

TEST REPORT

FCC Sub6 n70 Test for SM-X528U
Certification

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-RF-2502-FC021

DATE OF ISSUE
February 10, 2025

Tested by
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Applicant

SAMSUNG Electronics Co., Ltd.

129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Product Name

Tablet

Model Name

SM-X528U

Date of Test

December 23, 2024 ~ February 07, 2025

FCC ID

A3LSMX528U

Location of Test

☒ Permanent Testing Lab ☐ On Site Testing

(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)

FCC Classification:

PCS Licensed Transmitter (PCB)

Test Standard Used

FCC Rule Part: § 27

Test Results

PASS

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	February 10, 2025	Initial Release

Notice

Content

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section § 2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C. 853(a)

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).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

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

The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

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MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	SAMSUNG Electronics Co., Ltd.
Address:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
FCC ID:	A3LSMX528U
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	§ 27
EUT Type:	Tablet
Model(s):	SM-X528U
SCS(kHz):	15
Bandwidth(MHz):	5, 10, 15
Waveform:	CP-OFDM, DFT-S-OFDM
Modulation:	DFT-S-OFDM: PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: QPSK, 16QAM, 64QAM, 256QAM
Tx Frequency:	1697.5 MHz – 1707.5 MHz (Sub6 n70(5 MHz)) 1700.0 MHz – 1705.0 MHz (Sub6 n70(10 MHz)) 1705.5 MHz (Sub6 n70(15 MHz))
Date(s) of Tests:	December 23, 2024 ~ February 07, 2025
Serial number:	Radiated : R32XC00A63Z Conducted : B32XC00A2XL

1.1 MAXIMUM OUTPUT POWER

Mode (MHz)	Tx Frequency (MHz)	Emission Designator	Modulation	EIRP	
				Max. Power (W)	Max. Power (dBm)
Sub6 n70 (5)	1697.5 – 1707.5	4M53G7D	PI/2 BPSK	0.297	24.73
		4M52G7D	QPSK	0.296	24.71
		4M51W7D	16QAM	0.228	23.57
		4M53W7D	64QAM	0.164	22.16
		4M53W7D	256QAM	0.105	20.22
Sub6 n70 (10)	1700.0 – 1705.0	8M99G7D	PI/2 BPSK	0.305	24.85
		9M02G7D	QPSK	0.300	24.77
		9M00W7D	16QAM	0.239	23.79
		8M99W7D	64QAM	0.168	22.26
		8M97W7D	256QAM	0.104	20.16
Sub6 n70 (15)	1702.5	13M4G7D	PI/2 BPSK	0.294	24.69
		13M5G7D	QPSK	0.283	24.52
		13M5W7D	16QAM	0.227	23.56
		13M5W7D	64QAM	0.163	22.13
		13M4W7D	256QAM	0.104	20.18

2. INTRODUCTION

2.1 DESCRIPTION OF EUT

Please refer to the [3G] Test Report.

2.2 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.3 TEST FACILITY

The Fully-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, Republic of Korea

3. DESCRIPTION OF TESTS

3.1 TEST PROCEDURE

Test Description	Test Procedure Used
Occupied Bandwidth	- KDB 971168 D01 v03r01 – Section 4.3 - ANSI C63.26-2015 – Section 5.4.4
Band Edge	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Spurious and Harmonic Emissions at Antenna Terminal	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Conducted Output Power	- N/A (See SAR Report)
Peak- to- Average Ratio	- KDB 971168 D01 v03r01 – Section 5.7 - ANSI C63.26-2015 – Section 5.2.3.4 - ANSI C63.26-2015 – Section 5.2.6(only GSM)
Frequency stability	- ANSI C63.26-2015 – Section 5.6
Radiated Power	- ANSI C63.26-2015 – Section 5.2.4.4 - KDB 971168 D01 v03r01 – Section 5.8
Radiated Spurious and Harmonic Emissions	- ANSI C63.26-2015 – Section 5.5.3 - KDB 971168 D01 v03r01 – Section 5.8

3.2 RADIATED POWER

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna.

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5 % of the expected OBW, not to exceed 1 MHz
3. VBW \geq 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points > 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Note

1. The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission.
2. A half wave dipole is then substituted in place of the EUT. For emissions above 1 GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is calculated by the following formula;

$$P_d \text{ (dBm)} = P_g \text{ (dBm)} - \text{cable loss (dB)} + \text{antenna gain (dB)}$$

Where: P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.

3. The maximum value is calculated by adding the forward power to the calibrated source plus its appropriate gain value.

These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration

4. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
5. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

3.3 RADIATED SPURIOUS EMISSIONS

Test Overview

Radiated tests are performed in the Fully-anechoic chamber.

Radiated Spurious Emission Measurements at 3 meters by Substitution Method.

Test Settings

1. RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1 GHz
2. VBW \geq 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points > 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10th harmonics from 9 kHz.

Test Note

1. Measurements value show only up to 3 maximum emissions noted, or would be lesser
if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit)
and considered that's already beyond the background noise floor.
2. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets,
and channel bandwidth configurations shown in the test data
3. For spurious emissions above 1 GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is
driven by a signal generator and the previously recorded signal was duplicated.
The spurious emissions is calculated by the following formula;

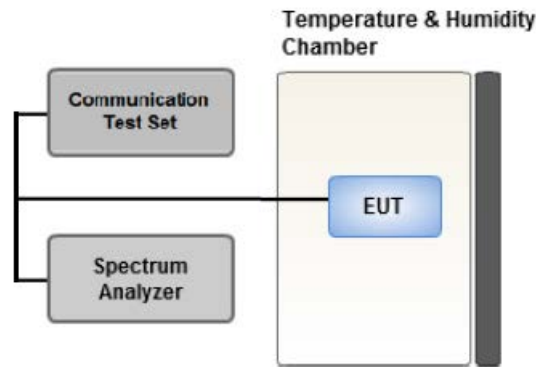
$$\text{Result}_{(\text{dBm})} = P_g_{(\text{dBm})} - \text{cable loss}_{(\text{dB})} + \text{antenna gain}_{(\text{dBi})}$$

Where: P_g is the generator output power into the substitution antenna.

If the fundamental frequency is below 1 GHz, RF output power has been converted to EIRP.

$$\text{EIRP}_{(\text{dBm})} = \text{ERP}_{(\text{dBm})} + 2.15$$

3.4 PEAK- TO- AVERAGE RATIO



Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth \geq signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Set the measurement interval as follows:
 - .- for continuous transmissions, set to 1 ms,
 - .- or 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 and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1 %.

② Alternate Procedure for PAPR

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as P_{Pk} .
 Use one of the applicable procedures presented 5.2(ANSI C63.26-2015) to measure the total average power and record as P_{Avg} . Determine the P.A.R. from:

$$P.A.R. (dB) = P_{Pk} (dBm) - P_{Avg} (dBm) \quad (P_{Avg} = \text{Average Power} + \text{Duty cycle Factor})$$

Test Settings(Peak Power)

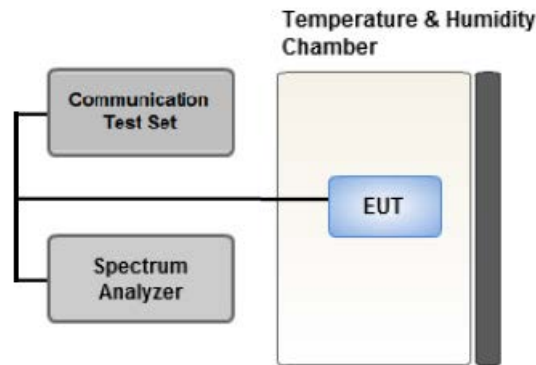
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW $\geq 3 \times$ RBW.

1. Set the RBW \geq OBW.
2. Set VBW $\geq 3 \times$ RBW.
3. Set span $\geq 2 \times$ OBW.
4. Sweep time $\geq 10 \times$ (number of points in sweep) \times (transmission symbol period).
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the peak amplitude level.

Test Settings(Average Power)

1. Set span to $2 \times$ to $3 \times$ the OBW.
2. Set RBW \geq OBW.
3. Set VBW $\geq 3 \times$ RBW.
4. Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
5. Sweep time:
Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$ for single sweep (automation-compatible) measurement. The transmission period is the (on + off) time.
6. Detector = power averaging (rms).
7. Set sweep trigger to "free run."
8. 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 the on and off period of the transmitter, 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.)
9. Use the peak marker function to determine the maximum amplitude level.
10. Add $[10 \log (1/\text{duty cycle})]$ to the measured maximum power level to compute the average power during continuous transmission. For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25 %.

3.5 OCCUPIED BANDWIDTH.



Test setup

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

The EUT makes a call to the communication simulator.

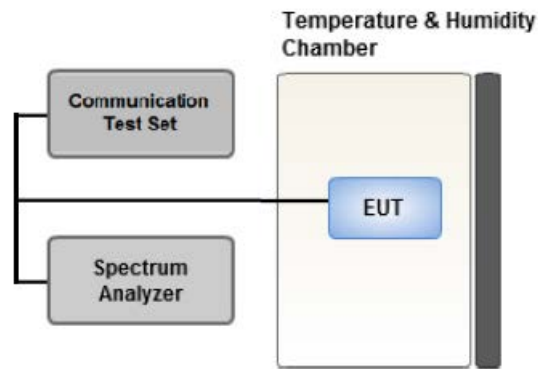
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99 % occupied bandwidth and the 26 dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5 % of the expected OBW
3. VBW \geq 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5 % of the 99 % occupied bandwidth observed in Step 7

3.6 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

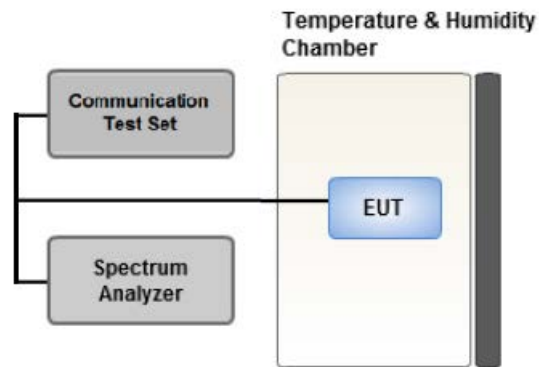
Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Settings

1. RBW = 1 MHz
2. VBW \geq 3 MHz
3. Detector = Peak
4. Trace Mode = Max Hold
5. Sweep time = auto
6. Number of points in sweep \geq 2 x Span / RBW

3.7 BAND EDGE



Test setup

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW > 1 % of the emission bandwidth
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

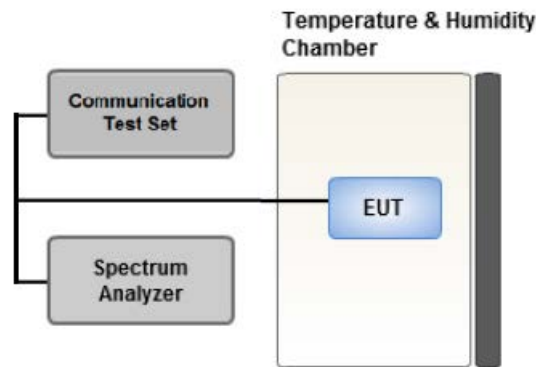
According to FCC 22.917, 24.238, 27.53 specified that power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

All measurements were done at 2 channels (low and high operational frequency range.)

The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

Where $\text{Margin} < 1$ dB the emission level is either corrected by $10 \log(1 \text{ MHz} / \text{RB})$ or the emission is integrated over a 1 MHz bandwidth to determine the final result. When using the integration method the integration window is either centered on the emission or, for emissions at the band edge, centered by an offset of 500 kHz from the block edge so that the integration window is the 1 MHz adjacent to the block edge.

3.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE



Test setup

Test Overview

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015.

The frequency stability of the transmitter is measured by:

1. Temperature:

The temperature is varied from -30 °C to +50 °C in 10 °C increments using an environmental chamber.

2. Primary Supply Voltage:

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

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20 °C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter.
Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10 °C intervals ranging from -30 °C to +50 °C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

3.9 WORST CASE(RADIATED TEST)

- Waveform : All Waveform of operation were investigated and the worst case configuration results are reported.
(Worst case: DFT-S-OFDM)
- The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
- All modes of operation were investigated and the worst case configuration results are reported.
Mode: SA Only
Mode : Stand alone, Stand alone + External accessories (Earphone, AC adapter, etc)
Worst case : Stand alone
- All simultaneous transmission scenarios of operation were investigated, and the test results showed no additional significant emissions relative to the least restrictive limit were observed.
Therefore, only the worst case(stand-alone) results were reported.
- All RB sizes, offsets of operation were investigated and the worst case configuration results are reported.
Please refer to the table below.
- In the case of radiated spurious emissions, all bandwidth of operation was investigated and the worst case bandwidth results are reported. (Worst case : 10 MHz)

[Worst case]				
Test Description	Modulation	RB size	RB offset	Axis
Equivalent Isotropic Radiated Power	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	See Section 8.1		X
Radiated Spurious and Harmonic Emissions	PI/2 BPSK	See Section 8.2		X

3.10 WORST CASE(CONDUCTED TEST)

- Waveform : All Waveform of operation were investigated and the worst case configuration results are reported.
(Worst case: DFT-S-OFDM)
- Modulation : All Modulation of operation were investigated and the worst case configuration results are reported.
(Worst case: PI/2 BPSK)
- All modes of operation were investigated and the worst case configuration results are reported.
Mode: SA Only
- All RB sizes, offsets of operation were investigated and the worst case configuration results are reported.
Please refer to the table below.

[Worst case]

Test Description	Modulation	Bandwidth (MHz)	Frequency	RB size	RB offset
Occupied Bandwidth, Peak-To-Average Ratio	PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM	5, 10, 15	Mid	Full RB	0
Band Edge	PI/2 BPSK	5	Low	1	0
			High	1	24
		10	Low	1	0
			High	1	51
		15	Low	1	0
			High	1	78
		5, 10, 15	Low, High	Full RB	0
Spurious and Harmonic Emissions at Antenna Terminal	PI/2 BPSK	5, 10, 15	Low, Mid, High	1	1

4. LIST OF TEST EQUIPMENT

Equipment	Model	Manufacture	Serial No.	Due to Calibration	Calibration Interval
Precision Dipole Antenna	UHAP	Schwarzbeck	01273	03/10/2026	Biennial
Precision Dipole Antenna	UHAP	Schwarzbeck	01274	03/10/2026	Biennial
Horn Antenna(1~18 GHz)	BBHA 9120D	Schwarzbeck	02289	02/14/2026	Biennial
Horn Antenna(1~18 GHz)	BBHA 9120D	Schwarzbeck	9120D-1299	04/27/2025	Biennial
Horn Antenna(15~40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170342	09/20/2026	Biennial
Horn Antenna(15~40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
Loop Antenna(9 kHz~30 MHz)	FMZB1513	Rohde & Schwarz	1513-175	01/06/2027	Biennial
Trilog Broadband Antenna	VULB9168	Schwarzbeck	895	08/28/2026	Biennial
Trilog Broadband Antenna	VULB9168	Schwarzbeck	1135	08/19/2026	Biennial
RF Switching System	FBSR-06B (1G HPF + LNA)	T&M SYSTEM	F3L1	05/14/2025	Annual
RF Switching System	FBSR-06B (3G HPF + LNA)	T&M SYSTEM	F3L2	05/14/2025	Annual
RF Switching System	FBSR-06B (6G HPF + LNA)	T&M SYSTEM	F3L3	05/14/2025	Annual
RF Switching System	FBSR-06B (LNA)	T&M SYSTEM	F3L4	05/14/2025	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/07/2025	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/26/2025	Annual
DC Power Supply	E3632A	Hewlett Packard	MY40004427	08/22/2025	Annual
Power Splitter(DC~26.5 GHz)	11667B	Hewlett Packard	11275	02/04/2026	Annual
Chamber	SU-642	ESPEC	93008124	02/19/2025	Annual
Signal Analyzer(10 Hz~26.5 GHz)	N9020A	Agilent	MY51110063	04/04/2025	Annual
ATTENUATOR(20 dB)	8493C	Hewlett Packard	17280	04/17/2025	Annual
Spectrum Analyzer (10 Hz~40 GHz)	FSV40	REOHDE & SCHWARZ	101436	02/04/2026	Annual
Signal & Spectrum Analyzer (2 Hz~67 GHz)	FSW67	REOHDE & SCHWARZ	101736	05/23/2025	Annual
Base Station	8960 (E5515C)	Agilent	MY48360800	08/05/2025	Annual
Wideband Radio Communication Tester	MT8821C	Anritsu Corp.	6262287701	05/16/2025	Annual
Wideband Radio Communication Tester	MT8000A	Anritsu Corp.	6262302511	05/14/2025	Annual
Signal Analyzer(5 Hz~40.0 GHz)	N9030B	KEYSIGHT	MY55480167	05/17/2025	Annual
4-Way Divider	ZC4PD-K1844+	Mini-Circuits	942907	09/10/2025	Annual
SIGNAL GENERATOR (100 kHz ~ 40 GHz)	SMB100A	REOHDE & SCHWARZ	177633	07/26/2025	Annual
FCC LTE Mobile Conducted RF Automation Test Software	-	HCT CO., LTD.,	-	-	-

Note:

- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
- Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (\pm kHz)
Occupied Bandwidth	95 (Confidence level about 95 %, $k=2$)
Frequency stability	28 (Confidence level about 95 %, $k=2$)

Parameter	Expanded Uncertainty (\pm dB)
Block Edge	0.70 (Confidence level about 95 %, $k=2$)
Conducted Spurious Emissions	1.18 (Confidence level about 95 %, $k=2$)
Peak- to- Average Ratio	0.68 (Confidence level about 95 %, $k=2$)
Radiated Power	4.74 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (Above 40 GHz)	5.58 (Confidence level about 95 %, $k=2$)

6. SUMMARY OF TEST RESULTS

6.1 Test Condition: Conducted Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Occupied Bandwidth	§ 2.1049	N/A	PASS
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§ 2.1051, § 27.53(h)	< 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions	PASS
Conducted Output Power	§ 2.1046	N/A	<u>See Note1</u>
Peak- to- Average Ratio	§ 27.50(d)(5)	< 13 dB	PASS
Frequency stability / variation of ambient temperature	§ 2.1055, § 27.54	Emission must remain in band	PASS

Note:

1. See SAR Report
2. All conducted tests were tested using 5G Wireless Tester.

6.2 Test Condition: Radiated Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Equivalent Isotropic Radiated Power	§ 27.50(d)(4)	< 1 Watts max. EIRP	PASS
Radiated Spurious and Harmonic Emissions	§ 2.1053, § 27.53(h)	< 43 + 10log10 (P[Watts]) for all out-of band emissions	PASS

Note:

1. Radiated tests were tested using 5G Wireless Tester.

7. SAMPLE CALCULATION

7.1 ERP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
channel	Freq.(MHz)						W	dBm
128	824.20	-21.37	38.40	-10.61	0.95	H	0.483	26.84

$$\text{ERP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test, the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power.

7.2 EIRP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol.	EIRP	
channel	Freq.(MHz)						W	dBm
20175	1,732.50	-15.75	18.45	9.90	1.76	H	0.456	26.59

$$\text{EIRP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test, the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of equivalent isotropic radiated power.

7.3. Emission Designator

GSM Emission Designator

Emission Designator = 249KGXW
GSM BW = 249 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 249KG7W
GSM BW = 249 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M17F9W
WCDMA BW = 4.17 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 4M48G7D
LTE BW = 4.48 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

QAM Modulation

Emission Designator = 4M48W7D
LTE BW = 4.48 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

8. TEST DATA

8.1 EQUIVALENT ISOTROPIC RADIATED POWER

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measure d Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1697.5	Sub6 n70/ 5 MHz [15 kHz]	PI/2 BPSK	-16.49	16.84	9.96	2.07	H	< 1.00	0.297	24.73	1	12
		QPSK	-16.51	16.82	9.96	2.07	H		0.296	24.71		
		16-QAM	-17.79	15.54	9.96	2.07	H		0.221	23.43		
		64-QAM	-19.06	14.27	9.96	2.07	H		0.164	22.16		
		256-QAM	-21.00	12.33	9.96	2.07	H		0.105	20.22		
1702.5		PI/2 BPSK	-16.40	16.75	10.02	2.06	H		0.296	24.71	1	23
		QPSK	-16.44	16.71	10.02	2.06	H		0.293	24.67		
		16-QAM	-17.54	15.61	10.02	2.06	H		0.228	23.57		
		64-QAM	-19.01	14.14	10.02	2.06	H		0.162	22.10		
		256-QAM	-21.04	12.11	10.02	2.06	H		0.102	20.07		
1707.5		PI/2 BPSK	-16.38	16.61	10.07	2.06	H	0.290	24.62	1	1	
		QPSK	-16.47	16.52	10.07	2.06	H	0.284	24.53			
		16-QAM	-17.52	15.47	10.07	2.06	H	0.223	23.48			
		64-QAM	-18.96	14.03	10.07	2.06	H	0.160	22.04			
		256-QAM	-21.01	11.98	10.07	2.06	H	0.100	19.99			

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1700.0	Sub6 n70/ 10 MHz [15 kHz]	Pl/2 BPSK	-16.37	16.96	9.96	2.07	H	< 1.00	0.306	24.85	1	50
		QPSK	-16.49	16.84	9.96	2.07	H		0.297	24.73		
		16-QAM	-17.52	15.81	9.96	2.07	H		0.235	23.70		
		64-QAM	-19.02	14.31	9.96	2.07	H		0.166	22.20		
		256-QAM	-21.06	12.27	9.96	2.07	H		0.104	20.16		
1702.5		Pl/2 BPSK	-16.44	16.71	10.02	2.06	H		0.293	24.67	1	1
		QPSK	-16.47	16.68	10.02	2.06	H		0.291	24.64		
		16-QAM	-17.46	15.69	10.02	2.06	H		0.232	23.65		
		64-QAM	-19.07	14.08	10.02	2.06	H		0.160	22.04		
		256-QAM	-21.14	12.01	10.02	2.06	H		0.099	19.97		
1705.0		Pl/2 BPSK	-16.32	16.83	10.02	2.06	H	0.302	24.79	1	26	
		QPSK	-16.34	16.81	10.02	2.06	H	0.300	24.77			
		16-QAM	-17.32	15.83	10.02	2.06	H	0.239	23.79			
		64-QAM	-18.85	14.30	10.02	2.06	H	0.168	22.26			
		256-QAM	-20.95	12.20	10.02	2.06	H	0.104	20.16			

Freq (MHz)	Mod/ Bandwidth [SCS (kHz)]	Modulation	Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol	Limit	EIRP		RB	
								W	W	dBm	Size	Offset
1702.5	Sub6 n70/ 15 MHz [15 kHz]	PI/2 BPSK	-16.42	16.73	10.02	2.06	H	< 1.00	0.294	24.69	1	39
		QPSK	-16.59	16.56	10.02	2.06	H		0.283	24.52		
		16-QAM	-17.55	15.60	10.02	2.06	H		0.227	23.56		
		64-QAM	-18.98	14.17	10.02	2.06	H		0.163	22.13		
		256-QAM	-20.93	12.22	10.02	2.06	H		0.104	20.18		

8.2 RADIATED SPURIOUS EMISSIONS

■ NR Band:	<u>N70</u>
■ Bandwidth:	<u>10 MHz</u>
■ Modulation:	<u>PI/2 BPSK</u>
■ Distance:	<u>3 meters</u>
■ SCS:	<u>15 kHz</u>

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBi)	Substitute Level (dBm)	C.L	Pol	Result (dBm)	Limit (dBm)	RB	
									Size	Offset
340000 (1700.0)	3 400.00	-60.81	11.60	-62.25	2.98	V	-53.63	-13.00	1	50
	5 100.00	-61.00	11.31	-55.26	3.78	V	-47.73	-13.00		
	6 800.00	-61.94	10.96	-50.34	4.36	V	-43.74	-13.00		
340500 (1702.5)	3 405.00	-61.88	11.63	-63.50	2.97	V	-54.84	-13.00	1	1
	5 107.50	-61.87	11.34	-56.27	3.79	V	-48.72	-13.00		
	6 810.00	-64.02	10.97	-52.63	4.38	V	-46.04	-13.00		
341000 (1705.0)	3 410.00	-61.19	11.66	-62.98	2.96	V	-54.28	-13.00	1	26
	5 115.00	-62.76	11.36	-57.09	3.80	V	-49.53	-13.00		
	6 820.00	-63.64	10.98	-52.39	4.37	V	-45.78	-13.00		

8.3 PEAK-TO-AVERAGE RATIO

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (dB)
Sub6 n70	5 MHz	1702.5	BPSK	25	0	5.13
			QPSK			5.86
			16-QAM			6.60
			64-QAM			6.58
			256-QAM			6.48
	10 MHz		BPSK	50		5.51
			QPSK			5.75
			16-QAM			6.24
			64-QAM			6.56
			256-QAM			6.46
	15 MHz		BPSK	75		4.36
			QPSK			5.61
			16-QAM			6.27
			64-QAM			6.52
			256-QAM			6.53

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 36 ~ 50.

8.4 OCCUPIED BANDWIDTH

Band	Band Width	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
Sub6 n70	5 MHz	1702.5	BPSK	25	0	4.5293
			QPSK			4.5155
			16-QAM			4.5110
			64-QAM			4.5340
			256-QAM			4.5264
	10 MHz		BPSK	50		8.9871
			QPSK			9.0231
			16-QAM			9.0009
			64-QAM			8.9872
			256-QAM			8.9672
	15 MHz		BPSK	75		13.445
			QPSK			13.525
			16-QAM			13.501
			64-QAM			13.489
			256-QAM			13.439

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 51 ~ 65.

8.5 CONDUCTED SPURIOUS EMISSIONS

Band	Band Width (MHz)	Frequency (MHz)	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result (dBm)	Limit (dBm)
Sub6 n70	5	1697.5	4.0180	30.200	-62.599	-32.399	-13.00
		1702.5	9.1625	30.815	-62.521	-31.706	
		1707.5	9.1924	30.815	-63.076	-32.261	
	10	1700.0	9.9202	30.815	-63.432	-32.617	
		1702.5	9.5713	30.815	-63.188	-32.373	
		1705.0	6.0419	30.815	-62.764	-31.949	
	15	1702.5	9.9801	30.815	-63.480	-32.665	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 66 ~ 79.
2. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
3. Factor(dB) = Cable Loss + Ext. Attenuator + Power Splitter

Frequency Range (GHz)	Factor [dB]
0.03 – 1	27.494
1 – 5	30.200
5 – 10	30.815
10 – 15	31.340
15 – 20	31.713
Above 20	32.355

8.6 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 80 ~ 97.

8.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

- ▣ BandWidth: 5 MHz
- ▣ Voltage(100 %): 3.860 VDC
- ▣ Batt. Endpoint: 3.400 VDC
- ▣ LIMIT: Emission must remain in band

Test. Frequency	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(°C)	(Hz)	Error (Hz)	(%)	
1697.5	100 %	+20(Ref)	1697 500 002	0.0	0.000 000	0.000
	100 %	-30	1697 500 001	-0.2	0.000 000	0.000
	100 %	-20	1697 500 002	0.2	0.000 000	0.000
	100 %	-10	1697 500 000	-1.7	0.000 000	-0.001
	100 %	0	1697 500 001	-0.6	0.000 000	0.000
	100 %	+10	1697 500 001	-0.2	0.000 000	0.000
	100 %	+30	1697 500 003	1.2	0.000 000	0.001
	100 %	+40	1697 500 002	0.1	0.000 000	0.000
	100 %	+50	1697 500 002	0.1	0.000 000	0.000
	Batt. Endpoint	+20	1697 500 002	0.7	0.000 000	0.000
1707.5	100 %	+20(Ref)	1707 499 999	0.0	0.000 000	0.000
	100 %	-30	1707 499 999	0.8	0.000 000	0.000
	100 %	-20	1707 499 997	-1.6	0.000 000	-0.001
	100 %	-10	1707 499 999	0.0	0.000 000	0.000
	100 %	0	1707 499 999	0.8	0.000 000	0.000
	100 %	+10	1707 499 997	-1.9	0.000 000	-0.001
	100 %	+30	1707 500 000	1.8	0.000 000	0.001
	100 %	+40	1707 499 998	-1.1	0.000 000	-0.001
	100 %	+50	1707 499 999	0.8	0.000 000	0.000
	Batt. Endpoint	+20	1707 499 999	0.7	0.000 000	0.000

- ▣ BandWidth: 10 MHz
- ▣ Voltage(100 %): 3.860 VDC
- ▣ Batt. Endpoint: 3.400 VDC
- ▣ LIMIT: Emission must remain in band

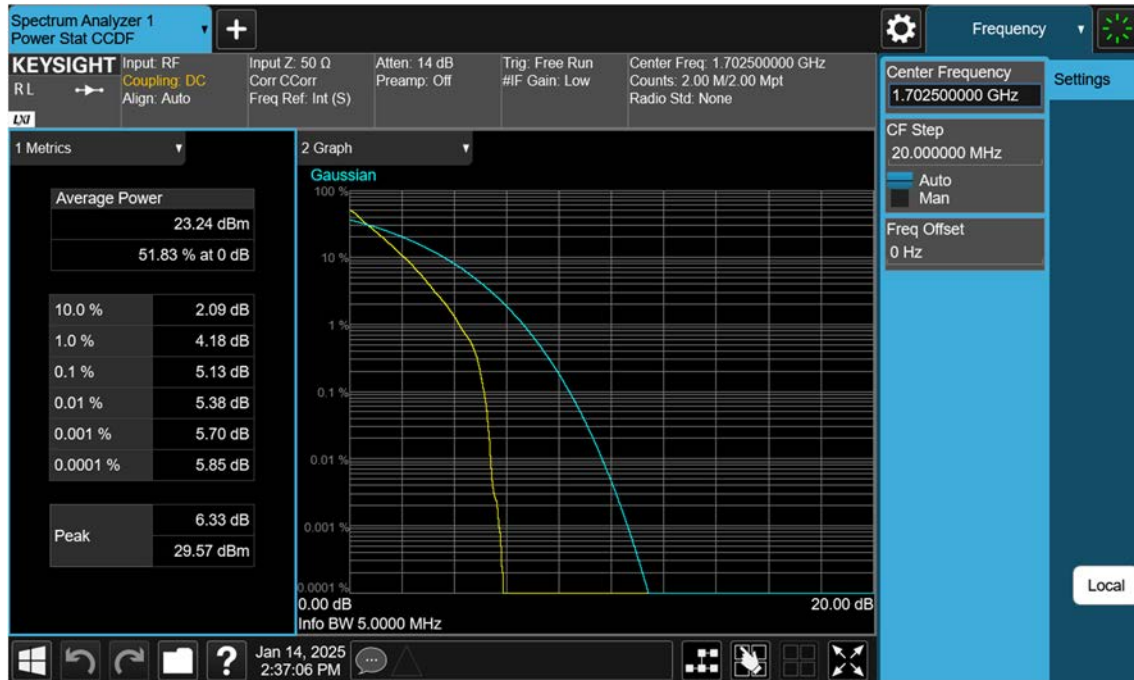
Test. Frequency	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(°C)	(Hz)	Error (Hz)	(%)	
1700.0	100 %	+20(Ref)	1699 999 997	0.0	0.000 000	0.000
	100 %	-30	1699 999 998	0.7	0.000 000	0.000
	100 %	-20	1699 999 998	0.8	0.000 000	0.000
	100 %	-10	1699 999 998	0.7	0.000 000	0.000
	100 %	0	1699 999 997	0.3	0.000 000	0.000
	100 %	+10	1699 999 996	-0.6	0.000 000	0.000
	100 %	+30	1699 999 998	1.5	0.000 000	0.001
	100 %	+40	1699 999 998	1.2	0.000 000	0.001
	100 %	+50	1699 999 996	-1.4	0.000 000	-0.001
	Batt. Endpoint	+20	1700 000 000	2.6	0.000 000	0.002
1705.0	100 %	+20(Ref)	1705 000 001	0.0	0.000 000	0.000
	100 %	-30	1705 000 002	1.7	0.000 000	0.001
	100 %	-20	1705 000 002	1.3	0.000 000	0.001
	100 %	-10	1705 000 002	1.6	0.000 000	0.001
	100 %	0	1705 000 001	0.7	0.000 000	0.000
	100 %	+10	1705 000 000	-0.8	0.000 000	0.000
	100 %	+30	1705 000 004	3.7	0.000 000	0.002
	100 %	+40	1705 000 001	0.3	0.000 000	0.000
	100 %	+50	1705 000 001	0.0	0.000 000	0.000
	Batt. Endpoint	+20	1705 000 003	2.4	0.000 000	0.001

- ▣ BandWidth: 15 MHz
- ▣ Voltage(100 %): 3.860 VDC
- ▣ Batt. Endpoint: 3.400 VDC
- ▣ LIMIT: Emission must remain in band

Test. Frequency	Voltage	Temp.	Frequency	Frequency	Deviation	ppm
(MHz)	(%)	(°C)	(Hz)	Error (Hz)	(%)	
1702.5	100 %	+20(Ref)	1702 499 998	0.0	0.000 000	0.000
	100 %	-30	1702 499 997	-1.2	0.000 000	-0.001
	100 %	-20	1702 499 998	-0.8	0.000 000	0.000
	100 %	-10	1702 499 997	-1.5	0.000 000	-0.001
	100 %	0	1702 499 998	-0.1	0.000 000	0.000
	100 %	+10	1702 499 996	-2.1	0.000 000	-0.001
	100 %	+30	1702 499 999	0.5	0.000 000	0.000
	100 %	+40	1702 500 000	1.6	0.000 000	0.001
	100 %	+50	1702 499 998	-0.4	0.000 000	0.000
	Batt. Endpoint	+20	1702 499 997	-1.2	0.000 000	-0.001

9. TEST PLOTS

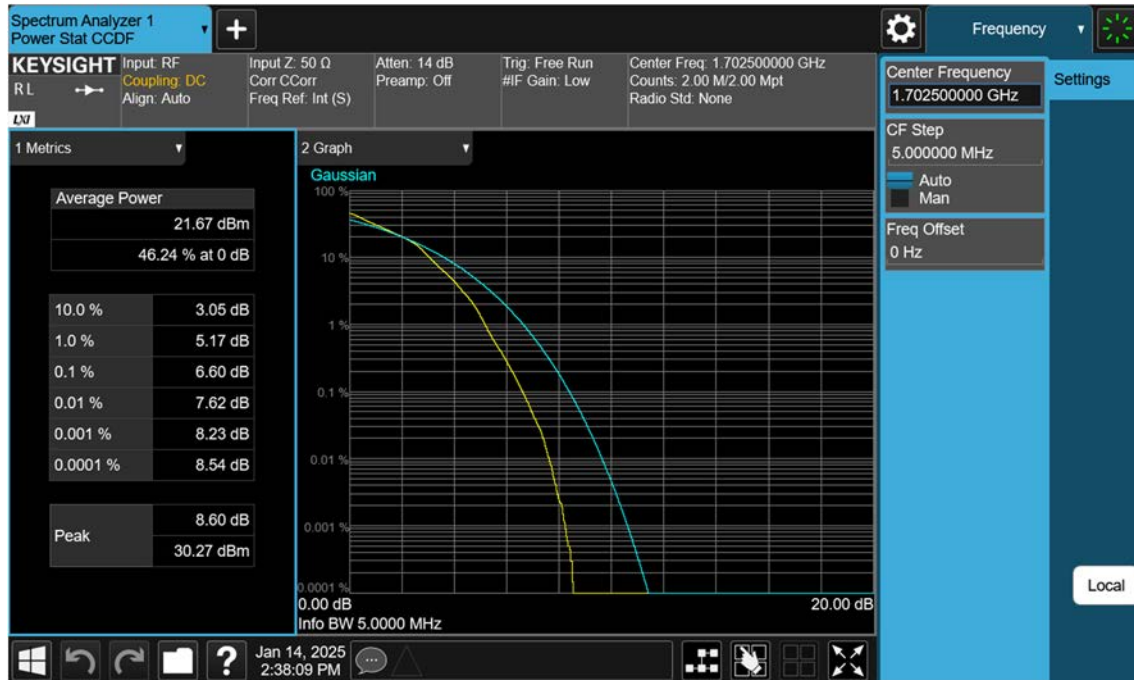
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NR70_5 M_PAR_Mid_QPSK_FullIRB



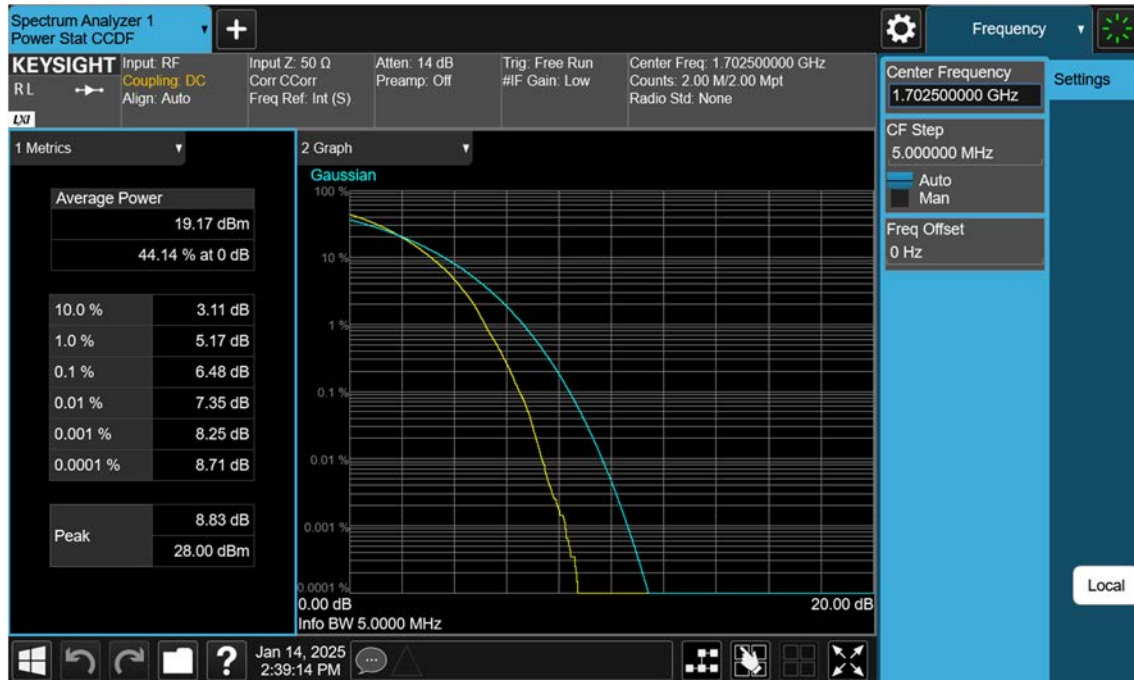
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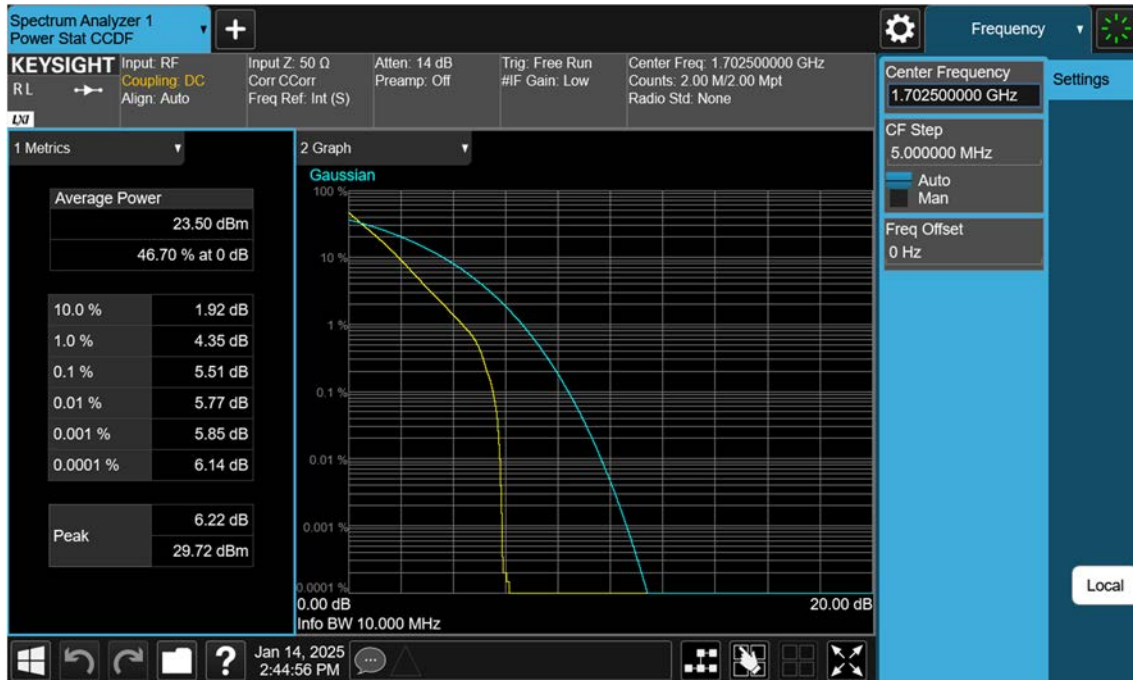
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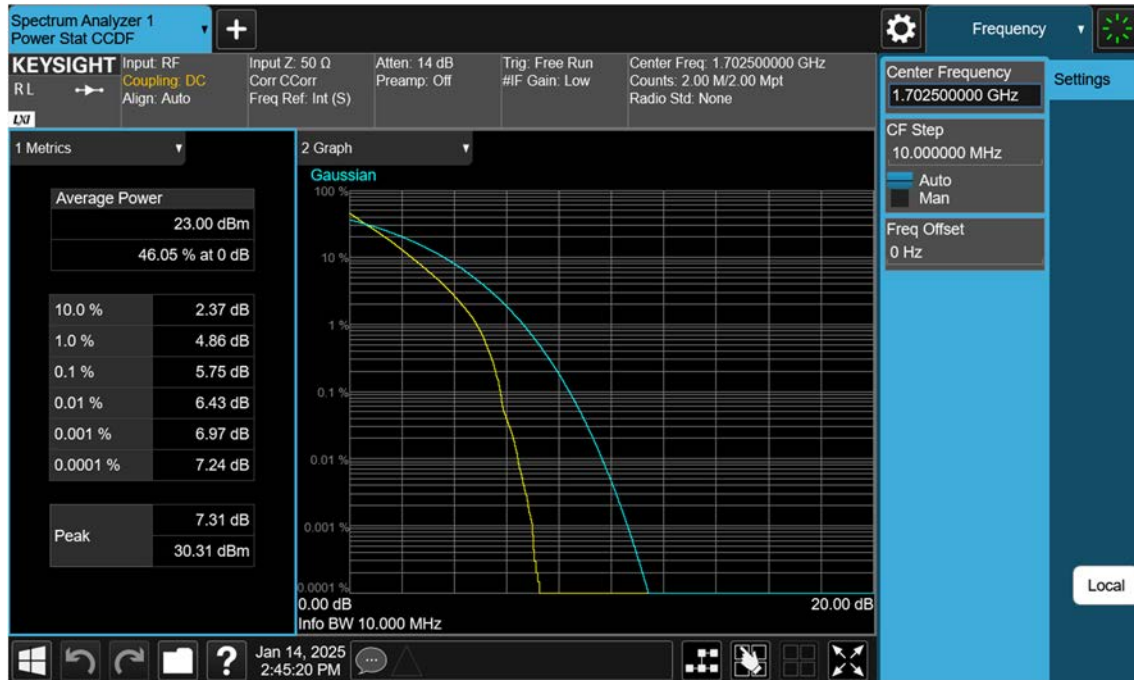
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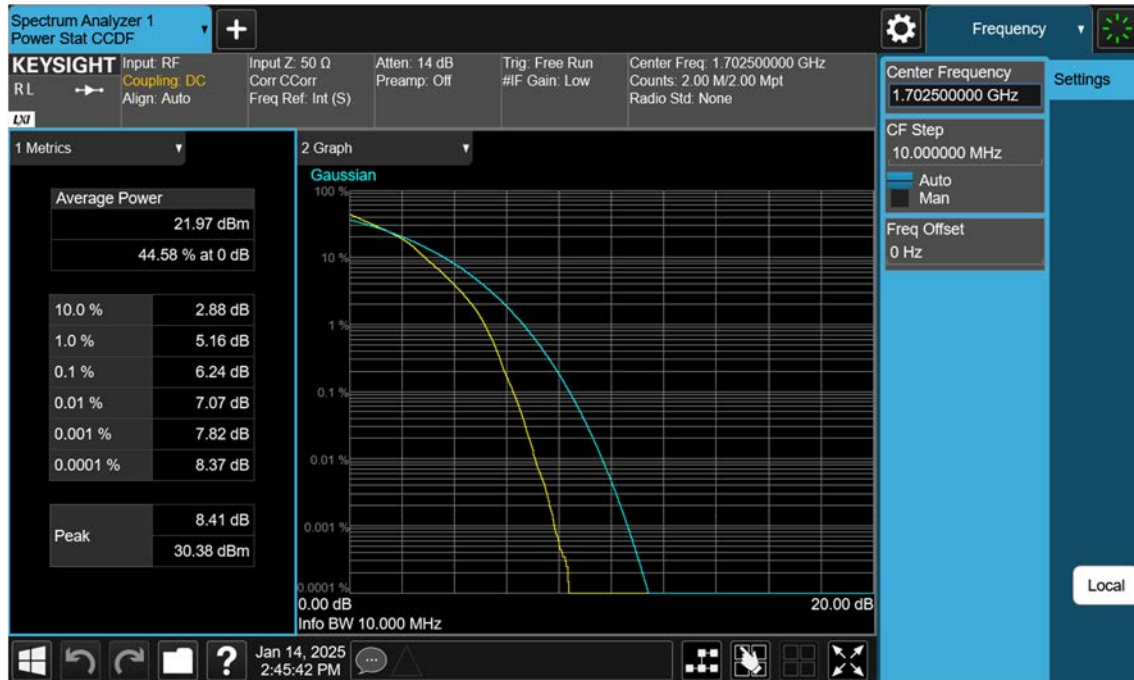
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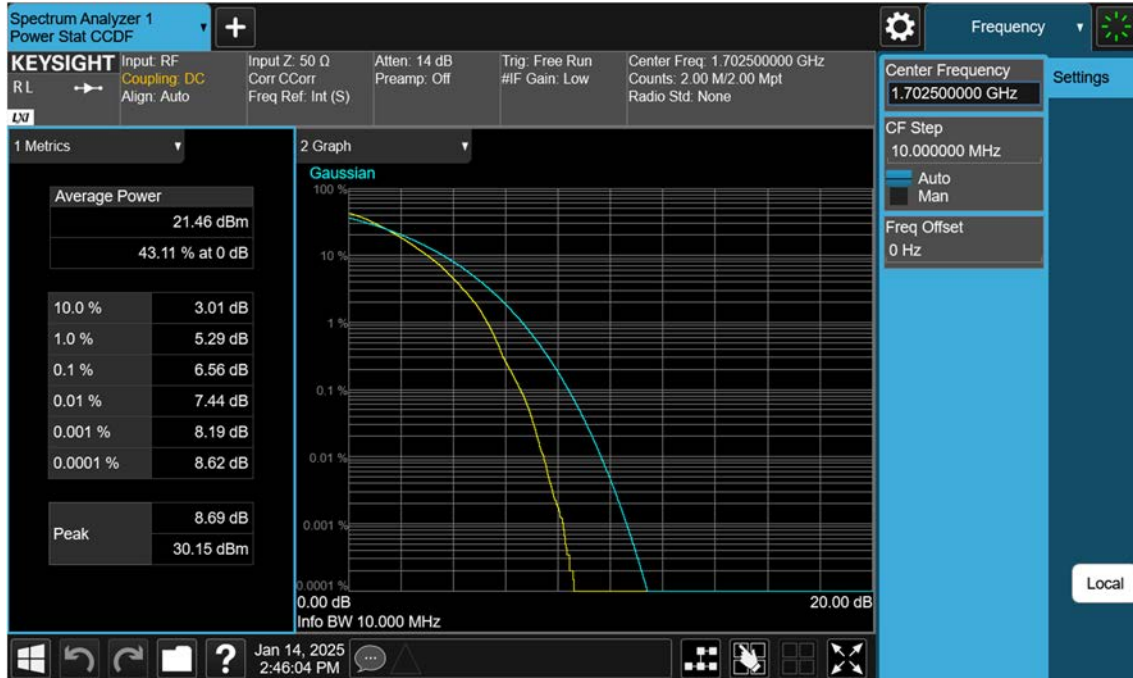
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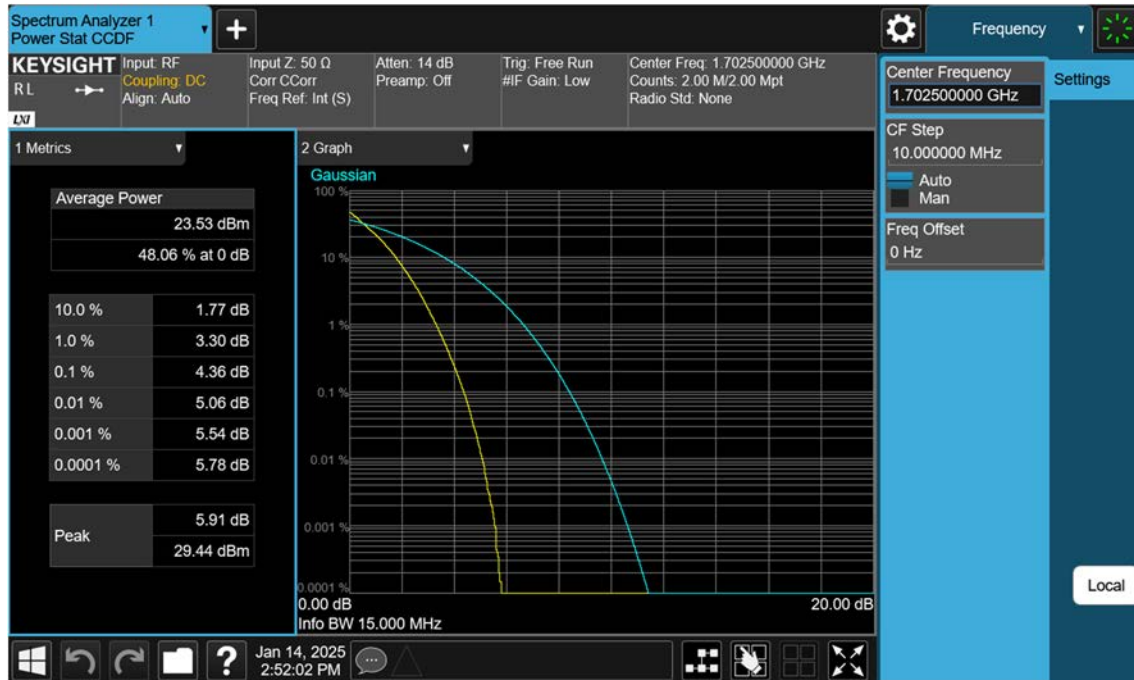
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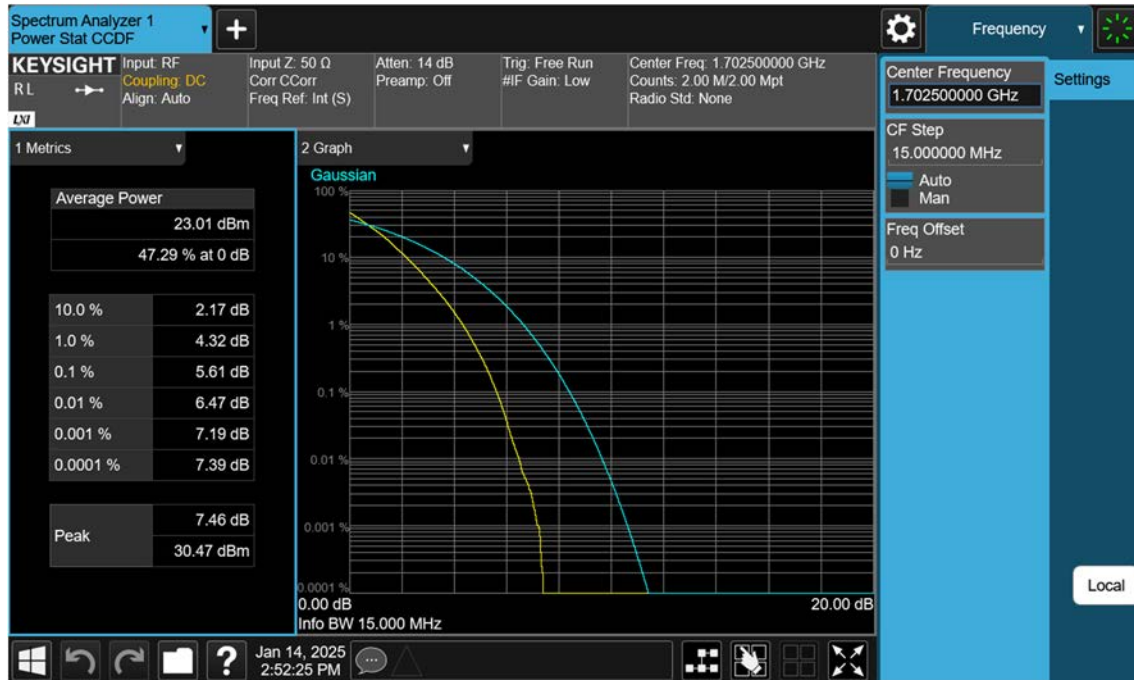
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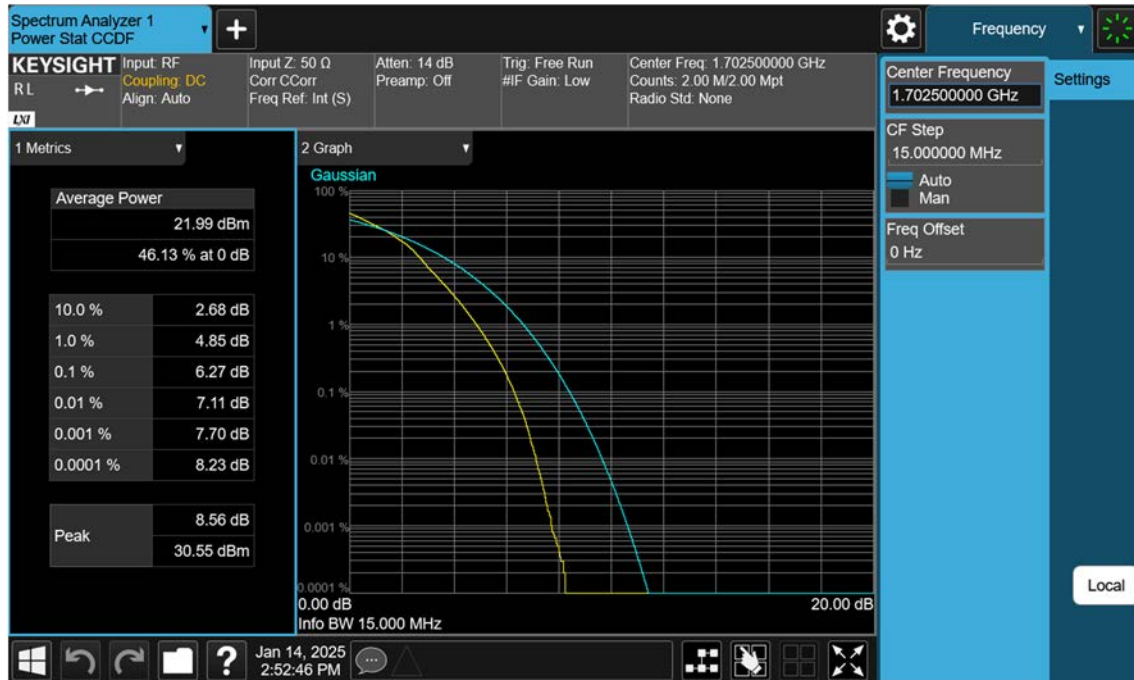
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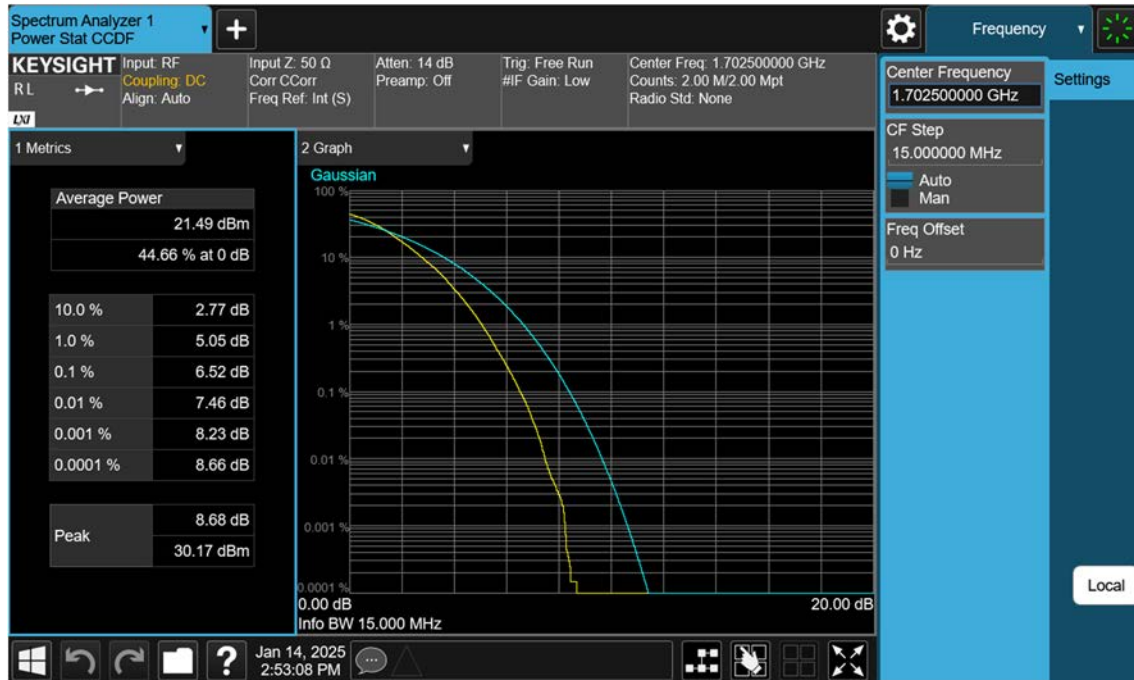
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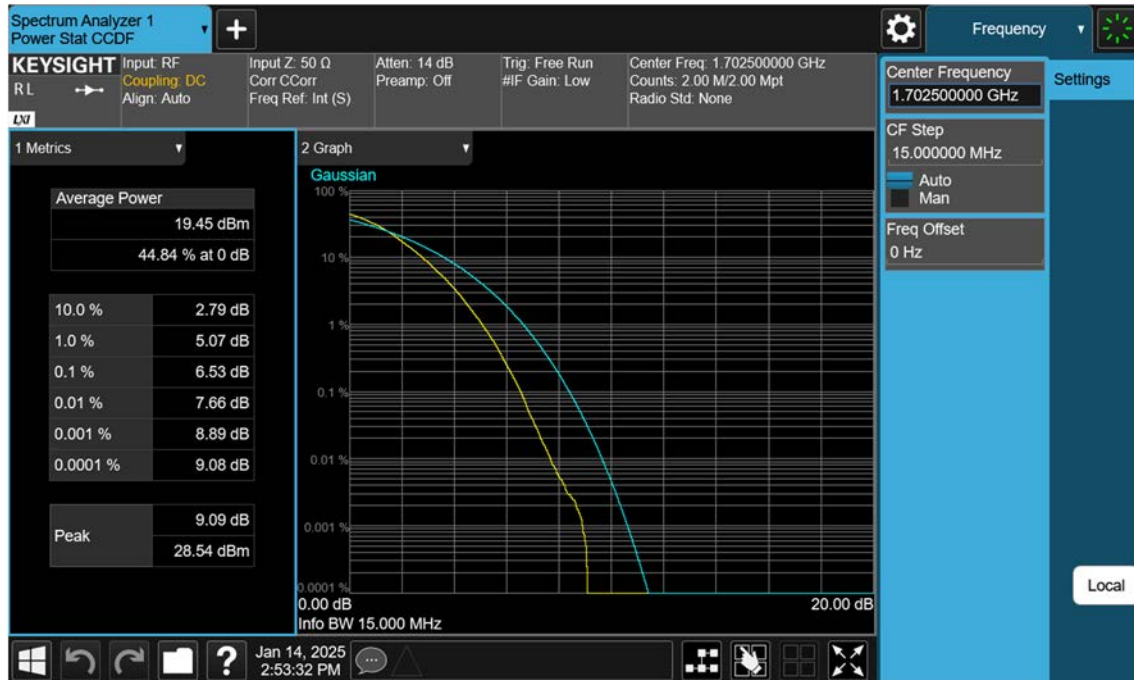
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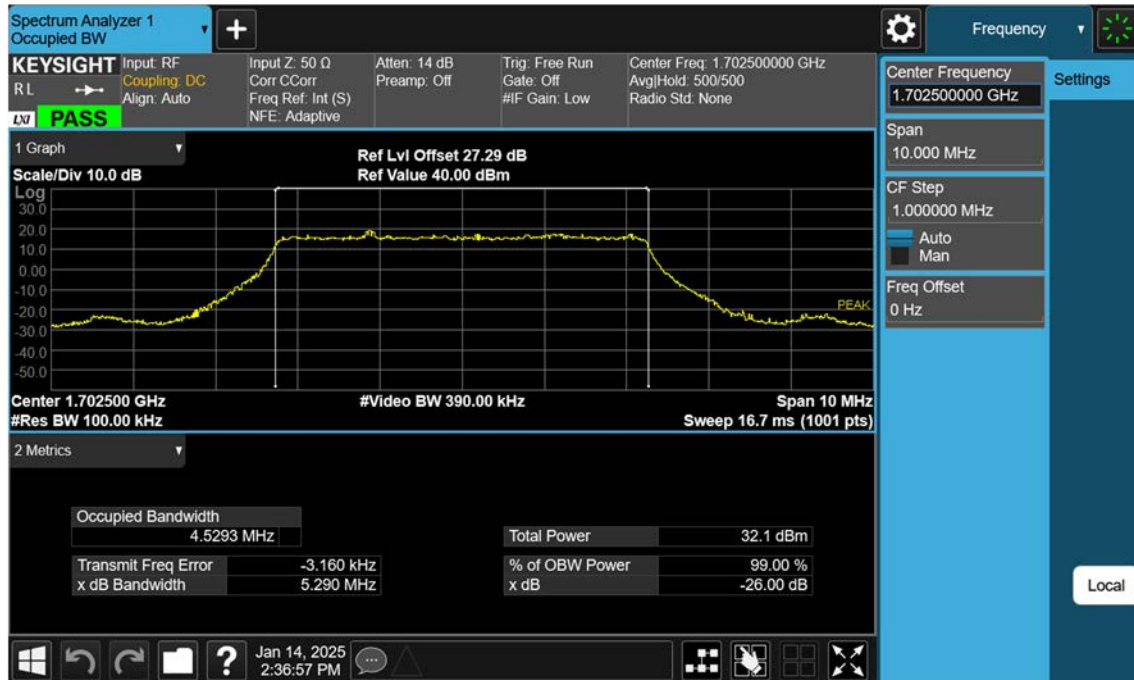
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NR70_15 M_PAR_Mid_256QAM_FullRB



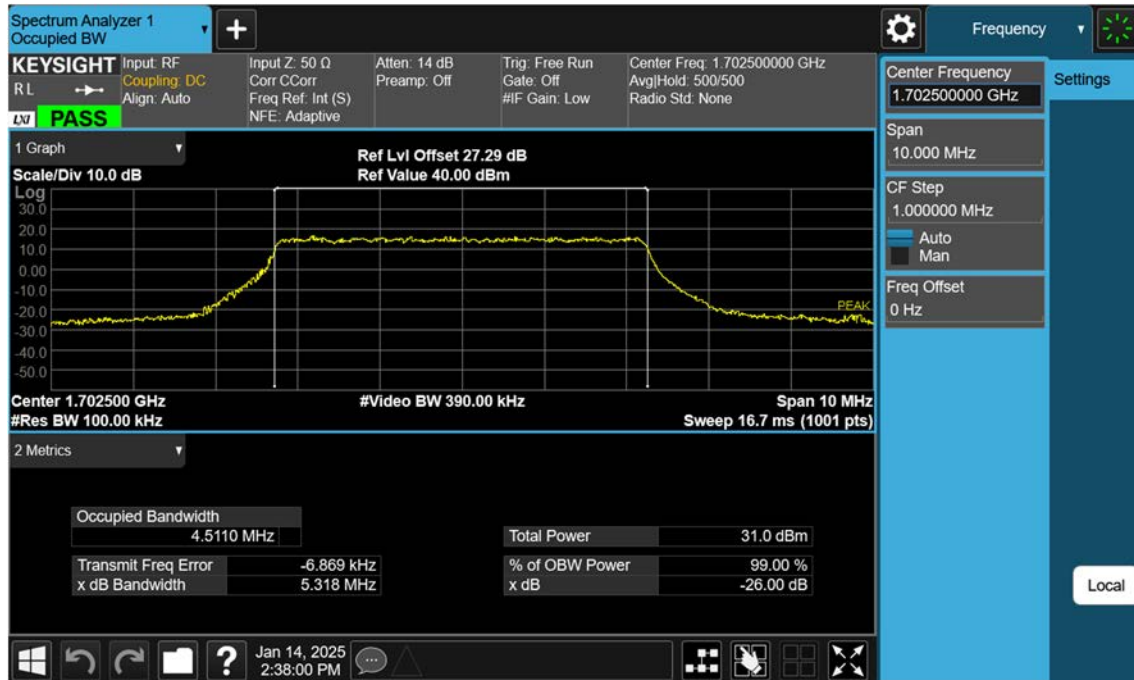
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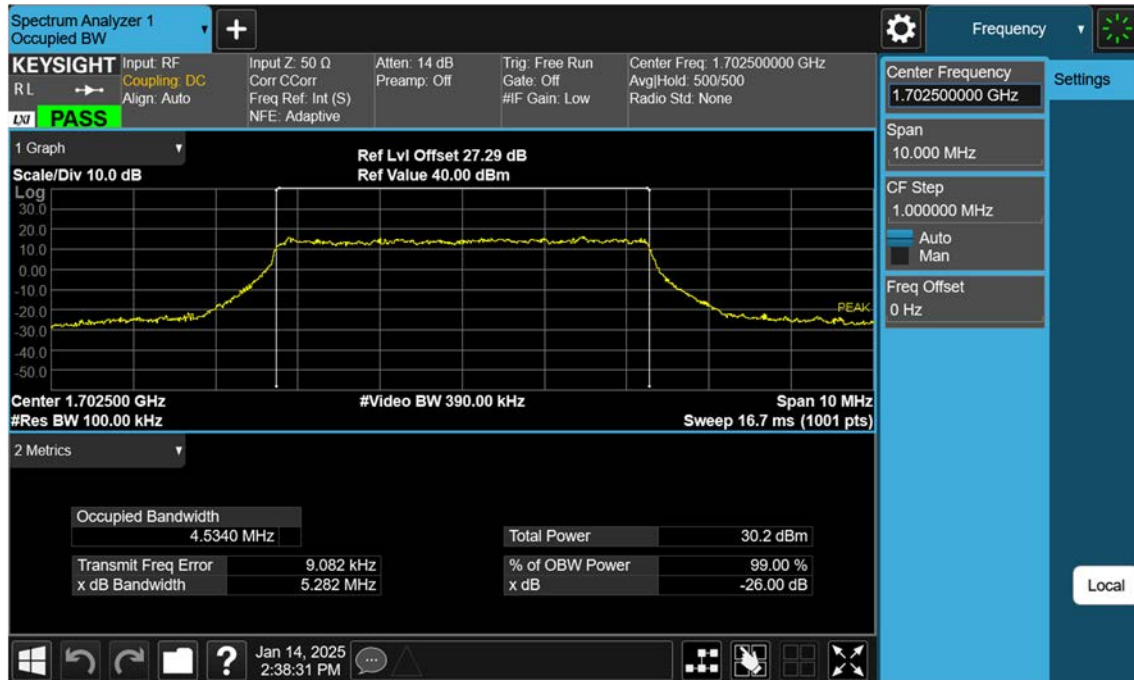
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NR70_5 M_OBW_Mid_16QAM_FullRB



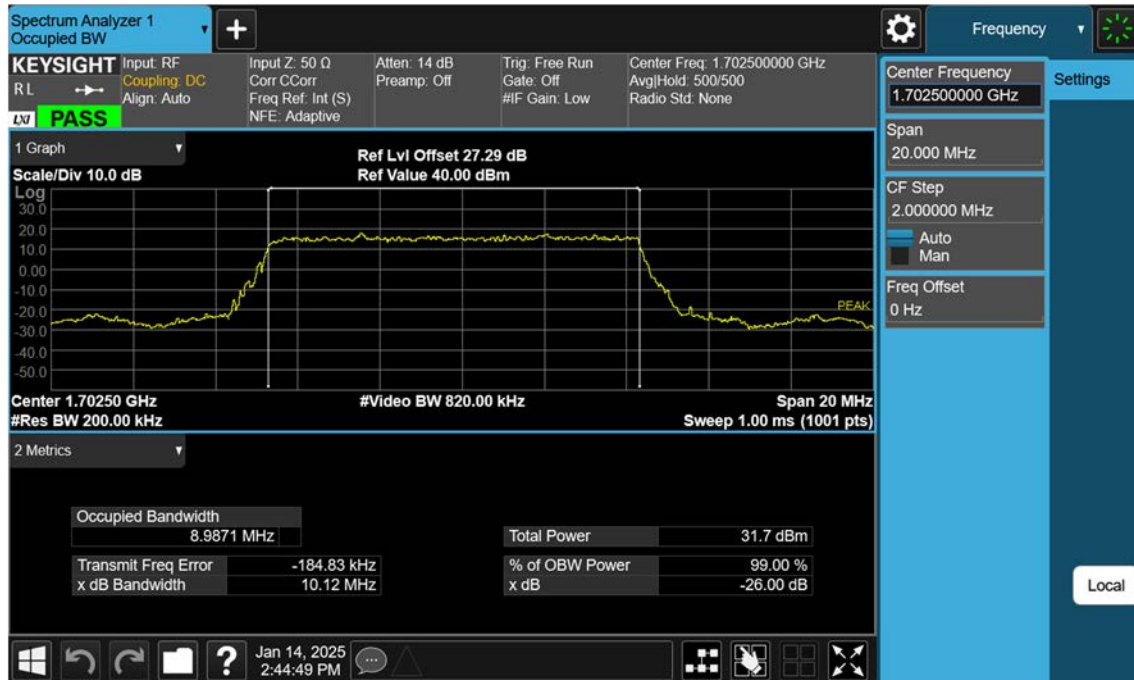
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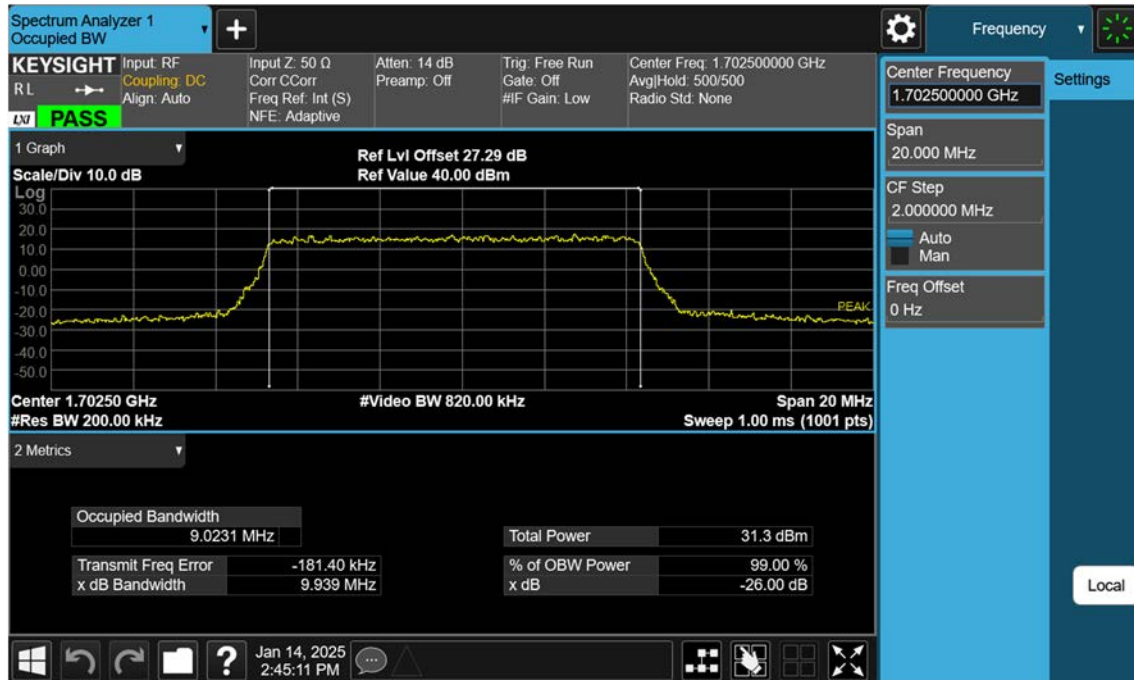
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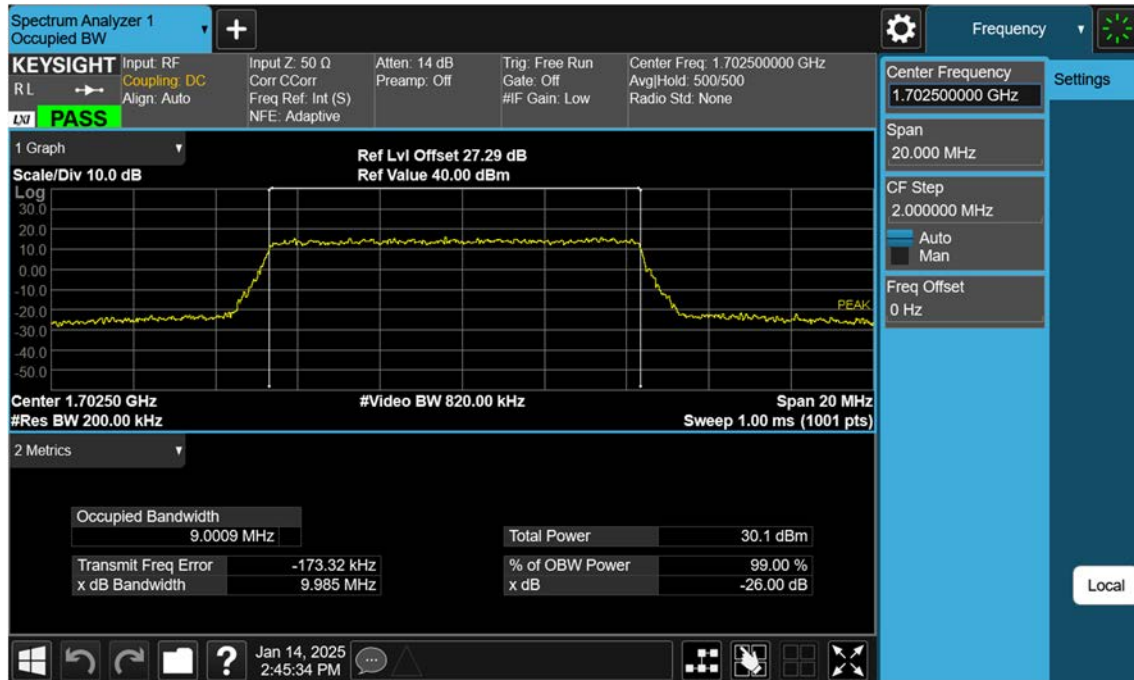
NR70_10 M_OBW_Mid_BPSK_FullRB



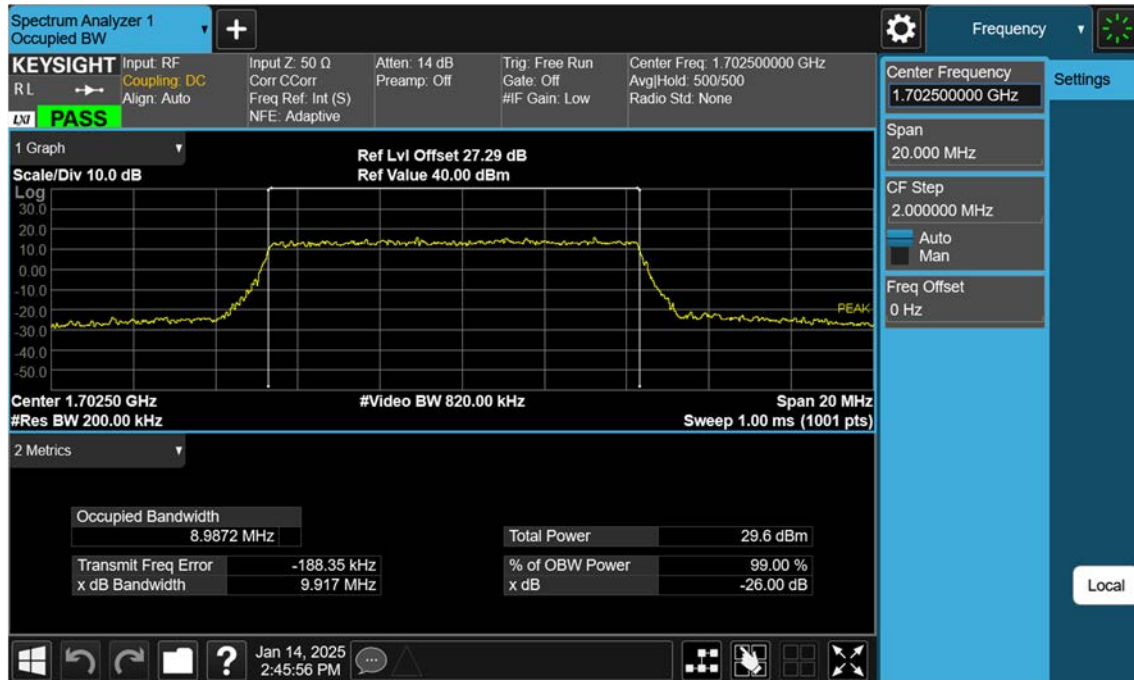
NR70_10 M_OBW_Mid_QPSK_FullRB



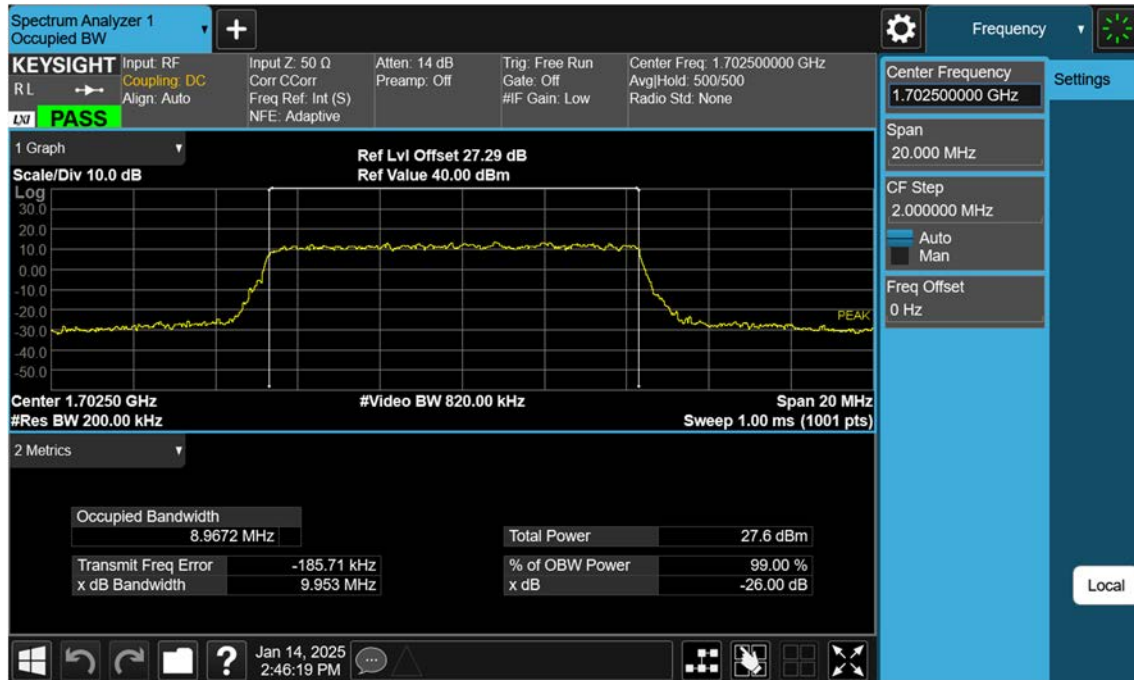
NR70_10 M_OBW_Mid_16QAM_FullRB



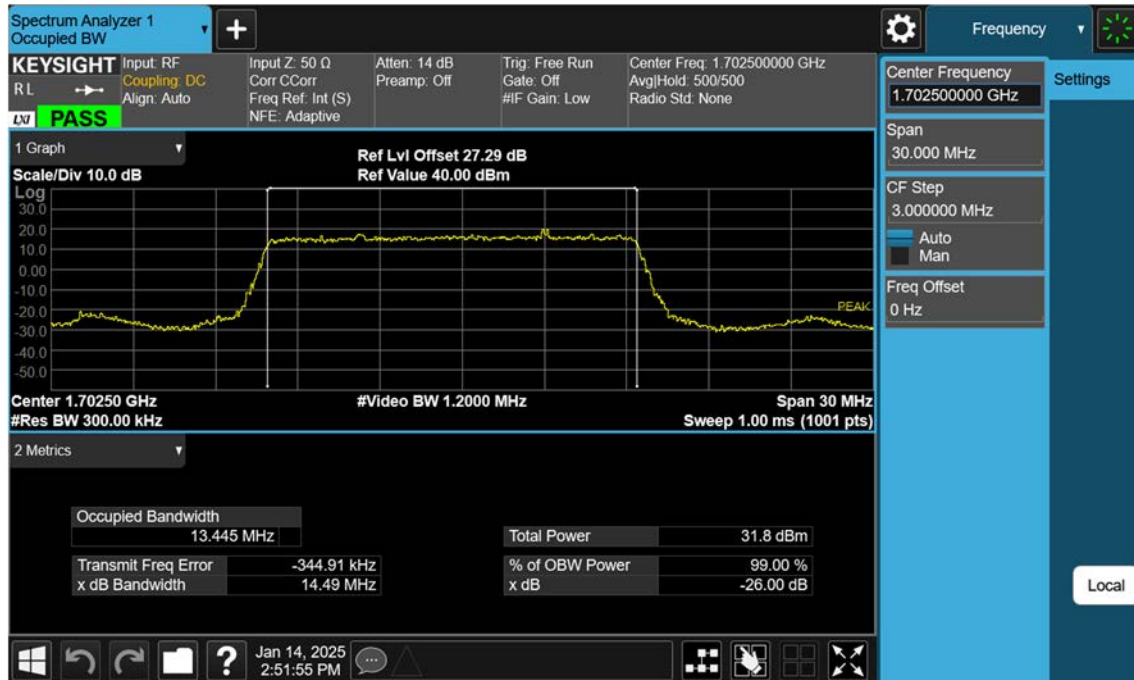
NR70_10 M_OBW_Mid_64QAM_FullRB



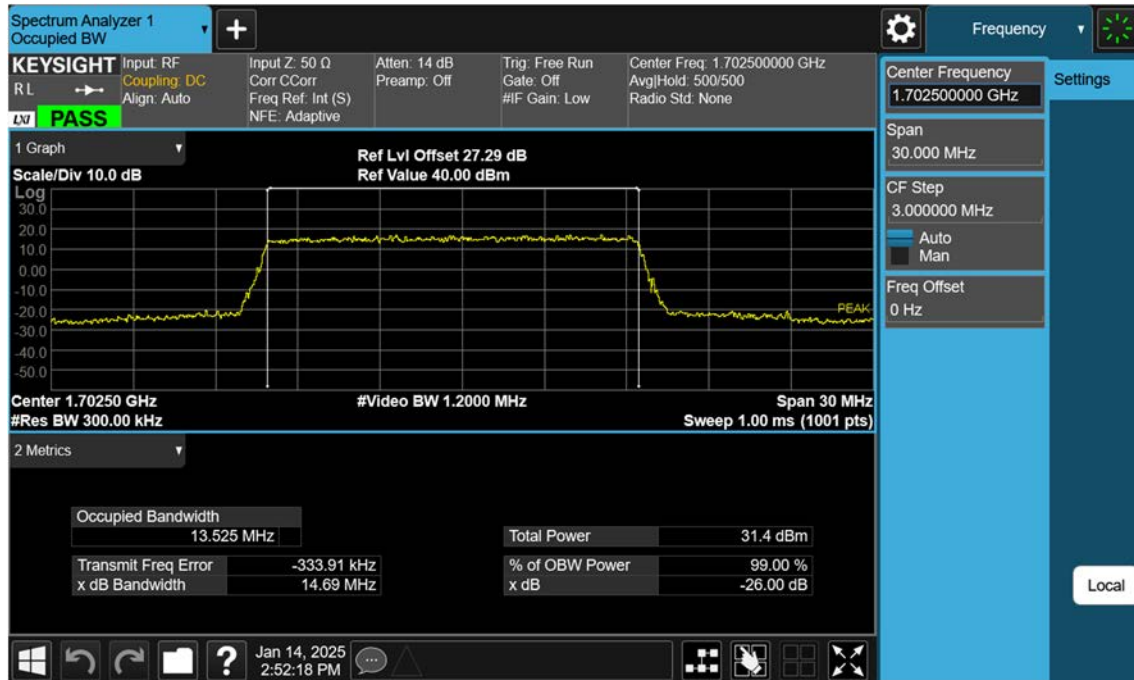
NR70_10 M_OBW_Mid_256QAM_FullRB



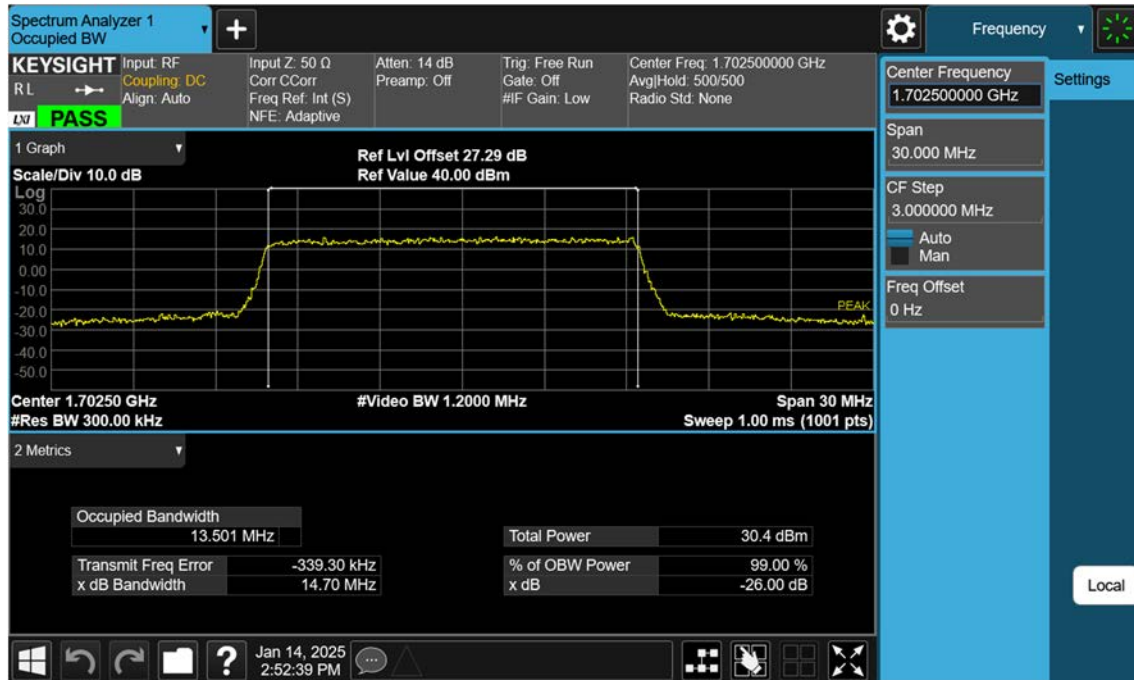
NR70_15 M_OBW_Mid_BPSK_FullRB



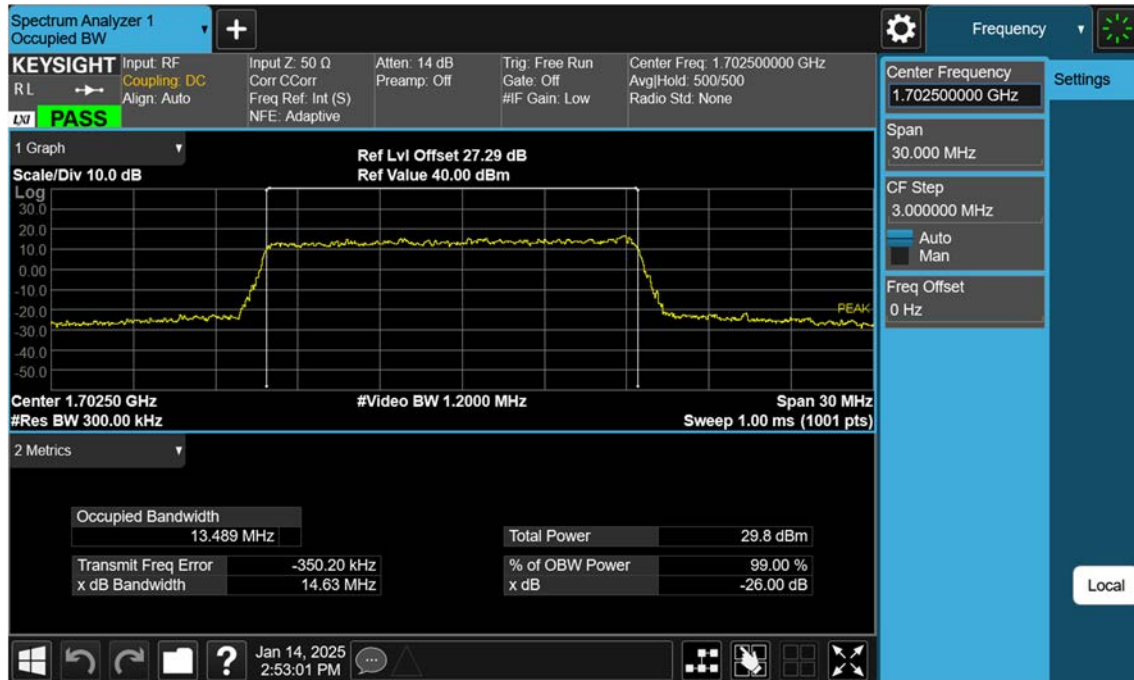
NR70_15 M_OBW_Mid_QPSK_FullRB



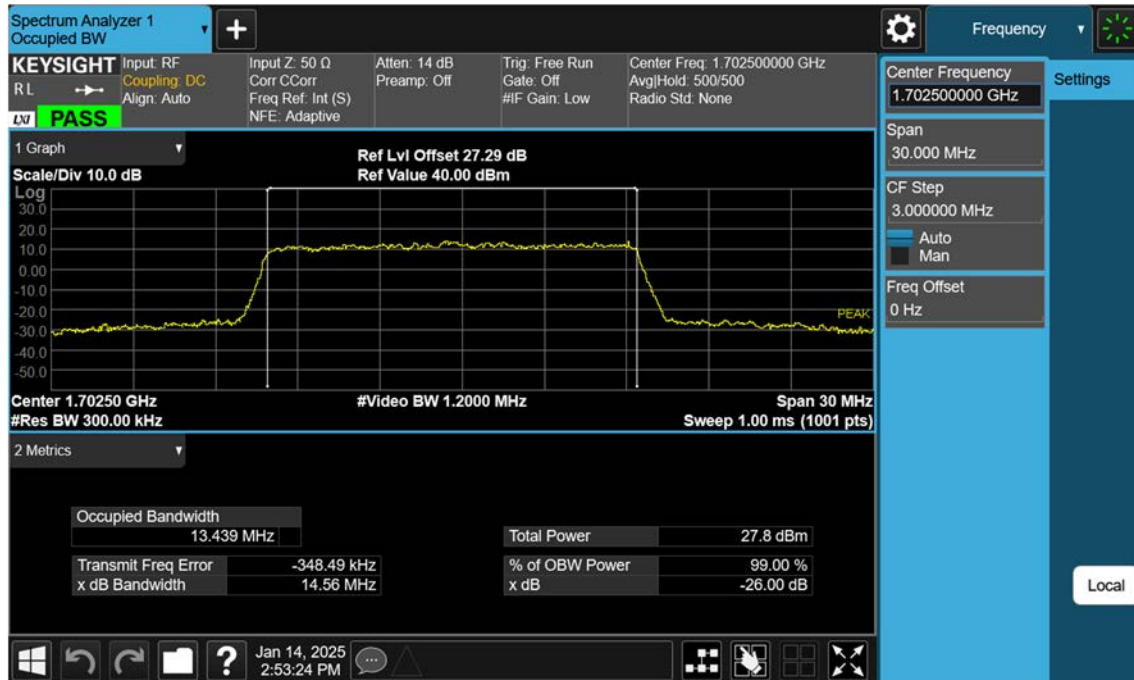
NR70_15 M_OBW_Mid_16QAM_FullRB



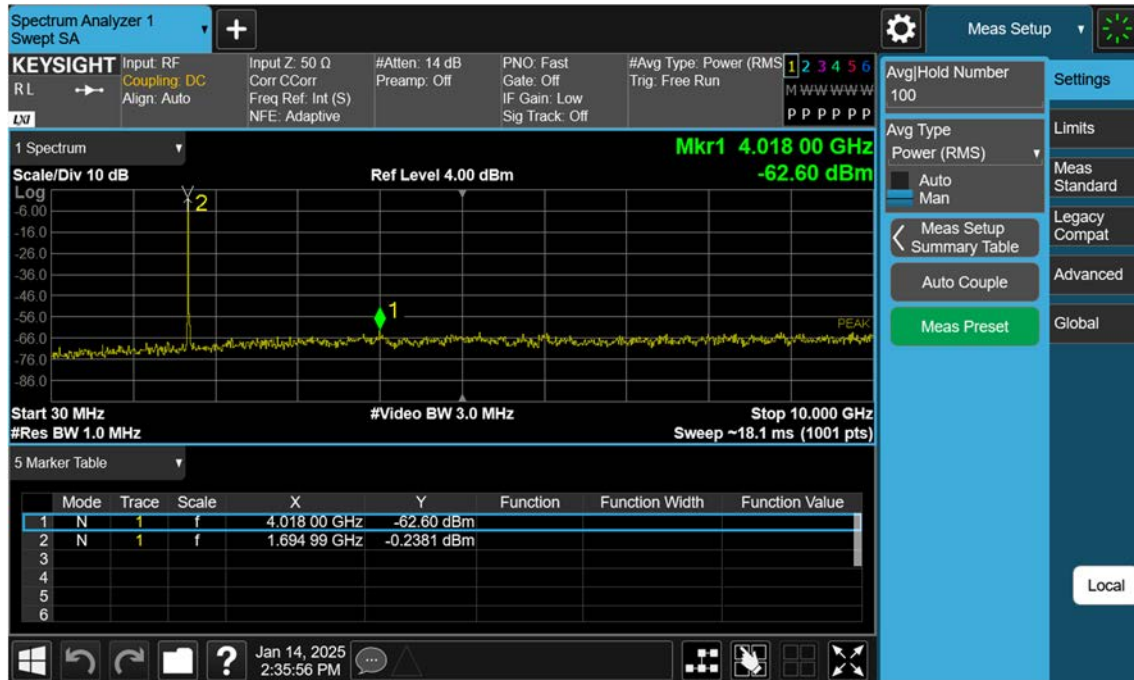
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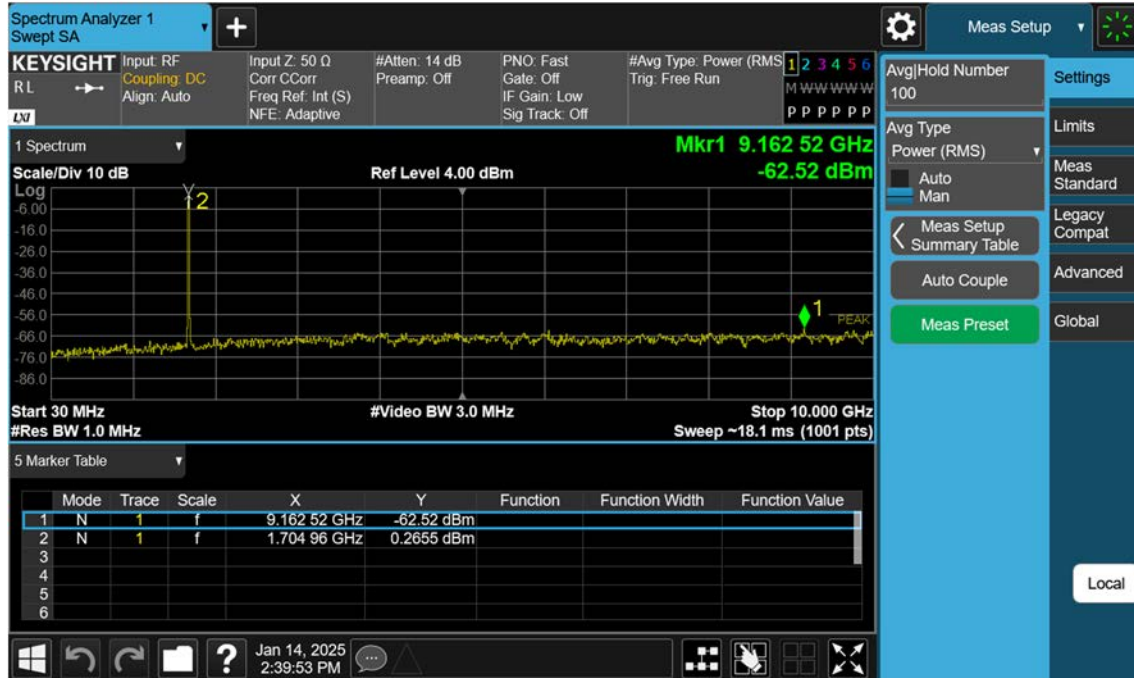
NR70_15 M_OBW_Mid_256QAM_FullRB



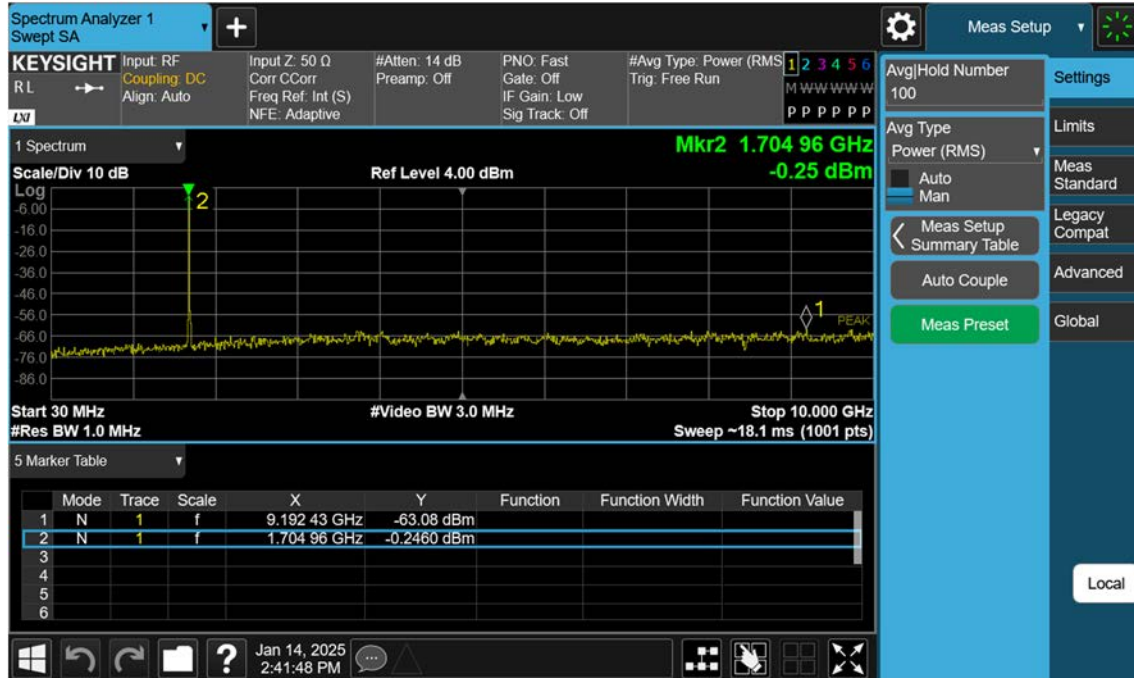
NR70_5 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



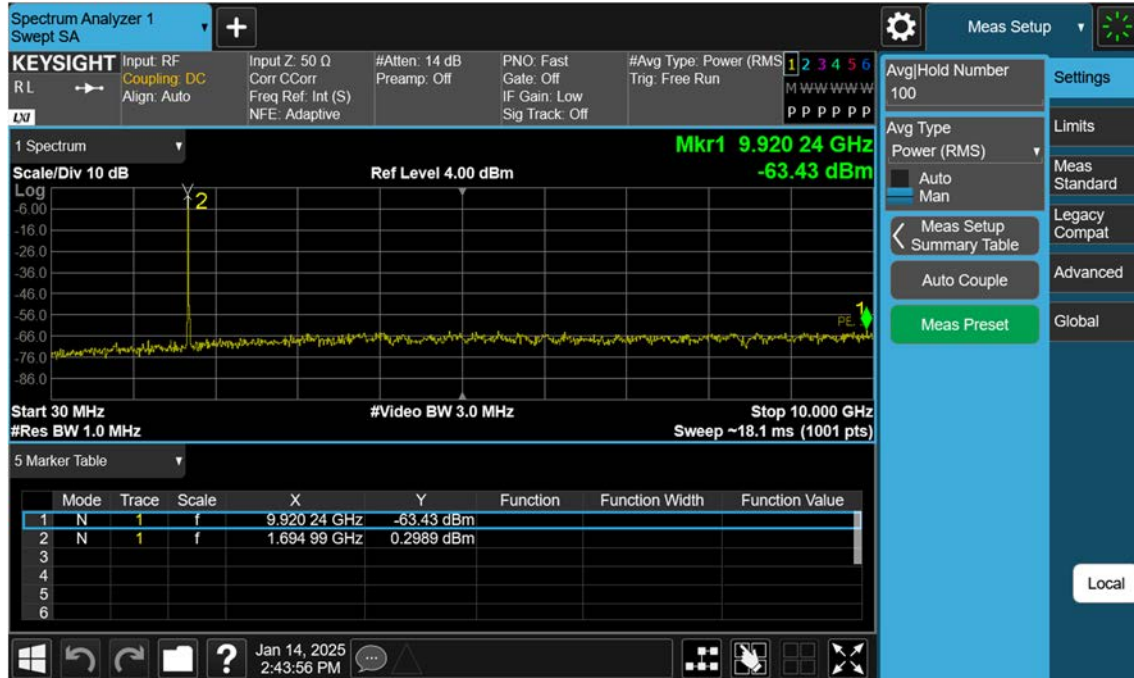
NR70_5 M_Conducted Spurious(30 M-10 G)_Mid_BPSK_1RB



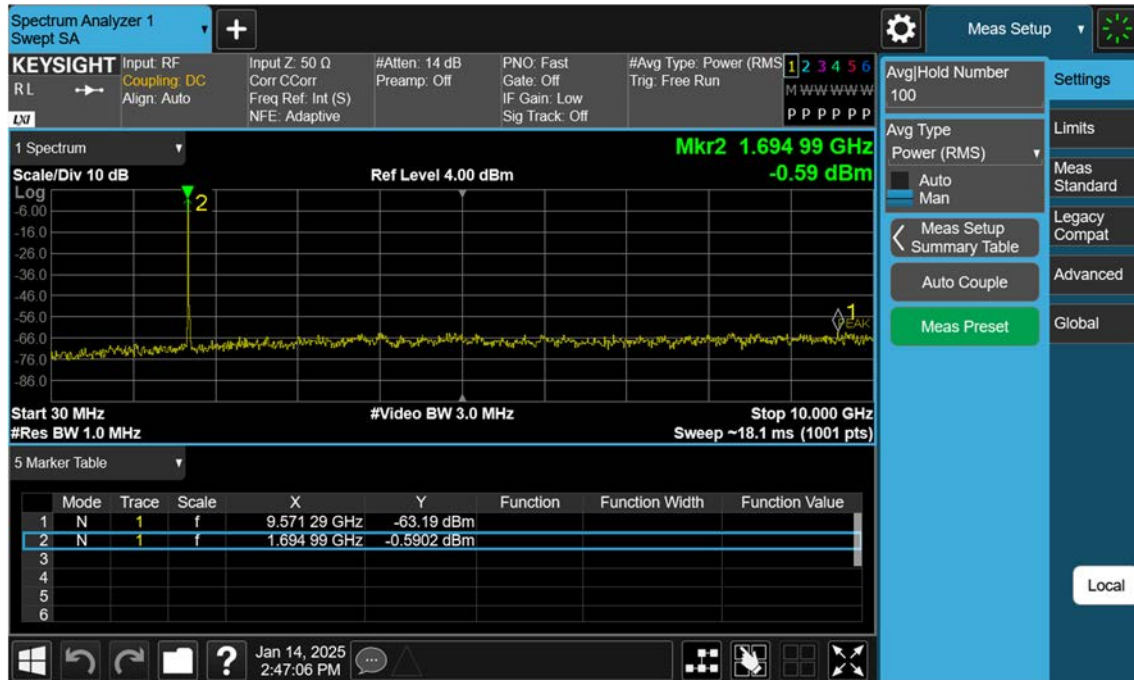
NR70_5 M_Conducted Spurious(30 M-10 G)_High_BPSK_1RB



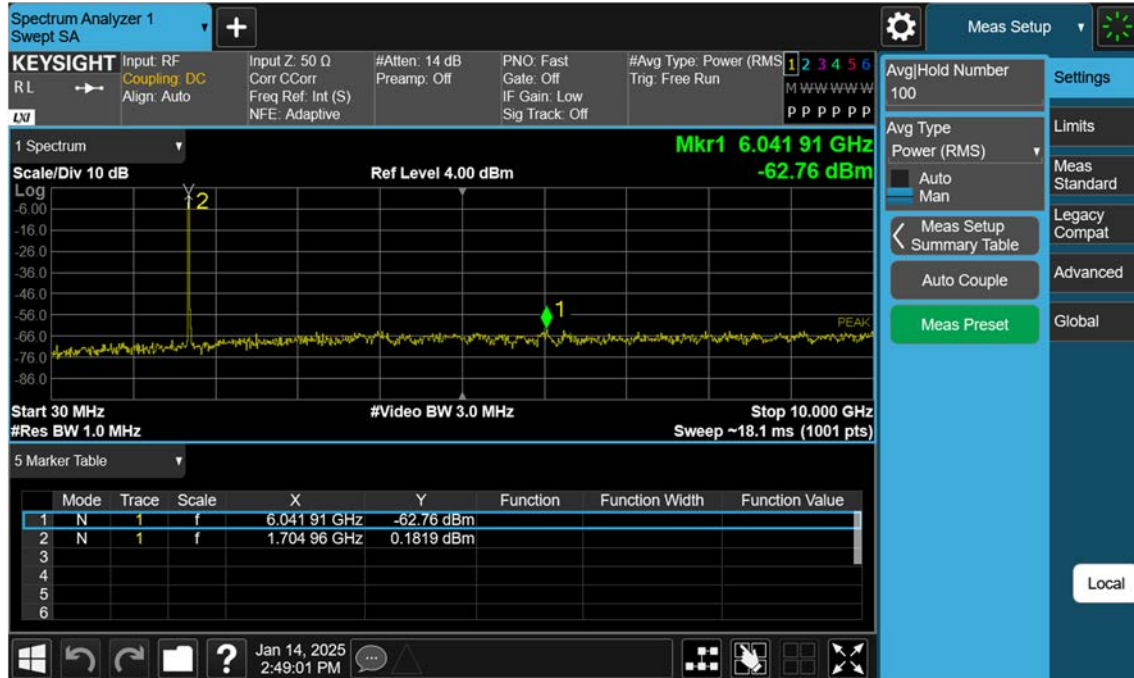
NR70_10 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



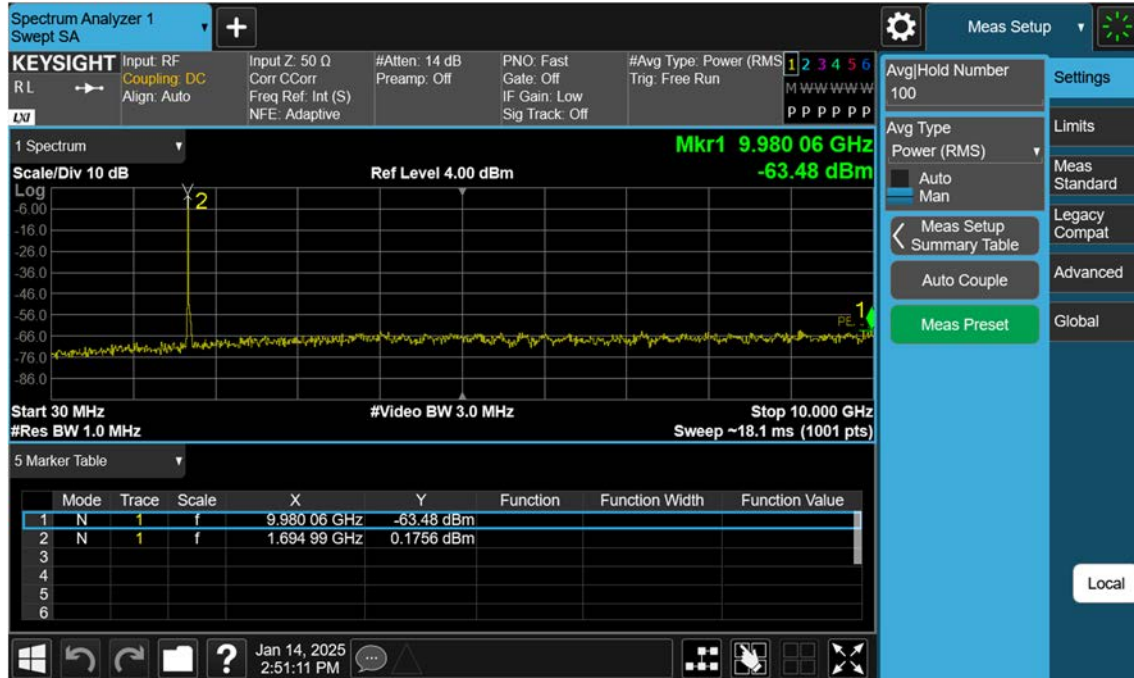
NR70_10 M_Conducted Spurious(30 M-10 G)_Mid_BPSK_1RB



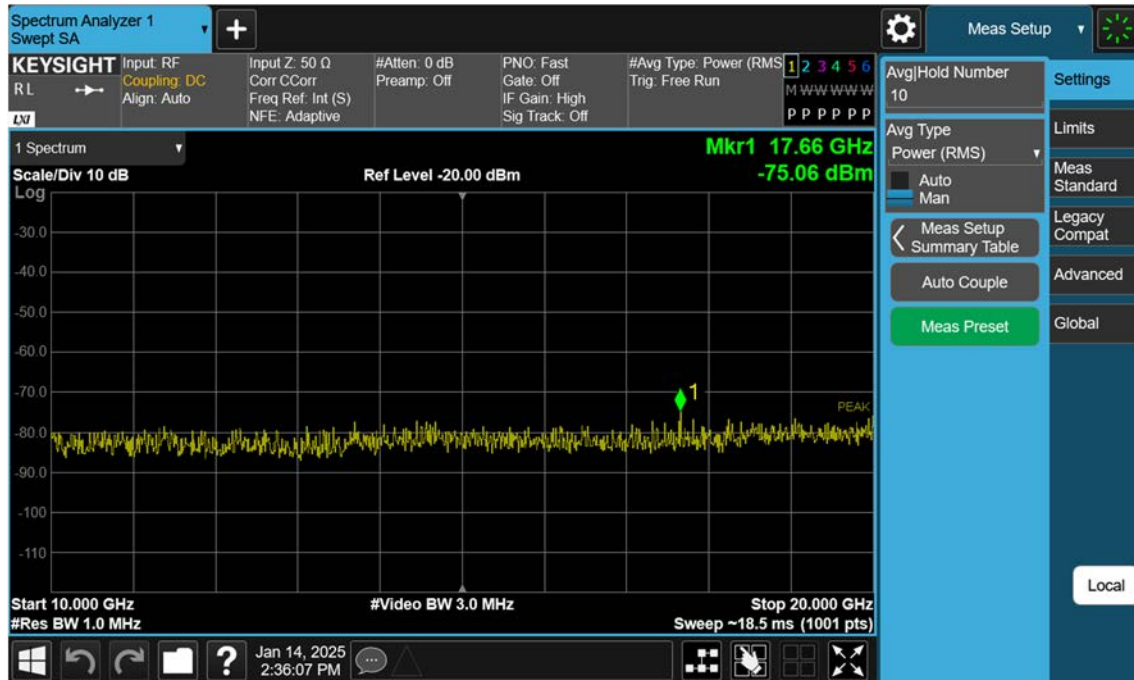
NR70_10 M_Conducted Spurious(30 M-10 G)_High_BPSK_1RB



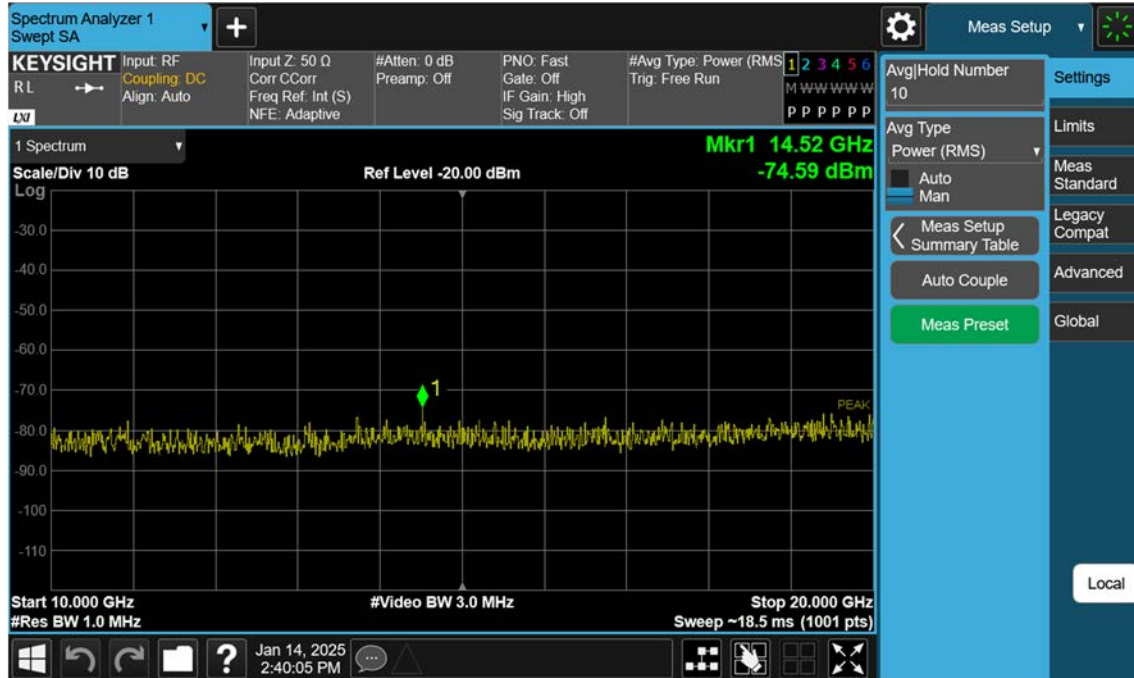
NR70_15 M_Conducted Spurious(30 M-10 G)_Low_BPSK_1RB



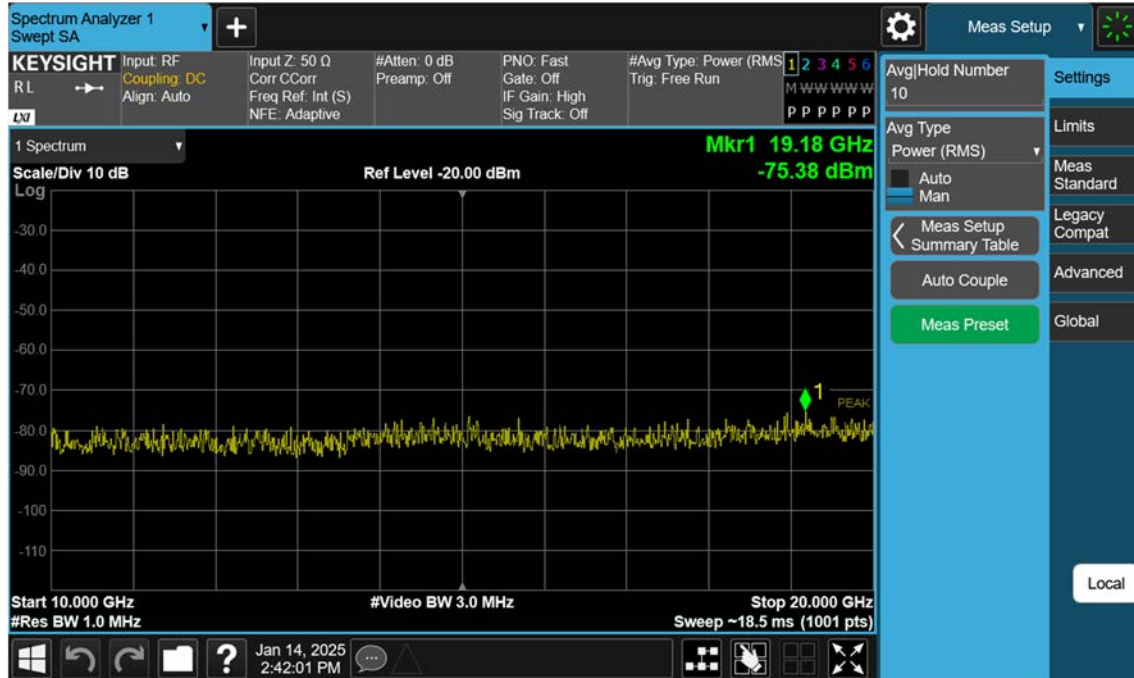
NR70_5 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



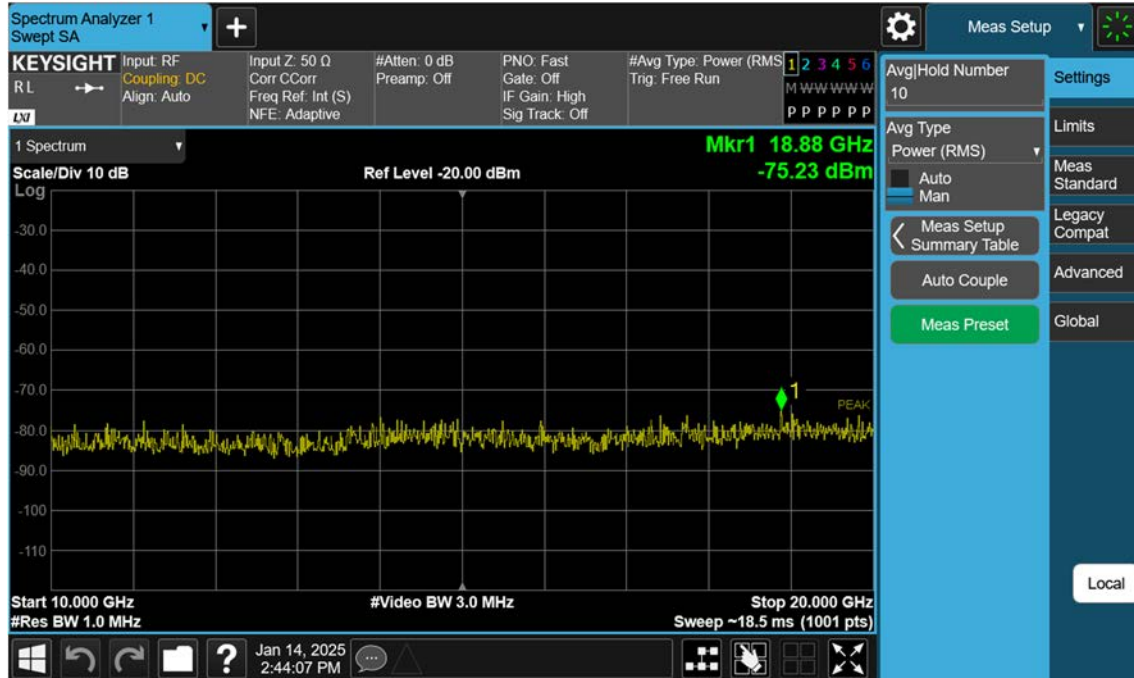
NR70_5 M_Conducted Spurious(Above10 G)_Mid_BPSK_1RB



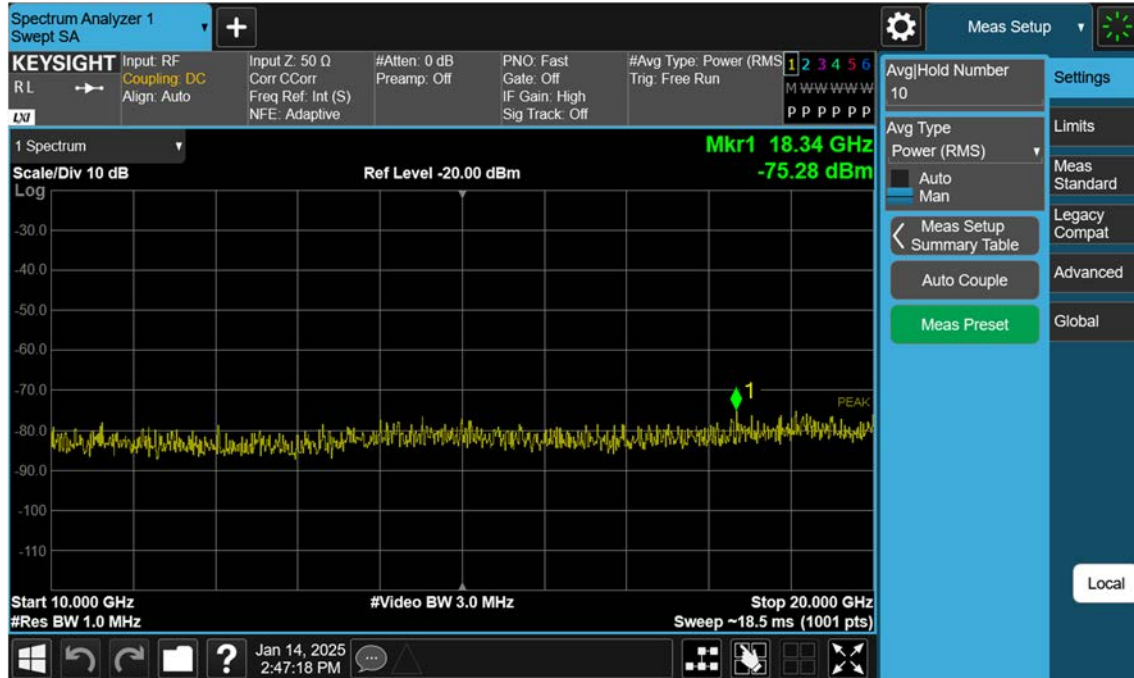
NR70_5 M_Conducted Spurious(Above10 G)_High_BPSK_1RB



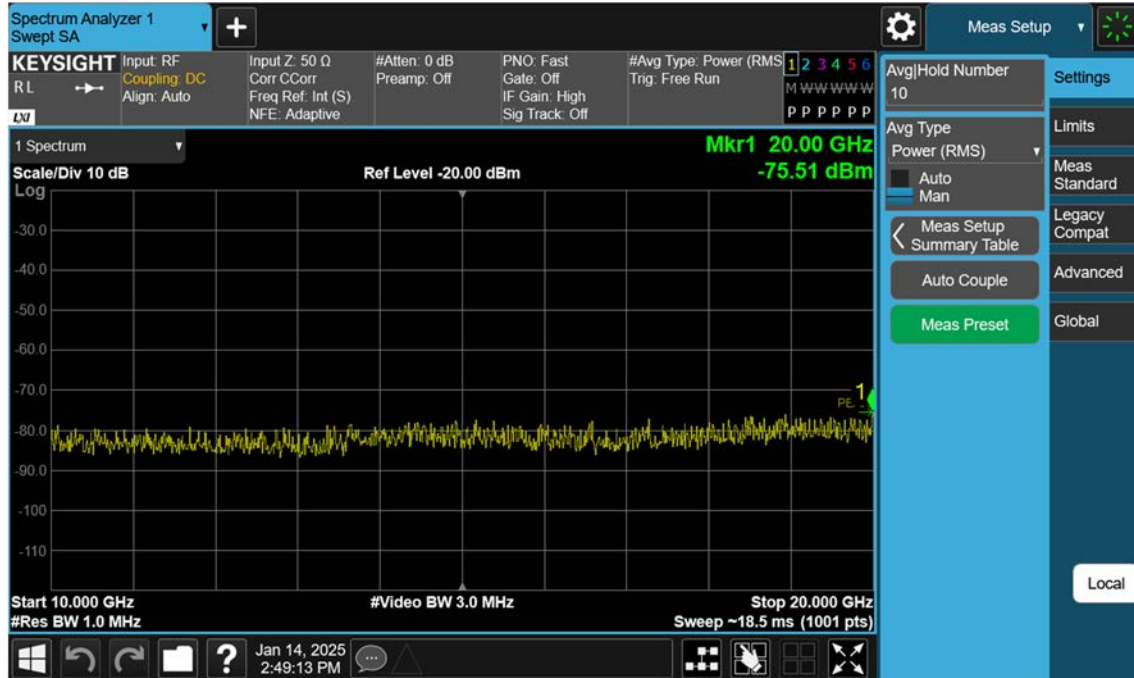
NR70_10 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



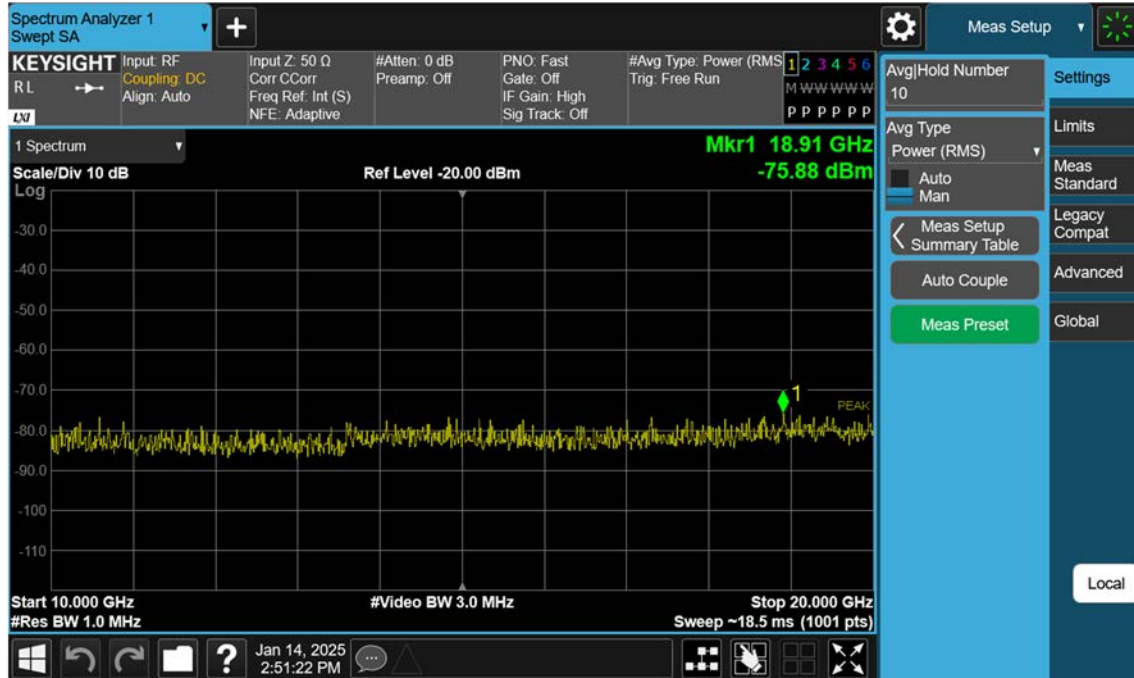
NR70_10 M_Conducted Spurious(Above10 G)_Mid_BPSK_1RB



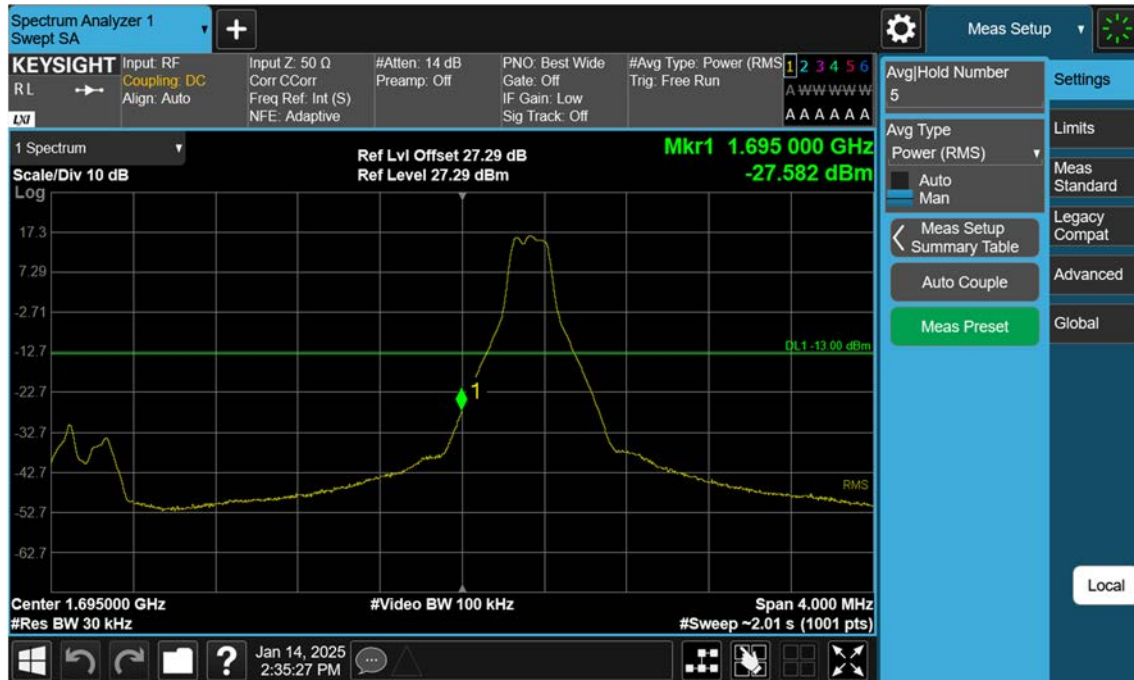
NR70_10 M_Conducted Spurious(Above10 G)_High_BPSK_1RB



NR70_15 M_Conducted Spurious(Above10 G)_Low_BPSK_1RB



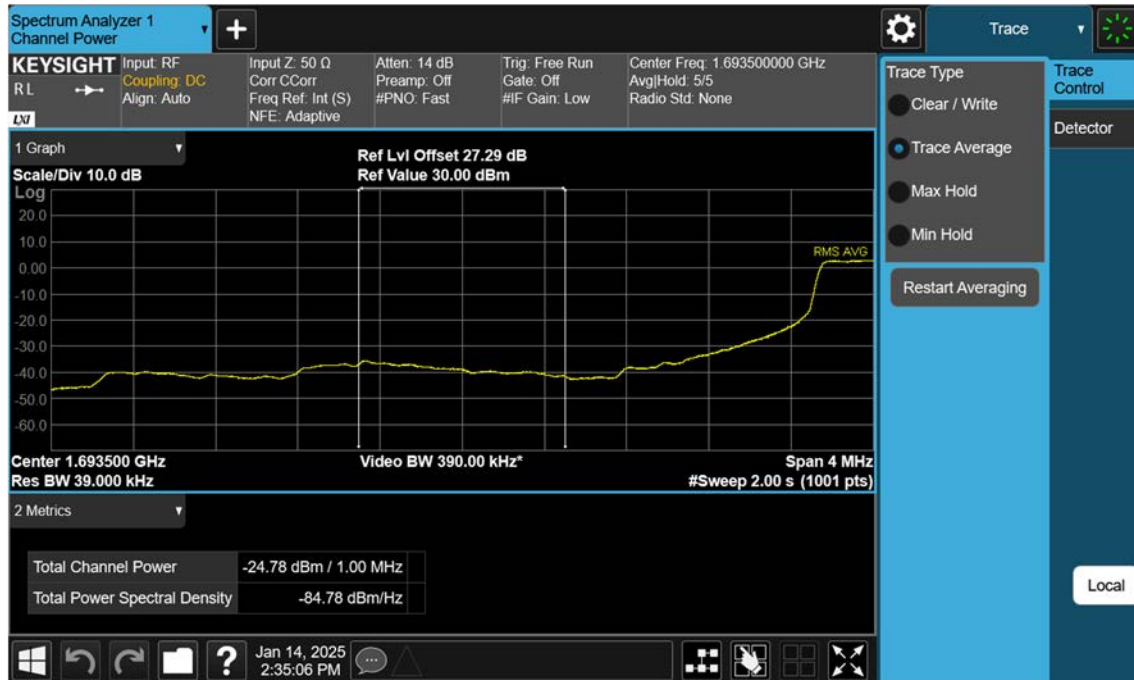
NR70_5 M_Band Edge_Low_BPSK_1RB



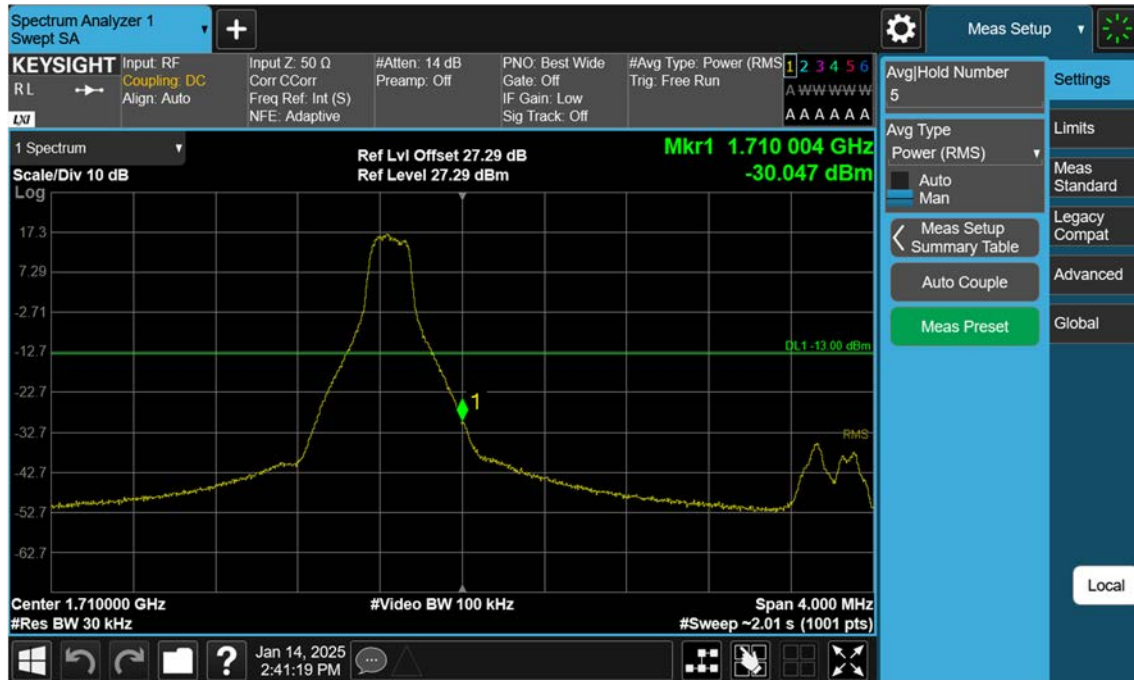
NR70_5 M_Band Edge_Low_BPSK_FullRB



NR70_5 M_Extended Band Edge_Low_BPSK_FullRB



NR70_5 M_Band Edge_High_BPSK_1RB



NR70_5 M_Band Edge_High_BPSK_FullRB



Spectrum Analyzer 1
Channel Power

KEYSIGHT Input: RF
RL **Coupling: DC**
Align: Auto

Input Z: 50 Ω
Corr C/Corr
Freq Ref: Int (S)
NFE: Adaptive

Atten: 14 dB
Preamp: Off
#PNO: Fast

Trig: Free Run
Gate: Off
#IF Gain: Low

Center Freq: 1.711500000 GHz
Avg/Hold: 5/5
Radio Std: None

Trace Type
☐ Clear / Write
☒ Trace Average
☐ Max Hold
☐ Min Hold
Restart Averaging

Trace Control
Detector

1 Graph
Scale/Div 10.0 dB
Log

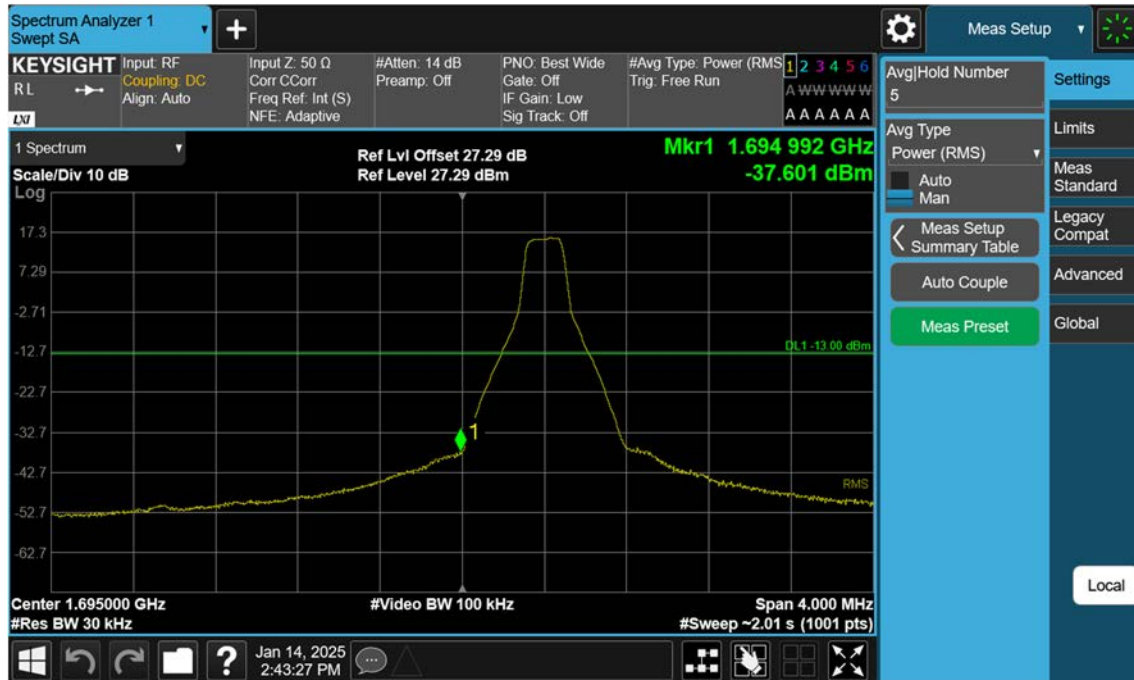
Ref Lvl Offset 27.29 dB
Ref Value 30.00 dBm

Center 1.711500 GHz
Res BW 39.000 kHz
Video BW 390.00 kHz*
Span 4 MHz
#Sweep 2.00 s (1001 pts)

2 Metrics
Total Channel Power -24.46 dBm / 1.00 MHz
Total Power Spectral Density -84.46 dBm/Hz

Jan 14, 2025
2:40:57 PM

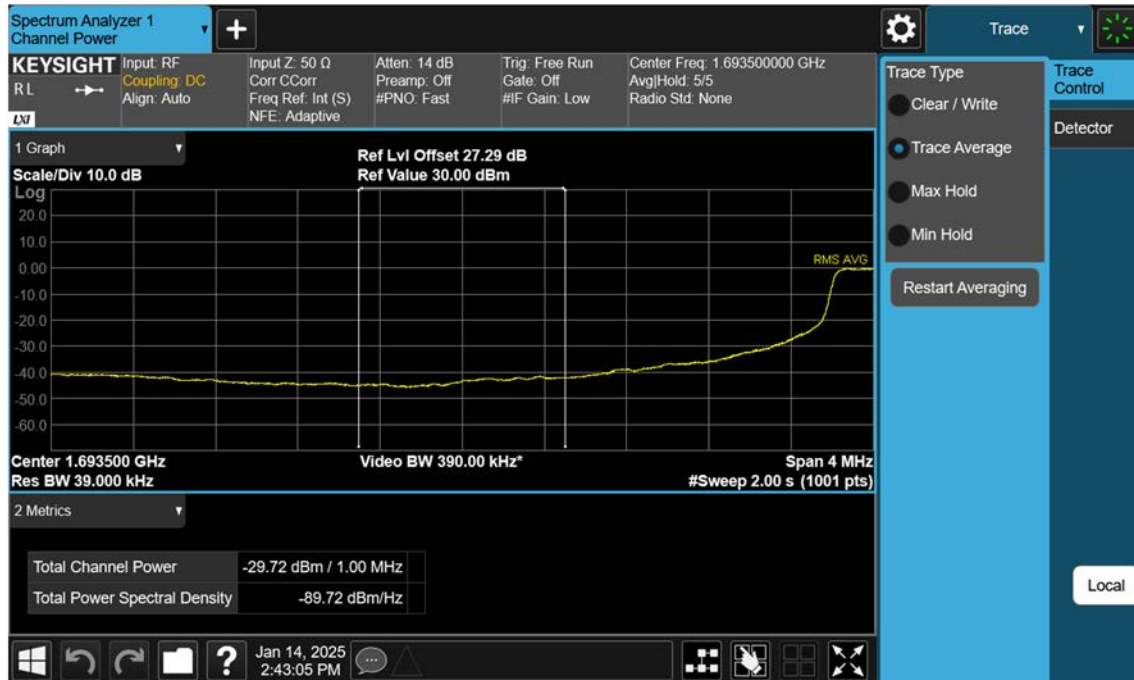
NR70_10 M_Band Edge_Low_BPSK_1RB



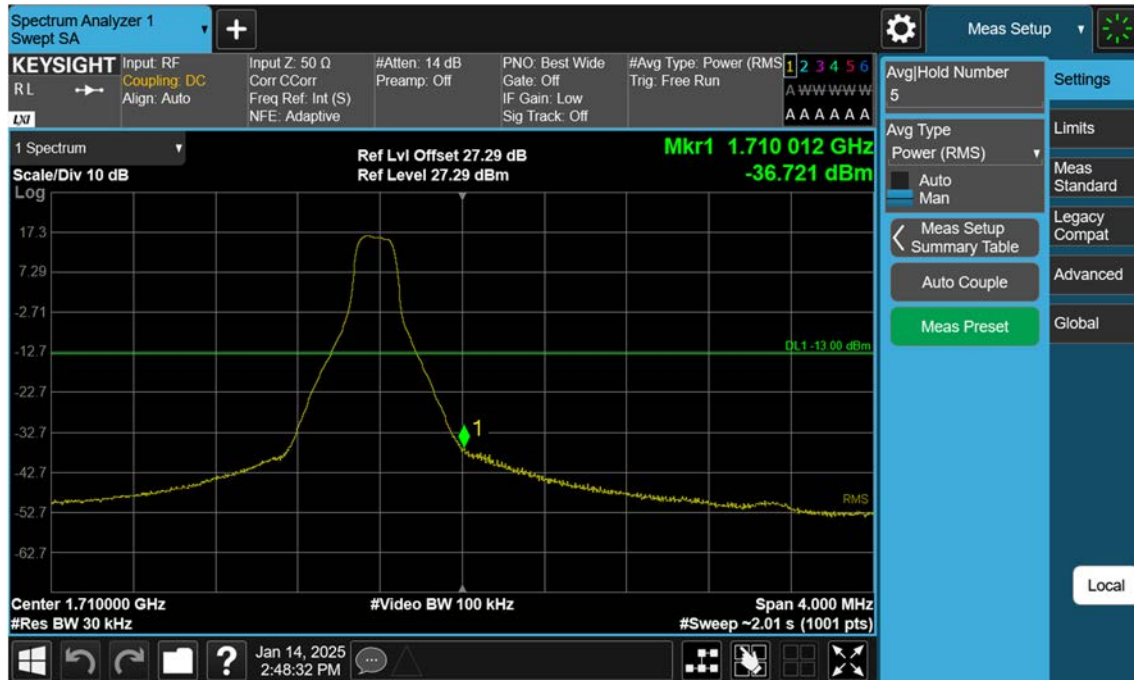
NR70_10 M_Band Edge_Low_BPSK_FullRB



NR70_10 M_Extended Band Edge_Low_BPSK_FullRB



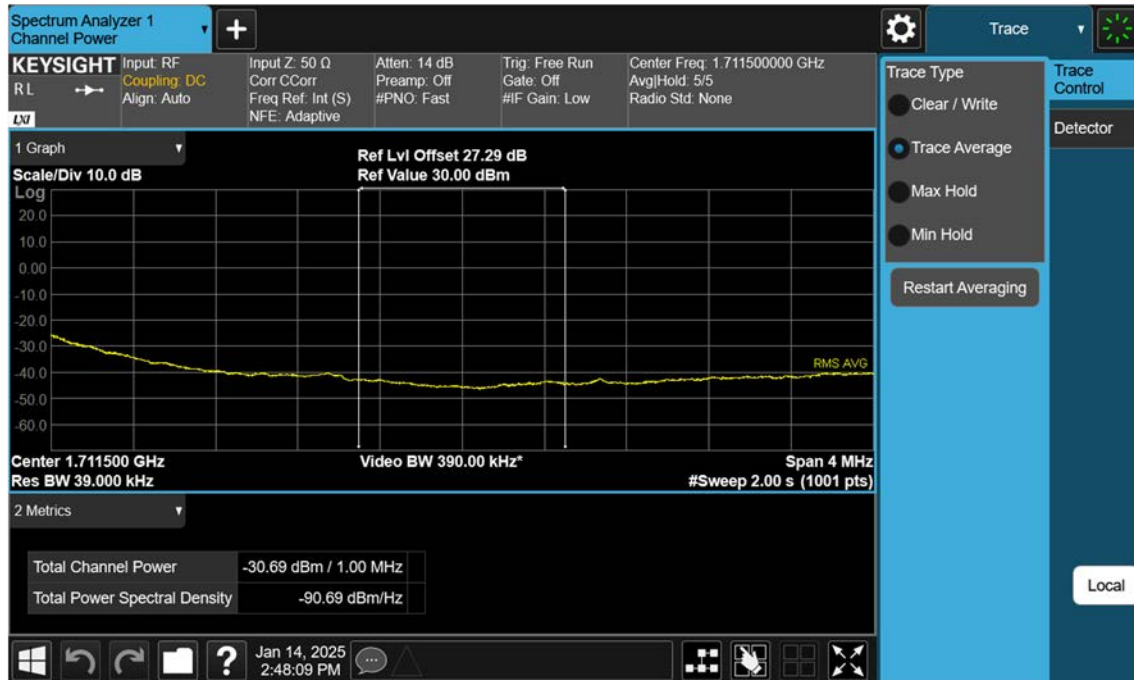
NR70_10 M_Band Edge_High_BPSK_1RB



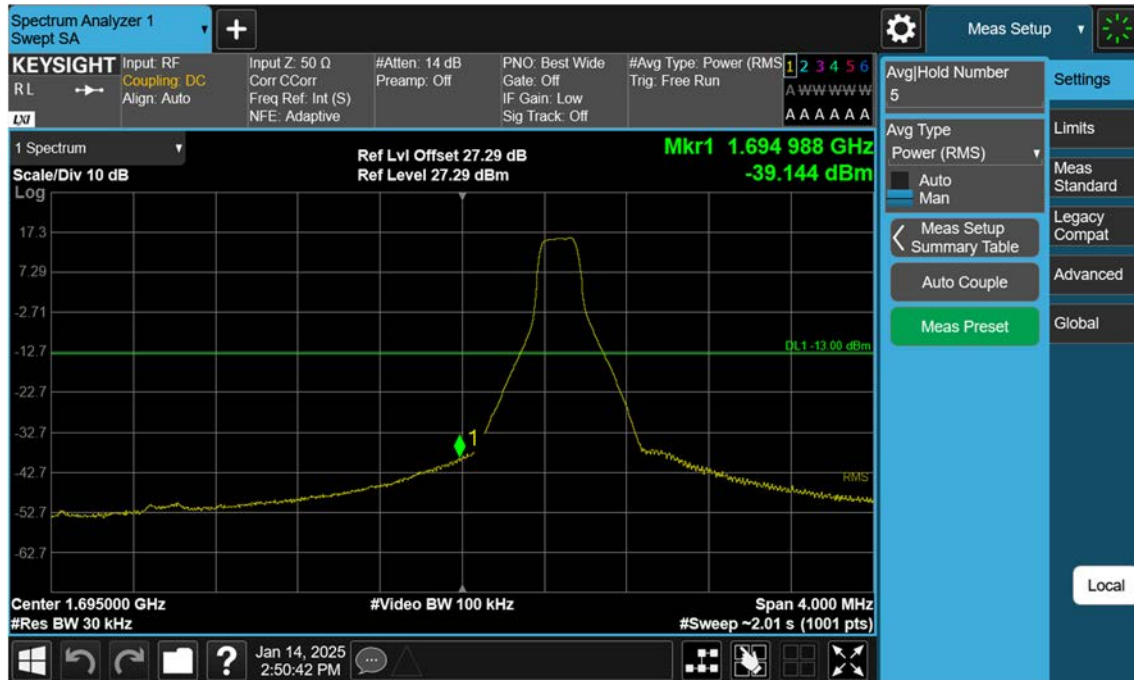
NR70_10 M_Band Edge_High_BPSK_FullRB



NR70_10 M_Extended Band Edge_High_BPSK_FullRB



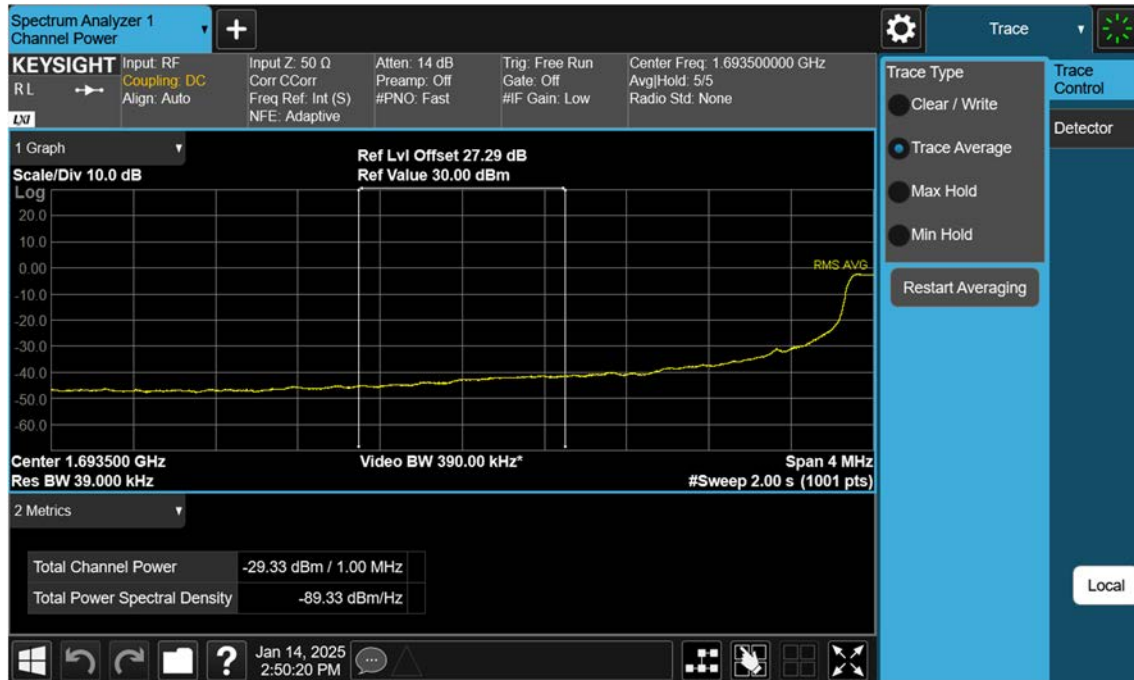
NR70_15 M_Band Edge_Low_BPSK_1RB



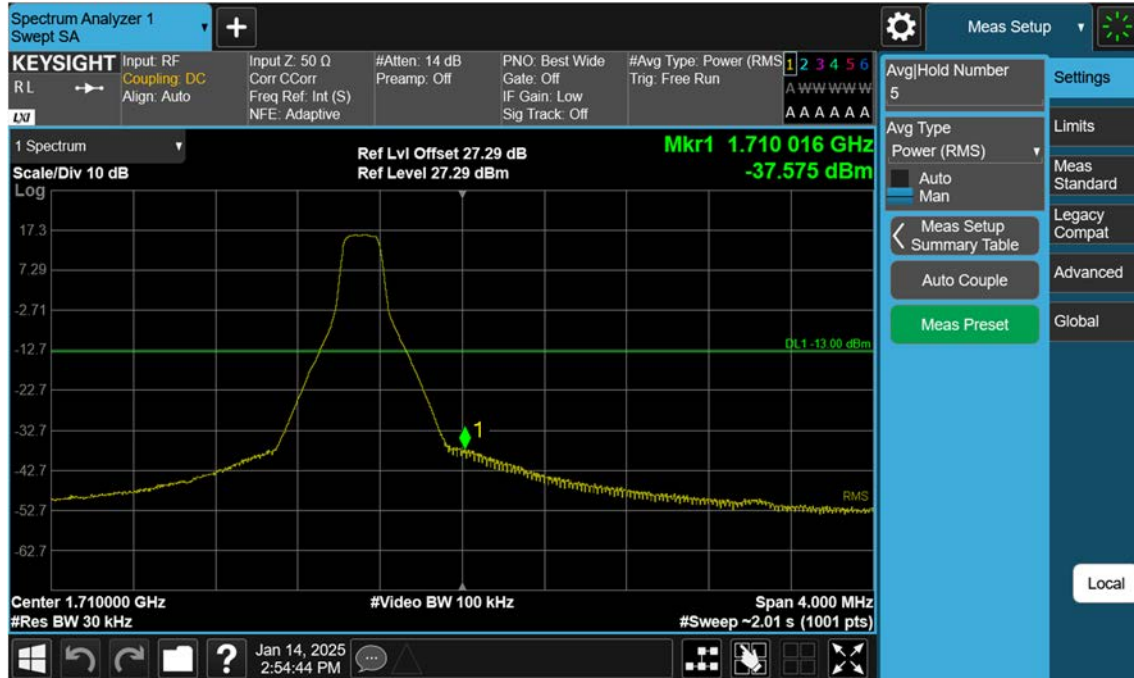
NR70_15 M_Band Edge_Low_BPSK_FullRB



NR70_15 M_Extended Band Edge_Low_BPSK_FullRB



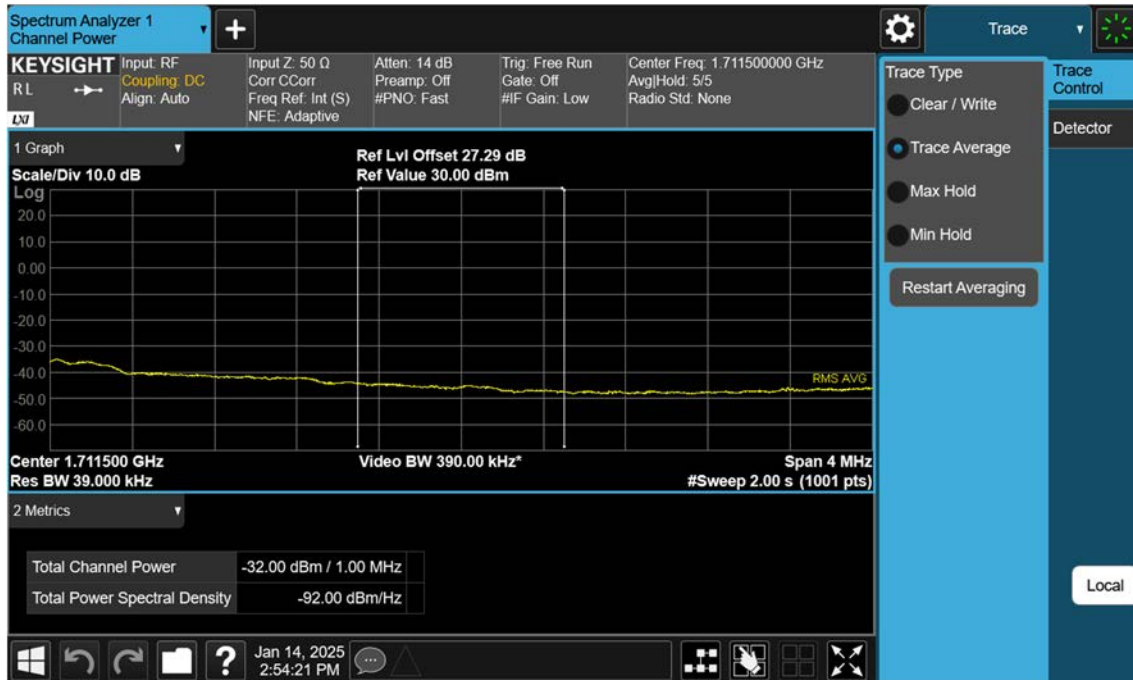
NR70_15 M_Band Edge_High_BPSK_1RB



NR70_15 M_Band Edge_High_BPSK_FullRB



NR70_15 M_Extended Band Edge_High_BPSK_FullRB



10. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2502-FC021-P