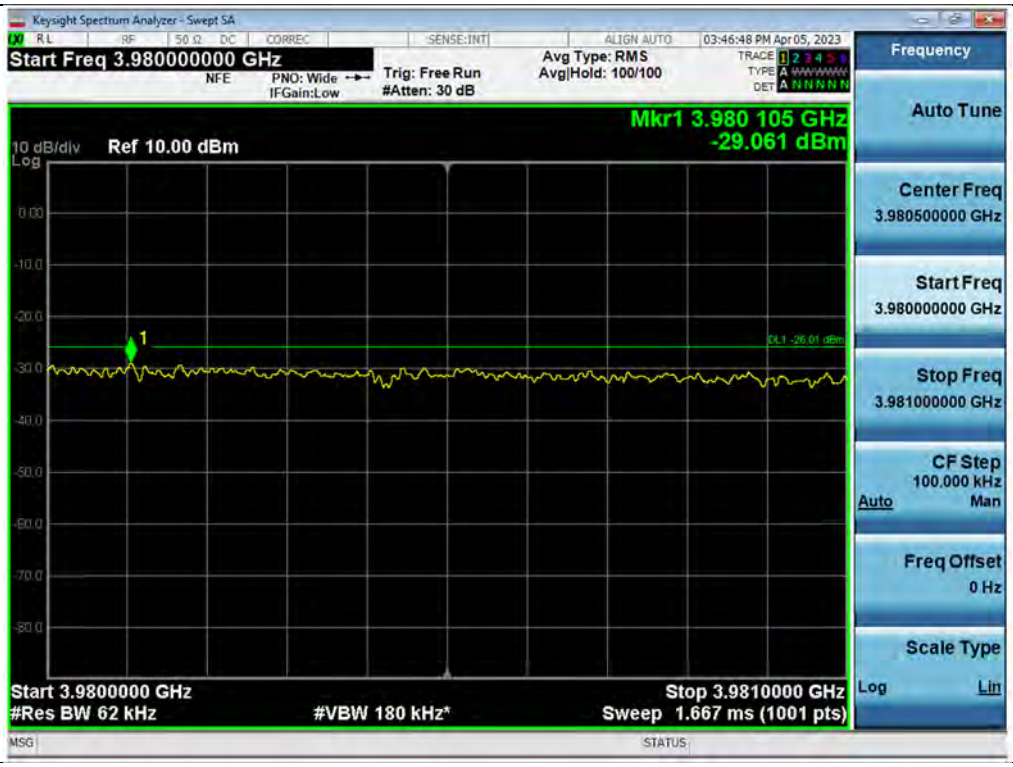
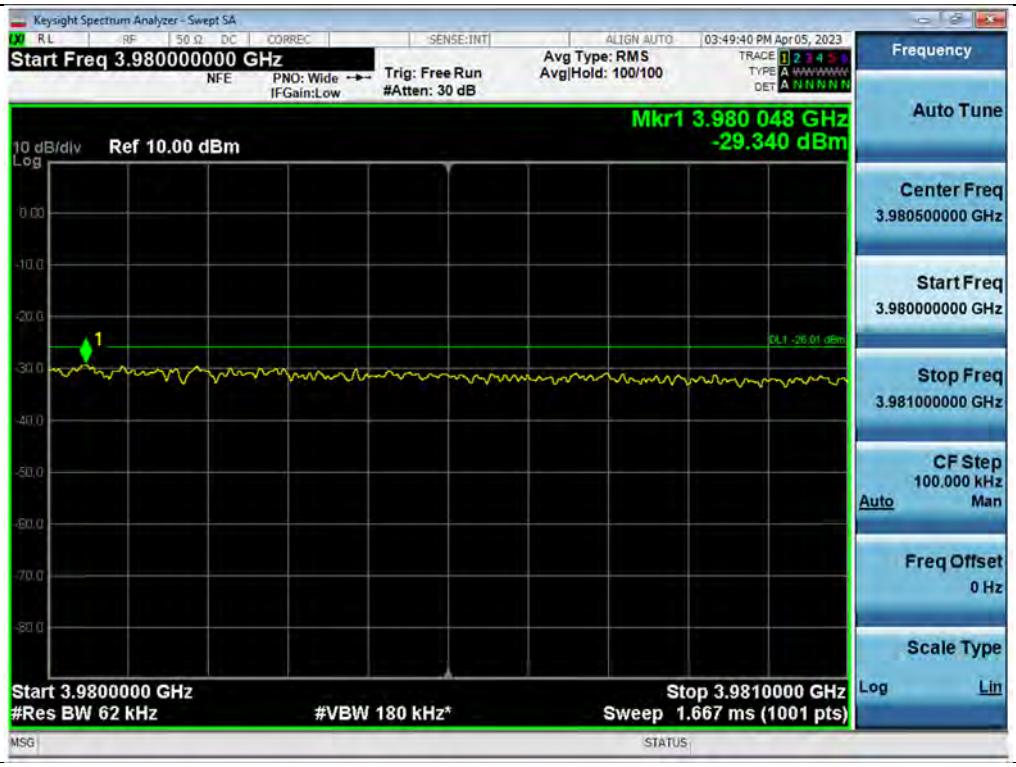
Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Lower

Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Upper



+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Lower

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Upper

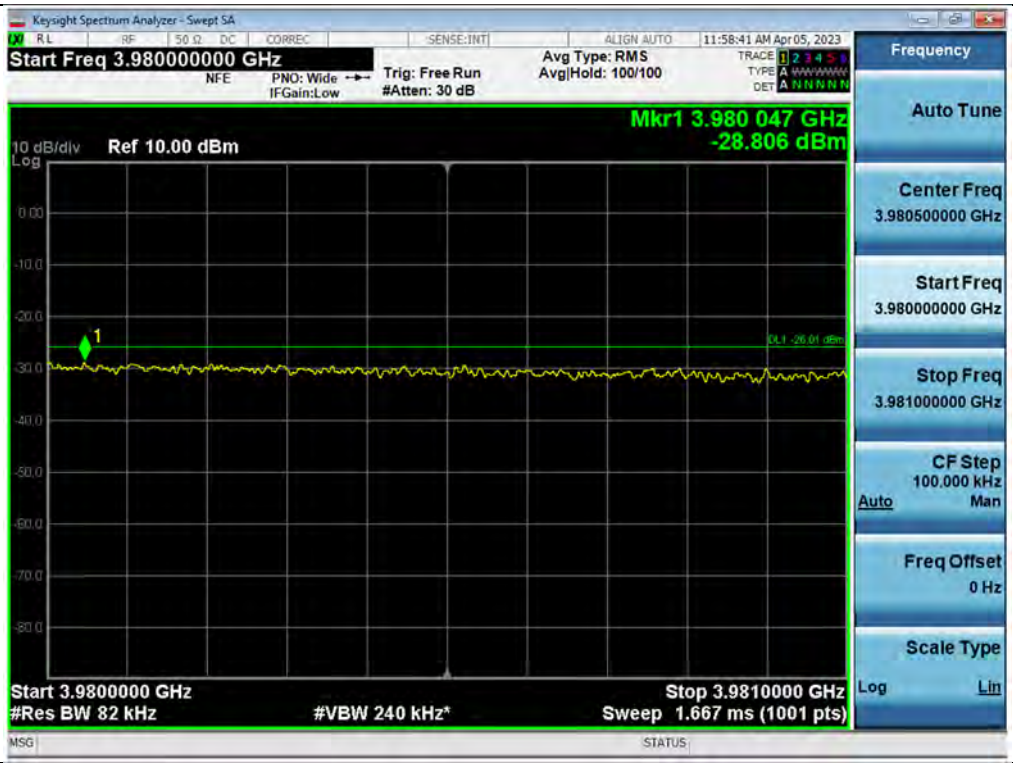


Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 80 MHz / Lower

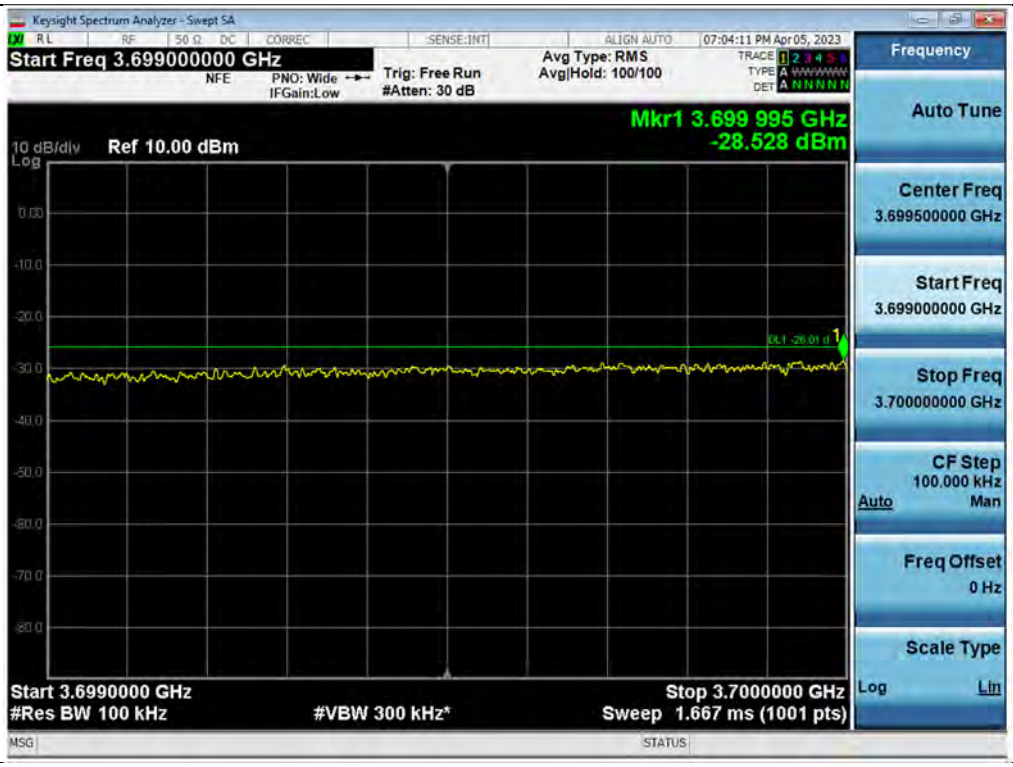
Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 80 MHz / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 80 MHz / Lower

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 80 MHz / Upper

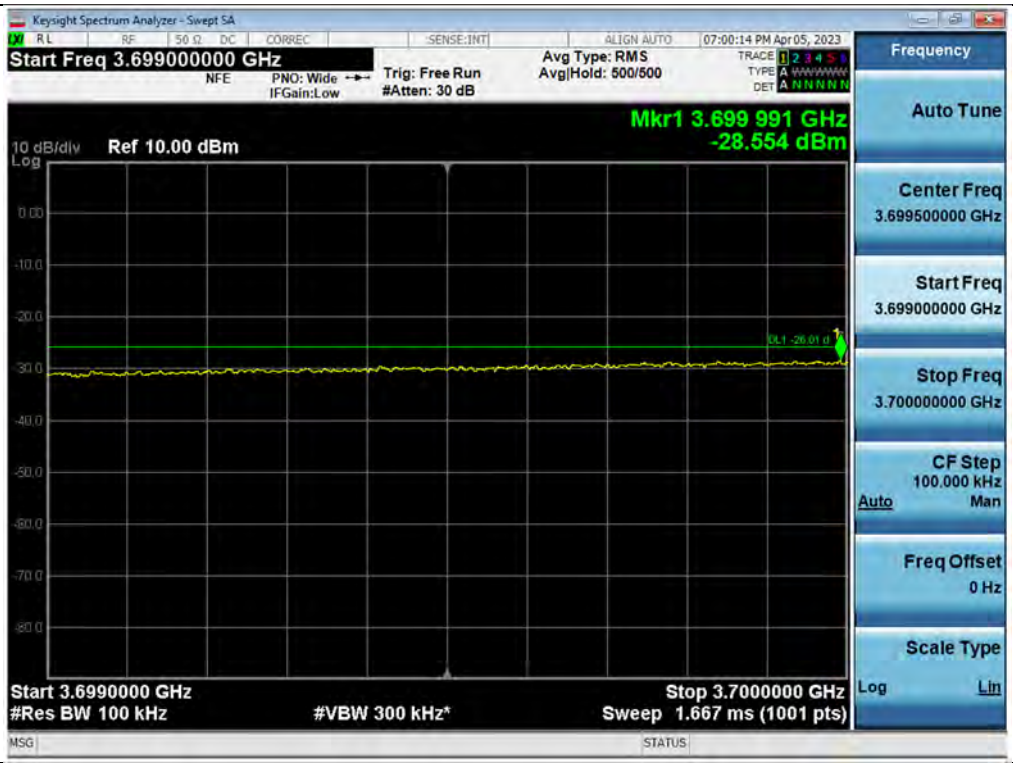


Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 100 MHz / Lower



Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 100 MHz / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 100 MHz / Lower

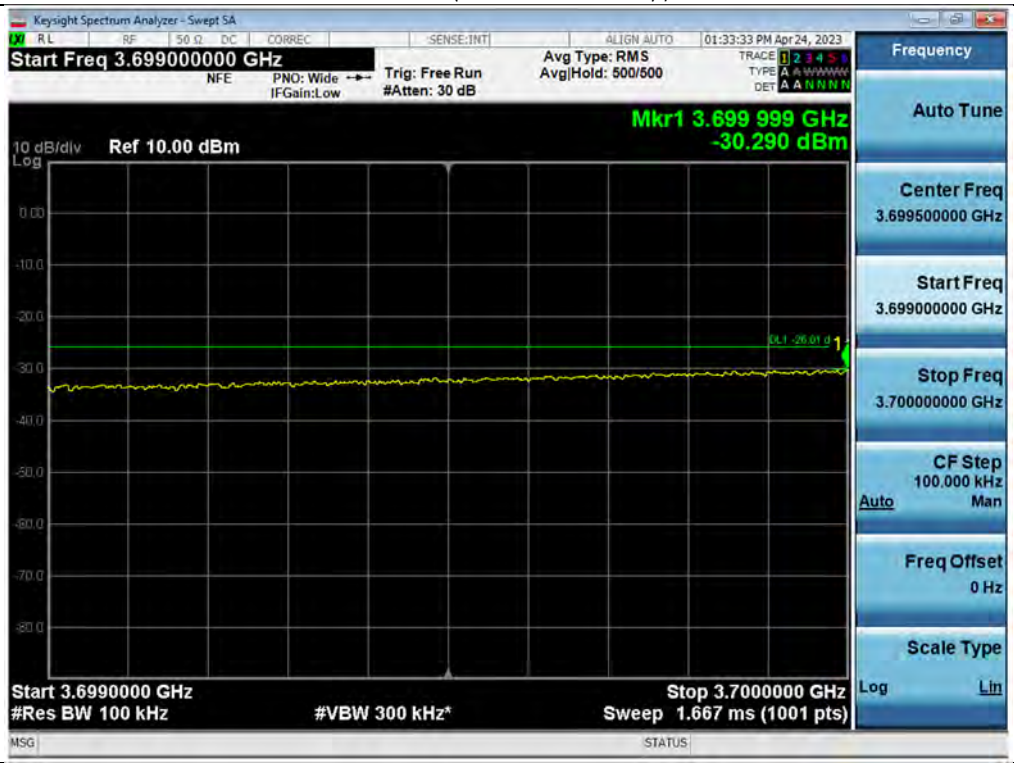


+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 100 MHz / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 4 Carriers(100 + 60 + 80 + 40) / Lower

Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink / 5G NR 4 Carriers(100 + 60 + 80 + 40) / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink /
5G NR 4 Carriers(100 + 60 + 80 + 40) / Lower



+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant1) / Downlink /
5G NR 4 Carriers(100 + 60 + 80 + 40) / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Lower

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Lower

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 40 MHz / Lower

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 40 MHz / Upper

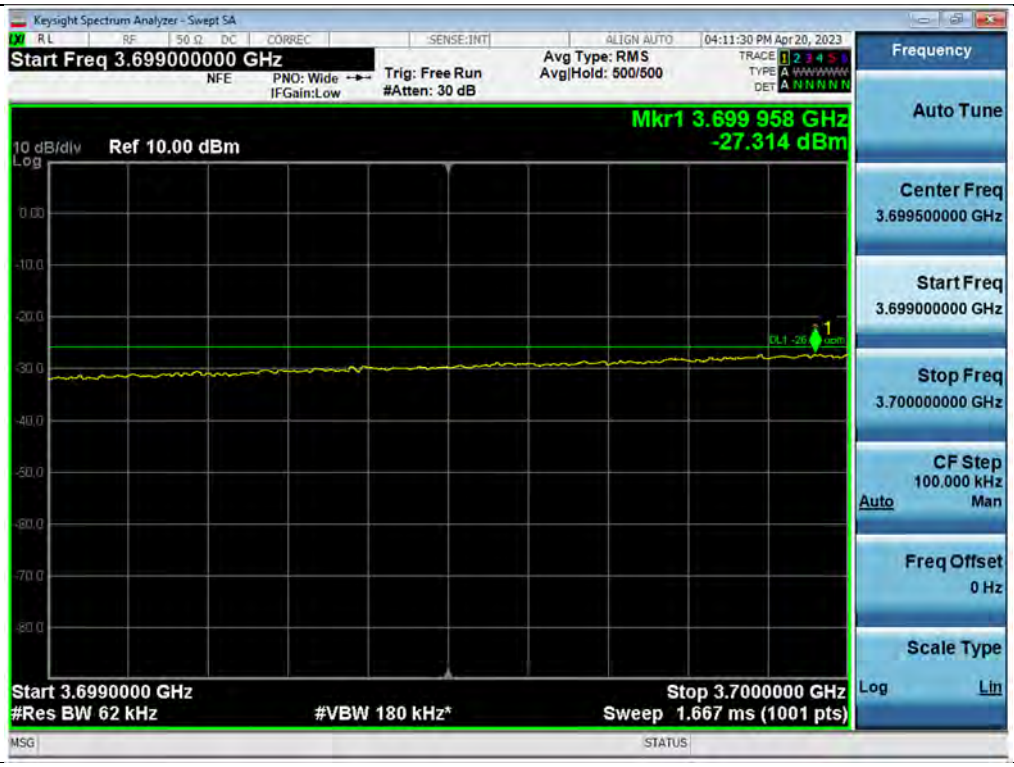
+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 40 MHz / Lower

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 40 MHz / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 60 MHz / Lower

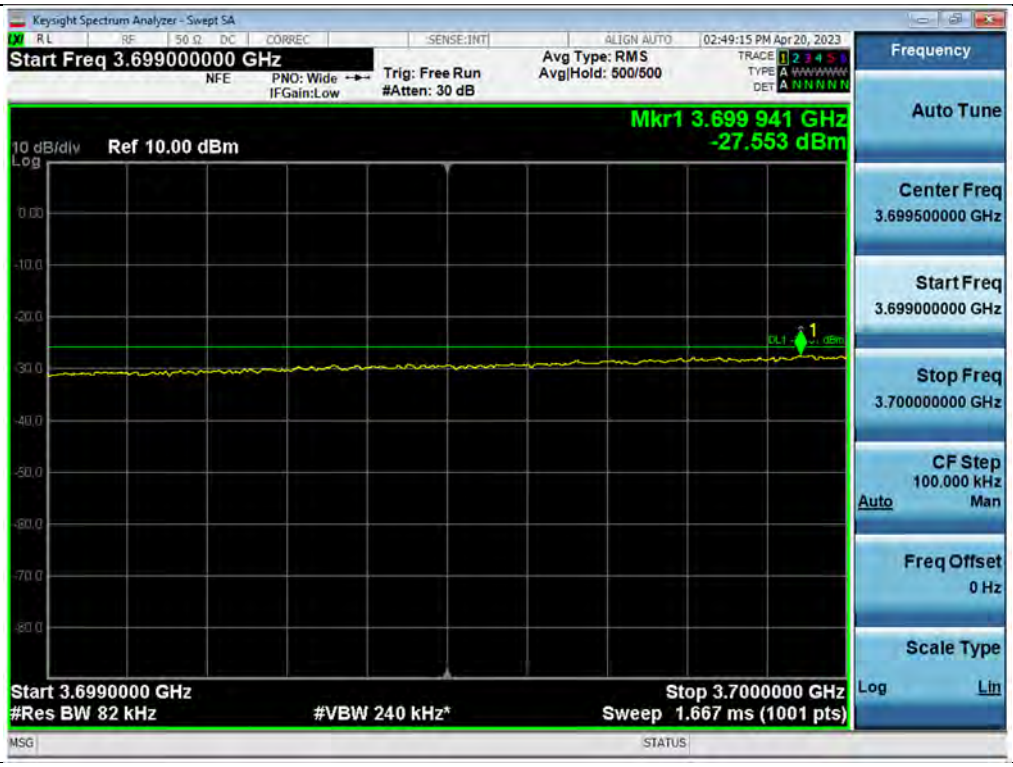
Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 60 MHz / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 60 MHz / Lower



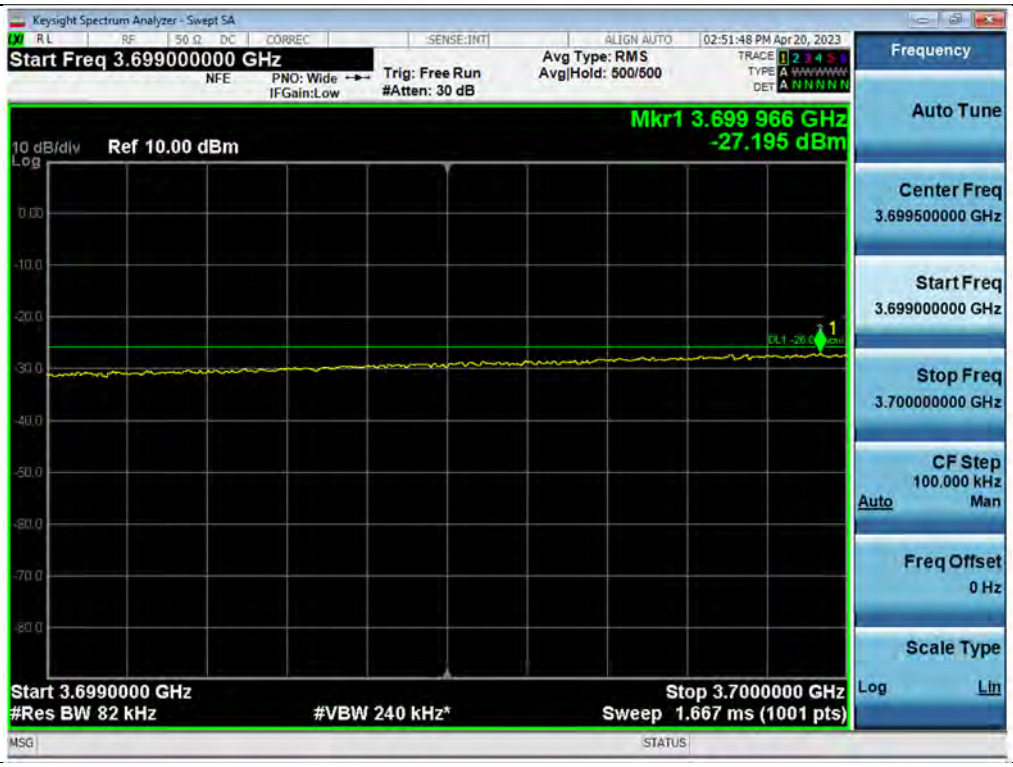
+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 60 MHz / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 80 MHz / Lower



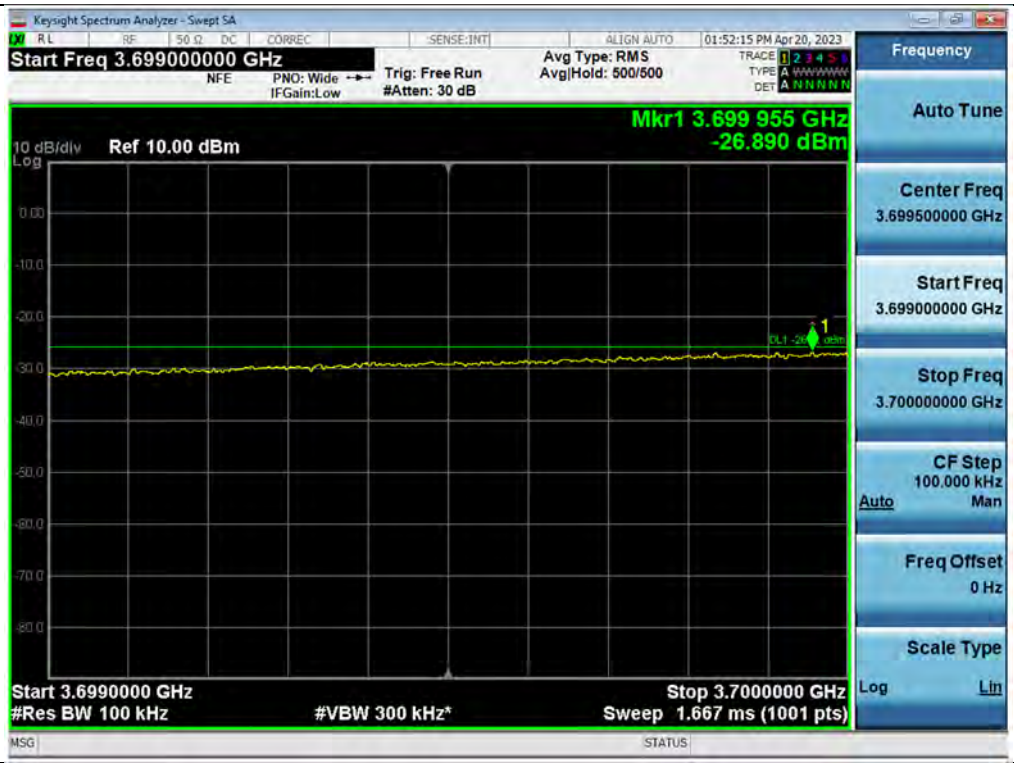
Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 80 MHz / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 80 MHz / Lower

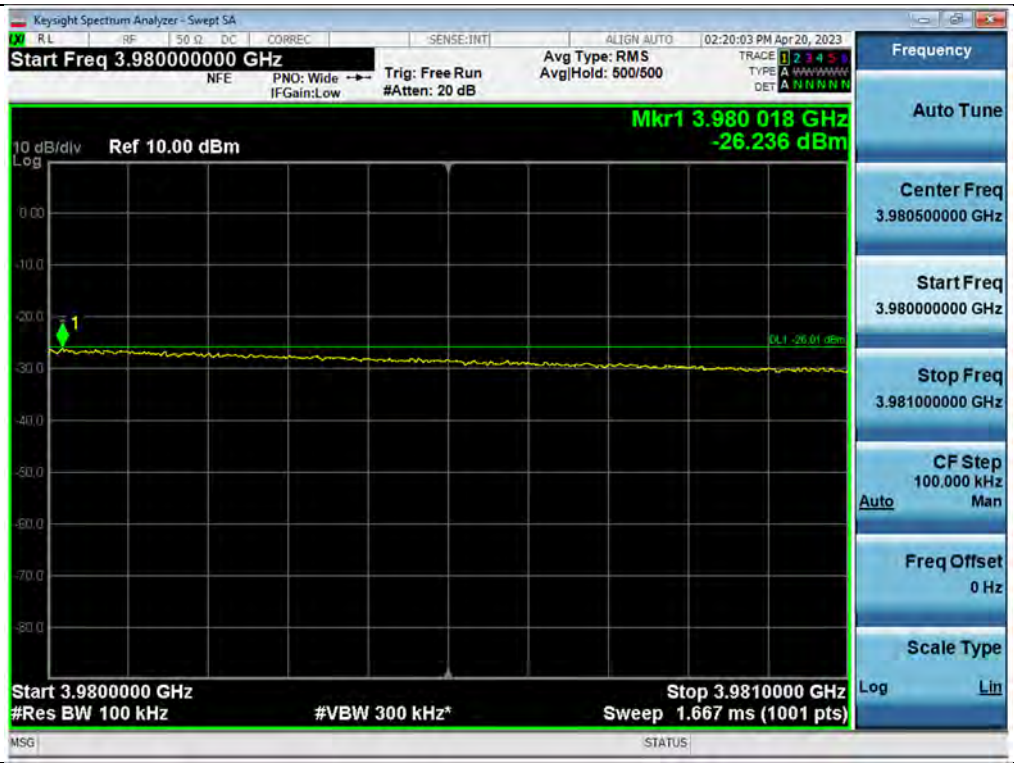


+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 80 MHz / Upper

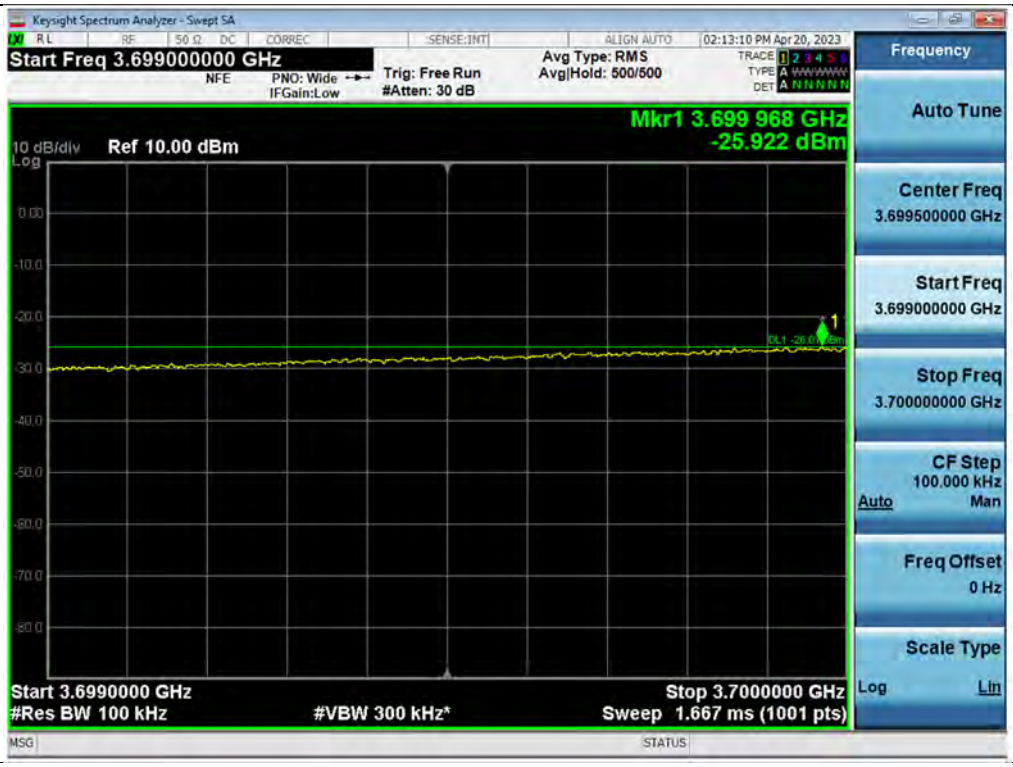
Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / Lower



Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / Upper



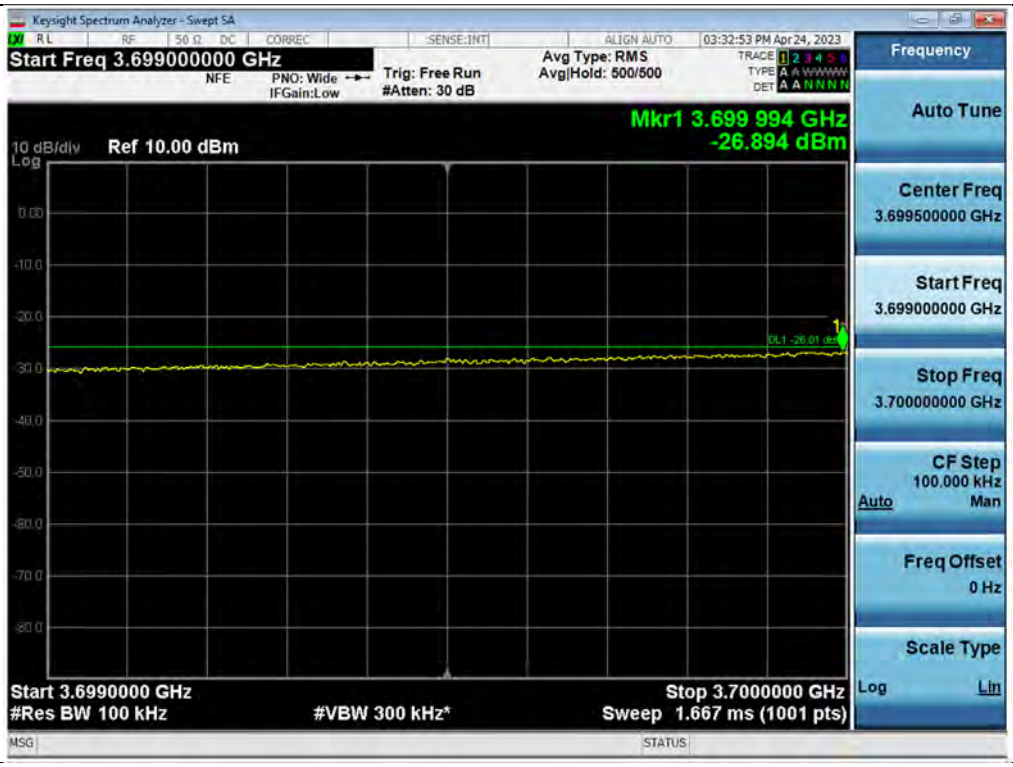
+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / Lower



*Note: The result is -15.922 dBm that has enough margin compared to SISO limit(-13 dBm). For 2Tx MIMO operation, 2Tx summation value is compliant with MIMO limit(-16.01 dBm) as shown in data table on page 80, 81.

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / Upper

Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 4 Carriers(100 + 60 + 80 + 40) / Lower



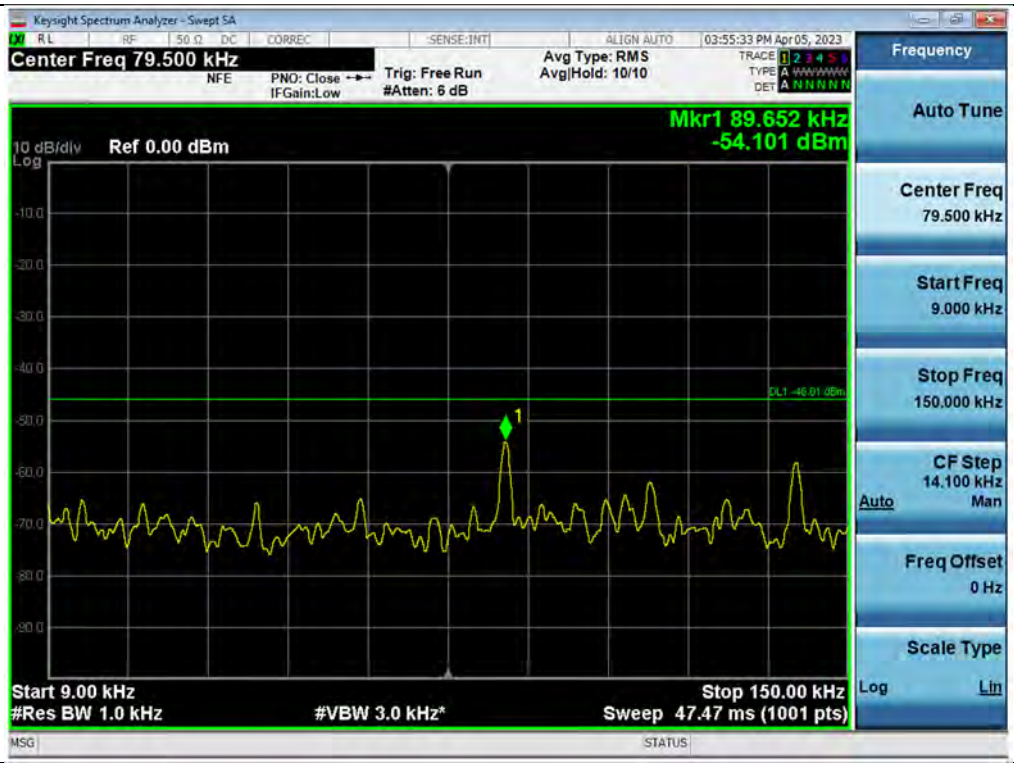
Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink / 5G NR 4 Carriers(100 + 60 + 80 + 40) / Upper

+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink /
5G NR 4 Carriers(100 + 60 + 80 + 40) / Lower

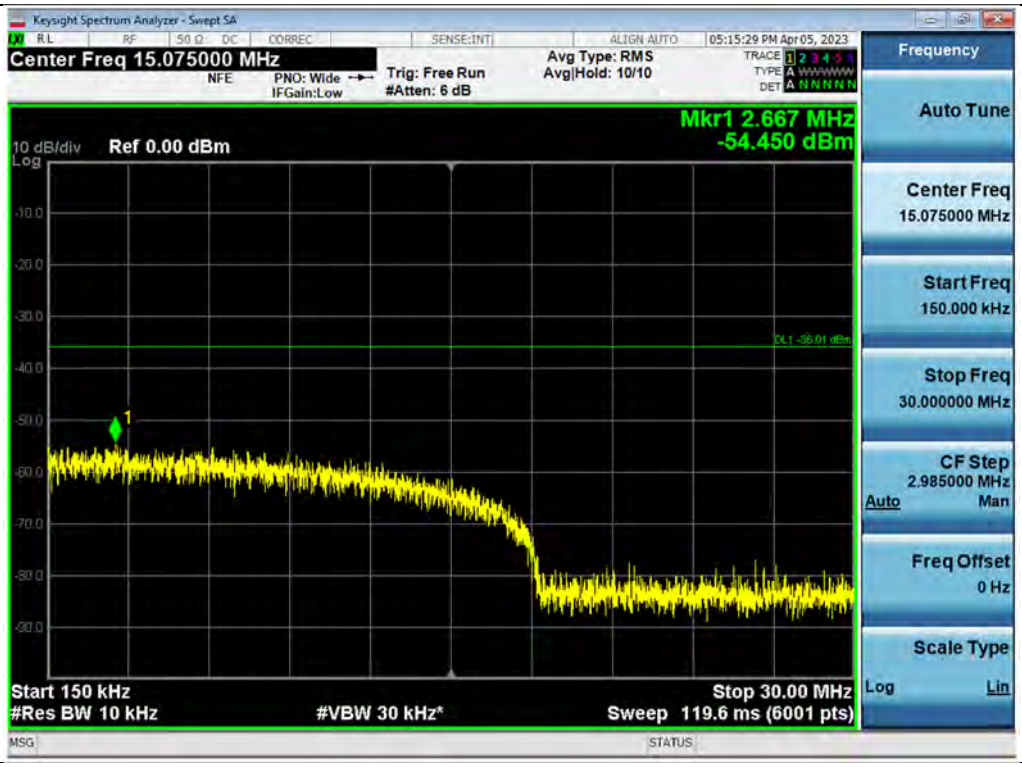
+3 dB above Out-of-band (single test signal) / 3.7 GHz Service (Ant2) / Downlink /
5G NR 4 Carriers(100 + 60 + 80 + 40) / Upper

Plot data of Spurious Emissions

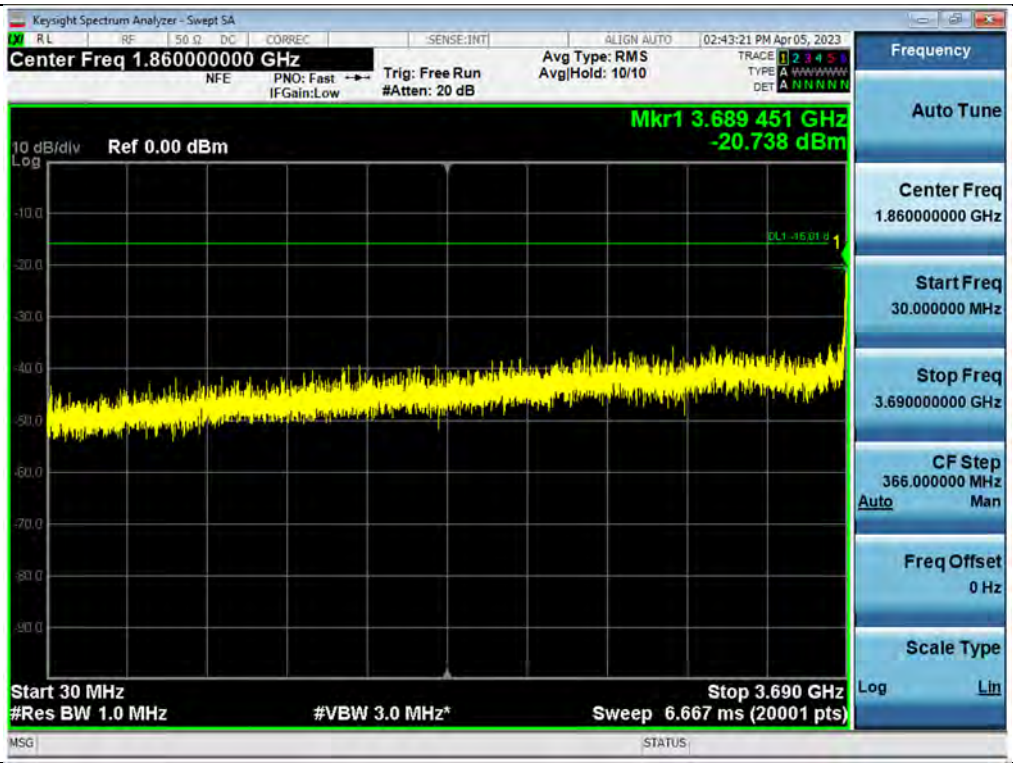
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Low / 9 kHz ~ 150 kHz



Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 20 MHz / Low / 150 kHz ~ 30 MHz



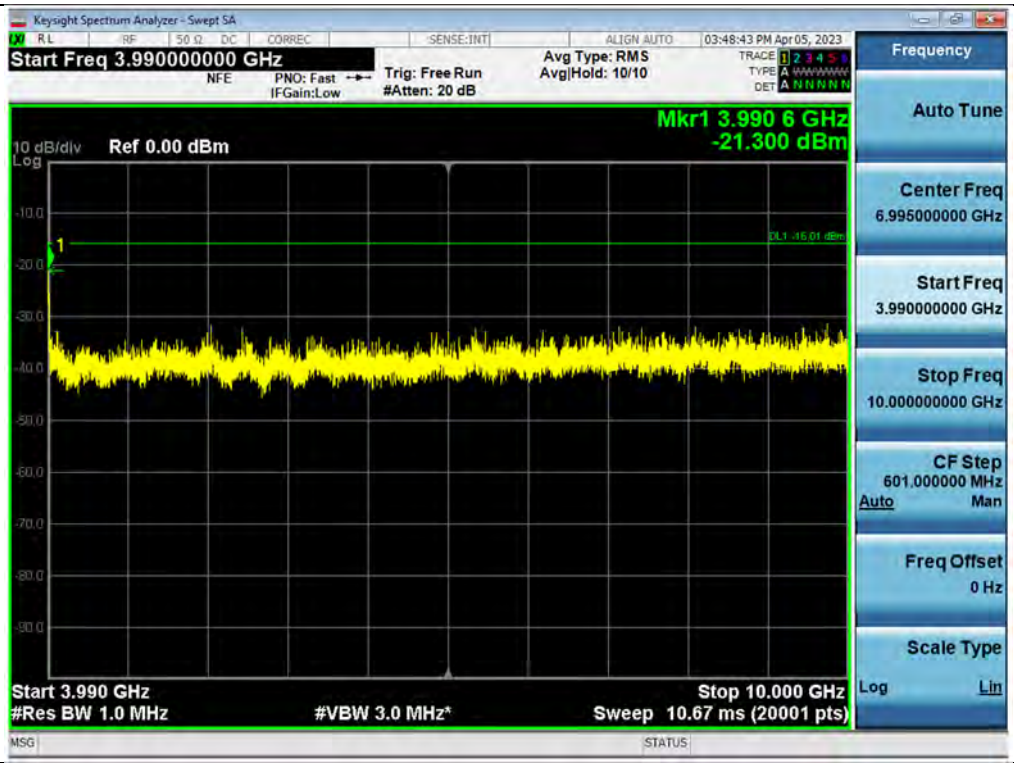
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 80 MHz / Low / 30 MHz ~ Low Edge - 10 MHz



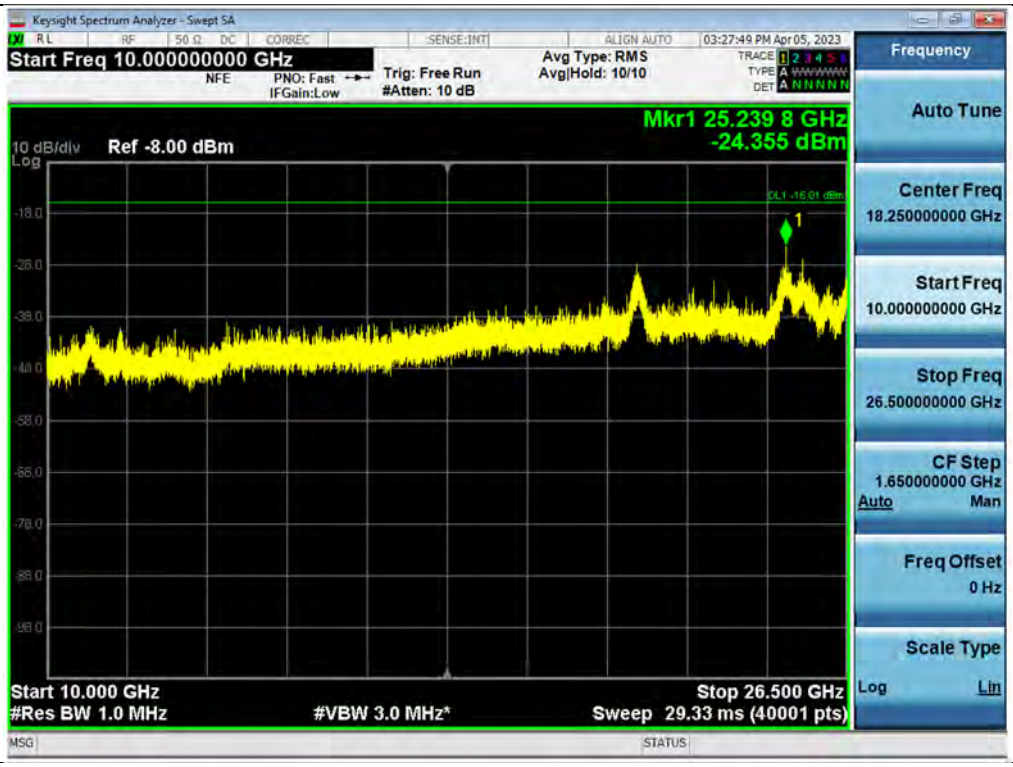
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 40 MHz / Low / Low Edge - 10 MHz ~ Low Edge

Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 40 MHz / High / High Edge ~ High Edge + 10 MHz

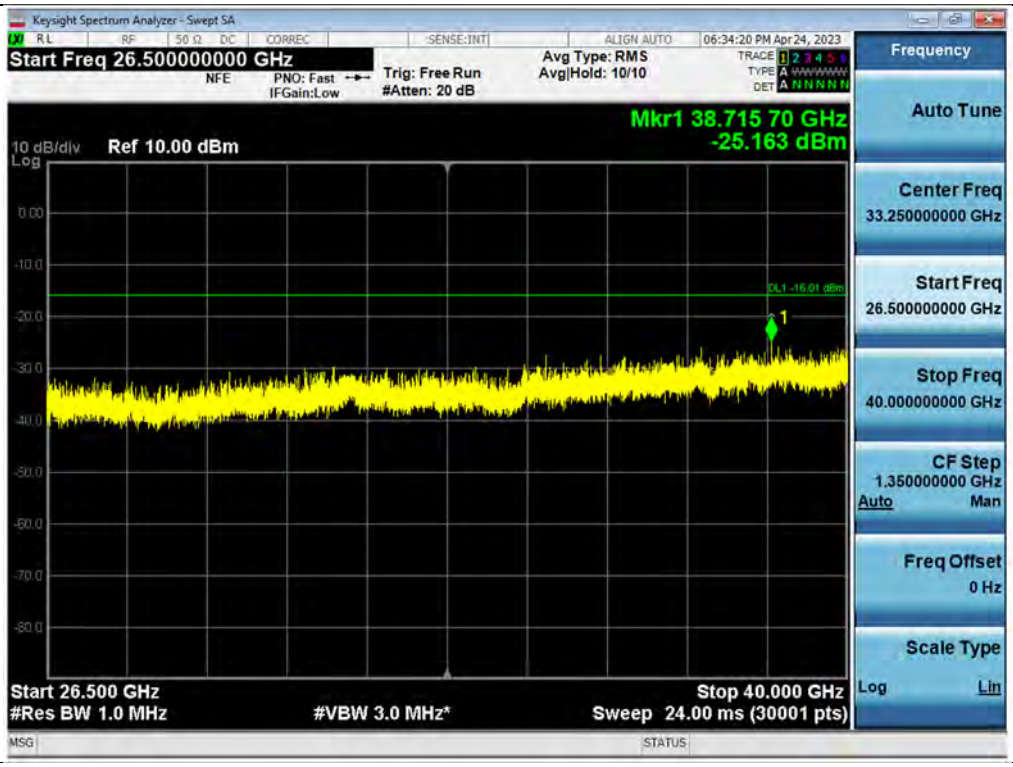
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / High / High Edge + 10 MHz ~ 10 GHz



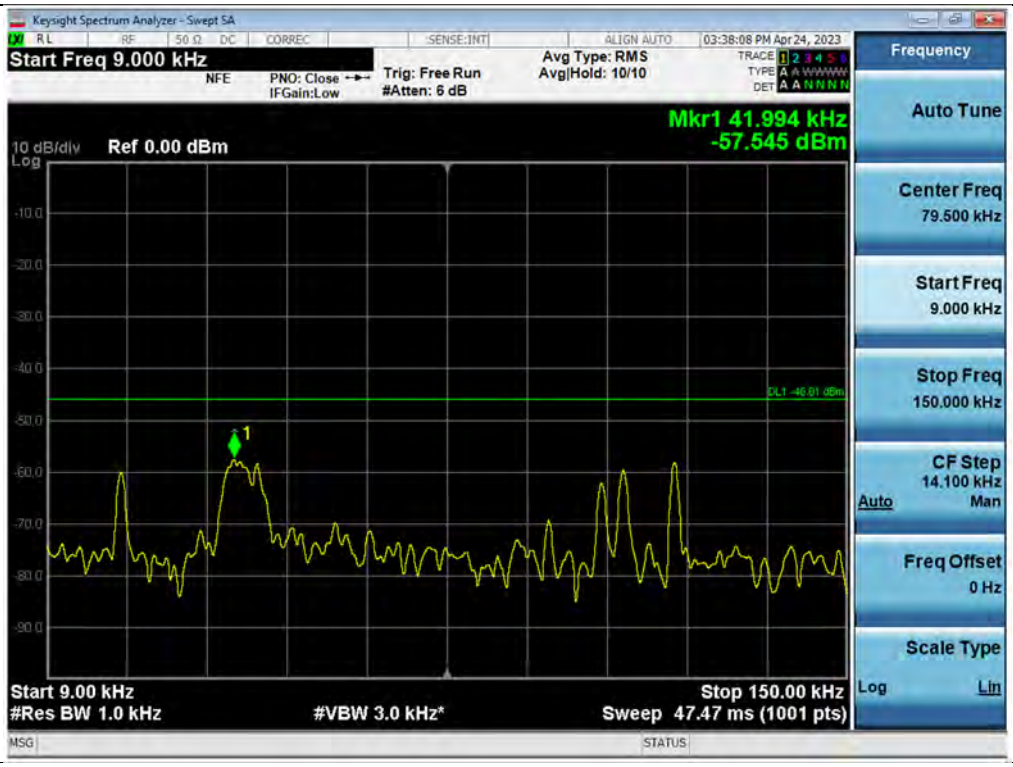
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 60 MHz / Middle / 10 GHz ~ 26.5 GHz



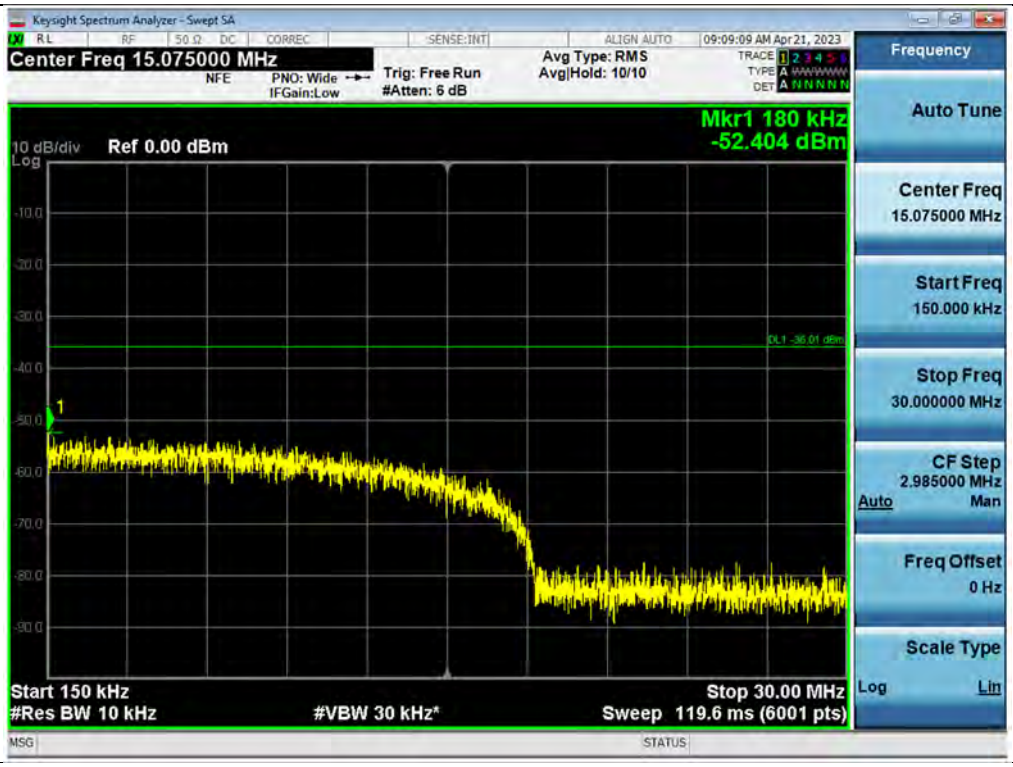
Spurious / 3.7 GHz Service (Ant1) / Downlink / 5G NR 20 MHz / Low / 26.5 GHz ~ 40 GHz



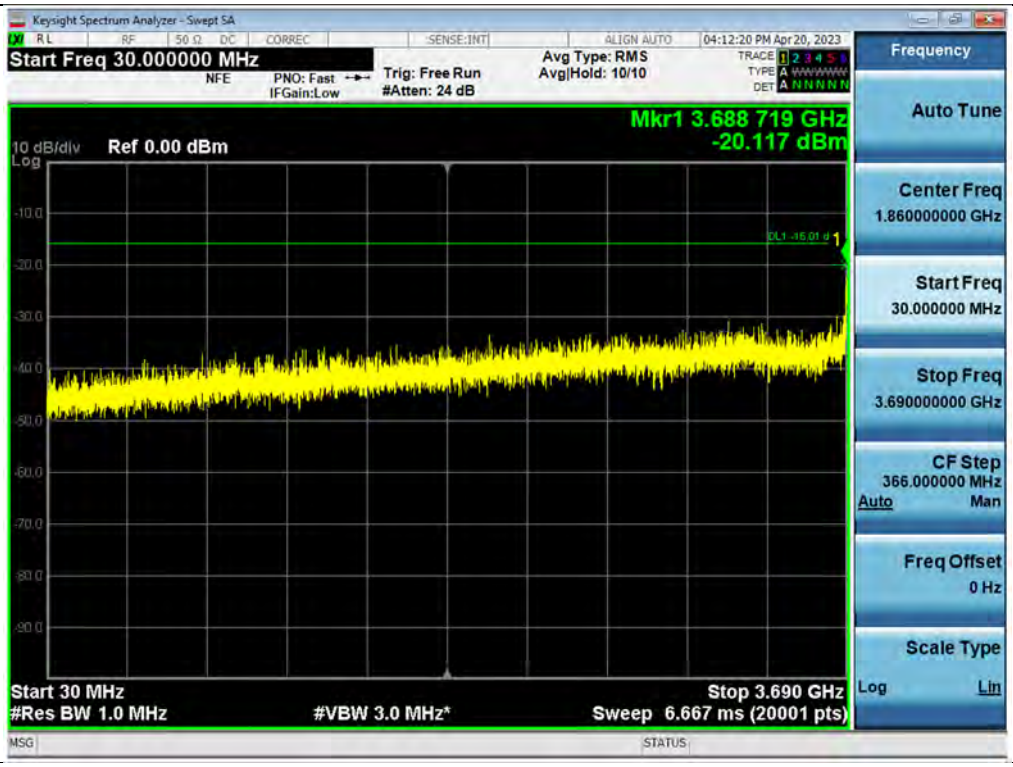
Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 4 Carriers(100 + 60 + 80 + 40) / Middle / 9 kHz ~ 150 kHz



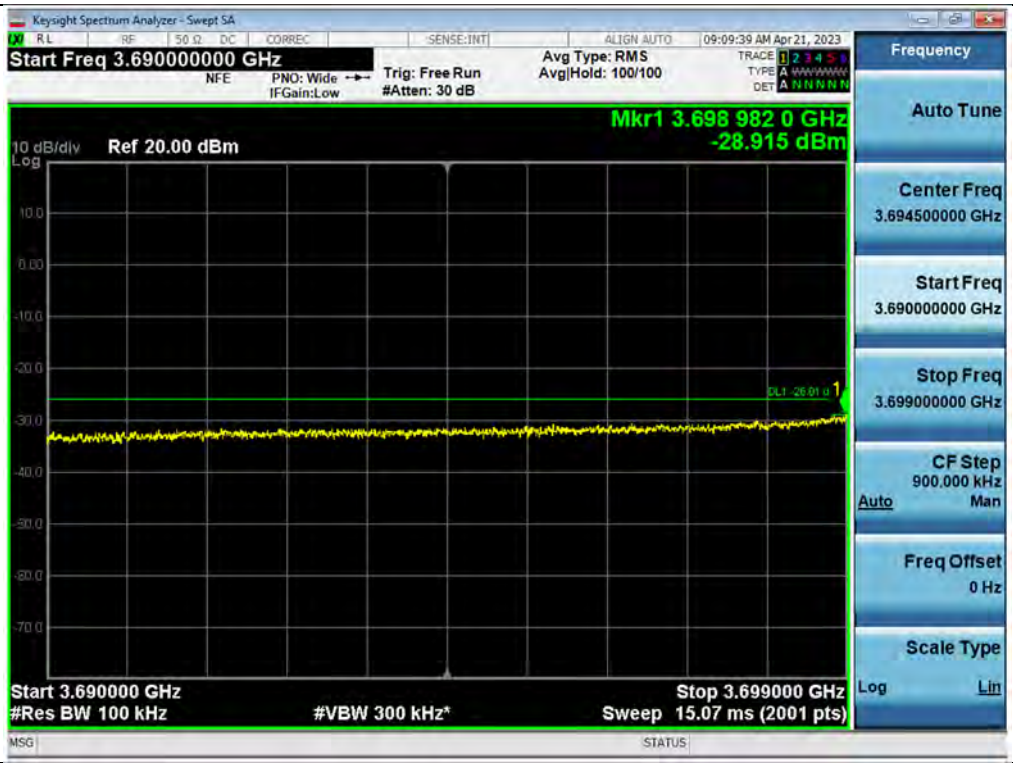
Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Low / 150 kHz ~ 30 MHz



Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 60 MHz / Low / 30 MHz ~ Low Edge - 10 MHz

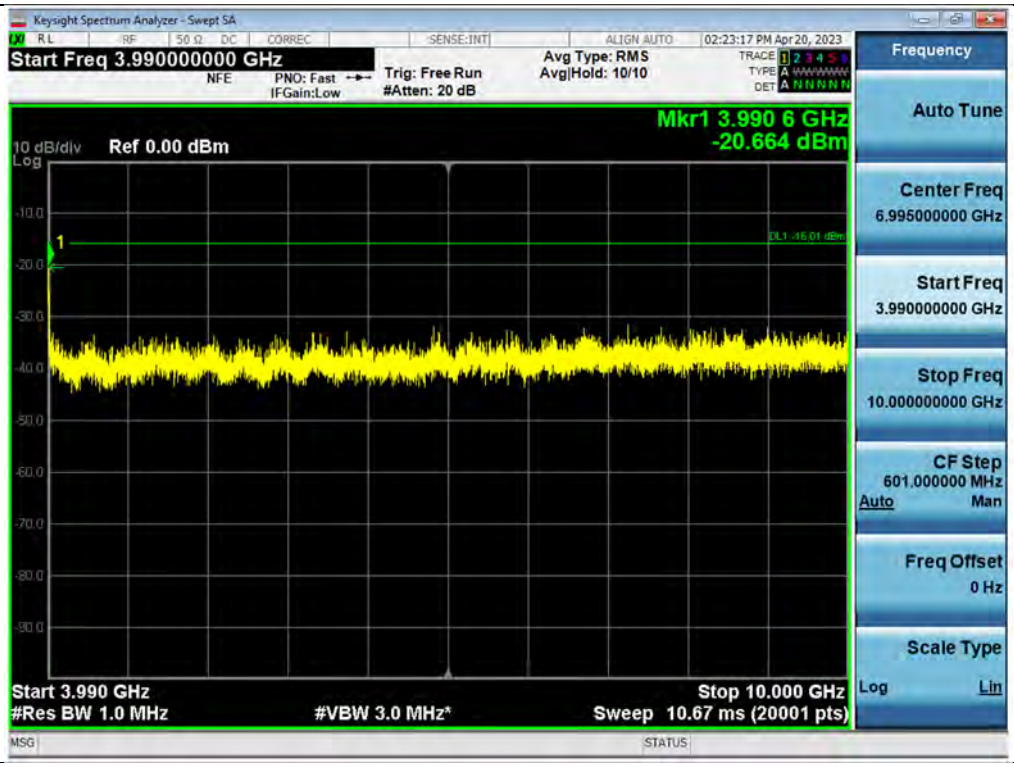


Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / Low / Low Edge - 10 MHz ~ Low Edge

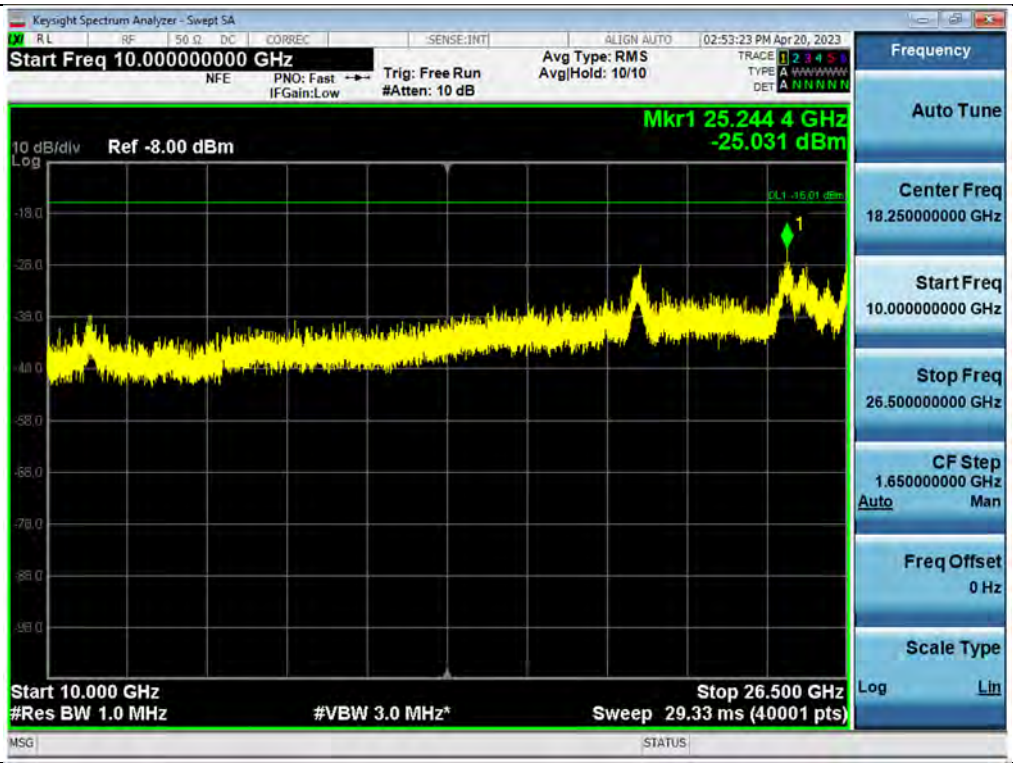


Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 20 MHz / High / High Edge ~ High Edge + 10 MHz

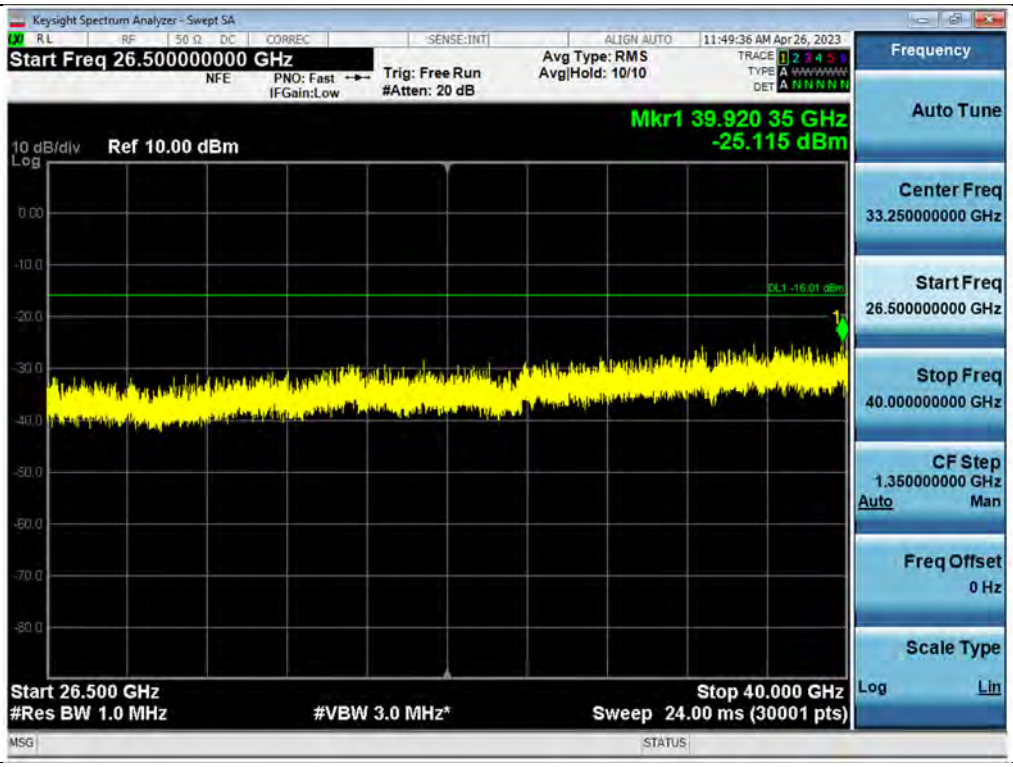
Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / High / High Edge + 10 MHz ~ 10 GHz



Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 80 MHz / Low / 10 GHz ~ 26.5 GHz



Spurious / 3.7 GHz Service (Ant2) / Downlink / 5G NR 100 MHz / Middle / 26.5 GHz ~ 40 GHz



Note : Only the worst case Spurious Emissions plots are attached for each frequency range.

5.6. RADIATED SPURIOUS EMISSIONS

Test Requirements:

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

§ 27.53 Emission limits.

(l) 3.7 GHz Service. The following emission limits apply to station transmitting in the 3700-3980 MHz band:

(1) For base station operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (l)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test Procedures:

Because KDB 935210 D05 procedure does not provide this requirement, measurements were in accordance with the test methods section 5.5 of ANSI C63.26-2015

a) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.

b) Each emission under consideration shall be evaluated:

   1) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.

   2) Rotate the EUT through 360° to determine the maximum emission level relative to the axial position.

   3) Return the turntable to the azimuth where the highest emission amplitude level was observed.

   4) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.

   5) Record the measured emission amplitude level and frequency using the appropriate RBW.

c) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.

Test Result:

Band Name	Mode	Frequency (MHz)	Measured Level (dBuV)	Ant. Factor (dB/m)	A.G.+C.L.+H.P.F. (dB)	Pol.	Measured Power (dBm)	Result (dBm/m)
No Critical Peaks Found.								

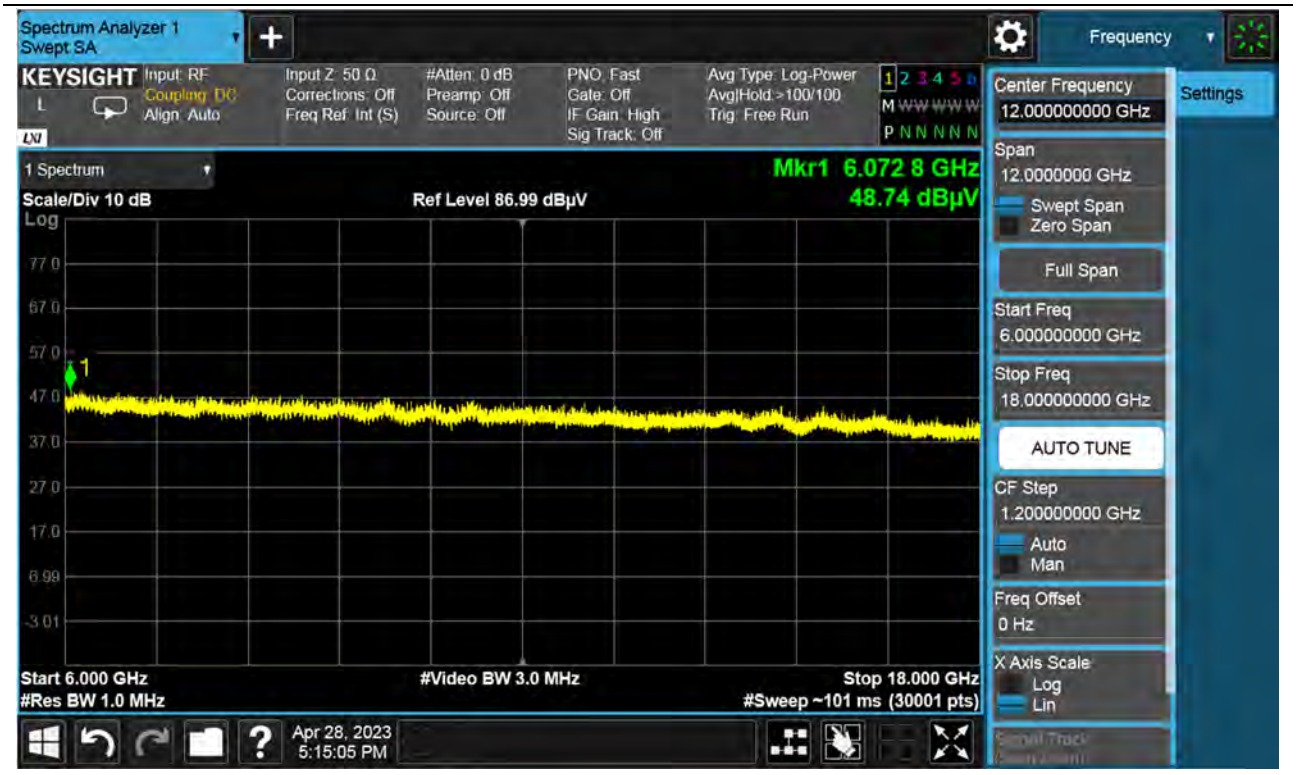
* C.L.: Cable Loss / A.G.: Amp. Gain / H.P.F.: High Pass Filter

Note:

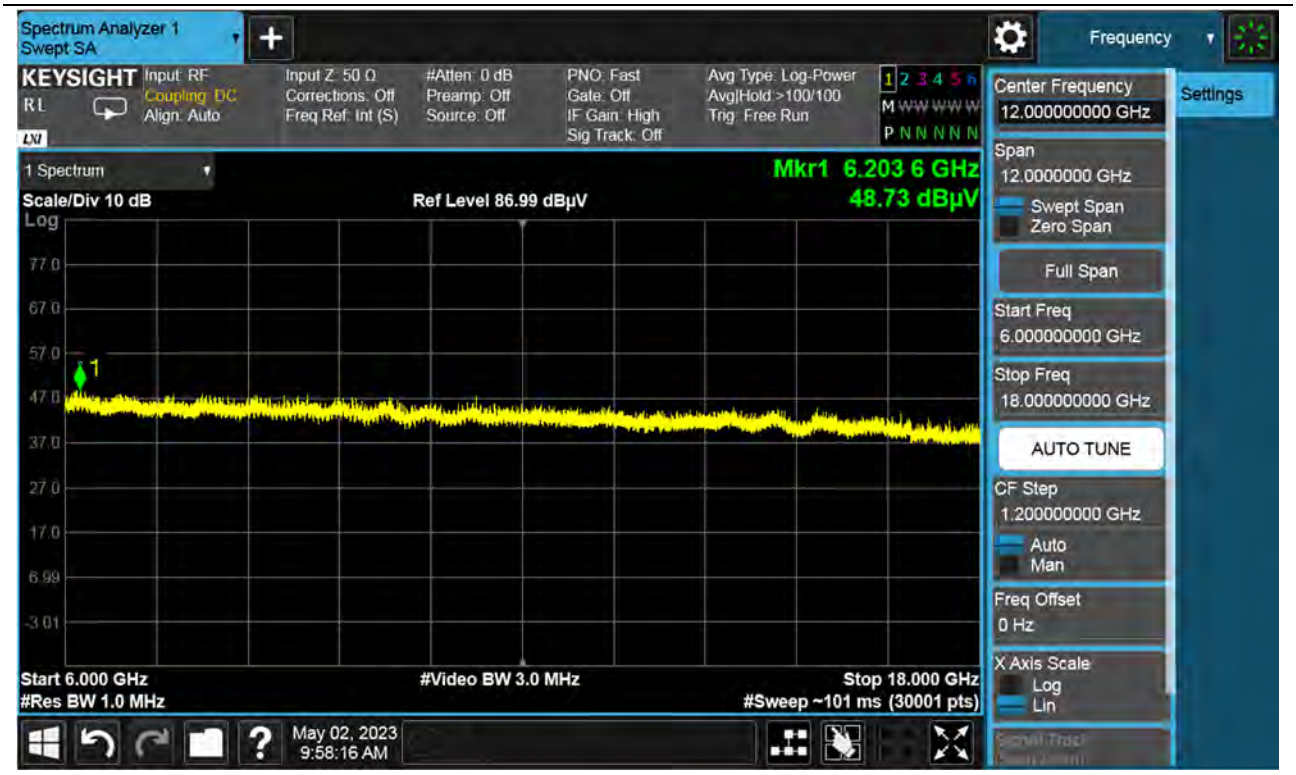
1. We have done horizontal and vertical polarization in detecting antenna.
2. Measure distance = 3 m
3. The amplitude of the spurious domain emission attenuated by more than 20 dB over the permissible value was not recorded according to ANSI C63.26, clause 5.1.1., c).
4. We have tested SISO(ANT1) and MIMO(ANT1+ANT2) operations, but we only attached the worst case result.

Plot data of radiated spurious emissions

SISO / AC / Downlink / 5G NR 20 MHz



SISO / DC / Downlink / 5G NR 20 MHz



Note : Only the worst case plots for Radiated Spurious Emissions.

5.7. FREQUENCY STABILITY

Test Requirements:

§ 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§ 27.54 Frequency stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Procedures:

The measurement is performed in accordance with Section 5.6.3, 5.6.4 and 5.6.5 of ANSI C63.26.

5.6.3 Procedure for frequency stability testing

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

a) At 10 °C intervals of temperatures between −30 °C and +50 °C at the manufacturer's rated supply voltage, and

b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the −15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

5.6.4 Frequency stability over variations in temperature

a) Supply the EUT with a nominal 60 Hz ac voltage, dc voltage, or install a new or fully charged battery in the EUT.

b) If possible a dummy load should be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible.

c) Turn on the EUT, and tune it to the center frequency of the operating band.

d) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible, make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away).

   NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

f) Turn the EUT off, and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

g) Set the temperature control on the chamber to the Highest temperature specified in the regulatory requirements for the type of device, and allow the oscillator heater and the chamber temperature to stabilize. Unless otherwise instructed by the regulatory authority, this temperature should be 50 °C.

h) While maintaining a constant temperature inside the environmental chamber, turn on the EUT and allow sufficient time for the EUT temperature to stabilize.

i) Measure the frequency.

j) Switch off the EUT, but do not switch off the oscillator heater.

k) Lower the chamber temperature to the next level that is required by the standard and allow the temperature inside the chamber to stabilize. Unless otherwise instructed by the regulators, this temperature step should be 10 °C.

l) Repeat step h) through step k) down to the lowest specified temperature. Unless otherwise instructed by the regulators, this temperature should be −30 °C. When the frequency stability limit is stated as being sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point shall be established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and Highest channel of operation shall be identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods shall be added or subtracted from the values of f_L and f_H and the resulting frequencies must remain within the band.

m) Omitted

5.6.5 Frequency stability when varying supply voltage

a) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away)

b) Supply the EUT with nominal ac or dc voltage. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

c) Turn on the EUT, and couple its output to a frequency counter or other frequency-measuring instrument.

d) Tune the EUT to the center frequency of the operating band. Adjust the location of the measurement antenna

and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Measure the frequency.

f) Unless otherwise specified, vary primary supply voltage from 85% to 115% of the nominal value for other than hand carried battery equipment.

g) For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

h) Repeat the frequency measurement.

NOTE—For band-edge compliance, it can be required to make these measurements at the low and High channel of the operating band.

Note: The results of the frequency stability test shown above the frequency deviation measured values are very small and similar trend for each port, so we are attached only the worst case data.

Test Results:

Reference: 110 Vac at 20°C **Freq.** = 3 840,000,000 Hz

Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(°C)	(Hz)	Error (Hz)	(Hz)	
100%	+20(Ref)	3 840 000 006	6.340	0.000	0.00000
	-30	3 840 000 011	4.810	-1.530	-0.00040
	-20	3 840 000 014	7.819	1.479	0.00039
	-10	3 840 000 011	4.682	-1.659	-0.00043
	0	3 840 000 010	3.330	-3.011	-0.00078
	+10	3 840 000 009	2.647	-3.693	-0.00096
	+30	3 840 000 014	7.246	0.905	0.00024
	+40	3 840 000 016	9.889	3.548	0.00092
	+50	3 840 000 014	8.060	1.720	0.00045
115%	+20	3 840 000 015	8.668	2.327	0.00061
85%	+20	3 840 000 011	4.835	-1.505	-0.00039

6. Annex A_EUT AND TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2305-FC003-P