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TEST REPORT

FCC Test for QC-336A
Certification

APPLICANT
Qucell Networks Co., Ltd.

REPORT NO.
HCT-RF-2402-FC015-R2

DATE OF ISSUE
February 22, 2024

Tested by
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TEST REPORT

REPORT NO.
HCT-RF-2402-FC015-R2

DATE OF ISSUE
February 22, 2024

Applicant	**Qucell Networks Co., Ltd.** 3F, Innowireless Building, 190, Seohyeon-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Eut Type Model Name	QUCELL 5G-S6 QC-336A
FCC ID	2AS48QC-336A
Date of Test	December 22, 2023 ~ February 06, 2024
FCC Rule Part(s)	CFR 47 Part 2, Part 96
Location of Test	■ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	February 13, 2024	Initial Release
1	February 20, 2024	- Added notes on page 8, 50. - Revised note number 3 on page 69. - Revised the test results in Section 5.5.
2	Feburary 22, 2024	- Revised the 'Output Power' description in the sum data on pages 17 ~ 20 to E.I.R.P. - Revised the 'Measured Level' description in the test results on pages 70 ~ 73 to 'Calculated Value'.

Notice

Content

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.
The test results have only been applied with the test methods required by the standard(s).

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

The above Test Report is not related to the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme) / A2LA(American Association for Laboratory Accreditation)(4114.01), which signed the ILAC-MRA.

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1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	Qucell Networks Co., Ltd.
Company Address	3F, Innowireless Building, 190, Seohyeon-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea

1.2. PRODUCT INFORMATION

EUT Type	QUCELL 5G-S6
EUT Serial Number	SC280700006
Power Supply	Adaptor DC 24.0 V PoE++ (IEEE802.3bt) 42.5 ~ 57 V

Output Power

Band	Carrier	Bandwidth	Power
(2 Port) 5G NR n48	1	10 MHz	0.100 W/path, Total: 0.200 W
(2 Port) 5G NR n48	1	20 MHz	0.126 W/path, Total: 0.252 W
(2 Port) 5G NR n48	1	30 MHz	0.126 W/path, Total: 0.252 W
(2 Port) 5G NR n48	1	40 MHz	0.126 W/path, Total: 0.252 W

Frequency Range	3 550 MHz ~ 3 700 MHz

Emission Designator

Mode	Bandwidth	Emission Designator			
		QPSK (G7D)	Total E.I.R.P. (W)	QAM (W7D)	Total E.I.R.P. (W)
(2 Port) 5G NR n48	10 MHz	8M63G7D	0.74	8M67W7D	0.73
(2 Port) 5G NR n48	20 MHz	18M2G7D	0.89	18M3W7D	0.91
(2 Port) 5G NR n48	30 MHz	27M9G7D	0.81	28M0W7D	0.82
(2 Port) 5G NR n48	40 MHz	37M9G7D	0.84	38M0W7D	0.84

Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
CBSD Category	Category A CBSD
Antenna Specification	Antenna type: PIFA Antenna Peak Gain : 4.98 dBi (SM-MIMO) (Directional Gain = G_{ANT} + 10 log(N_{ANT}/N_{SS}) = G_{ANT} + 10 log(2/2) = G_{ANT})

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 96
Measurement standards	ANSI C63.26-2015, KDB 662911 D01 v02r01, KDB 971168 D01 v03r01, KDB 940660 D01 v03
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated March 31, 2022 (CAB identifier: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

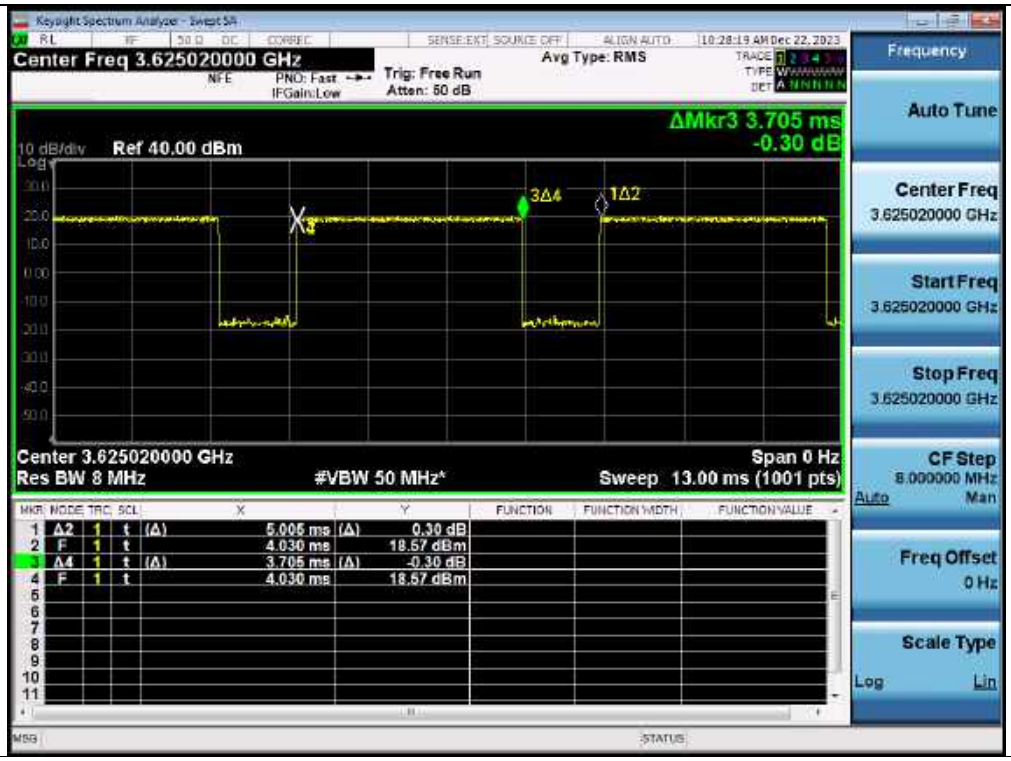
The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 96

Description	Reference	Results
RF Output Power and PSD	§ 2.1046, § 96.41 (b)	Compliant
PAPR	§ 2.1046, § 96.41 (g)	Compliant
Occupied Bandwidth	§ 2.1049	Compliant
Out-of-band Unwanted Emissions	§ 96.41 (e)	Compliant
Spurious Unwanted Emissions	§ 96.41 (e)	Compliant
Radiated Emissions	§ 96.41 (e)	Compliant
Frequency Stability	§ 2.1055	Compliant

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

- The EUT was operated in a manner representative of the typical usage of the equipment.
- During all testing, system components were manipulated within the confines of typical usage to maximize each emission.
- All 5G NR modulation types (QPSK, 16QAM, 64QAM, 256QAM) supported by the EUT have been tested.
- Both wall mount and ceiling mount were investgated during pre-scan testing, and the results for the worst case(wall-mounted) were reported.
- The dummy loads were connected to the RF output ports for radiated spurious emission testing.
- Because of the EUT using TDD technology, it cannot be configured to transmit continuously and measurement instrument cannot be configured to measure only during active transmissions. So, we performed the measurement using duty cycle method.

Measurement Result of QC-336A Transmit On/Off Timing



- The EUT duty cycle is calculated according to ANSI C63.26 - 5.2.4.3.4.

Duty Cycle = On-time / Transmitter period = 3.705 ms / 5.005 ms = 0.7402597...

Duty Correction = 10 log (1/duty cycle) = 1.31 dB (1.306... dB)*

* The value 1.31 is an approximate value, and actual values(1.306...) have been used in all calculations.

- The tests results in plots are already including the actual value of loss for the attenuator and cable combination. Please check correction factors below table.

Correction factor table

Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
500	20.109	20 000	29.215
600	20.232	21 000	29.590
700	20.381	22 000	32.943
800	20.416	23 000	34.445
900	20.522	24 000	35.474
1 000	20.632	25 000	32.033
2 000	21.345	26 000	31.115
3 000	21.908	27 000	30.152
4 000	22.488	28 000	33.175
5 000	23.055	29 000	34.448
6 000	23.059	30 000	32.641
7 000	23.577	31 000	34.525
8 000	23.979	32 000	30.602
9 000	24.263	33 000	32.094
10 000	24.898	34 000	29.991
11 000	25.617	35 000	33.240
12 000	26.118	36 000	36.145
13 000	26.172	37 000	33.392
14 000	26.221	38 000	30.137
15 000	27.001	39 000	31.987
16 000	27.328	40 000	29.099
17 000	27.833	-	-
18 000	27.300	-	-
19 000	28.273	-	-

3.3. MAXIMUM MEASUREMENT UNCERTAINTY

Description	Condition	Uncertainty
Radiated Disturbance	9 kHz ~ 30 MHz	4.36 dB
	30 MHz ~ 1 GHz	5.70 dB
	1 GHz ~ 18 GHz	5.52 dB
	18 GHz ~ 40 GHz	5.66 dB

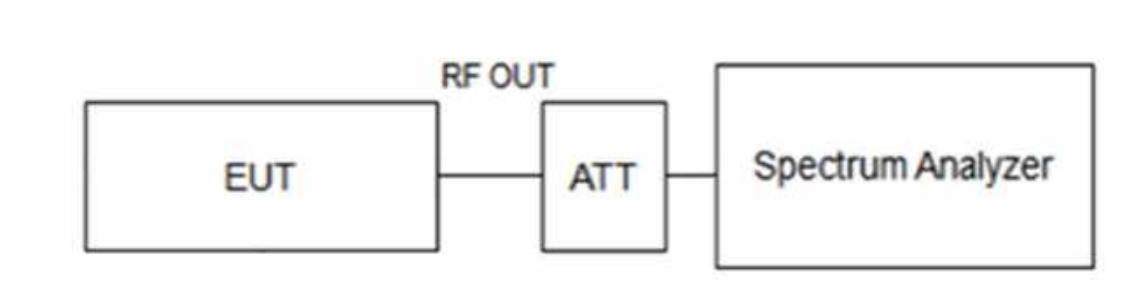
Coverage factor k = 2, Confidence levels of 95 %

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+15 °C to +35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

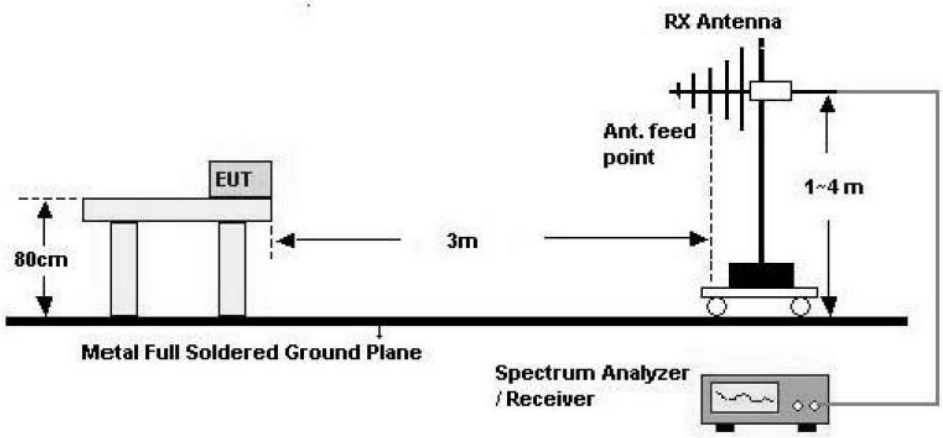
3.5. TEST DIAGRAMS

Conducted Test

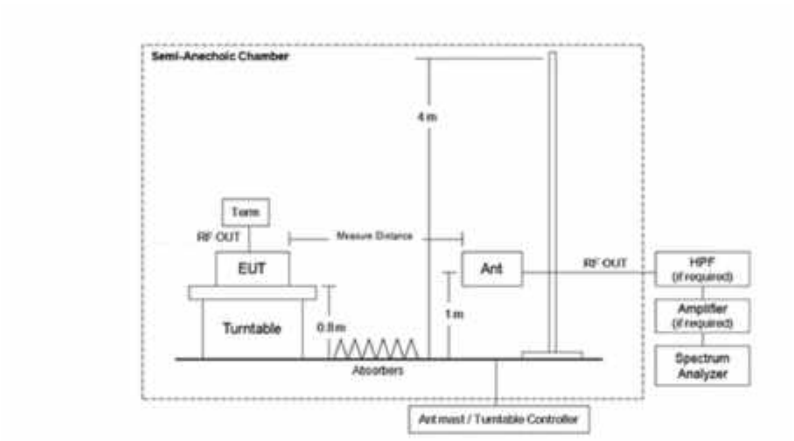


Radiated Test

30 MHz ~ 1 GHz

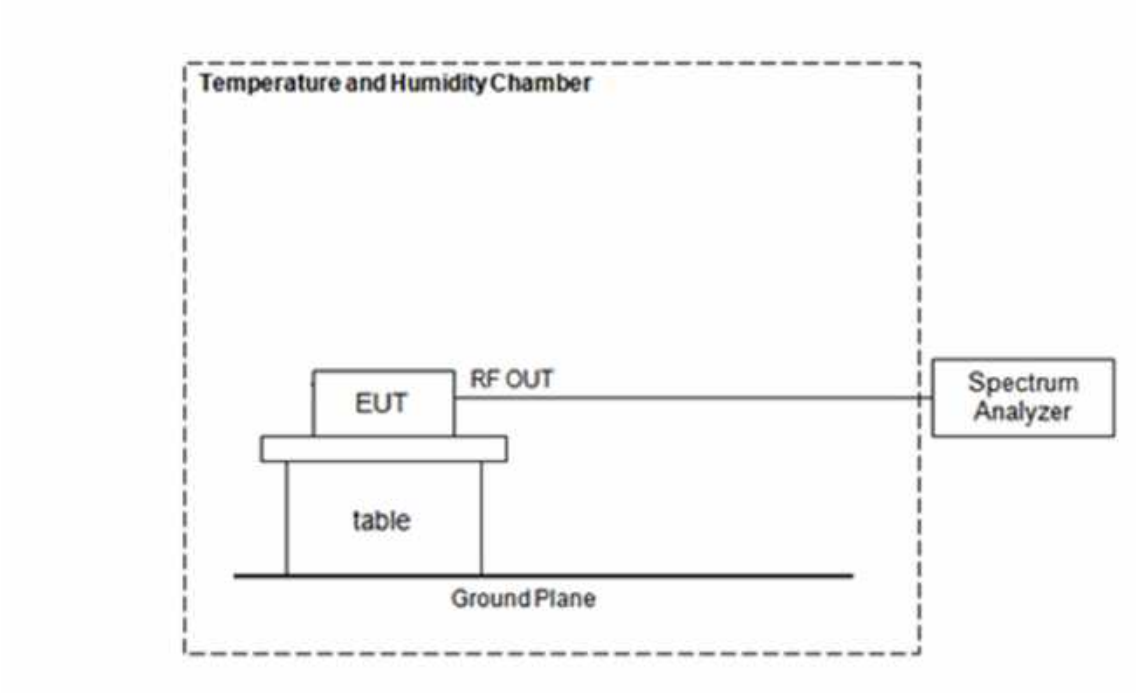


Above 1 GHz



※ EUT position is adopted by placement of floor-standing refer to section 5.5.2.3.2 of ANSI C63.26-2015

Frequency Stability



Note: All modulations(QPSK, 16QAM, 64QAM, 256QAM) were investigated and the worst case configuration channel results are reported.

4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
PXA Signal Analyzer	N9030A	Keysight	MY49431434	2024-12-27	Annual
20 dB Attenuator	FAS-23-20	MCLI	103756	2025-01-02	Annual
*30 dB Attenuator	67-30-33	API Weinschel, Inc.	CL4338	2024-05-02	Annual
*50Ω Termination	908A	H.P.	N/A	N/A	N/A
Temperature and Humidity Chamber	NY-THR18750	NANGYEAL	NY-200912201A	2025-01-04	Annual
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	N/A
Controller (Antenna Mast & Turn Table)	CO3000	Innco system	CO3000/1251/48920320/P	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Turn Table	DS2000-S	Innco system	N/A	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	2024-03-17	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	2024-08-16	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	2025-11-07	Biennial
Horn Antenna (15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	2025-03-28	Biennial
RF Switching System	FBSR-04C	TNM system	S4L1	2024-08-18	Annual
3G HPF	WHKX10-2700-3000-18000-40SS	WAINWRIGHT INSTRUMENT	45	2024-08-18	Annual
7G HPF	WHKX8-6090-7000-18000-40SS	WAINWRIGHT INSTRUMENT	86	2024-08-18	Annual
LNA	LLAU1183540Q	LTC Microwave	100	2024-08-18	Annual
LNA	LLA06185030Q	LTC Microwave	102	2024-08-18	Annual
Power Amplifier	CBL18265035	CERNEX	22966	2024-11-17	Annual
Power Amplifier	CBL26405040	CERNEX	25956	2024-03-02	Annual

*This equipment has been used to each port, but we only listed one equipment for simplicity.

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date, or will be tested after the calibration is completed.

5. TEST RESULT

5.1. RF OUTPUT POWER and PSD

Test Requirements:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 96.41(b) General radio requirements: Power limits.

(b) Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the table in this paragraph (b):

Device	Maximum EIRP (dBm/10megahertz)	Maximum PSD (dBm/MHz)
End User Device	23	n/a
Category A CBSD	30	20
Category B CBSD[1]	47	37

[1] Category B CBSDs will only be authorized for use after an ESC is approved and commercially deployed consistent with § § 96.15 and 96.67.

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.1 of ANSI C63.26.

The EUT is considered to transmit continuously if it can be configured to transmit at a burst duty cycle of greater than or equal to 98% throughout the duration of the measurement. If this condition can be achieved, then the following procedure can be used to measure the average output power of the EUT.

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1 % to 5 % of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

   1) Set = auto-couple, or

   2) Set ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. Transmission period is the on and off time of the transmitter.

f) Detector = power averaging (rms).

g) If the EUT can be configured to transmit continuously, then set the trigger to free run.

h) If the EUT cannot be configured to transmit continuously, then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Verify that the sweep time is less than or equal to the transmission burst duration. Time gating can also be used under similar constraints (i.e., configured such that measurement data is collected only during active full-power transmissions).

i) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.

j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

The measurement is performed in accordance with Section 5.2.4.5 of ANSI C63.26.
Some regulatory requirements specify the RF output power limits in terms of maximum or average PSD, (i.e., the output power or unwanted emissions power limits are defined within a specified reference bandwidth).
When average PSD limits are specified, the same fundamental measurement condition applies as previously discussed (i.e., averaging is to be performed only over durations of active transmissions at maximum output power level). Thus, when performing this measurement, the EUT must either be configured to transmit continuously at full power while the compliance measurement is performed, or else the measurement instrumentation must be configured to acquire data only over durations when the EUT is actively transmitting at full power. In circumstances where neither of these conditions can be realized, then alternative procedures are provided for both constant duty cycle and non-constant duty cycle transmissions.
The PSD is measured following the same procedures described in 5.2.4.4 for measuring the total average power, but with the RBW set to the reference bandwidth specified by the applicable regulatory requirement, and by using the marker function to identify the maximum PSD instead of summing the power across the OBW. If the fundamental measurement condition cannot be realized, then one of the alternative procedures in 5.2.4.4.2 or 5.2.4.4.3 should be selected, based on whether the transmitter duty cycle is constant (variations ≤ ±2%) or non-constant (variations > ±2%), respectively.

Note:

1. Because the test equipment does not support RBW of RBW narrower than reference bandwidth is used. So following correction factor is applied.
   - 10 log [(reference bandwidth)/(resolution bandwidth)]
     : All other NR signals applied 1 MHz RBW, 10 log (10 MHz / 1 MHz) = 10 dB
2. E.I.R.P. (dBm/10 MHz) Sample Calculation:
   - For greater or equal to 10 MHz NR Signal,
     10.55 dBm/MHz (Measured Value) + 4.98 dBi (Directional Gain) + 10 dB (RBW Correction)
     = 25.53 dBm/10 MHz (Final E.I.R.P.)
3. The results of the Conducted output power and PSD test shown below the frequency measured values are very small and similar trend for each port, so we are attached only the worst case plot.
4. All power supplies of operation were investigated and the worst case configuration results are reported.

Test Results:
Tabular Data of RF output power

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Calculated (W)
0	QPSK	Low	3 555.00	19.26	4.98	24.24	0.27
		Middle	3 625.02	19.44	4.98	24.42	0.28
		High	3 694.98	20.65	4.98	25.63	0.37
	16QAM	Low	3 555.00	19.24	4.98	24.22	0.26
		Middle	3 625.02	19.10	4.98	24.08	0.26
		High	3 694.98	20.68	4.98	25.66	0.37
	64QAM	Low	3 555.00	19.18	4.98	24.16	0.26
		Middle	3 625.02	19.40	4.98	24.38	0.27
		High	3 694.98	20.60	4.98	25.58	0.36
	256QAM	Low	3 555.00	19.40	4.98	24.38	0.27
		Middle	3 625.02	19.32	4.98	24.30	0.27
		High	3 694.98	20.41	4.98	25.39	0.35
1	QPSK	Low	3 555.00	18.67	4.98	23.65	0.23
		Middle	3 625.02	19.04	4.98	24.02	0.25
		High	3 694.98	20.74	4.98	25.72	0.37
	16QAM	Low	3 555.00	18.62	4.98	23.60	0.23
		Middle	3 625.02	18.92	4.98	23.90	0.25
		High	3 694.98	20.64	4.98	25.62	0.36
	64QAM	Low	3 555.00	18.70	4.98	23.68	0.23
		Middle	3 625.02	18.98	4.98	23.96	0.25
		High	3 694.98	20.63	4.98	25.61	0.36
	256QAM	Low	3 555.00	18.57	4.98	23.55	0.23
		Middle	3 625.02	18.85	4.98	23.83	0.24
		High	3 694.98	20.53	4.98	25.51	0.36

Sum Data of Port 0, Port 1

Frequency (MHz)	E.I.R.P.			
	QPSK	16QAM	64QAM	256QAM
	W			
3 555.00	0.50	0.49	0.49	0.50
3 625.02	0.53	0.50	0.52	0.51
3 694.98	0.74	0.73	0.72	0.70

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Calculated (W)
0	QPSK	Low	3 560.01	20.48	4.98	25.46	0.35
		Middle	3 625.02	20.10	4.98	25.08	0.32
		High	3 690.00	21.55	4.98	26.53	0.45
	16QAM	Low	3 560.01	20.53	4.98	25.51	0.36
		Middle	3 625.02	20.22	4.98	25.20	0.33
		High	3 690.00	21.53	4.98	26.51	0.45
	64QAM	Low	3 560.01	20.38	4.98	25.36	0.34
		Middle	3 625.02	20.05	4.98	25.03	0.32
		High	3 690.00	21.72	4.98	26.70	0.47
	256QAM	Low	3 560.01	20.32	4.98	25.30	0.34
		Middle	3 625.02	20.07	4.98	25.05	0.32
		High	3 690.00	21.66	4.98	26.64	0.46
1	QPSK	Low	3 560.01	19.86	4.98	24.84	0.30
		Middle	3 625.02	19.77	4.98	24.75	0.30
		High	3 690.00	21.48	4.98	26.46	0.44
	16QAM	Low	3 560.01	19.92	4.98	24.90	0.31
		Middle	3 625.02	19.76	4.98	24.74	0.30
		High	3 690.00	21.35	4.98	26.33	0.43
	64QAM	Low	3 560.01	19.85	4.98	24.83	0.30
		Middle	3 625.02	19.83	4.98	24.81	0.30
		High	3 690.00	21.44	4.98	26.42	0.44
	256QAM	Low	3 560.01	19.67	4.98	24.65	0.29
		Middle	3 625.02	19.72	4.98	24.70	0.29
		High	3 690.00	21.35	4.98	26.33	0.43

Sum Data of Port 0, Port 1

Frequency (MHz)	E.I.R.P.			
	QPSK	16QAM	64QAM	256QAM
	W			
3 560.01	0.66	0.66	0.65	0.63
3 625.02	0.62	0.63	0.62	0.61
3 690.00	0.89	0.88	0.91	0.89

(2 Port) 5G NR n48 30 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Calculated (W)
0	QPSK	Low	3 565.02	20.13	4.98	25.11	0.32
		Middle	3 625.02	20.02	4.98	25.00	0.32
		High	3 684.99	20.79	4.98	25.77	0.38
	16QAM	Low	3 565.02	20.14	4.98	25.12	0.32
		Middle	3 625.02	20.14	4.98	25.12	0.32
		High	3 684.99	20.65	4.98	25.63	0.37
	64QAM	Low	3 565.02	20.03	4.98	25.01	0.32
		Middle	3 625.02	20.21	4.98	25.19	0.33
		High	3 684.99	20.82	4.98	25.80	0.38
	256QAM	Low	3 565.02	20.03	4.98	25.01	0.32
		Middle	3 625.02	20.11	4.98	25.09	0.32
		High	3 684.99	20.92	4.98	25.90	0.39
1	QPSK	Low	3 565.02	19.71	4.98	24.69	0.29
		Middle	3 625.02	19.56	4.98	24.54	0.28
		High	3 684.99	21.34	4.98	26.32	0.43
	16QAM	Low	3 565.02	20.25	4.98	25.23	0.33
		Middle	3 625.02	19.49	4.98	24.47	0.28
		High	3 684.99	21.21	4.98	26.19	0.42
	64QAM	Low	3 565.02	19.89	4.98	24.87	0.31
		Middle	3 625.02	19.49	4.98	24.47	0.28
		High	3 684.99	21.44	4.98	26.42	0.44
	256QAM	Low	3 565.02	19.96	4.98	24.94	0.31
		Middle	3 625.02	19.49	4.98	24.47	0.28
		High	3 684.99	21.30	4.98	26.28	0.42

Sum Data of Port 0, Port 1

Frequency (MHz)	E.I.R.P.			
	QPSK	16QAM	64QAM	256QAM
	W			
3 565.02	0.62	0.66	0.62	0.63
3 625.02	0.60	0.60	0.61	0.60
3 684.99	0.81	0.78	0.82	0.81

(2 Port) 5G NR n48 40 MHz [1 Carrier]

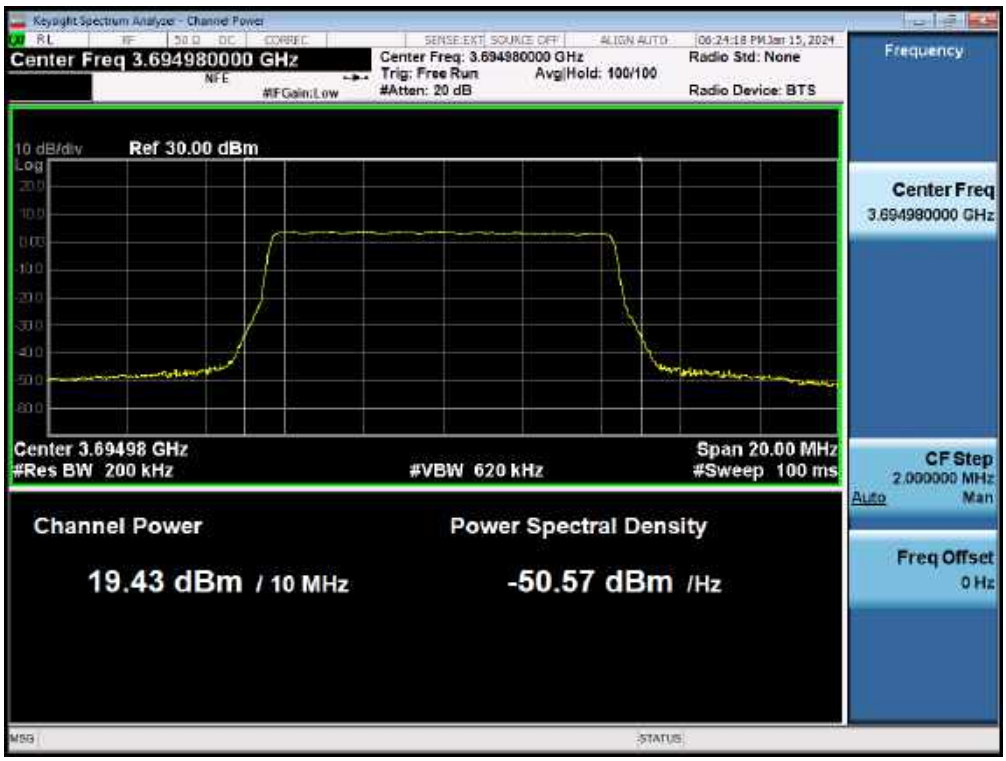
Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm)	Ant. Gain (dBi)	E.I.R.P. (dBm)	Calculated (W)
0	QPSK	Low	3 570.00	20.51	4.98	25.49	0.35
		Middle	3 625.02	20.02	4.98	25.00	0.32
		High	3 679.98	21.18	4.98	26.16	0.41
	16QAM	Low	3 570.00	20.39	4.98	25.37	0.34
		Middle	3 625.02	20.04	4.98	25.02	0.32
		High	3 679.98	21.11	4.98	26.09	0.41
	64QAM	Low	3 570.00	20.48	4.98	25.46	0.35
		Middle	3 625.02	20.04	4.98	25.02	0.32
		High	3 679.98	21.11	4.98	26.09	0.41
	256QAM	Low	3 570.00	20.45	4.98	25.43	0.35
		Middle	3 625.02	20.03	4.98	25.01	0.32
		High	3 679.98	21.07	4.98	26.05	0.40
1	QPSK	Low	3 570.00	20.11	4.98	25.09	0.32
		Middle	3 625.02	19.67	4.98	24.65	0.29
		High	3 679.98	21.35	4.98	26.33	0.43
	16QAM	Low	3 570.00	20.03	4.98	25.01	0.32
		Middle	3 625.02	19.65	4.98	24.63	0.29
		High	3 679.98	21.36	4.98	26.34	0.43
	64QAM	Low	3 570.00	20.06	4.98	25.04	0.32
		Middle	3 625.02	19.65	4.98	24.63	0.29
		High	3 679.98	21.22	4.98	26.20	0.42
	256QAM	Low	3 570.00	20.09	4.98	25.07	0.32
		Middle	3 625.02	19.70	4.98	24.68	0.29
		High	3 679.98	21.41	4.98	26.39	0.44

Sum Data of Port 0, Port 1

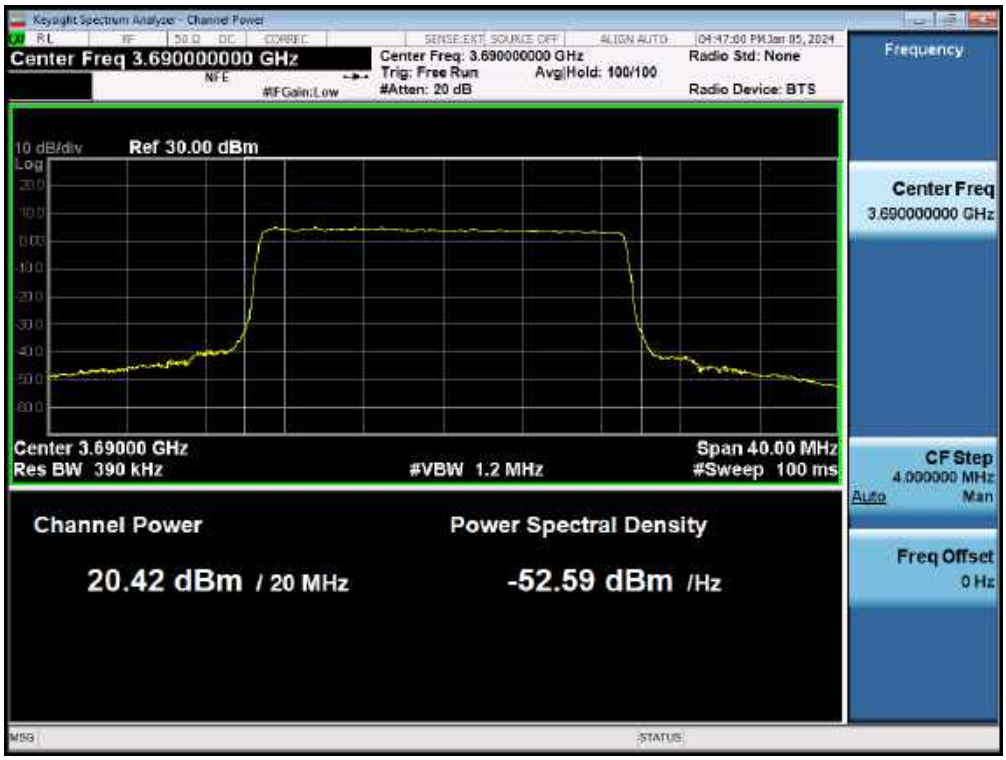
Frequency (MHz)	E.I.R.P.			
	QPSK	16QAM	64QAM	256QAM
	W			
3 570.00	0.68	0.66	0.67	0.67
3 625.02	0.61	0.61	0.61	0.61
3 679.98	0.84	0.84	0.82	0.84

Plot Data of RF Output Power

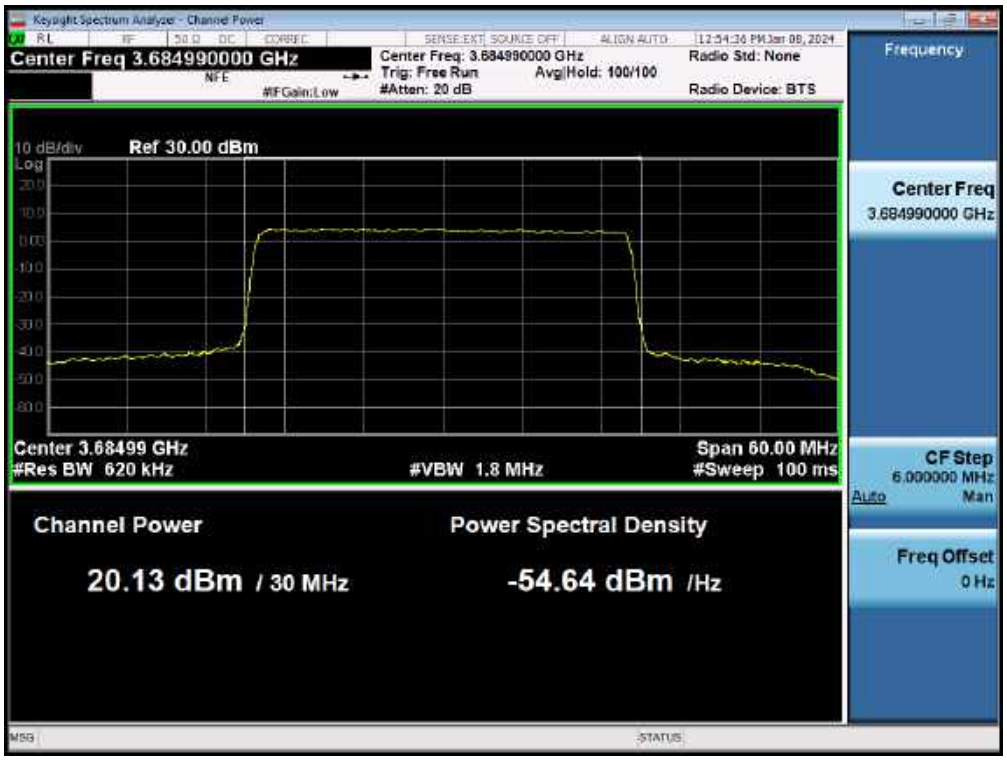
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / QPSK / High



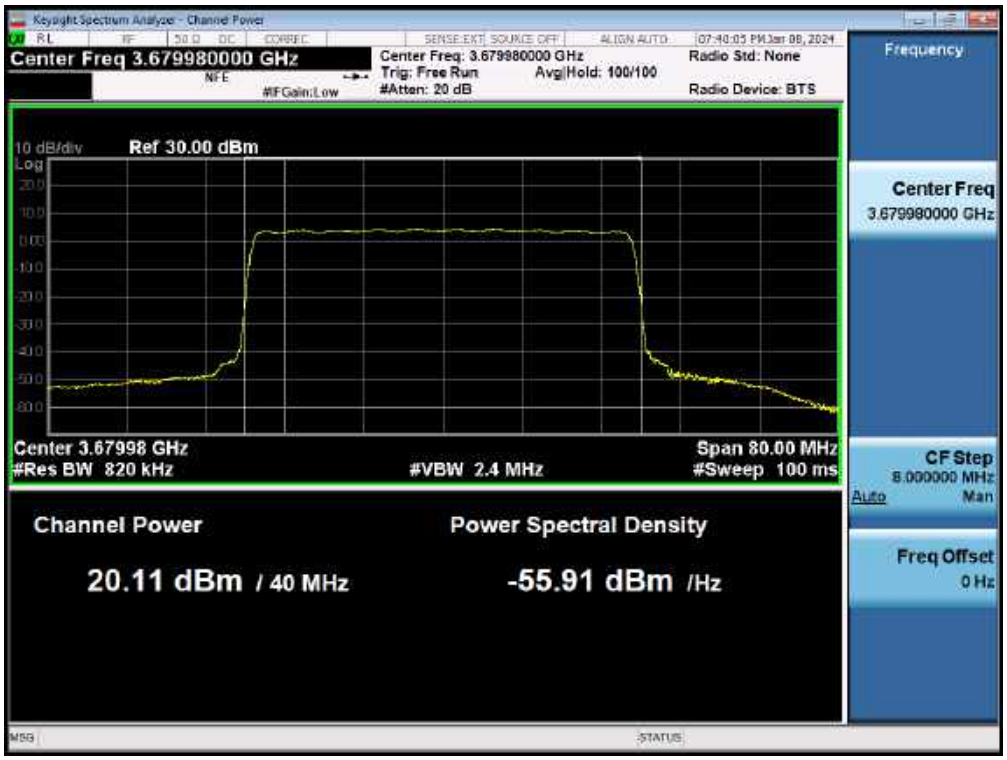
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 64QAM / High



Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 64QAM / High



Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 256QAM / High



Tabular Data of PSD

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm/MHz)	Ant. Gain (dBi)	PSD (dBm/MHz)	Limit (dBm/MHz)	E.I.R.P. (dBm/10 MHz)	Limit (dBm/10 MHz)
0	QPSK	Low	3 555.00	10.55	4.98	15.53	20	25.53	30
		Middle	3 625.02	10.93	4.98	15.91		25.91	
		High	3 695.00	11.89	4.98	16.87		26.87	
	16QAM	Low	3 555.00	10.59	4.98	15.57		25.57	
		Middle	3 625.02	10.56	4.98	15.54		25.54	
		High	3 694.98	11.98	4.98	16.96		26.96	
	64QAM	Low	3 555.00	10.79	4.98	15.77		25.77	
		Middle	3 625.02	10.88	4.98	15.86		25.86	
		High	3 694.98	11.90	4.98	16.88		26.88	
	256QAM	Low	3 555.00	10.82	4.98	15.80		25.80	
		Middle	3 625.02	10.73	4.98	15.71		25.71	
		High	3 694.98	11.84	4.98	16.82		26.82	
1	QPSK	Low	3 555.00	9.95	4.98	14.93		24.93	
		Middle	3 625.02	10.68	4.98	15.66		25.66	
		High	3 694.98	12.00	4.98	16.98		26.98	
	16QAM	Low	3 555.00	10.16	4.98	15.14		25.14	
		Middle	3 625.02	10.41	4.98	15.39		25.39	
		High	3 694.98	11.99	4.98	16.97		26.97	
	64QAM	Low	3 555.00	10.13	4.98	15.11		25.11	
		Middle	3 625.02	10.48	4.98	15.46		25.46	
		High	3 694.98	12.00	4.98	16.98		26.98	
	256QAM	Low	3 555.00	10.09	4.98	15.07		25.07	
		Middle	3 625.02	10.42	4.98	15.40		25.40	
		High	3 694.98	12.00	4.98	16.98		26.98	

Sum Data of Port 0, Port 1

Frequency (MHz)	PSD				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/MHz)				
3 555.00	18.25	18.37	18.46	18.46	20
3 625.02	18.79	18.47	18.68	18.57	
3 695.00	19.93	19.97	19.94	19.91	

Frequency (MHz)	E.I.R.P.				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/10 MHz)				
3 555.00	28.25	28.37	28.46	28.46	30
3 625.02	28.79	28.47	28.68	28.57	
3 695.00	29.93	29.97	29.94	29.91	

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm/MHz)	Ant. Gain (dBi)	PSD (dBm/MHz)	Limit (dBm/MHz)	E.I.R.P. (dBm/10 MHz)	Limit (dBm/10 MHz)
0	QPSK	Low	3 560.01	8.58	4.98	13.56	20	23.56	30
		Middle	3 625.02	8.23	4.98	13.21		23.21	
		High	3 690.00	9.98	4.98	14.96		24.96	
	16QAM	Low	3 560.01	8.62	4.98	13.60		23.60	
		Middle	3 625.02	8.29	4.98	13.27		23.27	
		High	3 690.00	9.92	4.98	14.90		24.90	
	64QAM	Low	3 560.01	8.76	4.98	13.74		23.74	
		Middle	3 625.02	8.25	4.98	13.23		23.23	
		High	3 690.00	10.05	4.98	15.03		25.03	
	256QAM	Low	3 560.01	8.65	4.98	13.63		23.63	
		Middle	3 625.02	8.19	4.98	13.17		23.17	
		High	3 690.00	10.16	4.98	15.14		25.14	
1	QPSK	Low	3 560.01	8.19	4.98	13.17		23.17	
		Middle	3 625.02	7.98	4.98	12.96		22.96	
		High	3 690.00	9.86	4.98	14.84		24.84	
	16QAM	Low	3 560.01	8.11	4.98	13.09		23.09	
		Middle	3 625.02	8.31	4.98	13.29		23.29	
		High	3 690.00	9.83	4.98	14.81		24.81	
	64QAM	Low	3 560.01	8.24	4.98	13.22		23.22	
		Middle	3 625.02	8.24	4.98	13.22		23.22	
		High	3 690.00	9.72	4.98	14.70		24.70	
	256QAM	Low	3 560.01	7.80	4.98	12.78		22.78	
		Middle	3 625.02	7.89	4.98	12.87		22.87	
		High	3 690.00	9.64	4.98	14.62		24.62	

Sum Data of Port 0, Port 1

Frequency (MHz)	PSD				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/MHz)				
3 560.01	16.38	16.36	16.49	16.24	20
3 625.02	16.10	16.29	16.23	16.03	
3 690.00	17.91	17.87	17.88	17.90	

Frequency (MHz)	E.I.R.P.				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/10 MHz)				
3 560.01	26.38	26.36	26.49	26.24	30
3 625.02	26.10	26.29	26.23	26.03	
3 690.00	27.91	27.87	27.88	27.90	

(2 Port) 5G NR n48 30 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm/MHz)	Ant. Gain (dBi)	PSD (dBm/MHz)	Limit (dBm/MHz)	E.I.R.P. (dBm/10 MHz)	Limit (dBm/10 MHz)
0	QPSK	Low	3 565.02	6.66	4.98	11.64	20	21.64	30
		Middle	3 625.02	6.31	4.98	11.29		21.29	
		High	3 684.99	7.32	4.98	12.30		22.30	
	16QAM	Low	3 565.02	6.70	4.98	11.68		21.68	
		Middle	3 625.02	6.40	4.98	11.38		21.38	
		High	3 684.99	7.19	4.98	12.17		22.17	
	64QAM	Low	3 565.02	6.72	4.98	11.70		21.70	
		Middle	3 625.02	6.64	4.98	11.62		21.62	
		High	3 684.99	7.55	4.98	12.53		22.53	
	256QAM	Low	3 565.02	6.59	4.98	11.57		21.57	
		Middle	3 625.02	6.53	4.98	11.51		21.51	
		High	3 684.99	7.75	4.98	12.73		22.73	
1	QPSK	Low	3 565.02	6.06	4.98	11.04		21.04	
		Middle	3 625.02	6.42	4.98	11.40		21.40	
		High	3 684.99	7.99	4.98	12.97		22.97	
	16QAM	Low	3 565.02	6.77	4.98	11.75		21.75	
		Middle	3 625.02	6.38	4.98	11.36		21.36	
		High	3 684.99	7.57	4.98	12.55		22.55	
	64QAM	Low	3 565.02	6.40	4.98	11.38		21.38	
		Middle	3 625.02	6.13	4.98	11.11		21.11	
		High	3 684.99	7.97	4.98	12.95		22.95	
	256QAM	Low	3 565.02	6.48	4.98	11.46		21.46	
		Middle	3 625.02	6.30	4.98	11.28		21.28	
		High	3 684.99	7.76	4.98	12.74		22.74	

Sum Data of Port 0, Port 1

Frequency (MHz)	PSD				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/MHz)				
3 565.02	14.36	14.72	14.55	14.53	20
3 625.02	14.35	14.38	14.38	14.41	
3 684.99	15.66	15.37	15.76	15.75	

Frequency (MHz)	E.I.R.P.				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/10 MHz)				
3 565.02	24.36	24.72	24.55	24.53	30
3 625.02	24.35	24.38	24.38	24.41	
3 684.99	25.66	25.37	25.76	25.75	

(2 Port) 5G NR n48 40 MHz [1 Carrier]

Ant.	Mod	Ch	Frequency (MHz)	Measured Value (dBm/MHz)	Ant. Gain (dBi)	PSD (dBm/MHz)	Limit (dBm/MHz)	E.I.R.P. (dBm/10 MHz)	Limit (dBm/10 MHz)
0	QPSK	Low	3 570.00	5.78	4.98	10.76	20	20.76	30
		Middle	3 625.02	4.77	4.98	9.75		19.75	
		High	3 679.98	6.28	4.98	11.26		21.26	
	16QAM	Low	3 570.00	5.61	4.98	10.59		20.59	
		Middle	3 625.02	5.47	4.98	10.45		20.45	
		High	3 679.98	6.37	4.98	11.35		21.35	
	64QAM	Low	3 570.00	5.64	4.98	10.62		20.62	
		Middle	3 625.02	5.47	4.98	10.45		20.45	
		High	3 679.98	6.20	4.98	11.18		21.18	
	256QAM	Low	3 570.00	5.74	4.98	10.72		20.72	
		Middle	3 625.02	4.90	4.98	9.88		19.88	
		High	3 679.98	6.23	4.98	11.21		21.21	
1	QPSK	Low	3 570.00	5.31	4.98	10.29		20.29	
		Middle	3 625.02	5.16	4.98	10.14		20.14	
		High	3 679.98	6.70	4.98	11.68		21.68	
	16QAM	Low	3 570.00	5.33	4.98	10.31		20.31	
		Middle	3 625.02	5.35	4.98	10.33		20.33	
		High	3 679.98	6.79	4.98	11.77		21.77	
	64QAM	Low	3 570.00	5.00	4.98	9.98		19.98	
		Middle	3 625.02	5.26	4.98	10.24		20.24	
		High	3 679.98	6.61	4.98	11.59		21.59	
	256QAM	Low	3 570.00	5.31	4.98	10.29		20.29	
		Middle	3 625.02	5.16	4.98	10.14		20.14	
		High	3 679.98	6.58	4.98	11.56		21.56	

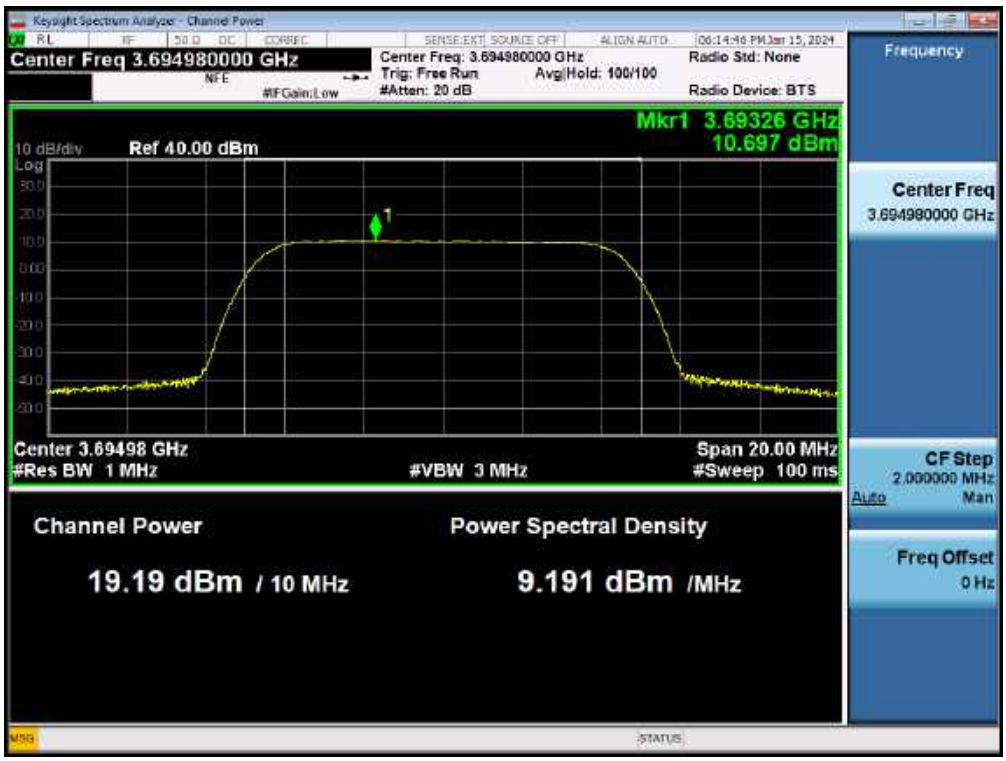
Sum Data of Port 0, Port 1

Frequency (MHz)	PSD				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/MHz)				
3 570.00	13.54	13.46	13.32	13.52	20
3 625.02	12.96	13.40	13.36	13.02	
3 679.98	14.48	14.58	14.40	14.40	

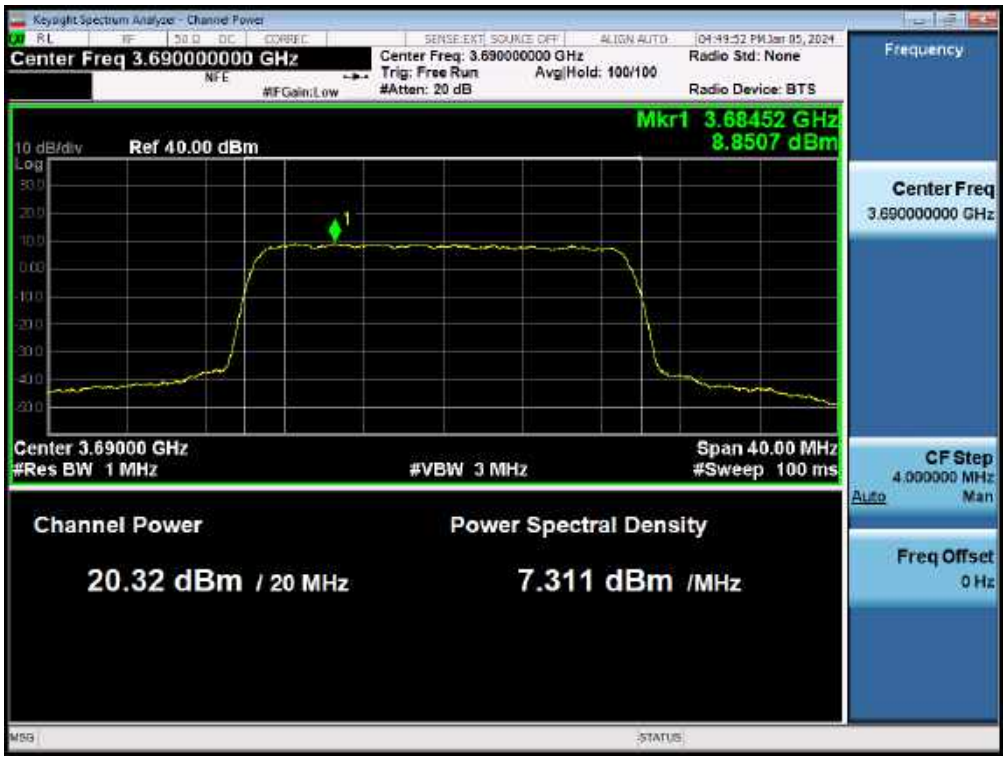
Frequency (MHz)	E.I.R.P.				Limit
	QPSK	16QAM	64QAM	256QAM	
	(dBm/10 MHz)				
3 570.00	23.54	23.46	23.32	23.52	30
3 625.02	22.96	23.40	23.36	23.02	
3 679.98	24.48	24.58	24.40	24.40	

Plot Data of PSD

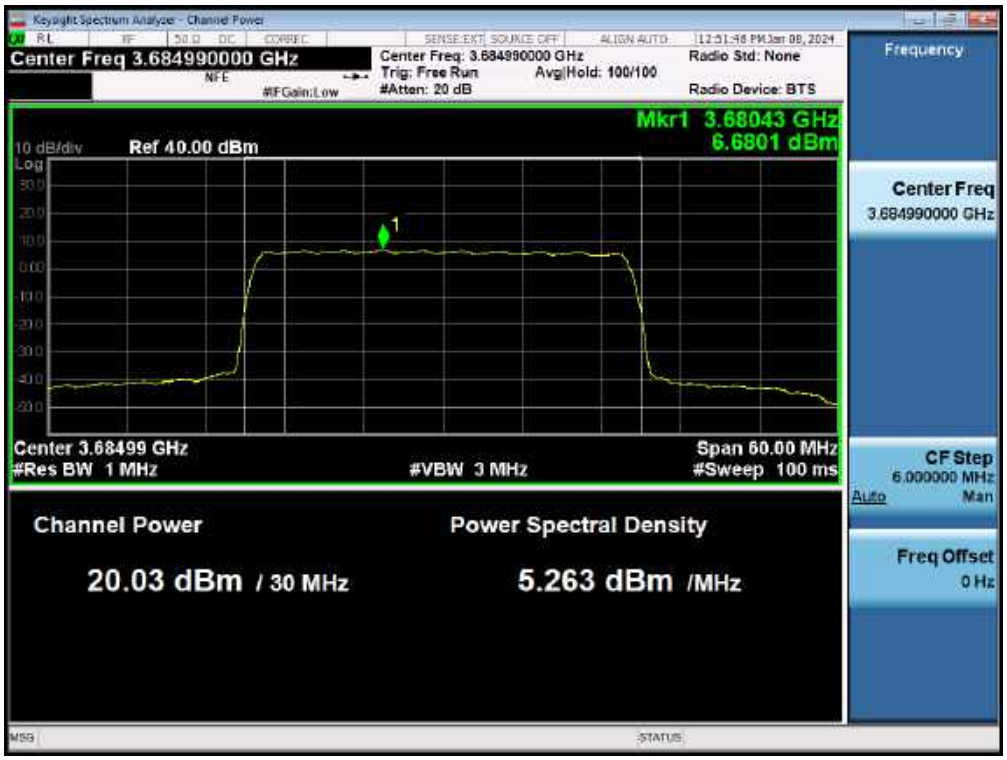
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 256QAM / High



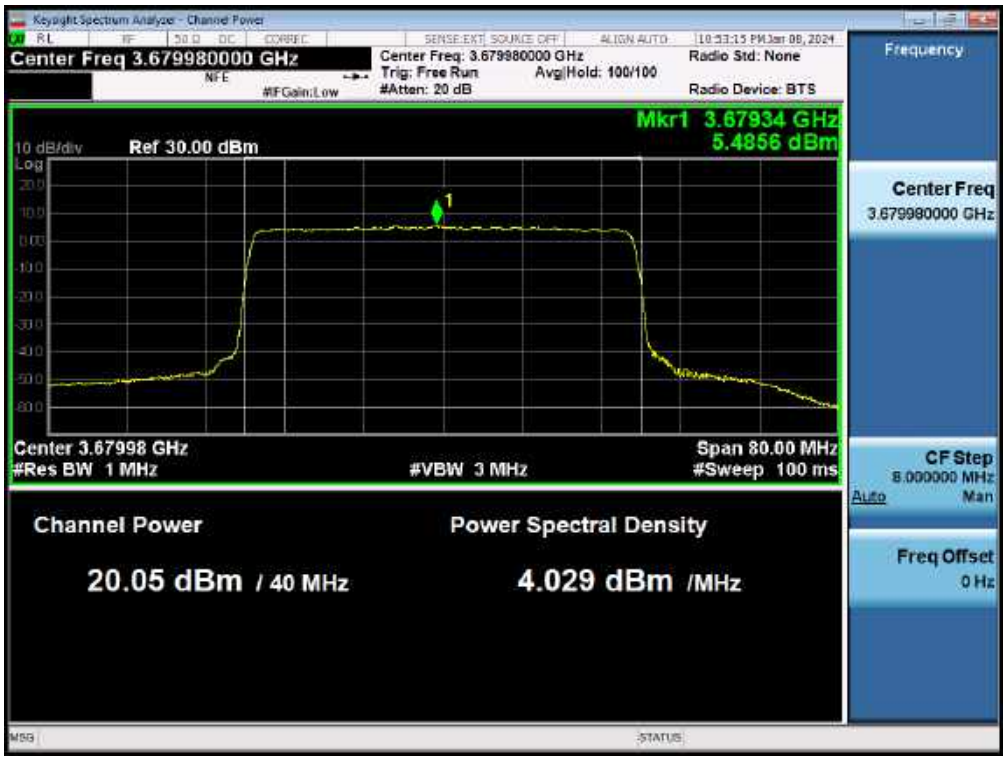
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 256QAM / High



Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / QPSK / High



Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 16QAM / High



5.2. PAPR

Test Requirements:

§ 96.41(g) General radio requirements: Power measurement.

The peak-to-average power ratio (PAPR) of any CBSD transmitter output power must not exceed 13 dB. PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

Test Procedures:

The measurement is performed in accordance with Section 5.2.3.4 of ANSI C63.26.

The following guidelines are offered for performing a CCDF measurement..

a) Set resolution/measurement bandwidth ≥ OBW or specified reference bandwidth.

b) Set the number of counts to a value that stabilizes the measured CCDF curve.

c) Set the measurement interval as follows:

   1) For continuous transmissions, set to the greater of [10 × (number of points in sweep) × (transmission symbol period)] or 1 ms.

   2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.

   3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.

d) Record the maximum PAPR level associated with a probability of 0.1%.

e) The peak power level is calculated form the sum of the PAPR value from step d) to the measured average power.

Note:

1. The results of PAPR test shown below the frequency measured values are very small and similar trend for each port, so we are attached only the worst case plot.
2. All power supply of operation were investigated and the worst case configuration results are reported.

Tabular data of PAPR

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Ant.	Modulation	Channel	Frequency (MHz)	0.1 % PAPR (dB)
0	QPSK	Low	3 555.00	9.86
		Middle	3 625.02	9.87
		High	3 694.98	9.89
	16QAM	Low	3 555.00	9.34
		Middle	3 625.02	9.26
		High	3 694.98	9.55
	64QAM	Low	3 555.00	9.47
		Middle	3 625.02	9.79
		High	3 694.98	9.81
	256QAM	Low	3 555.00	9.51
		Middle	3 625.02	9.49
		High	3 694.98	9.47
1	QPSK	Low	3 555.00	9.87
		Middle	3 625.02	9.69
		High	3 694.98	9.87
	16QAM	Low	3 555.00	9.23
		Middle	3 625.02	9.23
		High	3 694.98	9.52
	64QAM	Low	3 555.00	9.50
		Middle	3 625.02	9.68
		High	3 694.98	9.57
	256QAM	Low	3 555.00	9.68
		Middle	3 625.02	9.59
		High	3 694.98	9.64

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Ant.	Modulation	Channel	Frequency (MHz)	0.1 % PAPR (dB)
0	QPSK	Low	3 560.01	9.66
		Middle	3 625.02	9.74
		High	3 690.00	9.85
	16QAM	Low	3 560.01	9.56
		Middle	3 625.02	9.57
		High	3 690.00	9.54
	64QAM	Low	3 560.01	9.40
		Middle	3 625.02	9.63
		High	3 690.00	9.64
	256QAM	Low	3 560.01	9.58
		Middle	3 625.02	9.53
		High	3 690.00	9.67
1	QPSK	Low	3 560.01	9.75
		Middle	3 625.02	9.76
		High	3 690.00	9.84
	16QAM	Low	3 560.01	9.53
		Middle	3 625.02	9.67
		High	3 690.00	9.54
	64QAM	Low	3 560.01	9.56
		Middle	3 625.02	9.47
		High	3 690.00	9.53
	256QAM	Low	3 560.01	9.48
		Middle	3 625.02	9.51
		High	3 690.00	9.49

(2 Port) 5G NR n48 30 MHz [1 Carrier]

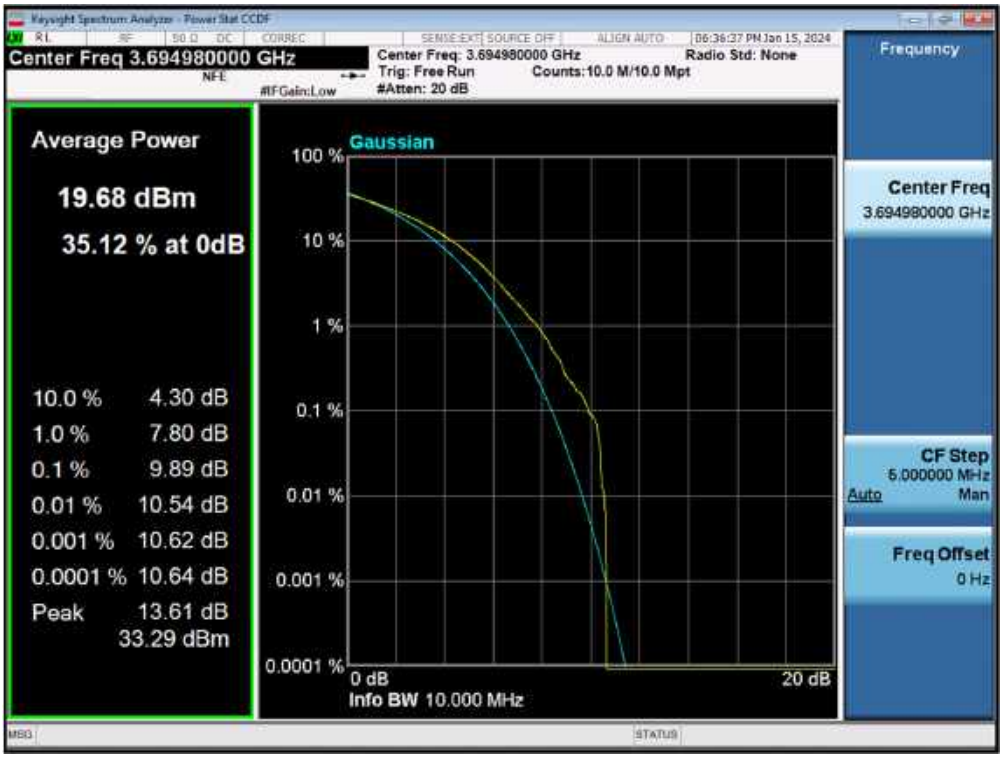
Ant.	Modulation	Channel	Frequency (MHz)	0.1 % PAPR (dB)
0	QPSK	Low	3 565.02	9.75
		Middle	3 625.02	9.89
		High	3 684.99	9.90
	16QAM	Low	3 565.02	9.45
		Middle	3 625.02	9.51
		High	3 684.99	9.53
	64QAM	Low	3 565.02	9.43
		Middle	3 625.02	9.48
		High	3 684.99	9.61
	256QAM	Low	3 565.02	9.48
		Middle	3 625.02	9.63
		High	3 684.99	9.51
1	QPSK	Low	3 565.02	9.60
		Middle	3 625.02	9.48
		High	3 684.99	9.57
	16QAM	Low	3 565.02	9.33
		Middle	3 625.02	9.41
		High	3 684.99	9.37
	64QAM	Low	3 565.02	9.41
		Middle	3 625.02	9.32
		High	3 684.99	9.34
	256QAM	Low	3 565.02	9.43
		Middle	3 625.02	9.39
		High	3 684.99	9.41

(2 Port) 5G NR n48 40 MHz [1 Carrier]

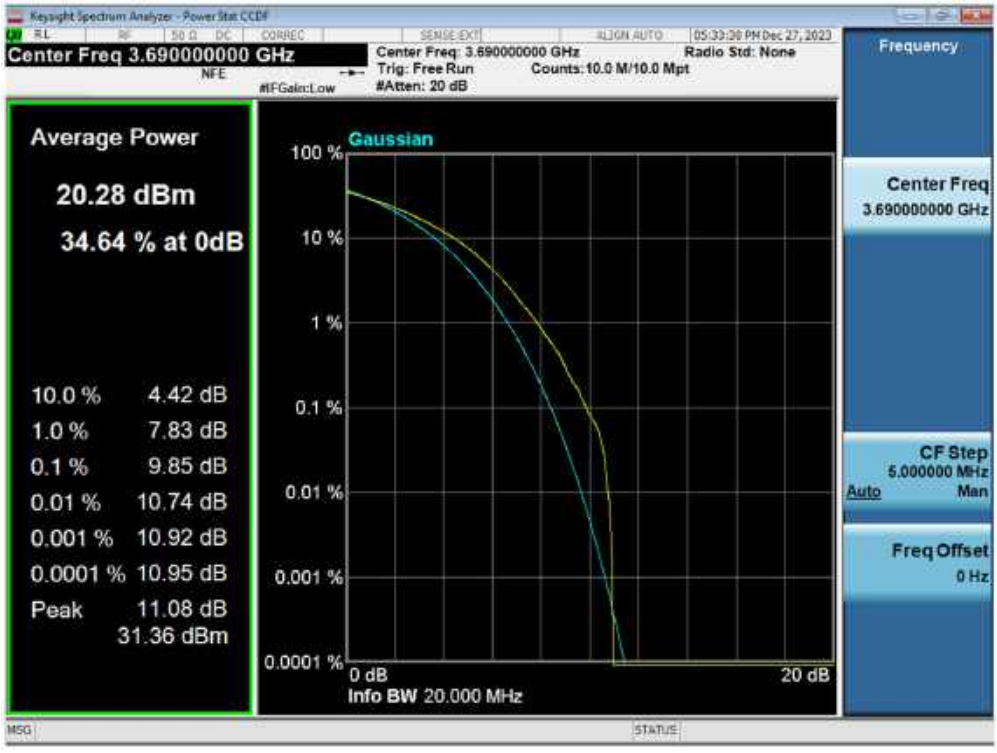
Ant.	Modulation	Channel	Frequency (MHz)	0.1 % PAPR (dB)
0	QPSK	Low	3 570.00	9.63
		Middle	3 625.02	9.54
		High	3 679.98	9.59
	16QAM	Low	3 570.00	9.47
		Middle	3 625.02	9.40
		High	3 679.98	9.30
	64QAM	Low	3 570.00	9.45
		Middle	3 625.02	9.33
		High	3 679.98	9.58
	256QAM	Low	3 570.00	9.62
		Middle	3 625.02	9.41
		High	3 679.98	9.46
1	QPSK	Low	3 570.00	9.44
		Middle	3 625.02	9.74
		High	3 679.98	9.66
	16QAM	Low	3 570.00	9.52
		Middle	3 625.02	9.46
		High	3 679.98	9.57
	64QAM	Low	3 570.00	9.42
		Middle	3 625.02	9.40
		High	3 679.98	9.61
	256QAM	Low	3 570.00	9.32
		Middle	3 625.02	9.26
		High	3 679.98	9.38

Plot Data of PAPR

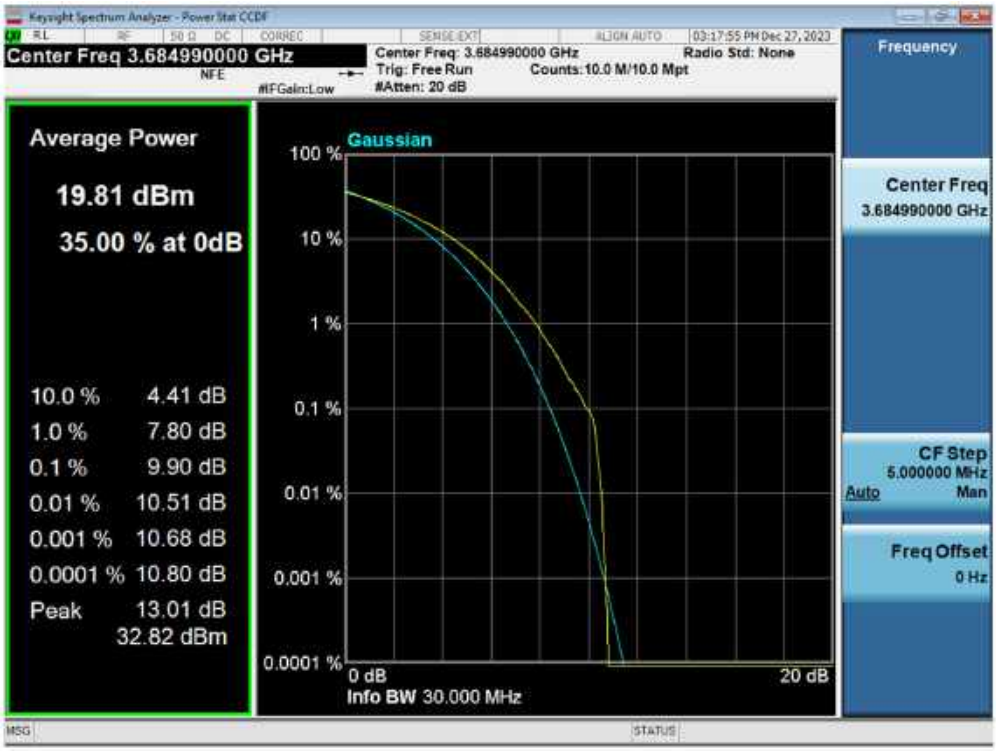
Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / QPSK / High



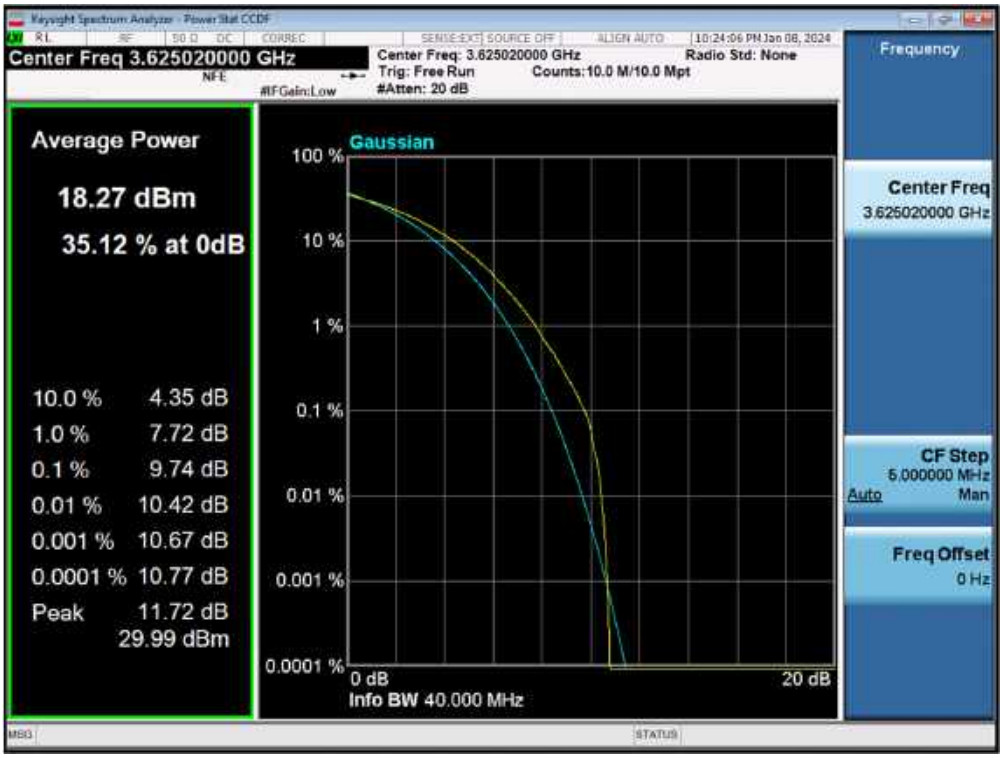
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / QPSK / High



Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / QPSK / High



Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / QPSK / Middle



5.3. OCCUPIED BANDWIDTH

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

The measurement is performed in accordance with Section 5.4.3 and 5.4.4 of ANSI C63.26.

5.4.3 Occupied bandwidth—Relative measurement procedure

The OBW is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). The typical ratio for transmitters is −26 dB, corresponding to the 26 dB BW; however, other ratios can be specified. In this subclause, the ratio is designated by "−X dB."

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

f) Determine the reference value by either of the following:
   1) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the Highest level of the displayed trace (this is the reference value).
   2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.

g) Determine the "−X dB amplitude" as equal to (Reference Value − X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.

h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used for step i).

i) Place two markers, one at the lowest and the other at the Highest frequency of the envelope of the spectral display such that each marker is at or slightly below the "−X dB amplitude" determined in step f). If a marker is below this "−X dB amplitude" value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers. The spectral envelope can cross the "−X dB amplitude" at multiple points. The lowest or Highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope

crosses the "−X dB amplitude."

j) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

5.4.4 Occupied bandwidth—Power bandwidth (99%) measurement procedure

The OBW is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring (99%) power bandwidth:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Note:

1. The results of the Occupied Bandwidth test shown below the frequency measured values are very small and similar trend for each port, so we are attached only the worst case plot.
2. All power supply of operation were investigated and the worst case configuration results are reported.

Test Results:
Tabular Data of Occupied Bandwidth

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Ant	Mod	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
0	QPSK	Low	3 555.00	8.5872
		Middle	3 625.02	8.6267
		High	3 694.98	8.6075
	16QAM	Low	3 555.00	8.6618
		Middle	3 625.02	8.6252
		High	3 694.98	8.6615
	64QAM	Low	3 555.00	8.6285
		Middle	3 625.02	8.5885
		High	3 694.98	8.5947
	256QAM	Low	3 555.00	8.5690
		Middle	3 625.02	8.5682
		High	3 694.98	8.5784
1	QPSK	Low	3 555.00	8.5944
		Middle	3 625.02	8.5991
		High	3 694.98	8.5957
	16QAM	Low	3 555.00	8.6360
		Middle	3 625.02	8.6183
		High	3 694.98	8.6714
	64QAM	Low	3 555.00	8.6096
		Middle	3 625.02	8.6248
		High	3 694.98	8.6096
	256QAM	Low	3 555.00	8.5873
		Middle	3 625.02	8.5862
		High	3 694.98	8.5752

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Ant	Mod	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
0	QPSK	Low	3 560.01	18.229
		Middle	3 625.02	18.204
		High	3 690.00	18.196
	16QAM	Low	3 560.01	18.305
		Middle	3 625.02	18.288
		High	3 690.00	18.305
	64QAM	Low	3 560.01	18.269
		Middle	3 625.02	18.266
		High	3 690.00	18.324
	256QAM	Low	3 625.02	18.214
		Middle	3 625.02	18.228
		High	3 690.00	18.236
1	QPSK	Low	3 560.01	18.217
		Middle	3 625.02	18.236
		High	3 690.00	18.238
	16QAM	Low	3 560.01	18.294
		Middle	3 625.02	18.243
		High	3 690.00	18.285
	64QAM	Low	3 560.01	18.244
		Middle	3 625.02	18.290
		High	3 690.00	18.259
	256QAM	Low	3 560.01	18.234
		Middle	3 625.02	18.224
		High	3 690.00	18.222

(2 Port) 5G NR n48 30 MHz [1 Carrier]

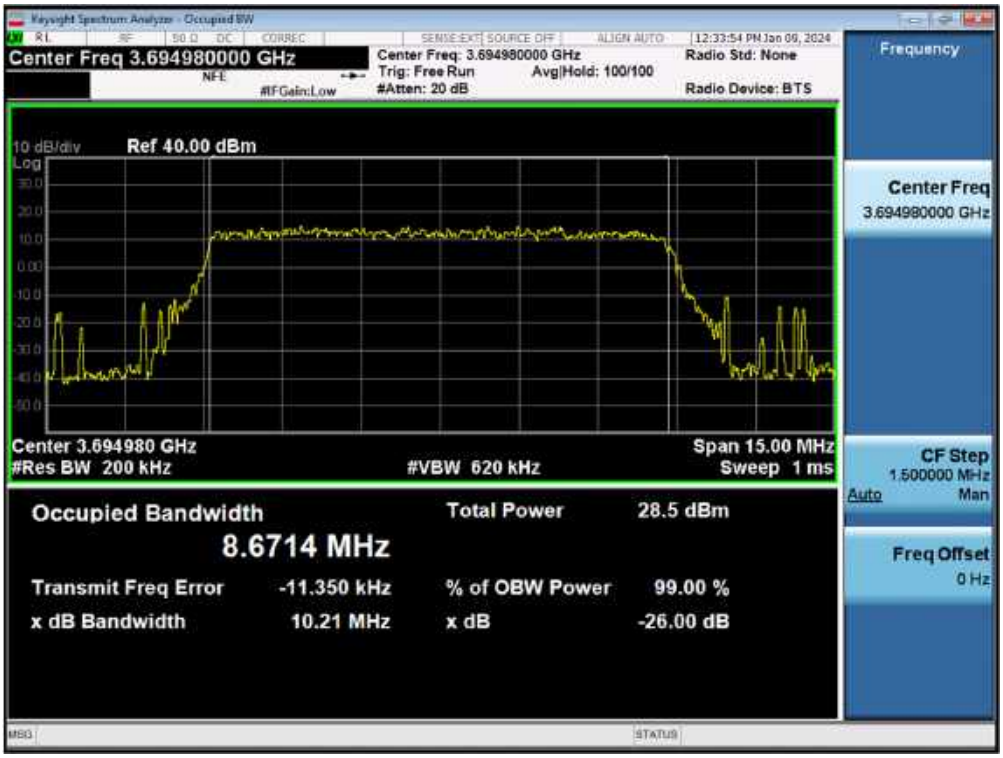
Ant	Mod	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
0	QPSK	Low	3 565.02	27.930
		Middle	3 625.02	27.925
		High	3 684.99	27.890
	16QAM	Low	3 565.02	27.913
		Middle	3 625.02	27.972
		High	3 684.99	27.943
	64QAM	Low	3 565.02	27.947
		Middle	3 625.02	27.926
		High	3 684.99	27.918
	256QAM	Low	3 565.02	27.892
		Middle	3 625.02	27.872
		High	3 684.99	27.919
1	QPSK	Low	3 565.02	27.947
		Middle	3 625.02	27.907
		High	3 684.99	27.912
	16QAM	Low	3 565.02	27.958
		Middle	3 625.02	27.979
		High	3 684.99	27.906
	64QAM	Low	3 565.02	27.971
		Middle	3 625.02	27.912
		High	3 684.99	27.938
	256QAM	Low	3 565.02	27.913
		Middle	3 625.02	27.902
		High	3 684.99	27.869

(2 Port) 5G NR n48 40 MHz [1 Carrier]

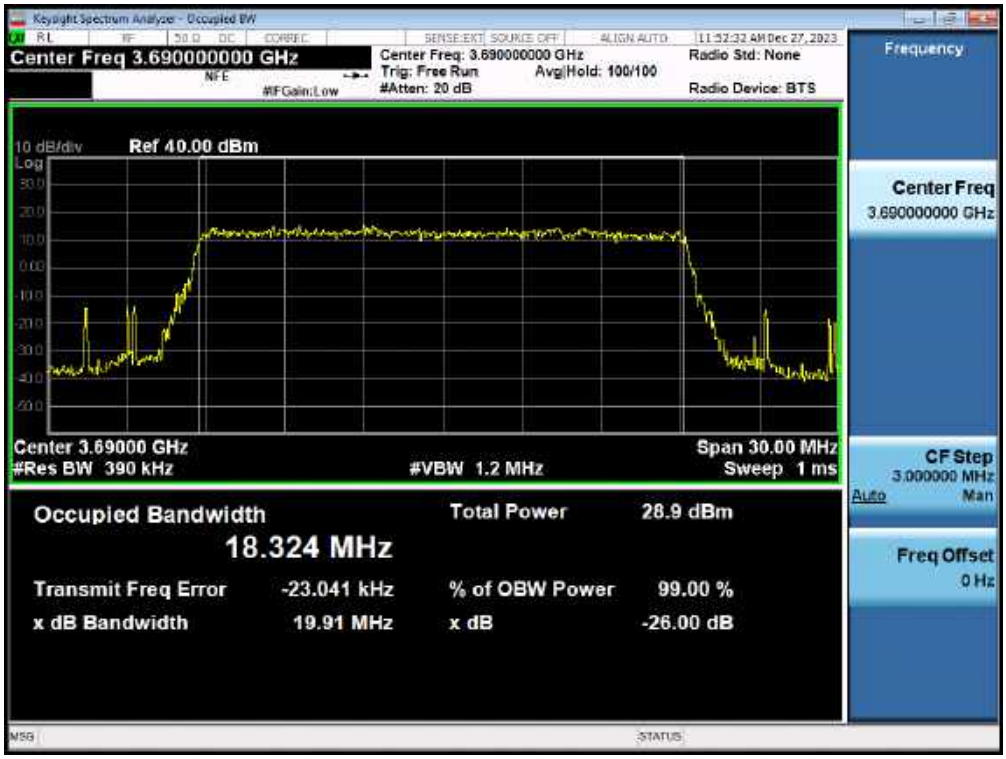
Ant	Mod	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
0	QPSK	Low	3 570.00	37.934
		Middle	3 625.02	37.874
		High	3 679.98	37.825
	16QAM	Low	3 570.00	37.919
		Middle	3 625.02	37.950
		High	3 679.98	37.829
	64QAM	Low	3 570.00	37.899
		Middle	3 625.02	38.007
		High	3 679.98	37.858
	256QAM	Low	3 570.00	37.904
		Middle	3 625.02	37.965
		High	3 679.98	37.894
1	QPSK	Low	3 570.00	37.943
		Middle	3 625.02	37.877
		High	3 679.98	37.807
	16QAM	Low	3 570.00	37.955
		Middle	3 625.02	37.868
		High	3 679.98	37.781
	64QAM	Low	3 570.00	37.956
		Middle	3 625.02	37.950
		High	3 679.98	37.839
	256QAM	Low	3 570.00	37.980
		Middle	3 625.02	37.877
		High	3 679.98	37.823

Plot Data of Occupied bandwidth

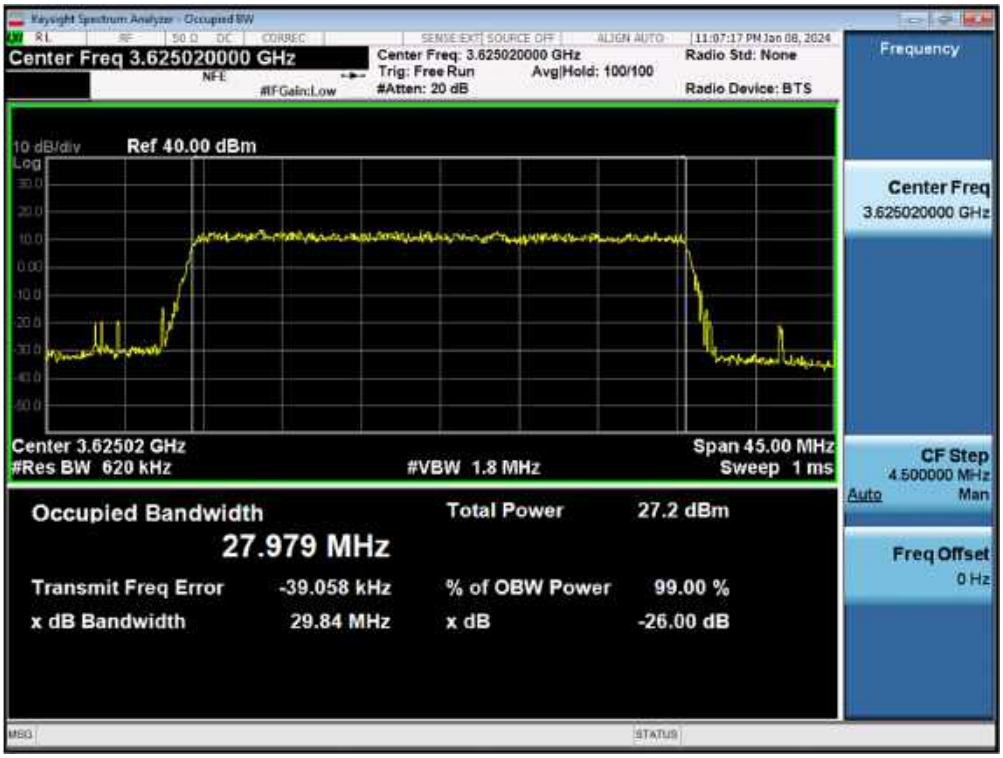
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 16QAM / High



Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 64QAM / High



Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 16QAM / Middle



Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 64QAM / Middle

5.4. OUT-OF-BAND UNWANTED EMISSIONS

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.

96.41(e) General radio requirement: 3.5 GHz Emissions and Interference Limits.

(1) General protection levels.

(i) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any CBSD emission outside the fundamental emission bandwidth as specified in paragraph (e)(3) of this section (whether the emission is inside or outside of the authorized band) shall not exceed −13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any CBSD emission shall not exceed −25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

(ii) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed −25 dBm/MHz. Notwithstanding the emission limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.

(2) Additional protection levels.

Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

(3) Measurement procedure.

(i) Compliance with this provision 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 authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental 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.

(ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits.

(iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

(4) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Test Procedures:

The measurement is performed in accordance with Section 5.7.3 of ANSI C63.26.

5.7.3 Out-of-band unwanted emissions measurements

a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.

b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the fundamental emission and the unwanted out-of-band (band-edge) emissions on either side of the authorized block, band, or channel. This can be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range can be maintained.

c) Set the number of points in sweep ≥ 2 × span / RBW.

d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:

1) If the device can be configured to transmit continuously (duty cycle ≥ 98%), set the (sweep time) > (number of points in sweep) × (symbol period) (e.g., by a factor of 10 × symbol period × number of points). Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols

2) If the device cannot be configured to transmit continuously (duty cycle < 98%) and a freerunning sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

3) If the device cannot be configured to transmit continuously (duty cycle < 98%) and a freerunning sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

4) If the device cannot be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations > ±2%), set the sweep time so that the averaging is performed over the on-period by setting the sweep time > (symbol period) × (number of points), while also maintaining the sweep time < (transmitter on-time). The trace mode shall be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold are necessary to ensure that the maximum power is measured.

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

f) See Annex I for example emission mask plots.

Note:

1. Due to MIMO operations, a correction has been added to the limit according to KDB 662911 D01 v02r01.
   - 2Tx MIMO correction: 10 log(N_{ANT}) = 10 log(4) = 6.02 dB // -13 dBm – 10*log (4) = -19.02 dBm
2. The measured value is calculated by adding duty correction.
   Sample Calculation:
   Calculated Value = measured value + duty correction
   = -32.65 dBm + 1.31 dB* = -31.34 dBm
   * The value 1.31 is an approximate value, and actual values(1.306...) have been used in all calculations.
3. The results of the Out-of-band Unwanted Emissions test shown below the frequency measured values are very small and similar trend for each port, so we are attached only the worst case plot.
4. All power supply of operation were investigated and the worst case configuration results are reported.

Test Results:

Tabular Data of Out-of-band Unwanted Emissions

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
0	QPSK	Low	Left	3549.945	-34.79
			Right	3570.139	-38.60
		Middle	Left	3614.861	-39.01
			Right	3630.076	-38.61
		High	Left	3689.924	-36.95
			Right	3700.000	-36.22
	16QAM	Low	Left	3549.979	-37.96
			Right	3560.050	-31.34
		Middle	Left	3619.968	-38.68
			Right	3630.241	-36.02
		High	Left	3689.968	-35.24
			Right	3700.351	-35.06
	64QAM	Low	Left	3549.968	-35.32
			Right	3560.021	-37.89
		Middle	Left	3619.957	-36.05
			Right	3630.065	-38.47
		High	Left	3689.990	-34.07
			Right	3700.050	-37.15
	256QAM	Low	Left	3549.781	-36.36
			Right	3560.021	-34.40
		Middle	Left	3619.759	-38.97
			Right	3630.021	-36.01
		High	Left	3689.990	-36.68
			Right	3700.087	-39.09

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
1	QPSK	Low	Left	3549.950	-37.67
			Right	3560.050	-37.81
		Middle	Left	3619.950	-33.99
			Right	3630.050	-39.20
		High	Left	3689.950	-34.87
			Right	3700.050	-36.80
	16QAM	Low	Left	3549.950	-37.74
			Right	3560.050	-36.38
		Middle	Left	3619.950	-36.17
			Right	3630.087	-34.07
		High	Left	3689.968	-34.28
			Right	3700.050	-35.13
	64QAM	Low	Left	3549.950	-38.03
			Right	3560.087	-40.28
		Middle	Left	3619.950	-36.11
			Right	3630.021	-35.39
		High	Left	3689.950	-31.44
			Right	3700.050	-37.00
	256QAM	Low	Left	3549.968	-37.52
			Right	3560.050	-36.80
		Middle	Left	3619.935	-33.53
			Right	3630.373	-37.84
		High	Left	3689.968	-33.46
			Right	3700.050	-36.96

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
0	QPSK	Low	Left	3549.924	-34.45
			Right	3570.559	-35.51
		Middle	Left	3614.882	-37.64
			Right	3635.100	-34.59
		High	Left	3679.900	-32.84
			Right	3700.538	-34.42
	16QAM	Low	Left	3549.900	-33.71
			Right	3570.100	-32.58
		Middle	Left	3614.900	-37.55
			Right	3635.100	-35.24
		High	Left	3679.900	-30.41
			Right	3700.100	-36.24
	64QAM	Low	Left	3549.798	-35.45
			Right	3570.139	-37.82
		Middle	Left	3614.900	-34.08
			Right	3635.097	-35.28
		High	Left	3679.693	-30.30
			Right	3700.100	-34.30
	256QAM	Low	Left	3549.924	-34.48
			Right	3570.000	-34.85
		Middle	Left	3614.900	-37.33
			Right	3635.100	-36.11
		High	Left	3679.945	-34.69
			Right	3700.013	-33.36

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
1	QPSK	Low	Left	3549.798	-37.84
			Right	3570.100	-36.15
		Middle	Left	3614.900	-36.66
			Right	3635.100	-34.19
		High	Left	3679.900	-32.93
			Right	3700.076	-34.25
	16QAM	Low	Left	3549.945	-35.79
			Right	3570.034	-36.38
		Middle	Left	3614.900	-37.54
			Right	3635.034	-36.81
		High	Left	3679.819	-34.91
			Right	3700.055	-34.62
	64QAM	Low	Left	3549.966	-35.91
			Right	3570.139	-37.67
		Middle	Left	3614.945	-37.31
			Right	3635.055	-37.25
		High	Left	3679.900	-30.95
			Right	3700.160	-36.78
	256QAM	Low	Left	3549.924	-34.73
			Right	3570.100	-34.88
		Middle	Left	3614.900	-37.91
			Right	3635.100	-34.56
		High	Left	3679.861	-36.86
			Right	3700.097	-35.80

(2 Port) 5G NR n48 30 MHz [1 Carrier]

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
0	QPSK	Low	Left	3549.850	-38.18
			Right	3580.150	-37.50
		Middle	Left	3609.850	-35.17
			Right	3640.150	-37.02
		High	Left	3669.850	-33.67
			Right	3700.150	-37.71
	16QAM	Low	Left	3549.850	-35.99
			Right	3580.150	-37.64
		Middle	Left	3609.868	-35.57
			Right	3640.132	-38.02
		High	Left	3669.850	-35.87
			Right	3700.150	-36.99
	64QAM	Low	Left	3549.868	-36.37
			Right	3580.150	-34.17
		Middle	Left	3609.961	-36.53
			Right	3640.150	-33.56
		High	Left	3669.713	-35.01
			Right	3700.150	-35.85
	256QAM	Low	Left	3549.961	-36.58
			Right	3580.150	-34.76
		Middle	Left	3609.850	-33.98
			Right	3640.150	-35.53
		High	Left	3669.850	-37.20
			Right	3700.150	-34.15

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
1	QPSK	Low	Left	3549.961	-35.93
			Right	3580.101	-35.39
		Middle	Left	3609.930	-37.93
			Right	3640.225	-39.88
		High	Left	3669.930	-34.91
			Right	3700.150	-38.13
	16QAM	Low	Left	3549.868	-35.67
			Right	3580.442	-35.32
		Middle	Left	3609.806	-36.04
			Right	3640.194	-34.37
		High	Left	3669.930	-35.73
			Right	3700.845	-37.48
	64QAM	Low	Left	3549.899	-38.01
			Right	3580.163	-36.33
		Middle	Left	3609.850	-37.89
			Right	3640.101	-38.98
		High	Left	3669.899	-35.57
			Right	3700.225	-39.29
	256QAM	Low	Left	3549.899	-36.18
			Right	3580.070	-34.92
		Middle	Left	3609.868	-37.32
			Right	3640.150	-37.96
		High	Left	3669.850	-35.28
			Right	3700.070	-35.43

(2 Port) 5G NR n48 40 MHz [1 Carrier]

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
0	QPSK	Low	Left	3549.902	-35.12
			Right	3590.180	-38.13
		Middle	Left	3604.820	-38.30
			Right	3645.200	-37.98
		High	Left	3659.800	-33.43
			Right	3700.200	-33.86
	16QAM	Low	Left	3549.861	-36.37
			Right	3590.200	-34.59
		Middle	Left	3604.861	-41.31
			Right	3645.139	-35.09
		High	Left	3659.800	-30.55
			Right	3700.098	-39.12
	64QAM	Low	Left	3550.000	-34.30
			Right	3590.000	-39.08
		Middle	Left	3604.779	-38.37
			Right	3645.057	-39.07
		High	Left	3659.943	-36.47
			Right	3700.139	-36.46
	256QAM	Low	Left	3549.800	-34.19
			Right	3590.139	-36.36
		Middle	Left	3604.800	-39.07
			Right	3645.098	-33.98
		High	Left	3659.902	-35.09
			Right	3700.200	-36.96

Ant	Modulation	Channel	Edge Position	Frequency (MHz)	Calculated Value (dBm)
1	QPSK	Low	Left	3549.800	-37.49
			Right	3590.057	-39.46
		Middle	Left	3604.800	-33.17
			Right	3645.221	-40.55
		High	Left	3659.697	-34.50
			Right	3700.180	-37.31
	16QAM	Low	Left	3549.943	-37.91
			Right	3590.180	-35.68
		Middle	Left	3604.943	-38.61
			Right	3645.200	-36.11
		High	Left	3659.800	-32.42
			Right	3700.180	-31.18
	64QAM	Low	Left	3549.861	-36.80
			Right	3590.098	-35.64
		Middle	Left	3604.800	-36.94
			Right	3645.200	-37.41
		High	Left	3659.800	-36.32
			Right	3700.139	-36.68
	256QAM	Low	Left	3549.800	-35.74
			Right	3590.221	-32.74
		Middle	Left	3604.800	-35.32
			Right	3645.139	-35.90
		High	Left	3659.800	-32.23
			Right	3700.200	-34.21

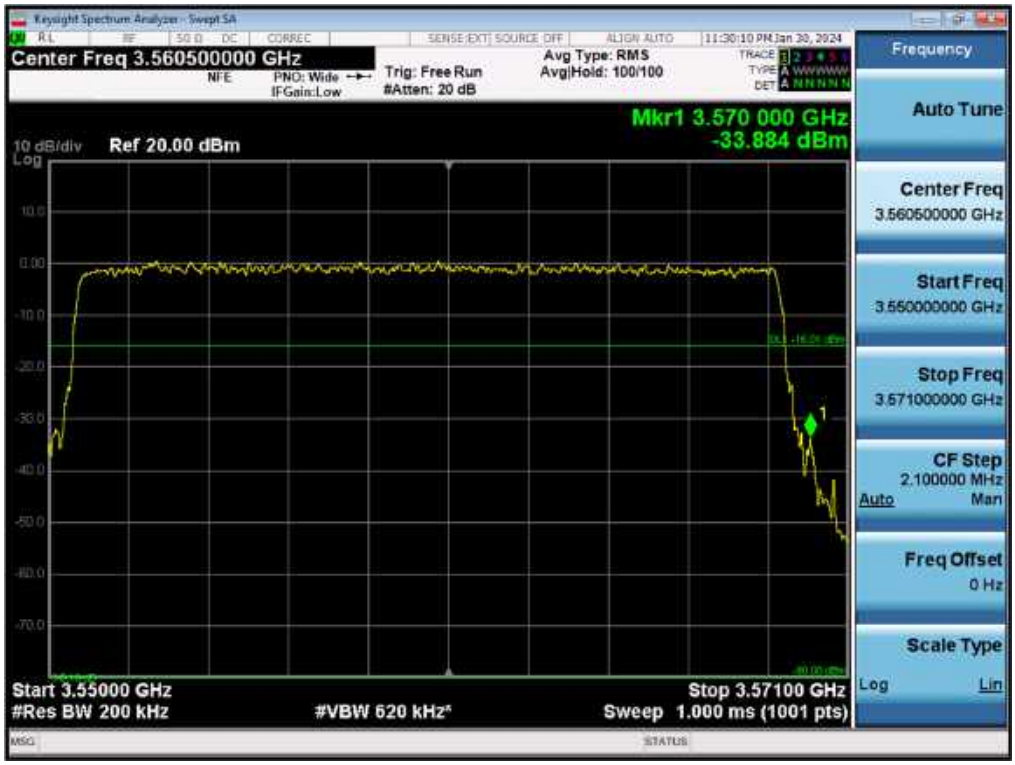
Plot Data of Out-of-band Unwanted Emissions

Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 16QAM / Low Right

Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 256QAM / Middle Left

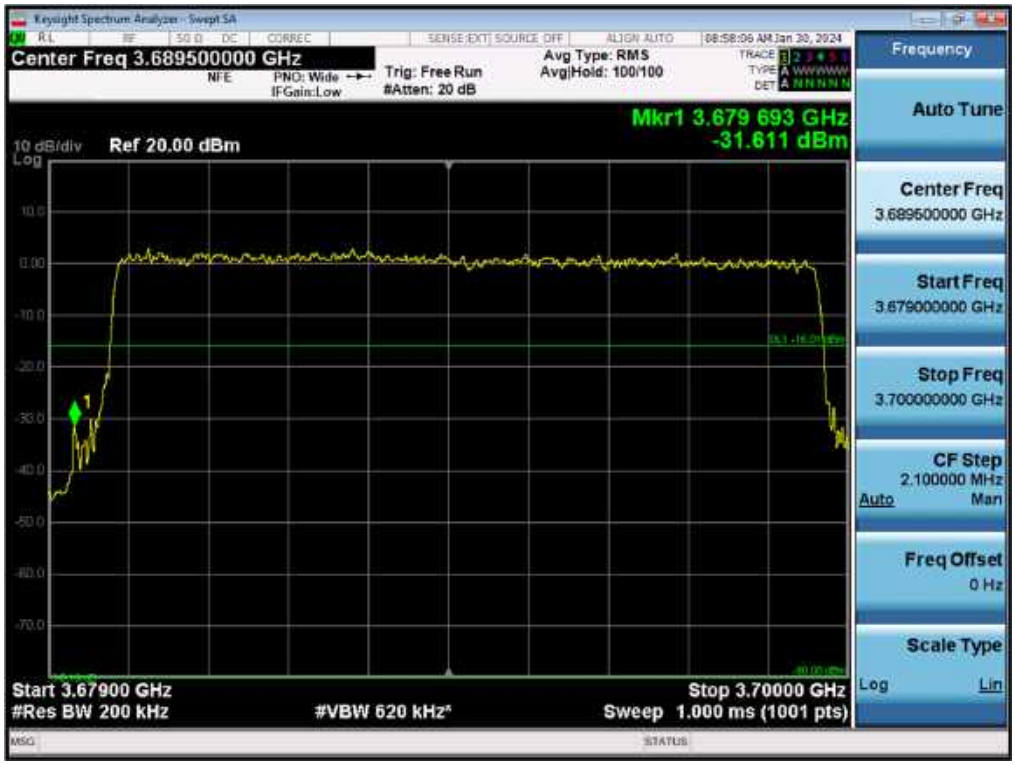
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 64QAM / High Left

Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 16QAM / Low Right



Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 64QAM / Middle Left

Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 64QAM / High Left

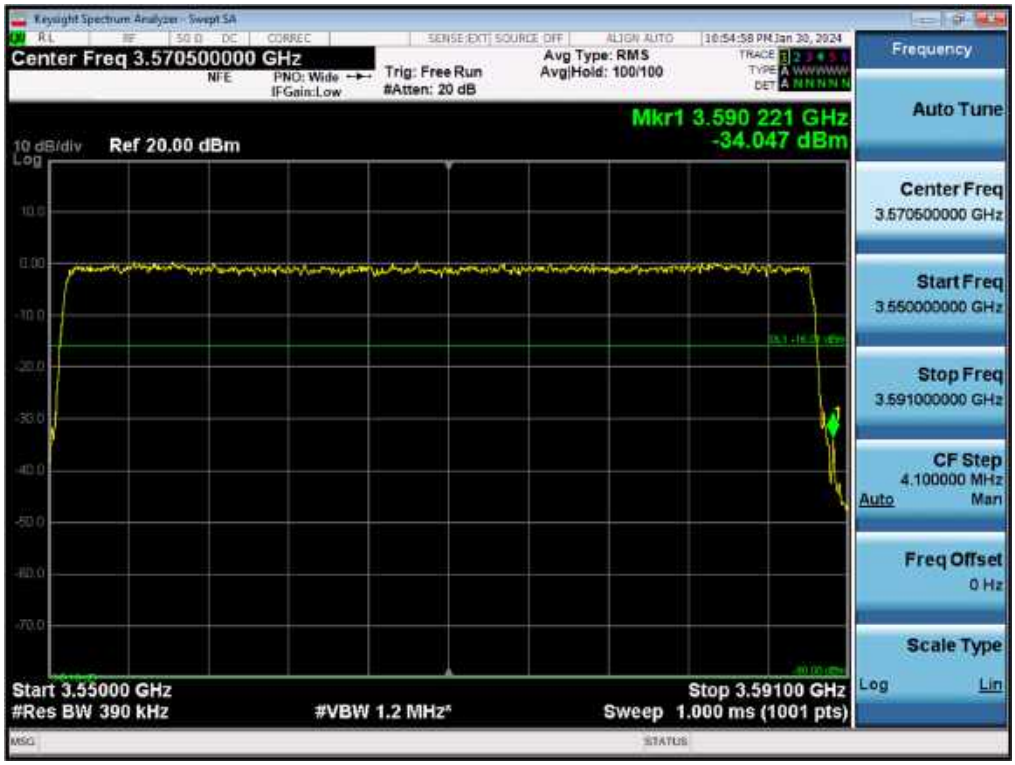


Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 64QAM / Low Right

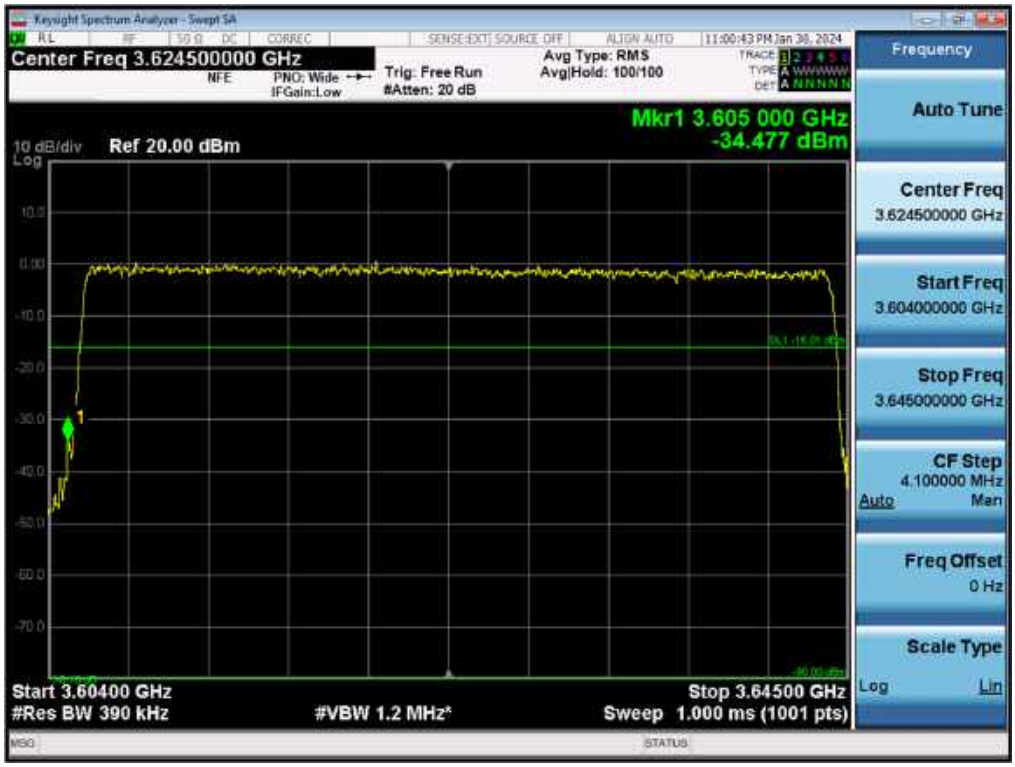
Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 64QAM / Middle Right

Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / QPSK / High Left

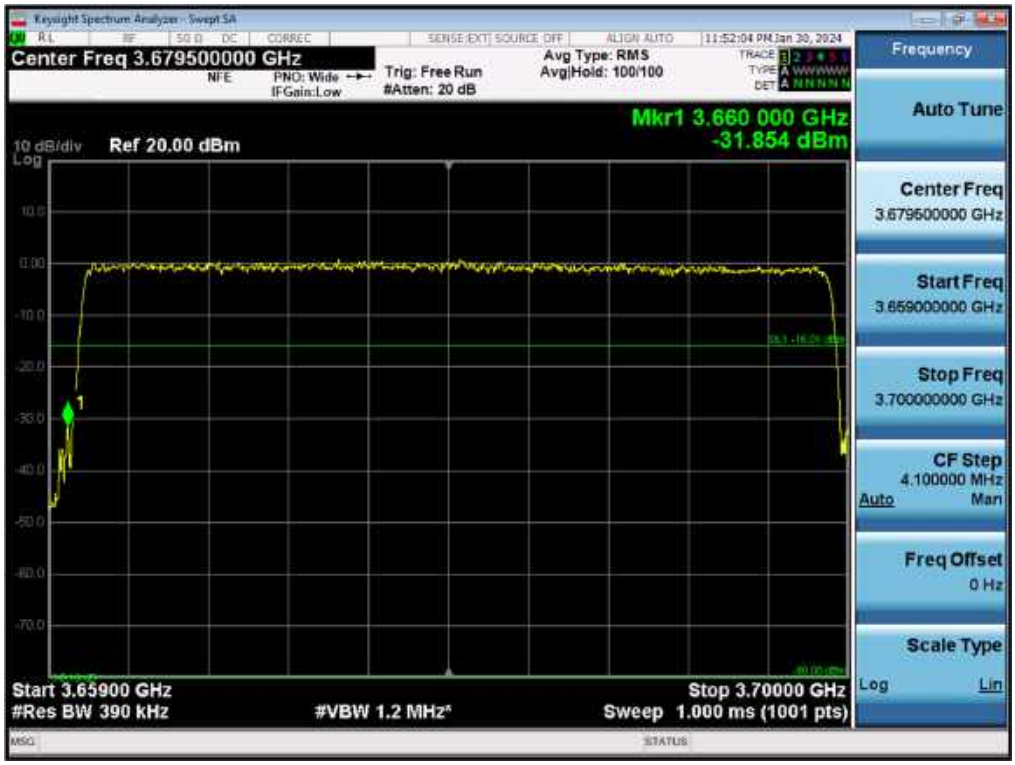
Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 256QAM / Low Right



Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / QPSK / Middle Left



Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 16QAM / High Left



5.5. SPURIOUS UNWANTED EMISSIONS

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.

96.41(e) General radio requirement: 3.5 GHz Emissions and Interference Limits.

(1) General protection levels.

(i) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any CBSD emission outside the fundamental emission bandwidth as specified in paragraph (e)(3) of this section (whether the emission is inside or outside of the authorized band) shall not exceed −13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any CBSD emission shall not exceed −25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

(ii) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed −25 dBm/MHz. Notwithstanding the emission limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.

(2) Additional protection levels.

Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

(3) Measurement procedure.

(i) Compliance with this provision 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 authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental 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.

(ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits.

(iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

(4) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

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 $\geq 2 \times$ (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.

Note:

1. In 9 kHz to 30 MHz band, RBW narrower than reference bandwidth is used. So following correction factor is applied.
   - 10 log [(reference bandwidth)/(resolution bandwidth)]
   : 9 kHz to 150 kHz applied 1 kHz RBW, 10 log (1 kHz / 1 MHz) = - 30 dB
   : 150 kHz to 30 MHz applied 10 kHz RBW, 10 log (10 kHz / 1 MHz) = - 20 dB
2. Due to MIMO operations, a correction has been added to the limit according to KDB 662911 D01 v02r01.
   - 2Tx MIMO correction: 10 log(N_{ANT}) = 10 log(2) = 3.01 dB
   From Channel Edge to Channel Edge ± 10 MHz, -13 dBm/MHz – 10*log (2) = -16.01 dBm/MHz
   From Channel Edge ± 10 MHz to 3 530 or 3 720 MHz, -25 dBm/MHz – 10*log (2) = -28.01 dBm/MHz
   For the rest, -40 dBm/MHz – 10*log (2) = -43.01 dBm/MHz
3. The measured value is calculated by adding duty correction.
   Sample Calculation:
   Calculated Value = measured value + duty correction
   = -48.989 dBm + 1.31 dB* = -47.683 dBm
   * The value 1.31 is an approximate value, and actual values(1.306...) have been used in all calculations.
4. The results of the Spurious Unwanted Emissions shown below the frequency measured values are very small and similar trend for each port, so we are attached only the worst case plot.
5. All power supply of operation were investigated and the worst case configuration results are reported.

Test Results: Tabular Data of Spurious Unwanted Emissions

(2 Port) 5G NR n48 10 MHz [1 Carrier]

Test Result for Output Port 0

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-47.683	-57.107	-51.024	-41.916	-30.770	-28.935	-42.068	-50.343	-44.939
	Middle	-44.424	-57.993	-52.086	-39.997	-35.464	-34.248	-40.731	-50.454	-44.799
	High	-45.793	-56.405	-52.383	-36.324	-33.364	-33.264	-39.483	-50.472	-44.337
16QAM	Low	-46.757	-56.420	-52.107	-44.321	-28.336	-28.710	-41.412	-50.878	-44.618
	Middle	-47.174	-56.930	-51.812	-42.884	-29.188	-28.211	-43.510	-51.168	-45.500
	High	-47.096	-57.405	-51.893	-38.554	-27.506	-27.636	-42.950	-50.452	-45.708
64QAM	Low	-44.388	-56.334	-52.103	-43.264	-31.271	-34.914	-41.755	-50.706	-44.692
	Middle	-45.293	-56.505	-52.232	-39.933	-31.440	-34.227	-42.232	-50.825	-45.141
	High	-48.172	-56.864	-51.949	-39.164	-30.811	-35.737	-42.315	-50.507	-44.057
256QAM	Low	-46.567	-57.212	-52.674	-43.317	-33.821	-30.472	-40.548	-50.637	-44.885
	Middle	-44.546	-55.785	-52.038	-37.820	-32.784	-29.849	-38.410	-51.106	-45.523
	High	-45.116	-56.625	-52.742	-36.026	-31.420	-30.901	-41.004	-50.974	-44.628
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

Test Result for Output Port 1

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-45.738	-56.160	-52.975	-41.391	-34.247	-33.916	-39.923	-45.193	-45.483
	Middle	-46.350	-56.697	-52.163	-38.727	-34.223	-33.521	-39.014	-45.708	-46.527
	High	-45.560	-57.140	-52.709	-38.067	-32.338	-31.114	-39.428	-48.038	-46.766
16QAM	Low	-45.250	-56.076	-51.801	-46.305	-30.057	-26.651	-42.415	-46.357	-44.752
	Middle	-45.143	-56.889	-52.195	-40.302	-29.473	-29.240	-45.506	-46.266	-45.129
	High	-45.417	-56.513	-53.276	-40.073	-25.450	-27.256	-43.344	-47.897	-45.803
64QAM	Low	-45.497	-56.804	-51.734	-41.240	-32.950	-35.359	-39.229	-45.242	-45.697
	Middle	-45.119	-56.426	-51.350	-36.605	-32.448	-33.944	-40.487	-45.863	-46.496
	High	-45.544	-57.106	-50.604	-38.508	-32.204	-34.020	-38.519	-47.953	-44.654
256QAM	Low	-44.819	-56.549	-51.129	-43.630	-33.450	-31.148	-39.971	-45.806	-45.627
	Middle	-44.903	-57.272	-52.252	-36.521	-31.770	-31.429	-38.802	-45.912	-46.636
	High	-44.983	-55.924	-52.889	-35.196	-28.003	-33.408	-40.631	-47.635	-45.058
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

(2 Port) 5G NR n48 20 MHz [1 Carrier]

Test Result for Output Port 0

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-45.386	-56.526	-52.936	-47.342	-33.291	-31.968	-41.698	-51.221	-44.629
	Middle	-46.088	-57.012	-52.866	-41.440	-33.703	-32.421	-43.004	-50.644	-44.388
	High	-44.543	-57.256	-52.400	-39.841	-29.358	-29.187	-42.280	-50.368	-44.631
16QAM	Low	-45.334	-57.067	-51.728	-44.830	-34.146	-35.150	-42.742	-50.072	-44.309
	Middle	-44.885	-56.749	-52.585	-41.136	-33.725	-36.561	-39.207	-51.104	-44.030
	High	-44.326	-57.057	-51.754	-39.847	-31.060	-33.987	-43.072	-50.636	-44.013
64QAM	Low	-44.857	-56.986	-52.522	-42.387	-31.659	-33.870	-42.084	-50.399	-44.561
	Middle	-44.565	-57.103	-52.486	-36.233	-32.529	-33.695	-43.834	-50.887	-45.108
	High	-44.366	-56.445	-52.485	-35.245	-30.446	-33.021	-45.194	-50.453	-44.515
256QAM	Low	-44.391	-56.196	-51.819	-46.897	-36.930	-39.354	-42.427	-50.667	-45.051
	Middle	-45.107	-56.481	-51.930	-41.182	-36.997	-37.815	-43.259	-51.172	-44.543
	High	-44.469	-57.593	-51.944	-41.728	-33.409	-35.699	-44.674	-50.593	-44.099
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

Test Result for Output Port 1

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-45.023	-56.633	-52.678	-46.871	-35.273	-32.938	-40.784	-47.238	-45.530
	Middle	-47.436	-56.630	-52.080	-43.133	-33.382	-31.269	-41.138	-48.047	-46.467
	High	-45.760	-57.250	-52.111	-42.396	-31.290	-29.948	-43.621	-48.359	-46.344
16QAM	Low	-45.313	-55.597	-53.047	-47.216	-34.967	-38.896	-41.504	-47.182	-45.081
	Middle	-44.582	-56.685	-52.798	-42.583	-35.028	-38.830	-44.087	-48.131	-46.012
	High	-46.572	-56.708	-52.757	-41.704	-30.359	-35.017	-42.088	-48.810	-44.840
64QAM	Low	-44.466	-56.225	-50.394	-41.023	-33.950	-35.419	-42.434	-47.663	-45.046
	Middle	-44.377	-57.424	-51.826	-39.498	-31.036	-34.322	-40.950	-48.813	-47.064
	High	-44.220	-56.728	-52.924	-35.286	-29.215	-32.102	-42.380	-48.099	-46.418
256QAM	Low	-45.356	-56.047	-52.916	-43.548	-32.301	-33.145	-39.162	-47.965	-45.952
	Middle	-44.199	-56.976	-53.252	-43.598	-36.308	-38.654	-43.675	-48.951	-46.949
	High	-45.801	-57.047	-52.635	-42.394	-32.360	-35.554	-43.297	-48.453	-46.290
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

(2 Port) 5G NR n48 30 MHz [1 Carrier]

Test Result for Output Port 0

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-44.863	-57.620	-52.417	-43.639	-36.918	-39.077	-42.633	-51.266	-44.081
	Middle	-47.442	-57.188	-52.148	-42.541	-37.382	-41.900	-47.607	-50.646	-44.890
	High	-46.106	-57.603	-52.256	-43.715	-36.485	-38.609	-45.880	-50.032	-44.165
16QAM	Low	-48.424	-56.270	-52.004	-41.597	-35.396	-33.543	-41.538	-50.920	-44.100
	Middle	-45.960	-56.929	-52.806	-38.735	-37.833	-34.820	-38.928	-50.864	-44.486
	High	-47.016	-57.333	-51.017	-37.621	-35.023	-35.647	-44.183	-50.177	-44.326
64QAM	Low	-46.024	-56.937	-51.516	-42.972	-36.861	-38.249	-40.395	-51.224	-44.200
	Middle	-45.789	-56.175	-52.741	-44.127	-37.309	-39.722	-40.415	-50.935	-44.407
	High	-46.140	-56.528	-51.265	-43.281	-35.891	-37.802	-44.512	-50.460	-44.445
256QAM	Low	-45.013	-57.455	-52.268	-43.951	-38.483	-38.494	-43.441	-50.872	-45.236
	Middle	-45.102	-55.949	-52.349	-42.561	-38.606	-38.976	-43.616	-50.851	-44.532
	High	-44.812	-57.147	-51.938	-43.073	-37.811	-37.284	-44.845	-50.800	-44.179
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

Test Result for Output Port 1

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-45.518	-56.432	-52.122	-42.062	-36.645	-37.251	-42.224	-47.483	-46.323
	Middle	-45.796	-56.573	-52.634	-38.603	-34.588	-38.951	-43.008	-48.606	-46.495
	High	-46.347	-55.878	-52.133	-38.355	-33.602	-35.046	-40.006	-47.068	-44.742
16QAM	Low	-44.503	-57.293	-51.699	-43.303	-33.423	-34.159	-41.877	-47.114	-45.093
	Middle	-45.474	-56.986	-52.751	-37.882	-34.397	-35.327	-40.026	-49.888	-45.472
	High	-46.829	-55.608	-52.259	-39.554	-34.487	-35.814	-41.226	-50.550	-44.521
64QAM	Low	-45.620	-56.353	-52.349	-41.538	-34.795	-36.298	-39.171	-47.686	-46.560
	Middle	-45.944	-56.939	-52.177	-38.188	-35.631	-40.202	-45.282	-48.966	-47.090
	High	-45.310	-56.266	-52.467	-34.960	-31.302	-33.639	-37.628	-47.508	-45.662
256QAM	Low	-45.913	-57.070	-51.527	-43.439	-36.781	-36.379	-44.227	-47.952	-46.447
	Middle	-44.208	-57.386	-52.553	-41.396	-38.402	-39.936	-43.737	-48.618	-46.480
	High	-46.580	-56.169	-51.793	-34.887	-31.034	-33.457	-37.446	-47.922	-45.985
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

(2 Port) 5G NR n48 40 MHz [1 Carrier]

Test Result for Output Port 0

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-44.325	-57.722	-52.162	-47.131	-38.234	-40.498	-44.033	-50.443	-44.194
	Middle	-45.324	-54.916	-51.963	-47.243	-38.900	-40.367	-44.499	-51.105	-44.461
	High	-44.803	-57.357	-52.579	-43.834	-37.659	-38.563	-46.593	-50.210	-44.399
16QAM	Low	-45.683	-57.416	-52.568	-45.919	-38.016	-35.220	-45.604	-49.408	-44.007
	Middle	-46.430	-57.597	-52.853	-45.069	-36.859	-35.237	-45.160	-50.783	-44.201
	High	-45.489	-57.106	-51.644	-44.423	-36.661	-33.940	-45.369	-51.079	-44.133
64QAM	Low	-45.092	-57.434	-52.500	-49.125	-37.839	-39.278	-44.944	-50.586	-44.966
	Middle	-44.943	-56.727	-52.830	-47.277	-39.141	-39.078	-44.772	-51.030	-44.368
	High	-46.057	-57.242	-52.515	-44.096	-36.916	-38.307	-46.857	-50.341	-44.157
256QAM	Low	-45.029	-56.494	-51.227	-47.757	-39.203	-36.695	-46.134	-51.060	-44.892
	Middle	-46.504	-56.510	-52.648	-45.242	-39.601	-36.570	-44.536	-50.407	-44.407
	High	-45.454	-57.514	-51.890	-43.712	-38.003	-35.585	-46.544	-50.835	-44.101
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

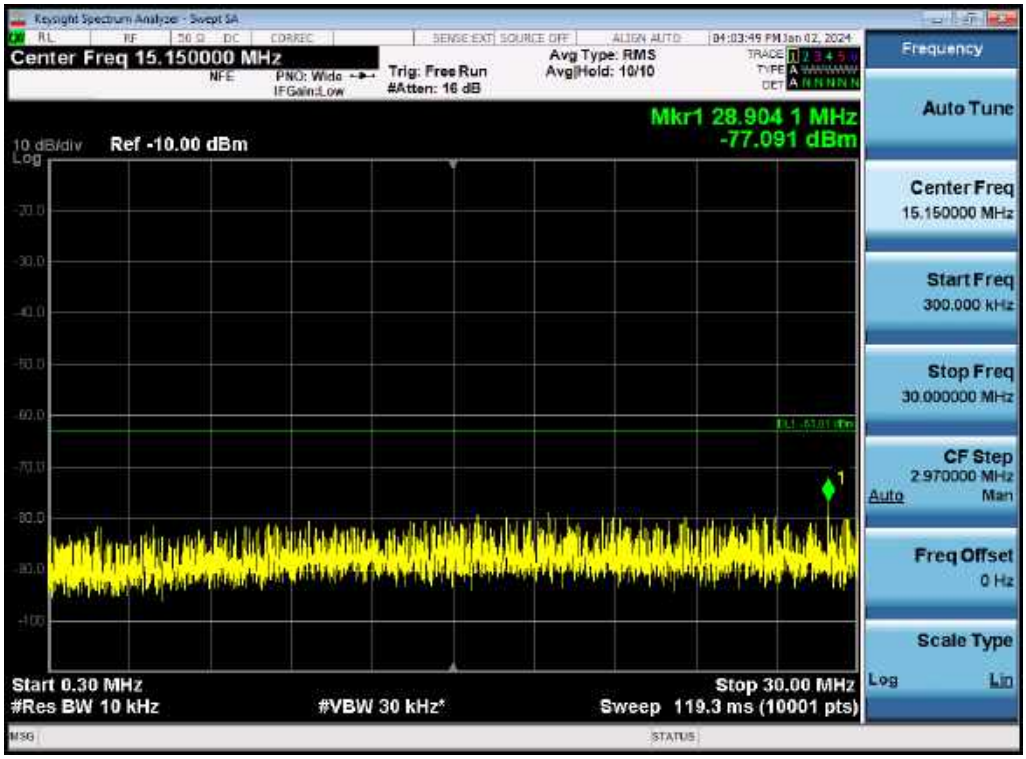
Test Result for Output Port 1

Mod.	Channel	Calculated Value (dBm)								
		9 kHz ~ 300 kHz	300 kHz ~ 30 MHz	30 MHz ~ 3 530 MHz	3 530 MHz ~ Low Edge – 10 MHz	Low Edge – 10 MHz ~ Low Edge – 1 MHz	High Edge + 1 MHz ~ High Edge + 10 MHz	High Edge + 10 MHz ~ 3 720 MHz	3 720 MHz ~ 18 GHz	18 GHz ~ 40 GHz
QPSK	Low	-47.660	-55.953	-51.781	-48.447	-39.650	-40.024	-45.481	-47.218	-45.608
	Middle	-45.416	-57.326	-52.176	-45.919	-38.087	-42.674	-46.348	-47.703	-45.033
	High	-46.512	-56.298	-52.279	-44.364	-37.948	-38.765	-46.392	-47.668	-44.776
16QAM	Low	-44.946	-57.414	-52.020	-47.472	-37.649	-34.757	-45.809	-47.461	-44.897
	Middle	-44.842	-54.988	-52.144	-44.504	-37.518	-32.940	-46.834	-50.849	-45.668
	High	-48.044	-55.212	-52.328	-41.531	-36.467	-34.524	-44.765	-50.428	-45.606
64QAM	Low	-47.518	-56.588	-52.139	-48.722	-38.944	-39.333	-45.095	-47.641	-44.905
	Middle	-45.048	-56.147	-51.658	-46.204	-37.489	-41.577	-46.897	-47.111	-45.139
	High	-45.910	-56.966	-52.695	-44.263	-35.411	-38.503	-46.320	-47.548	-45.849
256QAM	Low	-46.862	-55.663	-52.561	-48.320	-40.311	-36.661	-45.061	-47.679	-44.836
	Middle	-45.129	-57.229	-52.036	-43.578	-39.528	-34.898	-46.186	-47.452	-44.781
	High	-45.701	-56.178	-52.834	-44.254	-38.728	-35.981	-44.916	-48.500	-46.044
Limit (dBm/MHz)		-43.01	-43.01	-43.01	-28.01	-16.01	-16.01	-28.01	-43.01	-43.01

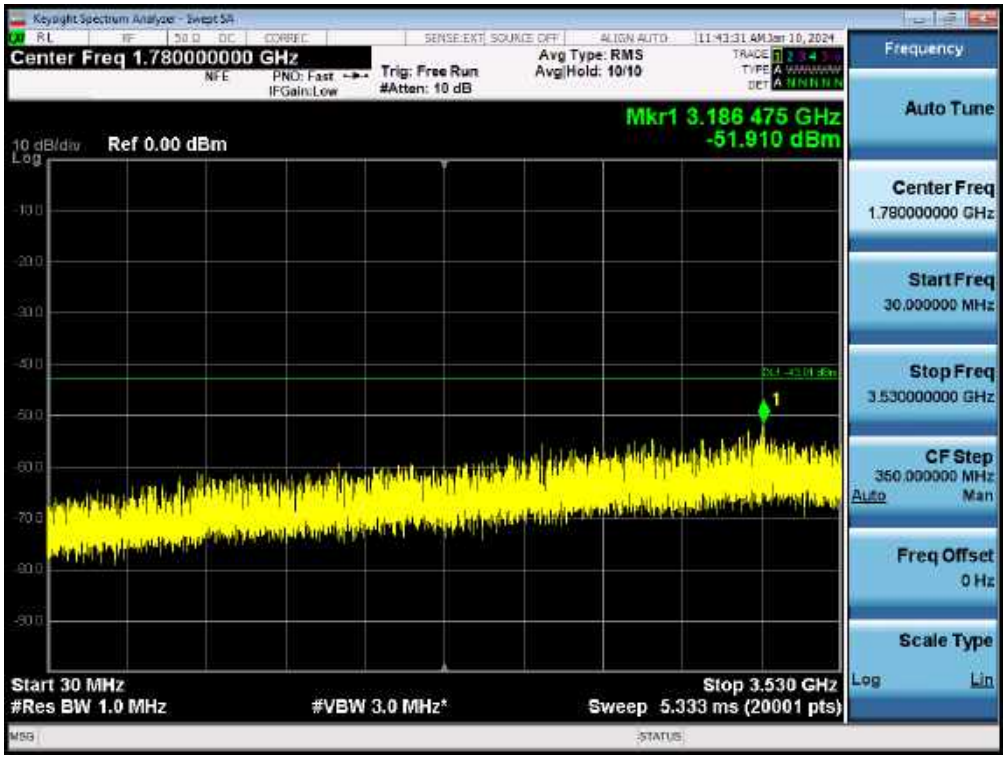
Plot Data of Spurious Unwanted Emissions

Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 9 kHz ~ 300 kHz / 64QAM / Low

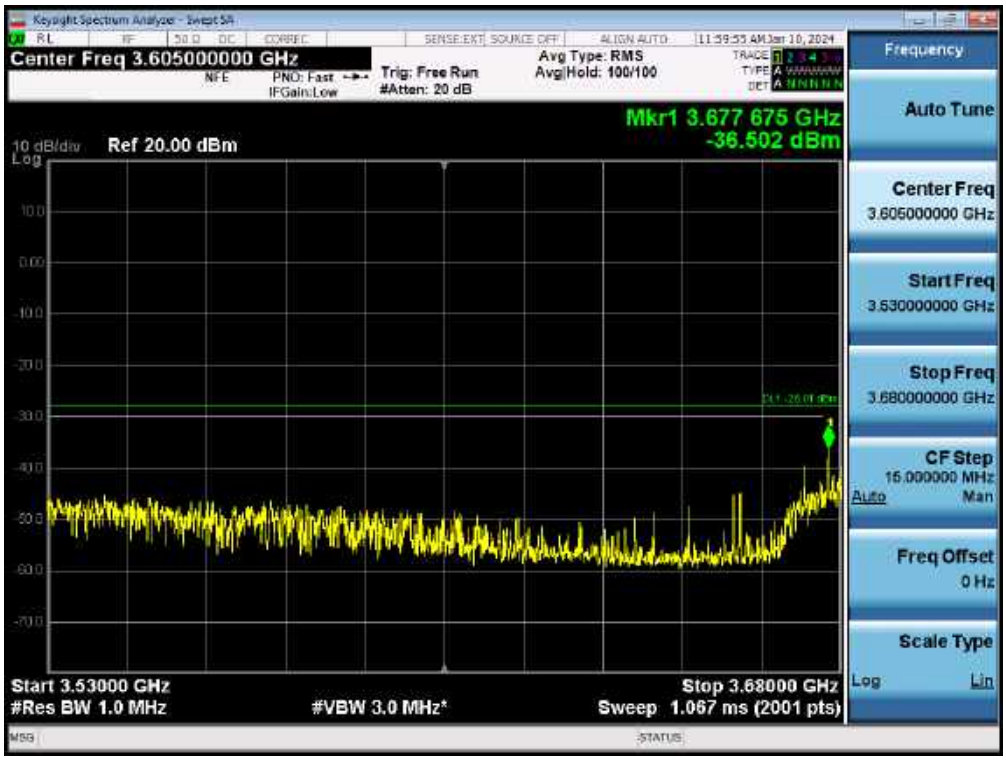
Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 300 kHz ~ 30 MHz / 256QAM / Middle



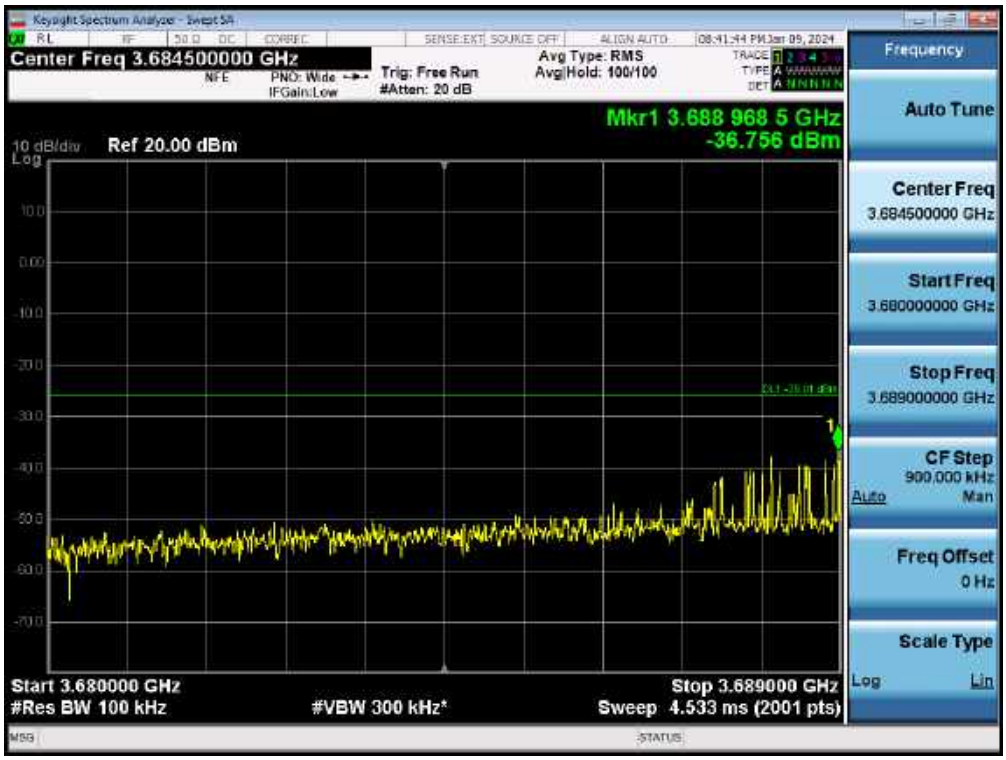
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 30 MHz ~ 3 530 MHz / 64QAM / High



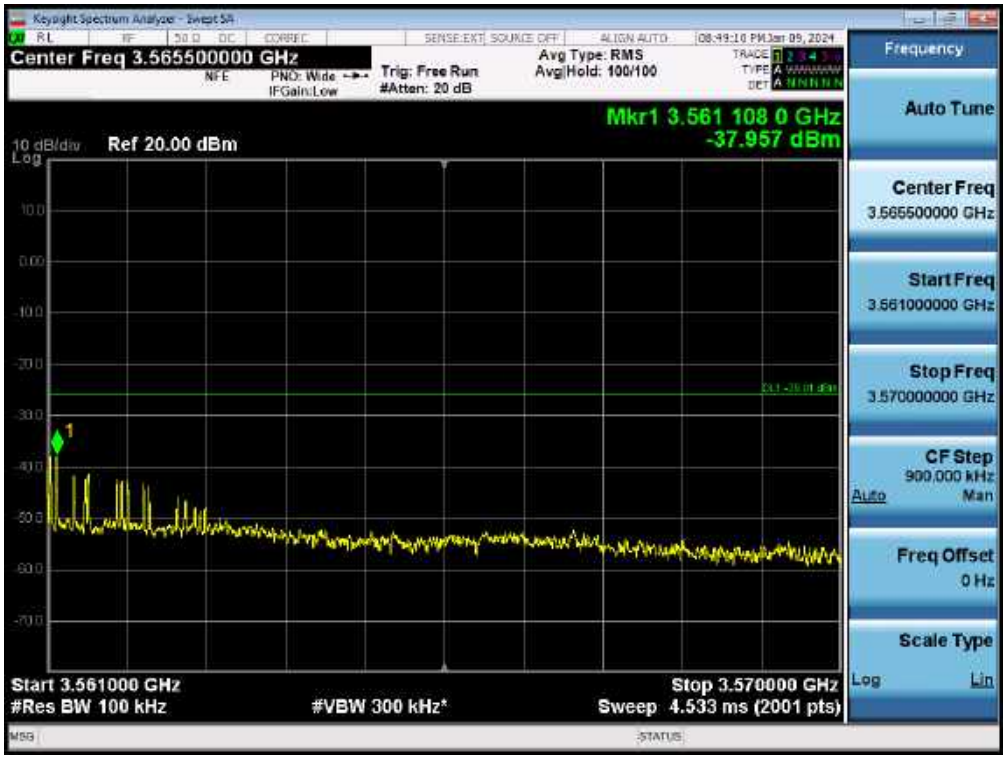
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 3 530 MHz ~ Low Edge – 10 MHz / 256QAM / High



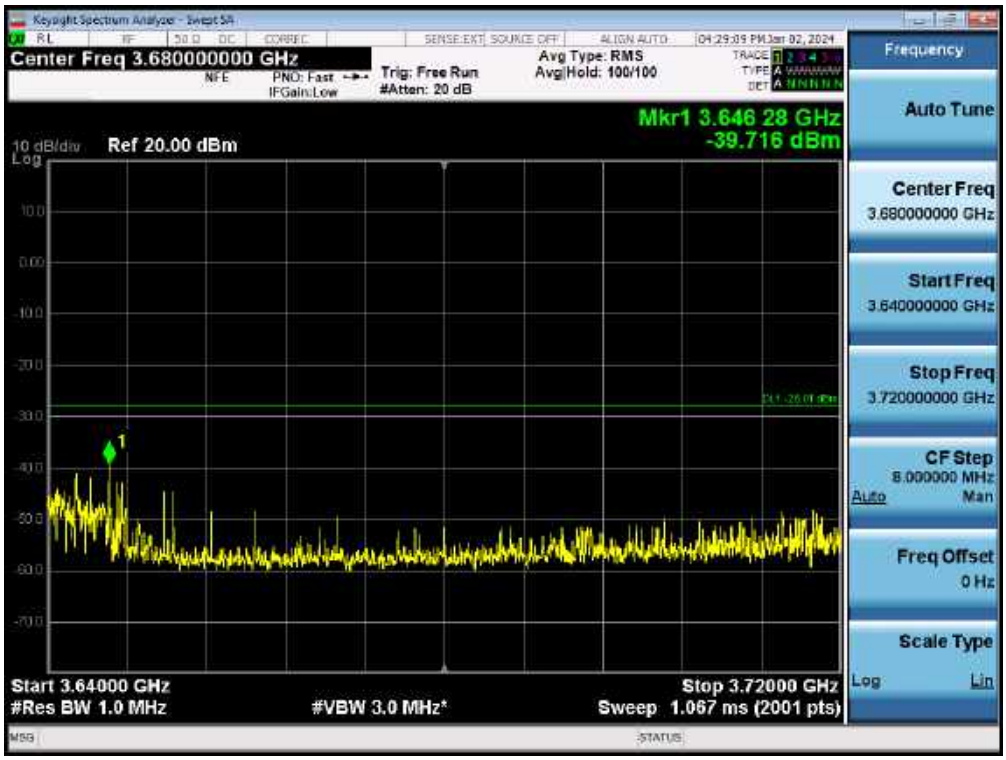
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / Low Edge – 10 MHz ~ Low Edge – 1 MHz / 16QAM / High



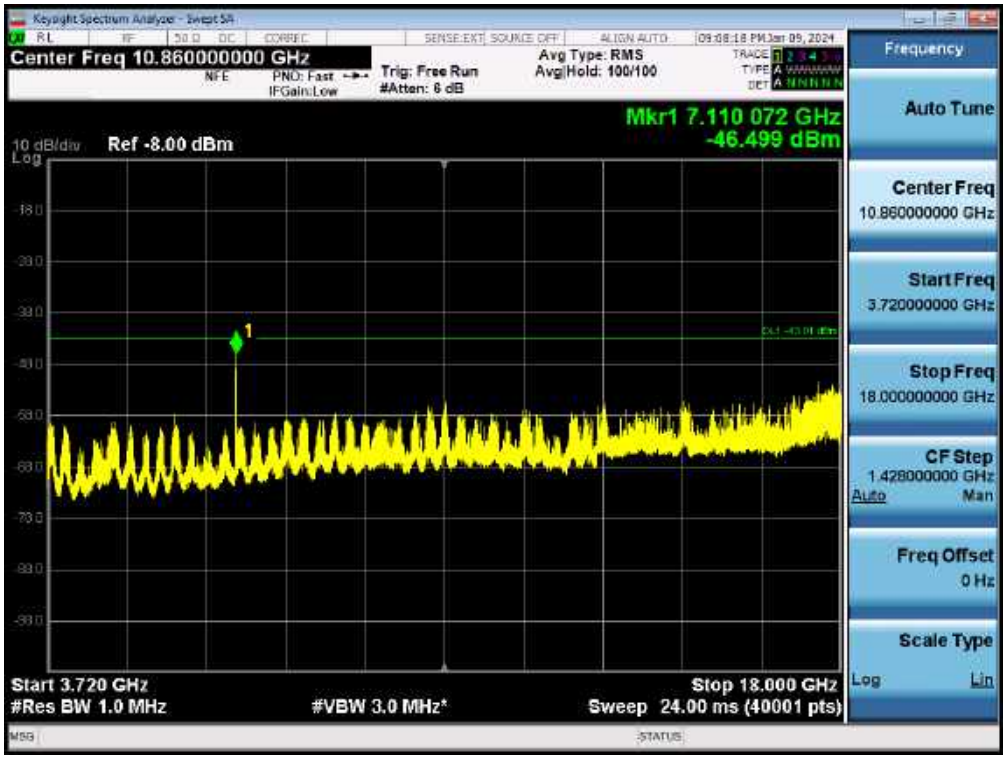
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / High Edge + 1 MHz ~ High Edge + 10 MHz / 16QAM / Low



Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / High Edge + 10 MHz ~ 3 720 MHz / 256QAM / Middle



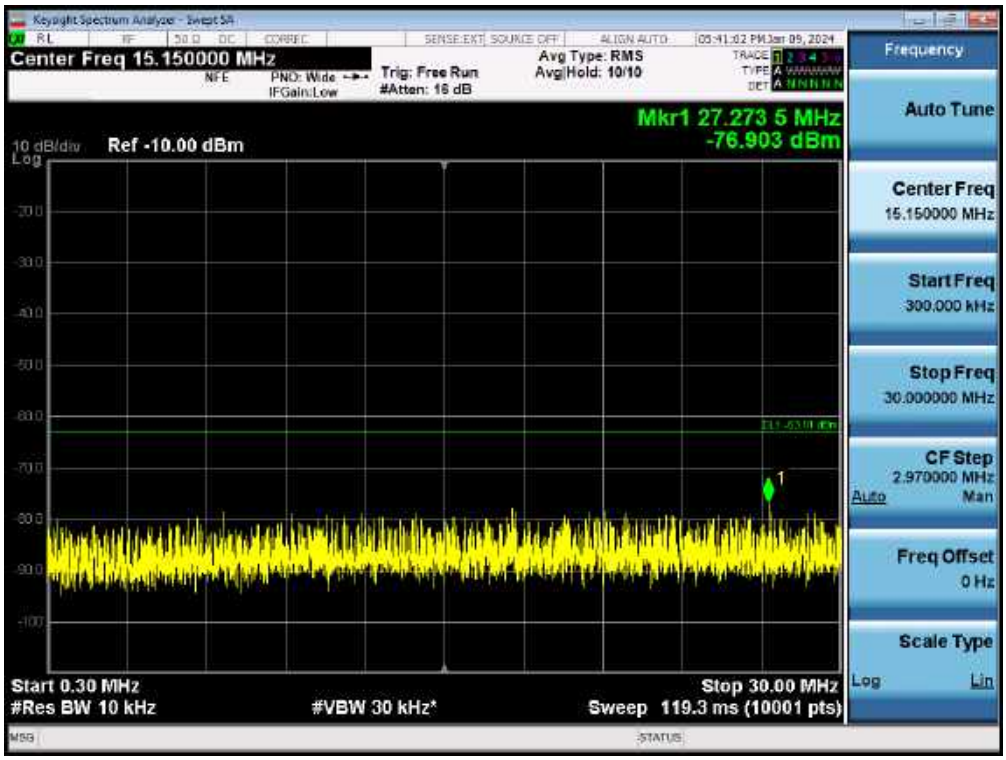
Antenna 1 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 3 720 MHz ~ 18 GHz / QPSK / Low



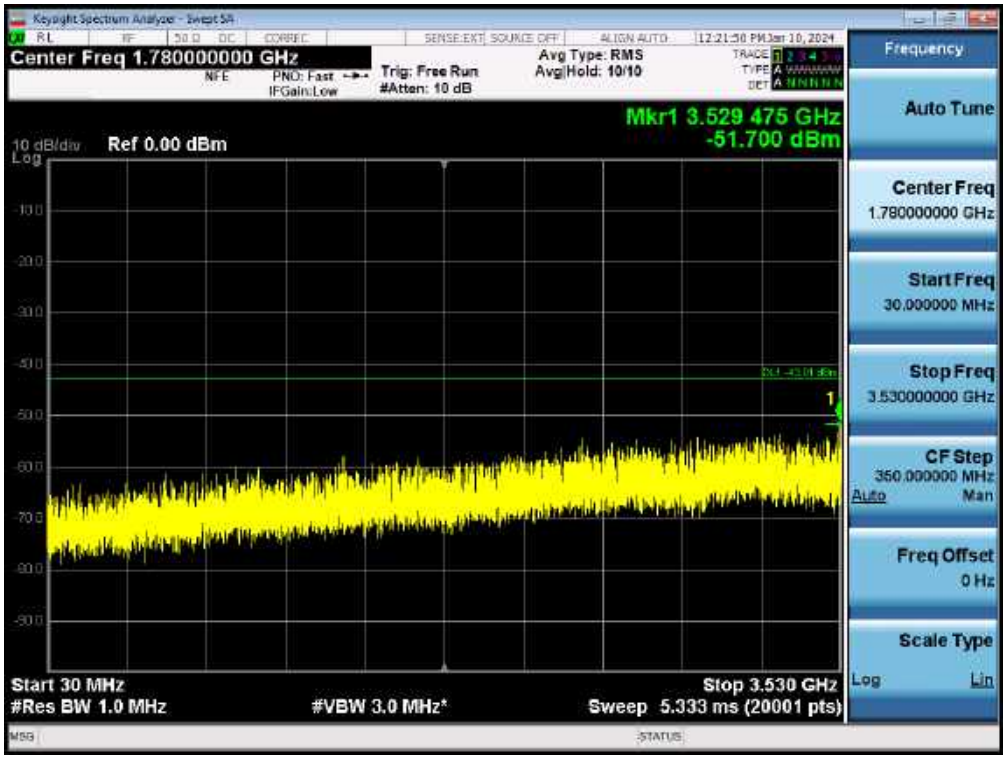
Antenna 0 / (2 Port) 5G NR n48 10 MHz [1 Carrier] / 18 GHz ~ 40 GHz / 64QAM / High

Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 9 kHz ~ 300 kHz / 256QAM / Middle

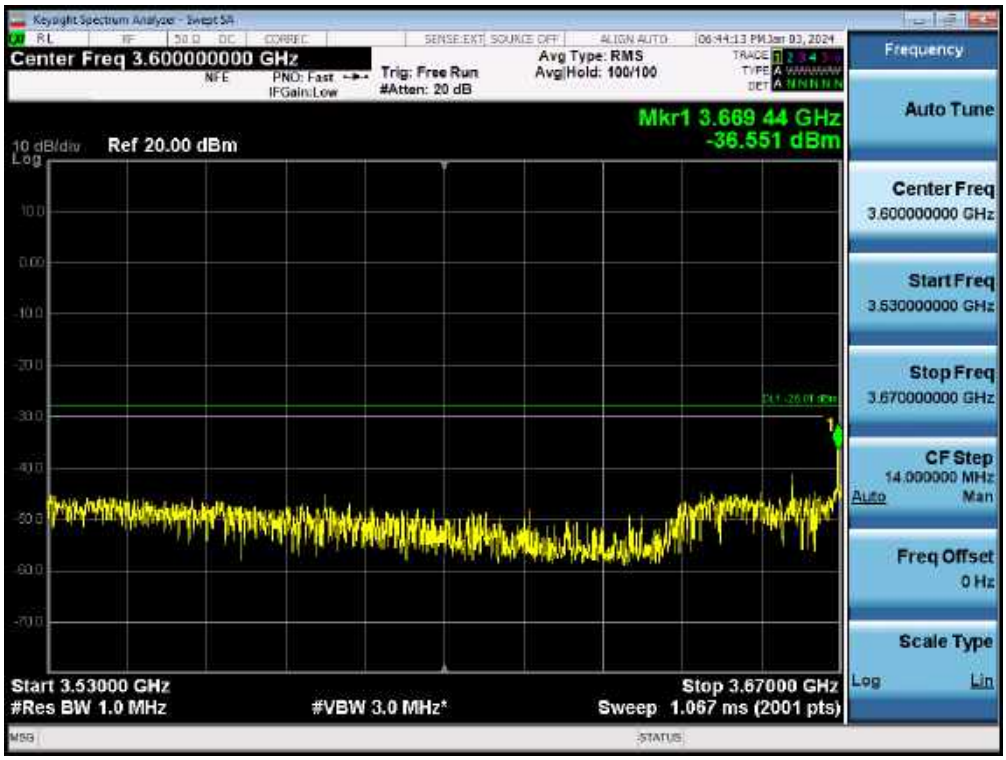
Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 300 kHz ~ 30 MHz / 16QAM / Low



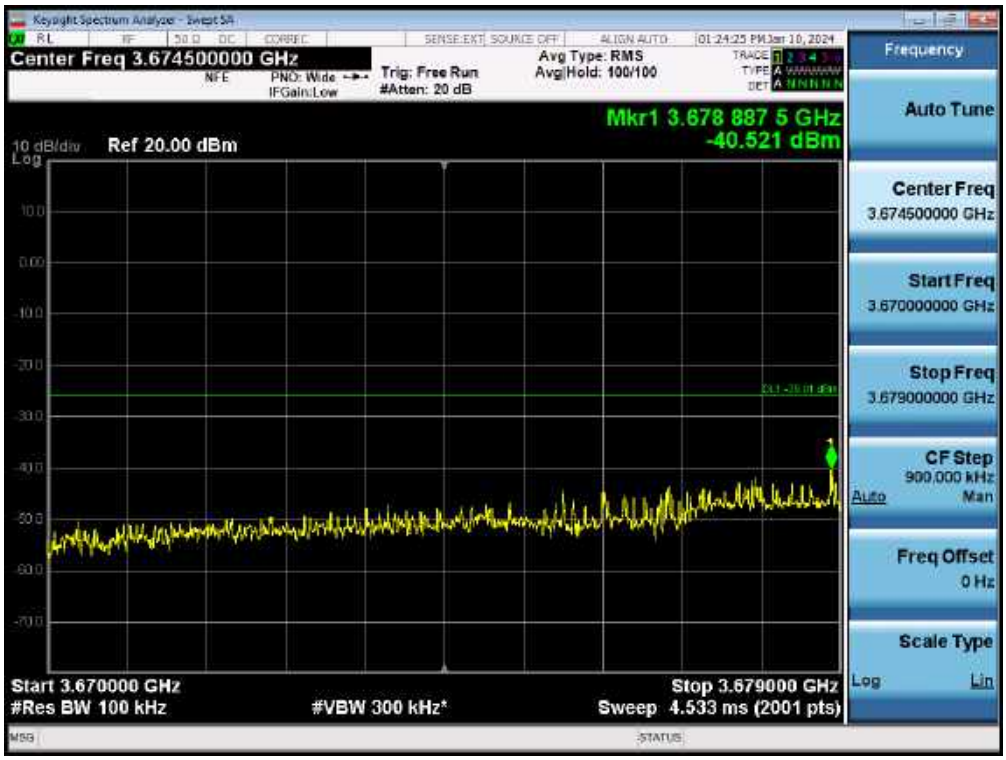
Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 30 MHz ~ 3 530 MHz / 64QAM / Low



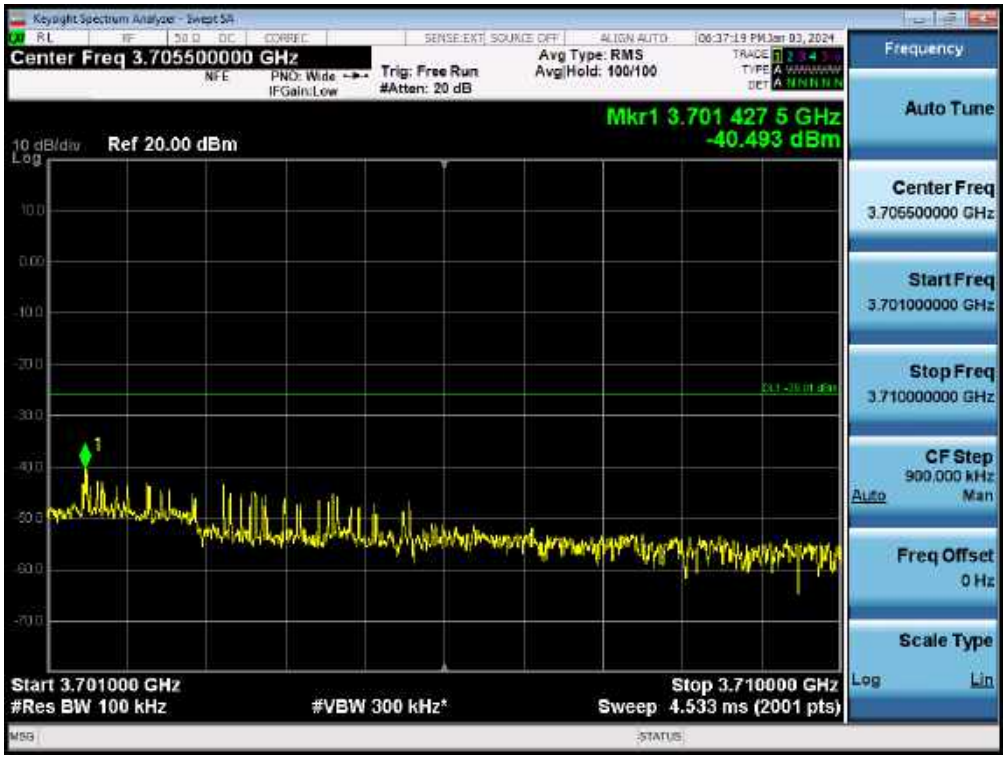
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 3 530 MHz ~ Low Edge – 10 MHz / 64QAM / High



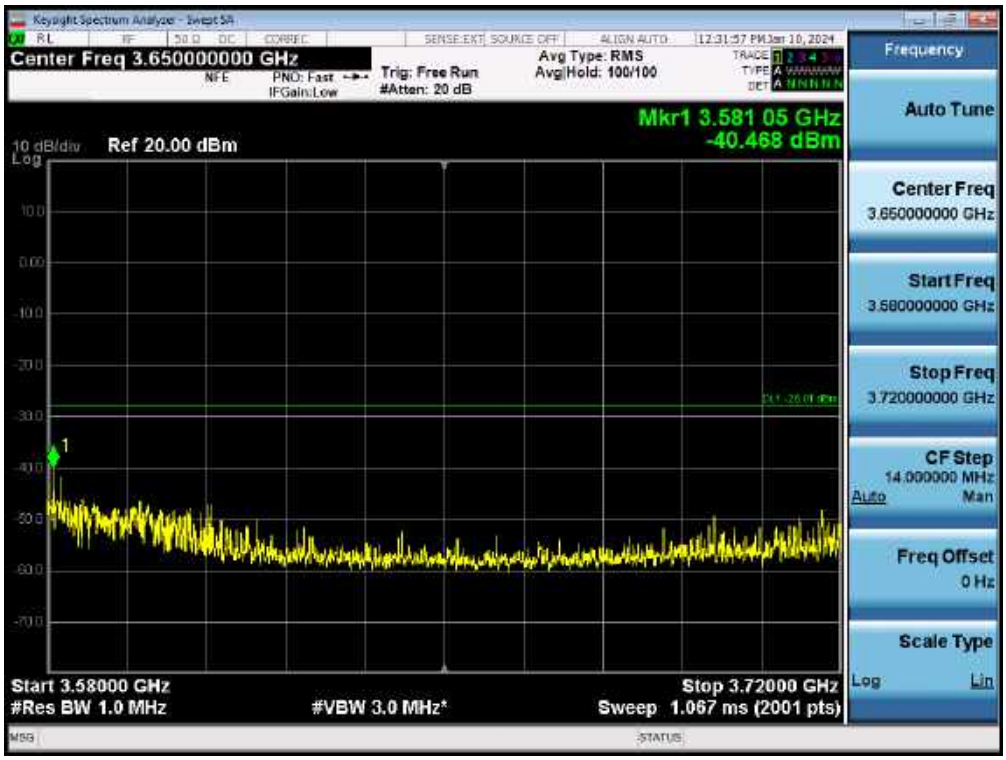
Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / Low Edge – 10 MHz ~ Low Edge – 1 MHz / 64QAM / High



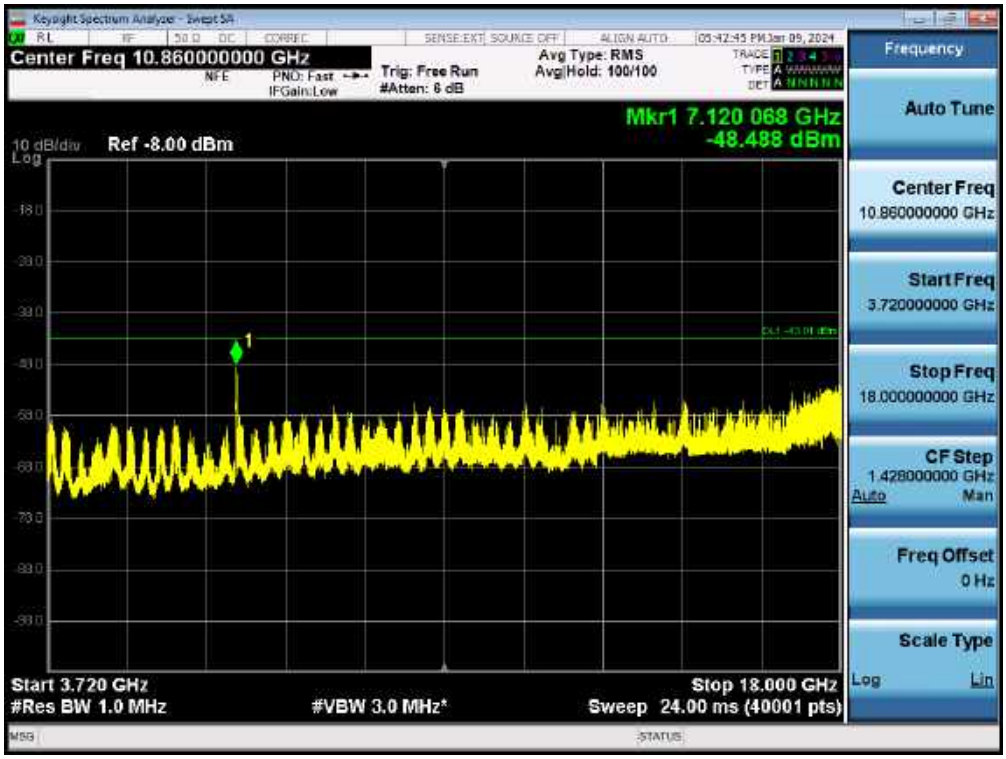
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / High Edge + 1 MHz ~ High Edge + 10 MHz / QPSK / High



Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / High Edge + 10 MHz ~ 3 720 MHz / 256QAM / Low



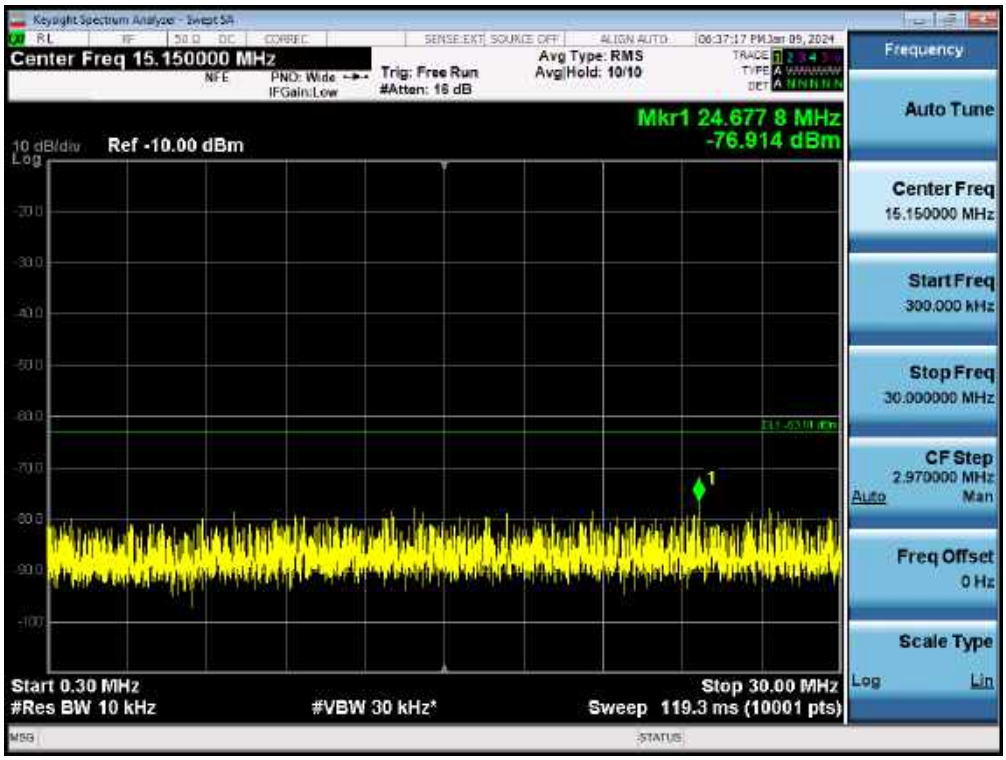
Antenna 1 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 3 720 MHz ~ 18 GHz / 16QAM / Low



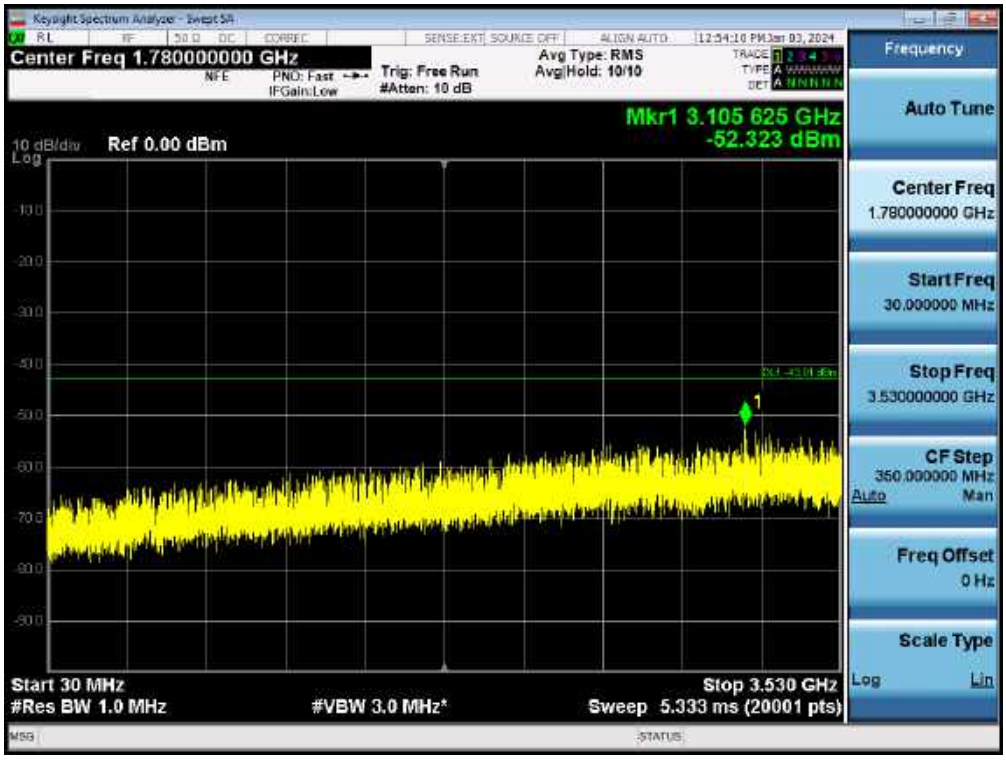
Antenna 0 / (2 Port) 5G NR n48 20 MHz [1 Carrier] / 18 GHz ~ 40 GHz / 16QAM / High

Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 9 kHz ~ 300 kHz / 256QAM / Middle

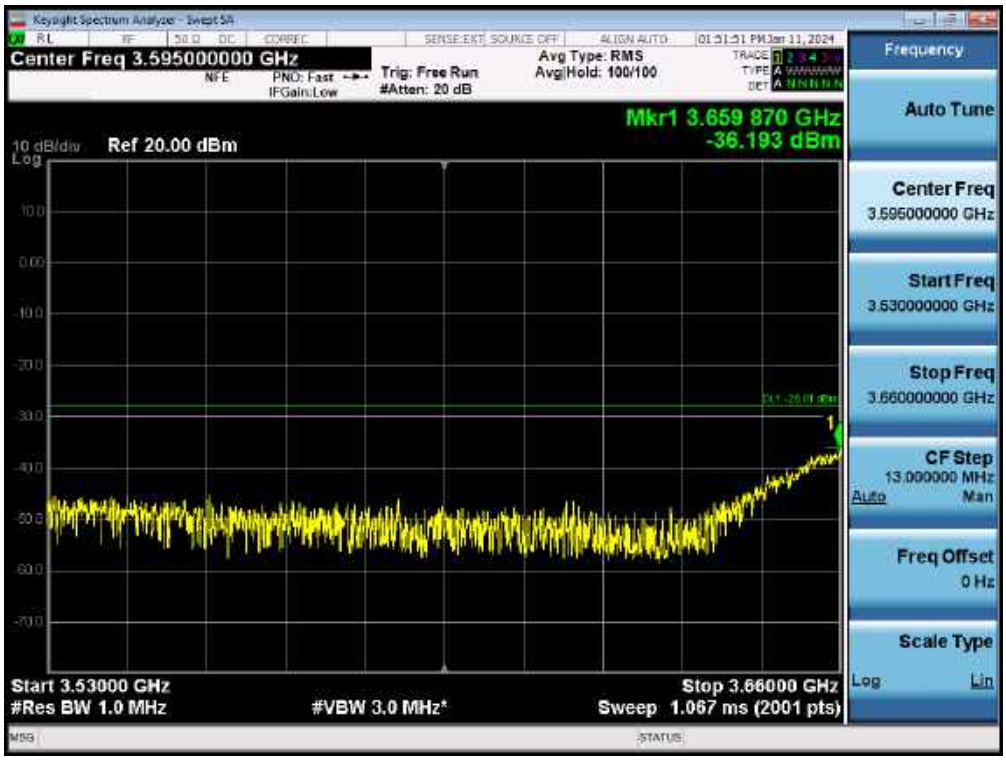
Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 300 kHz ~ 30 MHz / 16QAM / High



Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 30 MHz ~ 3 530 MHz / 16QAM / High

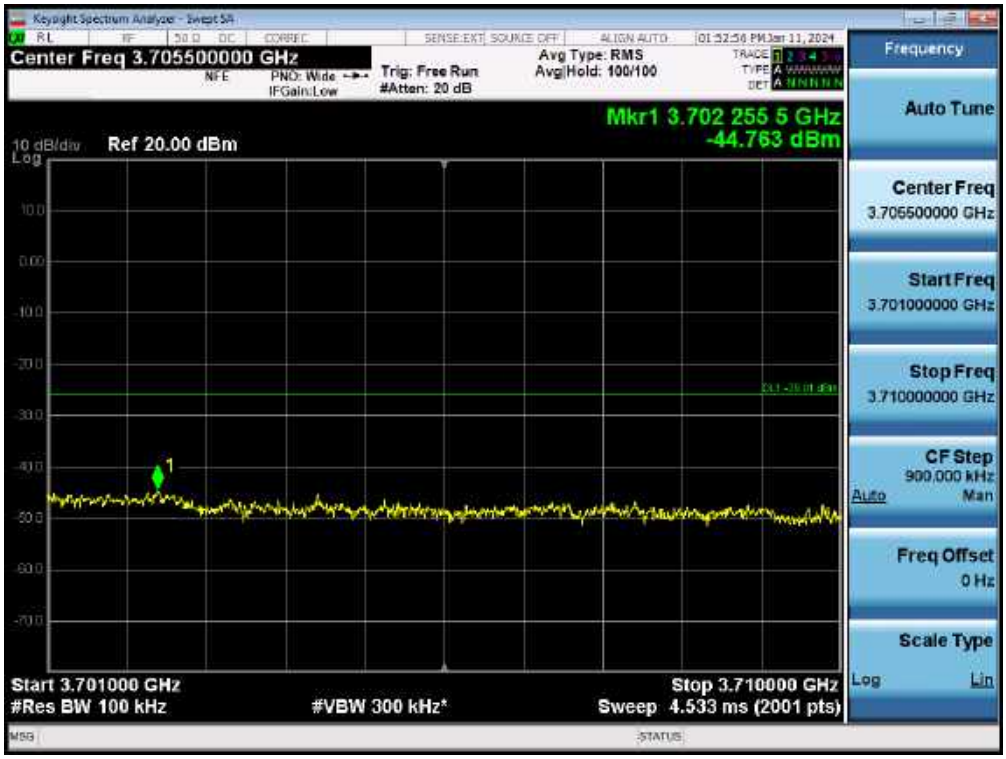


Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 3 530 MHz ~ Low Edge – 10 MHz / 256QAM / High



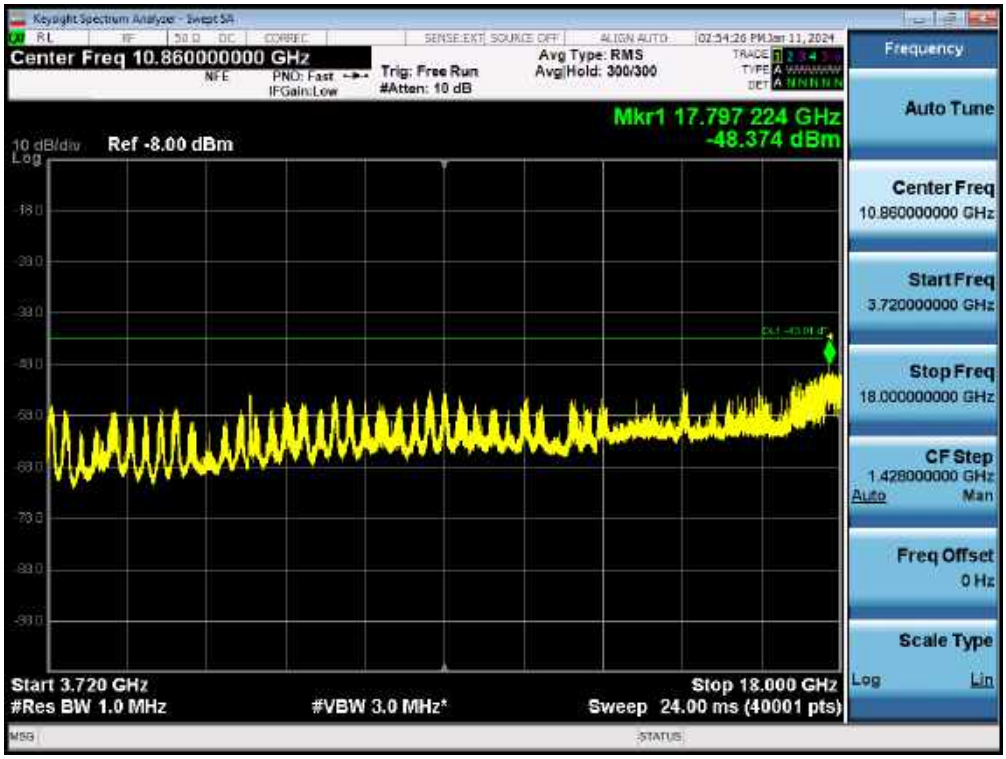
Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / Low Edge – 10 MHz ~ Low Edge – 1 MHz / 256QAM / High

Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / High Edge + 1 MHz ~ High Edge + 10 MHz / 256QAM / High



Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / High Edge + 10 MHz ~ 3 720 MHz / 256QAM / High

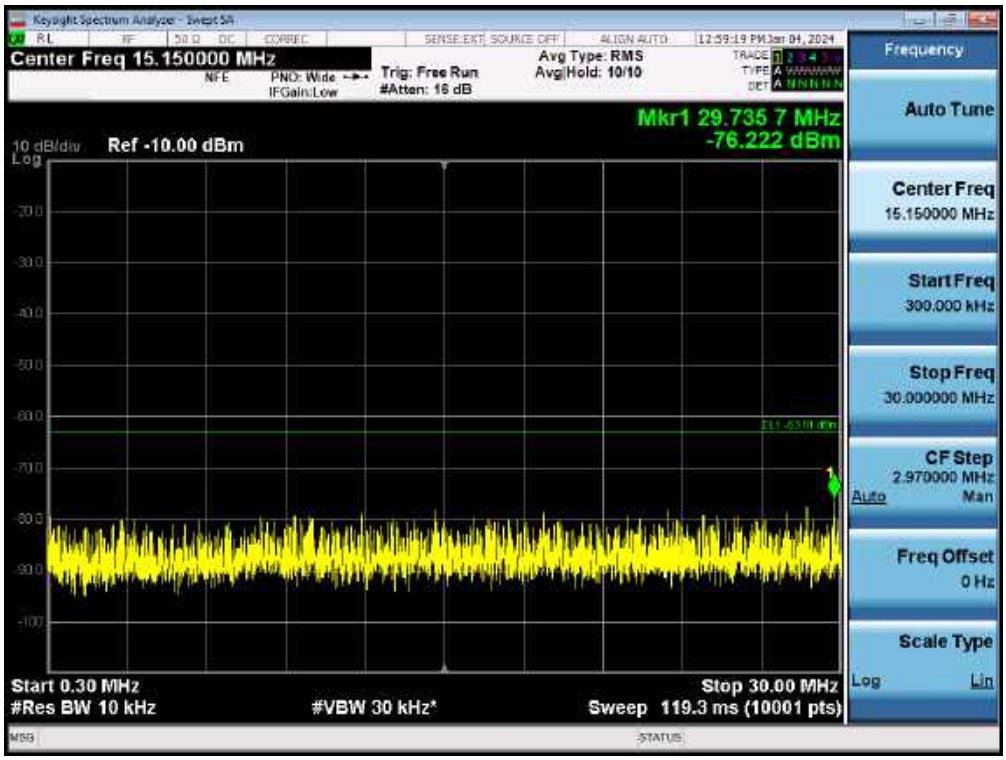
Antenna 1 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 3 720 MHz ~ 18 GHz / QPSK / High



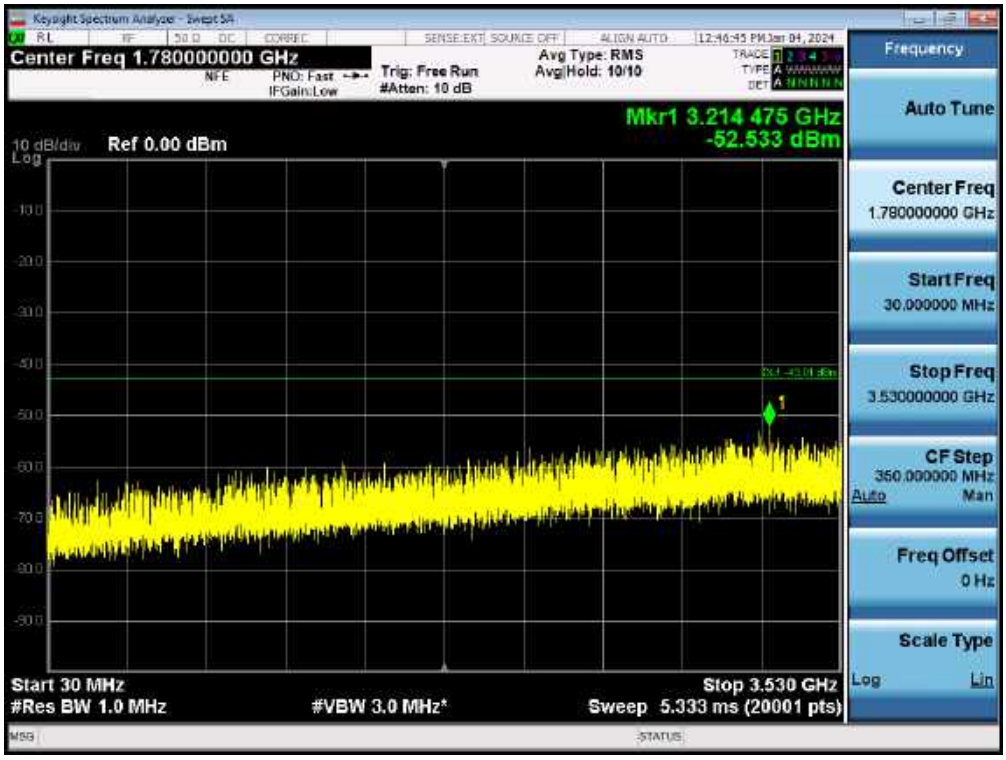
Antenna 0 / (2 Port) 5G NR n48 30 MHz [1 Carrier] / 18 GHz ~ 40 GHz / QPSK / Low

Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 9 kHz ~ 300 kHz / QPSK / Low

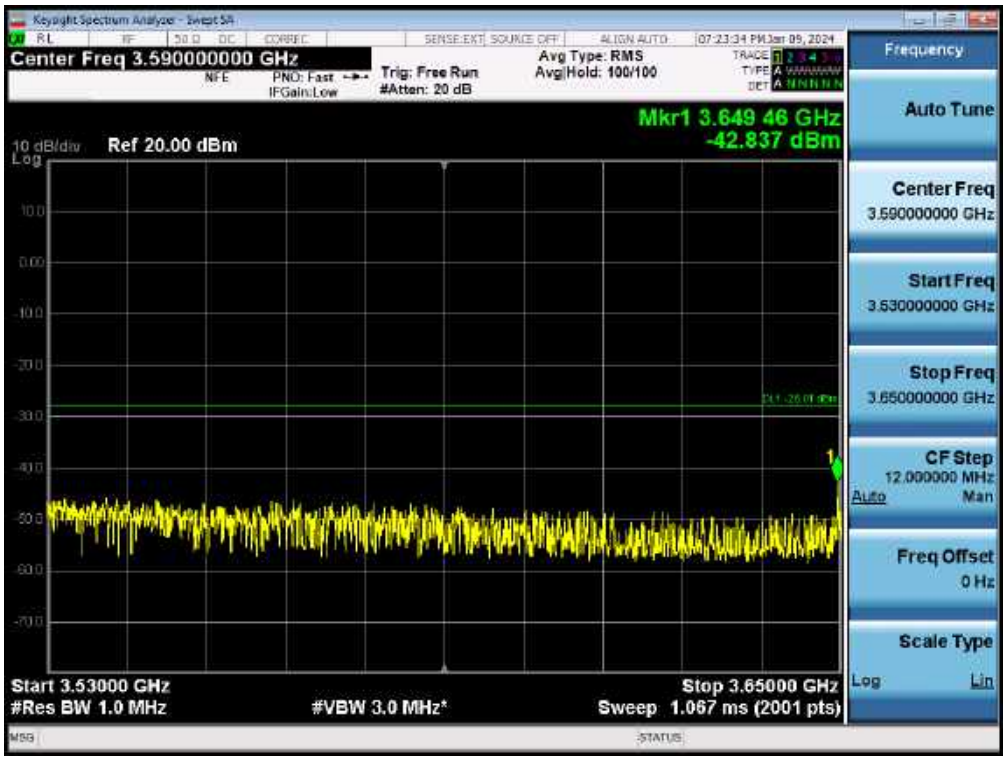
Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 300 kHz ~ 30 MHz / QPSK / Middle



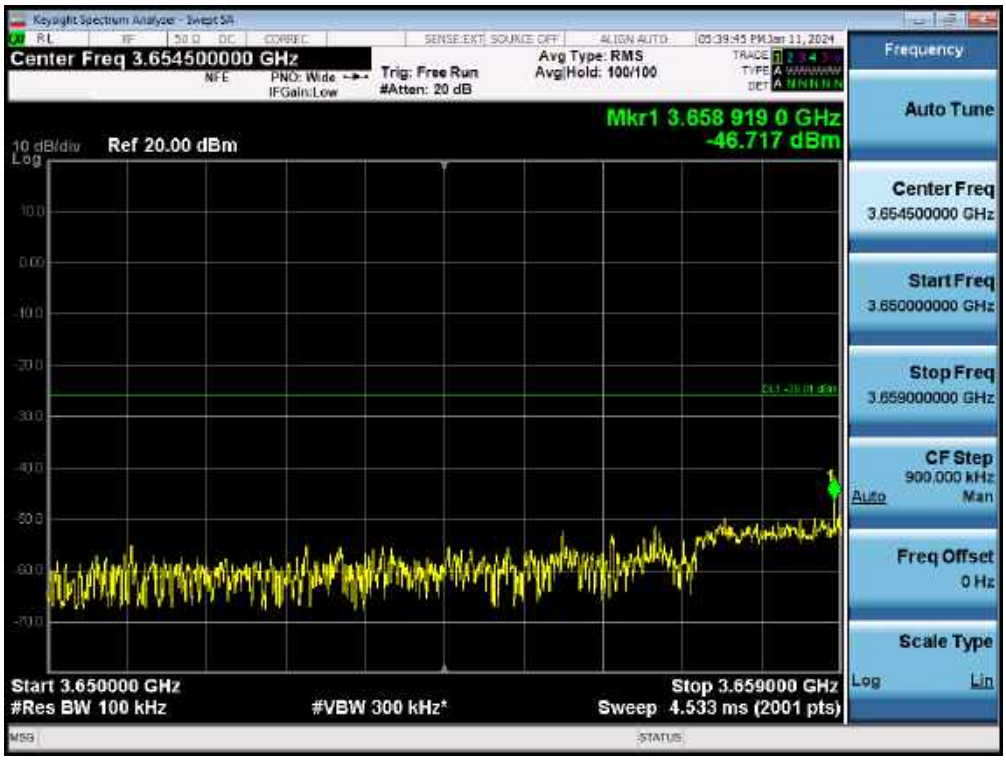
Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 30 MHz ~ 3 530 MHz / 256QAM / Low



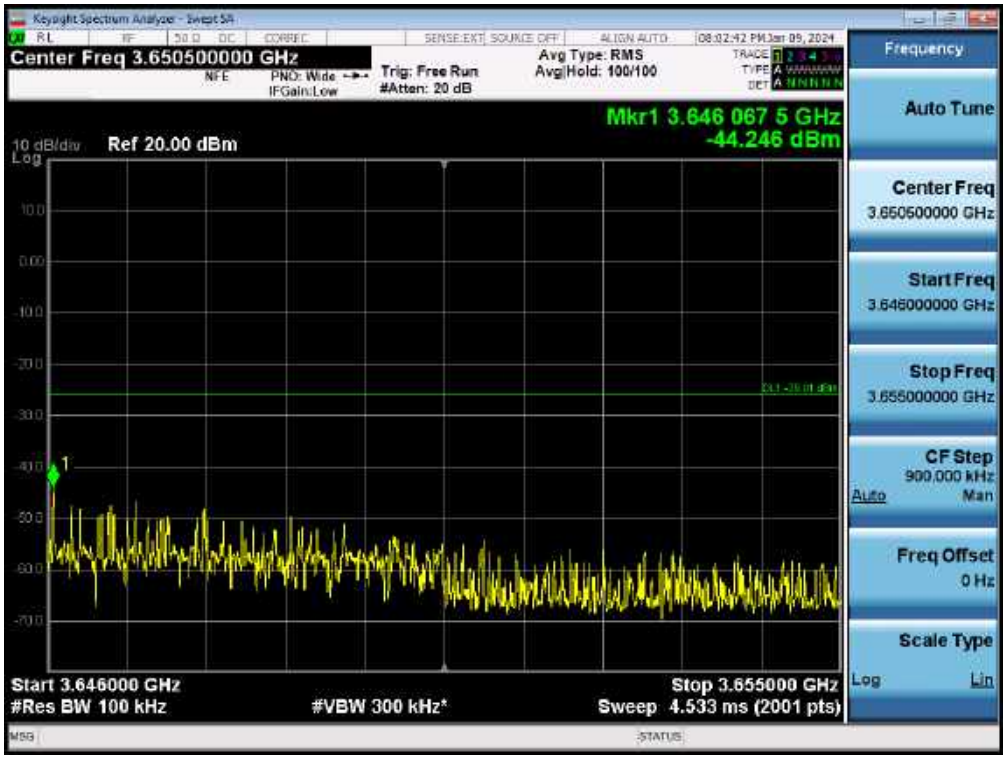
Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 3 530 MHz ~ Low Edge – 10 MHz / 16QAM / High



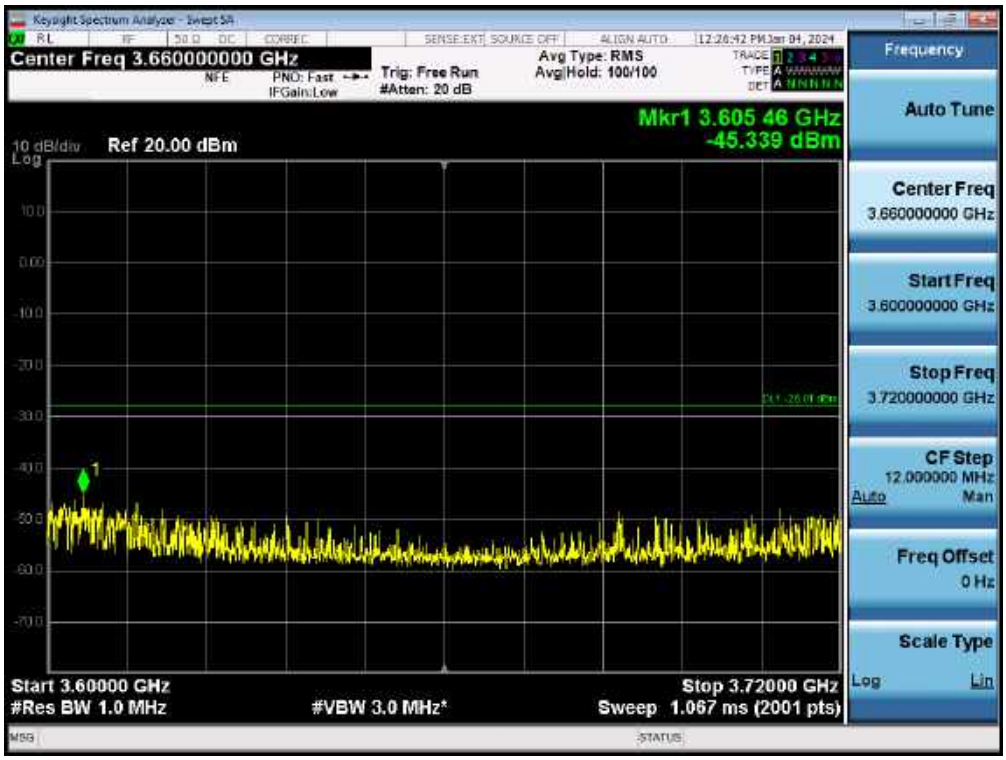
Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / Low Edge – 10 MHz ~ Low Edge – 1 MHz / 64QAM / High



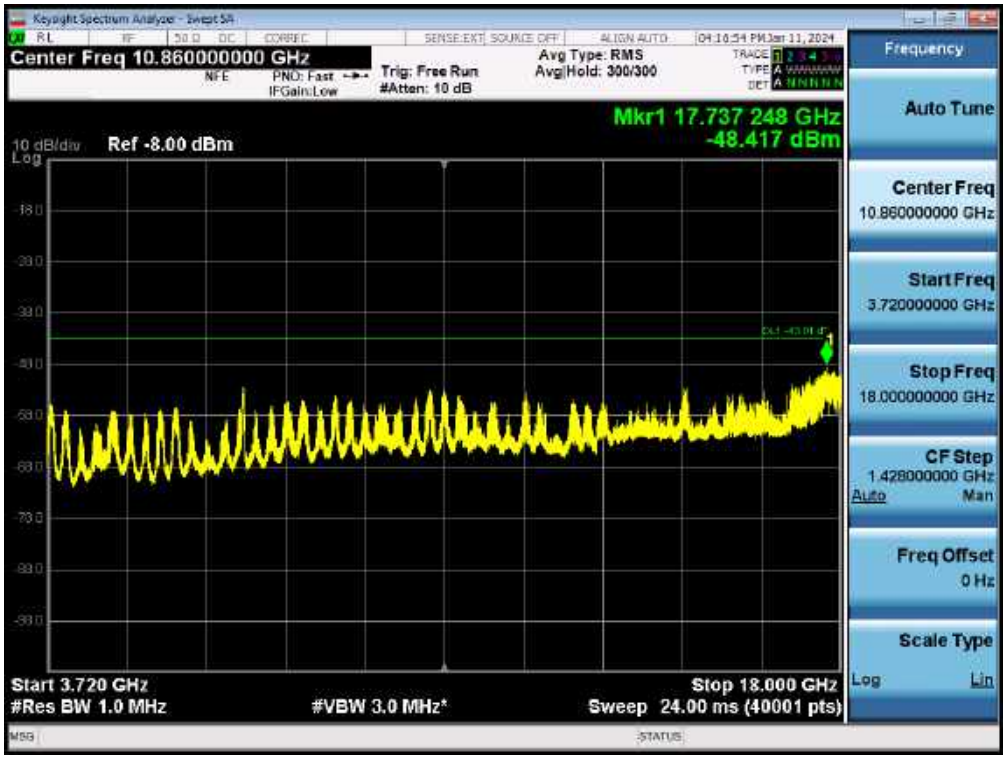
Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / High Edge + 1 MHz ~ High Edge + 10 MHz / 16QAM / Middle



Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / High Edge + 10 MHz ~ 3 720 MHz / QPSK / Low



Antenna 1 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 3 720 MHz ~ 18 GHz / 64QAM / Middle



Antenna 0 / (2 Port) 5G NR n48 40 MHz [1 Carrier] / 18 GHz ~ 40 GHz / 16QAM / Low

5.6. RADIATED 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.

96.41(e) General radio requirement: 3.5 GHz Emissions and Interference Limits.

(1) General protection levels.

(i) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any CBSD emission outside the fundamental emission bandwidth as specified in paragraph (e)(3) of this section (whether the emission is inside or outside of the authorized band) shall not exceed −13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any CBSD emission shall not exceed −25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

(ii) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed −25 dBm/MHz. Notwithstanding the emission

limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.

(2) Additional protection levels.

Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

(3) Measurement procedure.

(i) Compliance with this provision 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 authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental 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.

(ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits.

(iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

(4) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Test Procedures:

The measurement is performed in accordance with Section 5.5.3.2 of ANSI C63.26.

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.

d) ~ j) Omitted

k) Provide the complete measurement results as a part of the test report.

Note:

1. The results of the Radiated Emissions test shown above are measured at maximum power, and data values are attached only in the worst case.
2. We tested both single and simultaneous emissions, but we only attached the worst case result.
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. Measure distance = 3 m
5. All power supply of operation were investigated and the worst case configuration results are reported.

Test Results:

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 Peak Found								

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

Plot data of Radiated Emissions

(2 Port) 5G NR n48 10 MHz / Combine / QPSK / Middle

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.

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:

1. 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.
2. This test was performed From −20° to + 50° centigrade according to the operational description.
3. All power supply of operation were investigated and the worst case configuration results are reported.

Test Results:

Reference: Adaptor DC 24.0V at 20°C **Freq.** = 3,625,000,000 Hz

Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(°C)	(Hz)	Error (Hz)	(Hz)	
100 %	+20(Ref)	3 625 000 004.317	4.317	0.000	0.00000
	-30	3 625 000 001.471	1.471	-2.846	-0.00323
	-20	3 625 000 001.306	1.306	-3.011	-0.00342
	-10	3 625 000 003.814	3.814	-0.504	-0.00057
	0	3 625 000 002.336	2.336	-1.982	-0.00225
	+10	3 625 000 006.738	6.738	2.421	0.00275
	+30	3 625 000 007.907	7.907	3.590	0.00407
	+40	3 625 000 007.969	7.969	3.652	0.00414
	+50	3 625 000 007.696	7.696	3.379	0.00383
115 %	+20	3 625 000 007.974	7.974	3.656	0.00415
85 %	+20	3 625 000 002.646	2.646	-1.671	-0.00190

Note: The results of the frequency stability test shown above the frequency deviation measured values are very small and similer trend for each port, so attached datas were only the port 0.

6. Annex B_EUT AND TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2402-FC015-P