Starry, Inc.
TEST REPORT

SCOPE OF WORK
Emissions Testing – Model Titan 37

REPORT NUMBER
105391852BOX-001.4

ISSUE DATE
August 21, 2023

[REVISED DATE]
March 6, 2024

DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. October 2022

EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 105391852BOX-001.4
Project Number: G105391852

Report Issue Date: August 21, 2023
Report Issue Date: March 6, 2024

Model(s) Tested: Titan 37

Standards: FCC 47CFR Part 30 Subpart C: 2023
FCC 47CFR Part 2: 2023
KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 April 20, 2021

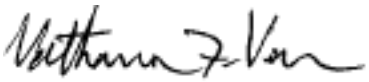
Tested by:
Intertek
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Starry, Inc.
38 Chauncy St. Suite 200
Boston, MA 02111
USA

Report prepared by

Kouma Sinn / Sr. EMC Staff Engineer

Report reviewed by



Vathana Ven / Sr. EMC Staff Engineer

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Output Power FCC 47CFR Part 30 Subpart C, Section 30.202 (a): 2023	Pass
7	Out of Band (OOB) Domain FCC 47CFR Part 30 Subpart C, Section 30.203 (a) (b): 2023	Pass
8	Radiated Spurious Emissions FCC 47CFR Part 30 Subpart C, Section 30.203 (a) (b): 2023	Pass
9	Occupied Bandwidths FCC 47CFR Part 2.1049(i): 2023, FCC 47CFR Part 30 Subparts E Section 30.403:2023, KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 April 20, 2021 Subclause 4.3, KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 April 20, 2021; Section 4.3	Pass
10	Frequency Tolerance* FCC 47CFR Part 30 Subpart E Section 30.402: 2023	Pass
11	AC Mains Conducted Emissions FCC 47CFR Part 15 Subpart B: 2023	Pass
12	Revision History	--

*Notes: Frequency tolerance is not required in FCC 47CFR Part 30 Subpart C. Testing was performed under FCC 47CFR Part 30 Subpart E.

3 Client Information

This EUT was tested at the request of:

Client: Starry, Inc.
38 Chauncy St Suite 200
Boston, MA 02111
USA

Contact: Ryan Lagoy
Telephone: None
Email: rlagoy@starry.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Starry, Inc.
38 Chauncy St Suite 200
Boston, MA 02111
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
See below	Starry, Inc.	Titan 37	2045200059

Receive Date:	04/20/2023
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The equipment under test (EUT) is a Titan37 mmWave based station access point, operating between 37-40 GHz. It utilizes OFDMA IEEE 802.11ac, MCS0-MCS9. Channel bandwidths are 160 MHz and 20 MHz unconverted and transmitted/received at mmWave frequencies between 37 GHz and 40 GHz. Signals are conveyed in two polarizations – horizontal and vertical through patch array with a lens antenna. The antenna is a patch array (4x8) for each polarization and a lens. There are 4 1x8 columns per polarization. The Titan37 base station is typically pole-mounted or building mounted.

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
48 VDC	5.84 A	DC	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Continuous Transmitting

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Proprietary Software that controls the operation of the radio.

Radio/Receiver Characteristics	
Frequency Band(s)	37.170-39.970 GHz
Modulation Type(s)	OFDMA
Maximum Output Power	55.2 dBm EIRP (With 4 Paths + beamforming, per pol)
Test Channels	37.170 GHz, 38.570 GHz, 39.970 GHz 37.100 GHz, 38.500 GHz, 39.900 GHz
Occupied Bandwidth	See section 9.6
MIMO Information (# of Transmit and Receive antenna ports)	8 x 8
Equipment Type	Proprietary upbanded and modified 802.11AC Radio
Antenna Type and Gain	The Titan 37 antenna consists of two 37-40 GHz patch array antennas (one each for horizontal and vertical polarization) with a focusing lens. Each of the eight conducted paths drives one 1x8 patch column. There are four paths per polarization. All beamforming is digital (no analog beamforming), and beamforming is only done in azimuth (elevation beam pattern is fixed). The following table provides maximum gain per polarization (4 paths beamformed) with a 60 degree lens over the operating frequency range.

Polarity	Frequency [GHz]	Maximum Array Gain (w/ Radome Loss) [dBi]
H	37.1	21.44
H	38.5	22.72
H	39.9	20.35
V	37.1	20.37
V	38.5	21.91
V	39.9	21.41

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

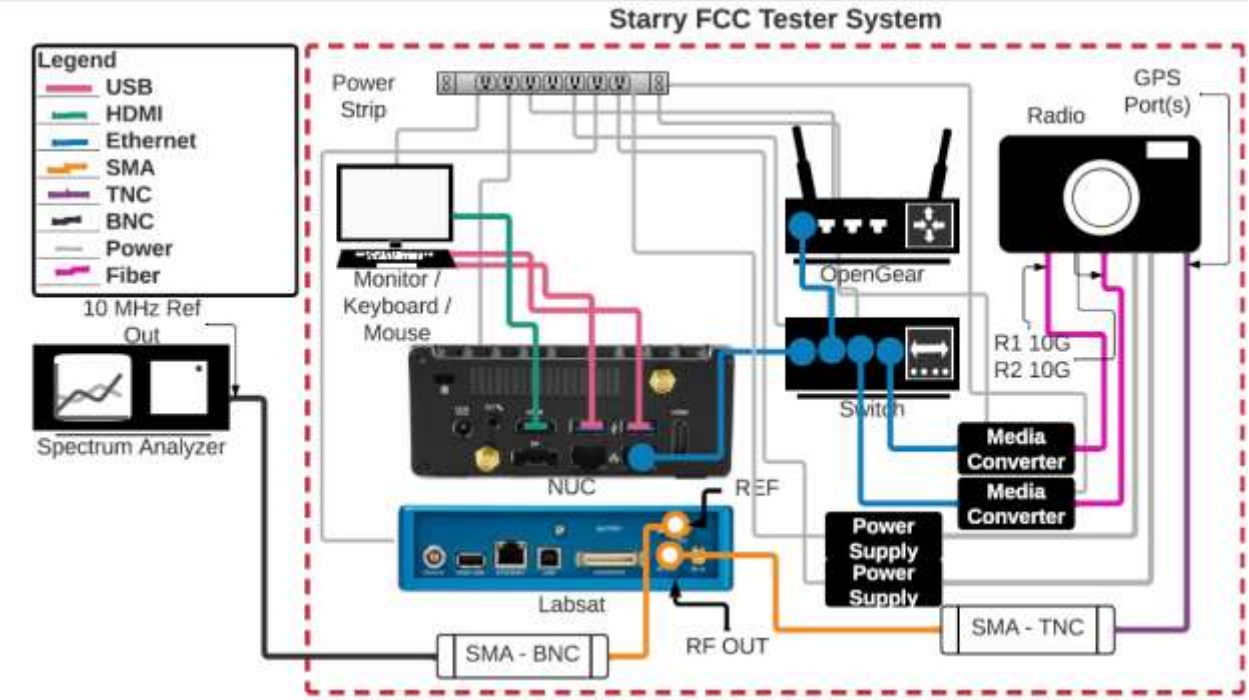
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
--	AC Cord	1	None	None	AC Mains
--	AC Adapter	1	None	Yes	Power Supply
--	Ethernet	10	None	None	Support Equipment
--	Fiber (2)	10	Yes	None	Support Equipment

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Monitor	Dell	P2317H	CN-03GJ21-74261-6BP-3TKM-A00
Keyboard	Dell	KB216t	CN-ORKRON-71616-6CD-1FLE-A03
Mouse	Dell	MS116t	CN-0DVORH-LO300-81G-1GFC
5-Port Gigabit Ethernet Switch	Netgear	GS305v3	5U81095VA3835
FCC System Tester	Starry	JBC313U591W-31ACB	19CF319X002872
Labsat GNSS Simulator	Racelogic	LS03	082600
Wireless Router	Opengear	ACM7004	70041901043136
48VDC Power Supply	Meanwell	GST200A48	None

5.1 Method:

Configuration as required by FCC 47CFR Part 30 Subpart C: 2023, FCC 47CFR Part 2: 2023, ANSI C63.26:2015, and KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 April 20, 2021.

5.2 EUT Block Diagram:



6 Output Power

6.1 Method

Tests are performed in accordance with FCC 47CFR Part 30 Subparts C: 2023, FCC 47CFR Part 2: 2023, KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 April 20, 2021 Subclause 4.2, and ANSI C63.26:2015 Subclause 5.5.4. The conducted method was used, using EMI Receiver power channel integration with RMS Average detector.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

6.2 Limit:

Limit – FCC 47CFR Part 30 Subpart C, Section 30.202 (a): For fixed and base stations operating in connection with mobile systems, the average power of the sum of all antenna elements is limited to an equivalent isotopically radiated power (EIRP) density of +75dBm/100 MHz. For channel bandwidths less than 100 megahertz the EIRP must be reduced proportionally and linearly based on the bandwidth relative to 100 megahertz.

6.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
Starry cable	Flexible 10' 40 GHz coaxial cable, 2.92mm M - 2.92mm M	San-tron	99139-02 M120	None	04/19/2023	N/A
Starry attenuator	20 dB Fixed Attenuator, 2.92mm M - 2.92mm F, 2W	Pasternack	PE7395-20	None	04/19/2023	N/A
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	11/18/2022	11/18/2023
DAV009'	weather station	Davis Instruments	6351 Vantage VUE	DAV009	03/27/2023	03/27/2024

Software Utilized:

Name	Manufacturer	Version
None	N/A	N/A

6.4 Results

The sample tested was found to Comply.

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6.5 Setup Photographs:

Conducted Power Test Setup

6.6 Plots/Data:

The antenna gains that we have provided are not done on a per-path basis, and already include beamforming effects. Backing this information out to per-path antenna gains would not be accurate. Each polarization antenna transmits four paths simultaneously; a table showing which Path (as measured by Intertek) maps to which polarization is provided below. Then, for each combination of frequency, polarization, bandwidth, and modulation (MCS), the measured conducted powers from the relevant individual paths are summed, and then the antenna gain (with beamforming included) is applied to calculate EIRP. The total EIRP limits / margins can be applied to the data in this supplemental table.

Intertek Label	T37 Polarization
Path 1	H
Path 2	H
Path 3	H
Path 4	H
Path 5	V
Path 6	V
Path 7	V
Path 8	V

Derivation of EIRP Calculations

Conducted power measurements were made for each individual transmit chain (eight total) for each combination of frequency, bandwidth, and MCS settings.

The radio transmits on both vertical and horizontal polarizations. Each polarization is the combination of four of the individual transmit chains, with mapping between the measured channels and the polarization shown in Section 6.

Maximum antenna array gain (as reported in section 4) is reported on a per-polarization basis, and includes beamforming effects.

EIRP is then calculated for each unique combination of the following conditions:

- Frequency (low, mid, and high band)
- MCS (MCS0 and MCS9)
- Bandwidth (20, 40, 80, and 160 MHz channels)
- Polarization (HPOL or VPOL)

Sample calculations:

P_C[x] = Conducted power for Path X, in dBm
G_[pol] = Maximum antenna array gain for specified polarization and frequency

$$EIRP\_V = G\_V + 10*\log_{10} \sum_{n=5}^{8} 10^{(P\_Cn / 10)}$$

$$EIRP\_H = G\_H + 10*\log_{10} \sum_{n=1}^{4} 10^{(P\_Cn / 10)}$$

Qualitative summary:

- Convert individual transmit chain conducted powers to linear power
- For each set of frequency, MCS, and bandwidth conditions, take the sum of the linear conducted power for the four paths that correspond to a polarization
- Convert this sum to dBm
- Add the antenna array gain for the specified frequency condition and polarization to find the EIRP

The maximum reported EIRP (e.g. as reported in Form 731) is then the maximum EIRP for any combination of polarization, bandwidth, and MCS conditions within each frequency band.

Polarization	Frequency (GHz)	BW (MHz)	MCS	EIRP (dBm)*	Limit +75 dBm/100 MHz**
H	37.17	20	MCS0	51.14	68.01
H	37.17	20	MCS9	52.07	68.01
H	37.16	40	MCS0	51.06	71.02
H	37.16	40	MCS9	51.18	71.02
H	37.14	80	MCS0	50.5	74.03
H	37.14	80	MCS9	50.69	74.03
H	37.1	160	MCS0	53.71	75.00
H	37.1	160	MCS9	54.35	75.00
H	38.57	20	MCS0	50.73	68.01
H	38.57	20	MCS9	50.8	68.01
H	38.56	40	MCS0	50.45	71.02
H	38.56	40	MCS9	50.53	71.02
H	38.54	80	MCS0	50.19	74.03
H	38.54	80	MCS9	50.17	74.03
H	38.5	160	MCS0	54.65	75.00
H	38.5	160	MCS9	55.19	75.00
H	39.97	20	MCS0	48.61	68.01
H	39.97	20	MCS9	48.08	68.01
H	39.96	40	MCS0	46.7	71.02
H	39.96	40	MCS9	46.7	71.02
H	39.94	80	MCS0	46.44	74.03
H	39.94	80	MCS9	46.42	74.03
H	39.9	160	MCS0	50.84	75.00
H	39.9	160	MCS9	50.55	75.00
V	37.17	20	MCS0	51.42	68.01
V	37.17	20	MCS9	51.23	68.01
V	37.16	40	MCS0	50.62	71.02
V	37.16	40	MCS9	50.61	71.02
V	37.14	80	MCS0	50.09	74.03
V	37.14	80	MCS9	50.11	74.03
V	37.1	160	MCS0	53.19	75.00
V	37.1	160	MCS9	53.32	75.00
V	38.57	20	MCS0	51.47	68.01
V	38.57	20	MCS9	51.42	68.01
V	38.56	40	MCS0	49.99	71.02
V	38.56	40	MCS9	49.92	71.02
V	38.54	80	MCS0	49.64	74.03
V	38.54	80	MCS9	49.78	74.03
V	38.5	160	MCS0	54.57	75.00
V	38.5	160	MCS9	54.6	75.00
V	39.97	20	MCS0	47.57	68.01
V	39.97	20	MCS9	47.8	68.01

V	39.96	40	MCS0	46.25	71.02
V	39.96	40	MCS9	46.35	71.02
V	39.94	80	MCS0	46.26	74.03
V	39.94	80	MCS9	46.2	74.03
V	39.9	160	MCS0	50.72	75
V	39.9	160	MCS9	50.77	75

*Note 1 – EIRP (dBm) calculation from the conducted power on plots.

1) There are 4 paths for horizontal (H) polarization; refer to the table on page 10 to map paths to polarization.
Find the conducted powers for H3, H2, H1, H0.
a) H3 – Path 1 (37.17 GHz, 20 MHz, MCS0) = 22.14 dBm, from plot on page 14.
b) H2 – Path 2 (37.17 GHz, 20 MHz, MCS0) = 25.53 dBm, from plot on page 20.
c) H1 – Path 3 (37.17 GHz, 20 MHz, MCS0) = 25.43 dBm, from plot on page 26.
c) H0 – Path 4 (37.17 GHz, 20 MHz, MCS0) = 18.04 dBm, from plot on page 32.

2) Convert the conducted powers in dBm to linear power with equation: 10^(conducted power (dBm)/10).

Path	Frequency (GHz)	Bandwidth (MHz)	Modulation	Power (dBm)	Linear Power (mW)
1	37.17	20	MCS0	22.14	163.68
2	37.17	20	MCS0	25.53	357.27
3	37.17	20	MCS0	25.43	349.14
4	37.17	20	MCS0	18.04	63.68

3) Sum the linear powers: 163.68 + 357.27 + 349.14 + 63.68 = 933.77 mW

4) Convert back to dBm: 10*log(933.77) = 29.7 dBm

5) Add the antenna gain for the 37.1 GHz frequency: 29.7 dBm + 21.44 dBi = 51.14 dBm, refer to page 6 for antenna gain.

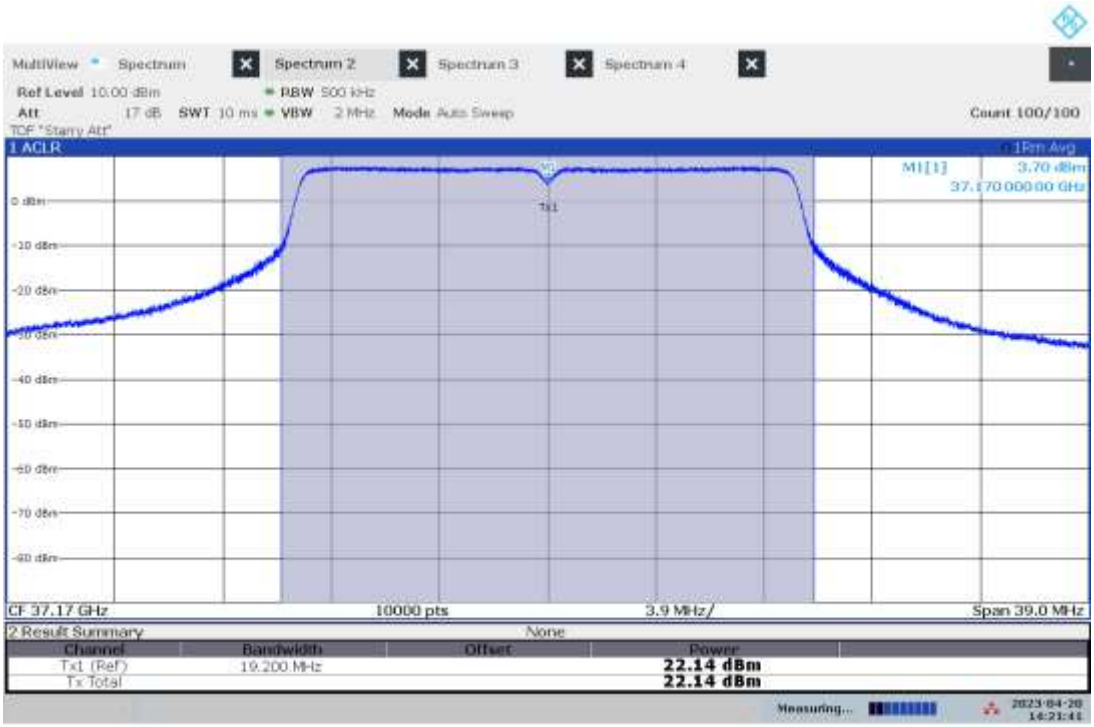
**Note 2: Limit +75 dBm/100 MHz calculation

The “EIRP (dBm) column” is measured (see below for a sample calculation), and “Limit +75 dBm/100 MHz” is the adjusted limit (not a measurement).

The limit for bandwidth less than 100 MHz is calculated as follows: 75 dBm + 10*log[BW(MHz)/100MHz]. This is per 47 CFR 30.202 Limits.

For 20 MHz, this calculation is: 75 dBm + 10*log[20 MHz/100 MHz] = 68.01 dBm

Path 1 Output Power – Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



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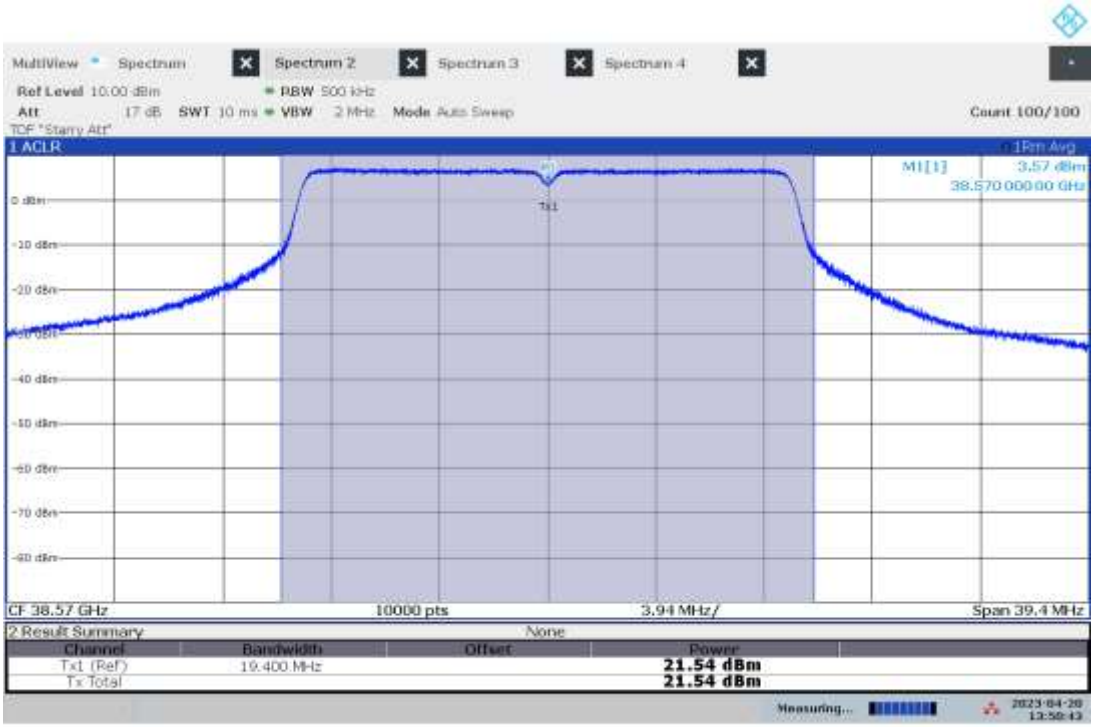
Path 1 Output Power – Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



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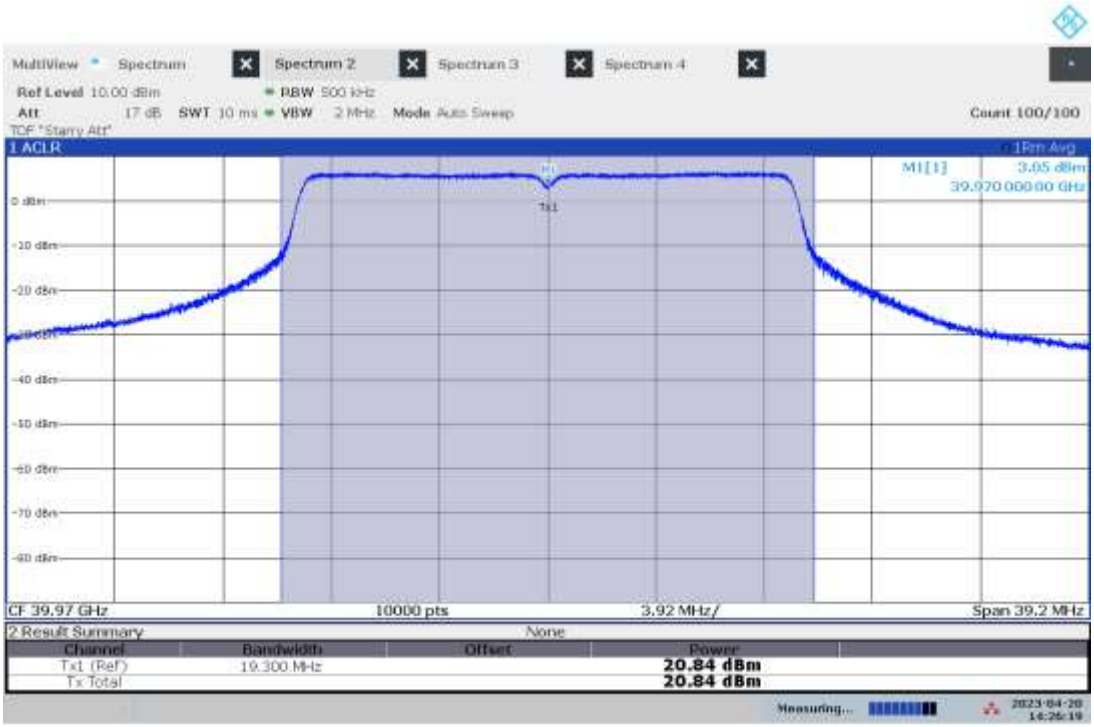
Output Power – Path 1, High 39.97 GHz, Modulation MCS0, Bandwidth 20 MHz



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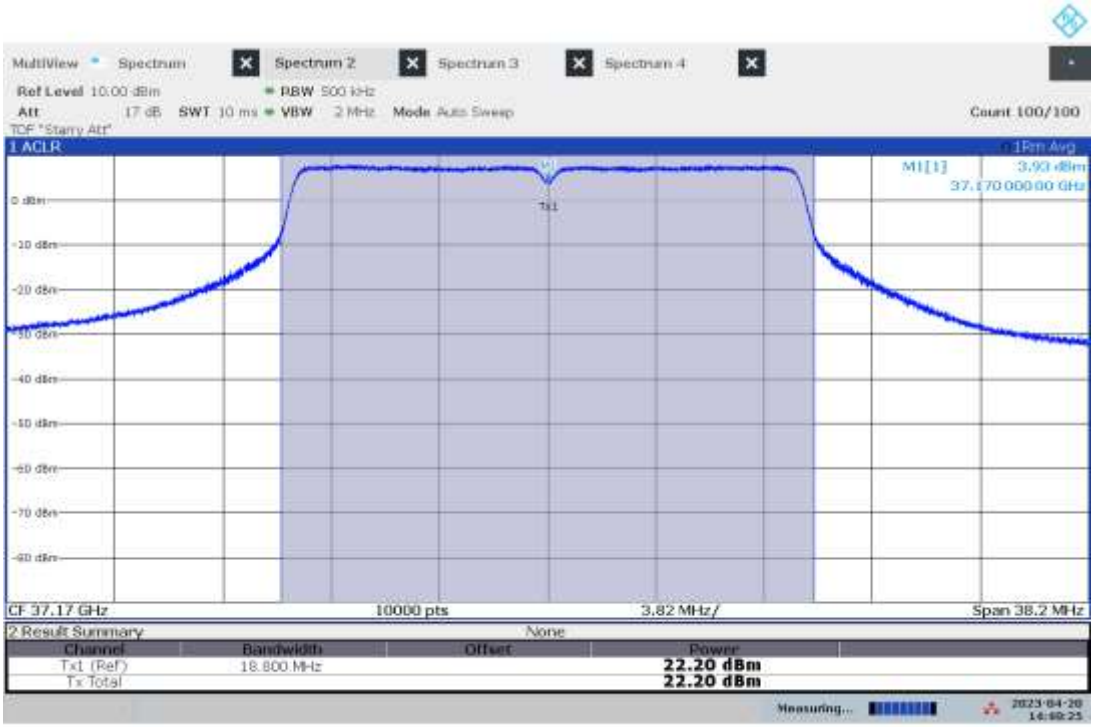
Output Power – Path 1, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



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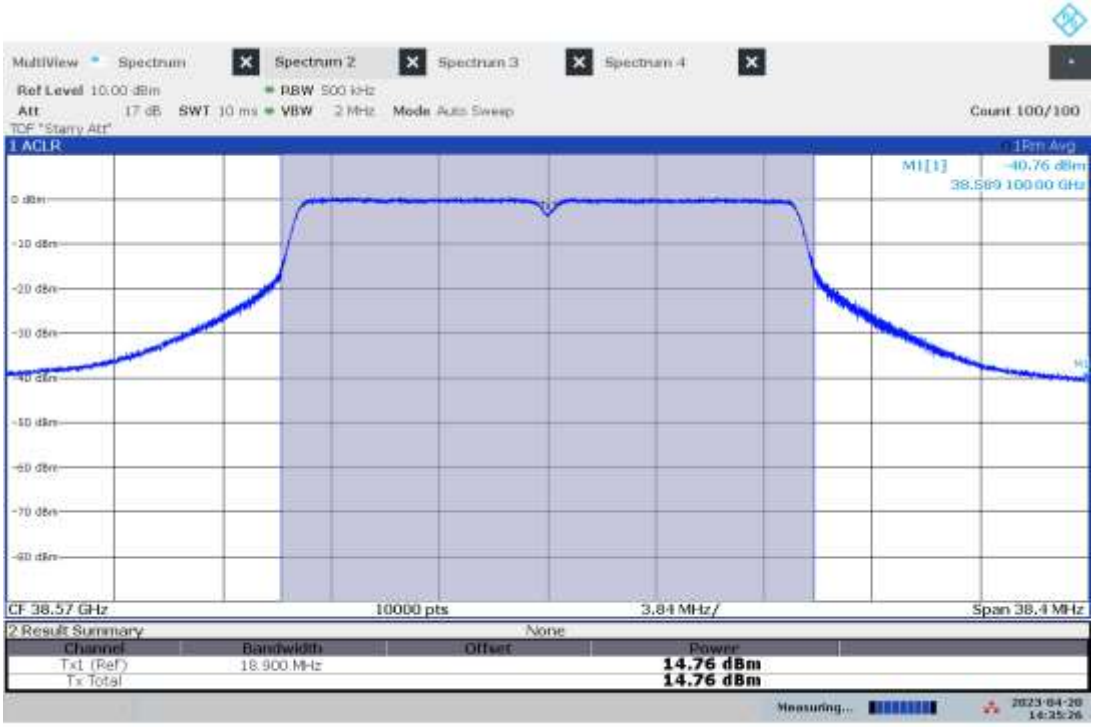
Output Power – Path 1, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



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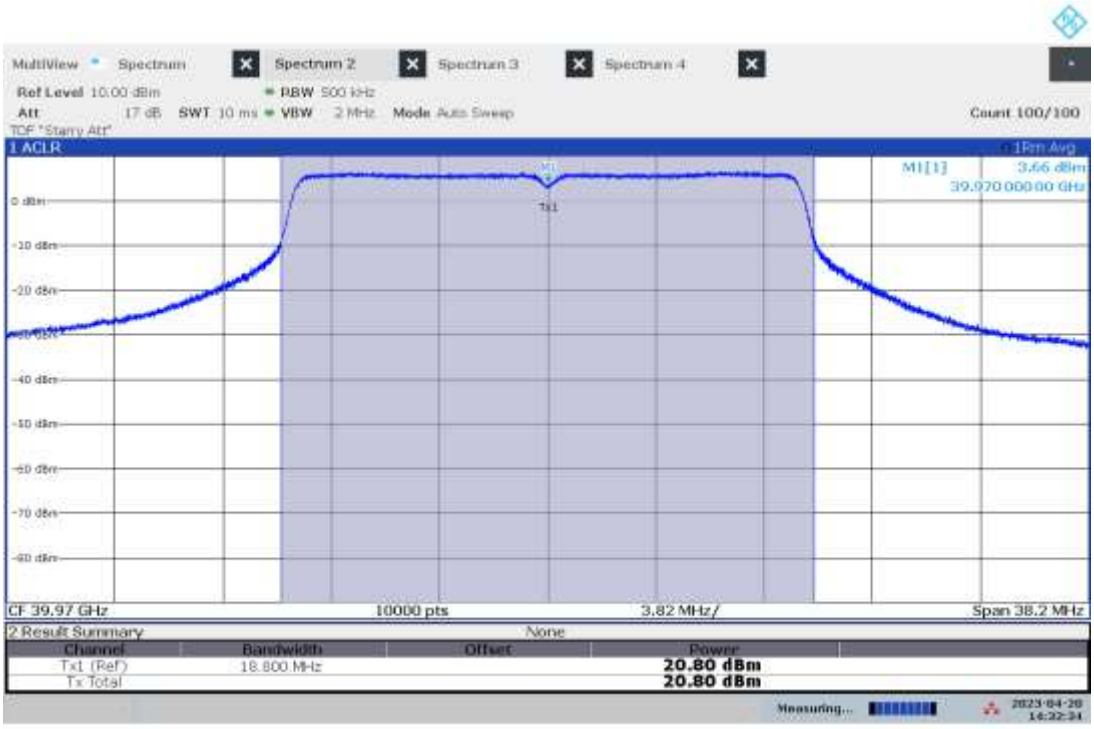
Output Power – Path 1, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



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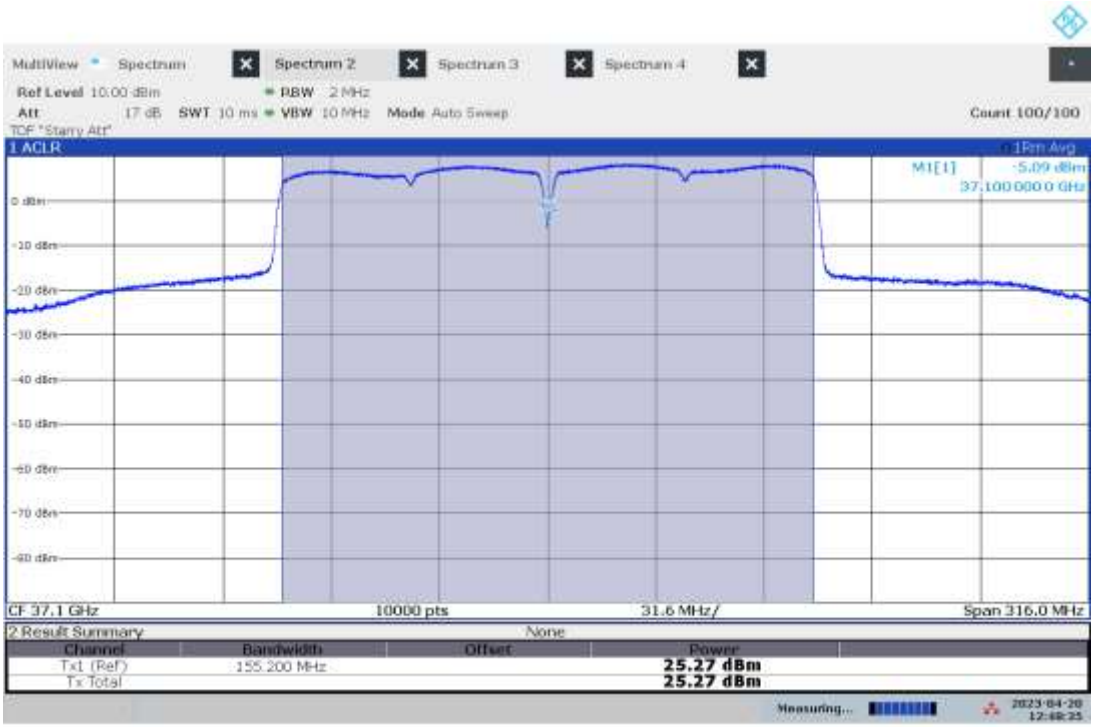
Output Power – Path 1, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



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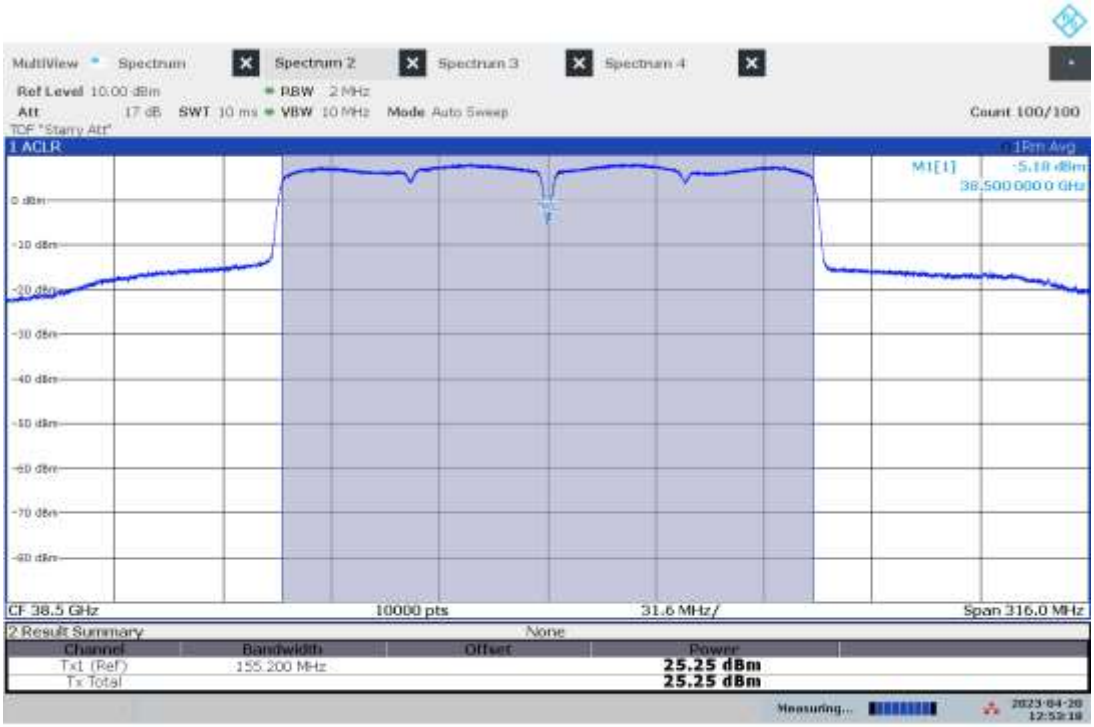
Output Power – Path 1, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz



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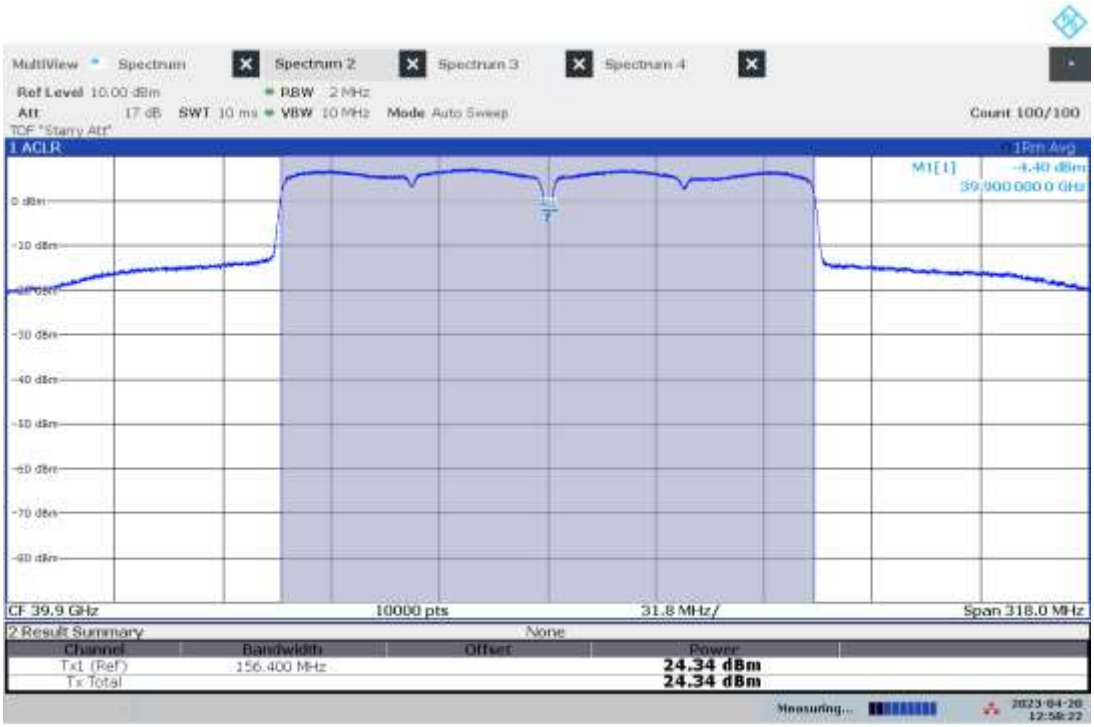
Output Power – Path 1, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz



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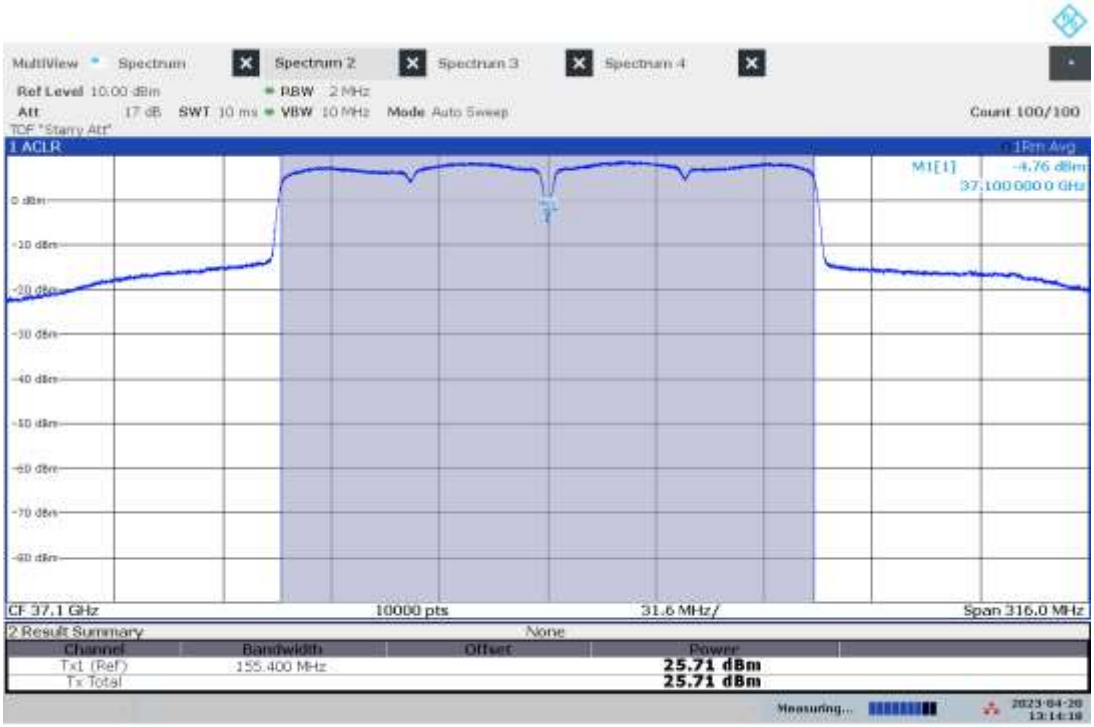
Output Power – Path 1, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



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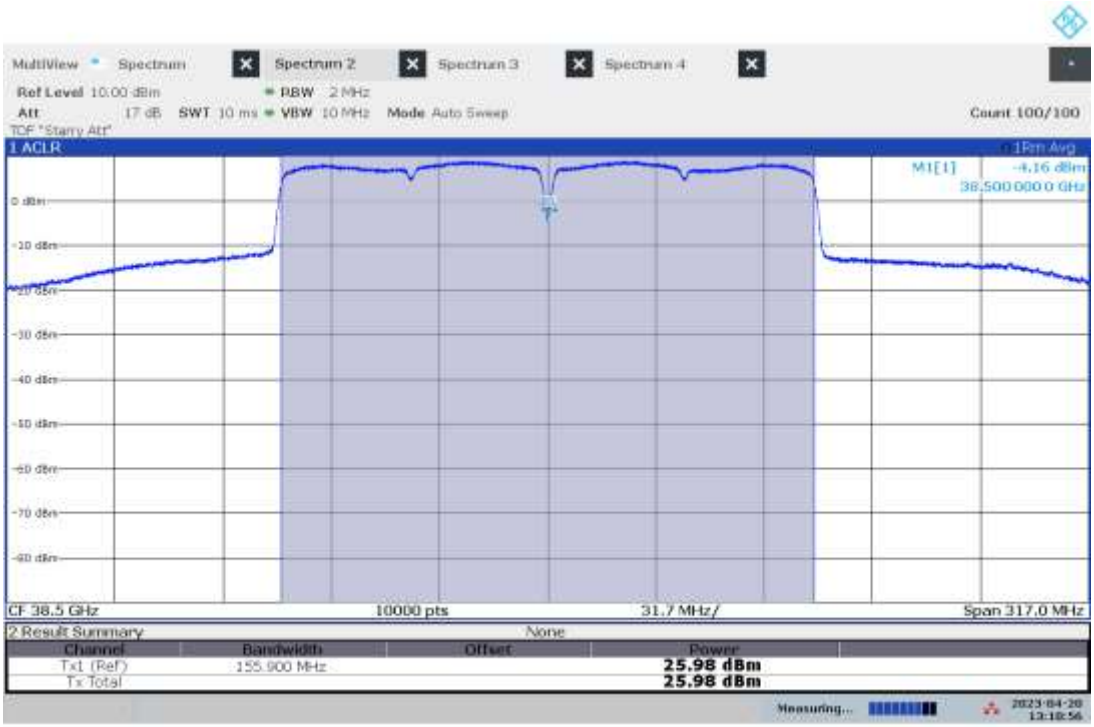
Output Power – Path 1, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz



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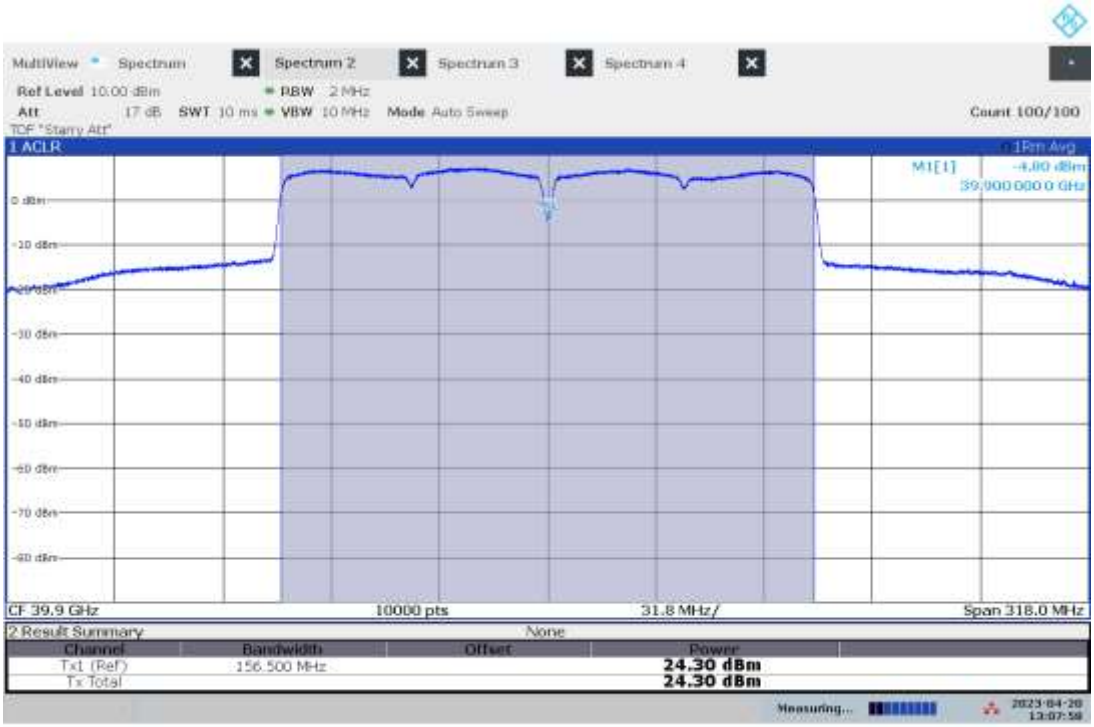
Output Power – Path 1, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz



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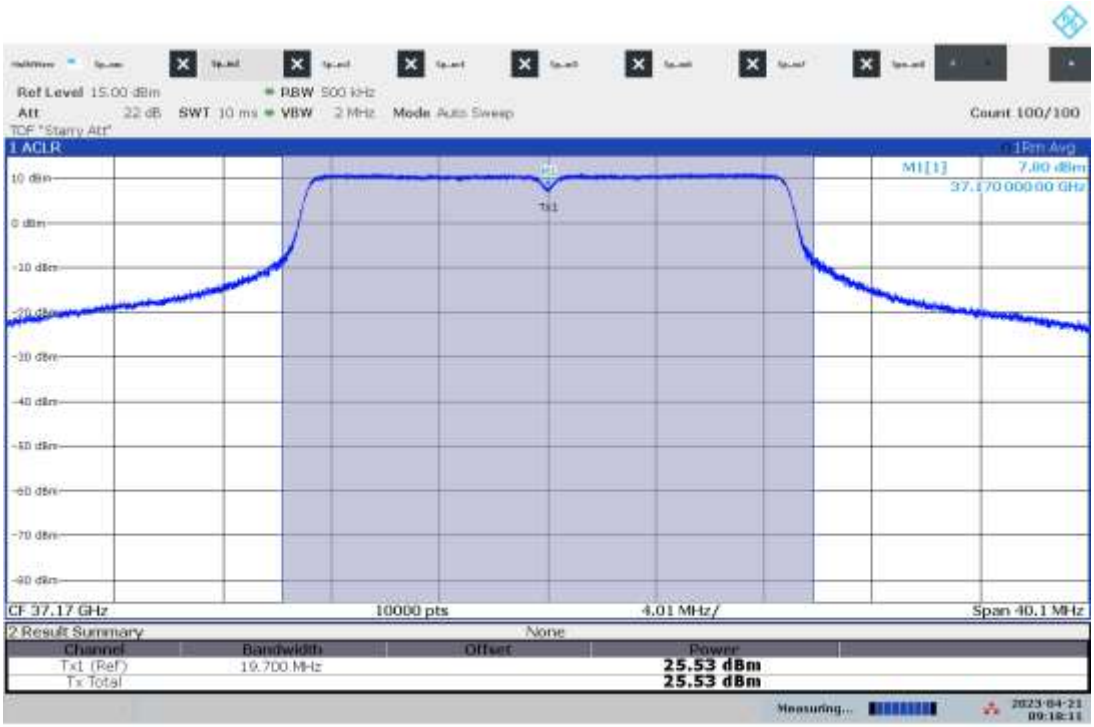
Output Power – Path 2, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



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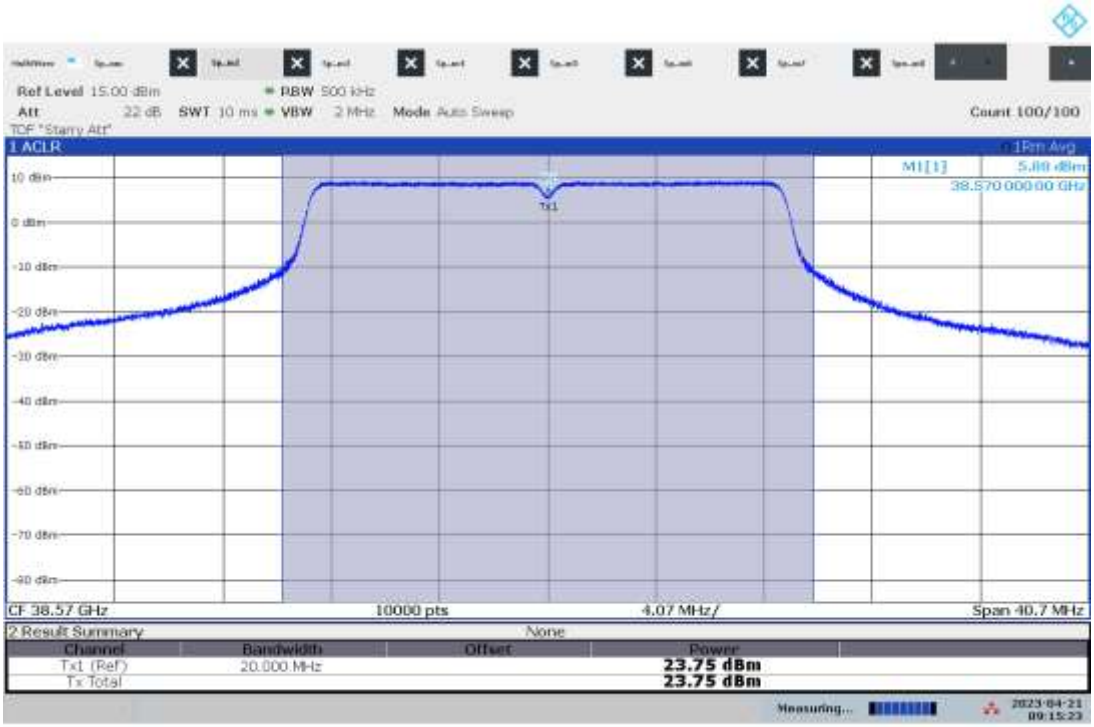
Output Power – Path 2, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



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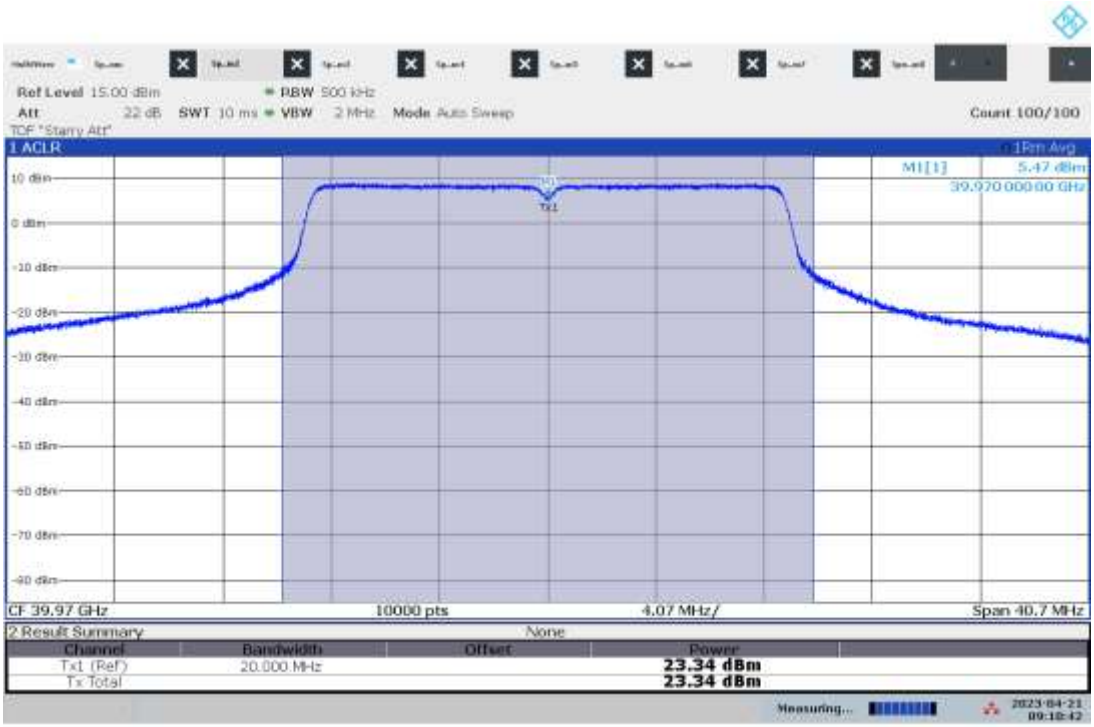
Output Power – Path 2, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



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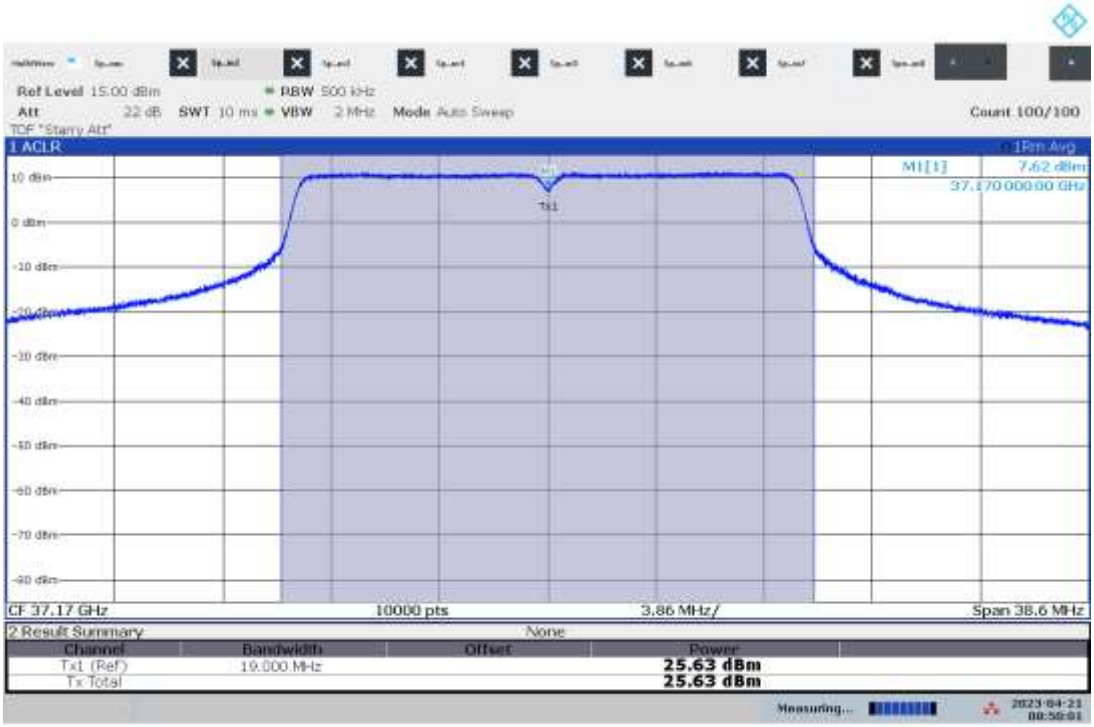
Output Power – Path 2, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



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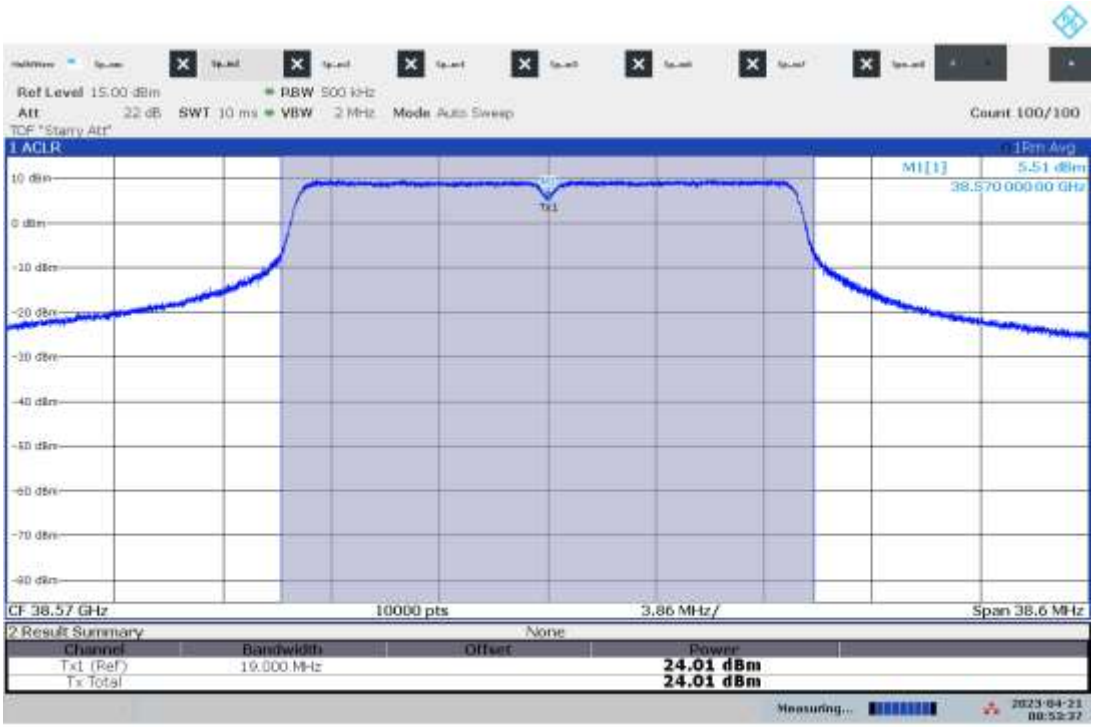
Output Power – Path 2, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



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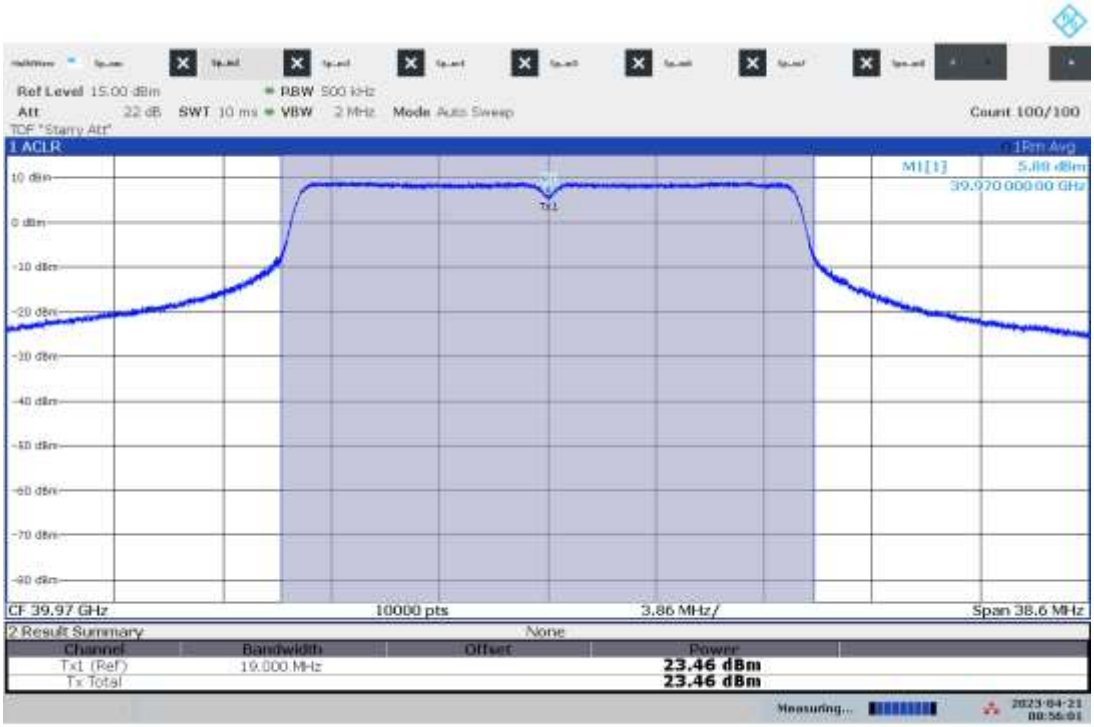
Output Power – Path 2, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



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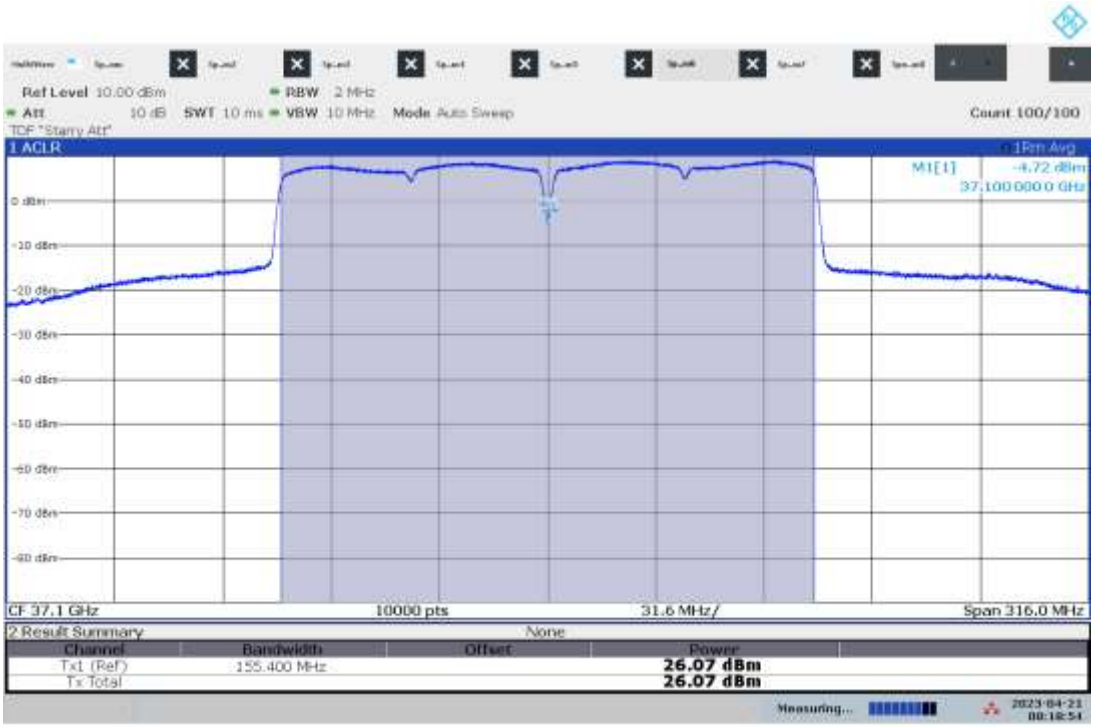
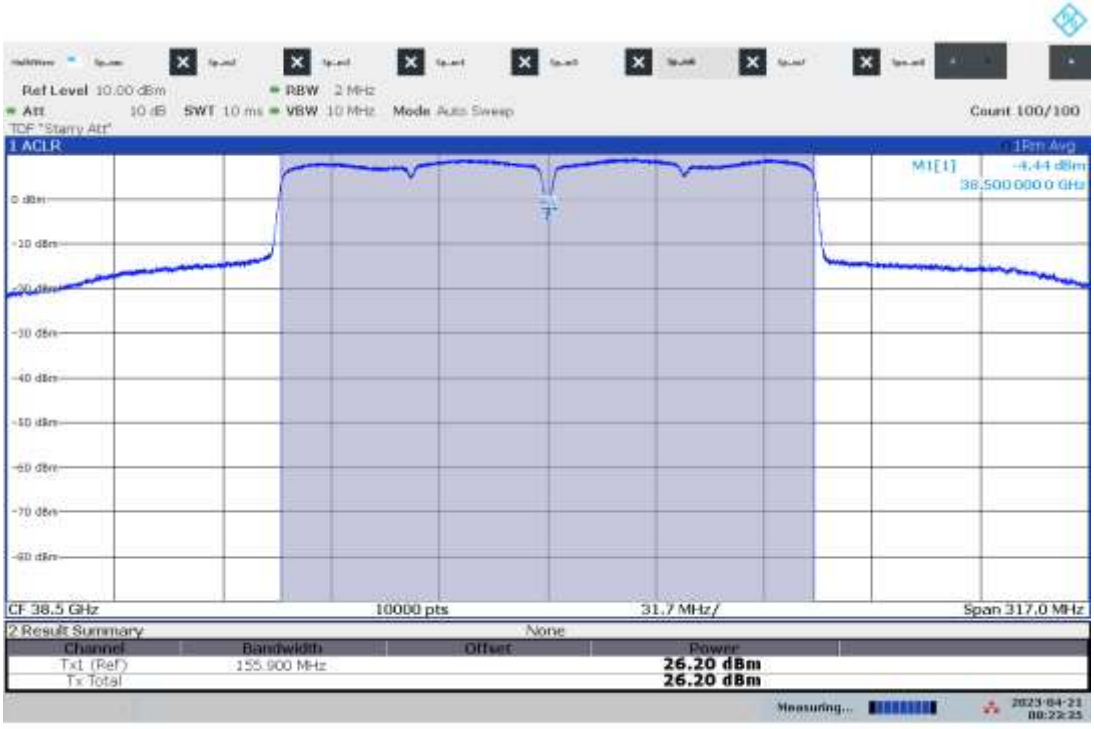
Output Power – Path 2, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



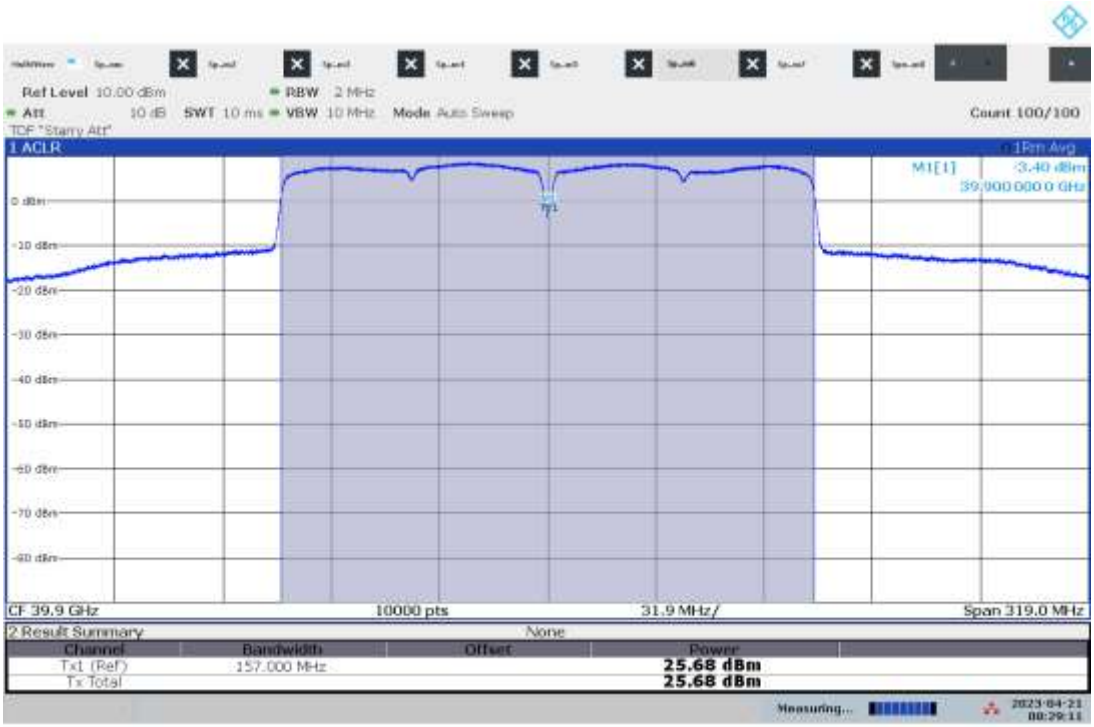
08:18:54 AM 04/21/2023

Output Power – Path 2, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz



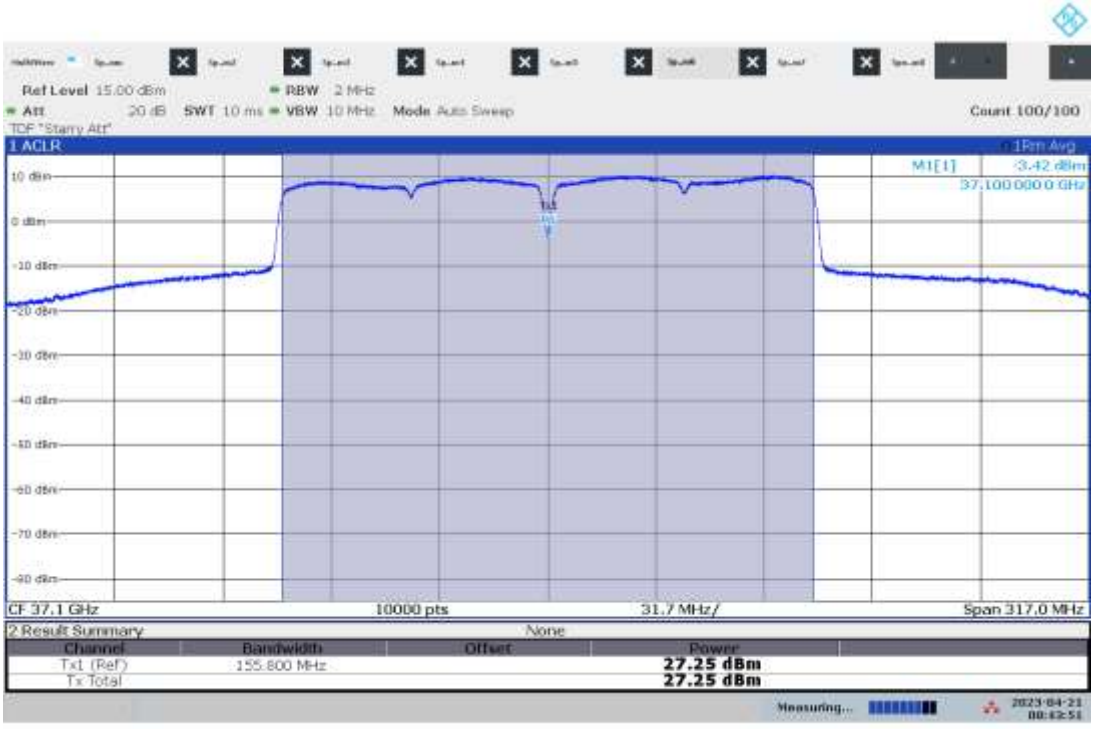
08:23:35 AM 04/21/2023

Output Power – Path 2, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz



08:29:11 AM 04/21/2023

Output Power – Path 2, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz

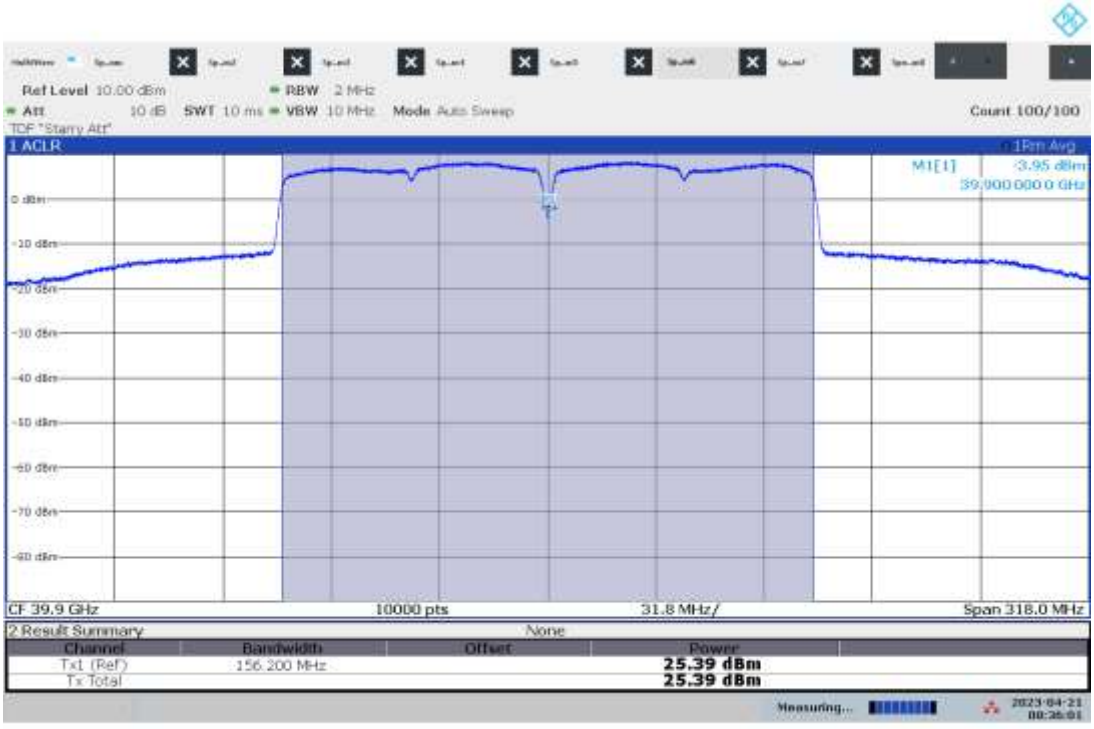


08:43:52 AM 04/21/2023

Output Power – Path 2, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz

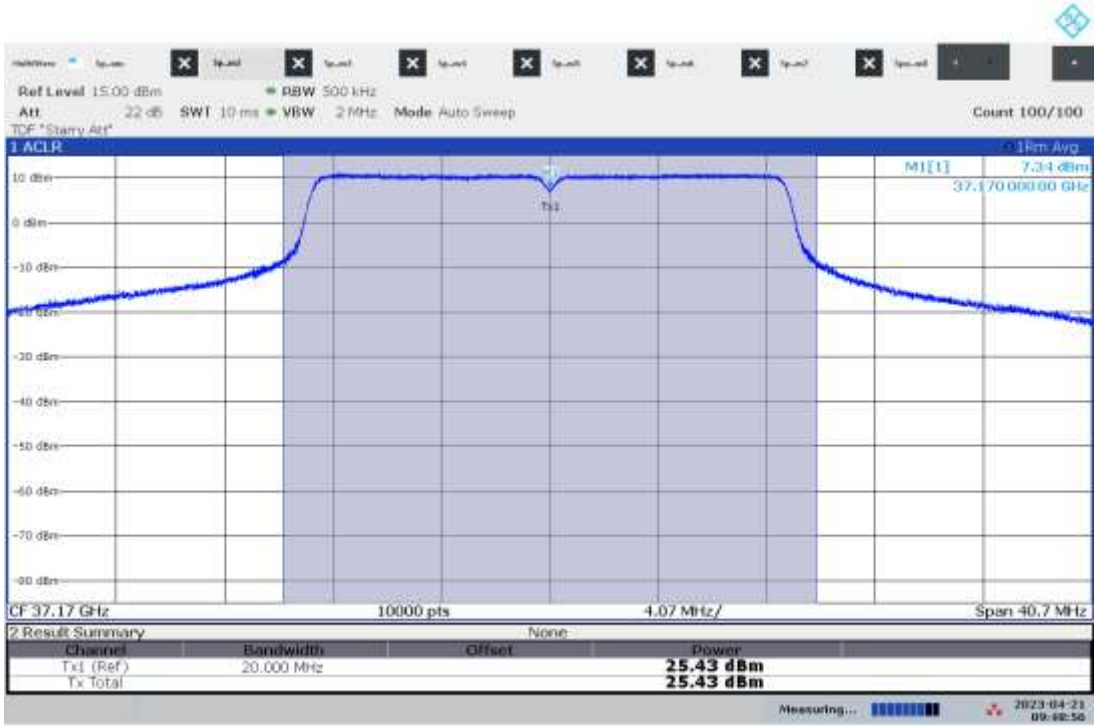
08:40:02 AM 04/21/2023

Output Power – Path 2, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz



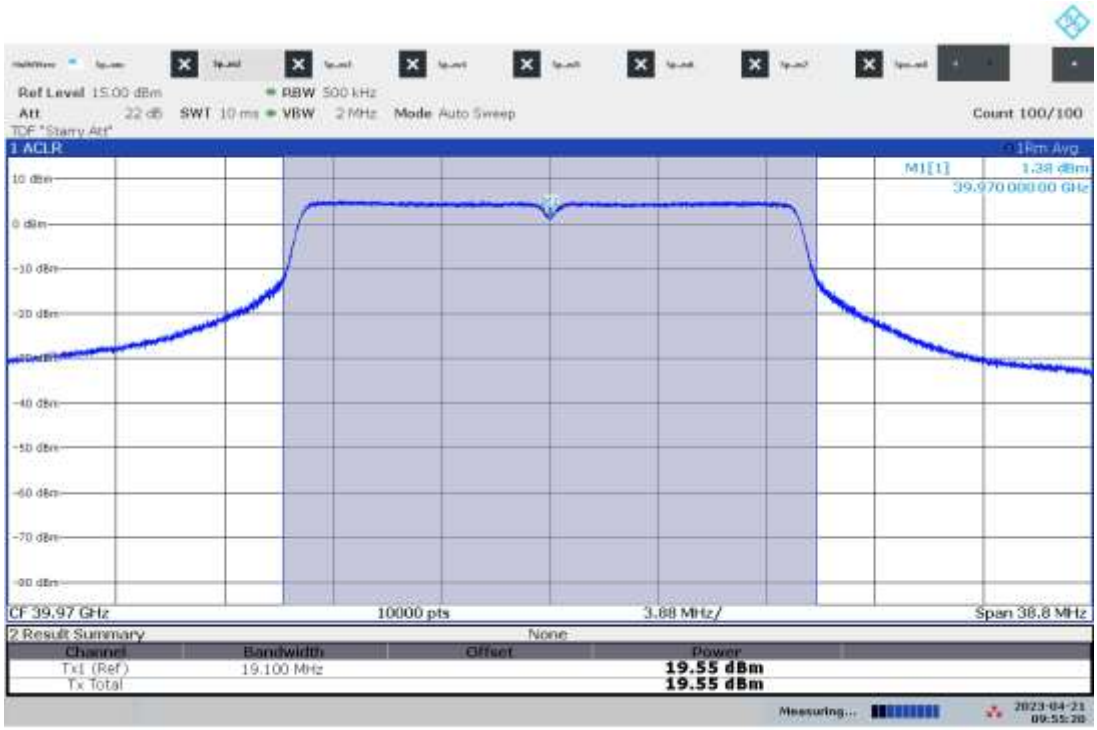
08:36:02 AM 04/21/2023

Output Power – Path 3, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



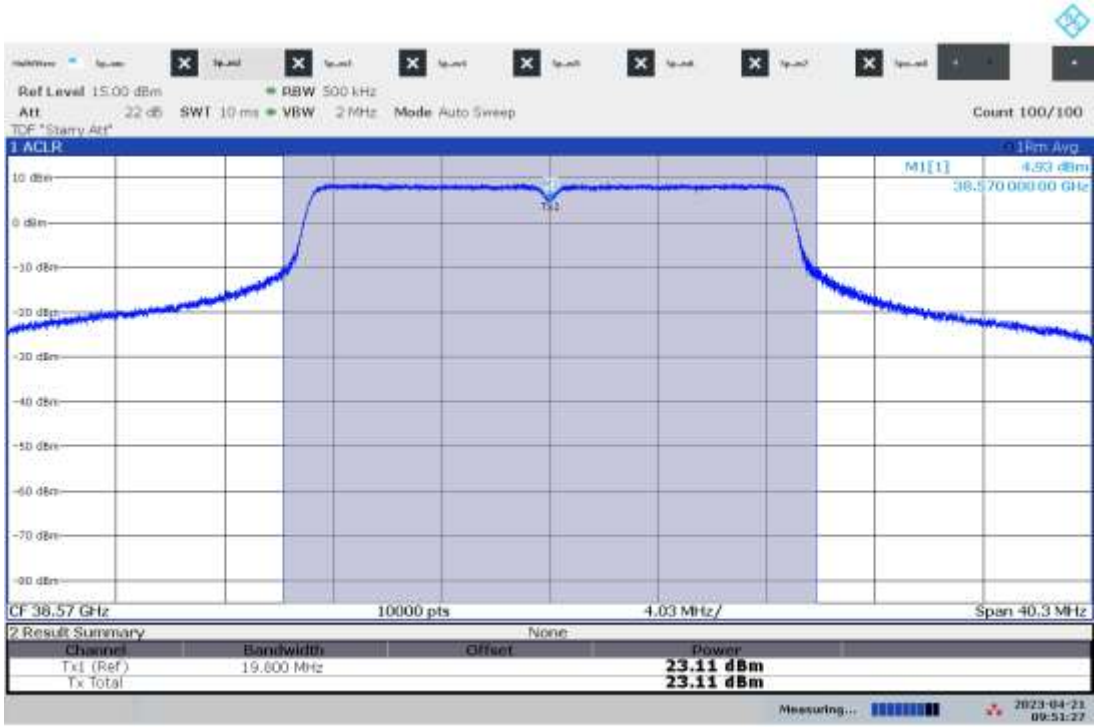
09:48:56 AM 04/21/2023

Output Power – Path 3, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



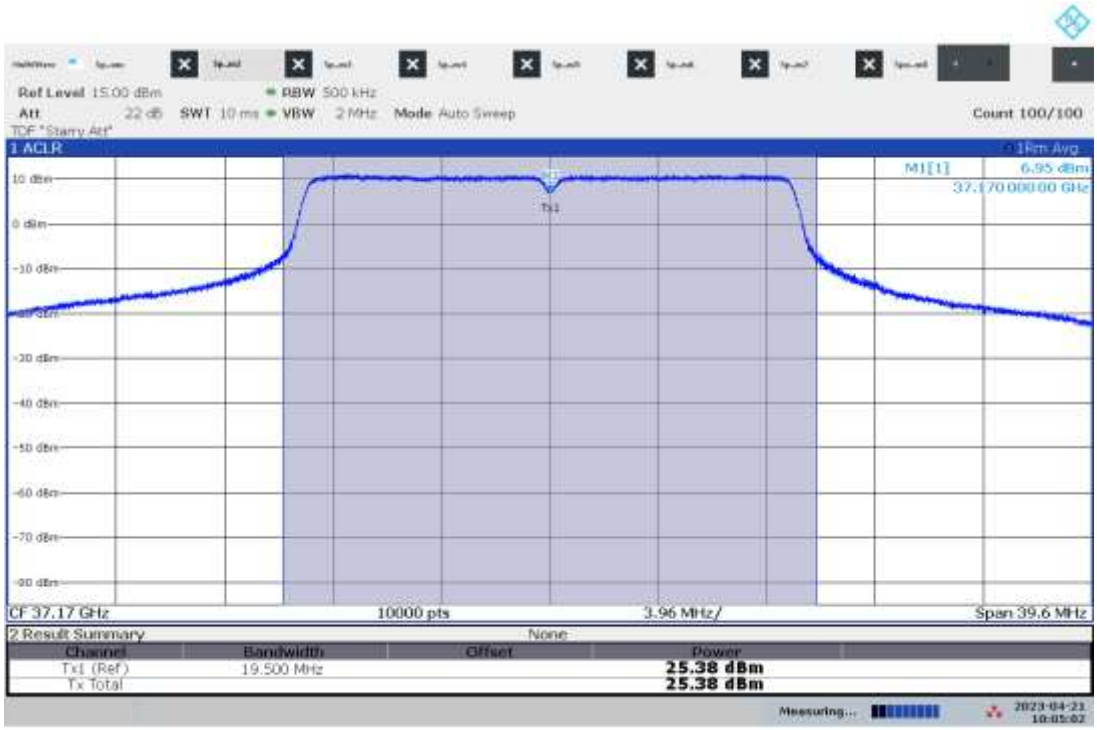
09:55:20 AM 04/21/2023

Output Power – Path 3, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



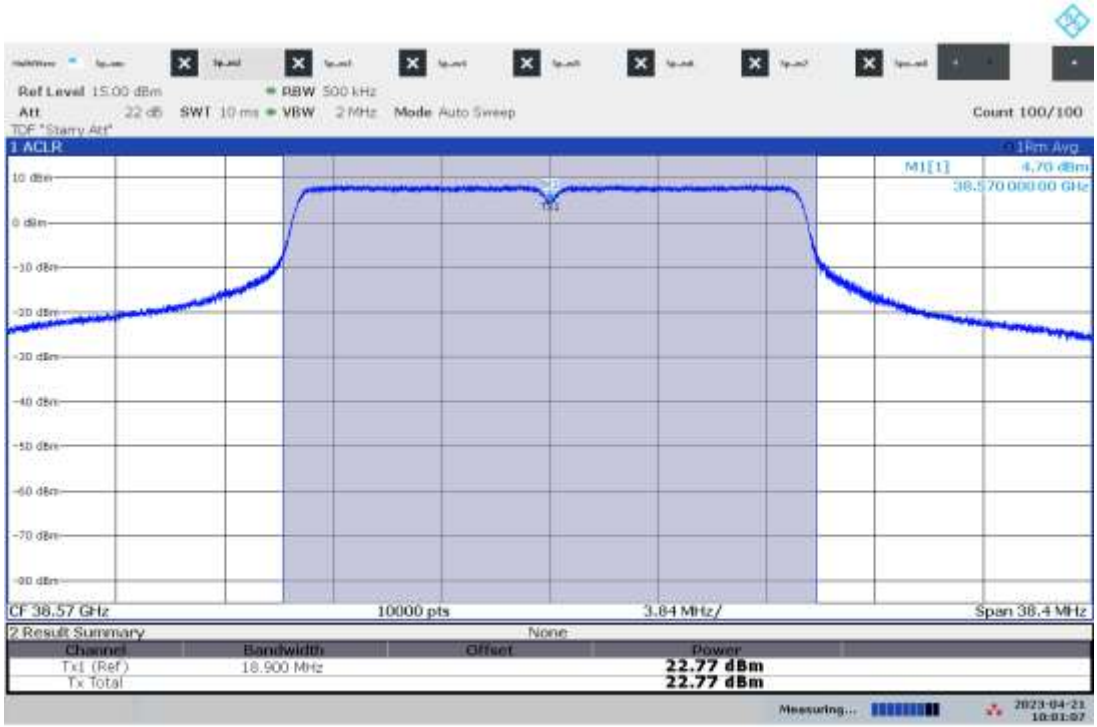
09:51:28 AM 04/21/2023

Output Power – Path 3, Low 37.100 GHz, Modulation MCS9, Bandwidth 20 MHz



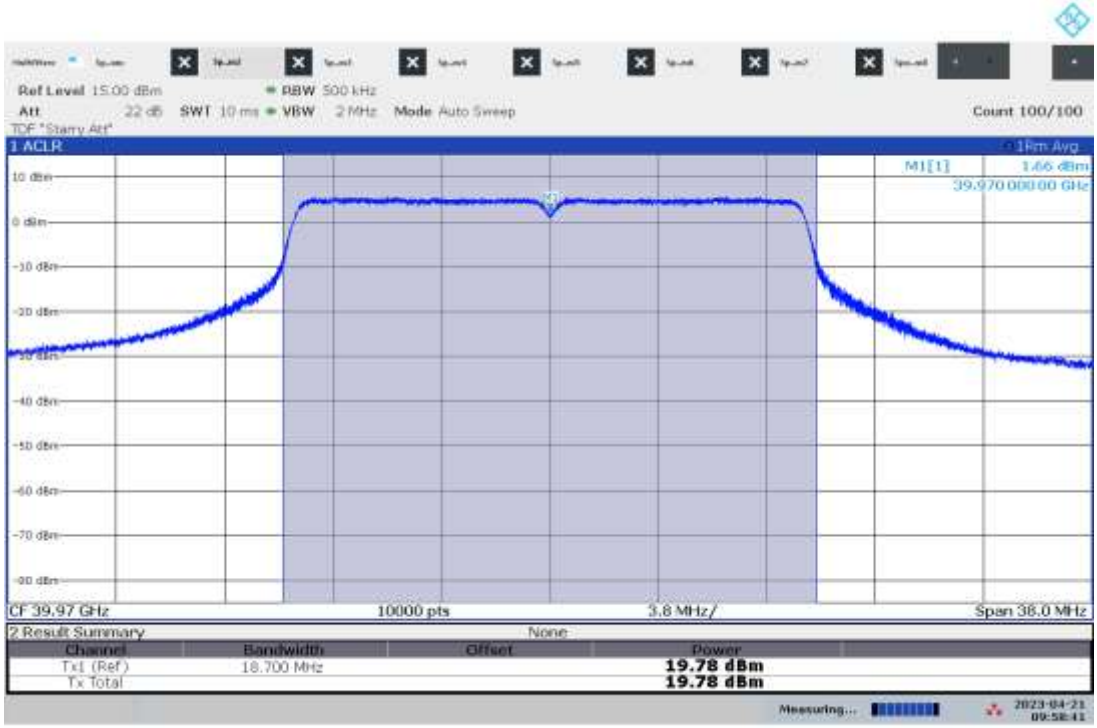
10:05:03 AM 04/21/2023

Output Power – Path 3, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



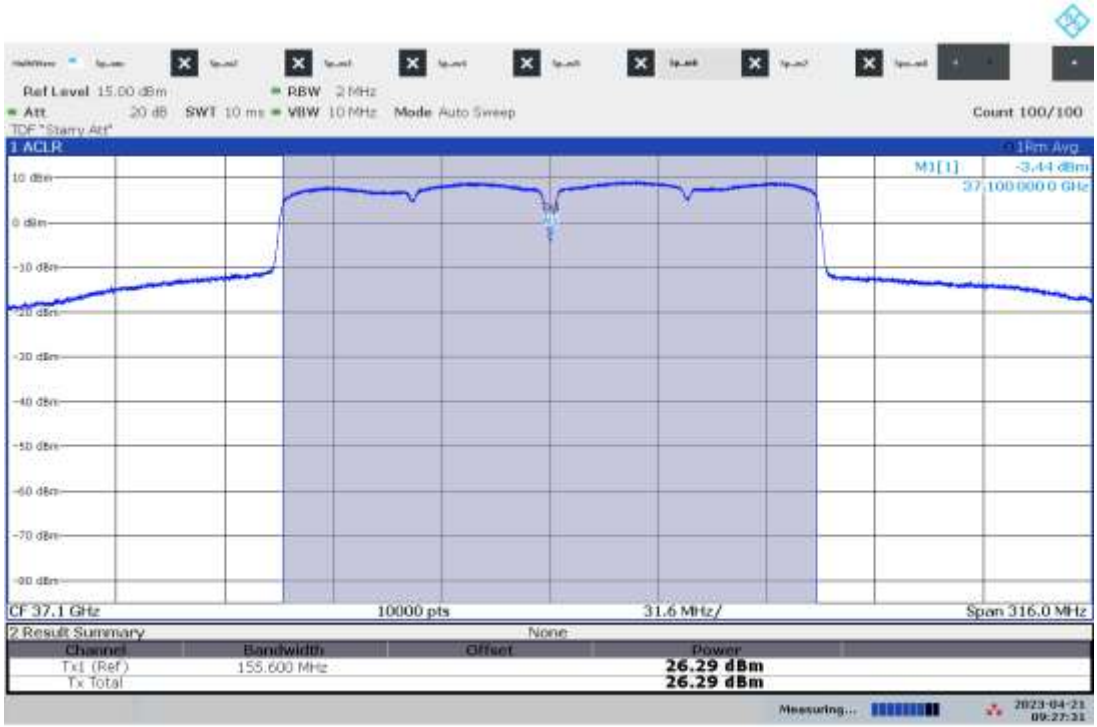
10:01:07 AM 04/21/2023

Output Power – Path 3, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



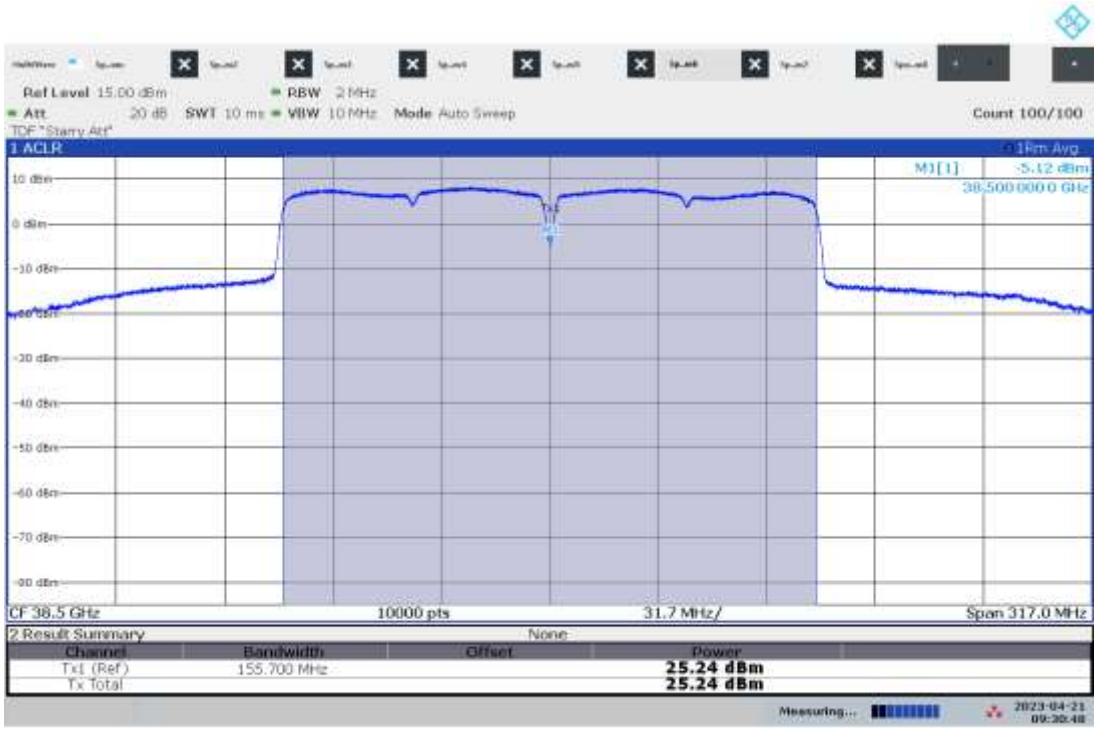
09:58:41 AM 04/21/2023

Output Power – Path 3, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



09:27:31 AM 04/21/2023

Output Power – Path 3, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz

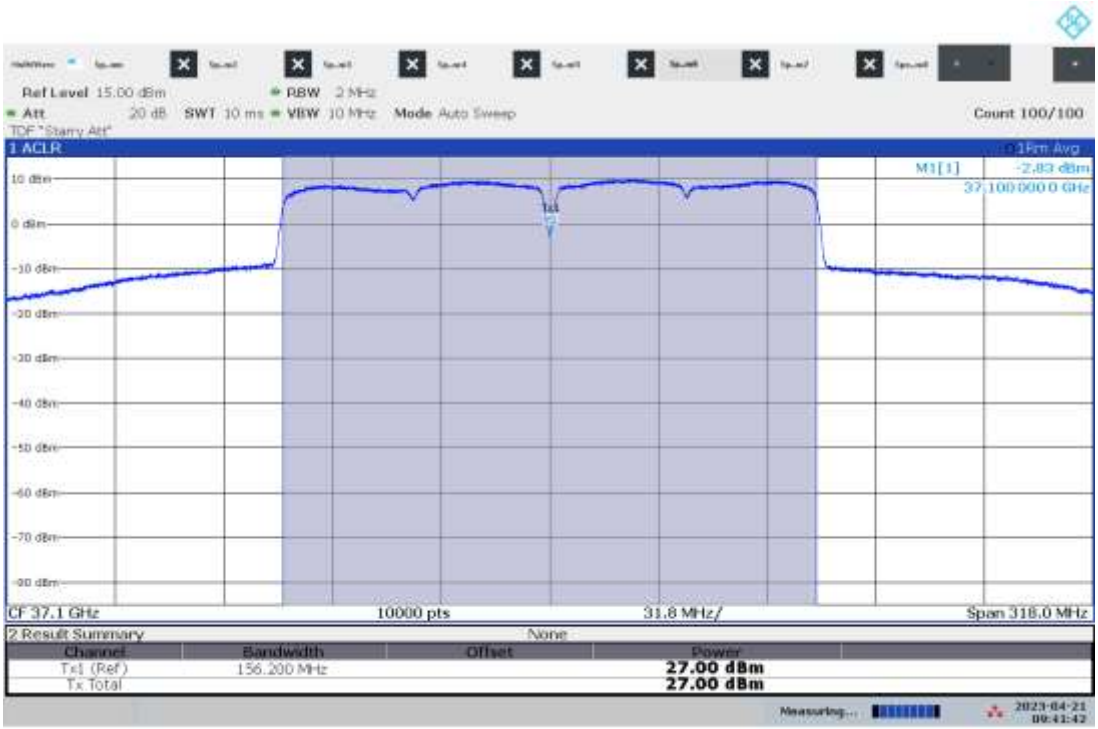


09:30:48 AM 04/21/2023

Output Power – Path 3, High 39.970 GHz, Modulation MCS0, Bandwidth 160 MHz

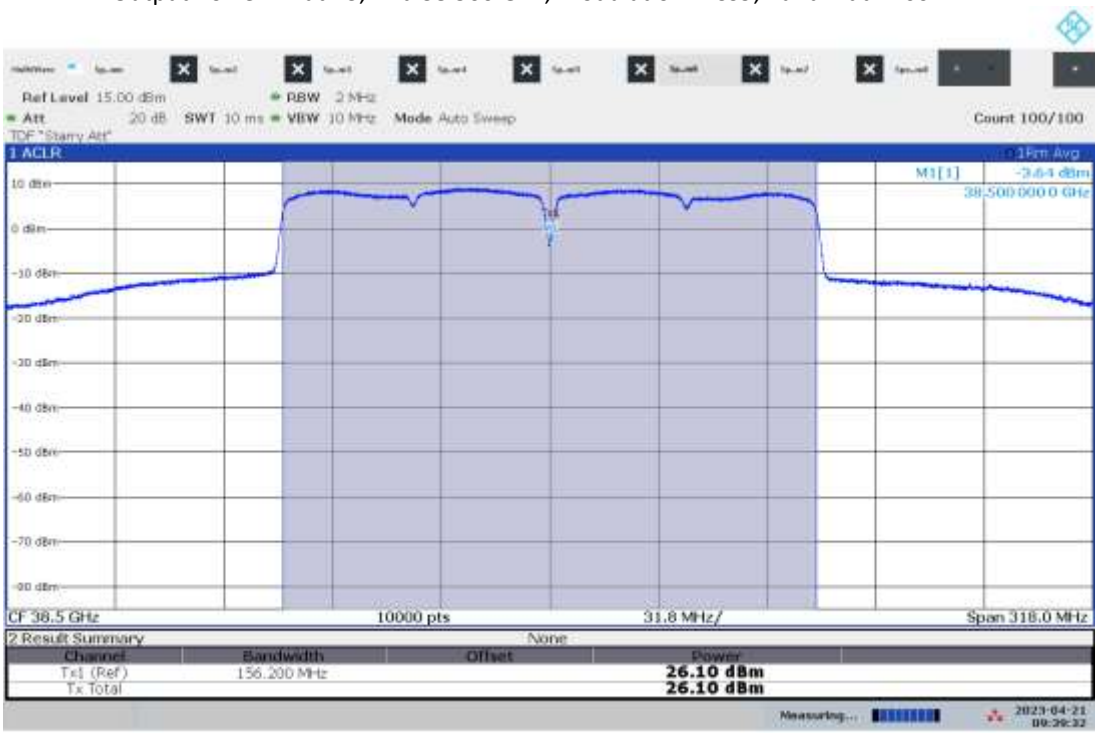
09:33:34 AM 04/21/2023

Output Power – Path 3, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



09:41:42 AM 04/21/2023

Output Power – Path 3, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz

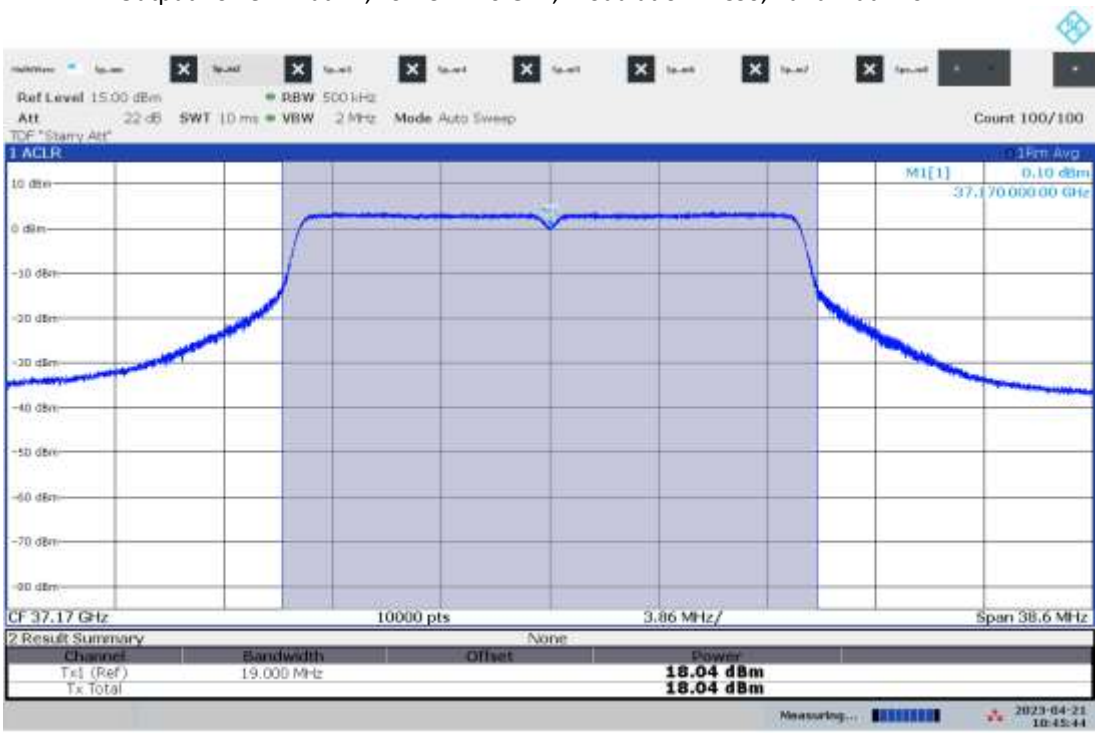


09:39:33 AM 04/21/2023

Output Power – Path 3, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz

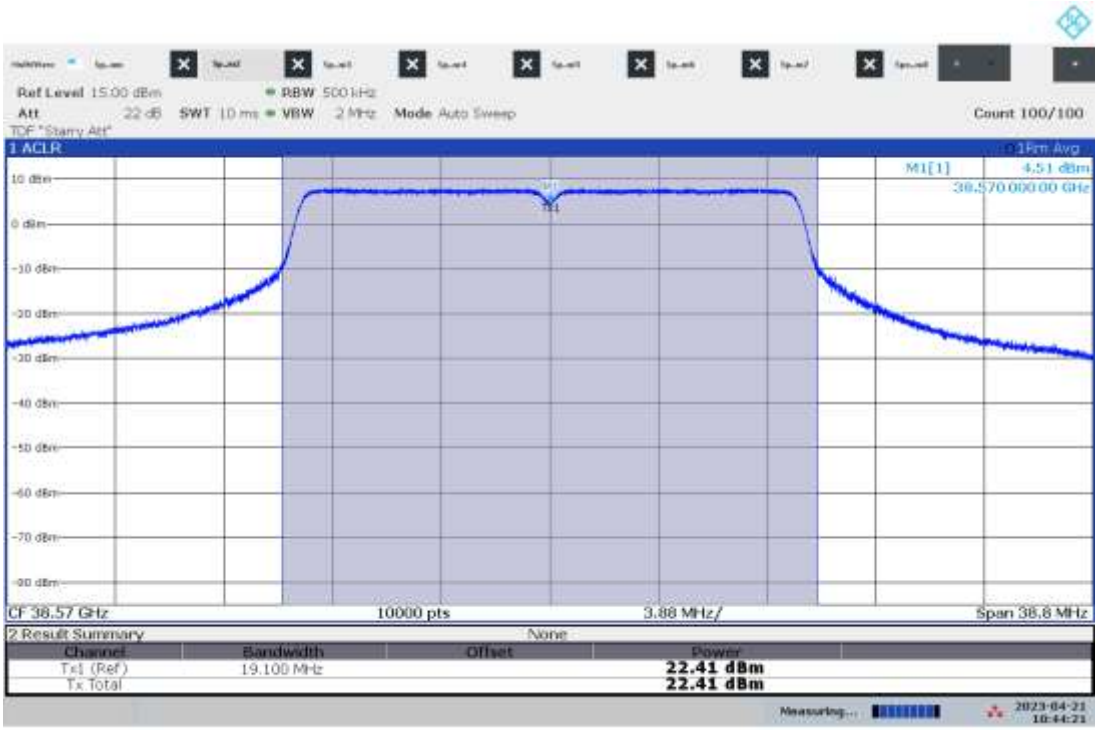
09:37:02 AM 04/21/2023

Output Power – Path 4, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



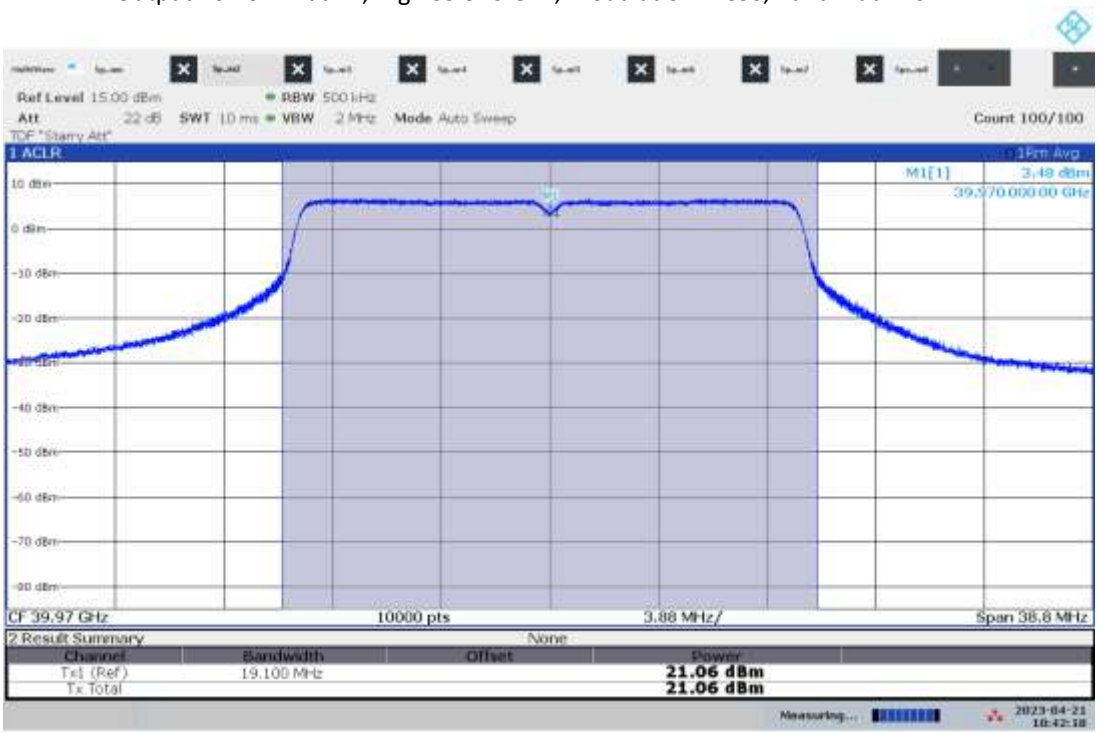
10:45:44 AM 04/21/2023

Output Power – Path 4, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



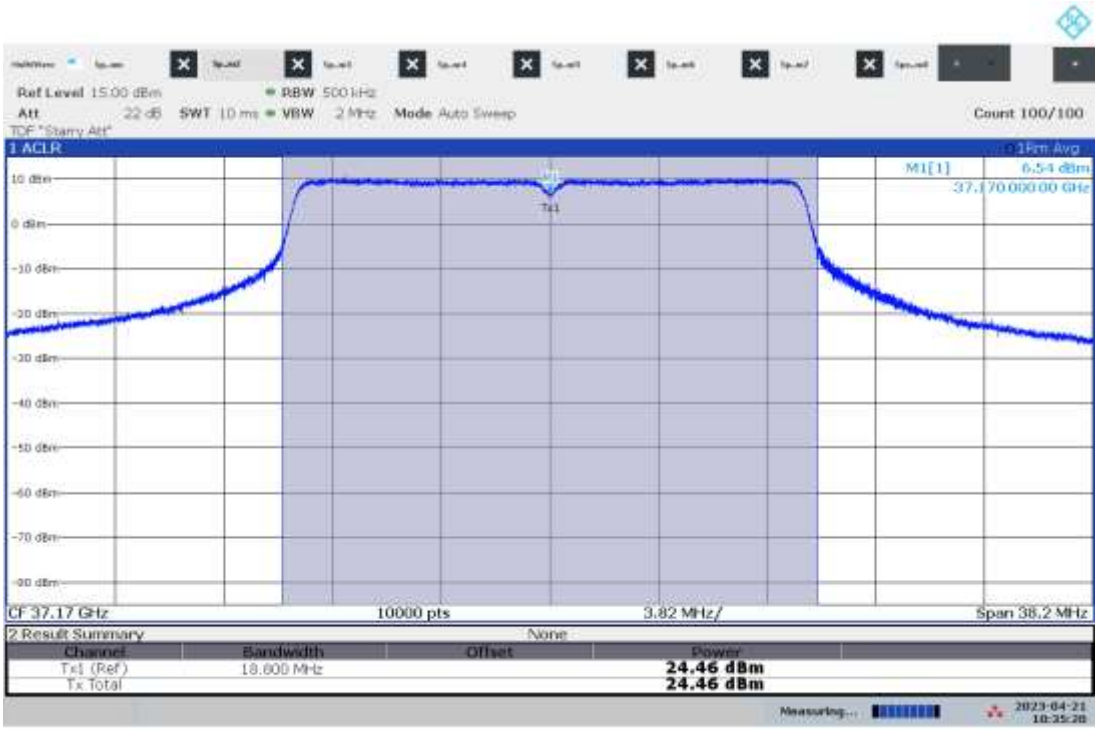
10:44:21 AM 04/21/2023

Output Power – Path 4, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



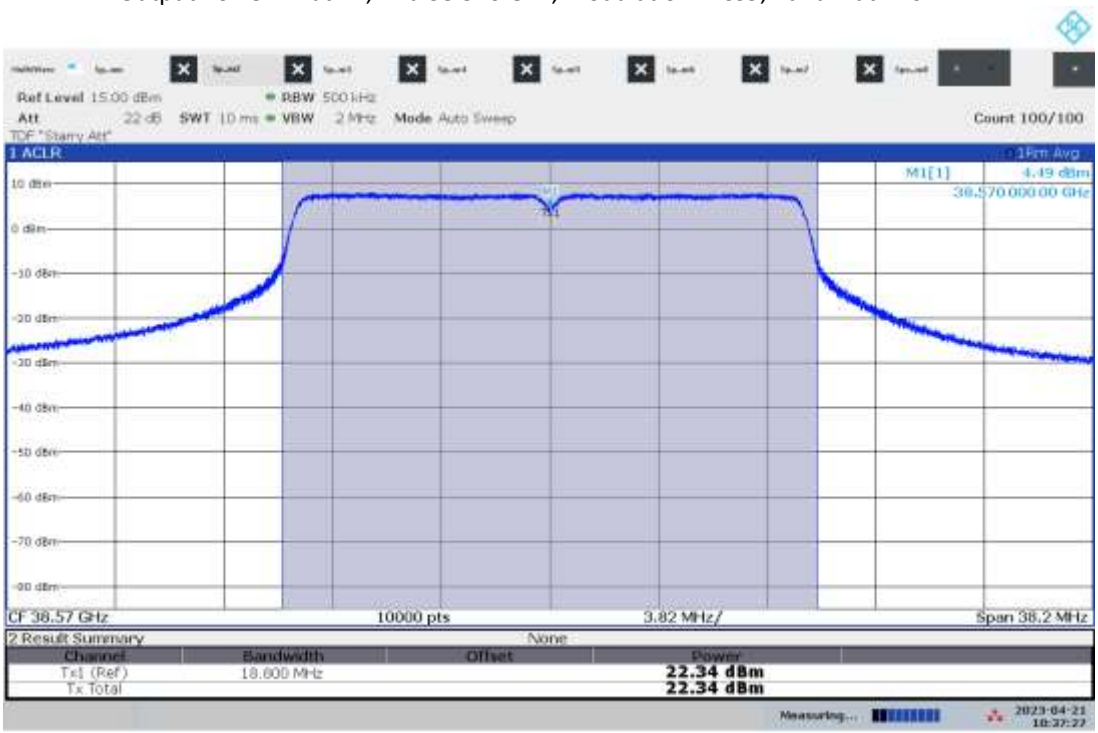
10:42:18 AM 04/21/2023

Output Power – Path 4, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



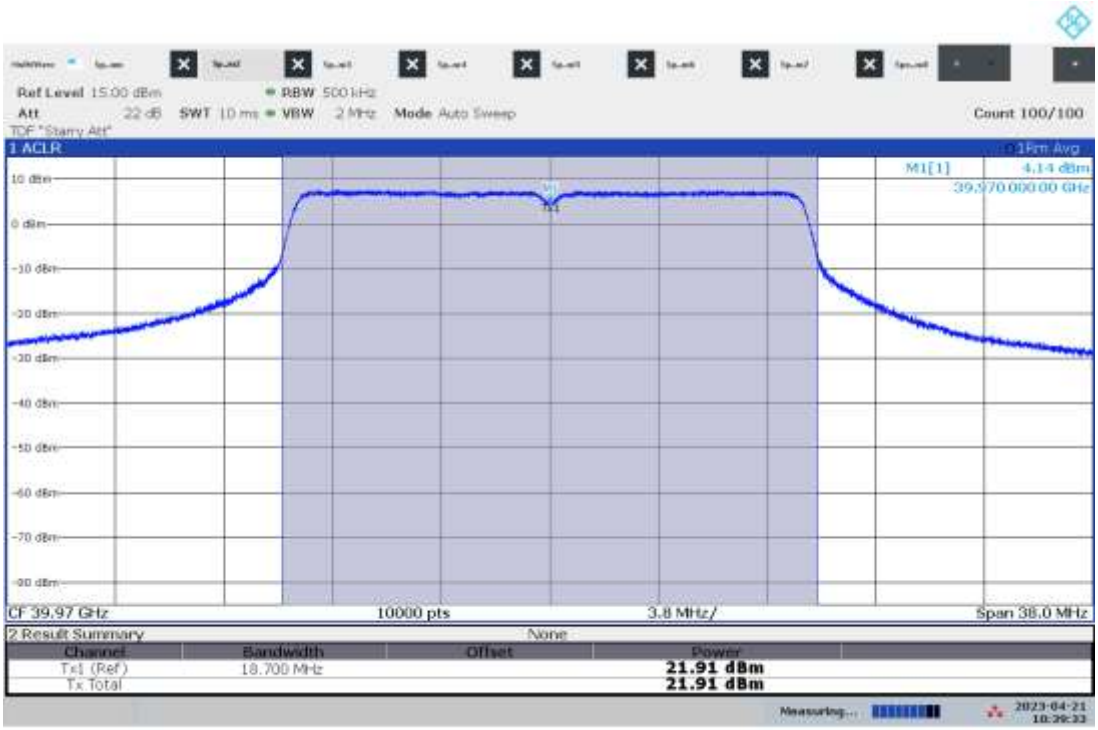
10:35:21 AM 04/21/2023

Output Power – Path 4, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



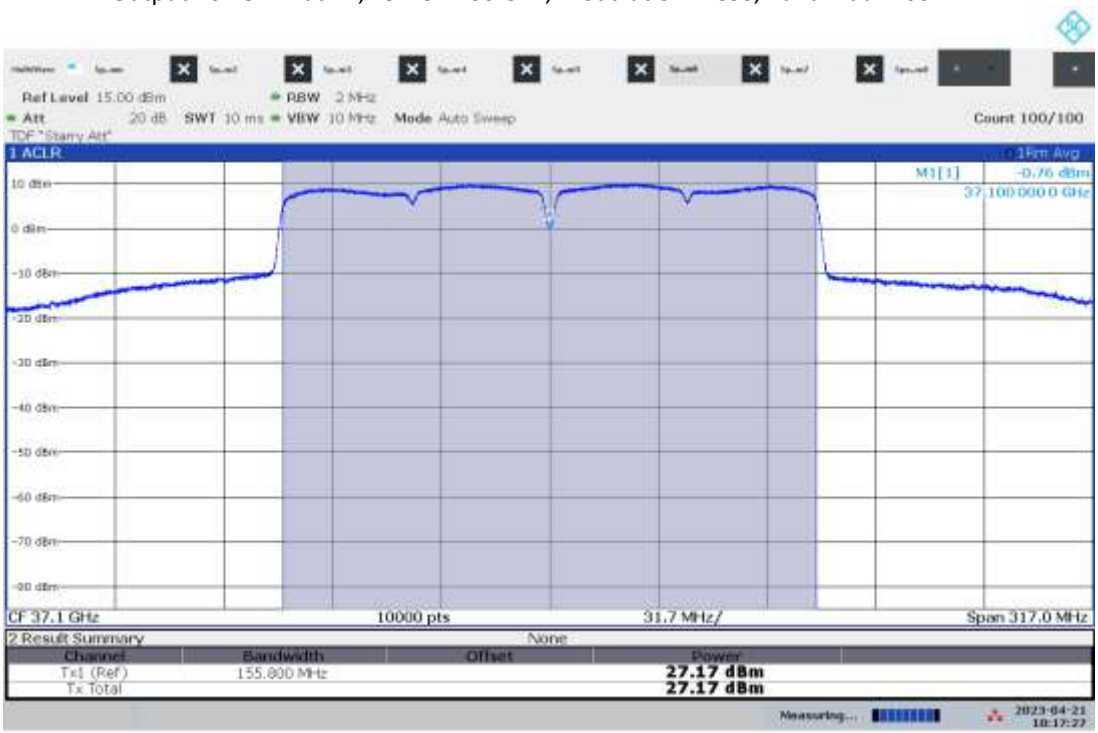
10:37:28 AM 04/21/2023

Output Power – Path 4, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



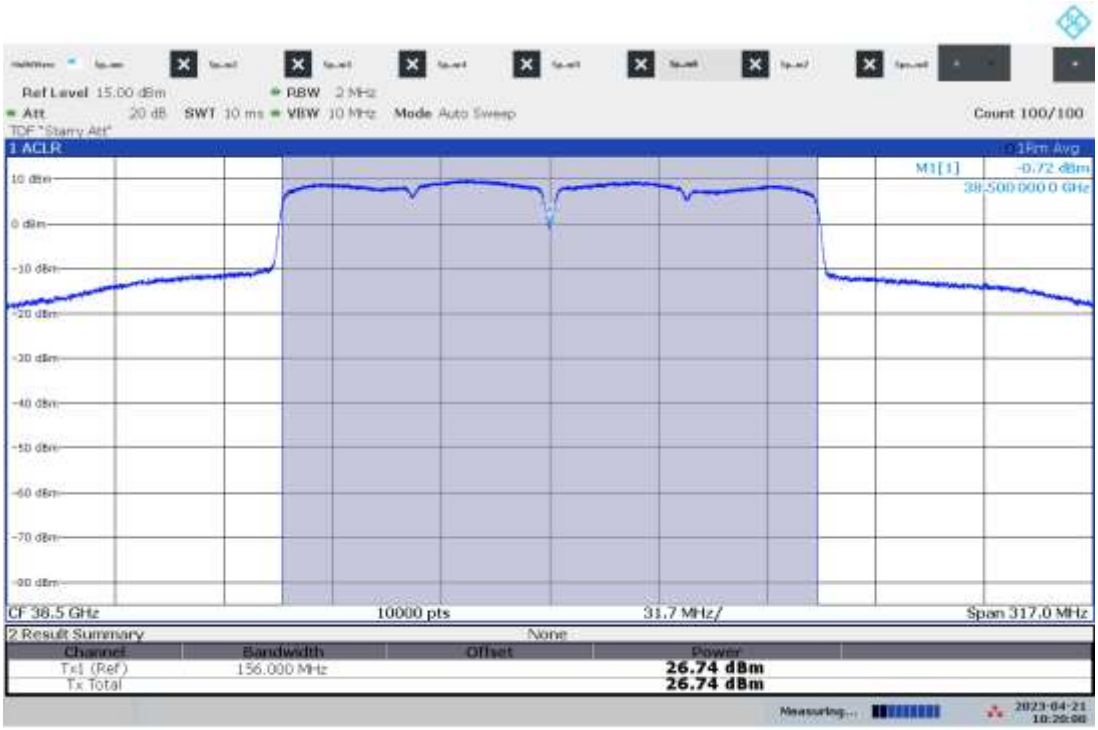
10:39:34 AM 04/21/2023

Output Power – Path 4, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



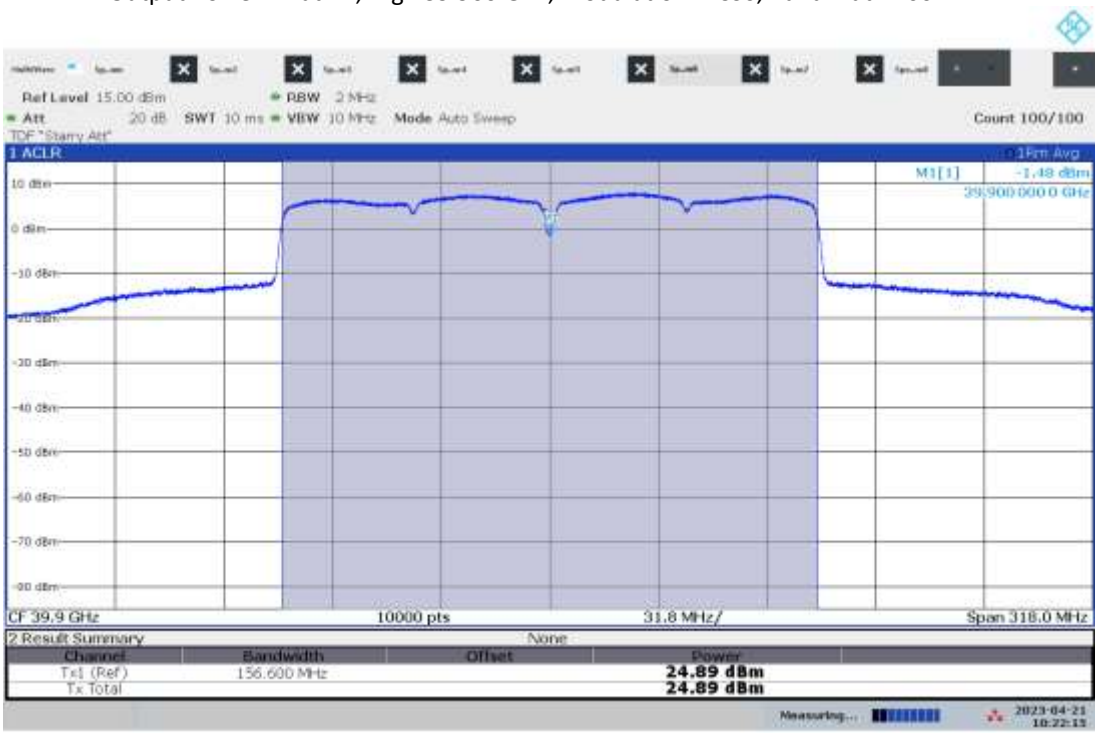
10:17:28 AM 04/21/2023

Output Power – Path 4, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz



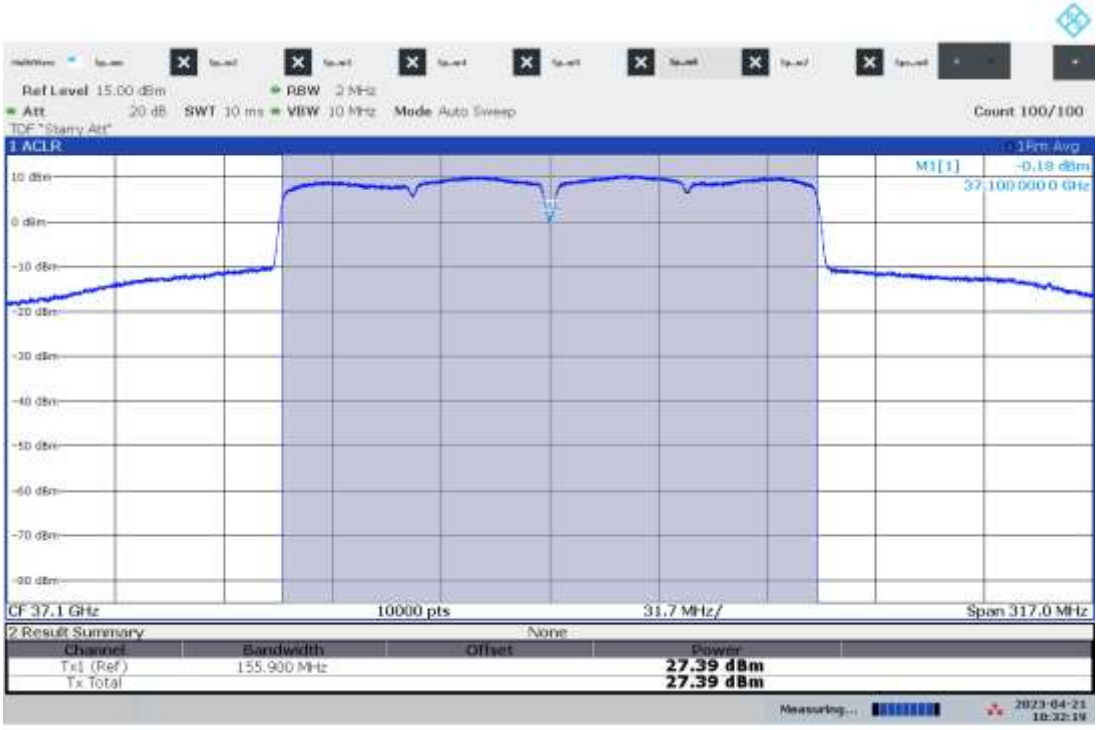
10:20:01 AM 04/21/2023

Output Power – Path 4, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz



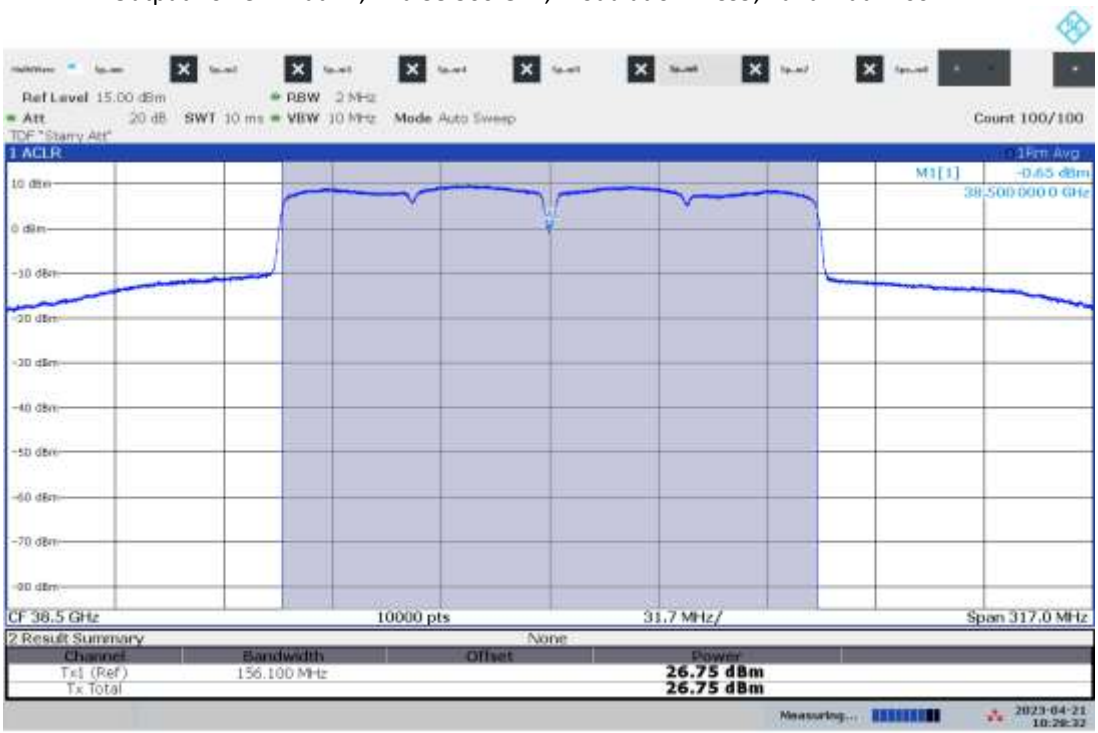
10:22:15 AM 04/21/2023

Output Power – Path 4, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



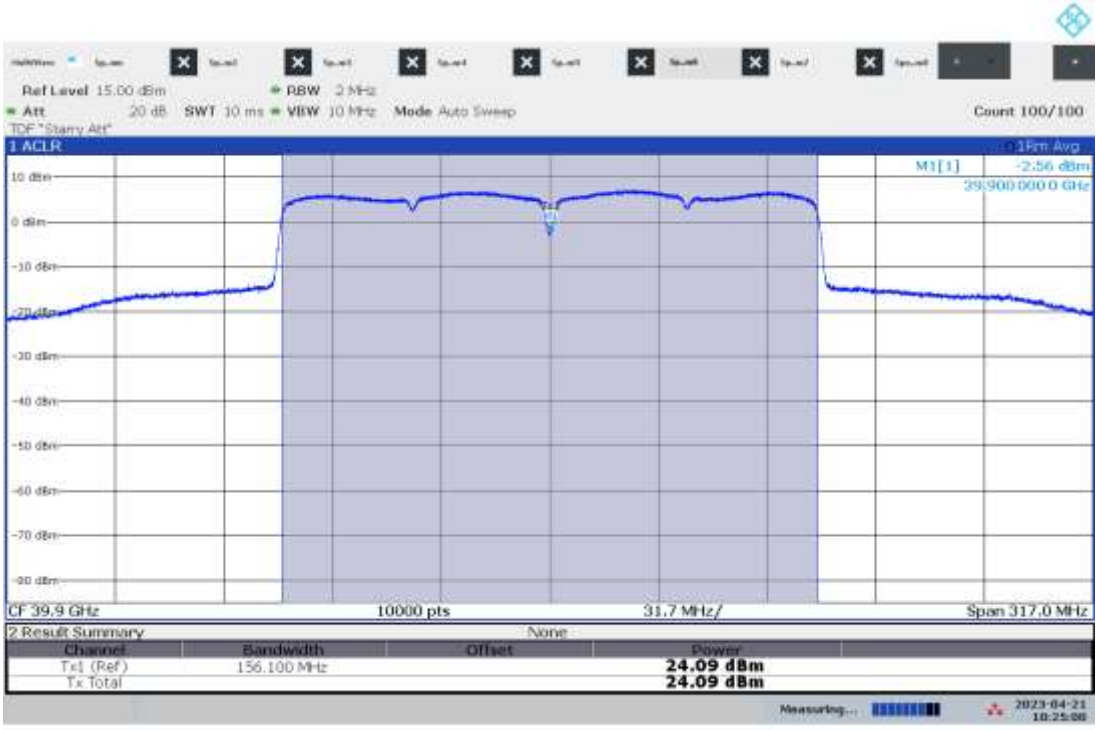
10:32:19 AM 04/21/2023

Output Power – Path 4, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz



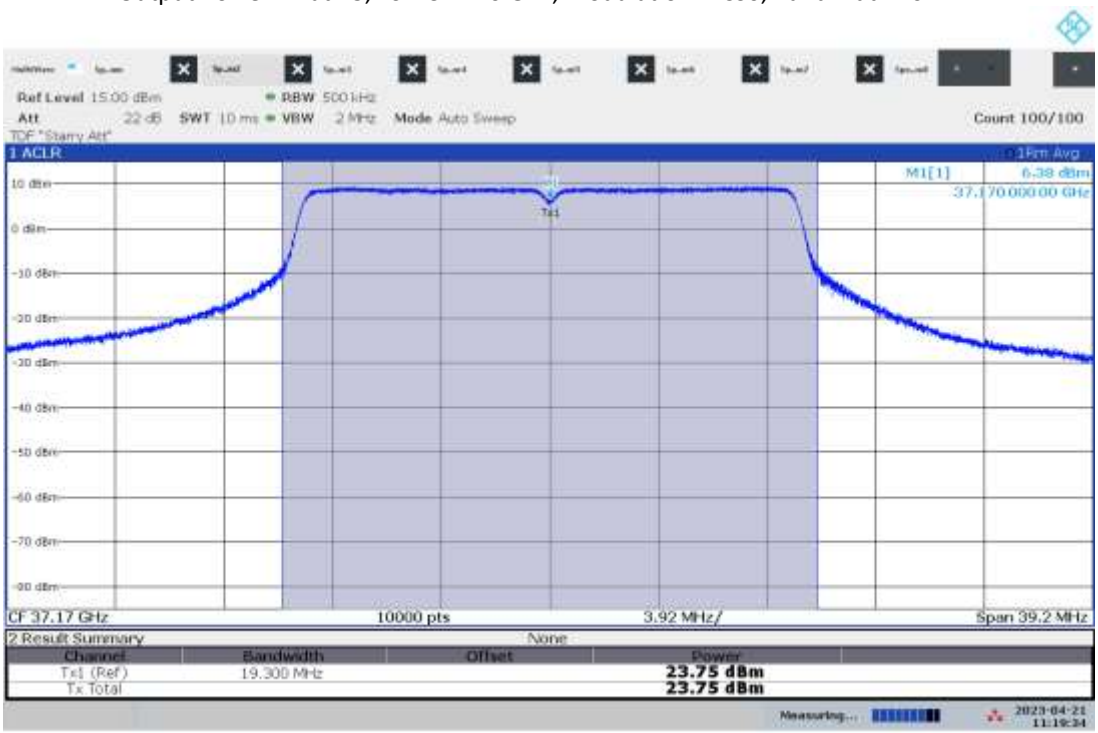
10:28:32 AM 04/21/2023

Output Power – Path 4, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz



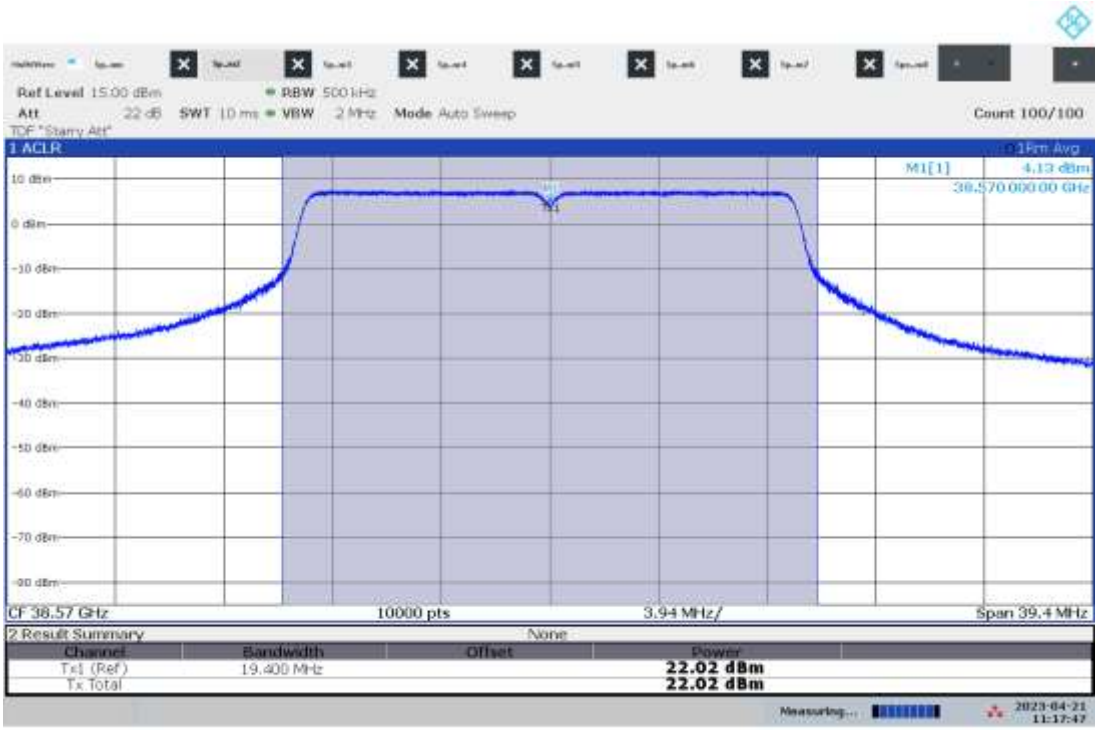
10:25:00 AM 04/21/2023

Output Power – Path 5, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



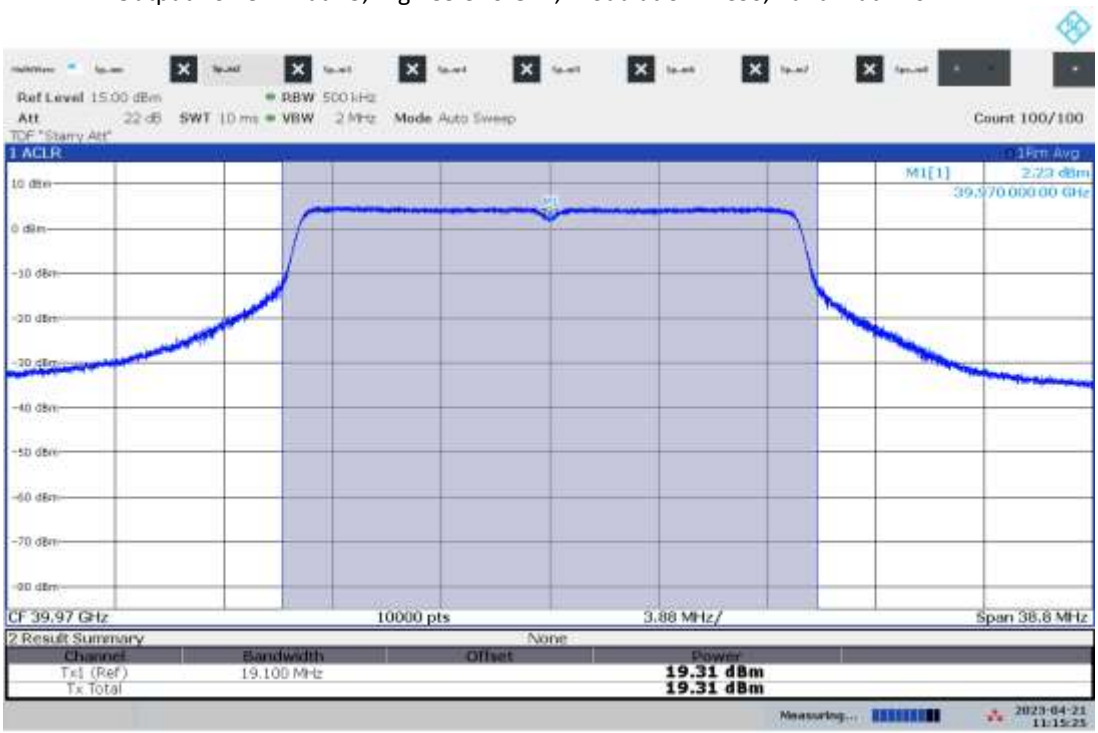
11:19:35 AM 04/21/2023

Output Power – Path 5, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



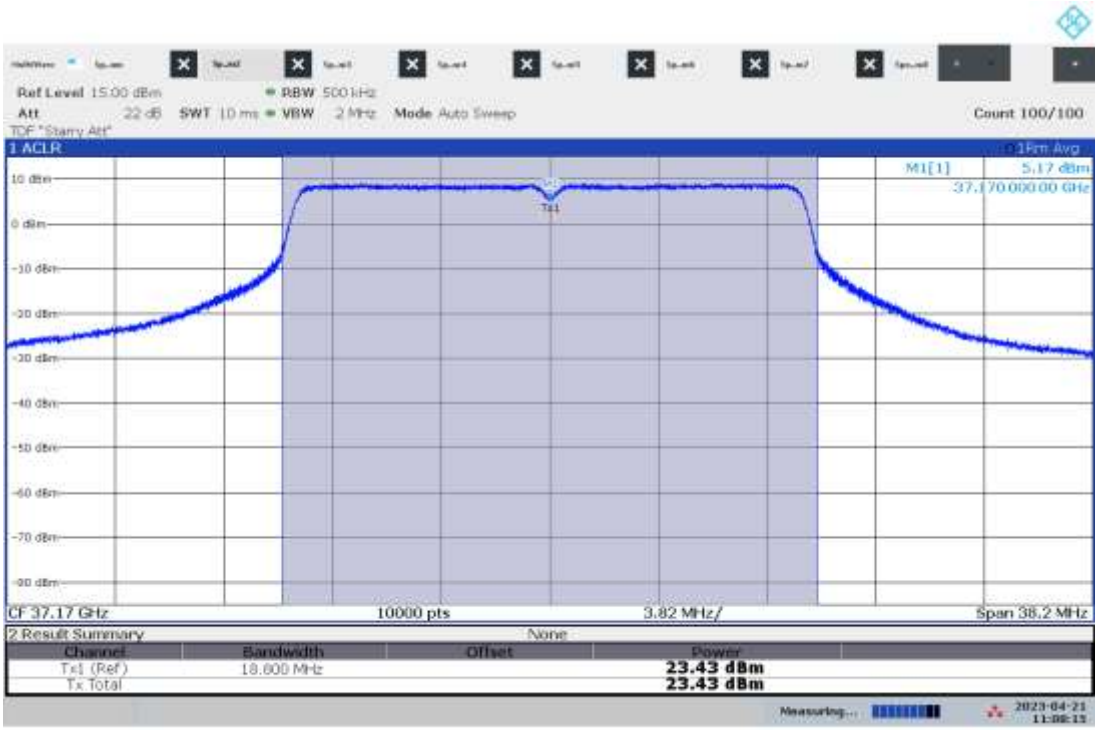
11:17:47 AM 04/21/2023

Output Power – Path 5, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



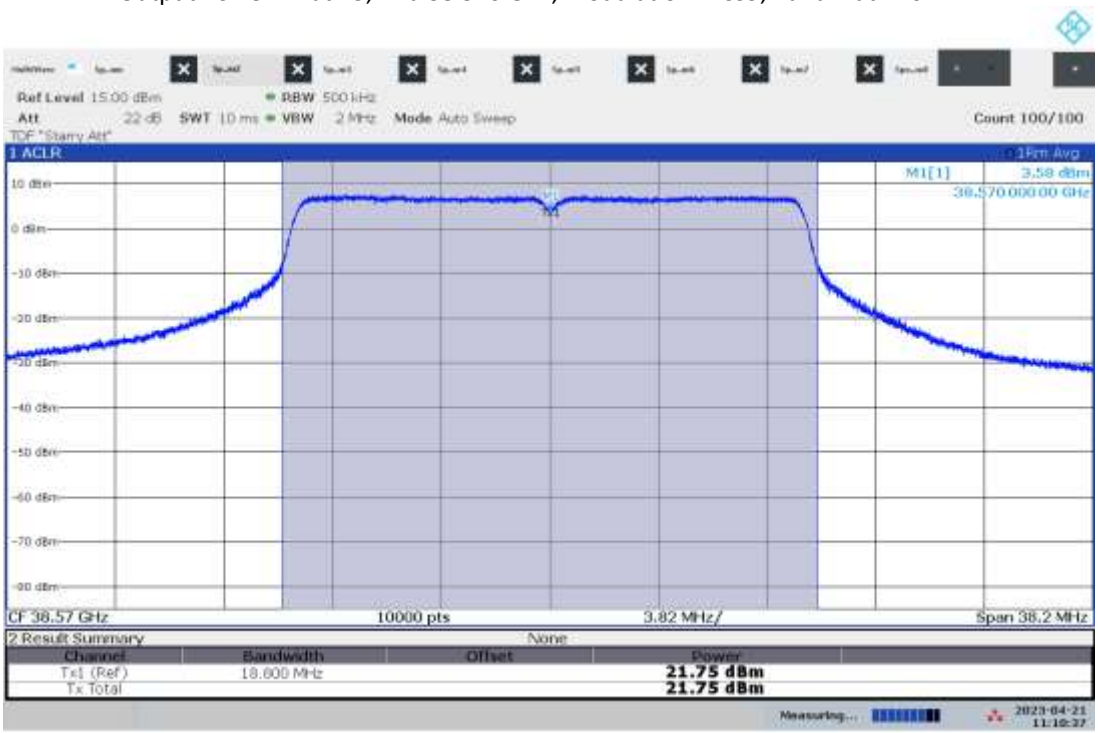
11:15:25 AM 04/21/2023

Output Power – Path 5, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



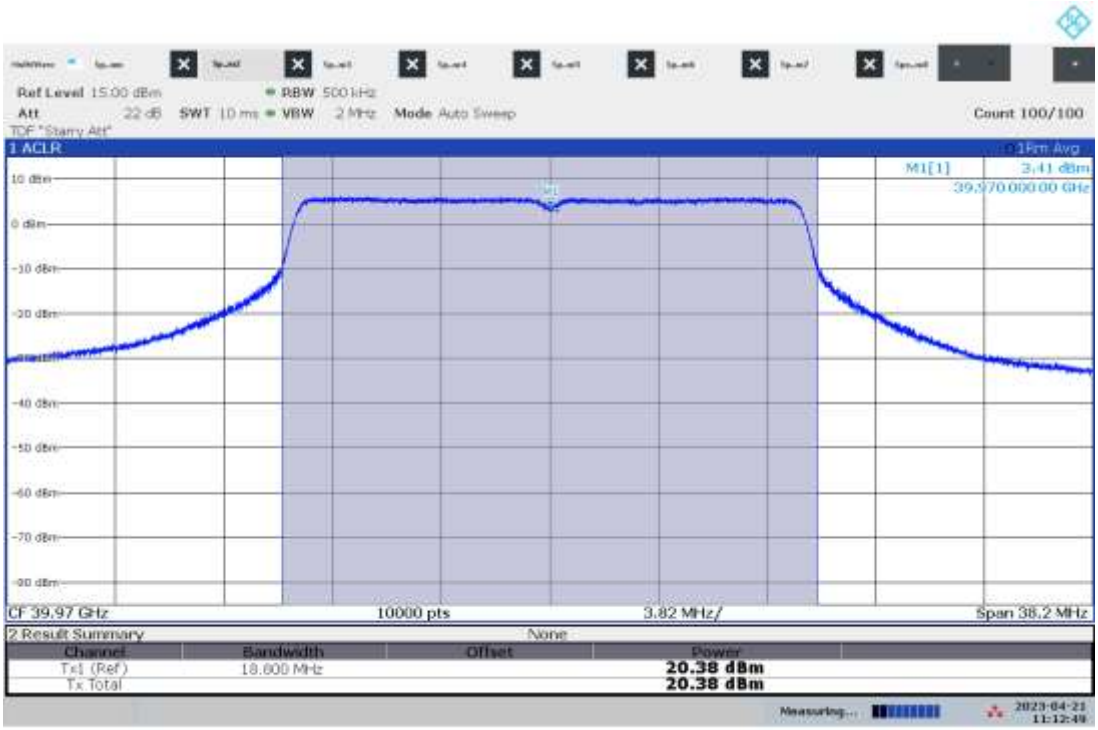
11:08:15 AM 04/21/2023

Output Power – Path 5, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



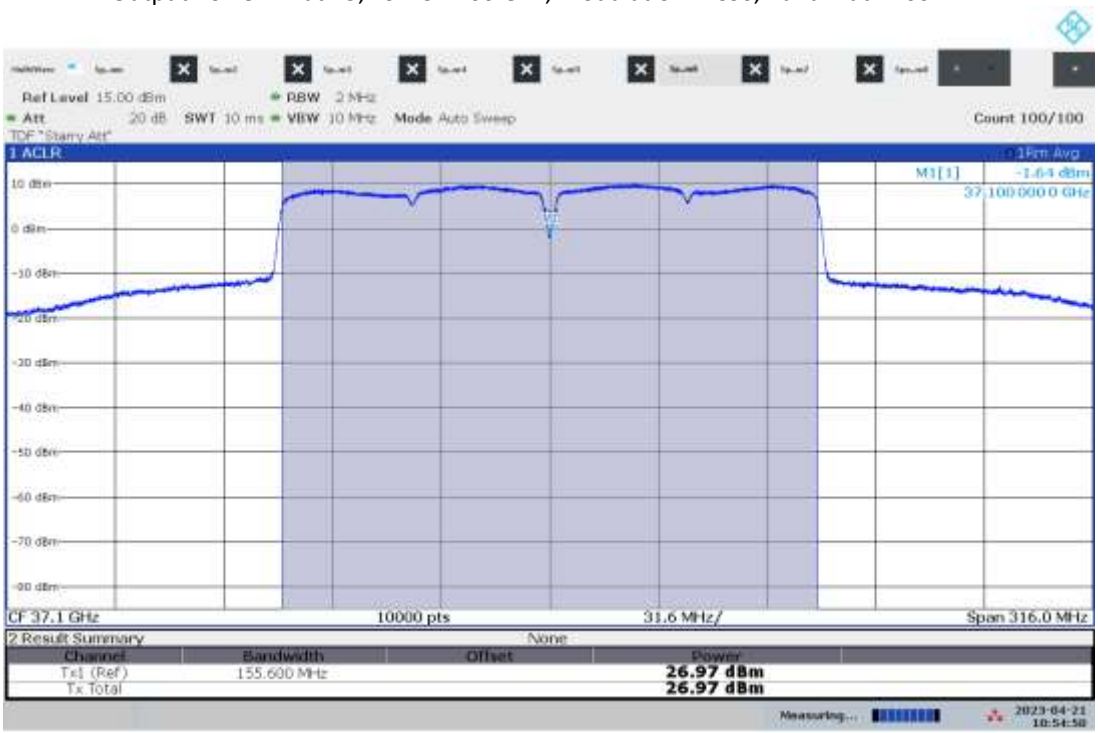
11:10:37 AM 04/21/2023

Output Power – Path 5, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



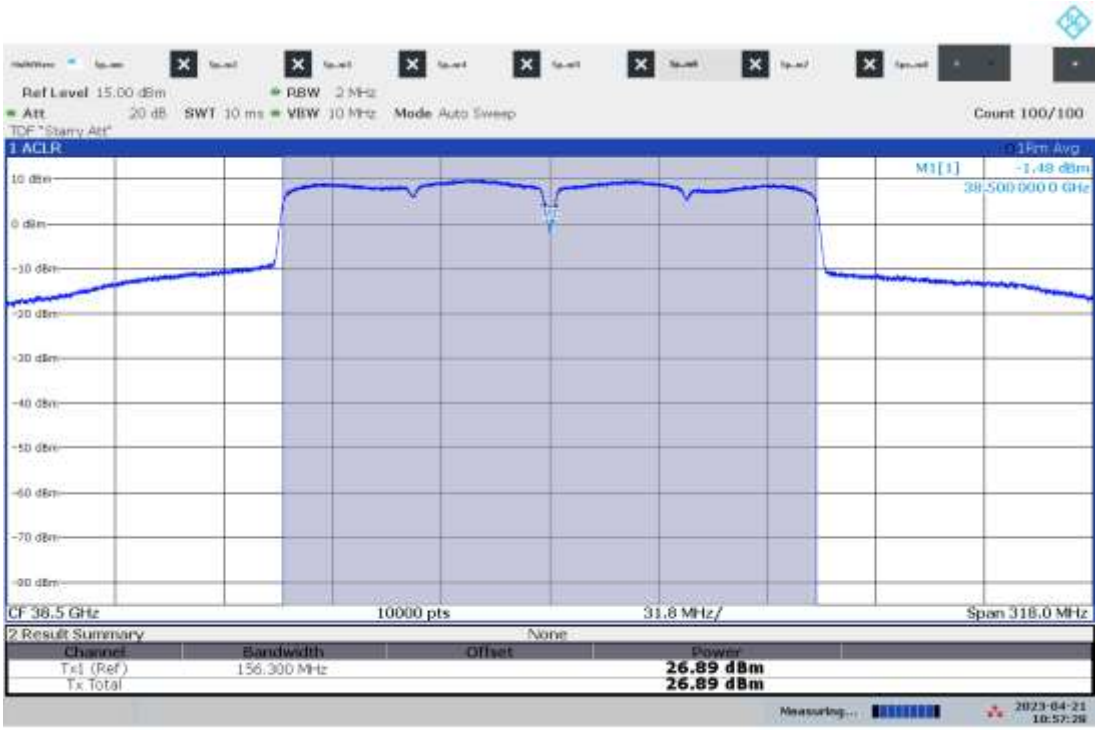
11:12:50 AM 04/21/2023

Output Power – Path 5, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



10:54:50 AM 04/21/2023

Output Power – Path 5, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz

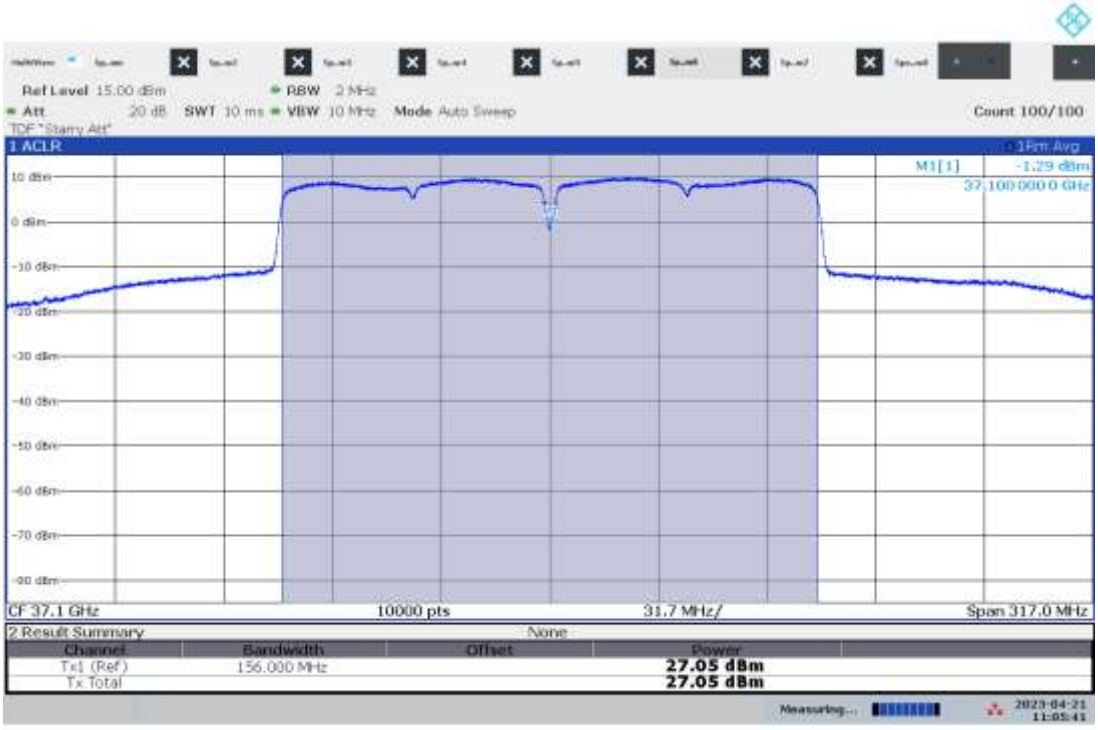


10:57:29 AM 04/21/2023

Output Power – Path 5, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz

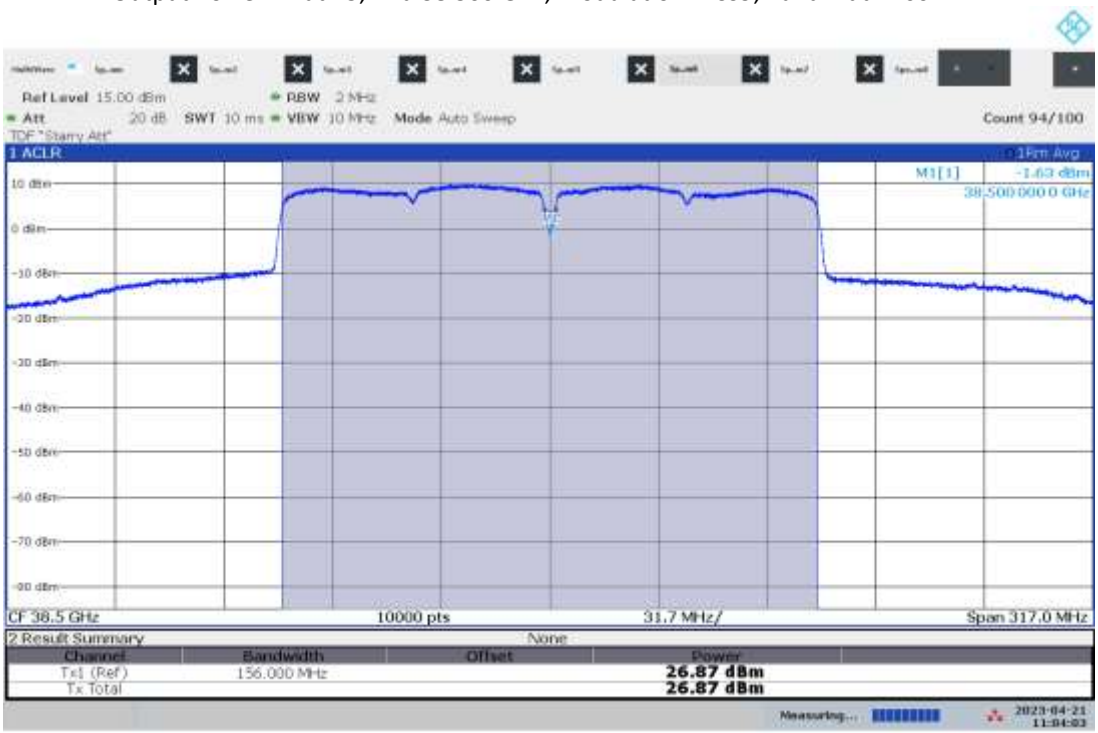
10:59:34 AM 04/21/2023

Output Power – Path 5, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



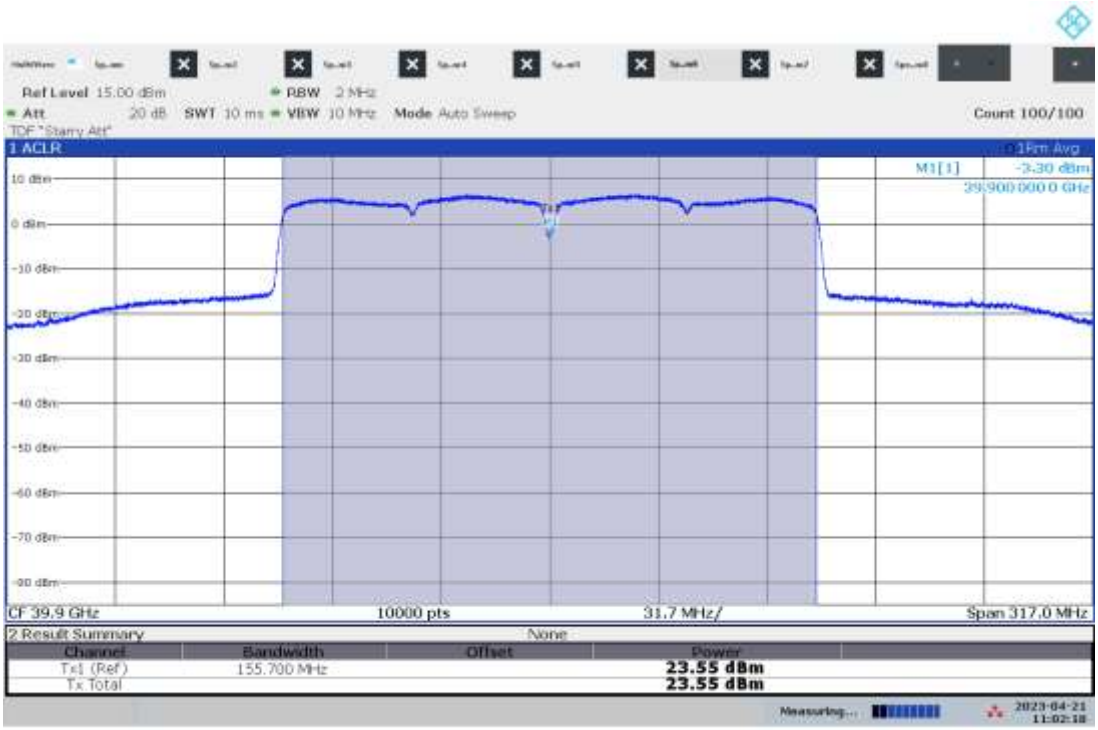
11:05:41 AM 04/21/2023

Output Power – Path 5, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz



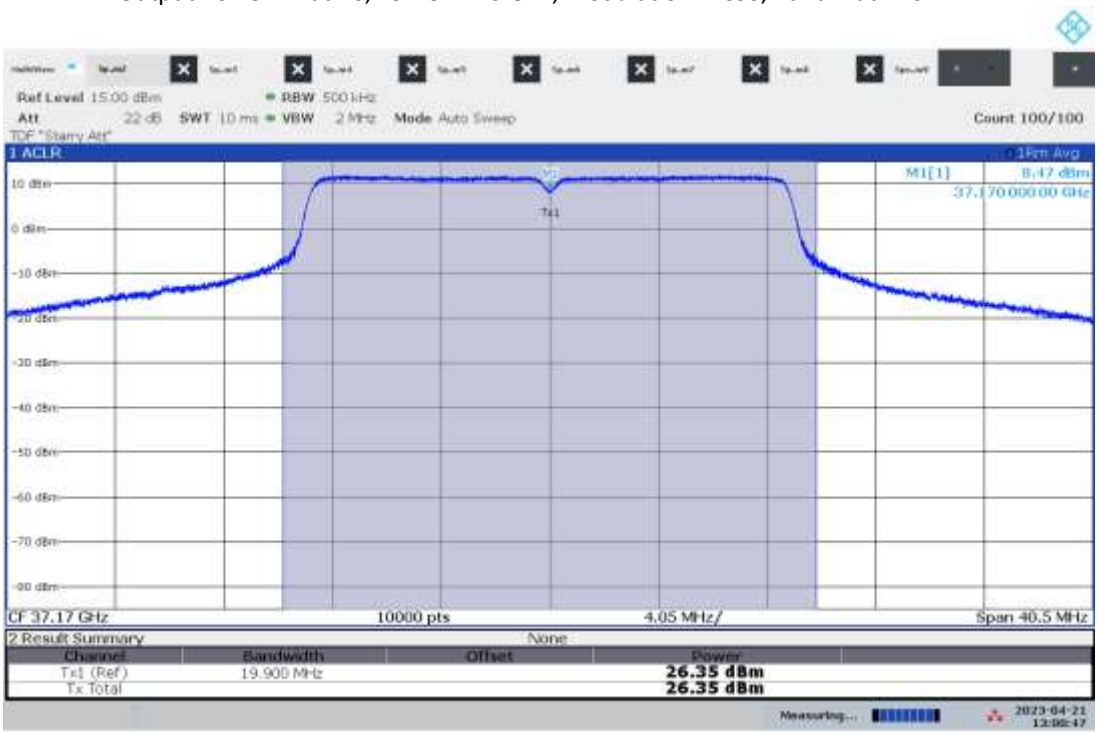
11:04:03 AM 04/21/2023

Output Power – Path 5, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz



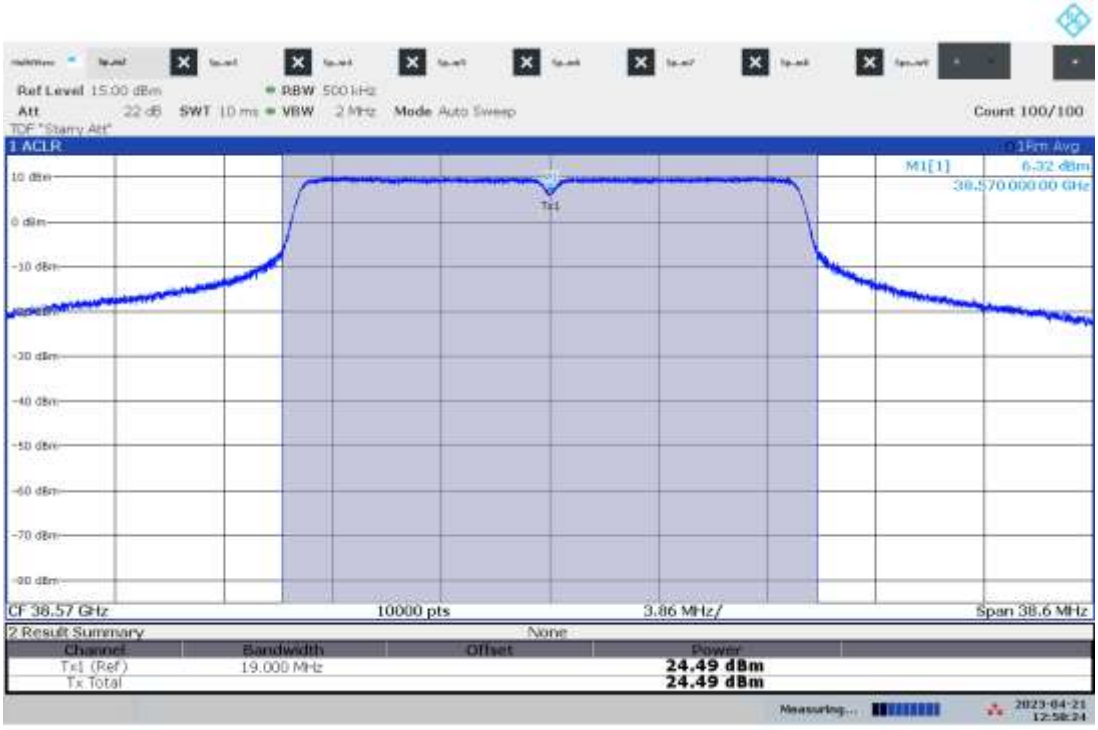
11:02:18 AM 04/21/2023

Output Power – Path 6, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



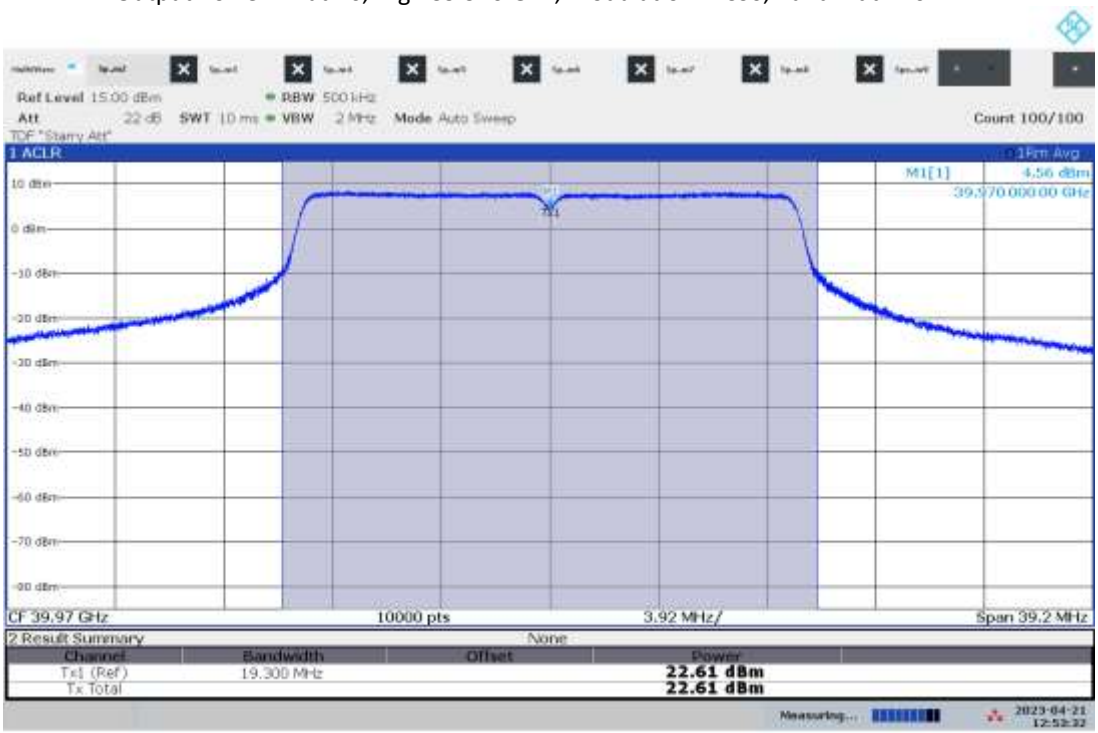
01:00:48 PM 04/21/2023

Output Power – Path 6, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



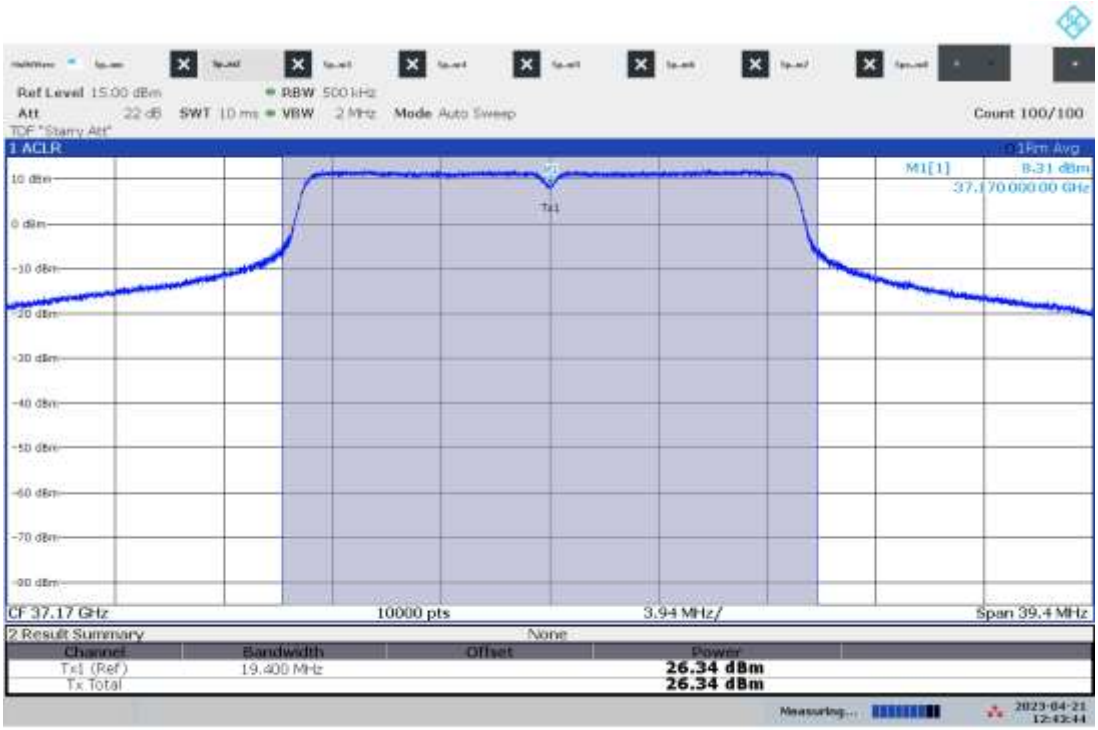
12:58:25 PM 04/21/2023

Output Power – Path 6, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



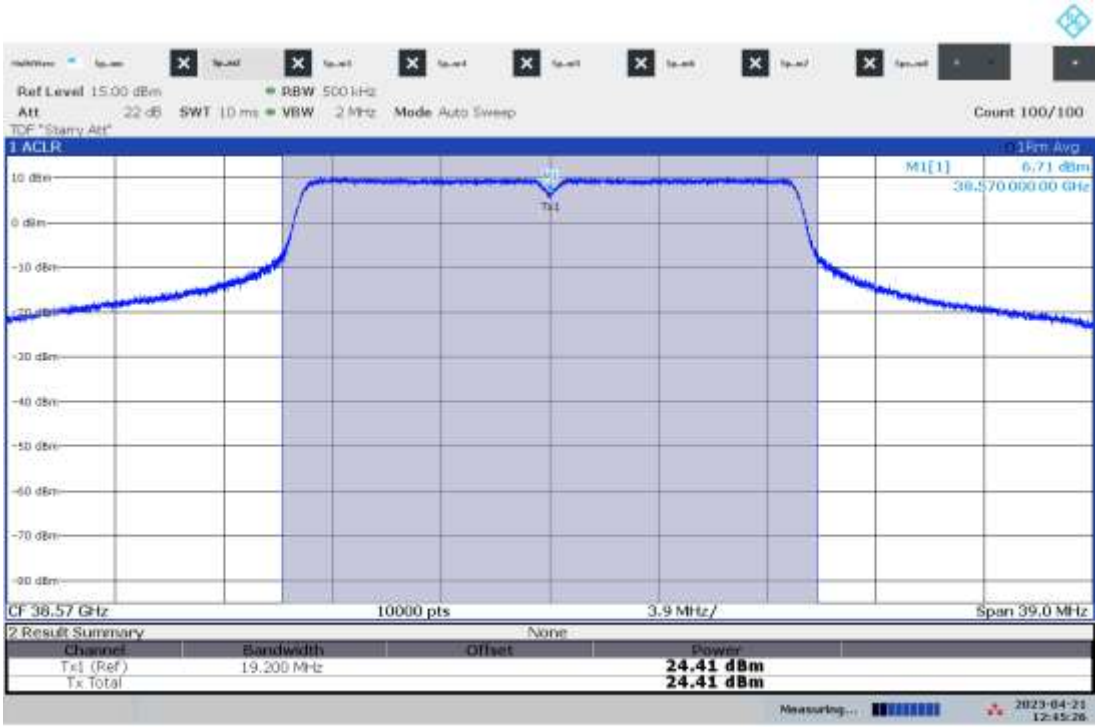
12:53:32 PM 04/21/2023

Output Power – Path 6, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



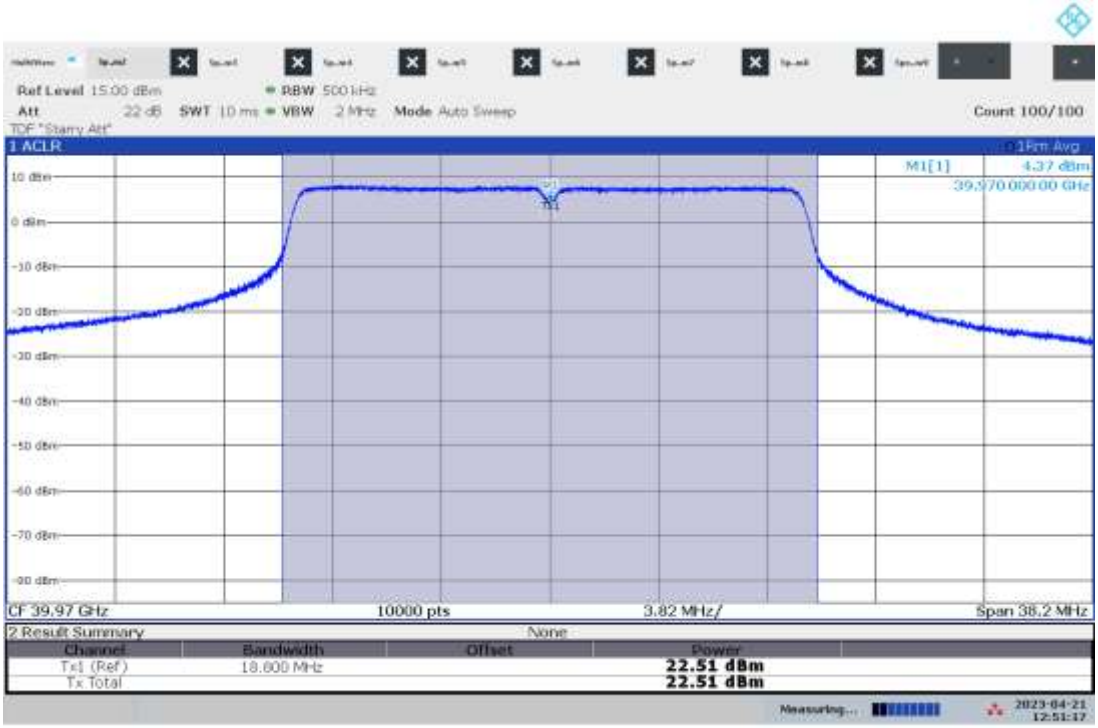
12:43:45 PM 04/21/2023

Output Power – Path 6, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



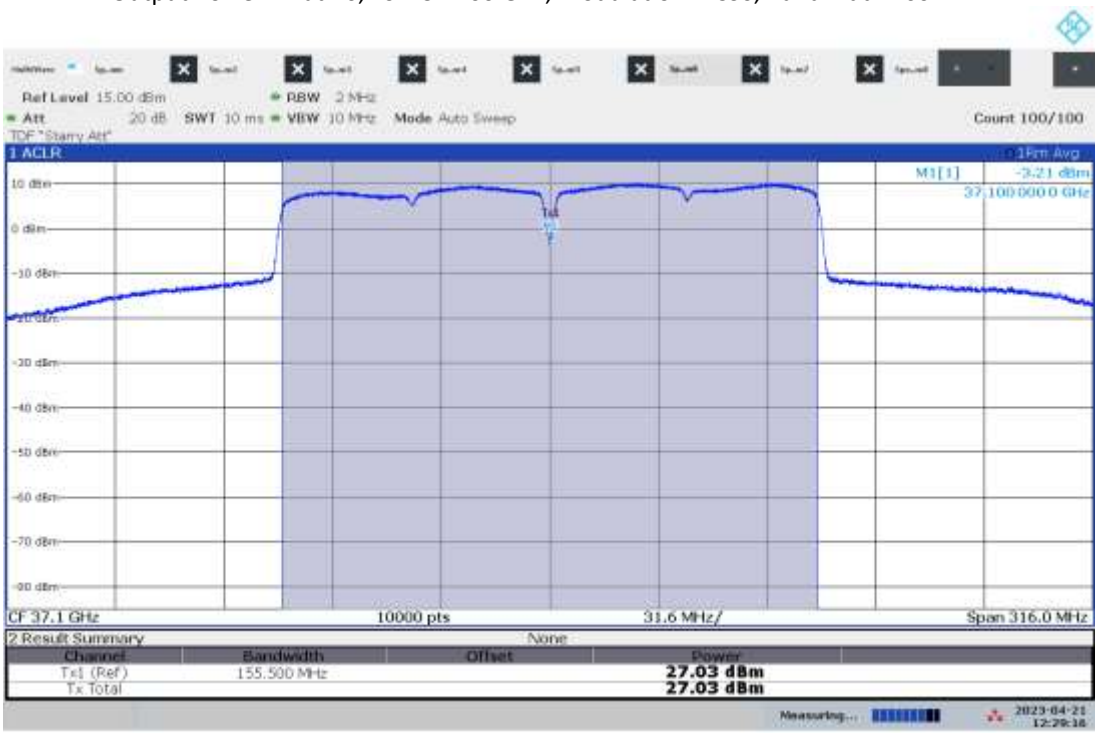
12:45:27 PM 04/21/2023

Output Power – Path 6, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



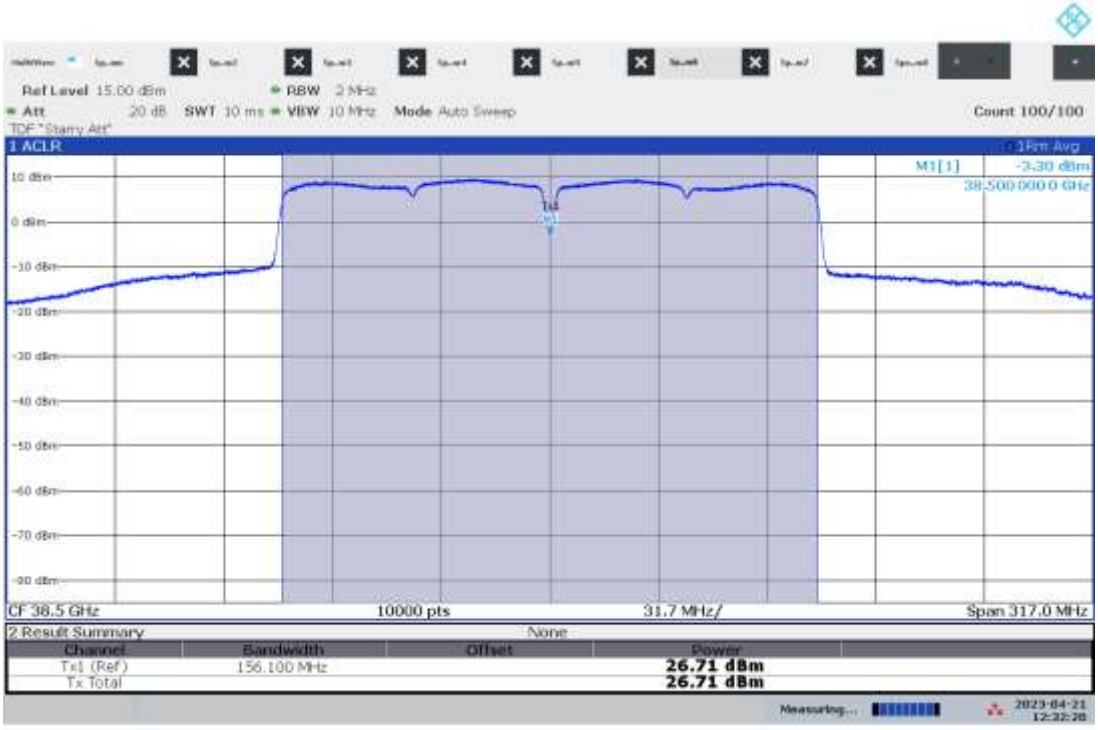
12:51:17 PM 04/21/2023

Output Power – Path 6, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



12:29:16 PM 04/21/2023

Output Power – Path 6, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz

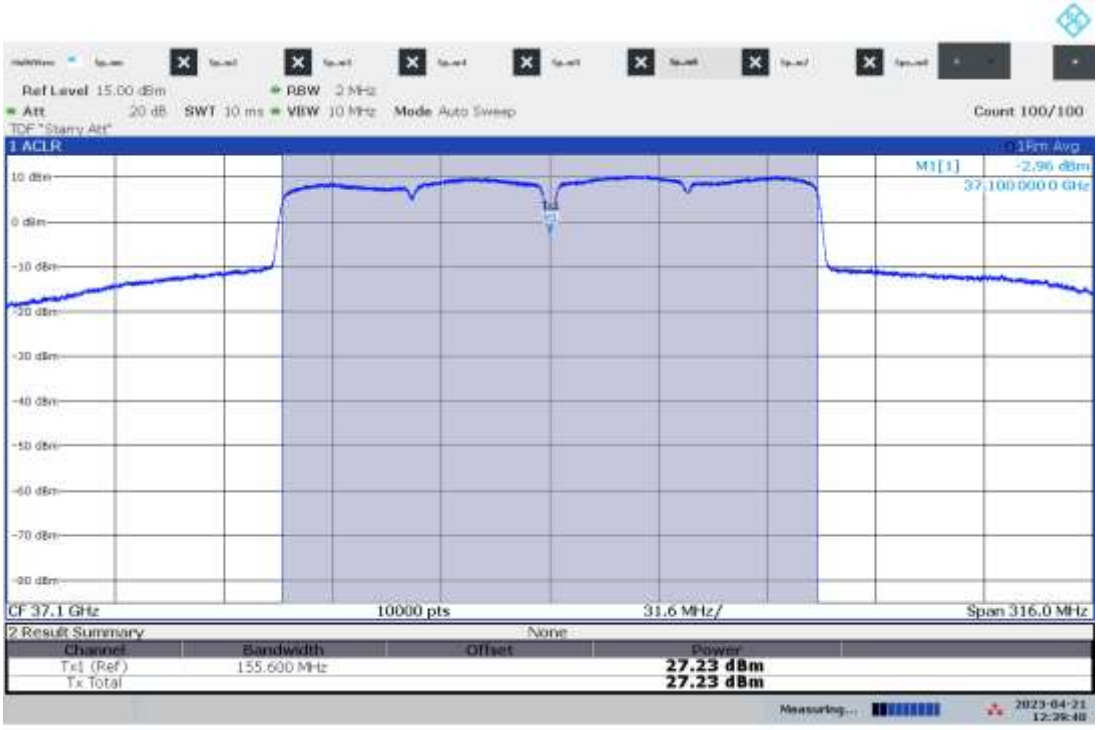


12:32:20 PM 04/21/2023

Output Power – Path 6, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz

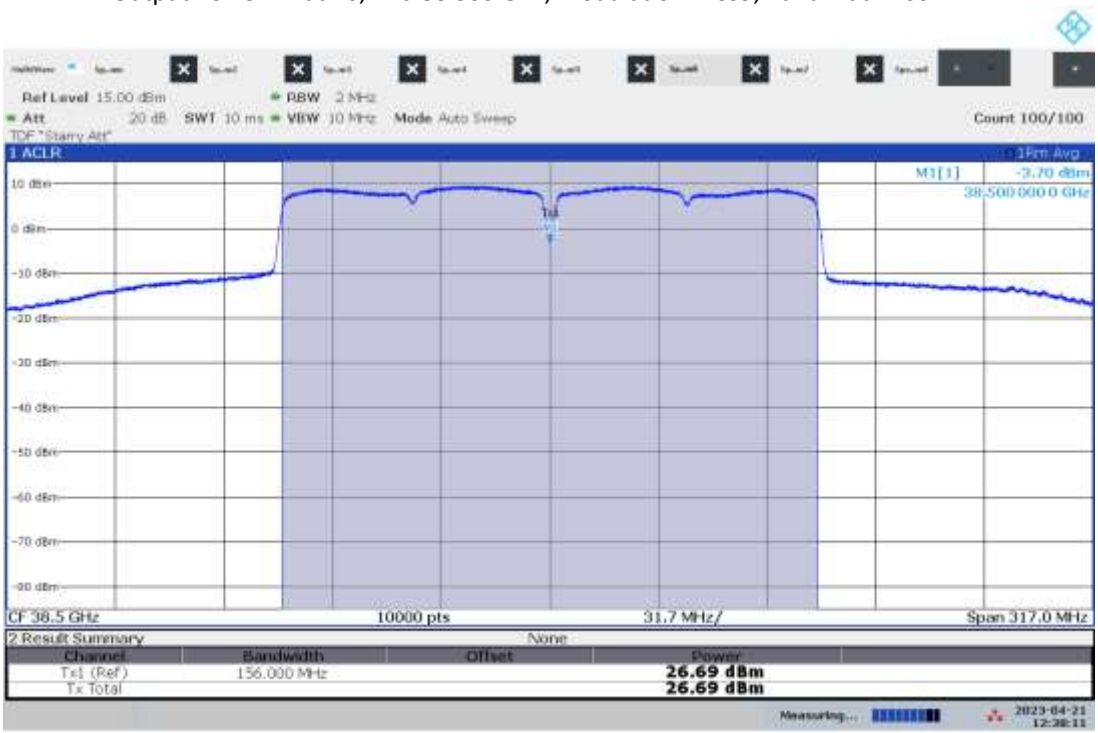
12:34:03 PM 04/21/2023

Output Power – Path 6, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



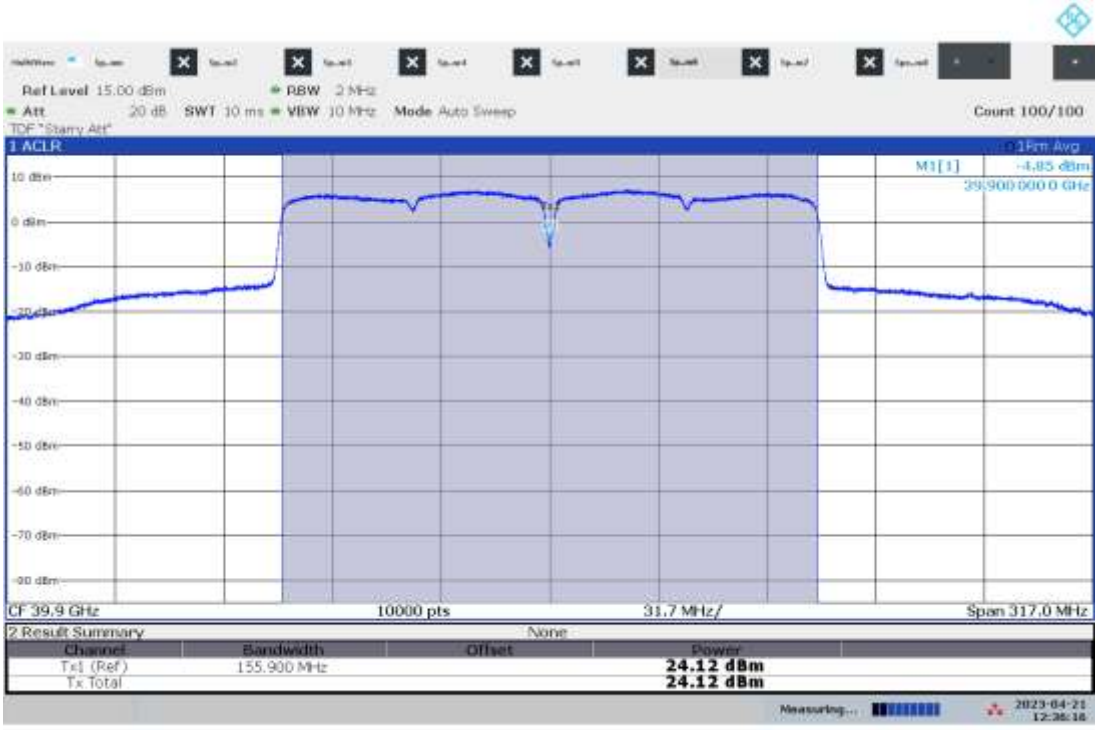
12:39:40 PM 04/21/2023

Output Power – Path 6, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz



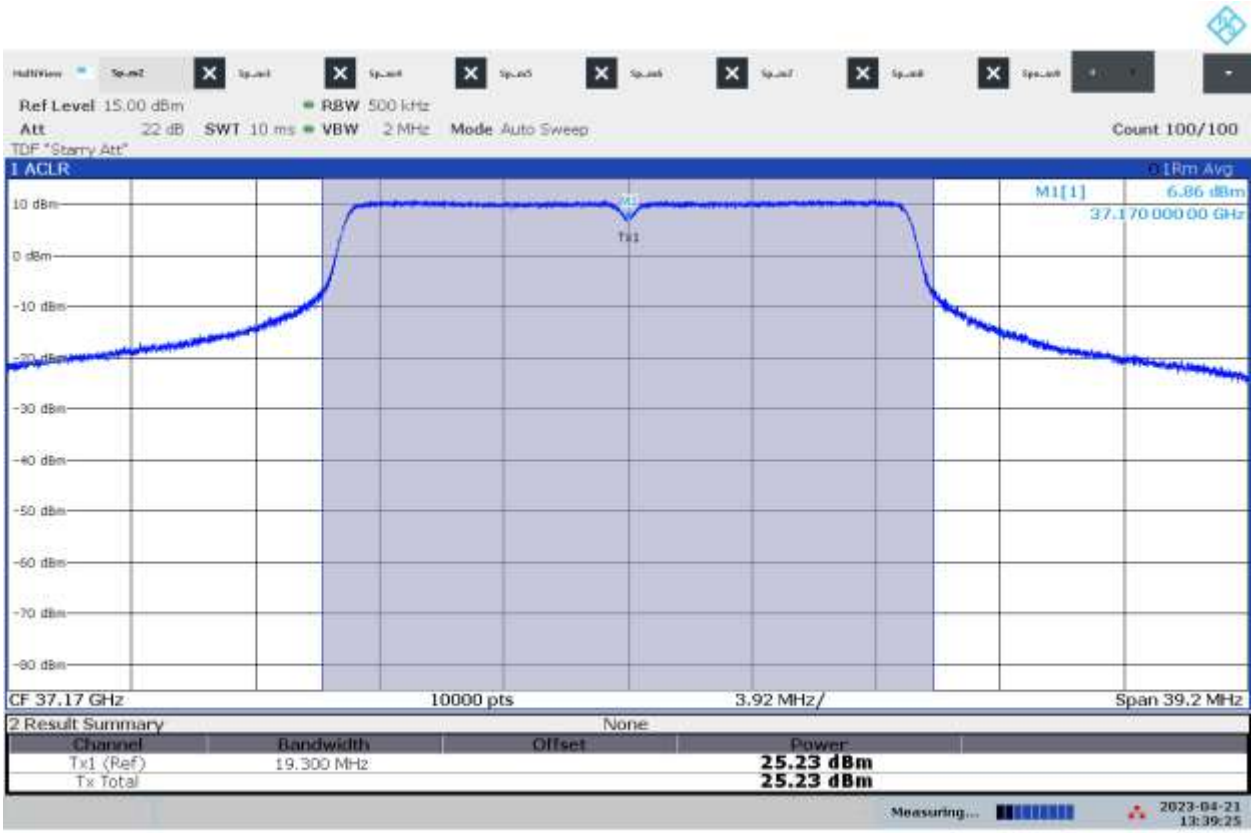
12:38:12 PM 04/21/2023

Output Power – Path 6, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz



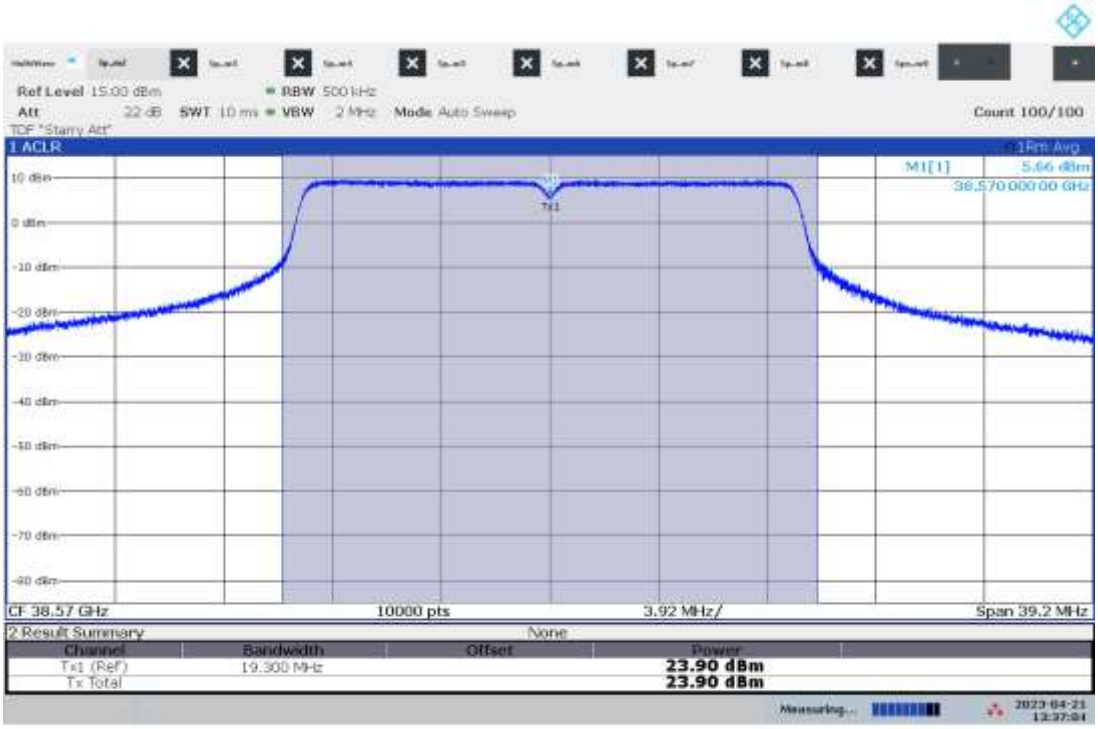
12:36:16 PM 04/21/2023

Output Power – Path 7, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



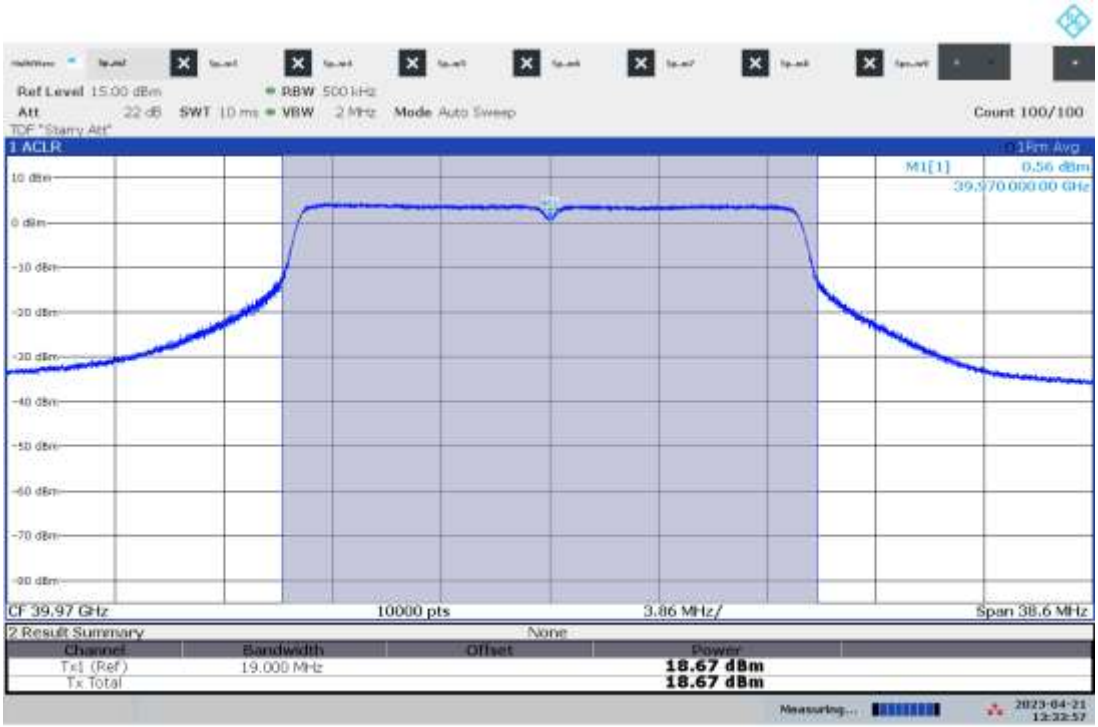
01:39:25 PM 04/21/2023

Output Power – Path 7, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



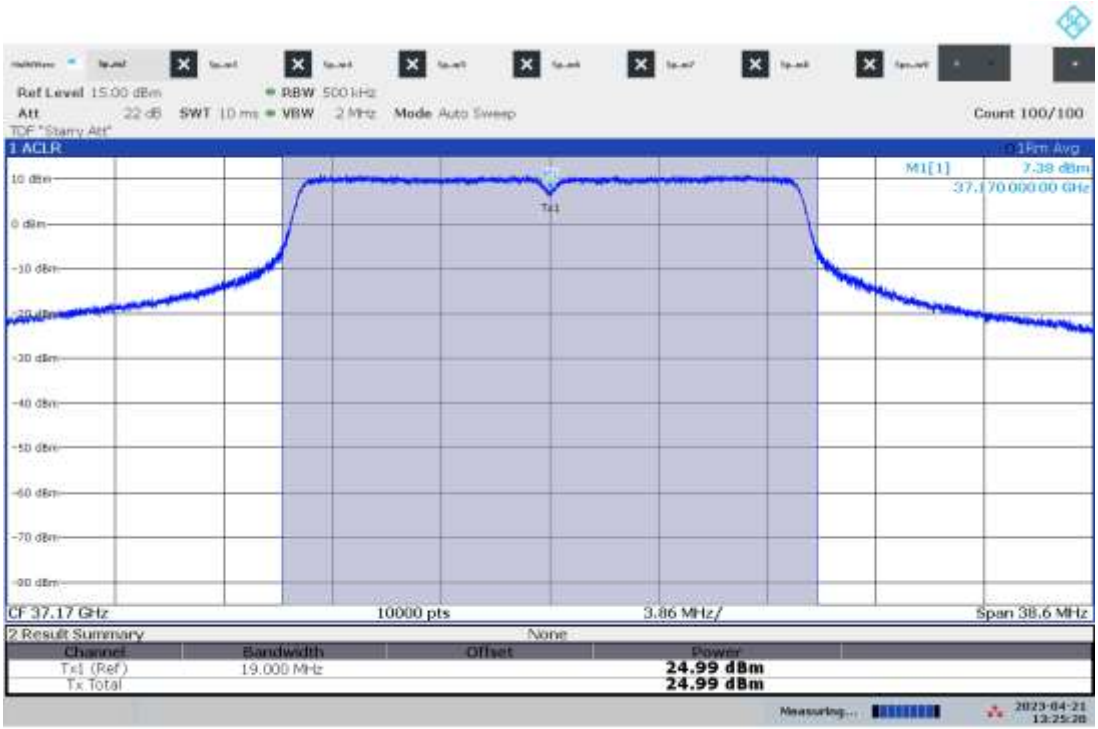
01:37:04 PM 04/21/2023

Output Power – Path 7, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



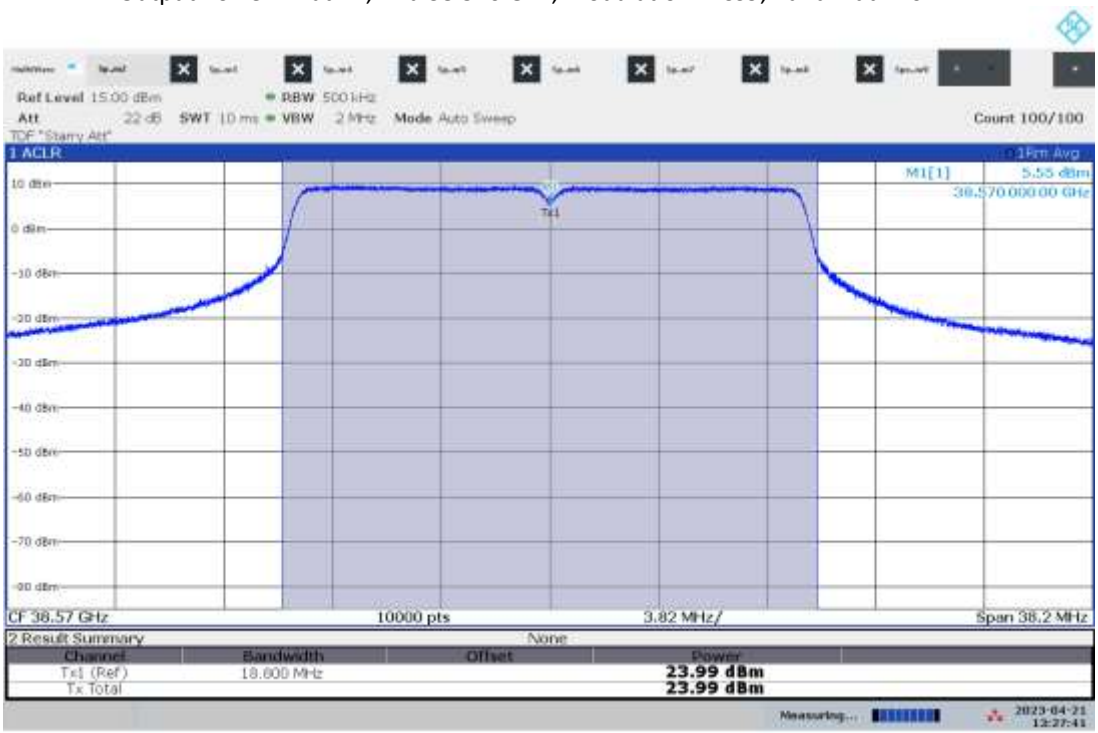
01:33:57 PM 04/21/2023

Output Power – Path 7, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



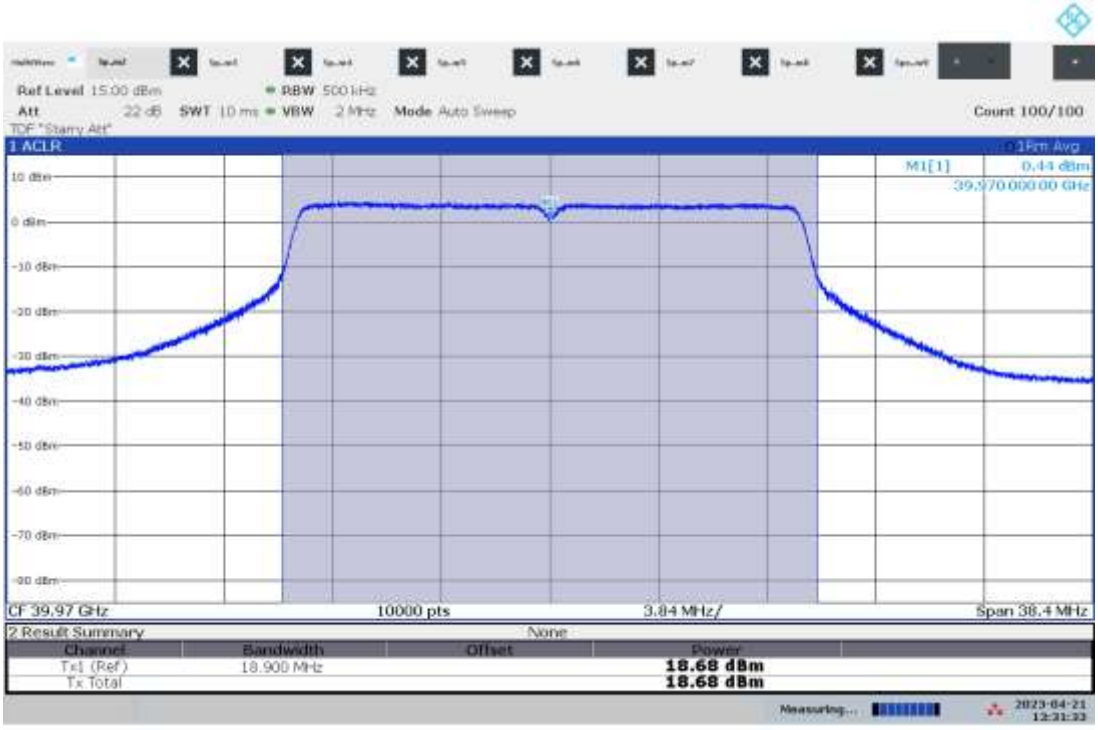
01:25:20 PM 04/21/2023

Output Power – Path 7, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



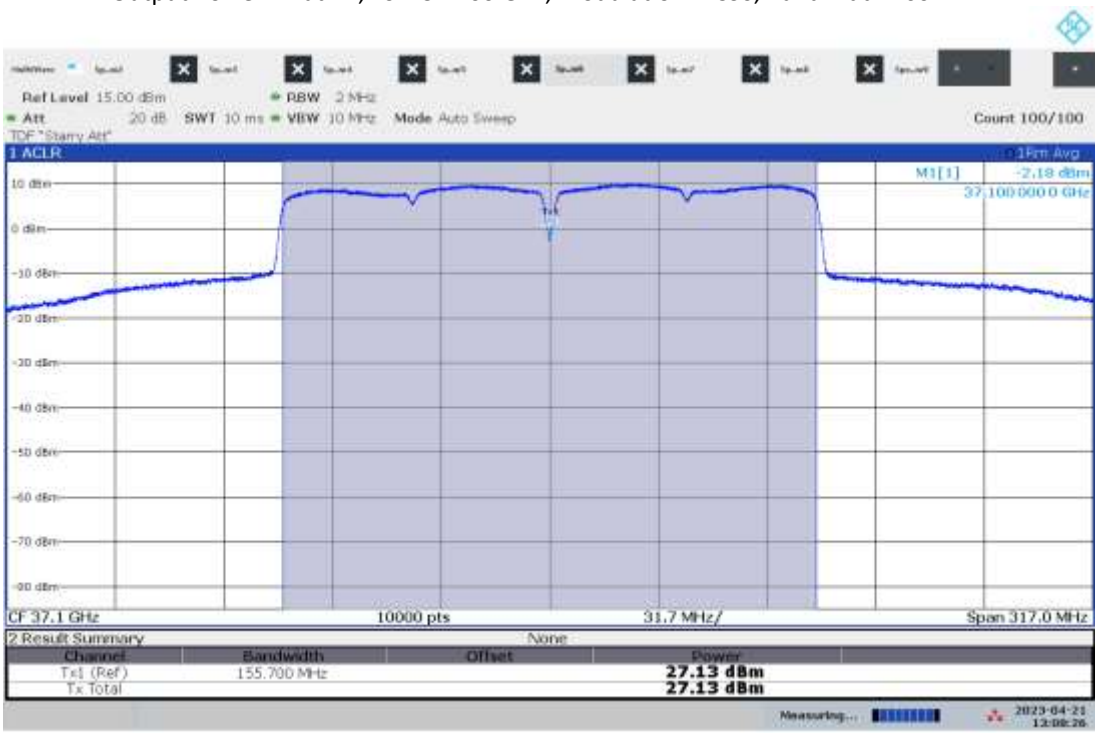
01:27:42 PM 04/21/2023

Output Power – Path 7, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz



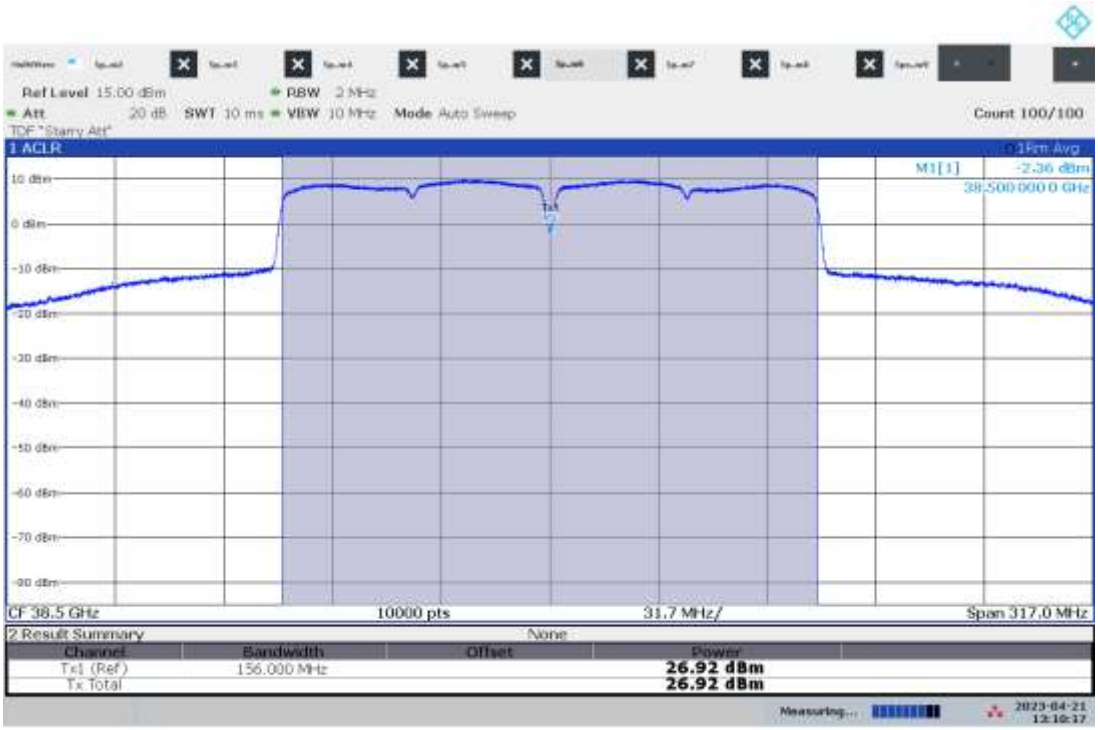
01:31:33 PM 04/21/2023

Output Power – Path 7, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



01:08:26 PM 04/21/2023

Output Power – Path 7, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz

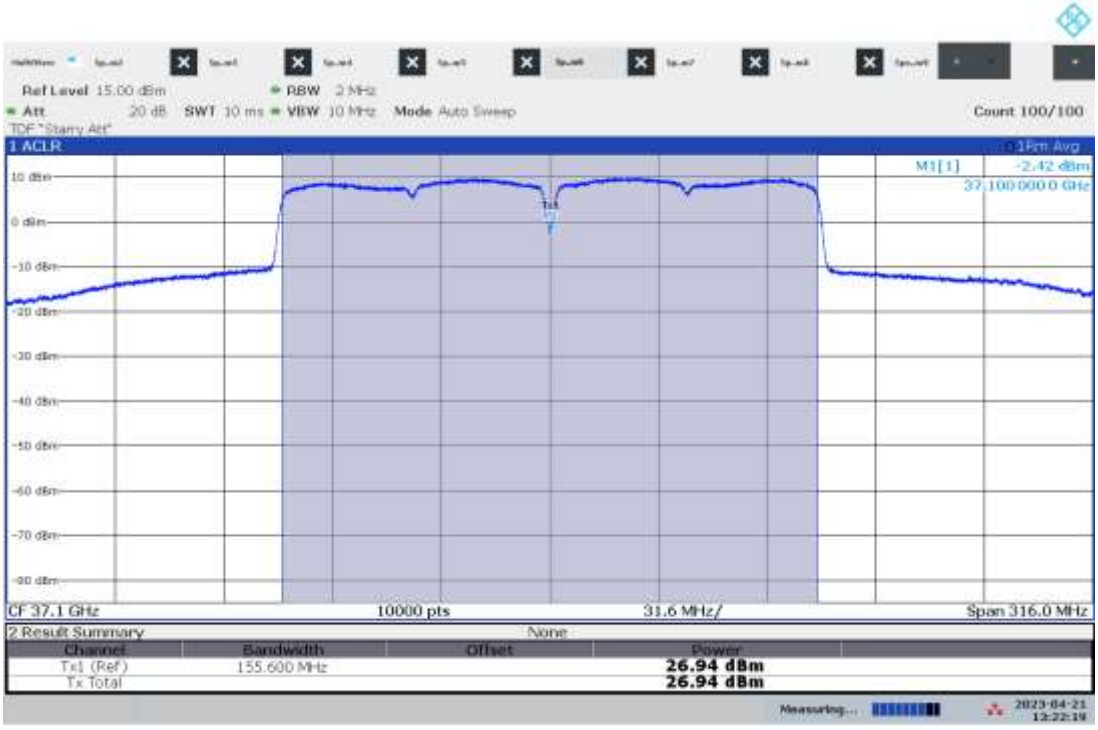


01:10:17 PM 04/21/2023

Output Power – Path 7, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz

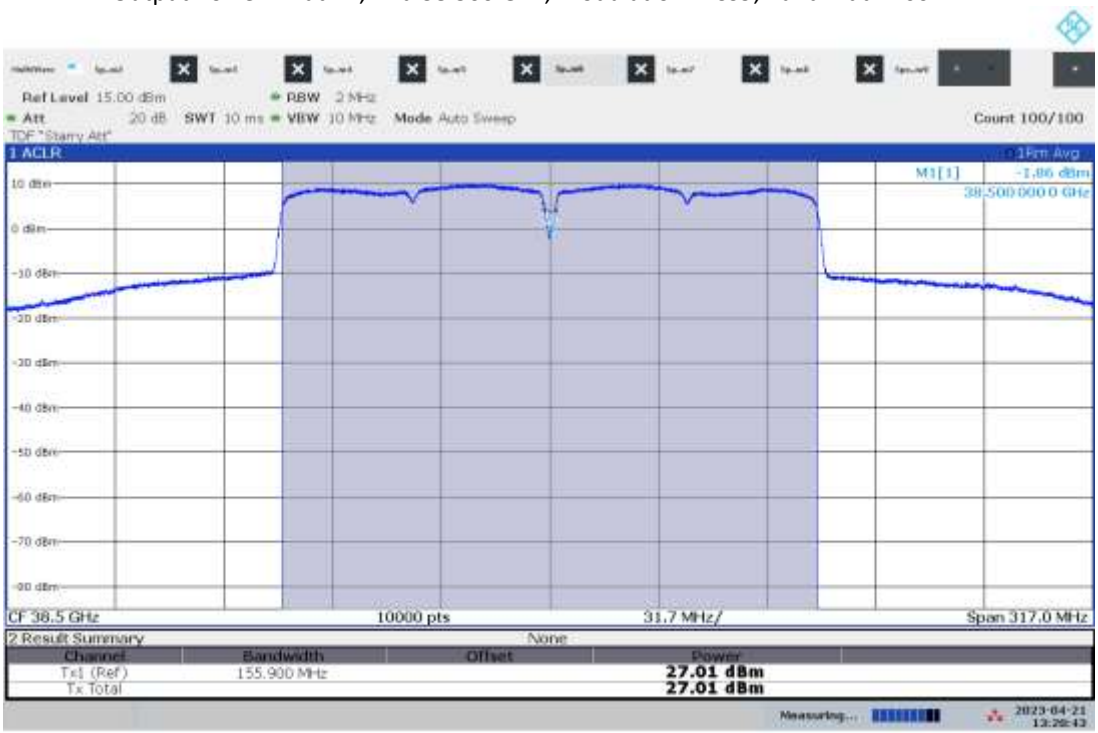
01:16:13 PM 04/21/2023

Output Power – Path 7, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



01:22:20 PM 04/21/2023

Output Power – Path 7, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz

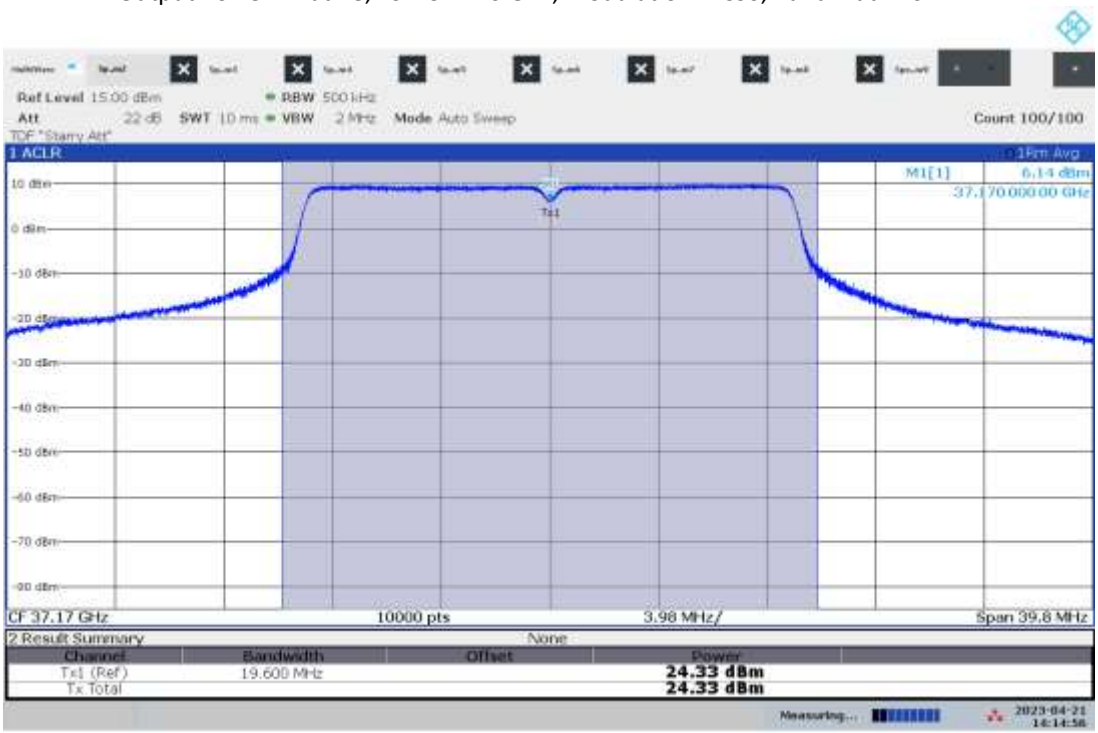


01:20:43 PM 04/21/2023

Output Power – Path 7, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz

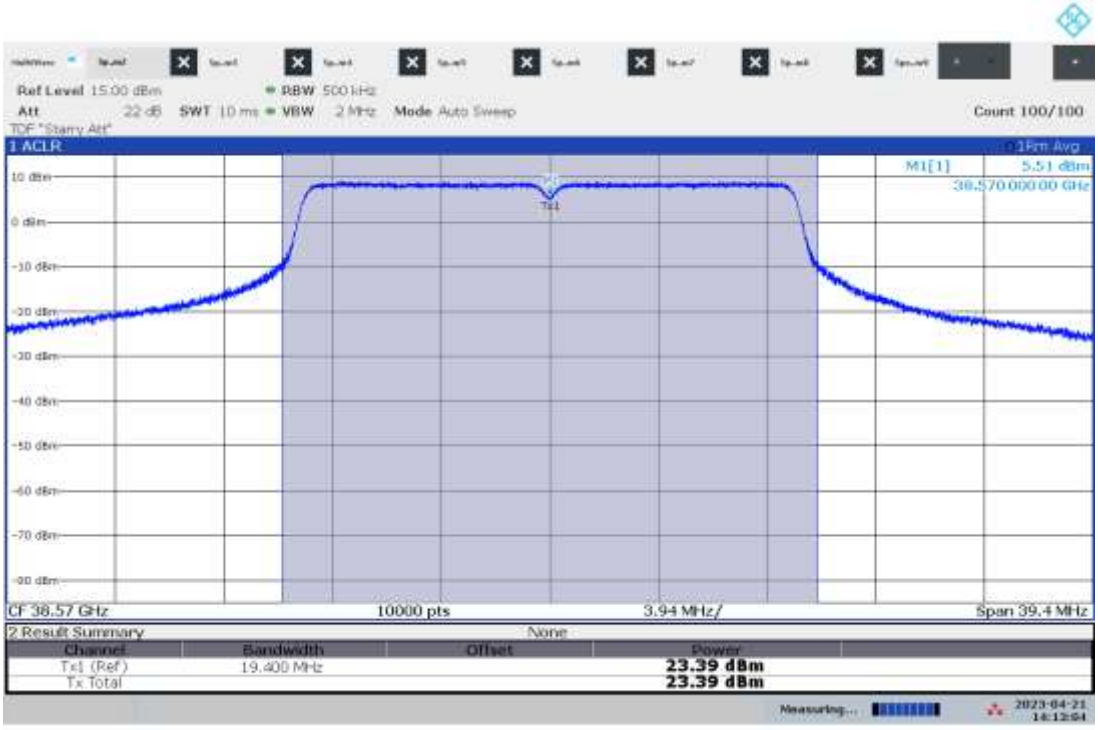
01:18:44 PM 04/21/2023

Output Power – Path 8, Low 37.170 GHz, Modulation MCS0, Bandwidth 20 MHz



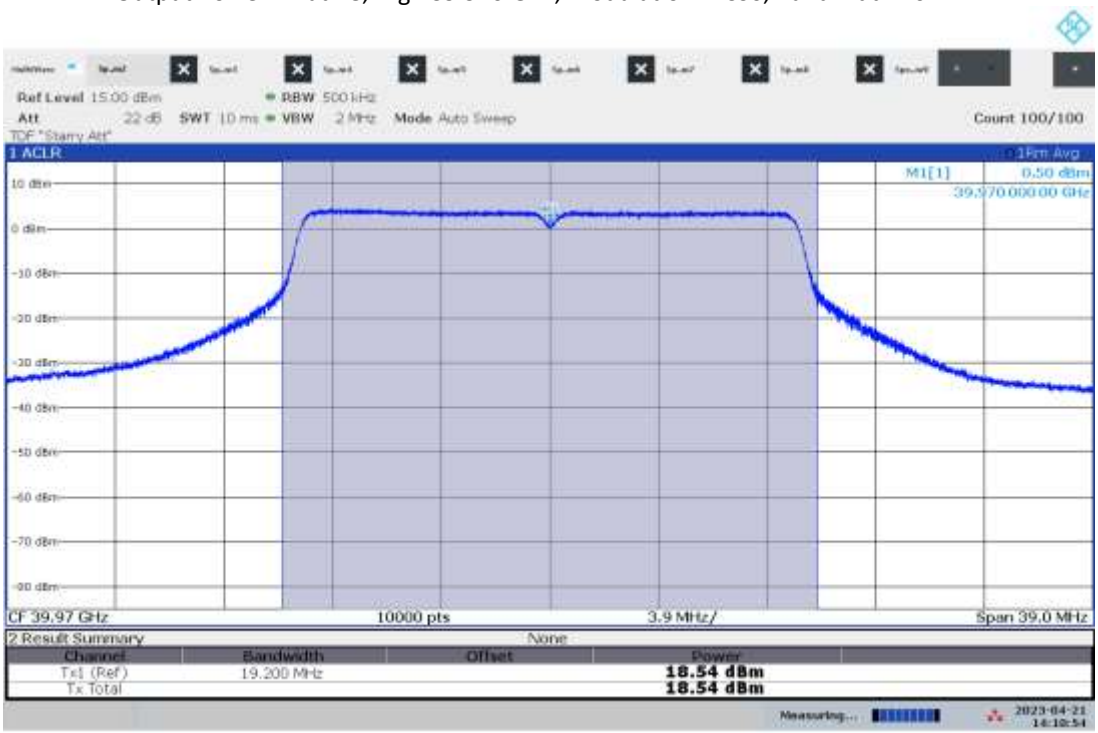
02:14:56 PM 04/21/2023

Output Power – Path 8, Mid 38.570 GHz, Modulation MCS0, Bandwidth 20 MHz



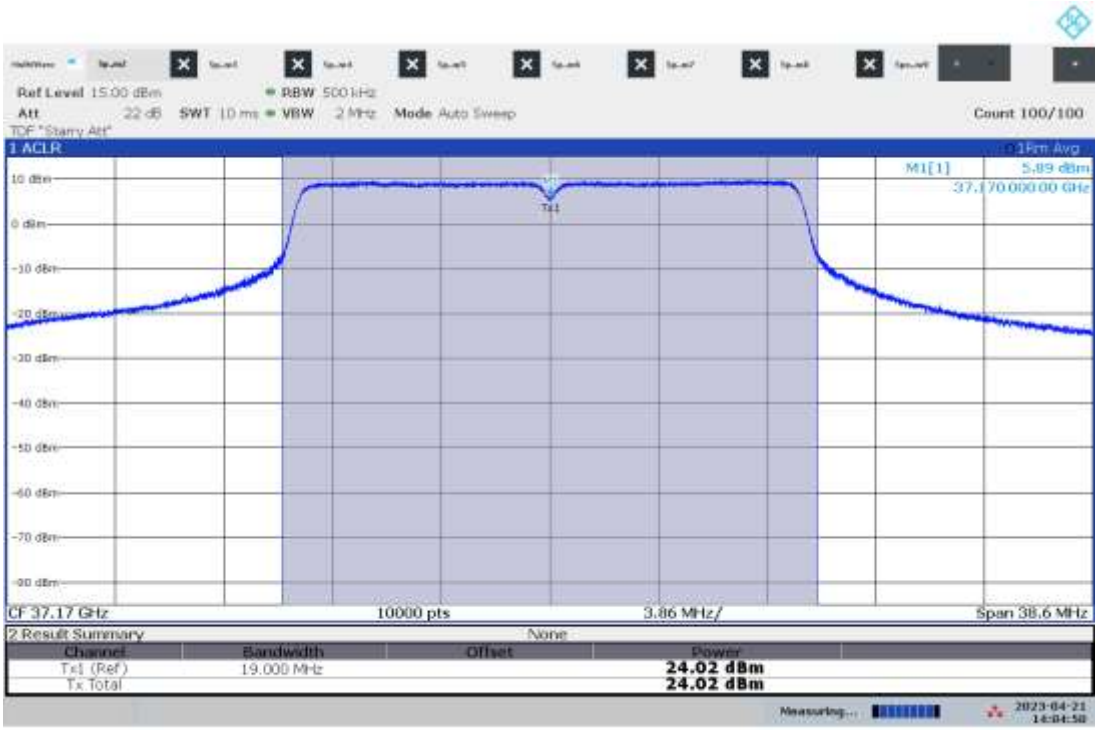
02:13:04 PM 04/21/2023

Output Power – Path 8, High 39.970 GHz, Modulation MCS0, Bandwidth 20 MHz



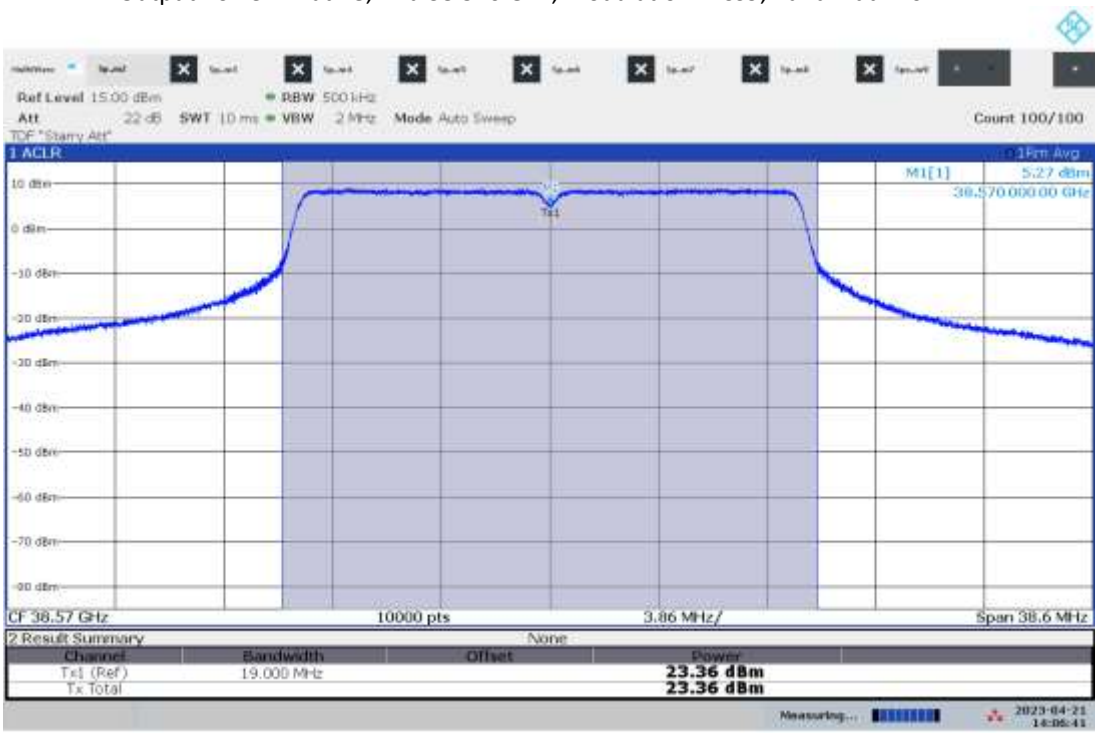
02:10:55 PM 04/21/2023

Output Power – Path 8, Low 37.170 GHz, Modulation MCS9, Bandwidth 20 MHz



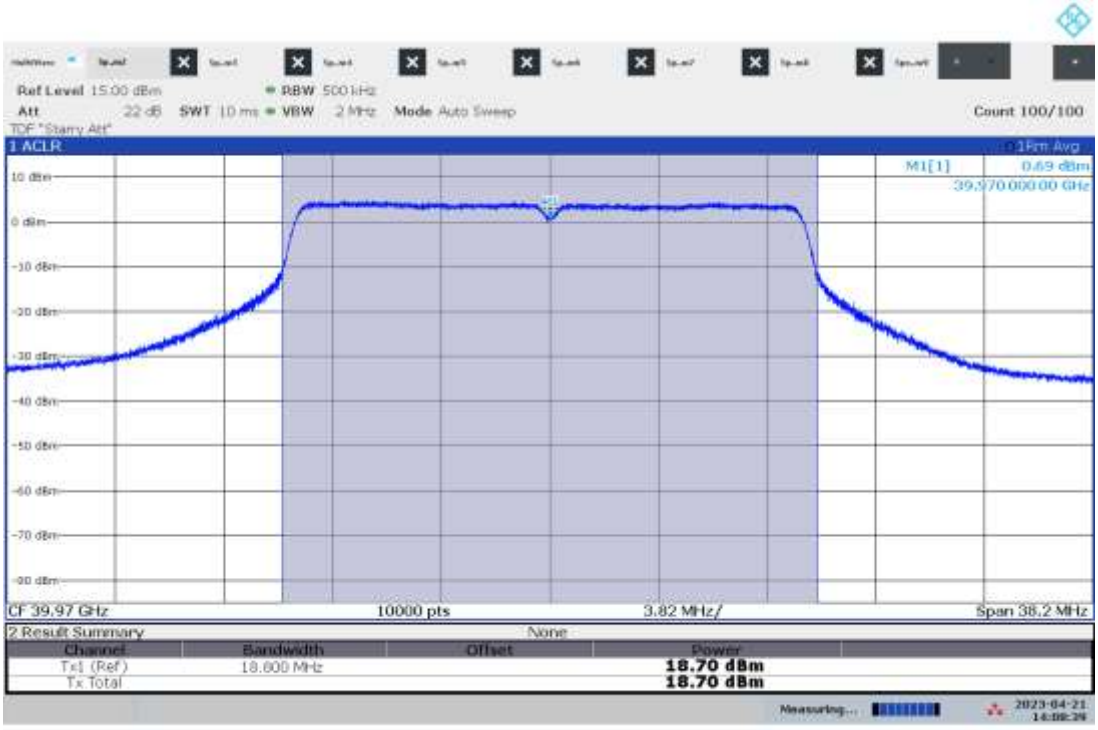
02:04:50 PM 04/21/2023

Output Power – Path 8, Mid 38.570 GHz, Modulation MCS9, Bandwidth 20 MHz



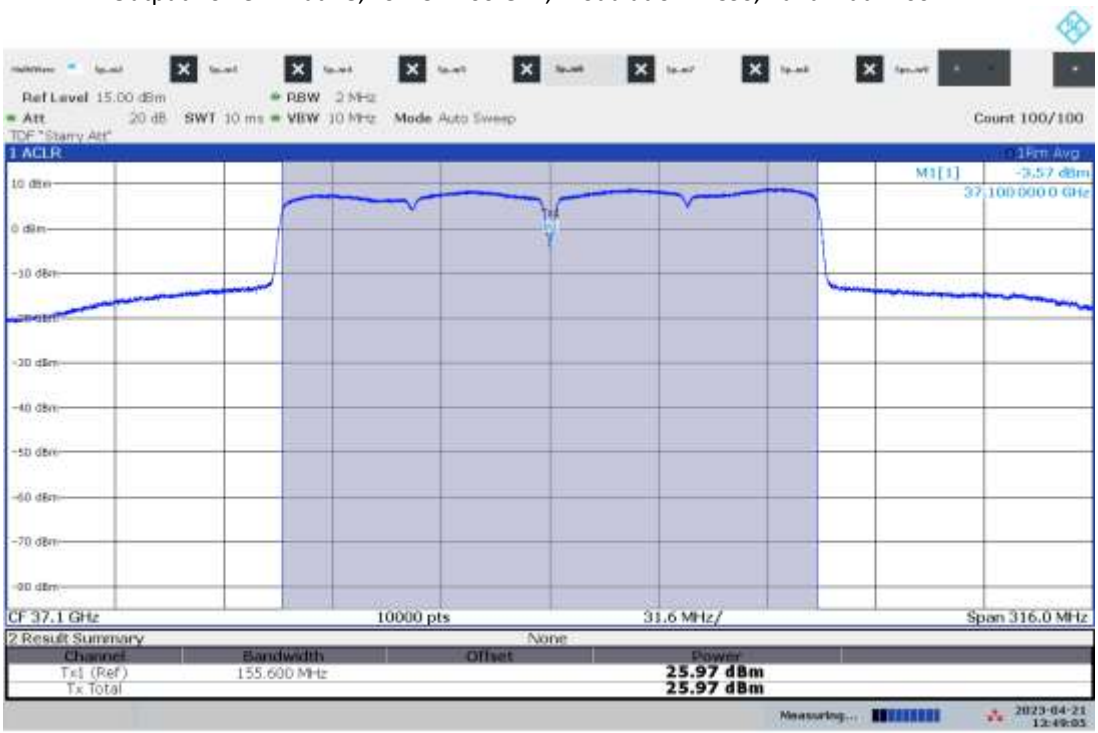
02:06:41 PM 04/21/2023

Output Power – Path 8, High 39.970 GHz, Modulation MCS9, Bandwidth 20 MHz

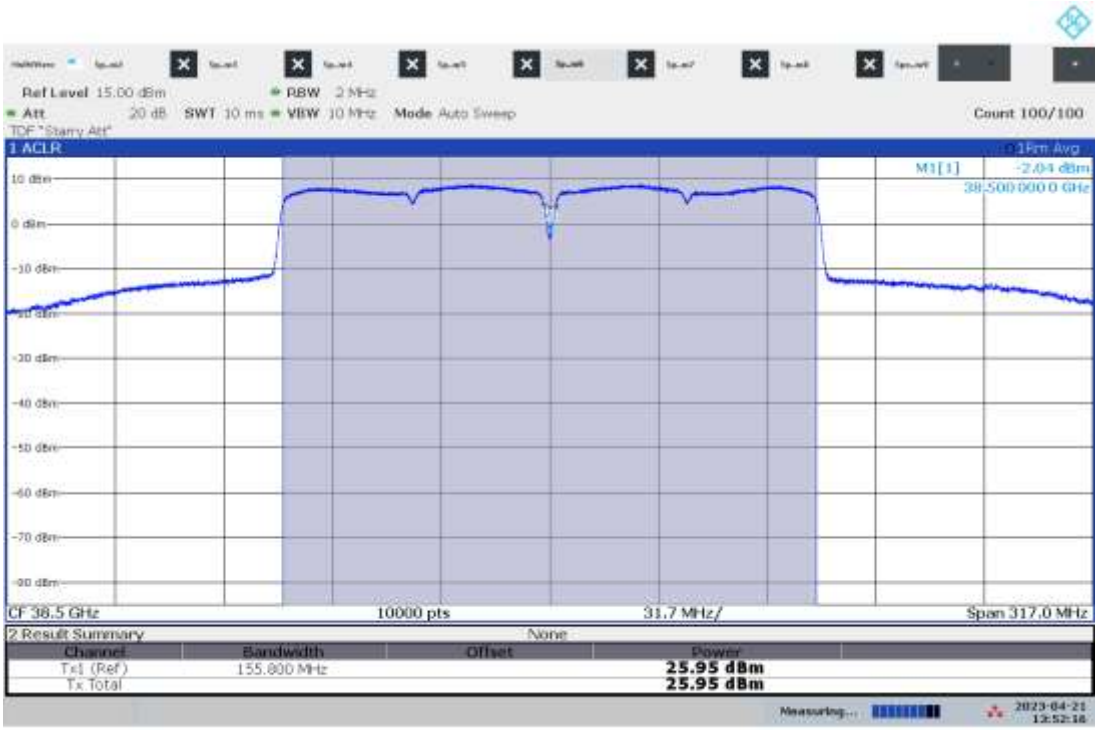


02:08:39 PM 04/21/2023

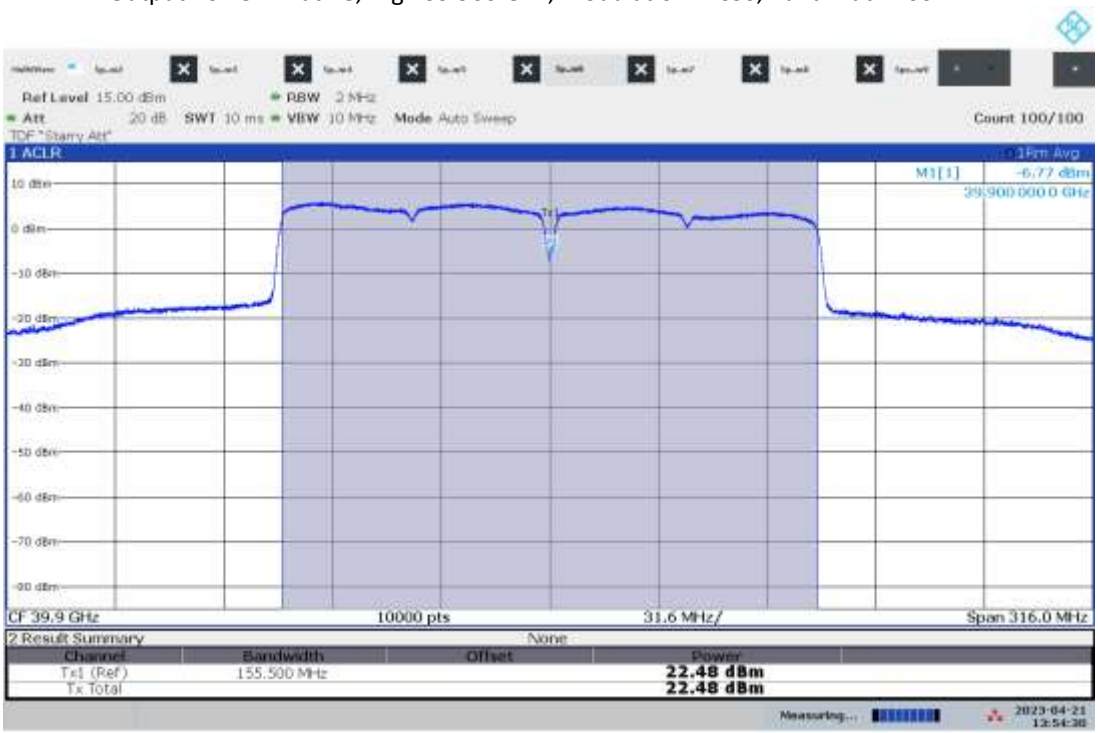
Output Power – Path 8, Low 37.100 GHz, Modulation MCS0, Bandwidth 160 MHz



Output Power – Path 8, Mid 38.500 GHz, Modulation MCS0, Bandwidth 160 MHz

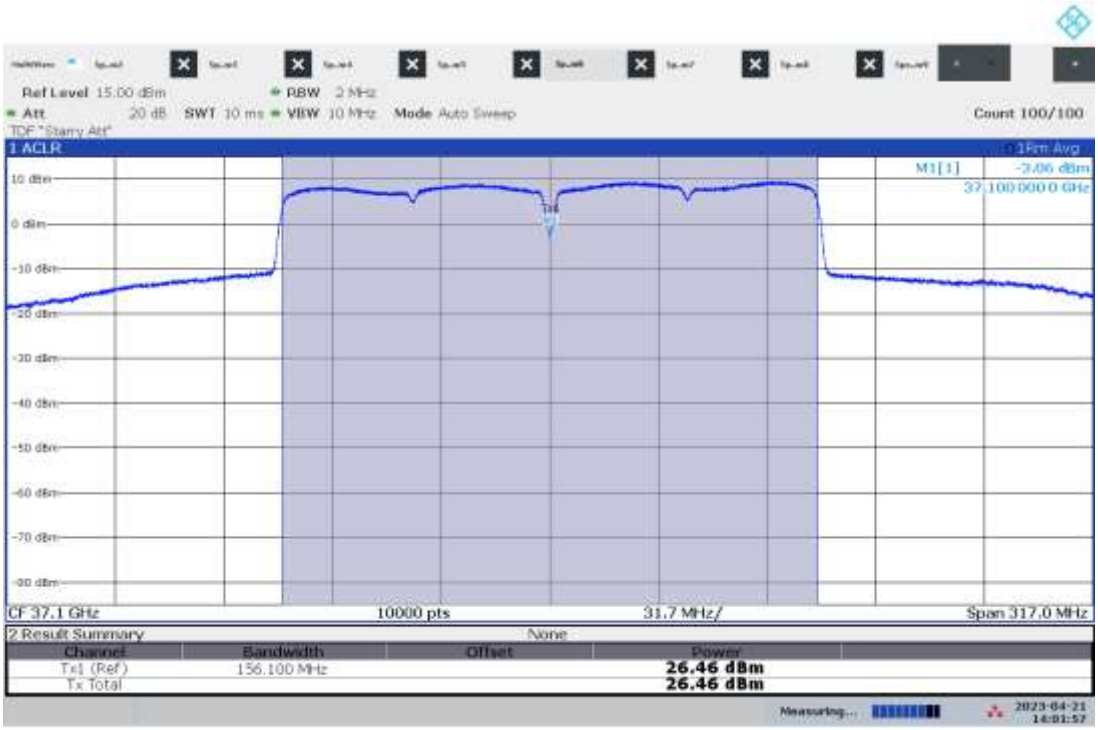


Output Power – Path 8, High 39.900 GHz, Modulation MCS0, Bandwidth 160 MHz



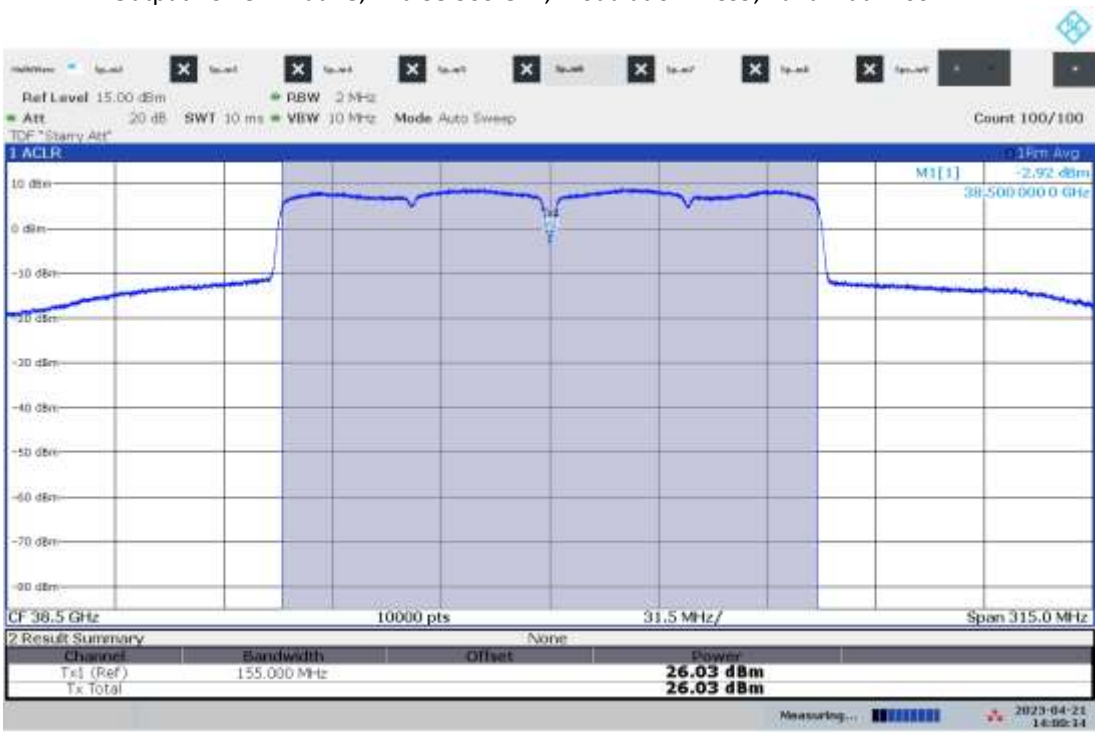
01:54:30 PM 04/21/2023

Output Power – Path 8, Low 37.100 GHz, Modulation MCS9, Bandwidth 160 MHz



02:01:57 PM 04/21/2023

Output Power – Path 8, Mid 38.500 GHz, Modulation MCS9, Bandwidth 160 MHz



02:00:15 PM 04/21/2023

Output Power – Path 8, High 39.900 GHz, Modulation MCS9, Bandwidth 160 MHz

01:58:08 PM 04/21/2023

Output Power – Path 1, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

09:08:40 AM 08/03/2023

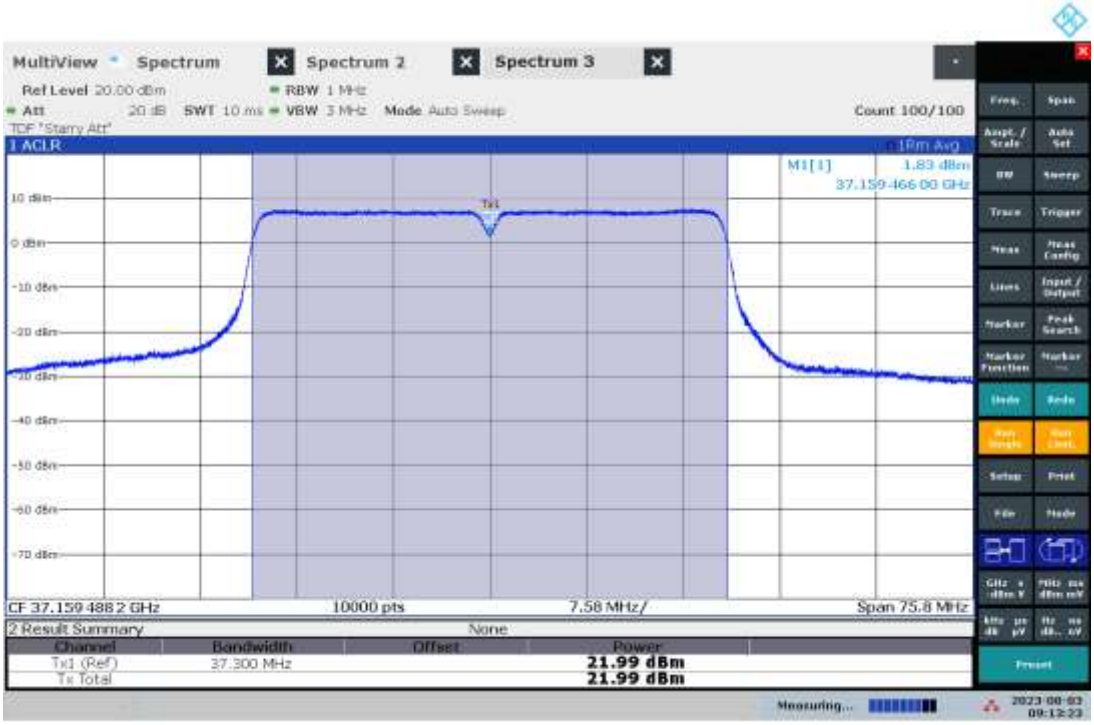
Output Power – Path 1, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

09:24:52 AM 08/03/2023

Output Power – Path 1, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

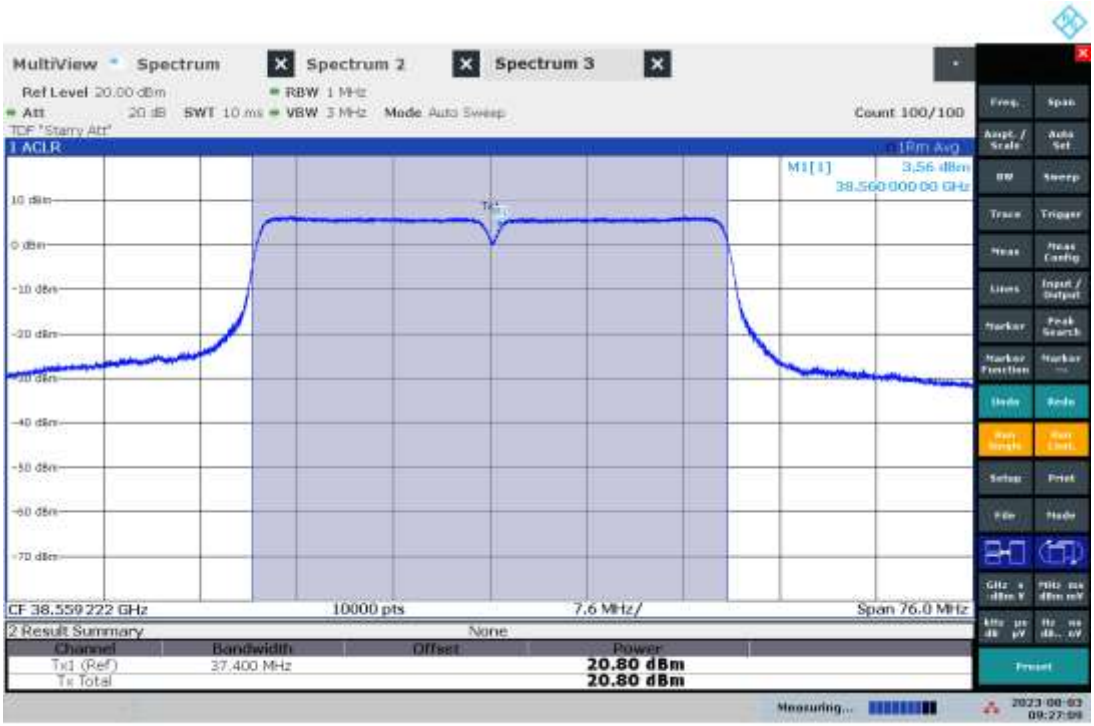
09:34:42 AM 08/03/2023

Output Power – Path 1, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz



09:13:24 AM 08/03/2023

Output Power – Path 1, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz



Output Power – Path 1, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 2, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

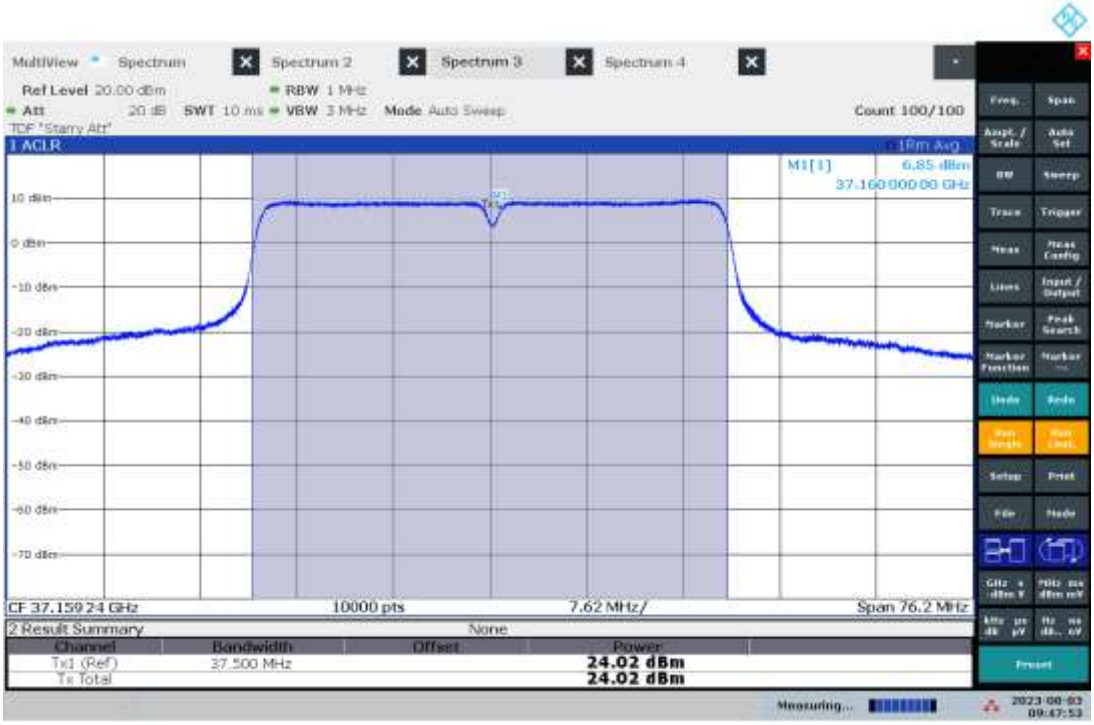
09:45:33 AM 08/03/2023

Output Power – Path 2, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

09:53:34 AM 08/03/2023

Output Power – Path 2, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

Output Power – Path 2, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz



Output Power – Path 2, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 2, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 3, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

10:10:40 AM 08/03/2023

Output Power – Path 3, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

10:16:58 AM 08/03/2023

Output Power – Path 3, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

10:23:07 AM 08/03/2023

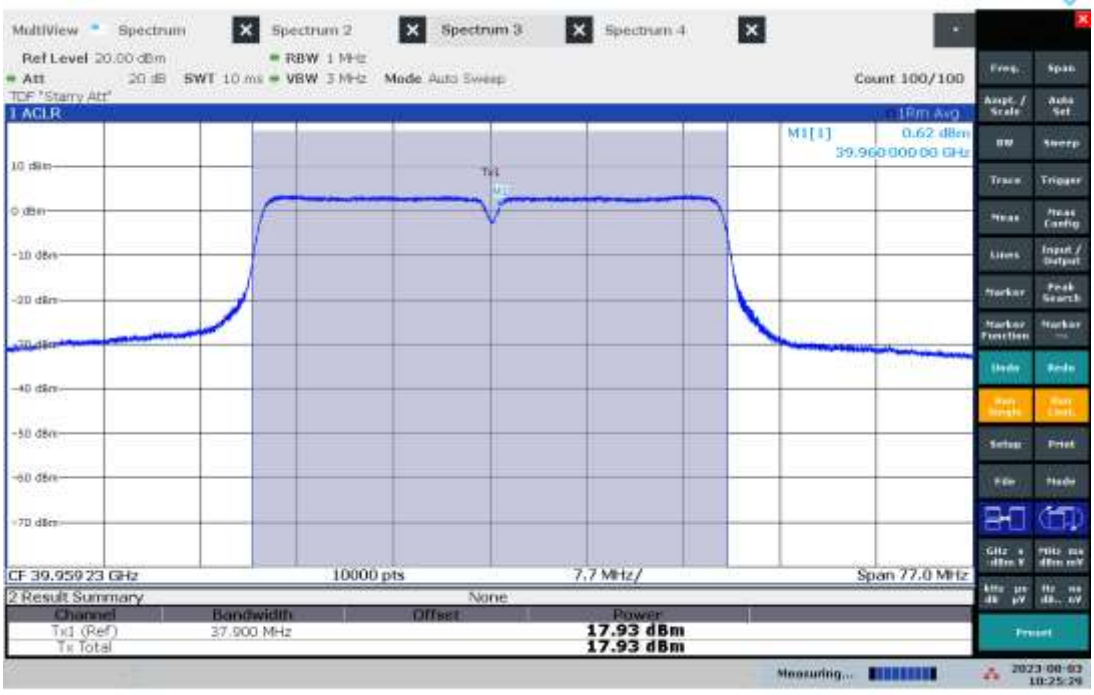
Output Power – Path 3, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz

10:12:59 AM 08/03/2023

Output Power – Path 3, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

10:19:16 AM 08/03/2023

Output Power – Path 3, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz



10:25:30 AM 08/03/2023

Output Power – Path 4, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

10:31:04 AM 08/03/2023

Output Power – Path 4, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

10:36:41 AM 08/03/2023

Output Power – Path 4, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

10:40:56 AM 08/03/2023

Output Power – Path 4, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz

10:33:10 AM 08/03/2023

Output Power – Path 4, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

10:38:26 AM 08/03/2023

Output Power – Path 4, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

10:42:55 AM 08/03/2023

Output Power – Path 5, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

10:54:30 AM 08/03/2023

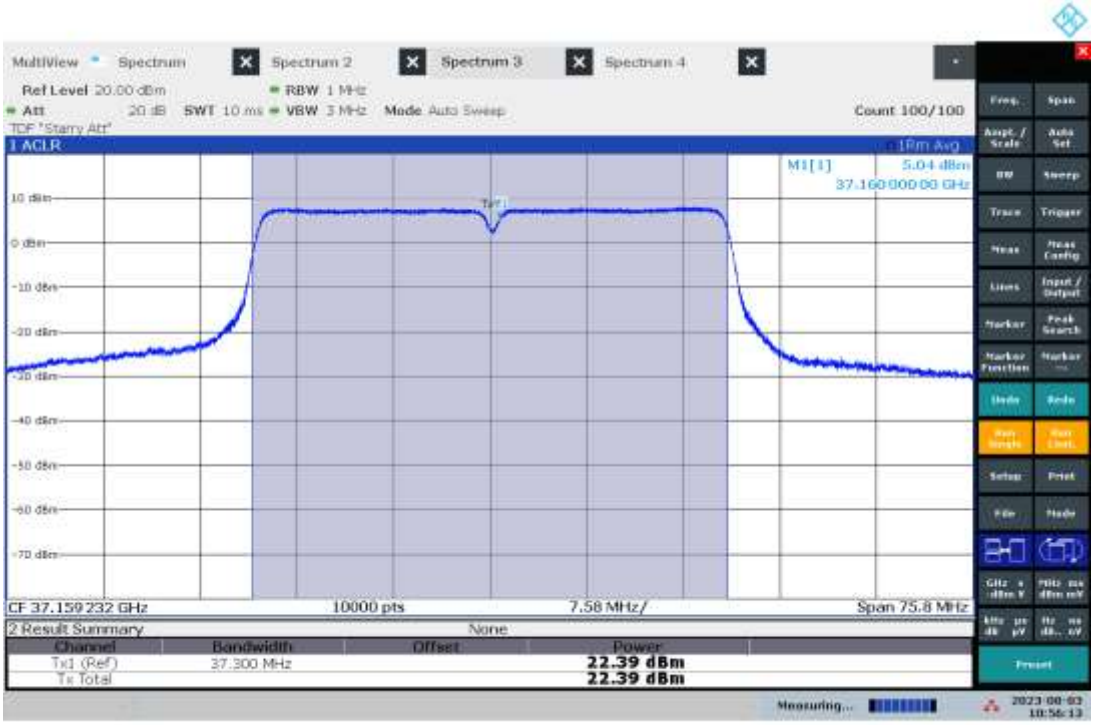
Output Power – Path 5, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

10:59:08 AM 08/03/2023

Output Power – Path 5, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

11:02:52 AM 08/03/2023

Output Power – Path 5, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz



10:56:14 AM 08/03/2023

Output Power – Path 5, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 5, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 6, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

Output Power – Path 6, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

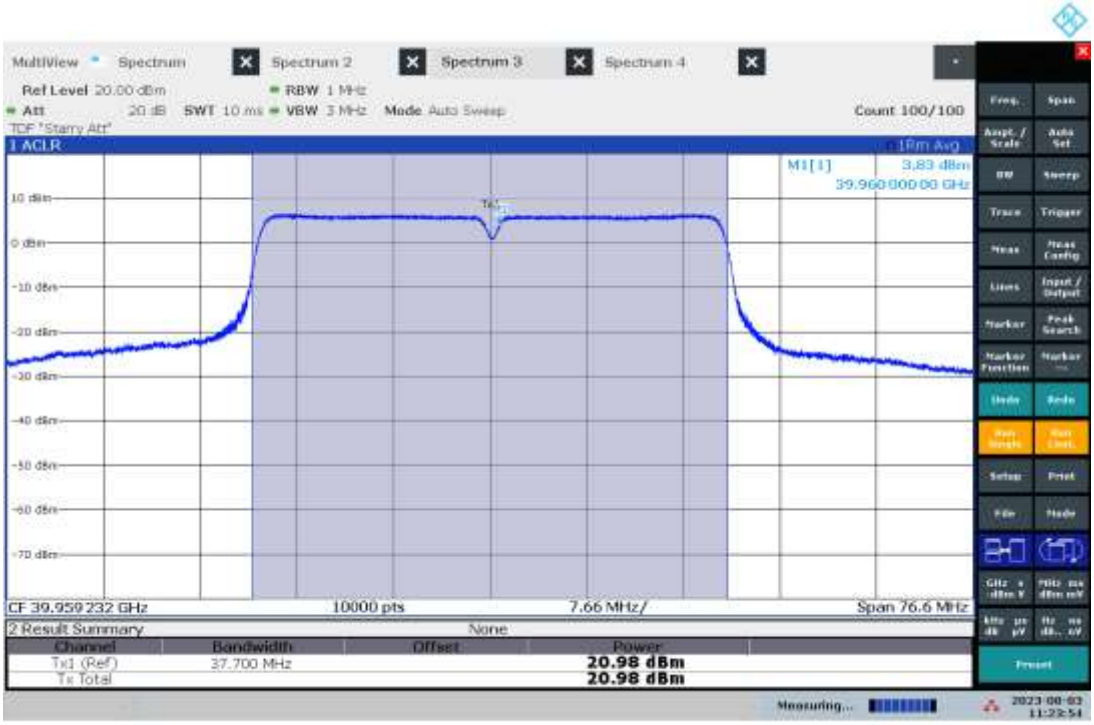
Output Power – Path 6, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

Output Power – Path 6, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz

Output Power – Path 6, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

11:19:46 AM 08/03/2023

Output Power – Path 6, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

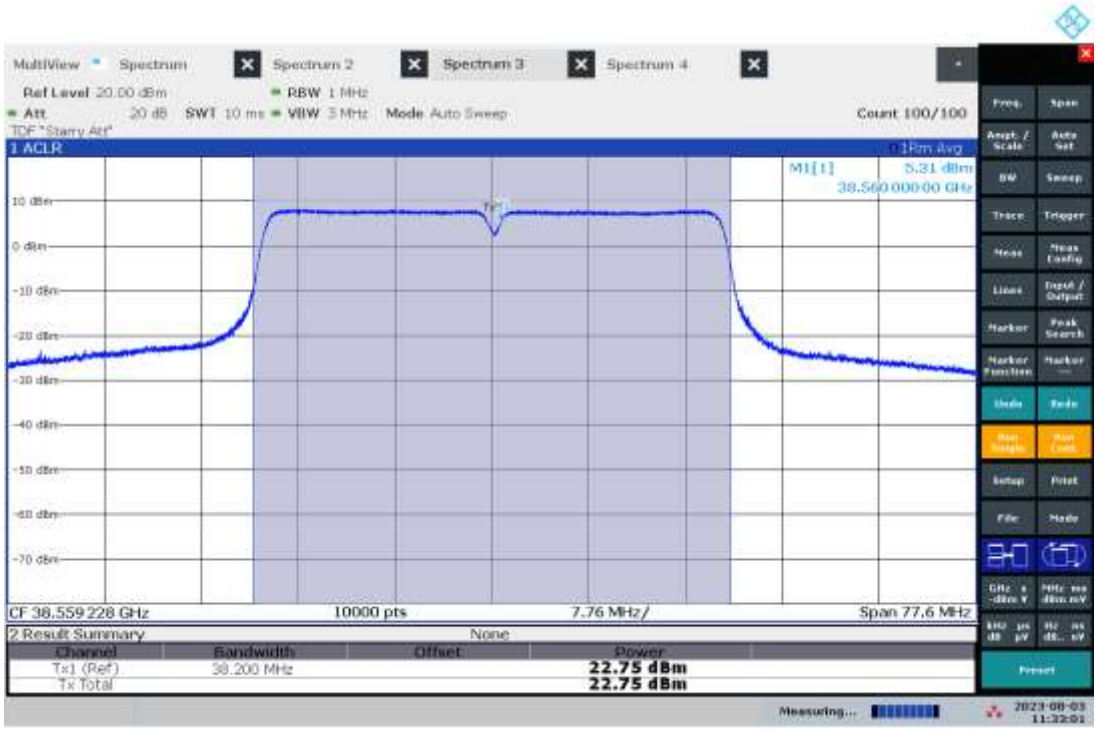


11:23:54 AM 08/03/2023

Output Power – Path 7, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

11:28:19 AM 08/03/2023

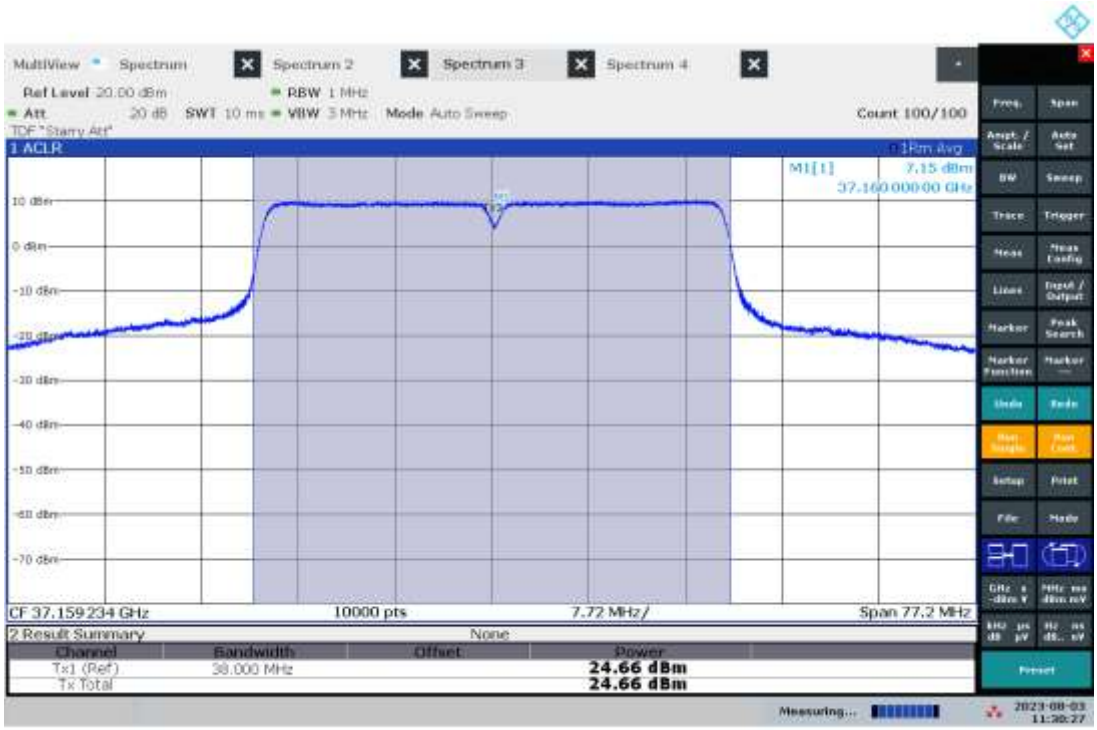
Output Power – Path 7, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz



11:33:01 AM 08/03/2023

Output Power – Path 7, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

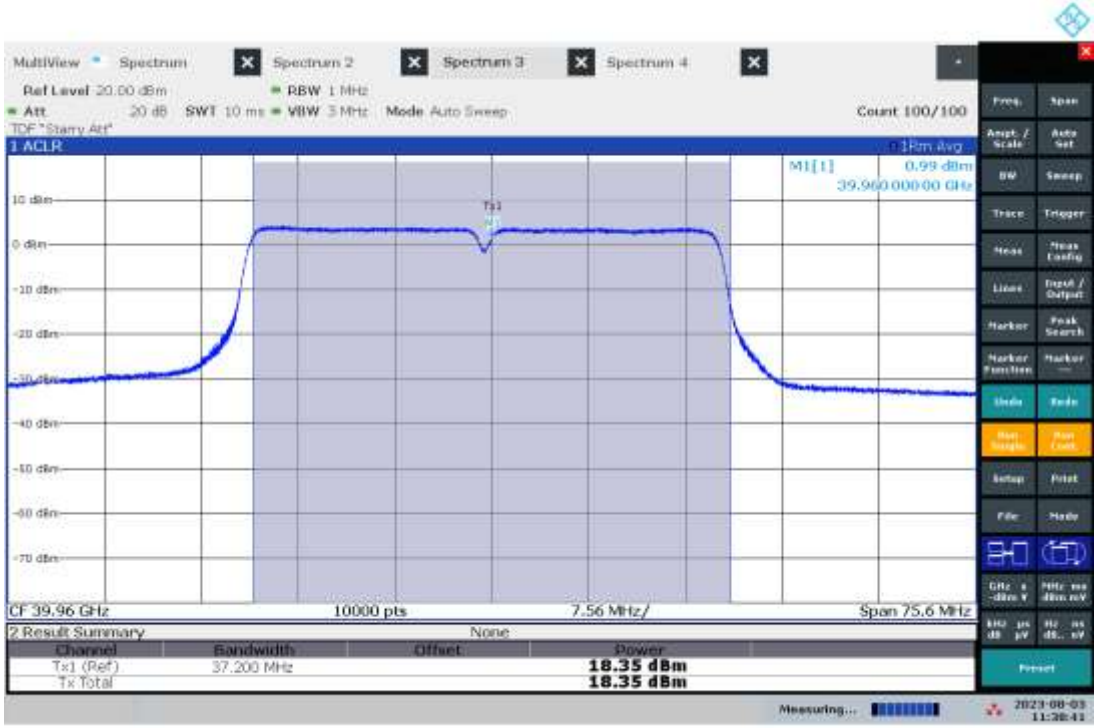
Output Power – Path 7, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz



Output Power – Path 7, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

11:34:43 AM 08/03/2023

Output Power – Path 7, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz



11:38:41 AM 08/03/2023

Output Power – Path 8, Low 37.160 GHz, Modulation MCS0, Bandwidth 40 MHz

12:39:42 PM 08/03/2023

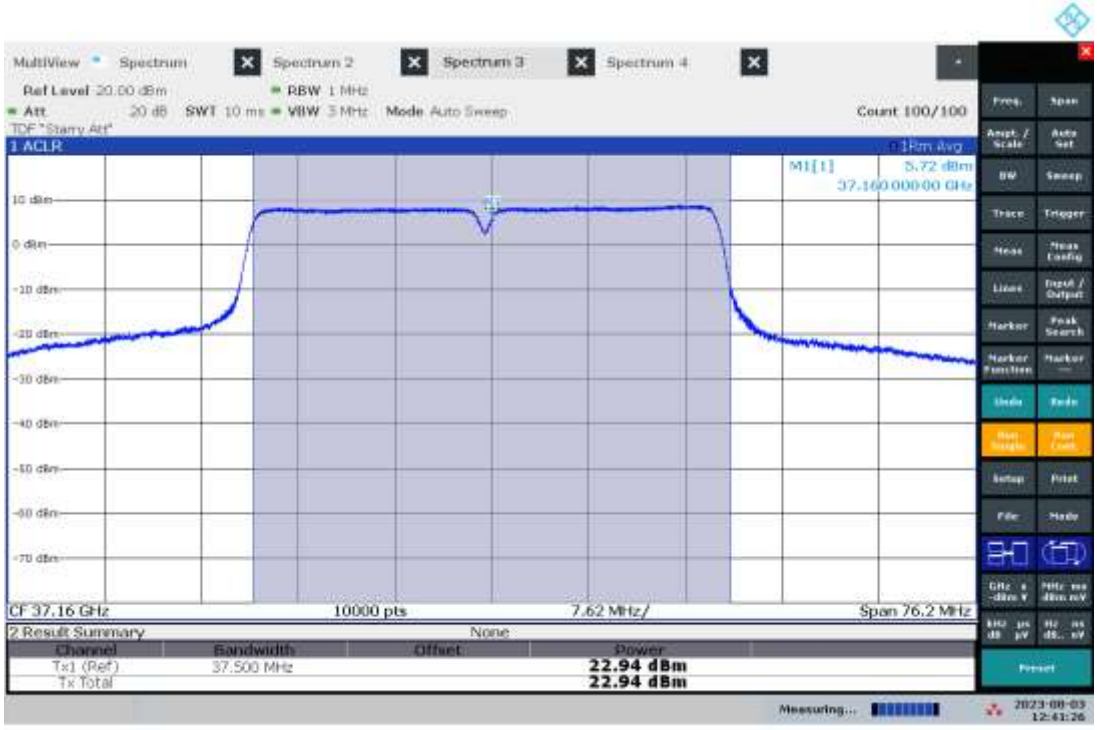
Output Power – Path 8, Mid 38.56 GHz, Modulation MCS0, Bandwidth 40 MHz

12:44:10 PM 08/03/2023

Output Power – Path 8, High 39.96 GHz, Modulation MCS0, Bandwidth 40 MHz

12:47:20 PM 08/03/2023

Output Power – Path 8, Low 37.160 GHz, Modulation MCS9, Bandwidth 40 MHz



12:41:26 PM 08/03/2023

Output Power – Path 8, Mid 38.56 GHz, Modulation MCS9, Bandwidth 40 MHz

12:45:25 PM 08/03/2023

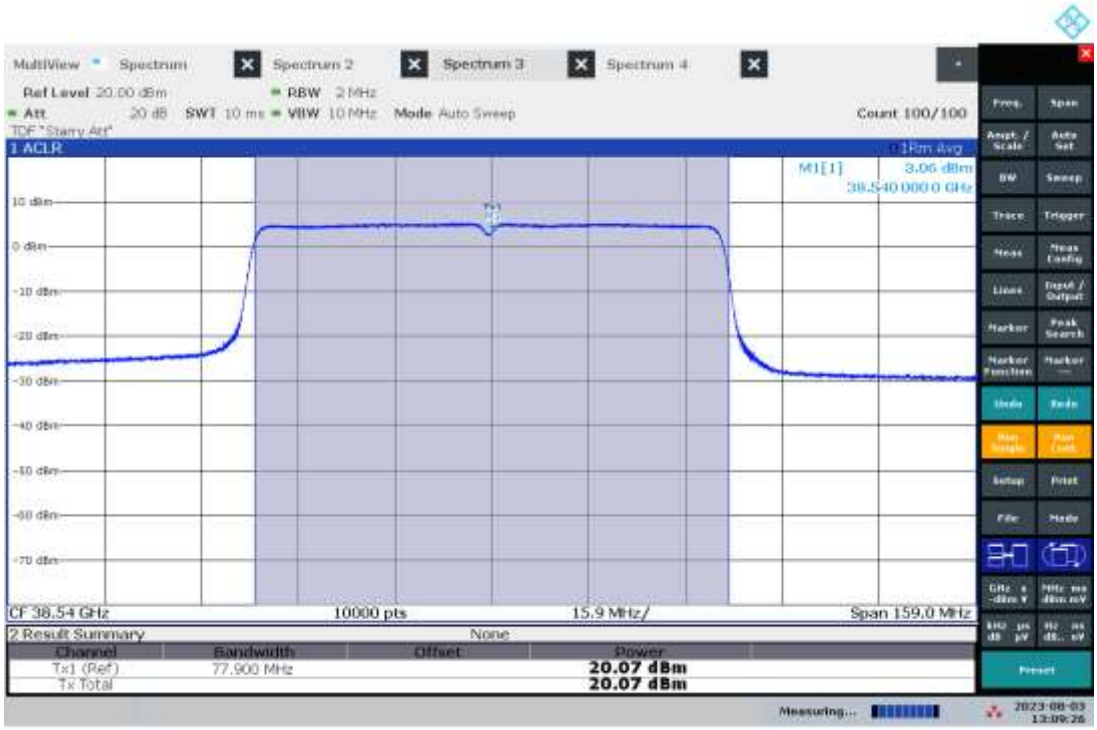
Output Power – Path 8, High 39.96 GHz, Modulation MCS9, Bandwidth 40 MHz

12:48:48 PM 08/03/2023

Output Power – Path 1, Low 37.14 GHz, Modulation MCS0, Bandwidth 80 MHz

01:00:35 PM 08/03/2023

Output Power – Path 1, Mid 38.54 GHz, Modulation MCS0, Bandwidth 80 MHz



01:09:26 PM 08/03/2023

Output Power – Path 1, High 39.94 GHz, Modulation MCS0, Bandwidth 80 MHz

01:12:44 PM 08/03/2023

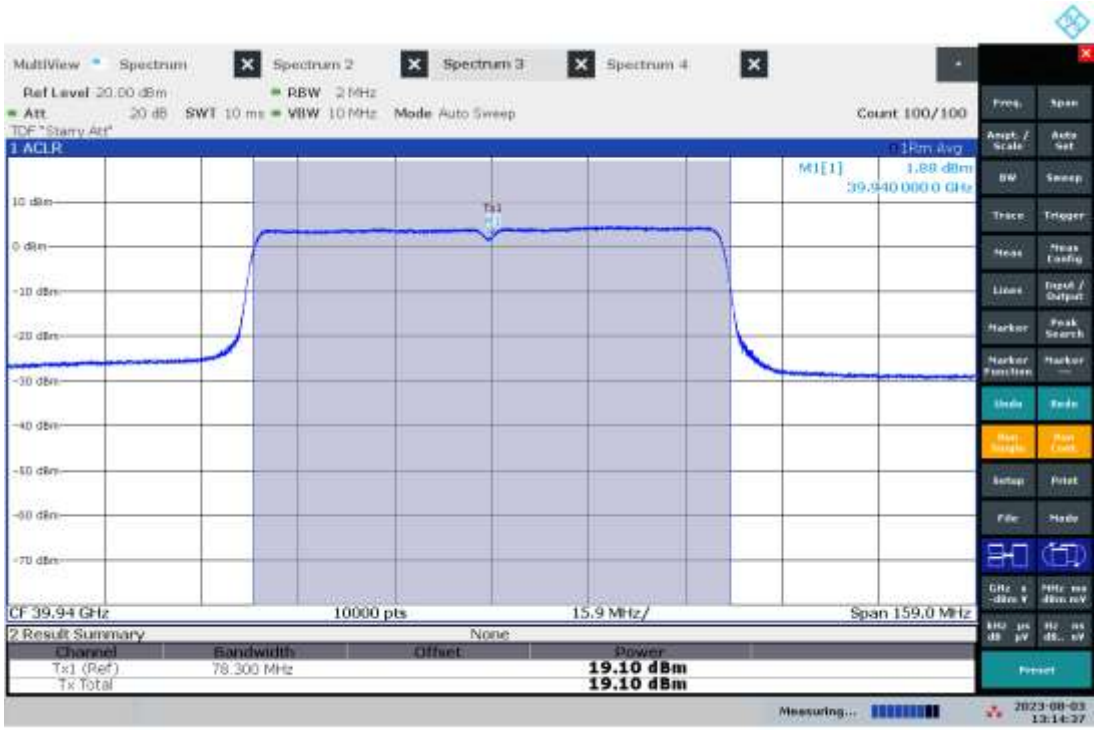
Output Power – Path 1, Low 37.14 GHz, Modulation MCS9, Bandwidth 80 MHz

01:05:16 PM 08/03/2023

Output Power – Path 1, Mid 38.54 GHz, Modulation MCS9, Bandwidth 80 MHz

01:10:50 PM 08/03/2023

Output Power – Path 1, High 39.94 GHz, Modulation MCS9, Bandwidth 80 MHz

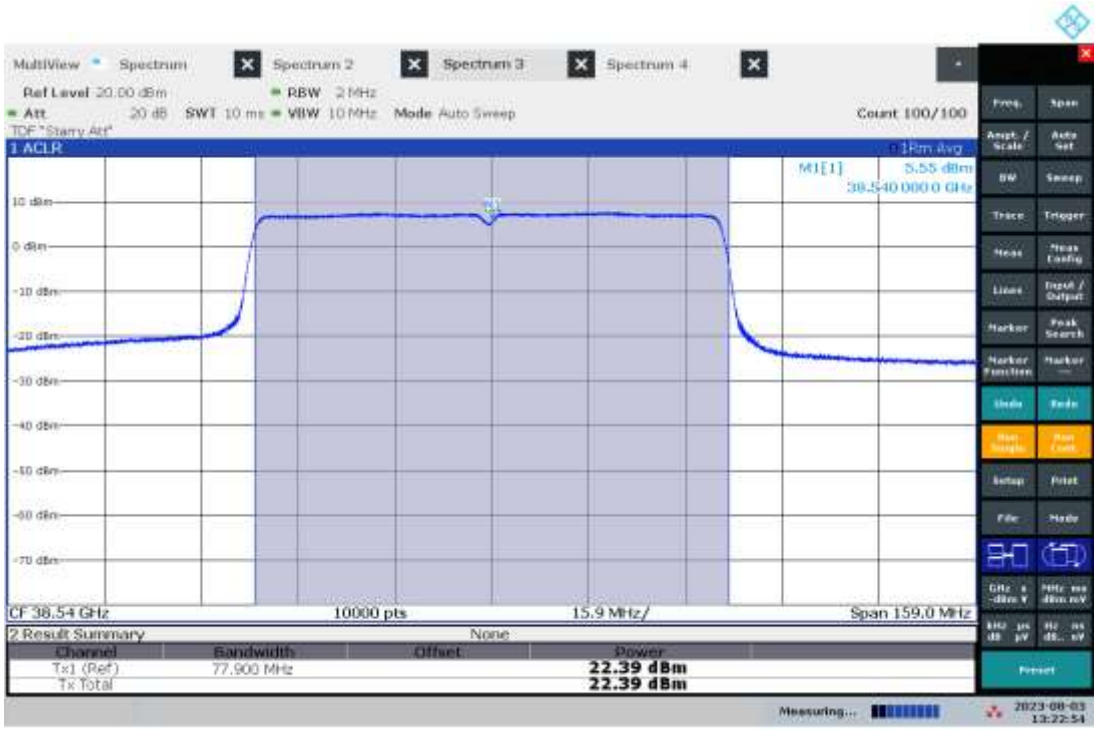


01:14:37 PM 08/03/2023

Output Power – Path 2, Low 37.14 GHz, Modulation MCS0, Bandwidth 80 MHz

01:18:09 PM 08/03/2023

Output Power – Path 2, Mid 38.54 GHz, Modulation MCS0, Bandwidth 80 MHz

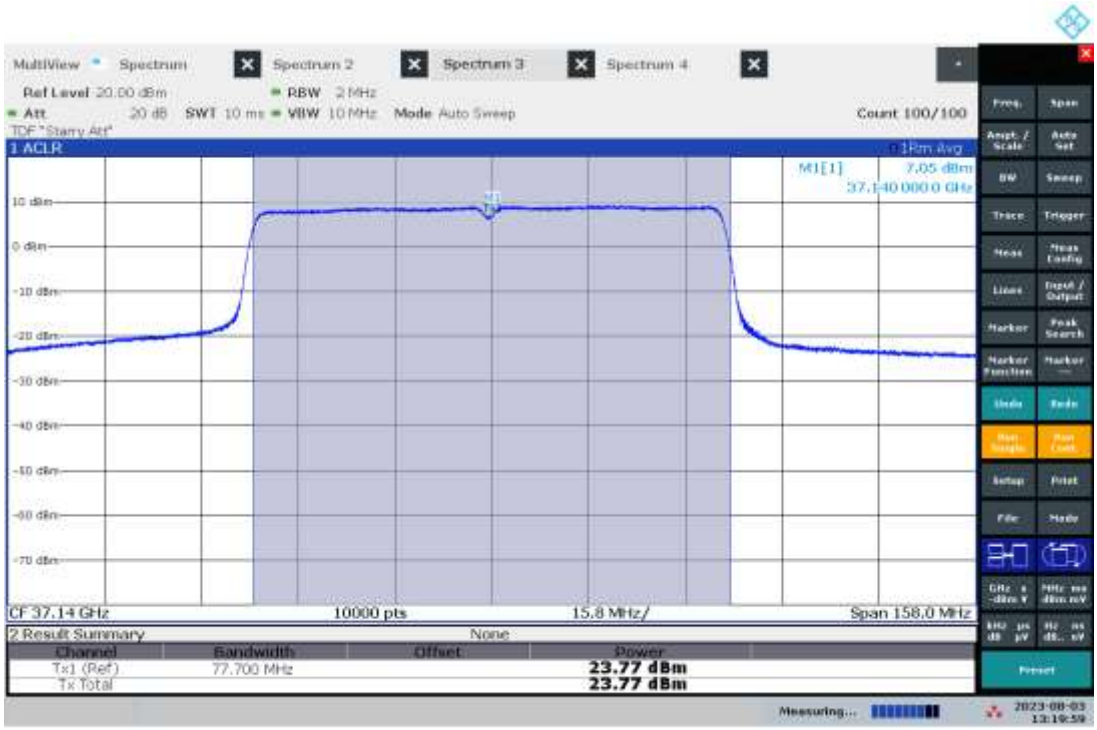


01:22:54 PM 08/03/2023

Output Power – Path 2, High 39.94 GHz, Modulation MCS0, Bandwidth 80 MHz

01:27:12 PM 08/03/2023

Output Power – Path 2, Low 37.14 GHz, Modulation MCS9, Bandwidth 80 MHz



01:20:00 PM 08/03/2023