT at the same position and signals generator (S.G) export the CW signal to the substitution antenna via a TX cable. The receiver antenna shall be rotated vertical and horizontal polarization to find the maximum radiation power.
Record the power level of maximum radiation power from spectrum.
So, the measured Factor value = Ref level of S.G + TX cables loss – Substituted Antenna Gain.
4) Result(dBm) = “Reading” + Factor

▣ TEST RESULTS

16K0F3E(2W)

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
450.05	900.10	H	-83.94	40.42	-43.51	-13.00	30.51
	1350.15	V	-78.13	34.93	-43.20	-13.00	30.20
	1800.20	V	-77.18	34.67	-42.51	-13.00	29.51

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
481.05	962.10	V	-80.64	41.58	-39.06	-13.00	26.06
	1443.15	V	-78.83	34.52	-44.31	-13.00	31.31
	1924.20	V	-76.48	35.19	-41.30	-13.00	28.30

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
511.95	1023.90	V	-76.05	32.70	-43.35	-13.00	30.35
	1535.85	V	-78.03	34.37	-43.66	-13.00	30.66
	2047.80	V	-78.14	35.88	-42.26	-13.00	29.26

16K0F3E(5W)

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
470.05	940.10	H	-84.36	41.35	-43.02	-13.00	30.02
	1410.15	V	-77.98	34.49	-43.49	-13.00	30.49
	1880.20	V	-77.43	35.09	-42.34	-13.00	29.34

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
491.05	982.10	V	-80.32	42.46	-37.86	-13.00	24.86
	1473.15	V	-78.47	34.40	-44.07	-13.00	31.07
	1964.20	V	-76.41	35.35	-41.06	-13.00	28.06

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
511.95	1023.90	V	-75.60	32.70	-42.90	-13.00	29.90
	1535.85	V	-78.23	34.37	-43.86	-13.00	30.86
	2047.80	V	-77.66	35.88	-41.78	-13.00	28.78

7K60FXD, 7K60FXE

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
450.05	900.10	H	-84.06	40.42	-43.64	-20.00	23.64
	1350.15	V	-77.86	34.93	-42.93	-20.00	22.93
	1800.20	V	-77.55	34.67	-42.88	-20.00	22.88

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
481.05	962.10	H	-83.02	41.58	-41.44	-20.00	21.44
	1443.15	V	-77.38	34.52	-42.86	-20.00	22.86
	1924.20	V	-78.42	35.19	-43.24	-20.00	23.24

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
511.95	1023.90	V	-75.23	32.70	-42.53	-20.00	22.53
	1535.85	V	-76.87	34.37	-42.50	-20.00	22.50
	2047.80	V	-78.52	35.88	-42.64	-20.00	22.64

4K00F1E, 4K00F1D, 4K00F7W

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
450.05	900.10	H	-84.52	40.42	-44.10	-25.00	19.10
	1350.15	V	-78.35	34.93	-43.42	-25.00	18.42
	1800.20	V	-77.44	34.67	-42.77	-25.00	17.77

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
481.05	962.10	V	-80.36	41.58	-38.78	-25.00	13.78
	1443.15	V	-78.29	34.52	-43.77	-25.00	18.77
	1924.20	V	-76.32	35.19	-41.13	-25.00	16.13

Test Frequency (MHz)	Measured Frequency (MHz)	Pol	Reading (dBm)	Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
511.95	1023.90	V	-75.74	32.70	-43.04	-25.00	18.04
	1535.85	V	-78.69	34.37	-44.32	-25.00	19.32
	2047.80	V	-78.08	35.88	-42.20	-25.00	17.20

8.11 Necessary Bandwidth Calculations

Modulation : 16K0F3E (Authorized Bandwidth 20 kHz)	
Maximum Modulation (M), kHz	3
Maximum Deviation (D), kHz	5
Constant Factor (K)	1
Necessary Bandwidth (BN), kHz	(2xM)+(2xDxK) = 16.0

Modulation : 11K0F3E (Authorized Bandwidth 11.25 kHz)	
Maximum Modulation (M), kHz	3
Maximum Deviation (D), kHz	2.5
Constant Factor (K)	1
Necessary Bandwidth (BN), kHz	(2xM)+(2xDxK) = 11.0

Modulation : 8K30F1E, 8K30F1D, 8K30F7W (4Level FSK / 9600bps, Authorized Bandwidth 11.25 kHz)	
Digital information rate (R), bps	9600
Maximum Deviation (D), kHz	3.391
Signaling States (S)	4
Numerical factor (K)	0.516
Necessary Bandwidth (BN), kHz	(R/log2S)+2DK = 8.3

Modulation : 4K00F1E, 4K00F1D, 4K00F7W (4Level FSK / 4800bps, Authorized Bandwidth 6 kHz)	
Digital information rate (R), bps	4800
Maximum Deviation (D), kHz	1.55
Signaling States (S)	4
Numerical factor (K)	0.516
Necessary Bandwidth (BN), kHz	(R/log2S)+2DK = 4.0

Modulation : 7K60FXD, 7K60FXE	
Digital information rate (R), bps	9600
Maximum Deviation (D), kHz	3.024
Signaling States (S)	4
Numerical factor (K)	0.463
Necessary Bandwidth (BN), kHz	$(R/\log_2 S)+2DK = 7.6$

Modulation : 4K00F2D (CWID, Authorized Bandwidth 6 kHz)	
Maximum Modulation (M), kHz	0.8
Maximum Deviation (D), kHz	1.2
Numerical factor (K)	1
Necessary Bandwidth (BN), kHz	(2xM)+(2xDxK) = 4.0

9. LIST OF TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Calibration Due	Serial No.
Agilent	N9020A/ Signal Analyzer	2020-11-17	Annual	2021-11-17	MY50200093
Agilent	N9030B / Signal Analyzer	2020-06-04	Annual	2021-06-04	MY55480167
Hewlett Packard	E3632A / DC Power Supply	2020-06-12	Annual	2021-06-12	KR75303960
Agilent	N1911A/Power Meter	2021-04-08	Annual	2022-04-08	MY45100523
Agilent	N1921A /POWER SENSOR	2021-04-08	Annual	2022-04-08	MY57820067
TEKTRONIX	RSA3408A/SPECTRUM ANALYZER	2020-08-21	Annual	2021-08-21	B010198
Hewlett Packard	8903B/Audio Analyzer	2020-09-18	Annual	2021-09-18	3413A13913
Hewlett Packard	8901B/Modulation Analyzer	2020-09-16	Annual	2021-09-16	3438A05231
Weinschel Associates	WA93-30-33 /30 dB Attenuator	2020-04-01	Annual	2021-04-01	0138
Hewlett Packard	8493C/ATTENUATOR(20dB)	2020-06-04	Annual	2021-06-04	17280
EAGLE	230NFNM/Tuneable Notch Filter	2020-10-12	Annual	2021-10-12	H00564-9
EAGLE	230NFNM/Tuneable Notch Filter	2020-10-12	Annual	2021-10-12	H00564-10
ESPEC	SU-642 / Chamber	2021-03-15	Annual	2022-03-15	0093008124
CERNEX	CBLU1183540B-01/AMP	2020-06-04	Annual	2021-06-04	26822
Wainwright	WHKX10-900-1000-15000/H.P.F	2020-07-13	Annual	2021-07-13	5
Rohde & Schwarz	Loop Antenna	2020-05-18	Biennial	2022-05-18	1513-175
Schwarzbeck	VULB9160/ Bilog Antenna	2021-03-03	Biennial	2023-03-03	3150
Schwarzbeck	VULB9160/ Bilog Antenna	2020-08-19	Biennial	2022-08-19	9160-3368
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	2019-08-29	Biennial	2021-08-29	147
Schwarzbeck	BBHA 9120D/ Horn Antenna(1~18GHz)	2019-09-25	Biennial	2021-09-25	9120D-1298
REOHDE&SCHWARZ	FSV40-N /Spectrum Analyzer	2020-09-22	Annual	2021-09-22	101068-SZ
Inn-co GmbH	DE 3260/Turn table	N/A	N/A	N/A	N/A
EMERSON&CUMING	10m×5m×5m/ Full anechoic chamber	N/A	N/A	N/A	N/A

10. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2105-FC002-P