5.5. RADIATED SPURIOUS EMISSIONS

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 30.203 Emission limits.

(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. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be －5 dBm/MHz or lower.

(b)(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

EIRP Test Procedures:

The measurement is performed in accordance with Section 5.7.4 of ANSI C63.26.

5.7.4 Spurious unwanted emission measurements

a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.

b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a

power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.

d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.

f) Compare the results with the corresponding limit in the applicable regulation.

g) The test report shall include the data plots of the measuring instrument display and the measured data.

TRP Test Procedures:

The measurement is performed in accordance with Section 4.4.3.3.2 of KDB 842590 v01 (2019-04).

a) Align the EUT with a chosen xy-plane and the xz-plane of the antenna measurement coordinate system.
NOTE 1 For harmonics and spurious emission frequencies which are beamforming as identified in exploratory scan, it may be required to align the orthogonal cuts to include the peak based on exploratory scans.

b) Measure the EUT dimensions, i.e., depth (d), width (w), and height (h); see Figure A.1 in Appendix A.

c) Calculate the spherical and cylindrical diameters (D and Dcyl) using Equations (A.1) and (A.2) (see Appendix A).

d) For the highest frequency (smallest wavelength) of the frequency band measured, calculate the reference angular steps $\Delta\theta$ref and $\Delta\phi$ref using Equations (A.3) and (A.4).

e) Set the grid spatial sampling step $\Delta\theta \leq \Delta\theta$ref for the vertical angle and $\Delta\phi \leq \Delta\phi$ref for the horizontal cut.

f) For each emission frequency, measure the EIRP (as a sum of two orthogonal polarizations) at each spatial sampling step on the selected grid.

g) For each emission frequency, calculate the average EIRP for both the cuts separately, and then take the average of these two average values.

h) Add 2 dB as a correction factor to the averaged value computed in step g).

i) If the TRP limit is exceeded, a third orthogonal cut in the yz-plane and using the $\Delta\theta$ angular step, can be added. Now, calculate the average values in all three cuts separately, and then take the average value of these three average values.

j) Add 1.5 dB as a correction factor to the averaged value computed in step i).

k) Evaluate the pass/fail decision by comparing TRP from step h) or step j) against the applicable TRP limit.

Note:

1) Spurious emission test is performed up to 100 GHz frequency according to section 5.1.1 of ANSI C63.26 -2015.
2) Measurement distance is 3 m at frequency below 18 GHz and other frequencies applied far field condition on page 8.
3) In case of 9 kHz to 30 MHz, the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
4) Emissions in 26.5 GHz to 29.35 GHz band can be founded in section 5.1 through 5.4 of this report
5) Test plot doesn't include any factors and all factors such as AFCL is calculated in tabular data.
6) In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, amplifier gain and duty correction.
7) Emissions value is first converted by distance factor as follow.

Converted value (dBm) = Measured Value (dBuV) + 20 LOG(D)-104.77

8) Final spurious emissions result is calculated as follows.

Spurious Emissions = Converted Value (dBm) + AFCL

9) Refer to conducted output power test, spurious emissions test is performed about the worst case of modulation type (QPSK).
10) Sample calculations

30 MHz ~ 1 GHz

9.82 dBμV (measured) + 11.48 (distance) - 104.77 + 16.01(AFCL) = -67.46dBm

1 GHz ~ 18 GHz

19.158 dBμV (measured) + 11.48 (distance) - 104.77 + 43.92 (AFCL) = -30.21 dBm

18 GHz ~ 26.5 GHz

24.995 dBμV (measured) + 11.48 (distance) - 104.77 + 45.82 (AFCL) = -22.48 dBm

29.35 GHz ~ 40 GHz

25.000 dBμV (measured) + 11.48 (distance) - 104.77 + 48.10 (AFCL) = -20.19 dBm

40 GHz ~ 60 GHz

9.65 dBµV (measured) + 11.48 (distance) - 104.77 + 47.70 (AFCL) = -35.94 dBm

60 GHz ~ 90 GHz

6.99 dBµV (measured) + 11.48 (distance) - 104.77 + 60.06 (AFCL) = -26.24 dBm

90 GHz ~ 100 GHz

7.581 dBµV (measured) + 11.48 (distance) - 104.77 + 57.85 (AFCL) = -27.86 dBm

Test Results:

Tabular Data of Radiated Spurious Emissions

Freq.	CH	Mod	Distance (m)	Ant. Pol.	Frequency (MHz)	Measured (dBuV)	Converted (dBm)	AFCL (dB)	Limit (dBm)	Result (dBm)
30 MHz ~1 GHz (1cc)	L	QPSK	3.75	H	38.366	9.82	-83.47	16.01	-13	-67.46
				V	38.366	9.71	-83.58	16.01		-67.57
	M			H	38.366	10.43	-82.86	16.01		-66.85
				V	38.366	10.12	-83.17	16.01		-67.16
	H			H	38.366	10.07	-83.22	16.01		-67.21
				V	38.366	10.35	-82.94	16.01		-66.93
30 MHz ~1 GHz (8cc)	L			H	38.366	10.22	-83.07	16.01		-67.06
				V	143.975	10.2	-83.09	14.85		-68.24
	M			H	38.366	10.66	-82.63	16.01		-66.62
				V	38.366	10.09	-83.20	16.01		-67.19
	H			H	38.366	9.99	-83.30	16.01		-67.29
				V	38.366	9.78	-83.51	16.01		-67.50
1~18 GHz (1cc)	L			H	16243	19.158	-74.13	43.92		-30.21
				V	14180	18.801	-74.49	46.21		-28.28
	M			H	14567	18.541	-74.75	47.01		-27.74
				V	17980	18.488	-74.80	52.53		-22.28
	H			H	17293	18.701	-74.59	46.79		-27.80
				V	17686	18.592	-74.70	49.38		-25.32
1~18 GHz (8cc)	L			H	17120	18.636	-74.65	46.06		-28.60
				V	15186	18.977	-74.31	45.45		-28.87
	M			H	13699	18.75	-74.54	45.39		-29.15
				V	14666	19.273	-74.02	46.66		-27.36
	H			H	14580	18.709	-74.58	46.53		-28.06
				V	14361	18.931	-74.36	46.40		-27.96

Note:

1. Because of no critical emissions are detected in the test, only peak value is recorded in this report.

Freq.	CH	Mod.	Distance (m)	Ant. Angle	Frequency (GHz)	Measured (dBuV)	Converted (dBm)	AFCL (dB)	Limit (dBm)	Result (dBm)
18~26.5 GHz (1cc)	L	QPSK	3.75	45	25.985	24.995	-68.29	45.82	-13	-22.48
				135	25.872	25.186	-68.10	45.82		-22.29
	M			45	25.986	24.169	-69.12	45.82		-23.31
				135	25.828	24.56	-68.73	45.82		-22.91
	H			45	25.991	23.834	-69.46	45.82		-23.64
				135	25.994	24.572	-68.72	45.82		-22.90
18~26.5 GHz (8cc)	L			45	*25.934	30.6	-62.69	45.82		-16.87
				135	*25.934	35.63	-57.66	45.82		-11.84
	M			45	*25.959	35.72	-57.57	45.82		-11.75
				135	*25.959	35.63	-57.66	45.82		-11.84
	H			45	26.494	26.676	-66.61	46.00		-20.62
				135	*25.984	36.97	-56.32	45.82		-10.50
29.35 ~40 GHz (1cc)	L			45	*33.120	40.050	-53.24	48.10		-5.14
				135	*33.120	43.59	-49.70	48.10		-1.60
	M			45	*33.450	35.41	-57.88	48.10		-9.78
				135	*33.450	40.82	-52.47	48.10		-4.37
	H			45	*33.900	31.44	-61.85	48.41		-13.44
				135	*33.900	34.640	-58.65	48.41		-10.24
29.35 ~40 GHz (8cc)	L			45	*33.480	38.380	-54.91	48.10		-6.81
				135	*33.480	39.36	-53.93	48.10		-5.83
	M			45	*33.510	39.36	-53.93	48.10		-5.83
				135	*33.510	39.27	-54.02	48.10		-5.92
	H			45	*33.540	34.02	-59.27	48.10		-11.17
				135	*33.540	37.86	-55.43	48.10		-7.33
40~60 GHz (1cc)	L		3.75	45	43.567	9.65	-83.64	47.70		-35.94
				135	43.424	9.48	-83.81	47.70		-36.11
	M			45	43.292	9.60	-83.69	47.70		-35.99
				135	43.279	9.44	-83.85	47.70		-36.15
	H			45	43.427	9.37	-83.92	47.70		-36.22
				135	43.422	9.59	-83.70	47.70		-36.00

Note:

1. Because of no critical emissions are detected in the test, only peak value is recorded in this report.

2. '*' This checked frequency is measured by TRP, because it is EIRP fail

TRP Results.

CC / CH / Mod	Frequency [GHz]	Result [dBm]	Limit [dBm]	Margin [dB]
8CC / L / QPSK	25.934	-19.39	-13	6.39
8CC / M / QPSK	25.959	-19.33	-13	6.33
8CC / H / QPSK	25.984	-19.28	-13	6.28
1CC / L / QPSK	33.120	-15.31	-13	2.31
1CC / M / QPSK	33.450	-16.36	-13	3.36
1CC / H / QPSK	33.900	-17.16	-13	4.16
8CC / L / QPSK	33.480	-16.10	-13	3.10
8CC / M / QPSK	33.510	-16.27	-13	3.27
8CC / H / QPSK	33.540	-16.60	-13	3.60

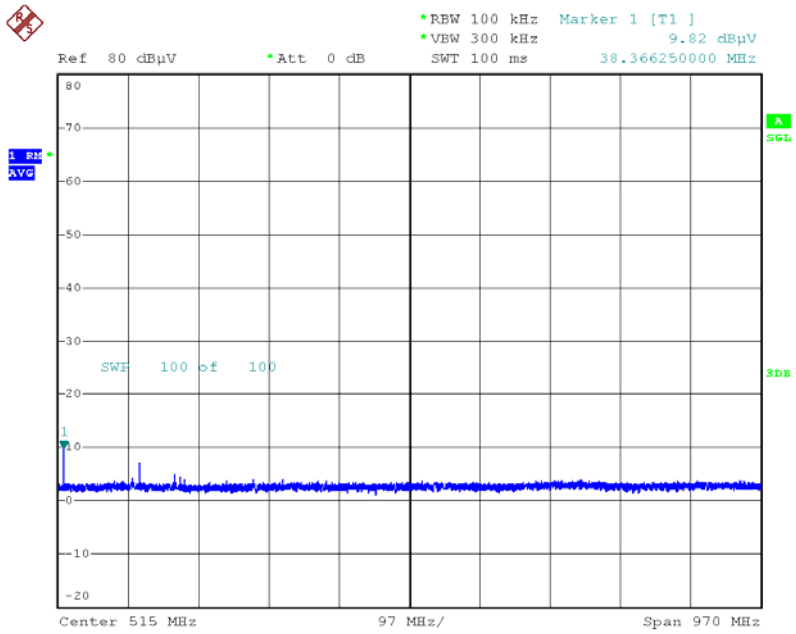
Freq.	CH	Mod.	Distance (m)	Ant. Angle	Frequency (GHz)	Measured (dBuV)	Converted (dBm)	AFCL (dB)	Limit (dBm)	Result (dBm)
40~60 GHz (8cc)	L	QPSK	3.75	45	43.154	11.64	-81.65	47.30	-13	-34.35
				135	43.837	11.71	-81.58	47.96		-33.62
	M			45	43.566	11.72	-81.57	47.70		-33.87
				135	43.841	11.65	-81.64	47.96		-33.68
	H			45	41.492	11.60	-81.69	47.61		-34.08
				135	43.983	11.71	-81.58	47.99		-33.59
60~90 GHz (1cc)	L		3.75	45	64.726	6.99	-86.30	60.06		-26.24
				135	64.703	6.94	-86.35	60.06		-26.29
	M			45	64.726	6.92	-86.37	60.06		-26.31
				135	64.938	7.11	-86.18	59.84		-26.34
	H			45	68.456	7.01	-86.28	54.07		-32.21
				135	64.501	7.02	-86.27	60.06		-26.21
60~90 GHz (8cc)	L			45	64.279	7.08	-86.21	61.18		-25.03
				135	64.504	6.99	-86.30	60.06		-26.24
	M			45	64.109	6.97	-86.32	61.18		-25.14
				135	64.509	7.02	-86.27	60.06		-26.21
	H			45	64.721	6.91	-86.38	60.06		-26.32
				135	64.925	7.08	-86.21	60.04		-26.17
90~100 GHz (1cc)	L		3.75	45	98.393	7.581	-85.71	57.85		-27.86
				135	98.768	7.623	-85.67	57.85		-27.82
	M			45	99.597	7.591	-85.70	53.18		-32.52
				135	99.531	7.571	-85.72	52.99		-32.73
	H			45	98.807	7.578	-85.71	57.85		-27.86
				135	99.517	7.798	-85.49	52.99		-32.50
90~100 GHz (8cc)	L			45	99.511	7.672	-85.62	52.99		-32.63
				135	99.940	7.421	-85.87	53.03		-32.84
	M			45	99.566	7.696	-85.59	52.99		-32.60
				135	99.525	7.620	-85.67	52.99		-32.68
	H			45	98.775	7.643	-85.65	57.85		-27.80
				135	99.237	7.516	-85.77	52.99		-32.78

Note:

1. Because of no critical emissions are detected in the test, only peak value is recorded in this report.

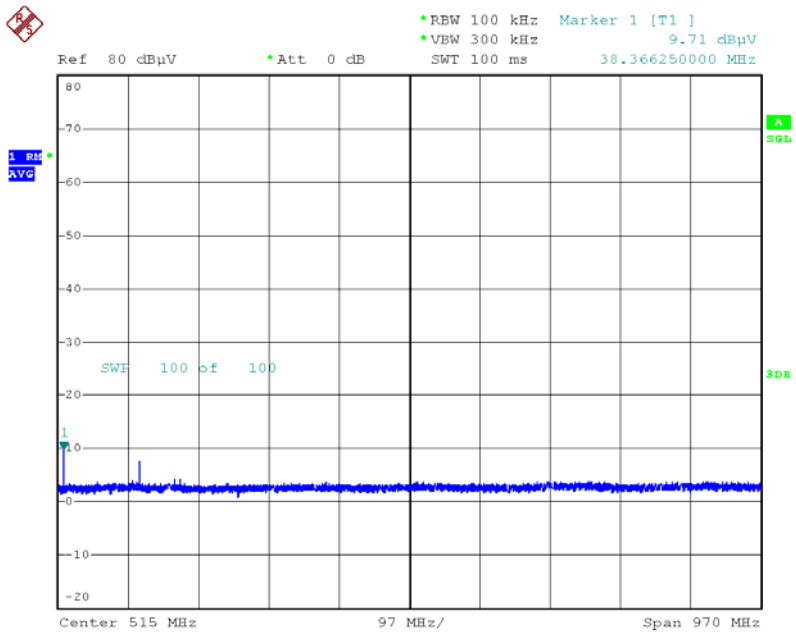
Plot data of Radiated Spurious Emissions

30 MHz ~ 1 GHz / 1cc / Low / H



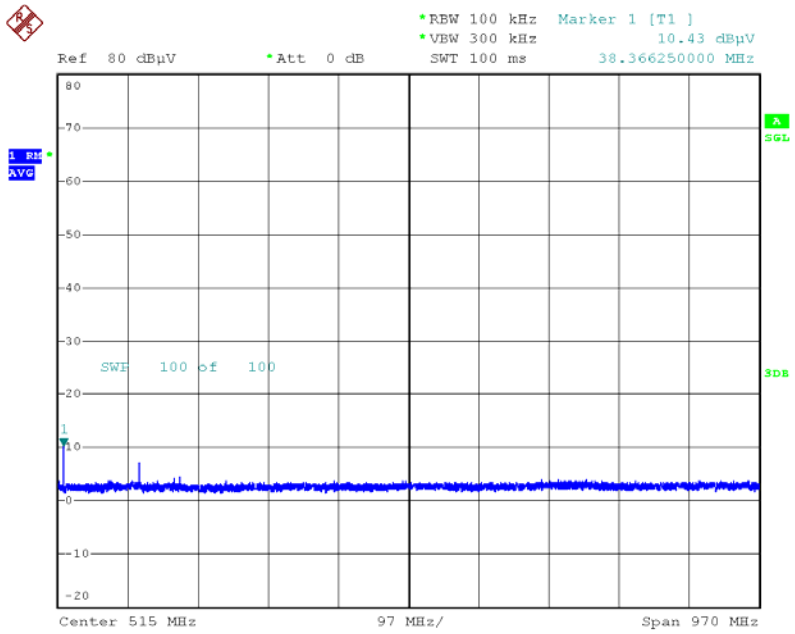
Date: 1.JAN.2003 00:23:34

30 MHz ~ 1 GHz / 1cc / Low / V



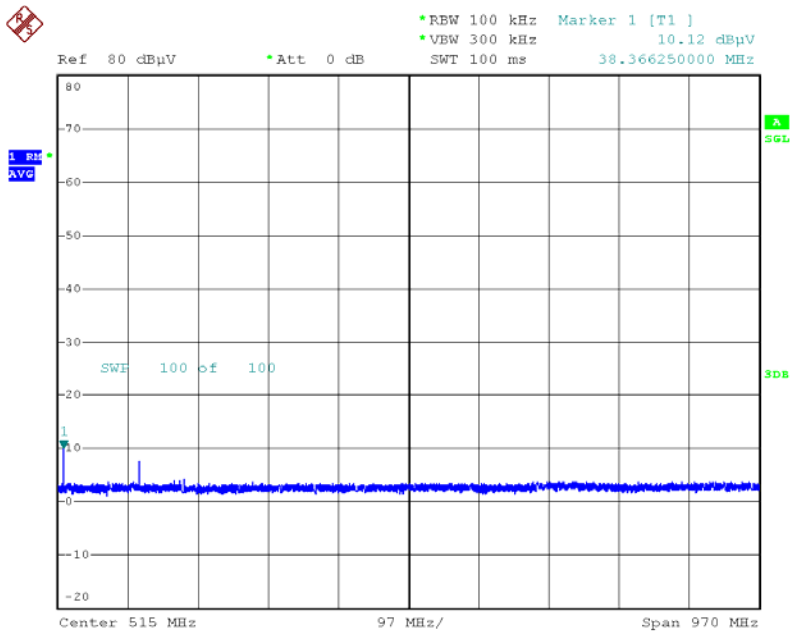
Date: 1.JAN.2003 00:24:48

30 MHz ~ 1 GHz / 1cc / Middle / H



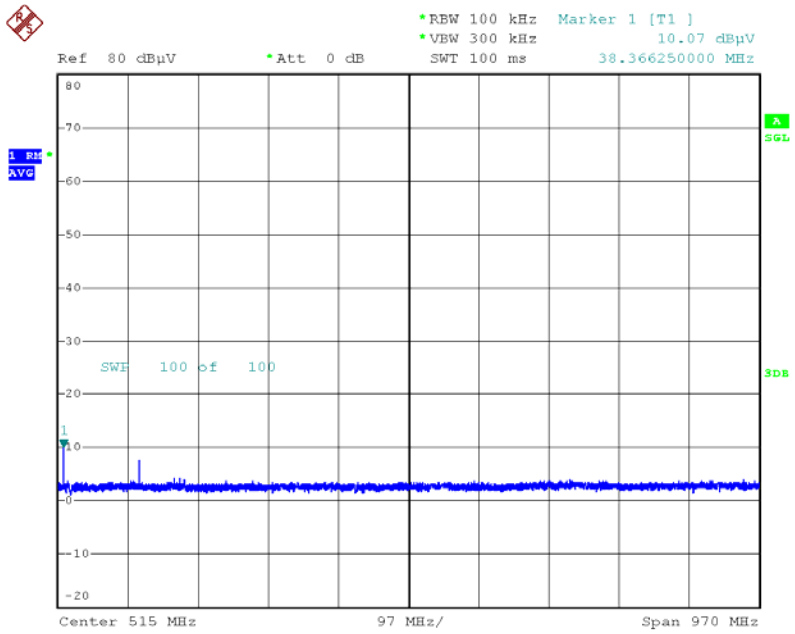
Date: 1.JAN.2003 00:25:26

30 MHz ~ 1 GHz / 1cc / Middle / V

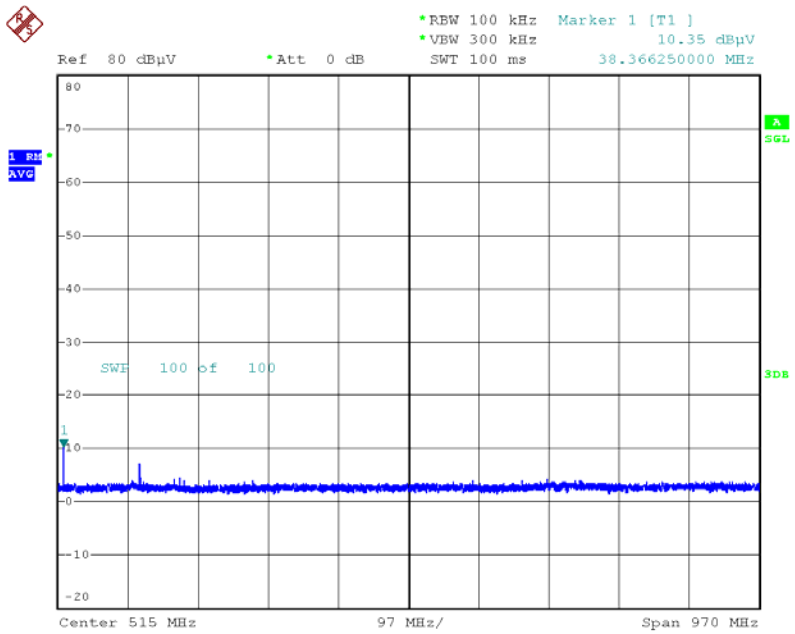


Date: 1.JAN.2003 00:26:12

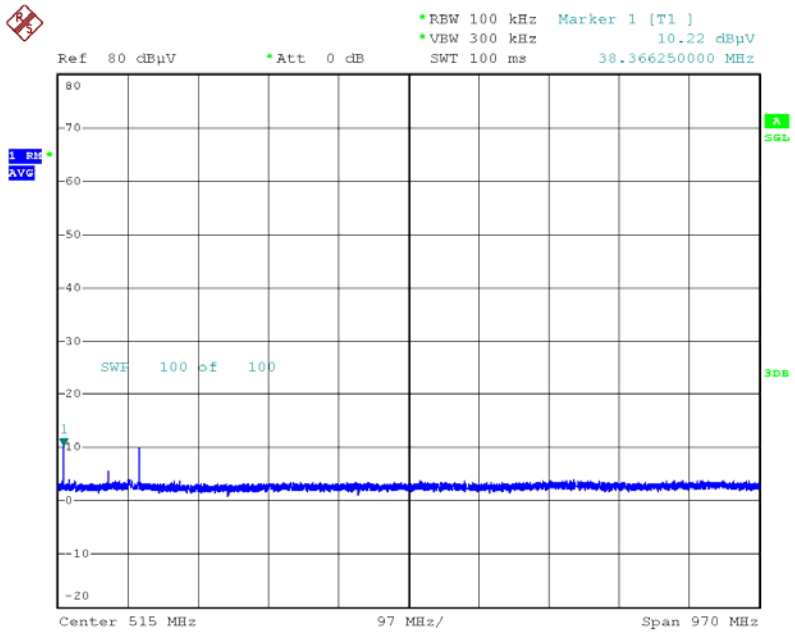
30 MHz ~ 1 GHz / 1cc / High / H



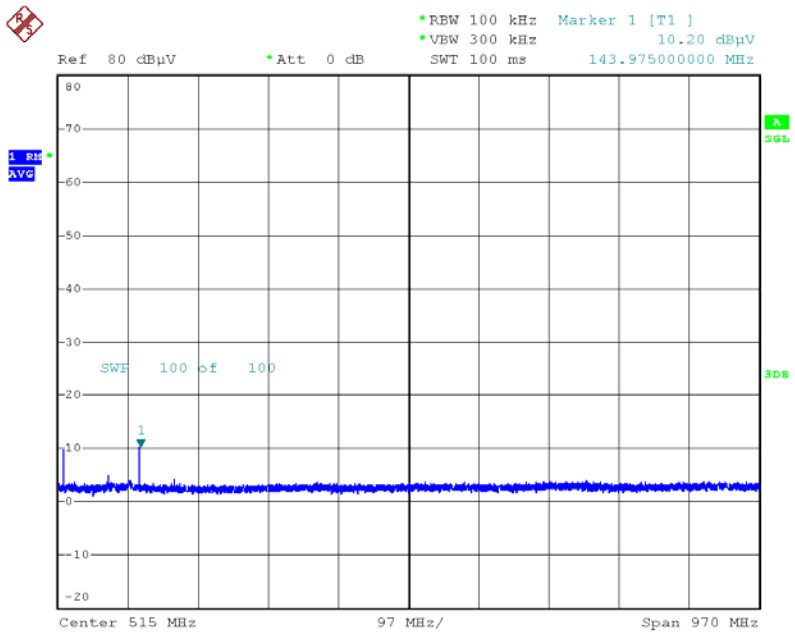
30 MHz ~ 1 GHz / 1cc / High / V



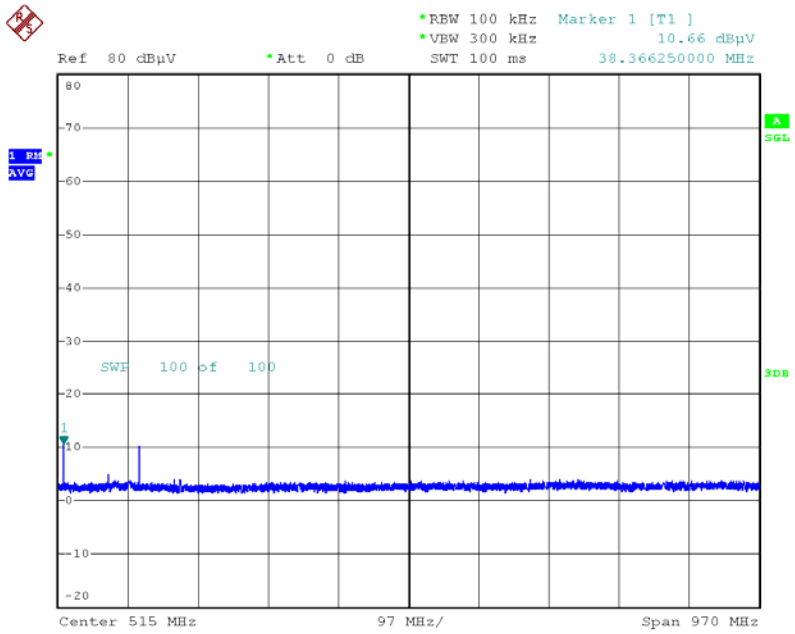
30 MHz ~ 1 GHz / 8cc / Low / H



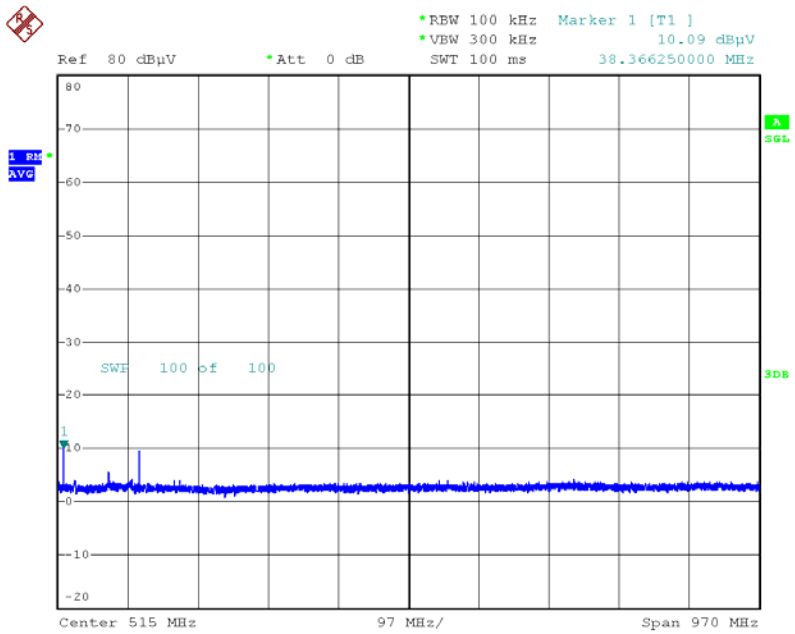
30 MHz ~ 1 GHz / 8cc / Low / V



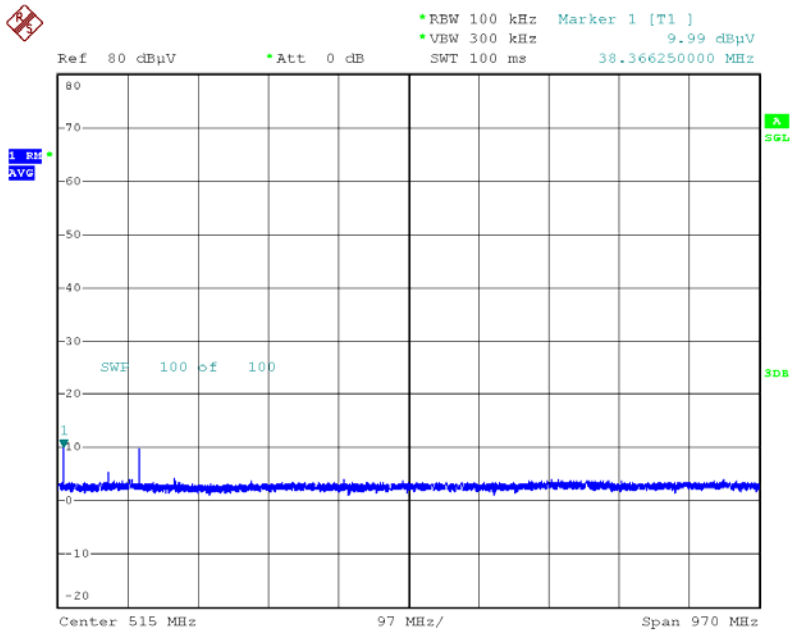
30 MHz ~ 1 GHz / 8cc / Middle / H



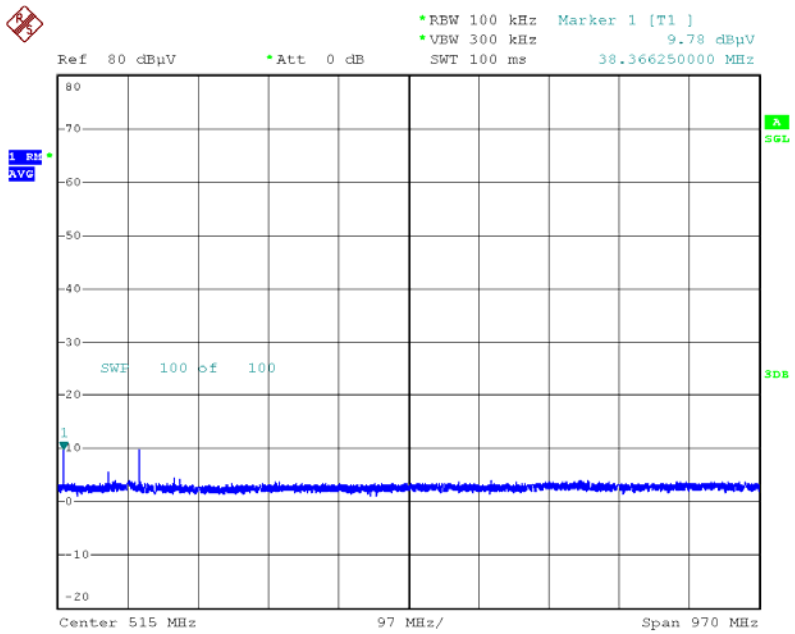
30 MHz ~ 1 GHz / 8cc / Middle / V



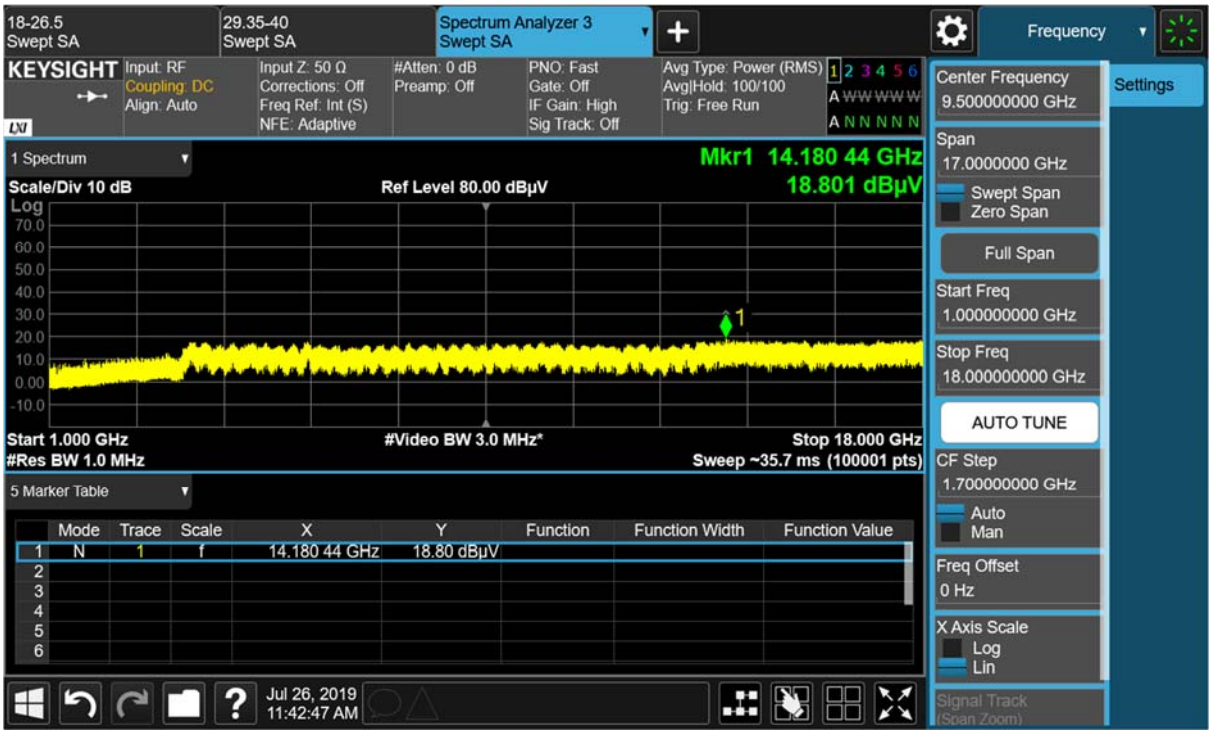
30 MHz ~ 1 GHz / 8cc / High / H



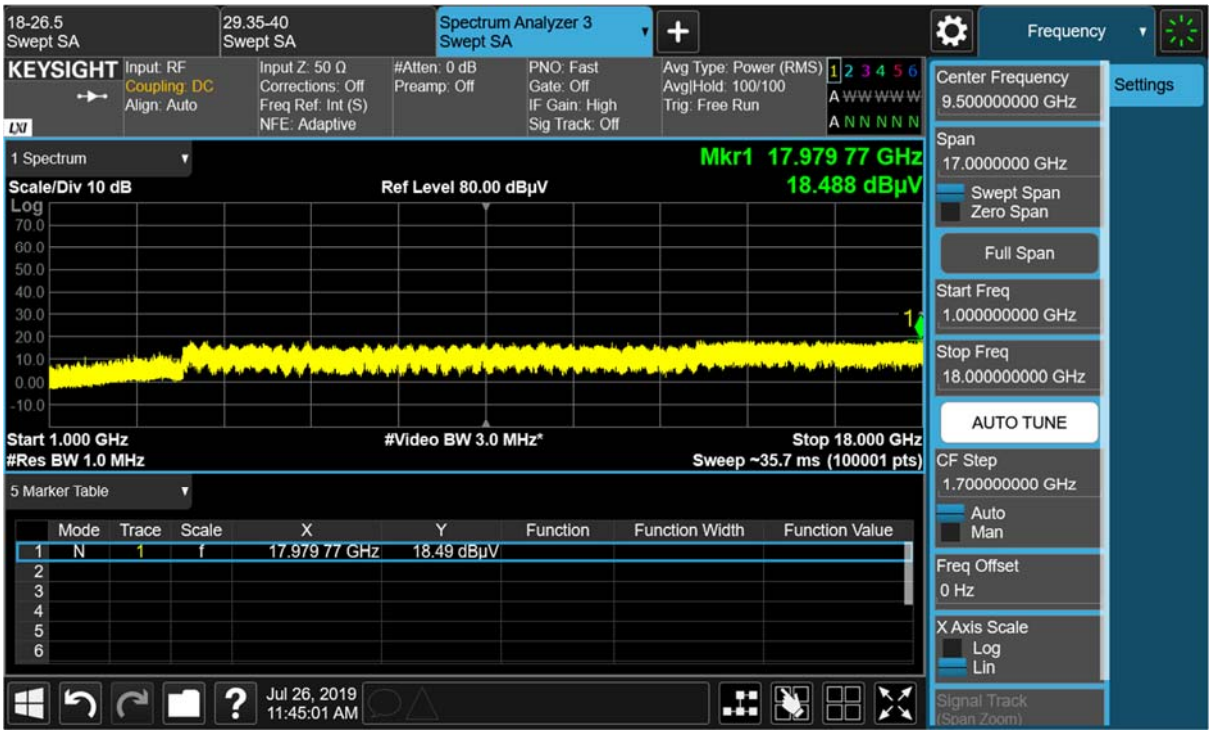
30 MHz ~ 1 GHz / 8cc / High / V

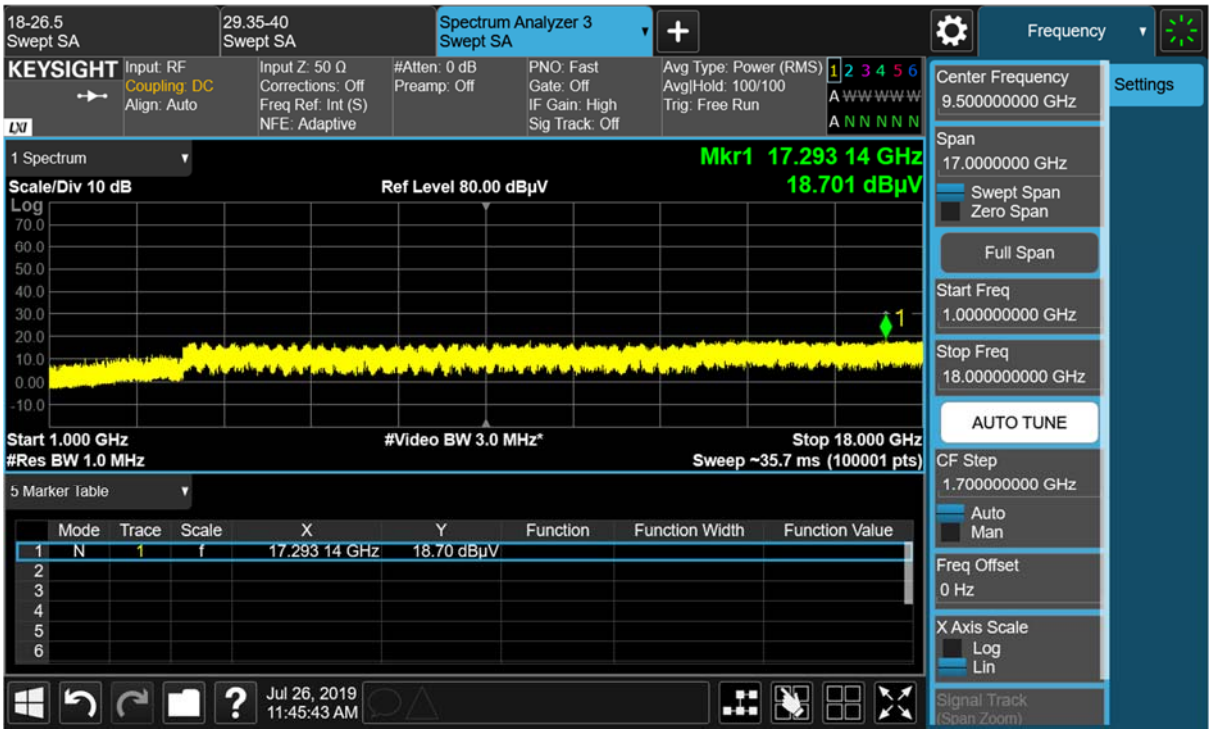


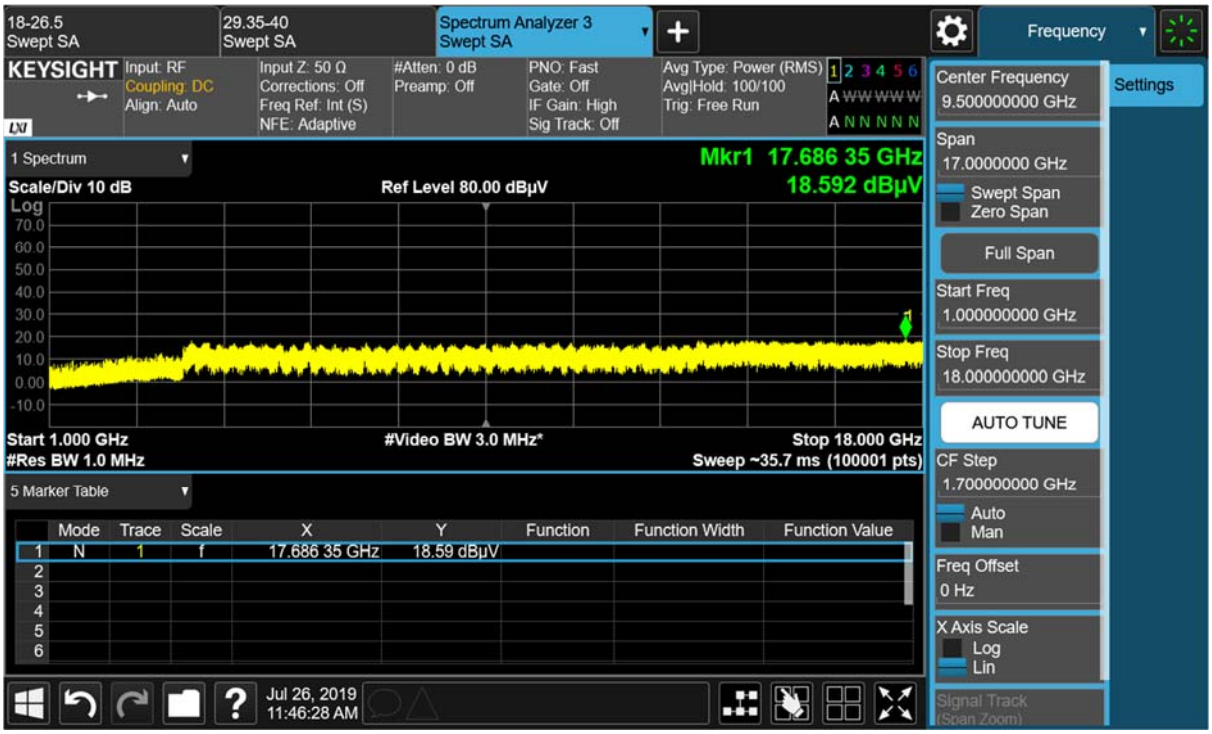
1 GHz ~ 18 GHz / 1cc / Low / H

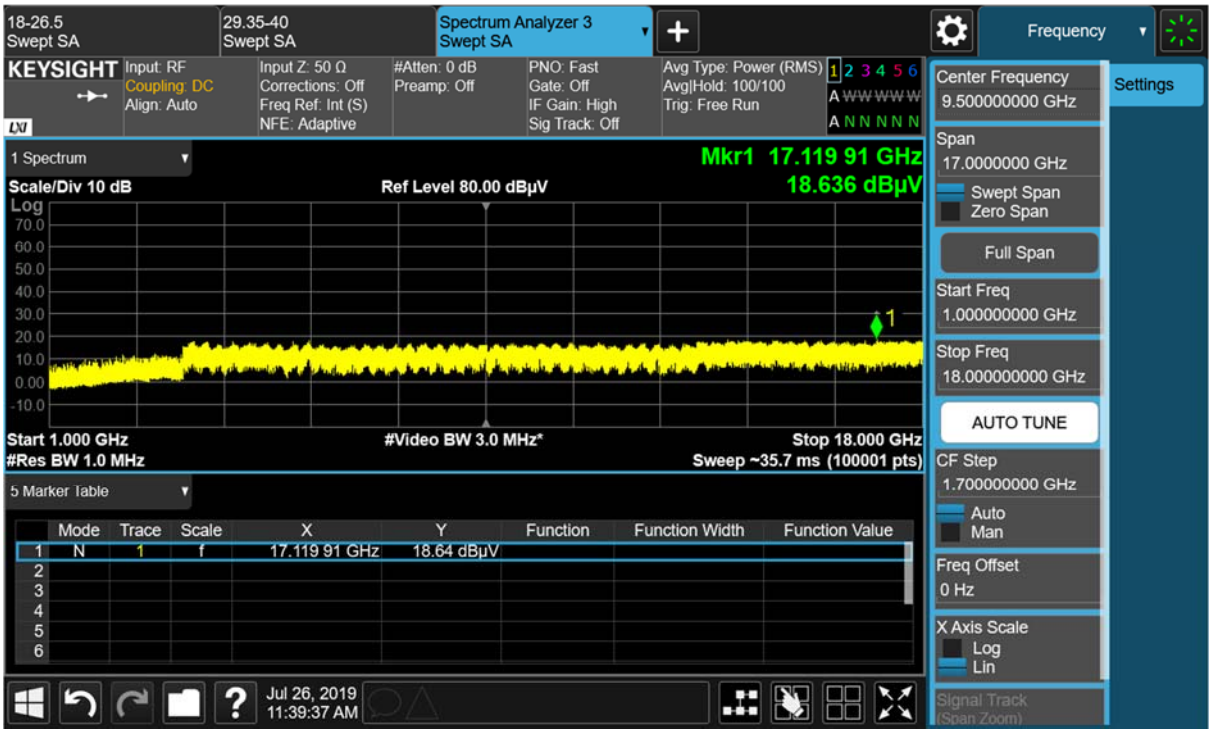

1 GHz ~ 18 GHz / 1cc / Low / V


1 GHz ~ 18 GHz / 1cc / Middle / H


1 GHz ~ 18 GHz / 1cc / Middle / V


1 GHz ~ 18 GHz / 1cc / High / H


1 GHz ~ 18 GHz / 1cc / High / V


1 GHz ~ 18 GHz / 8cc / Low / H


1 GHz ~ 18 GHz / 8cc / Low / V