

TEST REPORT

FCC Test for AT1H04-A10

APPLICANT

SAMSUNG Electronics Co., Ltd.

REPORT NO.

HCT-RF-2109-FC040-R1

DATE OF ISSUE

September 30, 2021

Tested by
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TEST
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Additional Model

-

Applicant**SAMSUNG Electronics Co., Ltd.**

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

Product Name

AU (AT1H04)

Model Name

AT1H04-A10

FCC ID

A3LAT1H04-A10

Date of Test

August 31, 2021~ September 16, 2021

Test Standard Used

CFR 47 Part 2, Part 30

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.

This test results were applied only to the test methods required by the standard.

REVISION HISTORY

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

Revision No.	Date of Issue	Description
0	September 28, 2021	Initial Release
1	September 30, 2021	We corrected the typo. We added a note in Section 3.2.

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

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

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1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	Samsung Electronics Co., Ltd.
Company Address	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

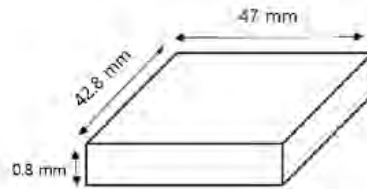
1.2. PRODUCT INFORMATION

EUT Type	AU (AT1H04)				
EUT Serial Number	DKN210706B				
Equipment Class	5GB-Part 30 Fixed Transmitter				
Power Supply	-48 V DC				
Output Power	Installation	Wall and Pole		Ceiling	
	Mode	EIRP	Total (2 path)	EIRP	Total (2 path)
		(dBm/CC/path)	(dBm)	(dBm/CC/path)	(dBm)
	1CC	37.0	40.0	33.0	36.0
	2CC	34.0	40.0	30.0	36.0
	3CC	32.2	40.0	28.2	36.0
	4CC	31.0	40.0	27.0	36.0
Frequency Range	37 000 MHz ~ 40 000 MHz				
Emission Designator	Mode	QPSK (G7D)	QPSK Max EIRP Density [W/100 MHz]	16/64 QAM (W7D)	QAM Max EIRP Density [W/100 MHz]
	1CC Contiguous	94M5G7D	12.853	94M5W7D	13.002
	4CC Contiguous	392MG7D	3.532	392MW7D	3.556
	1CC+ 3CC Non-Contiguous	385MG7D	2.858	386MW7D	3.006
	3CC+ 1CC Non-Contiguous	386MG7D	3.467	386MW7D	3.491
Channel Bandwidths	100 MHz, 200 MHz, 300 MHz, 400 MHz				
Modulation Type	QPSK, 16QAM, 64QAM				

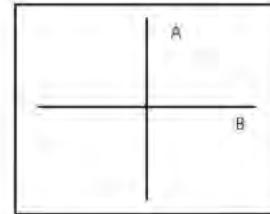
Antenna Specification

Maximum Gain: 20 dBi (Wall/Pole) / 16 dBi (Ceiling)

Size:



Array:



1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 30
Measurement standards	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 662911 D01 v02r01, KDB 662911 D02 v01, KDB 842590 D01 v01r02
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 30

Description	Reference	Results
Occupied Bandwidth	§ 2.1049	Compliant
EIRP Density	§ 30.202	Compliant
Equivalent Isotropic Radiated Power	§ 2.1046	Compliant
Band Edge	§ 2.1051, § 30.203	Compliant
Radiated Spurious Emissions	§ 2.1051, § 30.203	Compliant
Frequency Stability	§ 2.1055	Compliant

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

- All tests is performed by radiated measurement and applied below conditions.

: Used measurement distance with far field of test such as EIRP, OBW and Band edge are as follow.

$$\text{Wavelength} = \text{Speed of light} / \text{Measurement frequency} = 30 / 4\,000 = 0.0075$$

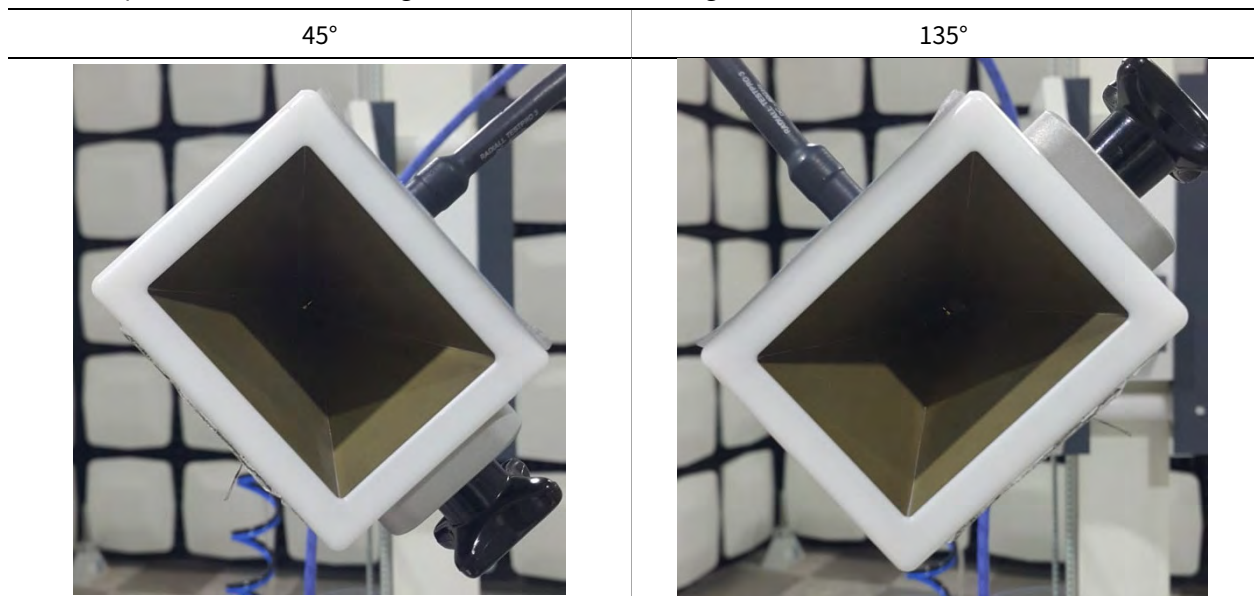
$$(2 \times (\text{Max measured antenna dimension})^2) / \text{Wavelength} = (2 \times (0.06357)^2) / 0.0075 = 1.08 \text{ m}$$

So, measurement distance is 1.5 m.

: Spurious emissions measurement distance is shown in table below(Reference : Measurement Antenna Dimension).

Frequency Range (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance(m)
18 ~ 40	0.75	2.46	3.00
40 ~ 50	0.60	1.130	3.00
50 ~ 60	0.50	1.354	3.00
60 ~90	0.33	0.856	3.00
90 ~ 140	0.214	0.572	3.00
140 ~ 200	0.15	0.332	1.50

: Radiated test is performed on various angle of antenna and following location is worst test case.



- CC means component carriers and EUT support 1 cc ~ 4 cc.

- Test was performed the carrier 1 and 4 case having maximum output power and maximum PSD(It means the worst case.).

- Unwanted radiated emissions test was performed on state of all EUT antenna path is operated with a maximum output power level.

- Transmitter output signals are correlated.

- In case of far-field distance for fundamental, we applied the measured antenna dimension because the measured antenna is bigger than the antenna of EUT.

- Because of the EUT using TDD technology, it cannot be configured to transmit continuously and measurement instrument cannot be configured to measure only during active transmissions. So we perform the measurement using duty cycle method.

Measurement Result of AT1H04-A10 Transmit On/Off Timing



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

$$\text{Duty Cycle} = \text{On-time} / \text{Transmitter period} = 0.4646 \text{ ms} / 0.6256 \text{ ms} = 0.743$$

$$\text{Duty Correction} = 10 \log (1/\text{duty cycle}) = 10 \log (1/0.743) = 1.29 \text{ dB}$$

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

- After pre-testing in all modes from 1CC to 4CC, 1CC and 4CC modes has founded out as worst mode.

And in non-contiguous operation, 4CC is the mode which has highest total power and 3+1/1+3 CC Mode as non-contiguous mode is the worst case in both RSE and Bandedge test.

- After full testing in higher EIRP(Wall/Pole installation), and worst case spot checking in lower EIRP(Ceiling installation), full testing data are reported.

3.3. MAXIMUM MEASUREMENT UNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor $k=2$, Confidence levels of 95 %

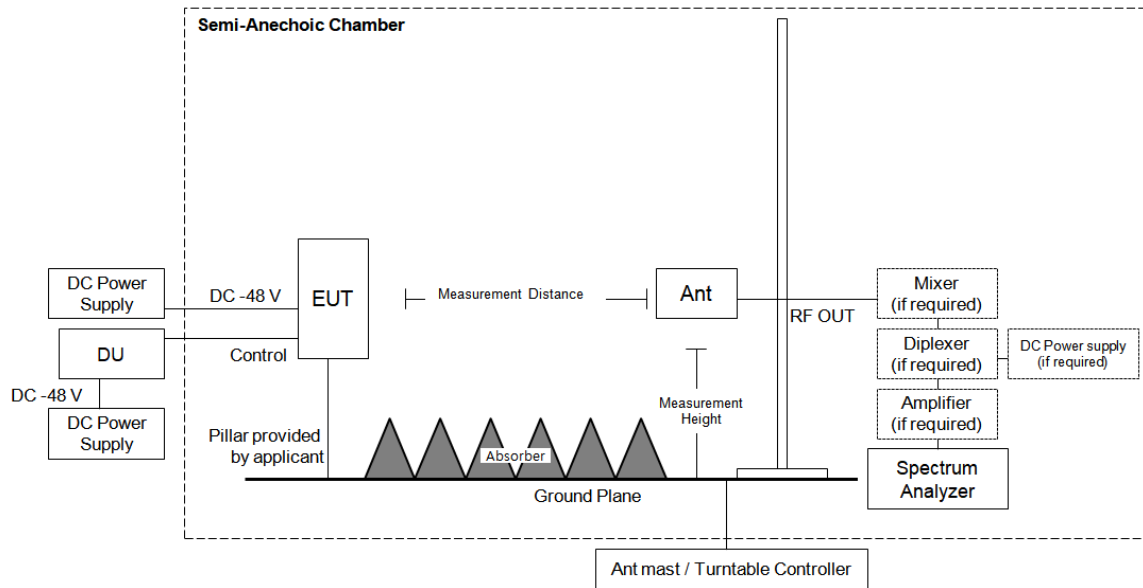
Description	Frequency	Uncertainty
Occupied Bandwidth	37 ~ 40 GHz	± 0.31 MHz
Conducted Output Power	37 ~ 40 GHz	± 5.05 dB
EIRP Density		
Band Edge		
Radiated Spurious Emissions	9 kHz ~ 30 MHz	± 3.40 dB
	30 MHz ~ 1 GHz	± 4.80 dB
	1 GHz ~ 18 GHz	± 5.70 dB
	18 GHz ~ 40 GHz	± 5.05 dB
	40 GHz ~ 200 GHz	± 4.59 dB
Frequency Stability	37 ~ 40 GHz	69.61 kHz

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

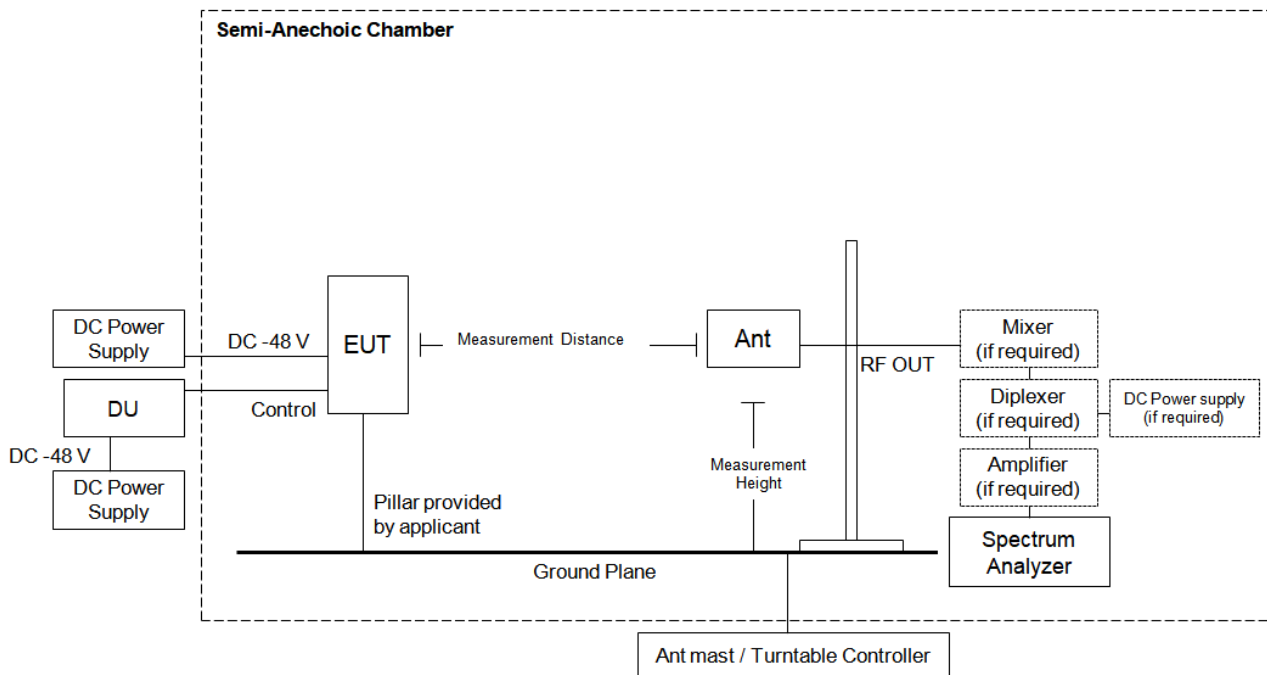
Temperature :	+15 °C to +35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

3.5. TEST DIAGRAMS

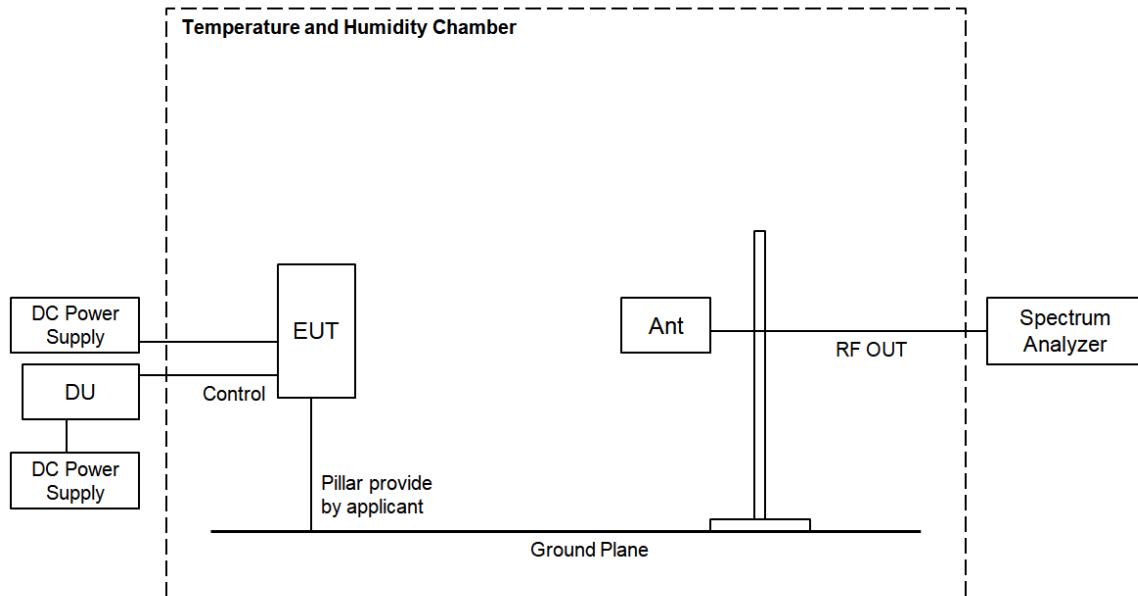
Occupied Bandwidth / EIRP / Band Edge / Radiated Spurious Emissions in 1 GHz to 40 GHz



Radiated Spurious Emissions in other bands



Frequency stability



4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
PXA Signal Analyzer	N9030B	Agilent	MY55480167	06/02/2022	Annual
Horn Antenna	BBHA 9170	Schwarzbeck	BBHA9170541	11/29/2021	Biennial
DC Power Supply	PWR800L	KIKUSUI	RE002047	07/13/2022	Annual
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Spectrum Analyzer	FSP	Rohde&Schwarz	836650/016	09/13/2022	Annual
Loop Antenna	Loop Antenna	Rohde & Schwarz	1513-175	05/18/2022	Biennial
Controller	2090	Emco	060520	N/A	N/A
Turn Table	Turn Table	Ets	N/A	N/A	N/A
Hybrid Antenna	VULB 9168	Schwarzbeck	00895	07/14/2023	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1300	06/23/2022	Biennial
Horn Antenna	WR-19 Horn Antenna	OML INC.	18042301	04/23/2022	Biennial
Horn Antenna	WR-19 Horn Antenna	OML INC.	18042302	04/23/2022	Biennial
Horn Antenna	WR-12 Horn Antenna	OML INC.	18042301	04/23/2022	Biennial
Horn Antenna	WR-12 Horn Antenna	OML INC.	18042302	04/23/2022	Biennial
Horn Antenna	WR-08 Horn Antenna	OML INC.	18050101	04/23/2022	Biennial
Horn Antenna	WR-08 Horn Antenna	OML INC.	18050102	04/23/2022	Biennial
Horn Antenna	WR-05 Horn Antenna	OML INC.	18050101	04/23/2022	Biennial
Horn Antenna	WR-05 Horn Antenna	OML INC.	18050102	04/23/2022	Biennial
Harmonic Mixer	WR-5	VDI	SAX774	04/02/2022	Annual
Harmonic Mixer	WR-8	VDI	SAX779	04/02/2022	Annual
Harmonic Mixer	WR-12	VDI	SAX773	04/02/2022	Annual
Harmonic Mixer	WR-19	VDI	SAX771	03/17/2022	Annual
Source Module	WR-19	OML INC.	S19MS-A-160516-1	09/02/2022	Annual
Source Module	WR-12	OML INC.	S12MS-A-160419-1	09/02/2022	Annual
Source Module	WR-08	OML INC.	S08MS-A-160419-1	09/02/2022	Annual
Source Module	WR-05	OML INC.	S05MS-A-160419-1	09/02/2022	Annual
Temperature and Humidity Chamber	NY-THR18750	NANGYEUL CO., LTD.	NY-2009012201A	01/14/2022	Annual
Signal Generator	SMV100A	Rohde & Schwarz	177633	07/05/2022	Annual

Note:

- Equipment listed above that calibrated during the testing period was set for test after the calibration.
- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. TEST RESULT

5.1. OCCUPIED BANDWIDTH

FCC Rules

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

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

Test Procedures:

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

5.4.3 Occupied bandwidth—Relative measurement procedure

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
- b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

- d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “–X dB” requirement, i.e., if the requirement calls for measuring the –26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
- e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
- f) Determine the reference value by either of the following:
 - 1) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
 - 2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.
- g) Determine the “–X dB amplitude” as equal to (Reference Value – X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.
- h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used for step i).
- i) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “–X dB amplitude” determined in step f). If a marker is below this “–X dB amplitude” value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers. The spectral envelope can cross the “–X dB amplitude” at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the “–X dB amplitude.”
- j) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

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

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).
- b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall

be set $\geq 3 \times \text{RBW}$.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

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

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

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

Test Results:

Tabular Data of Occupied Bandwidth

1. Contiguous

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)
A	45°	1	Low	QPSK	94.158
				16QAM	94.132
				64QAM	94.370
		4		QPSK	391.996
				16QAM	391.016
				64QAM	391.583
B	135°	1		QPSK	94.475
				16QAM	94.023
				64QAM	94.111
		4		QPSK	391.478
				16QAM	391.795
				64QAM	391.425
A	45°	1	Middle	QPSK	94.158
				16QAM	93.940
				64QAM	94.228
		4		QPSK	391.246
				16QAM	391.424
				64QAM	390.987
B	135°	1		QPSK	94.116
				16QAM	94.113
				64QAM	94.160
		4		QPSK	391.211
				16QAM	391.120
				64QAM	391.252

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)
A	45°	1	High	QPSK	94.246
				16QAM	94.108
				64QAM	94.190
		4		QPSK	391.045
				16QAM	390.512
				64QAM	391.427
B	135°	1		QPSK	94.223
				16QAM	94.266
				64QAM	94.454
		4		QPSK	391.545
				16QAM	391.611
				64QAM	391.415

2. Non-Contiguous

1+3_Low

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	135°	1+3	Low	QPSK	94.192	291.677	385.869
				16QAM	94.099	291.565	385.664
				64QAM	94.324	291.420	385.744
B	45°	1+3		QPSK	94.070	291.795	385.865
				16QAM	94.061	292.009	386.070
				64QAM	94.454	291.237	385.691

1+3_High

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	135°	1+3	High	QPSK	94.207	291.904	386.111
				16QAM	94.239	291.931	386.170
				64QAM	94.511	291.823	386.334
B	45°	1+3		QPSK	94.275	291.822	386.096
				16QAM	94.354	291.979	386.333
				64QAM	94.487	290.718	385.205

3+1_Low

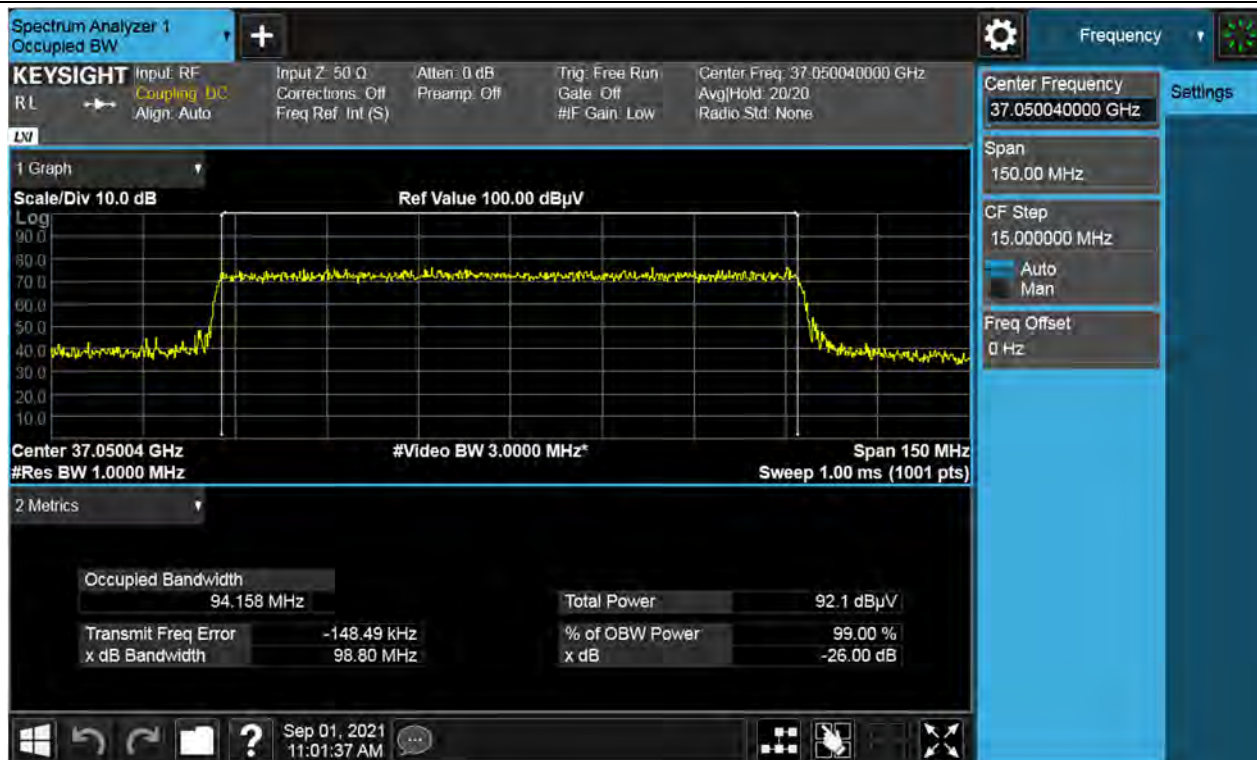
Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	135°	3+1	Low	QPSK	291.413	94.226	385.639
				16QAM	291.704	94.259	385.964
				64QAM	292.064	94.205	386.270
B	45°	3+1		QPSK	291.545	94.072	385.617
				16QAM	291.991	94.079	386.070
				64QAM	292.248	94.108	386.355

3+1_High

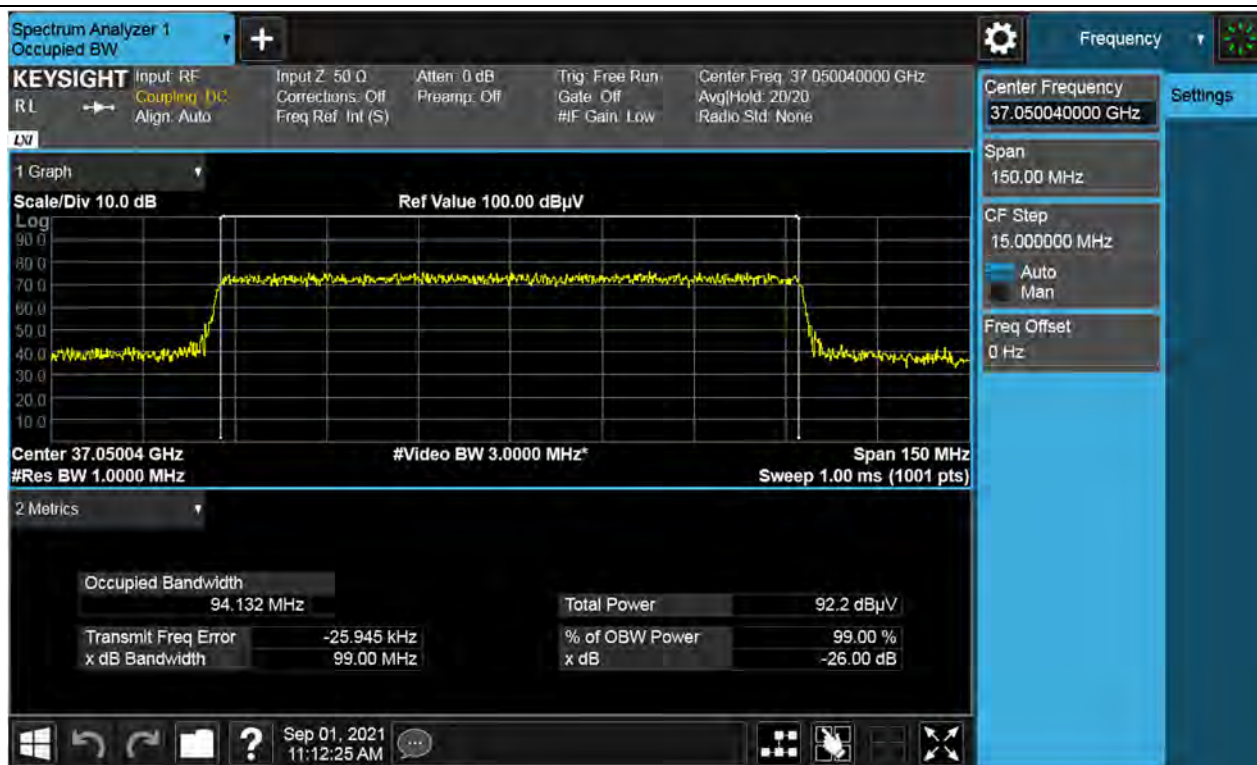
Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	135°	3+1	High	QPSK	292.337	94.127	386.463
				16QAM	292.213	94.243	386.456
				64QAM	291.951	94.266	386.218
B	45°	3+1		QPSK	292.131	94.175	386.306
				16QAM	292.250	94.220	386.470
				64QAM	292.317	94.317	386.634

Plot Data of RF Occupied Bandwidth

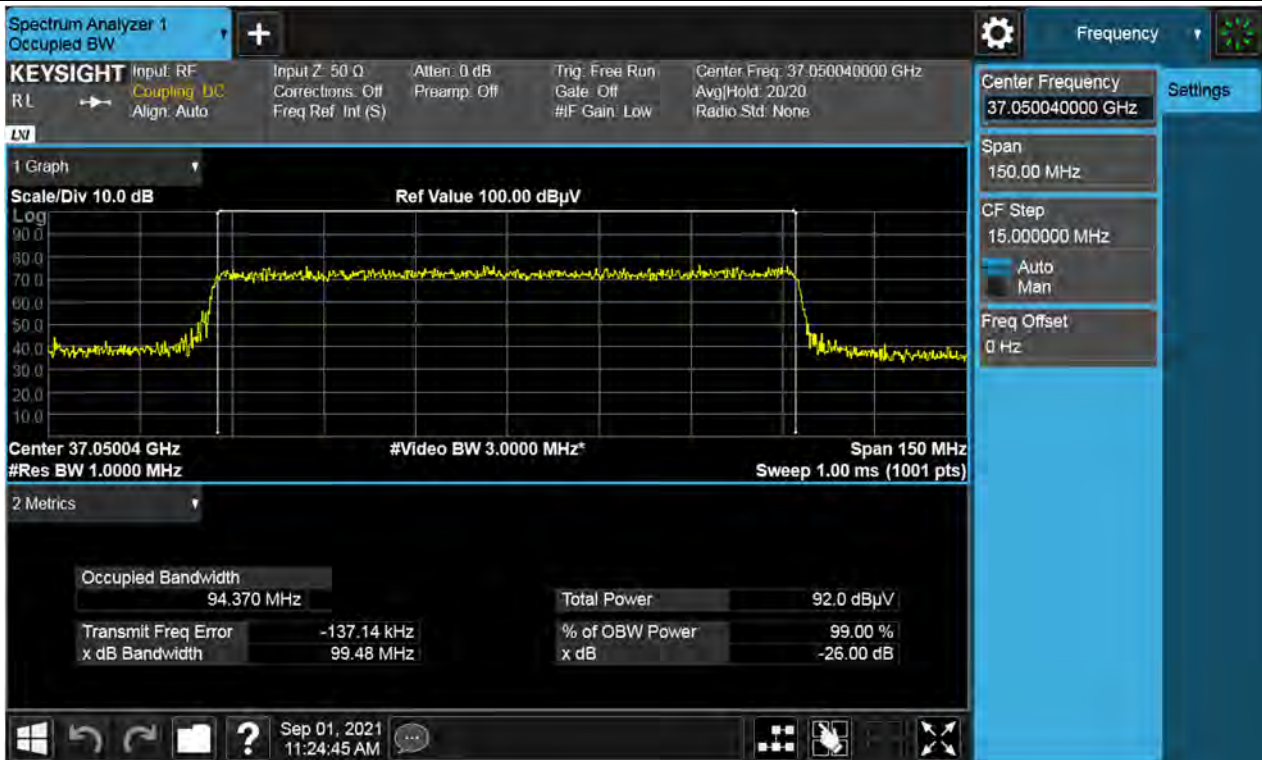
Antenna A / 1cc / QPSK / Low



Antenna A / 1cc / 16QAM / Low



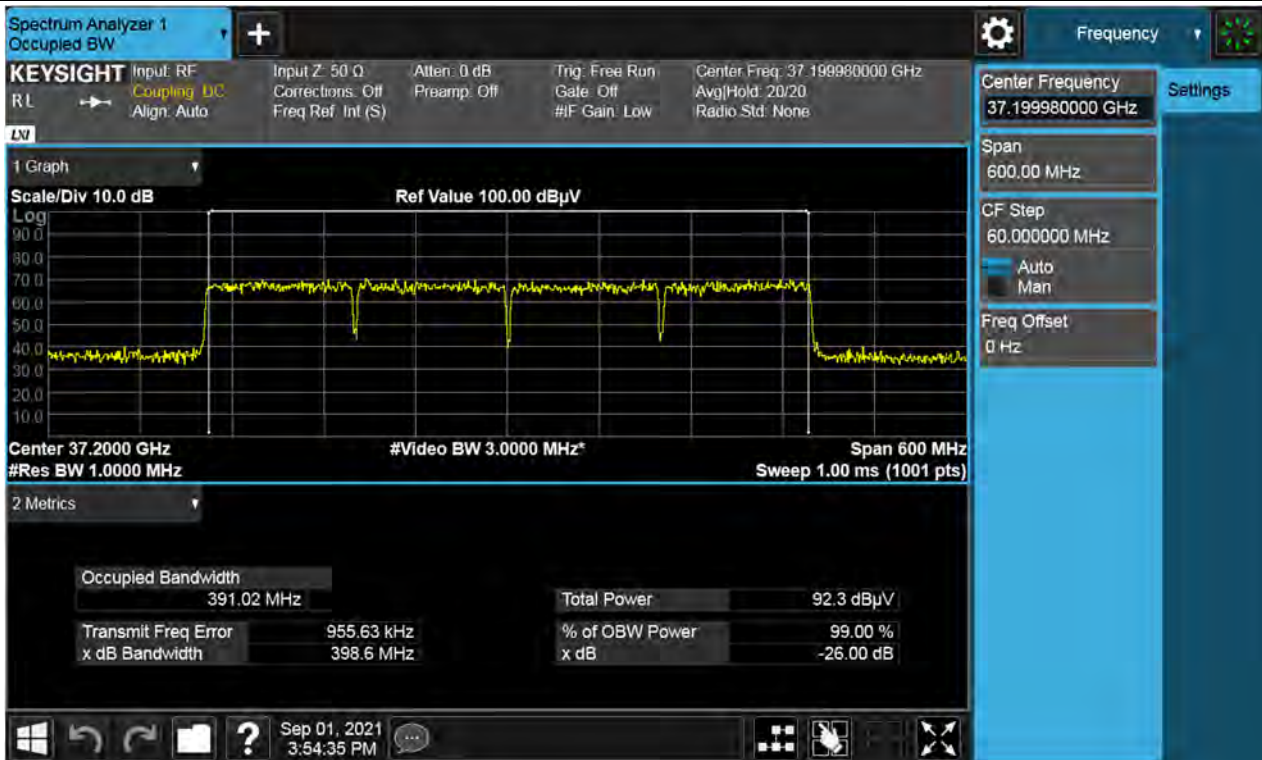
Antenna A / 1cc / 64QAM / Low



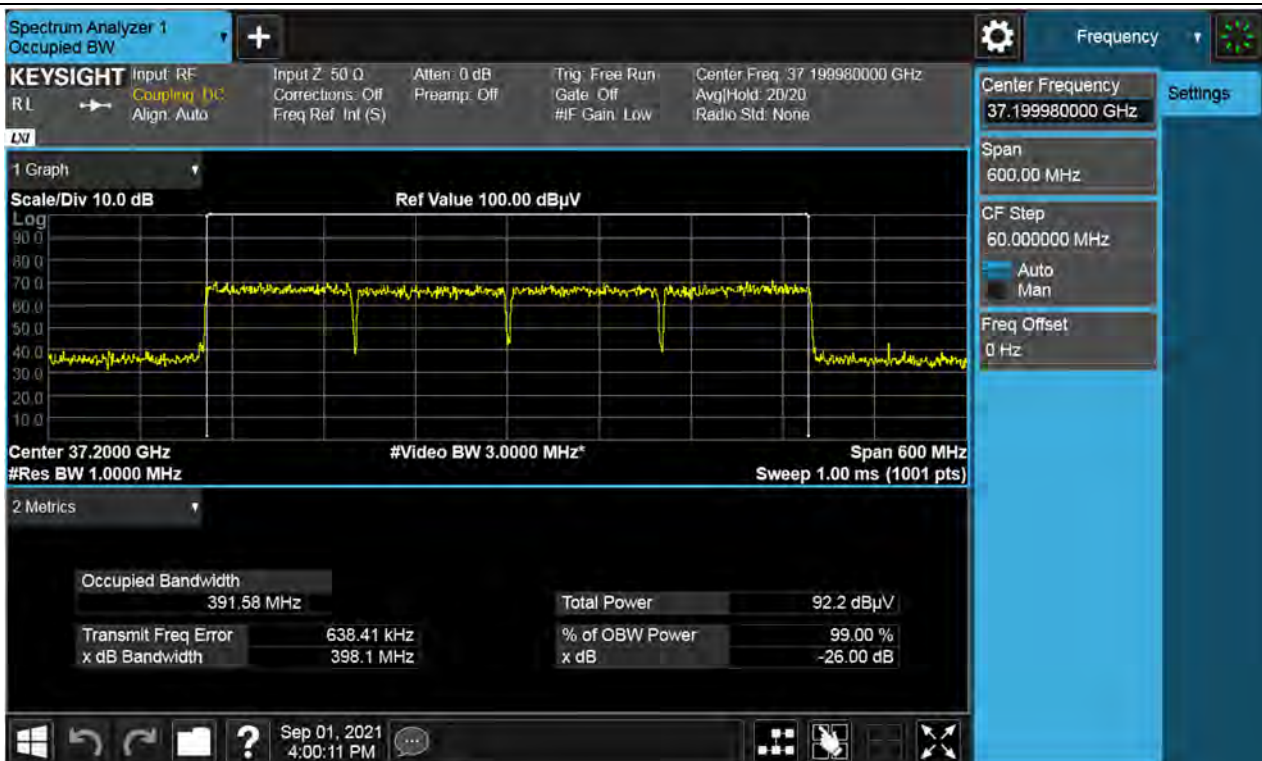
Antenna A / 4cc / QPSK / Low



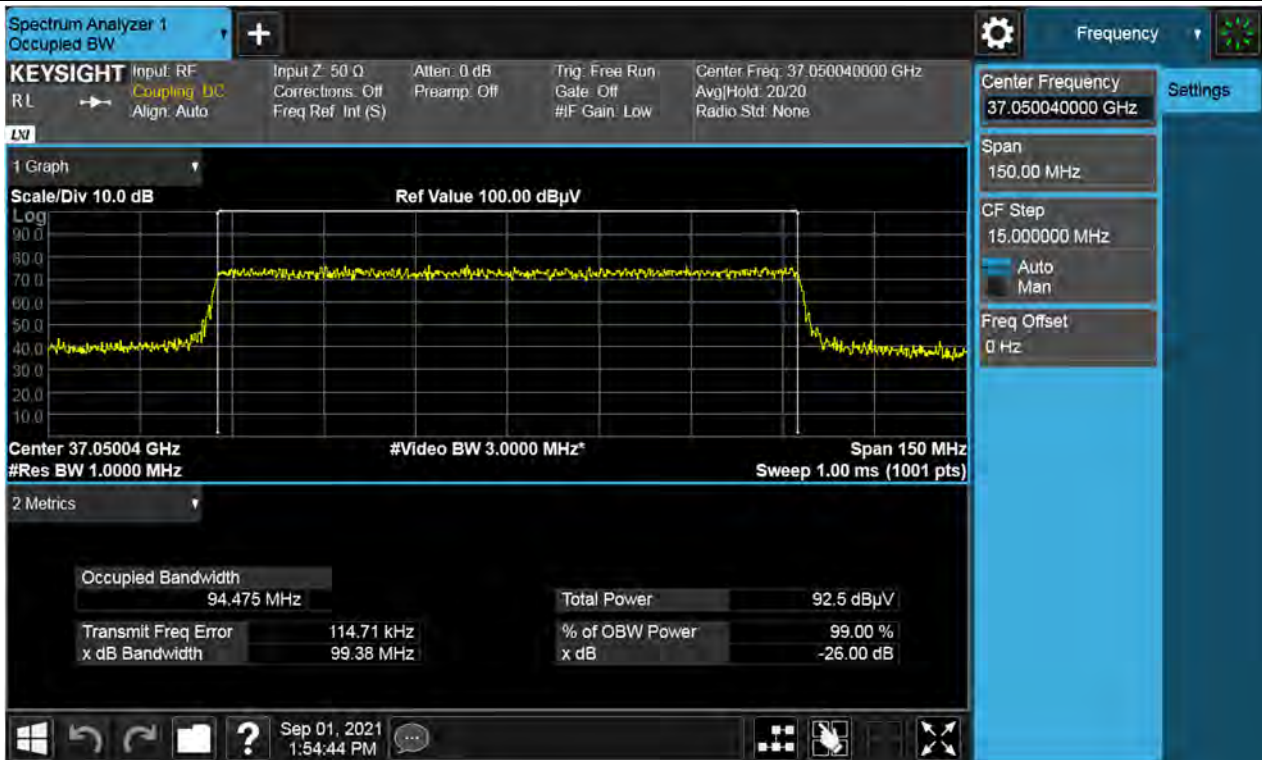
Antenna A / 4cc / 16QAM / Low



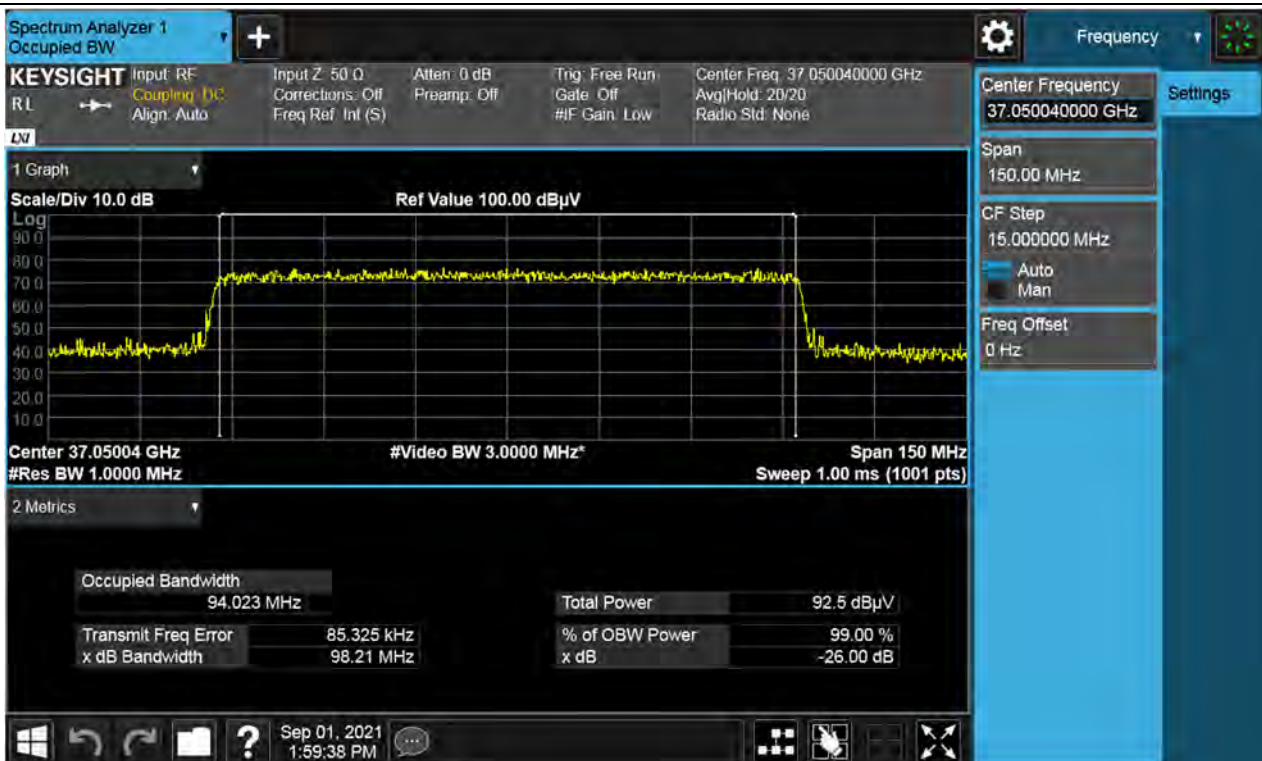
Antenna A / 4cc / 64QAM / Low



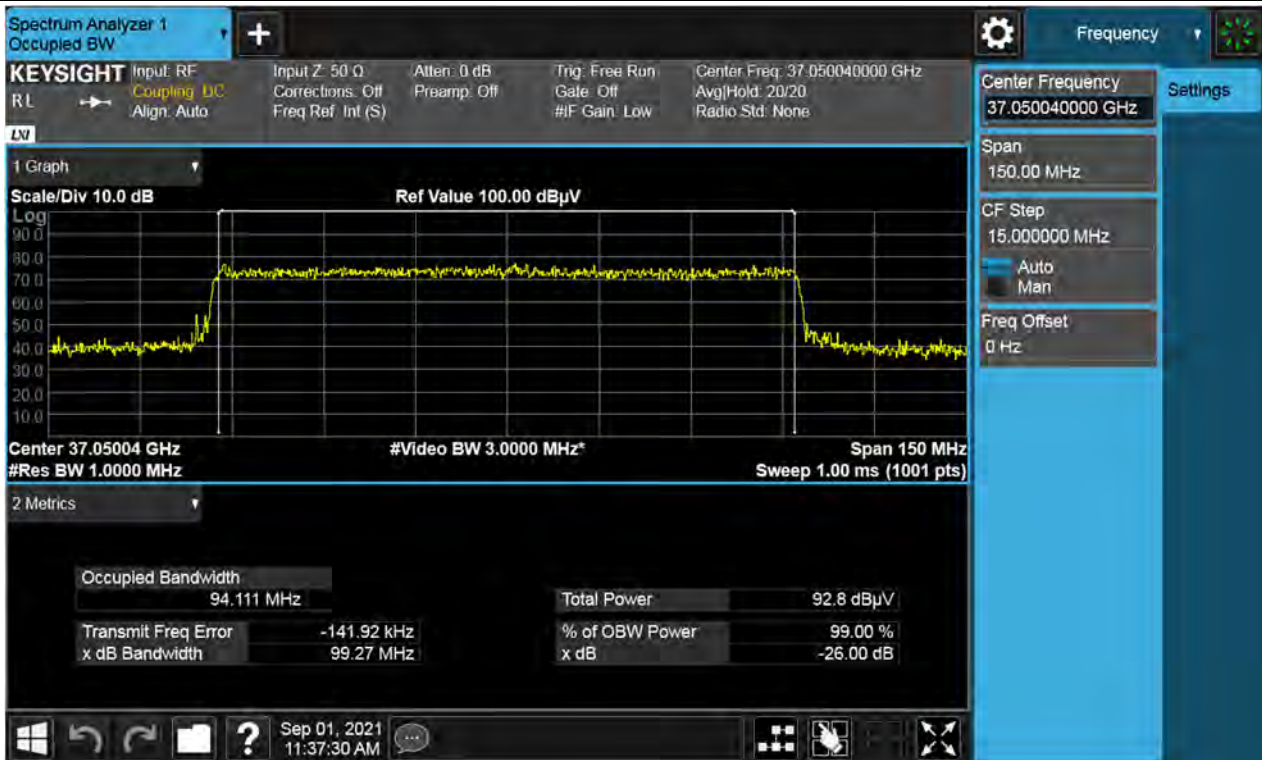
Antenna B / 1cc / QPSK / Low



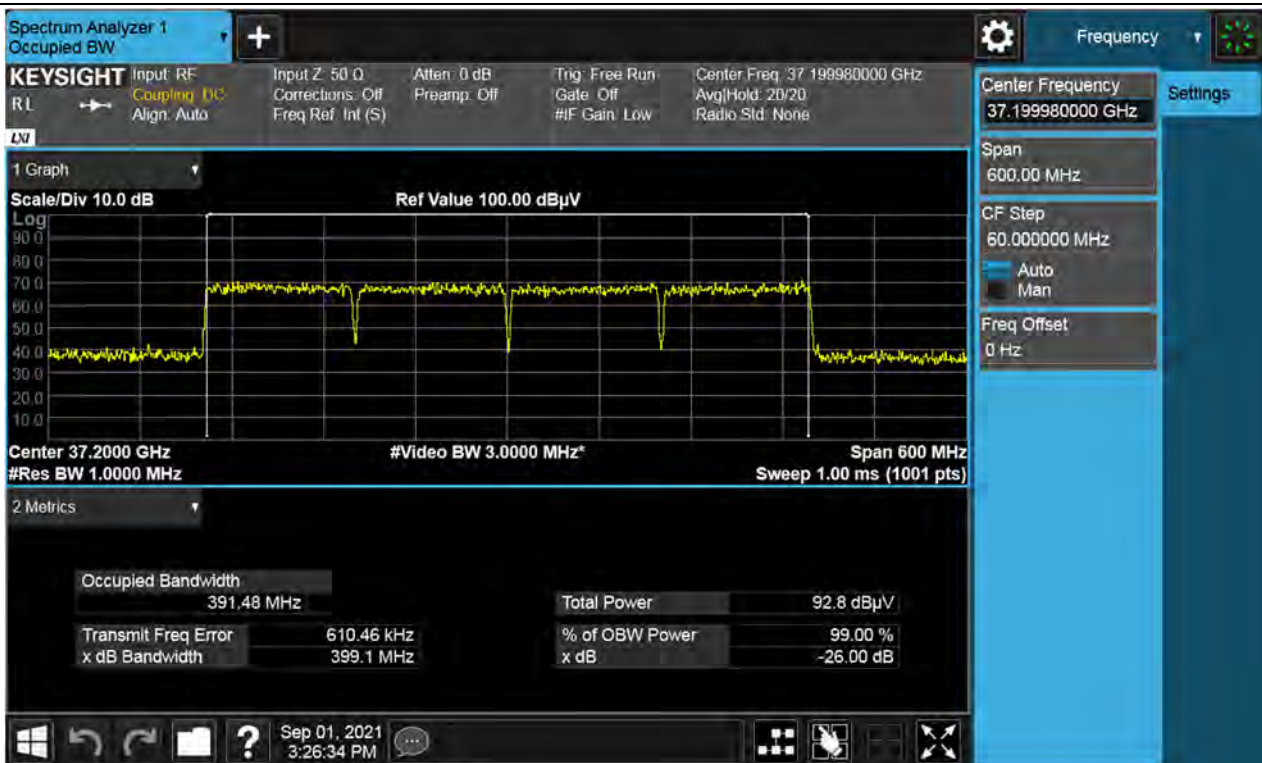
Antenna B / 1cc / 16QAM / Low



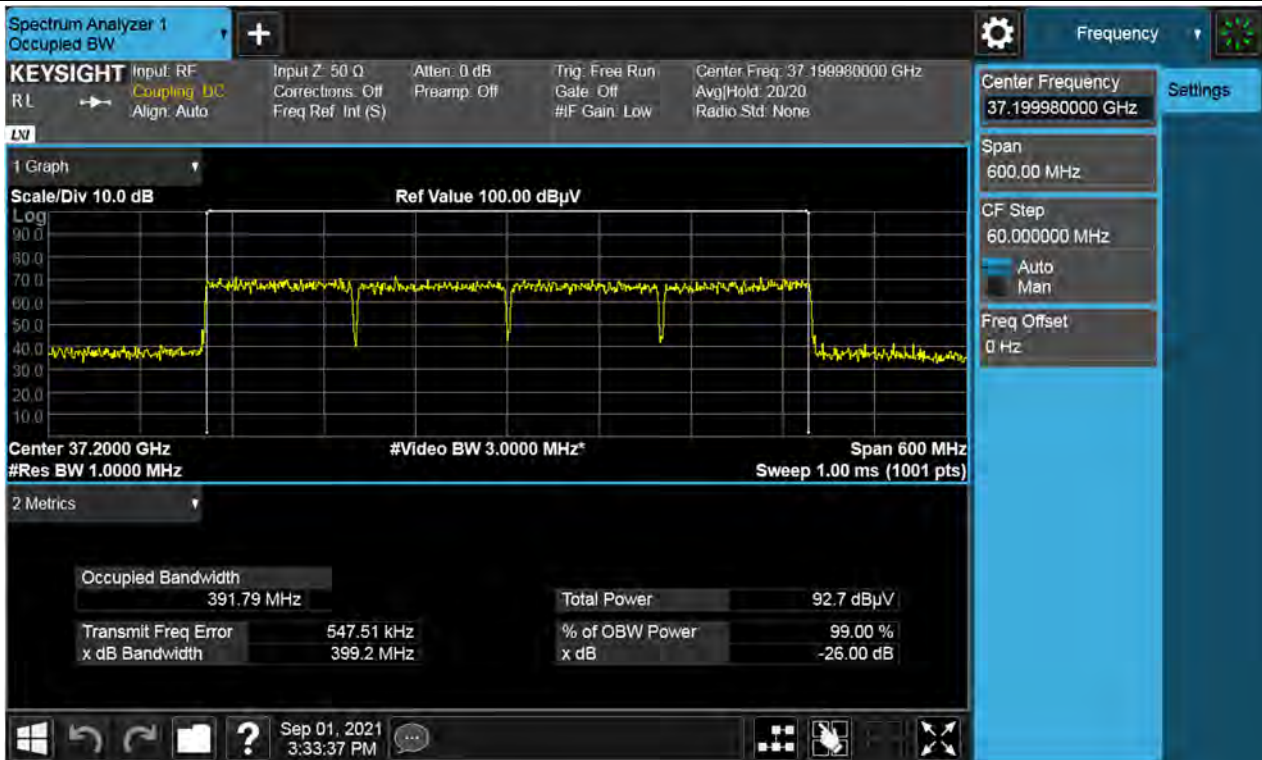
Antenna B / 1cc / 64QAM / Low



Antenna B / 4cc / QPSK / Low



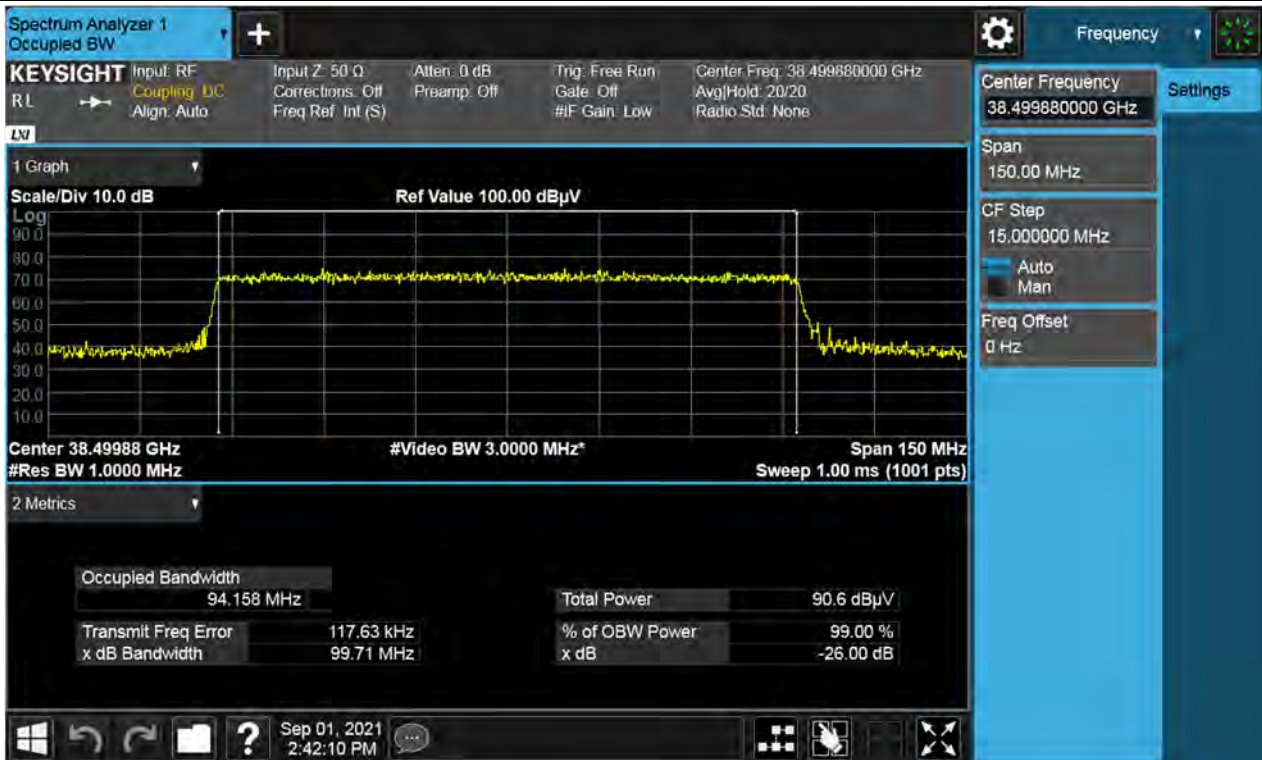
Antenna B / 4cc / 16QAM / Low



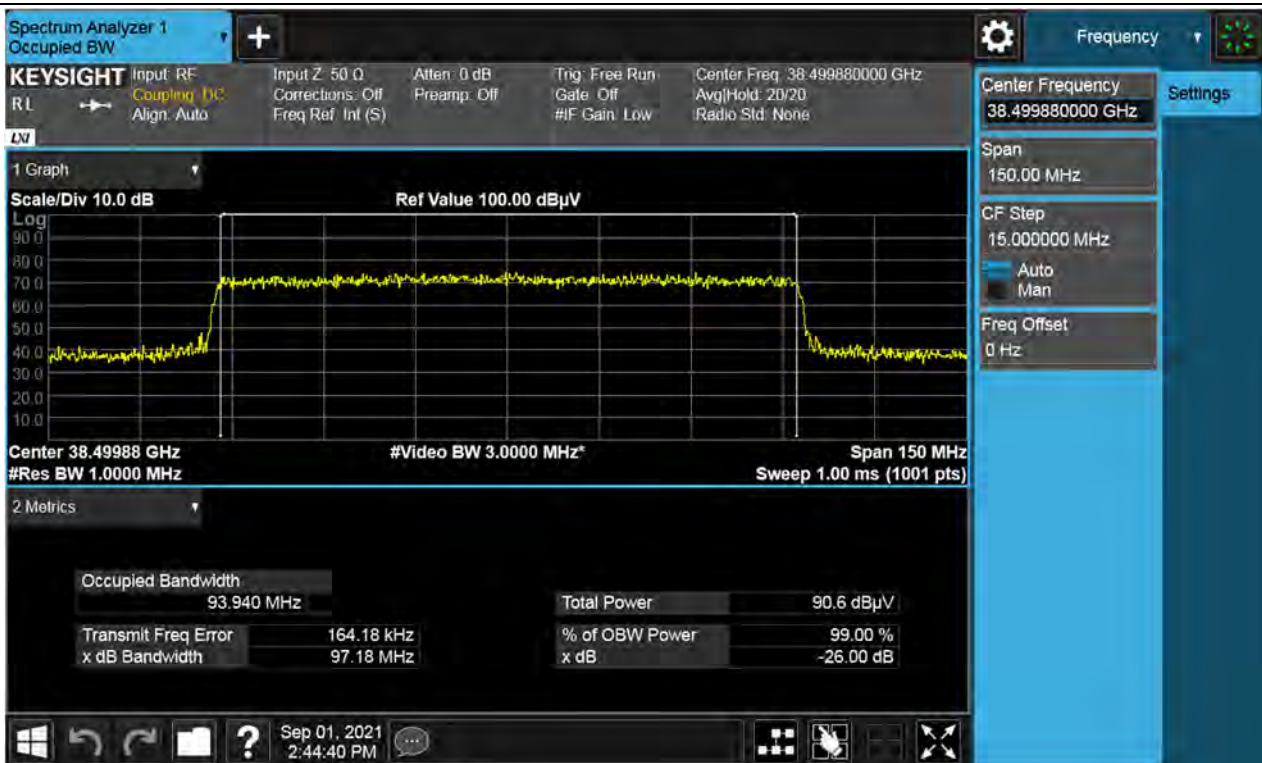
Antenna B / 4cc / 64QAM / Low



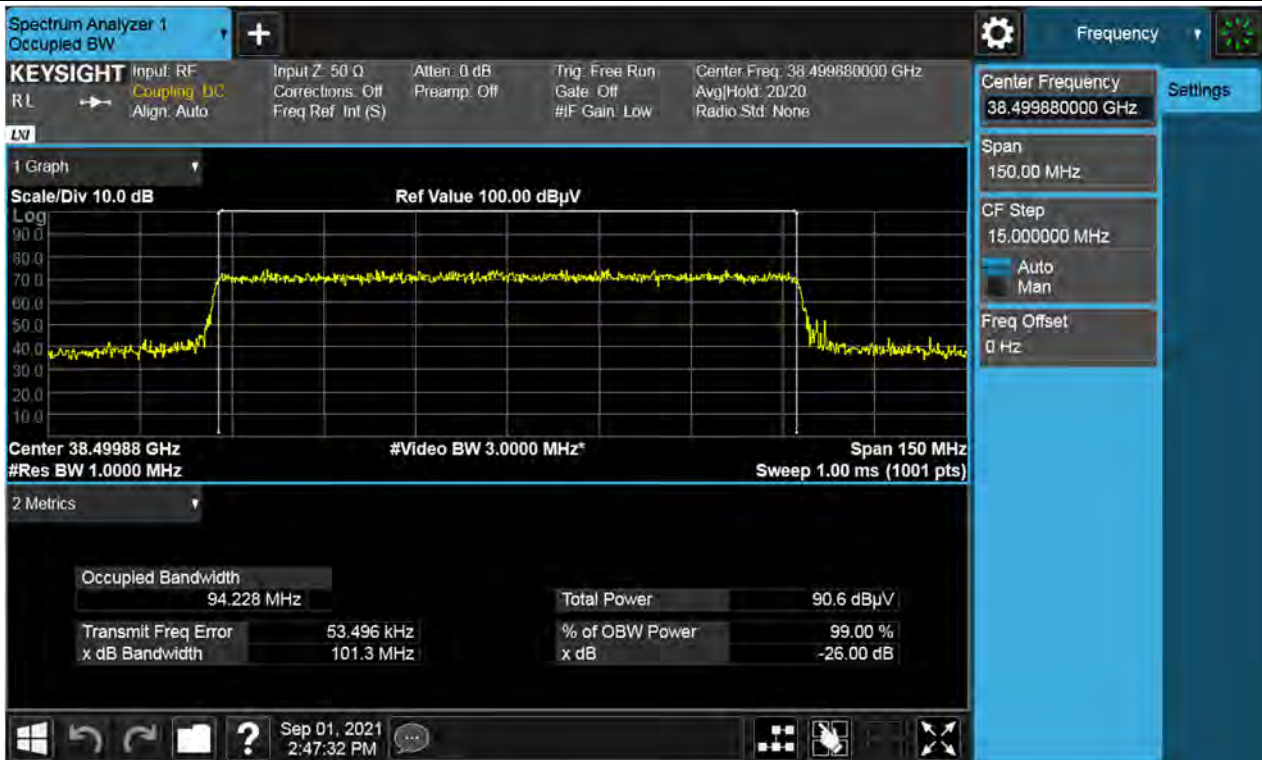
Antenna A / 1cc / QPSK / Middle



Antenna A / 1cc / 16QAM / Middle



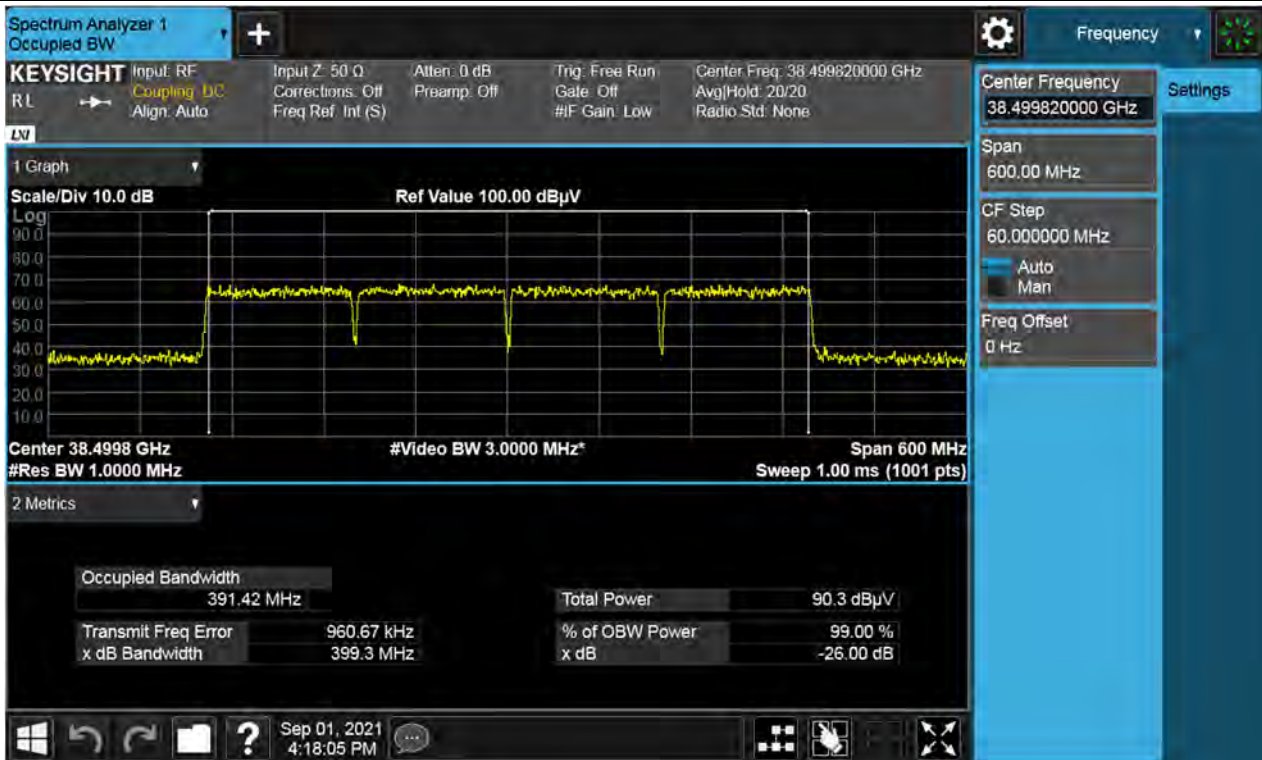
Antenna A / 1cc / 64QAM / Middle



Antenna A / 4cc / QPSK / Middle



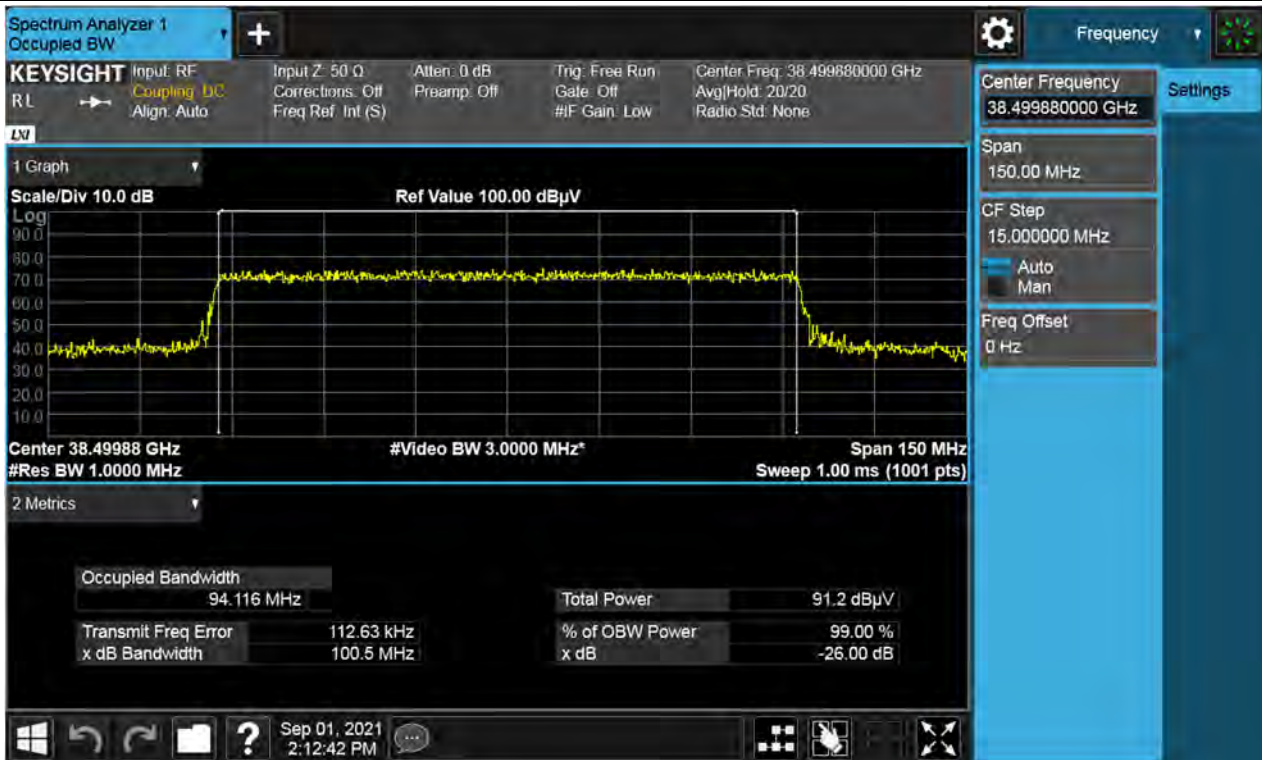
Antenna A / 4cc / 16QAM / Middle



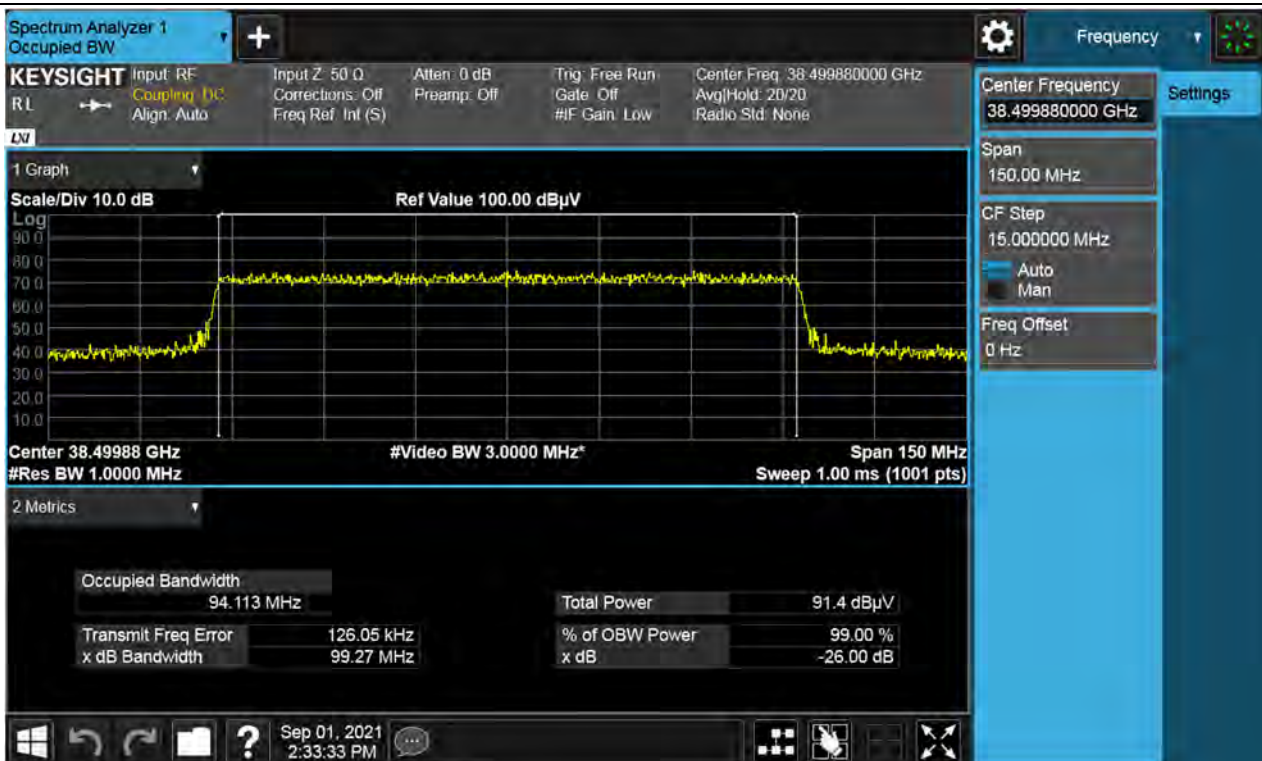
Antenna A / 4cc / 64QAM / Middle



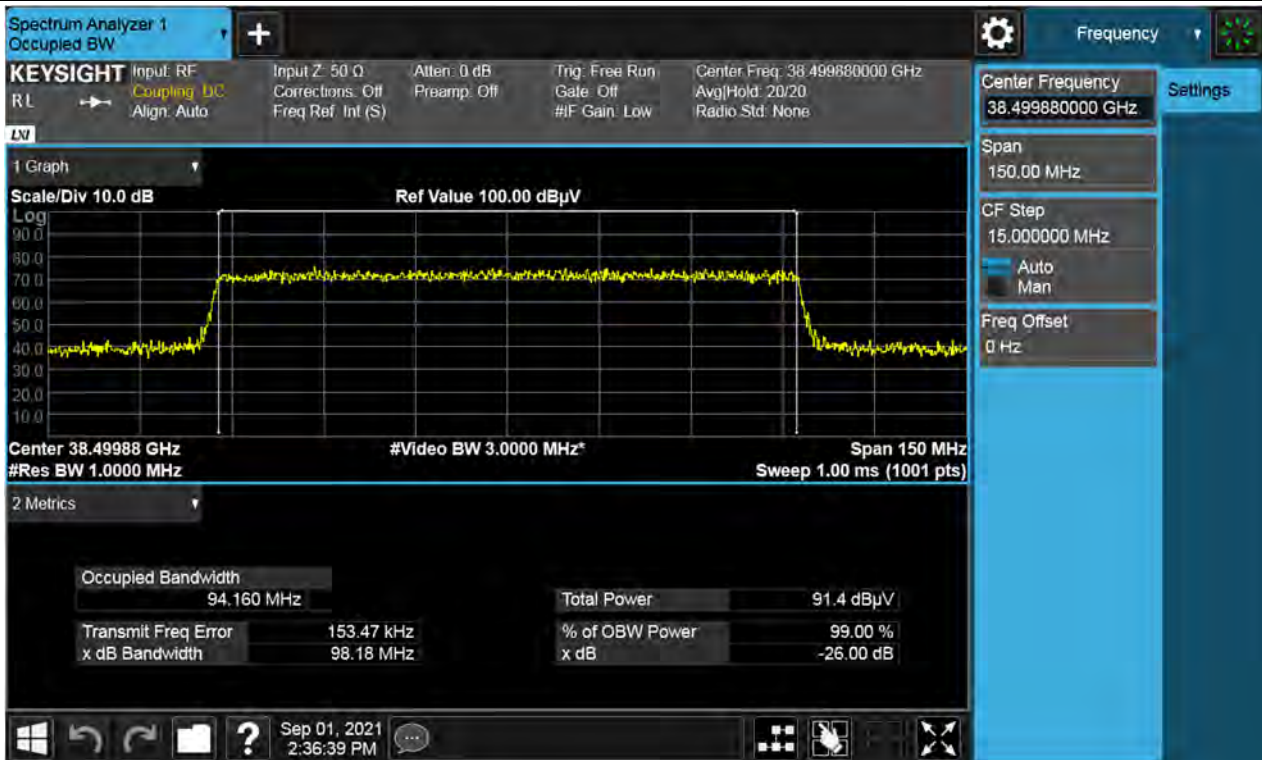
Antenna B / 1cc / QPSK / Middle



Antenna B / 1cc / 16QAM / Middle



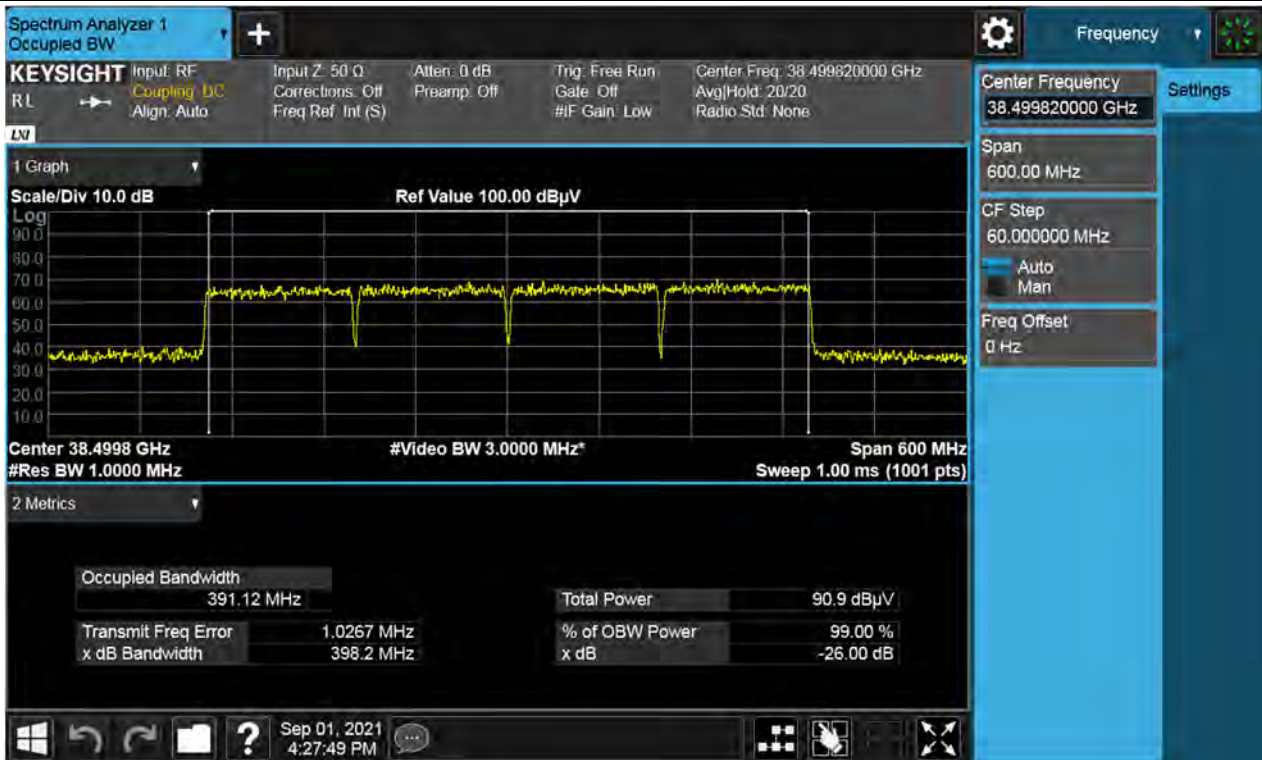
Antenna B / 1cc / 64QAM / Middle



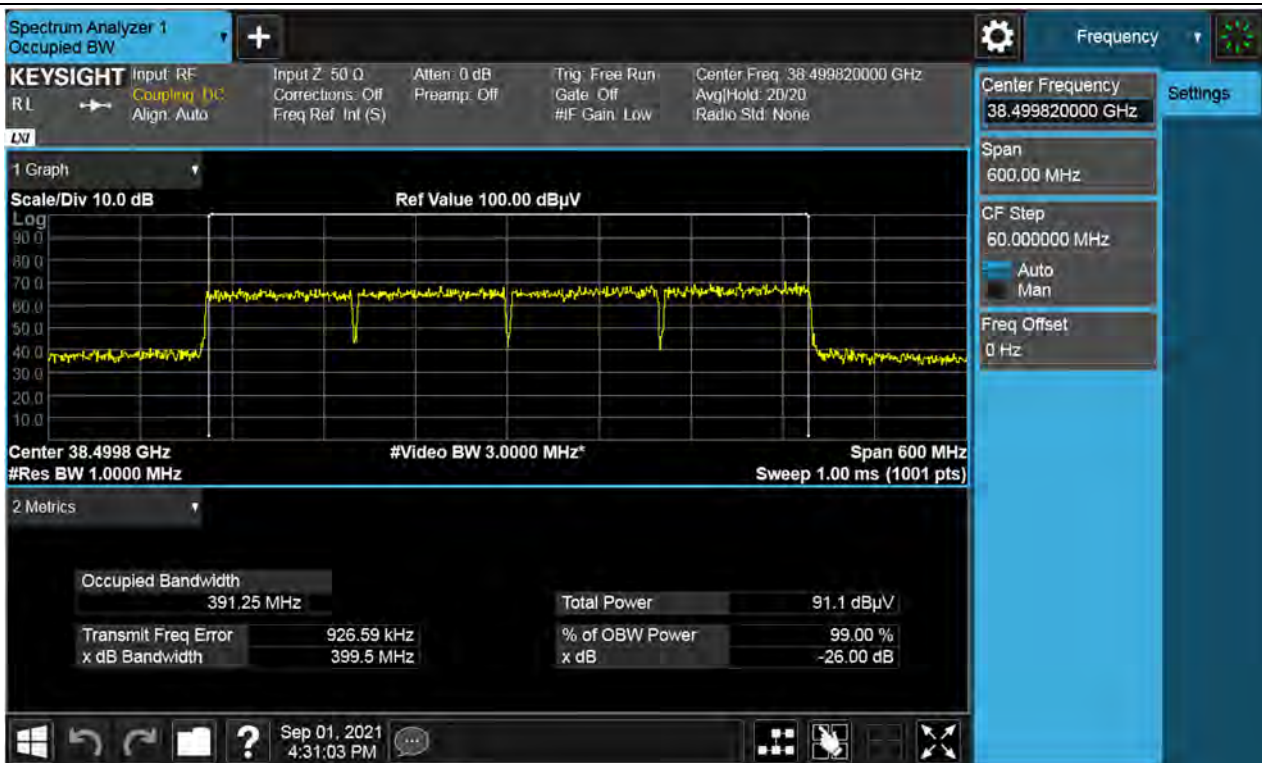
Antenna B / 4cc / QPSK / Middle



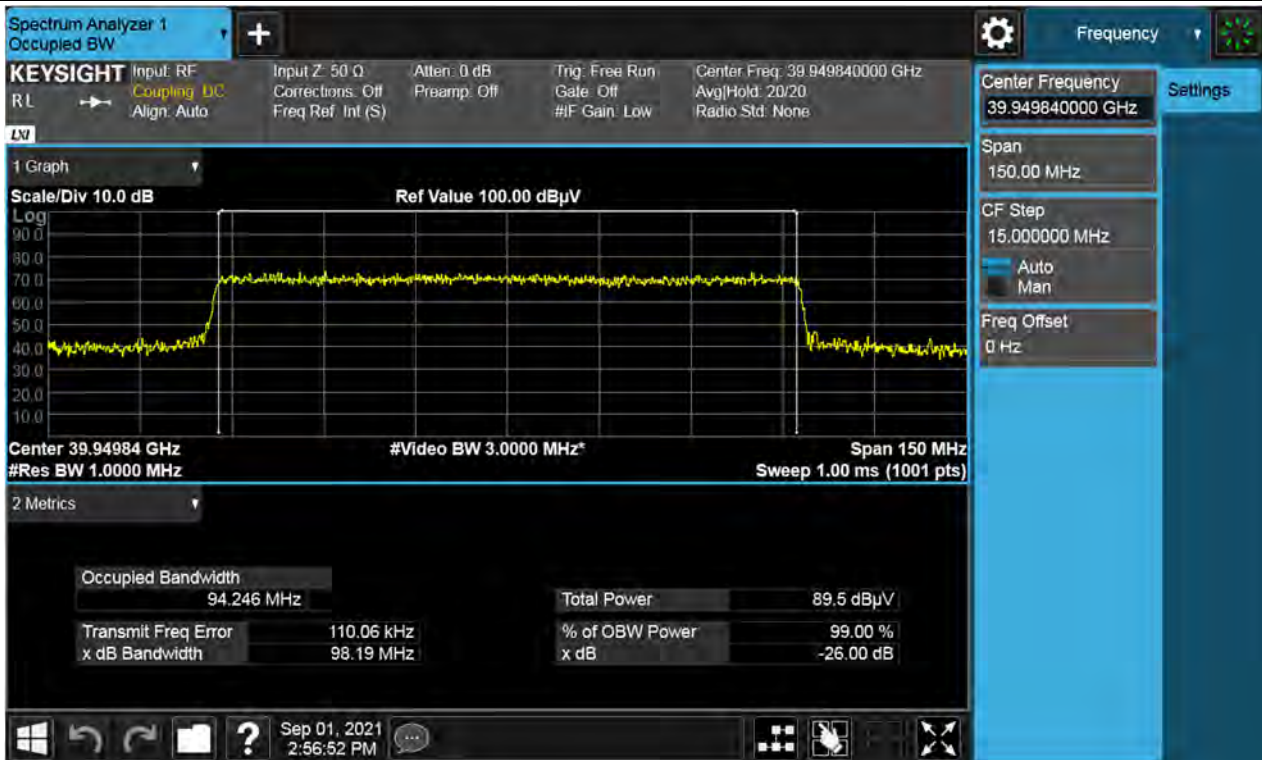
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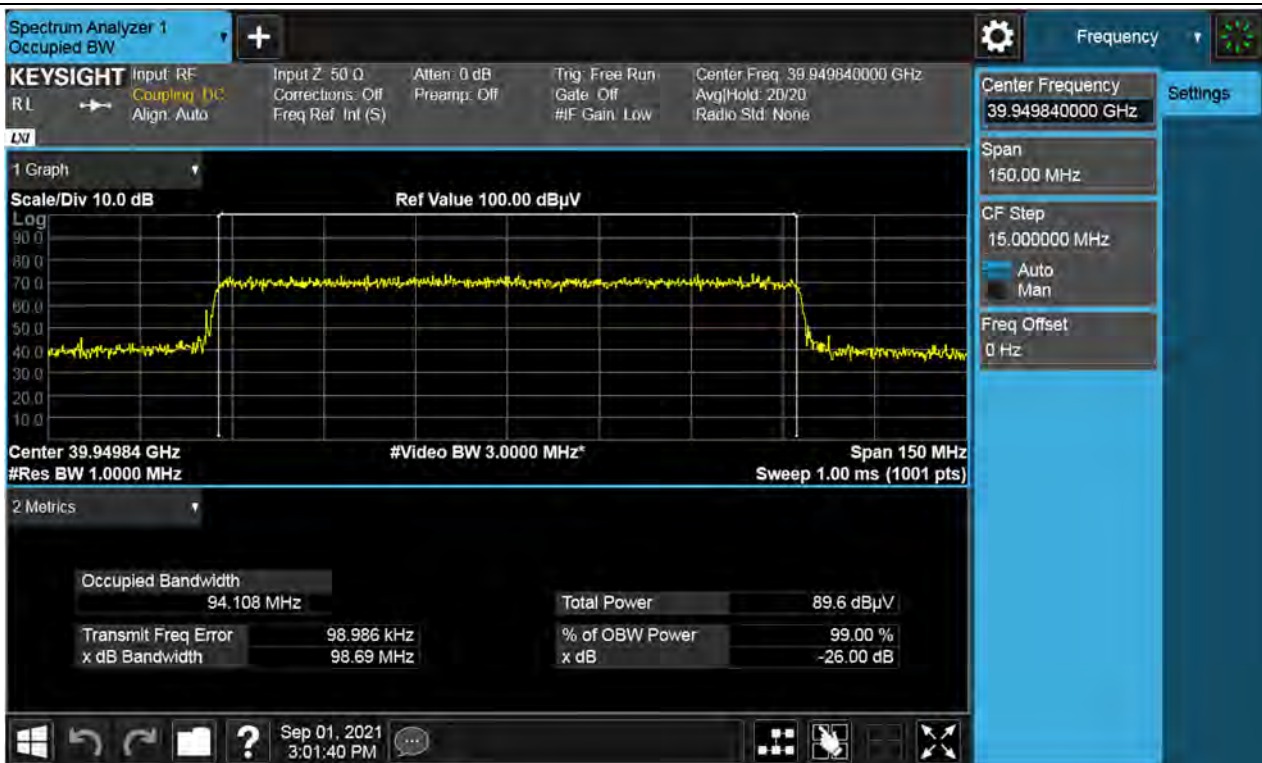
Antenna B / 4cc / 64QAM / Middle



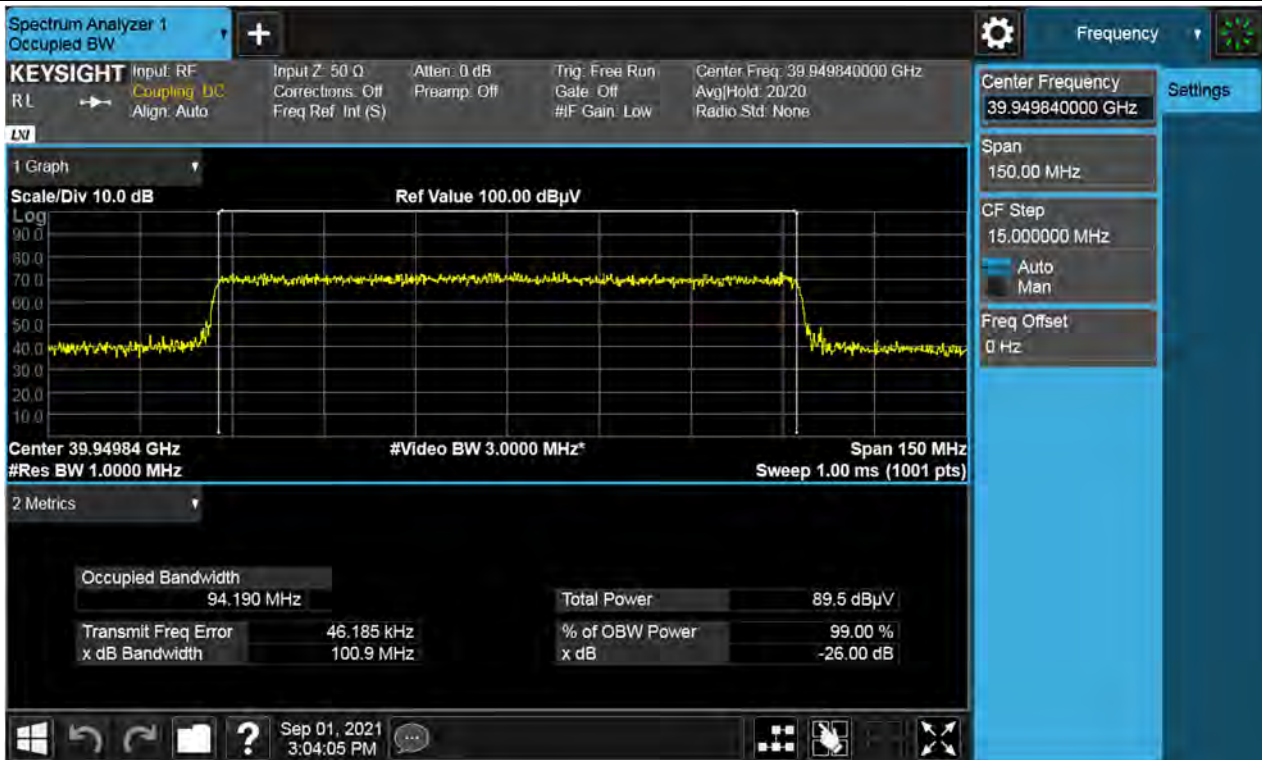
Antenna A / 1cc / QPSK / High



Antenna A / 1cc / 16QAM / High



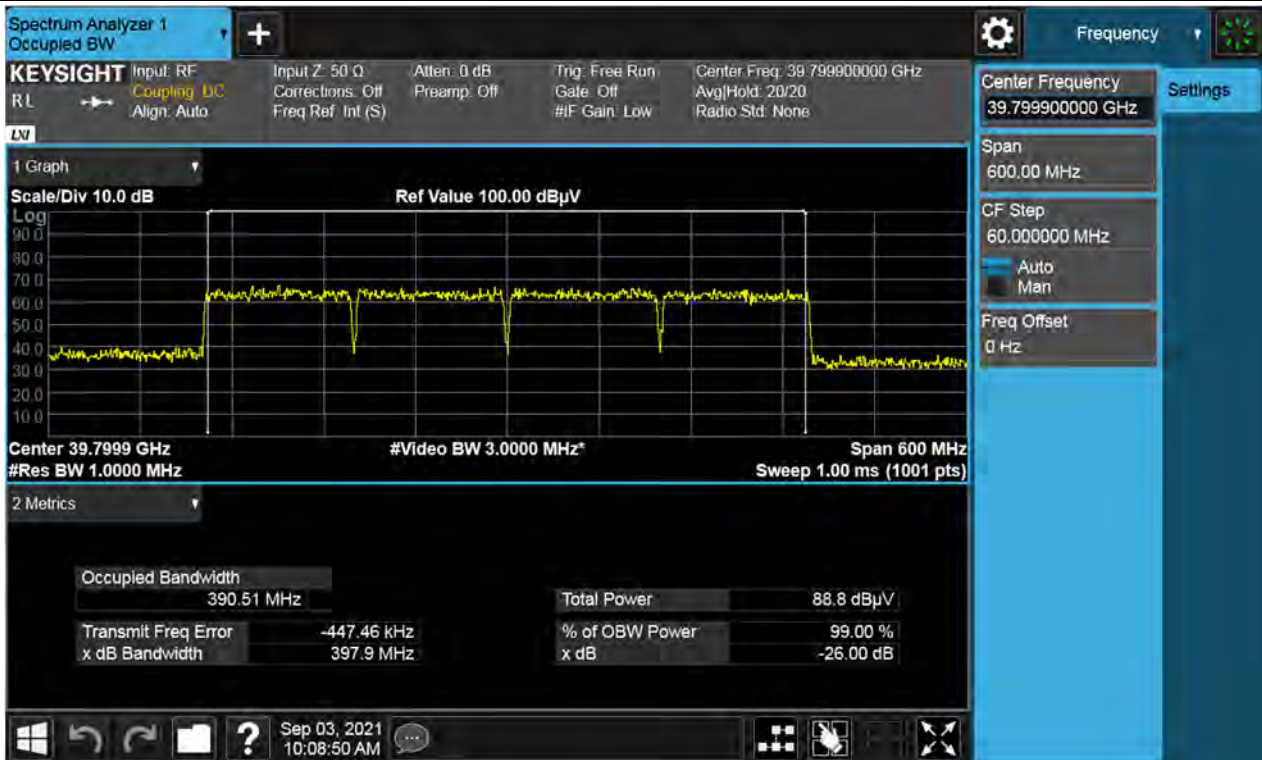
Antenna A / 1cc / 64QAM / High



Antenna A / 4cc / QPSK / High



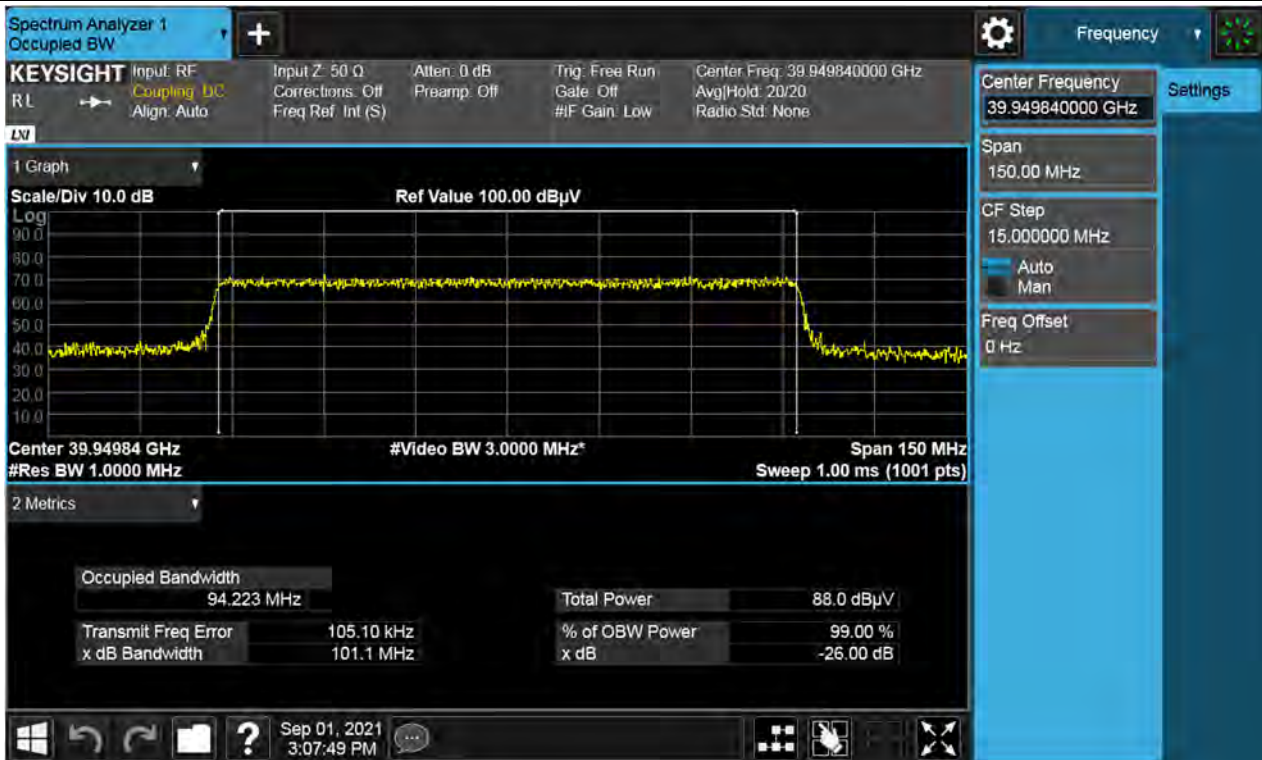
Antenna A / 4cc / 16QAM / High



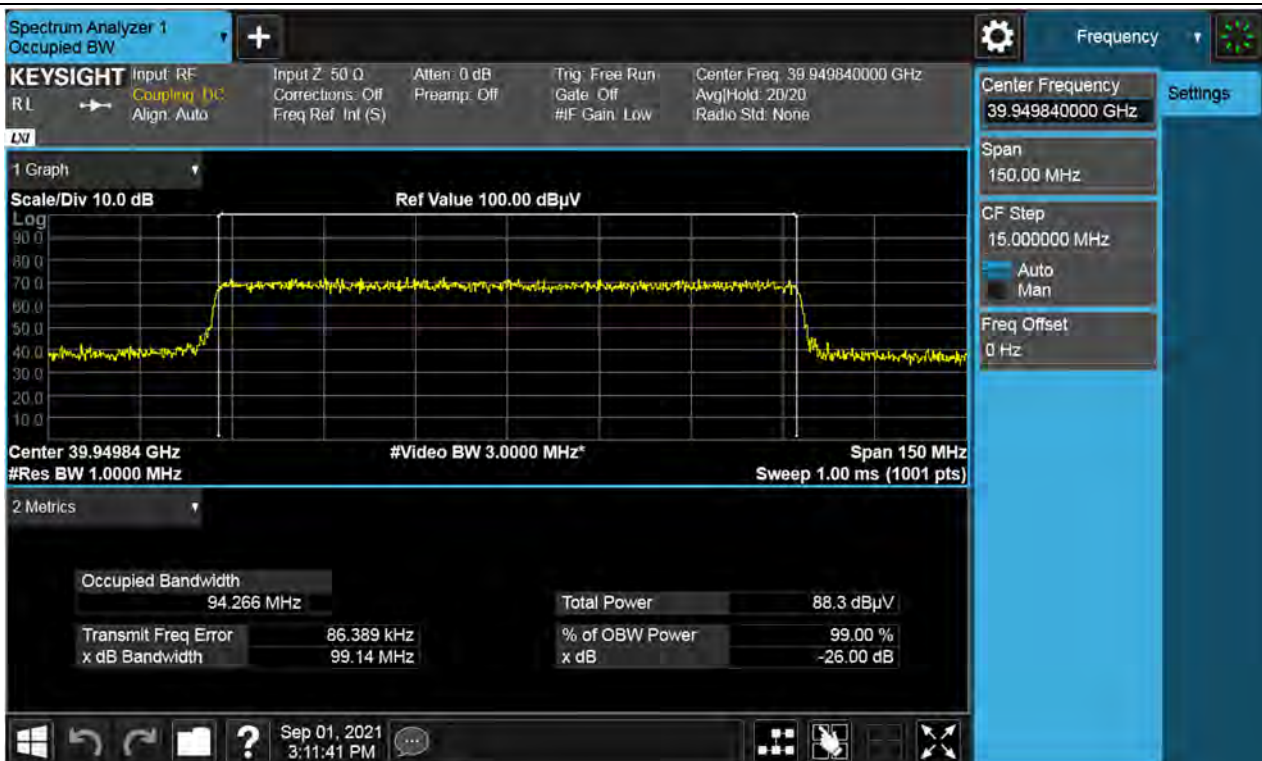
Antenna A / 4cc / 64QAM / High



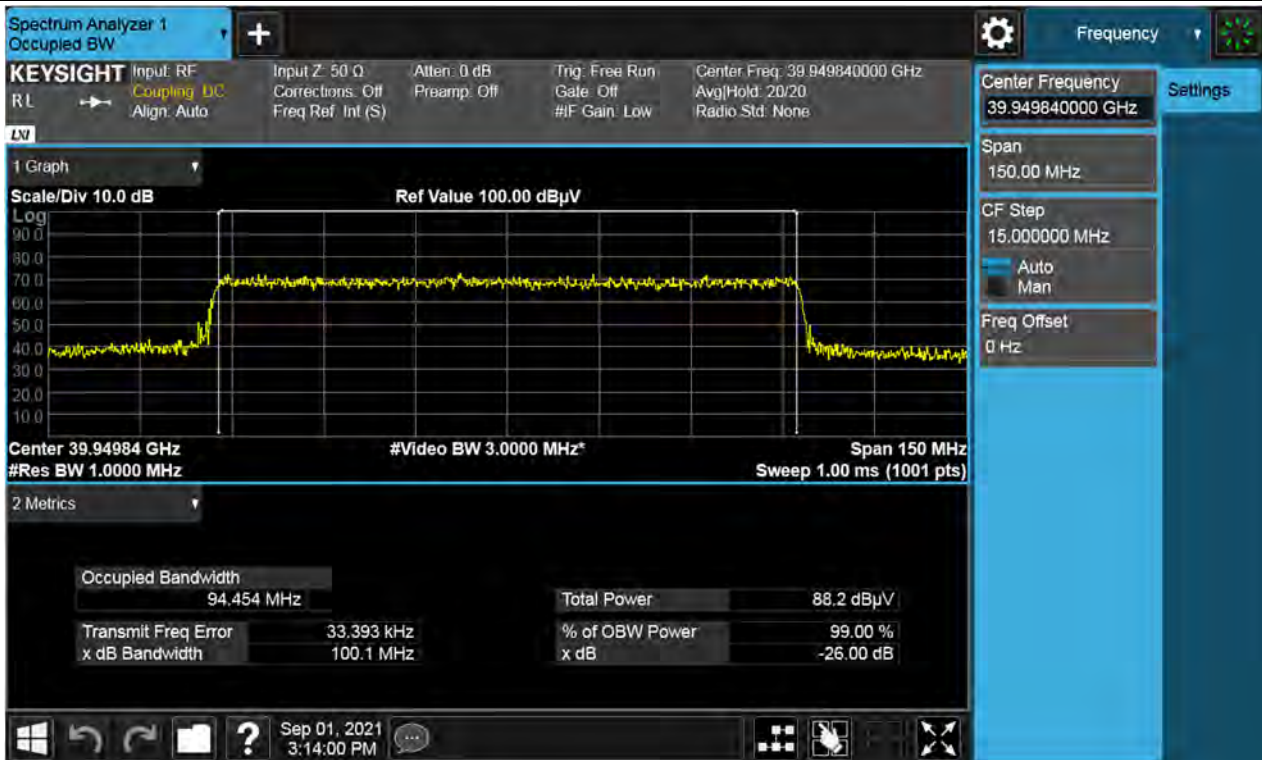
Antenna B / 1cc / QPSK / High



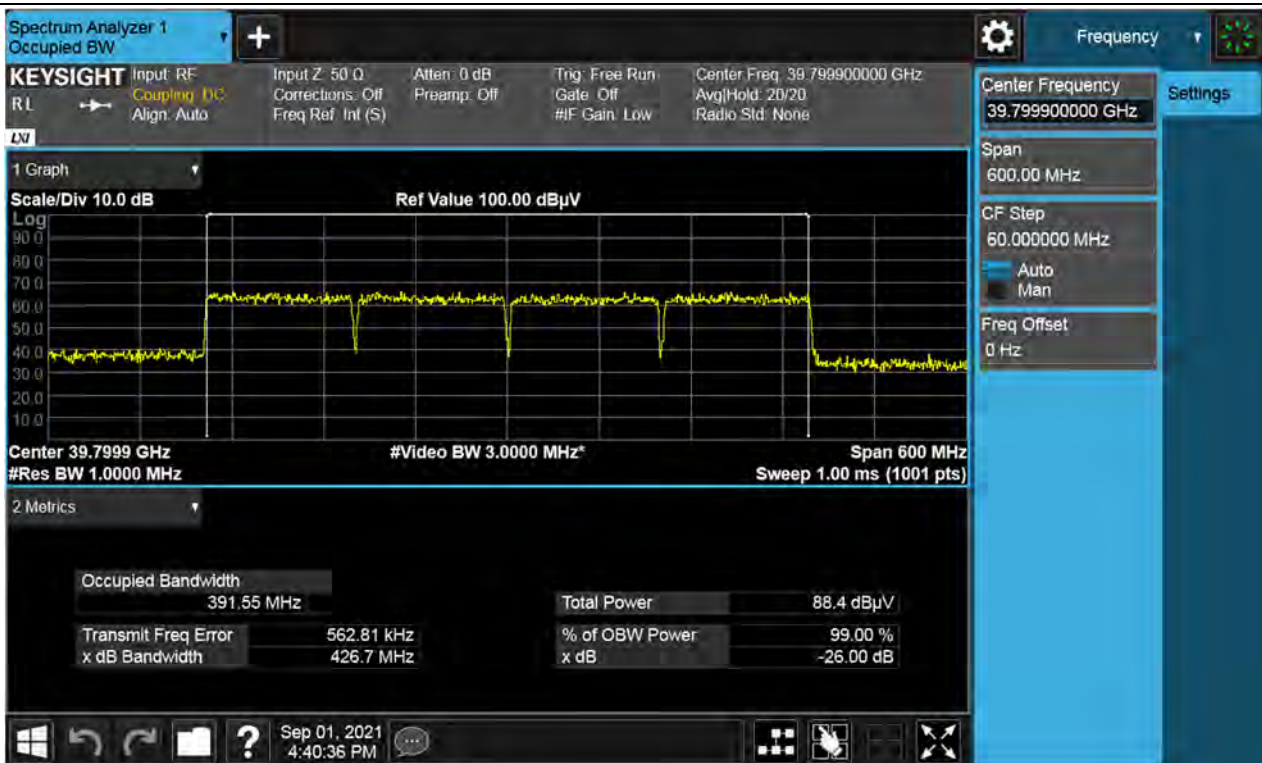
Antenna B / 1cc / 16QAM / High



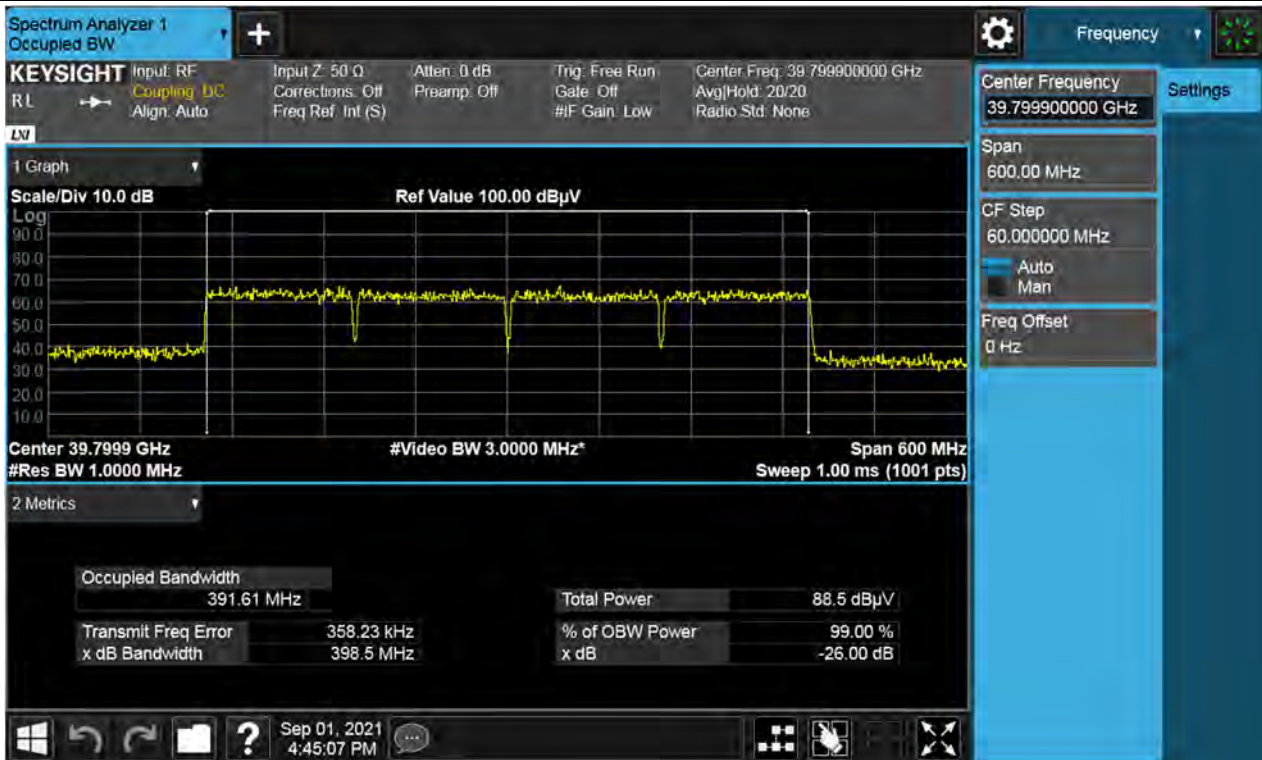
Antenna B / 1cc / 64QAM / High



Antenna B / 4cc / QPSK / High



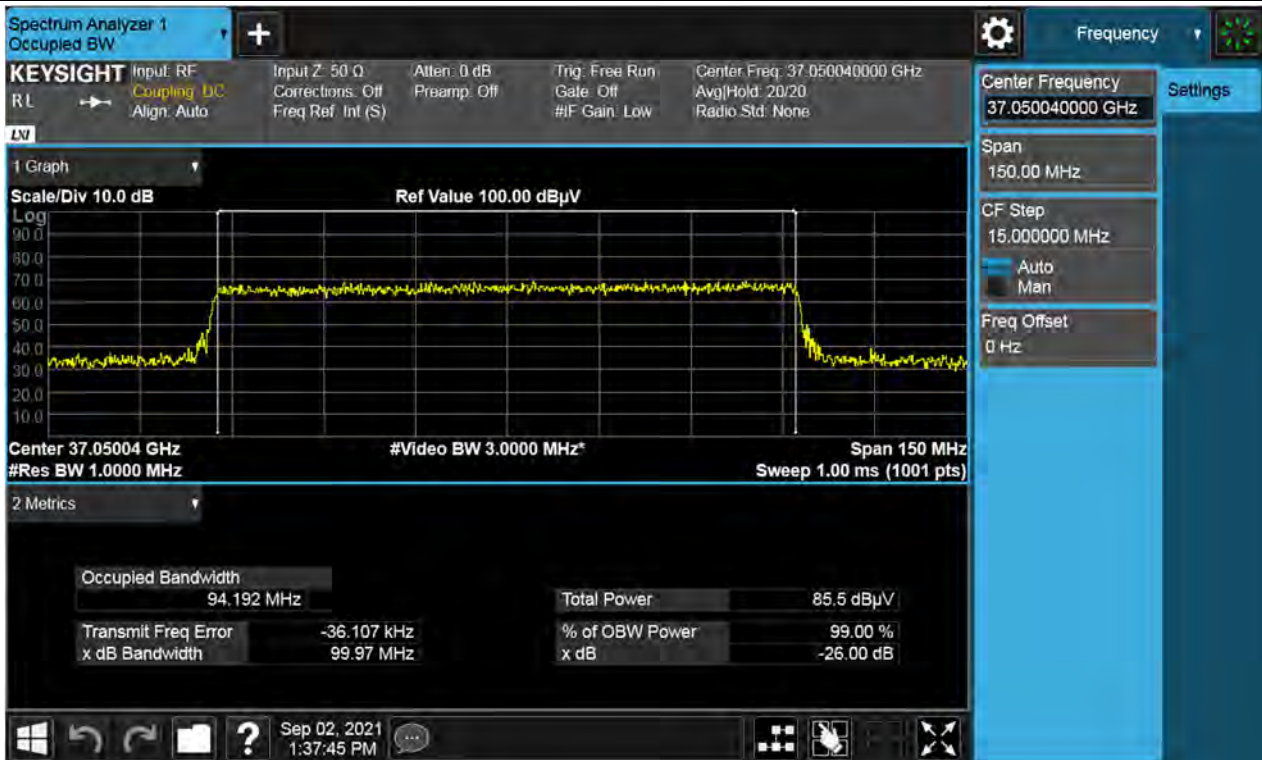
Antenna B / 4cc / 16QAM / High



Antenna B / 4cc / 64QAM / High



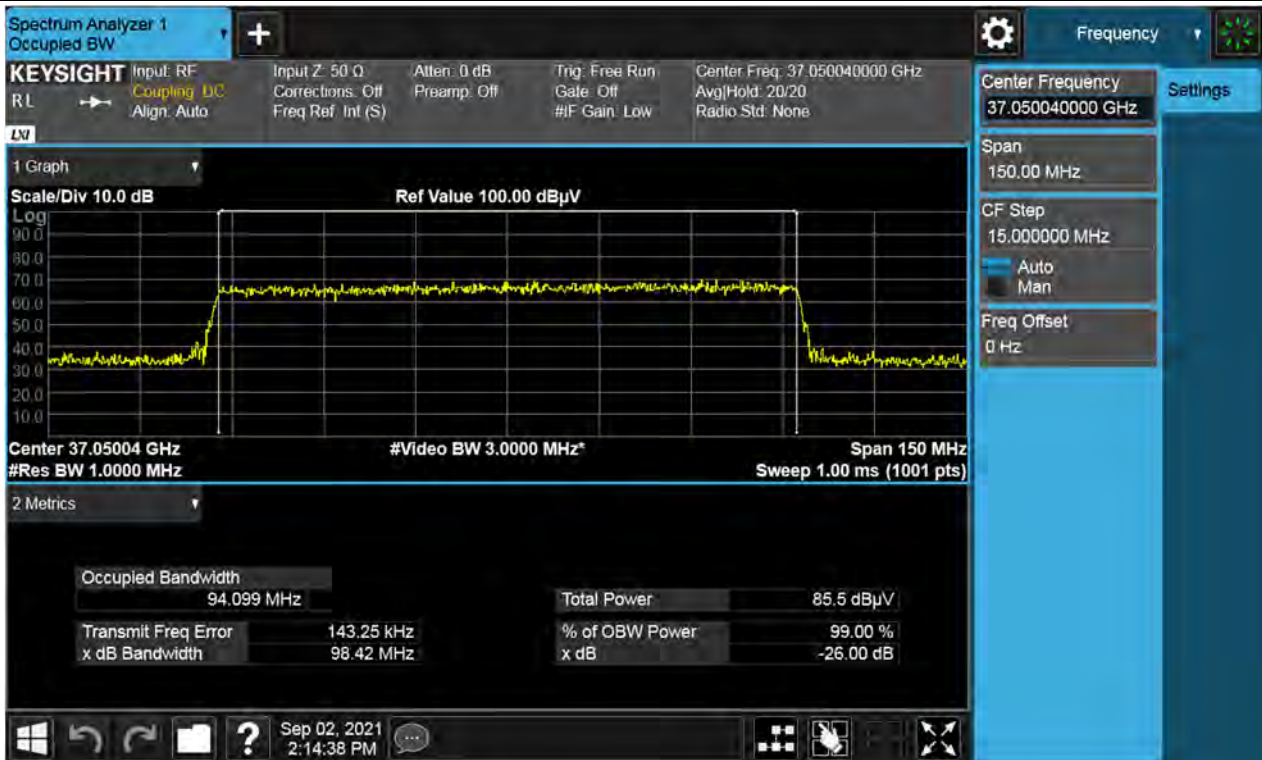
Antenna A / 1+3 cc / QPSK / Low_1



Antenna A / 1+3 cc / QPSK / Low_2



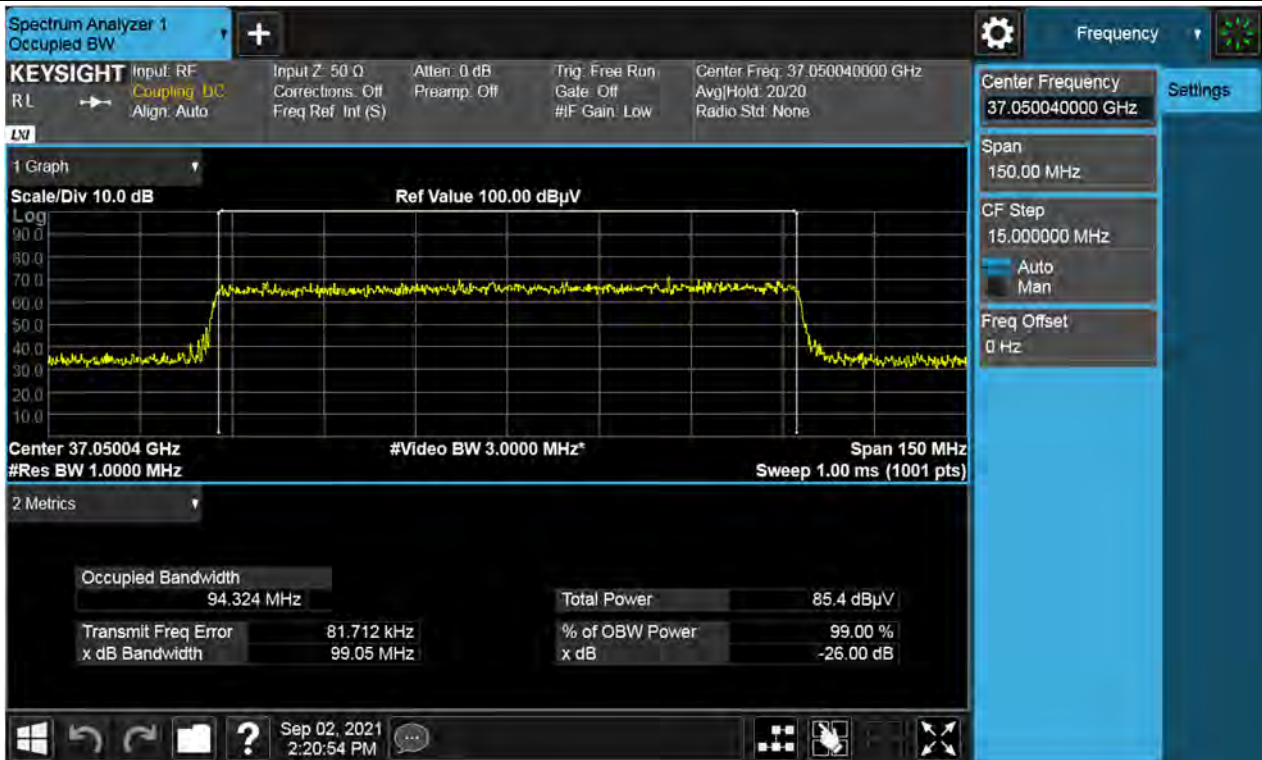
Antenna A / 1+3 cc / 16QAM / Low_1



Antenna A / 1+3 cc / 16QAM / Low_1



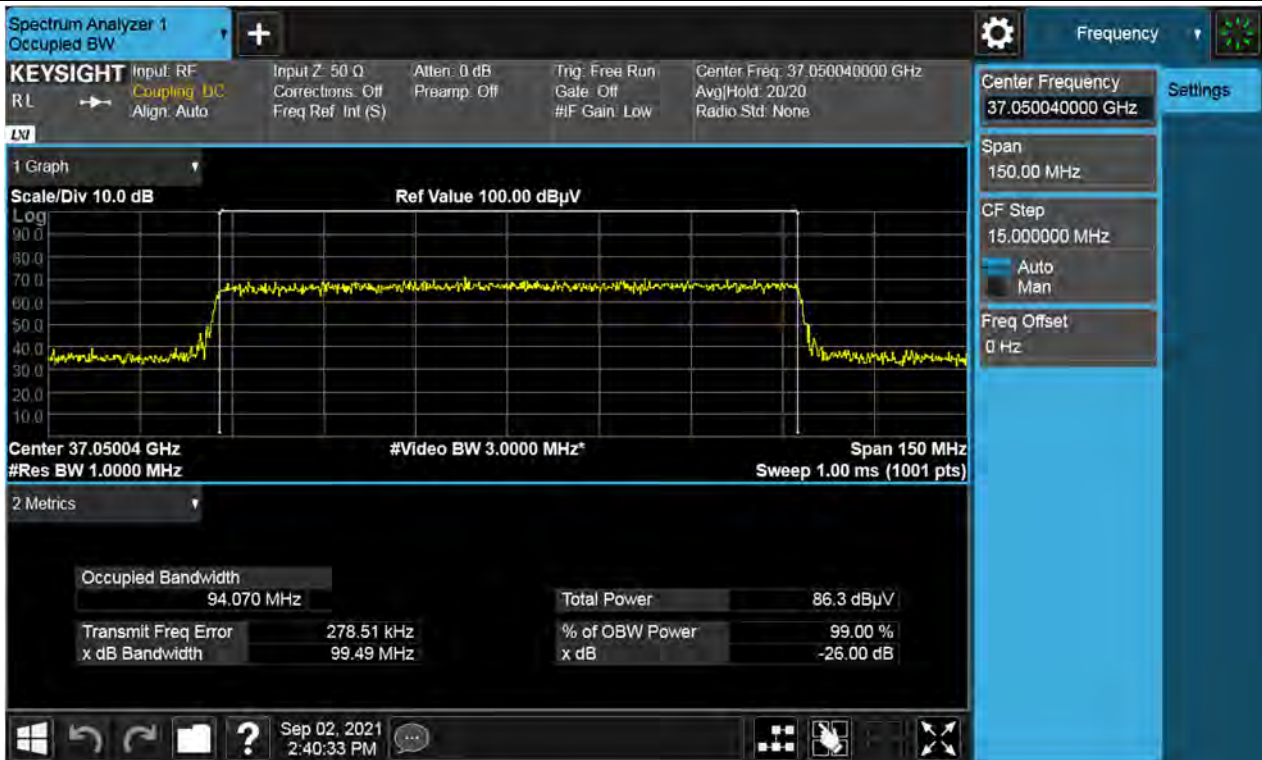
Antenna A / 1+3 cc / 64QAM / Low_1



Antenna A / 1+3 cc / 64QAM / Low_1



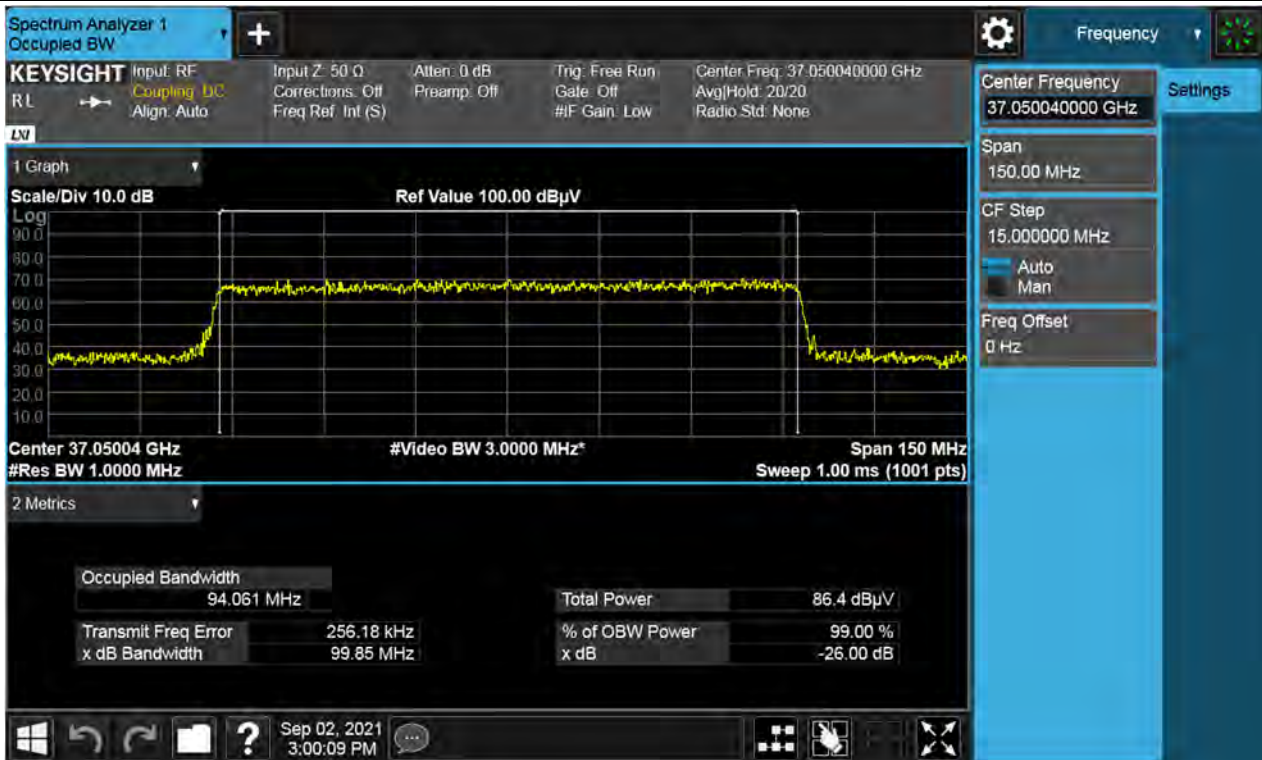
Antenna B / 1+3 cc / QPSK / Low_1



Antenna B / 1+3 cc / QPSK / Low_2



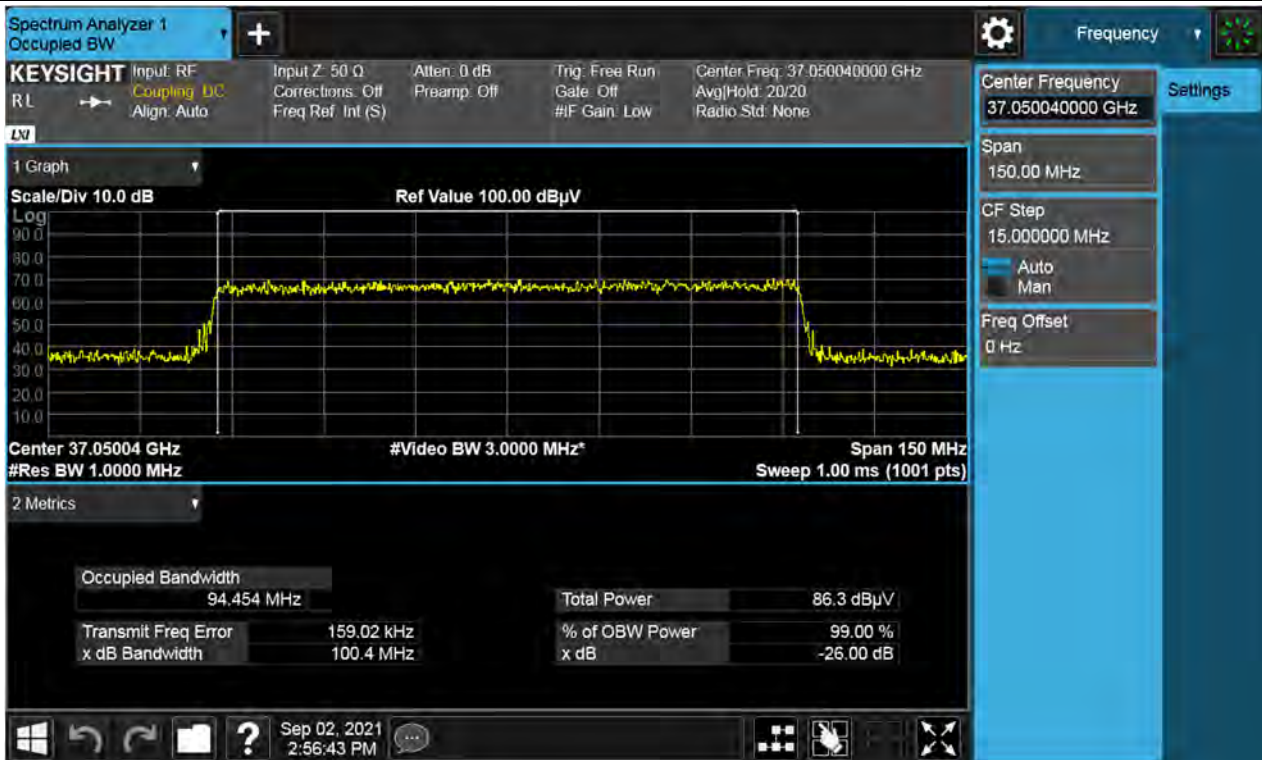
Antenna B / 1+3 cc / 16QAM / Low_1



Antenna B / 1+3 cc / 16QAM / Low_2



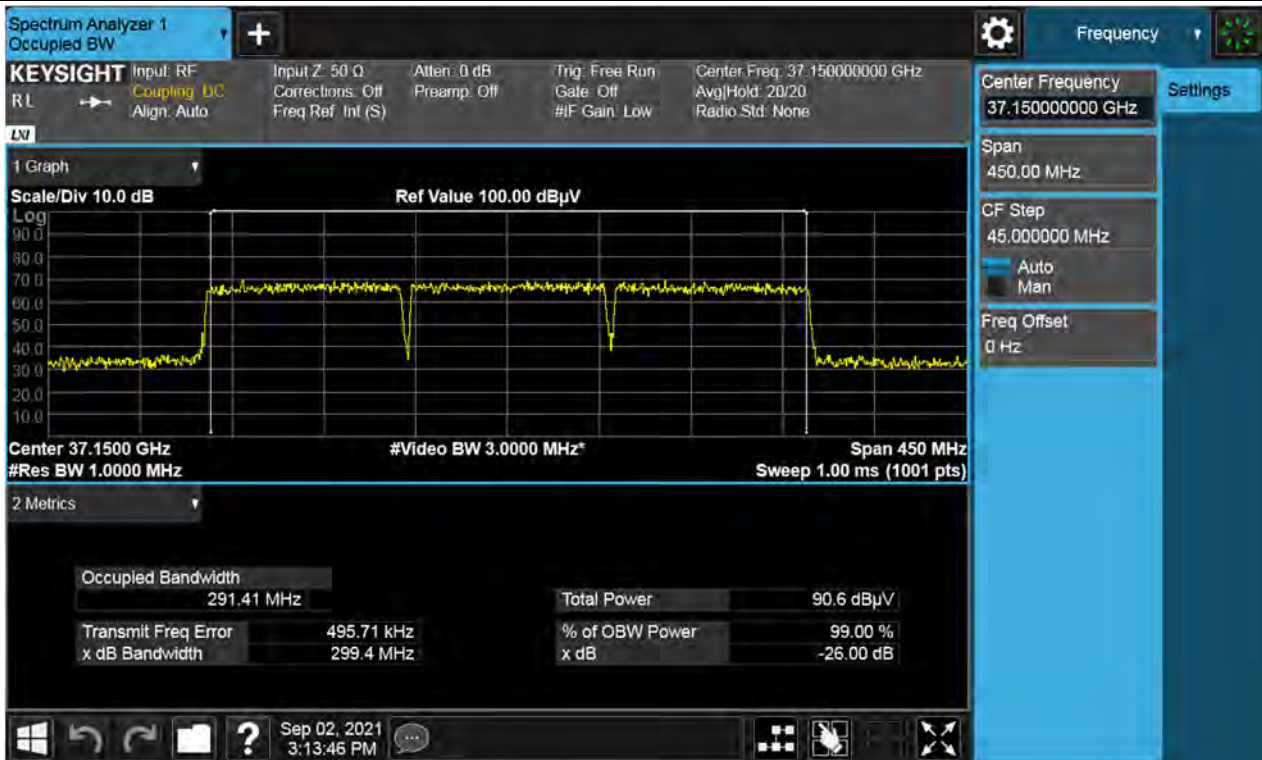
Antenna B / 1+3 cc / 64QAM / Low_1



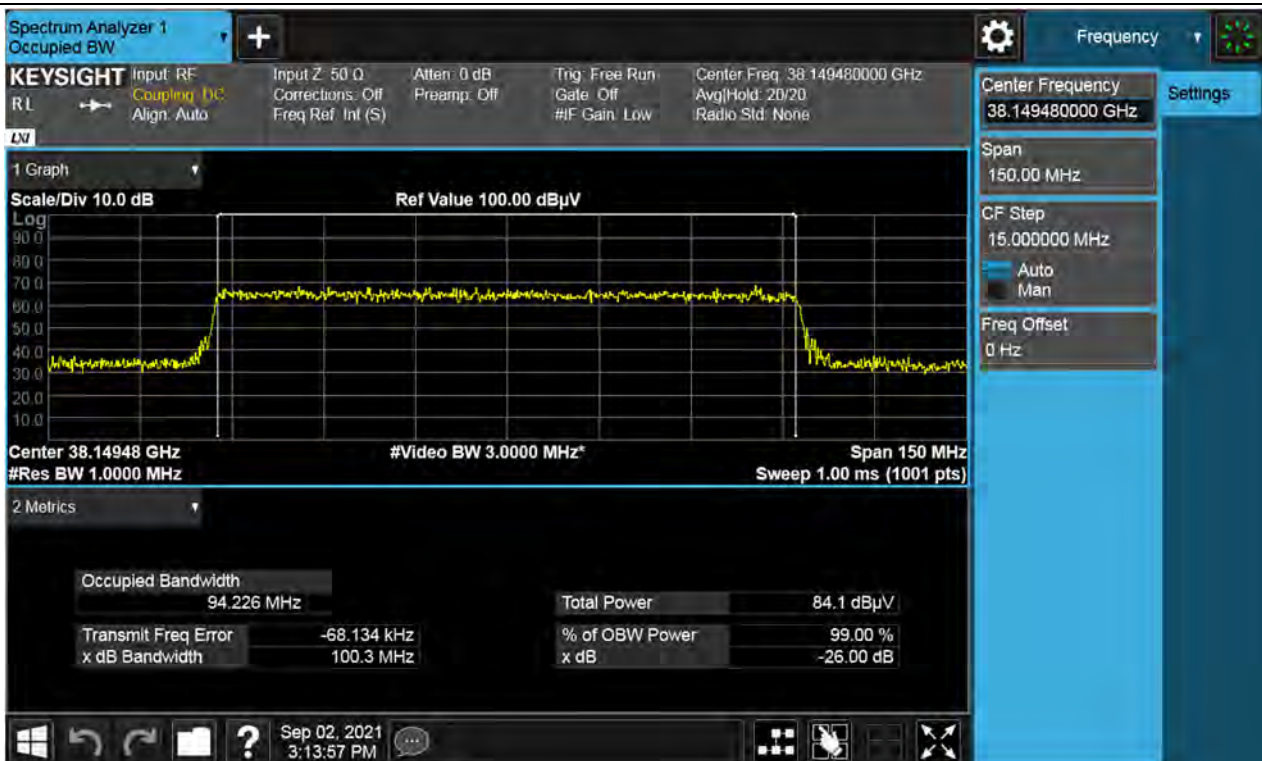
Antenna B / 1+3 cc / 64QAM / Low_2



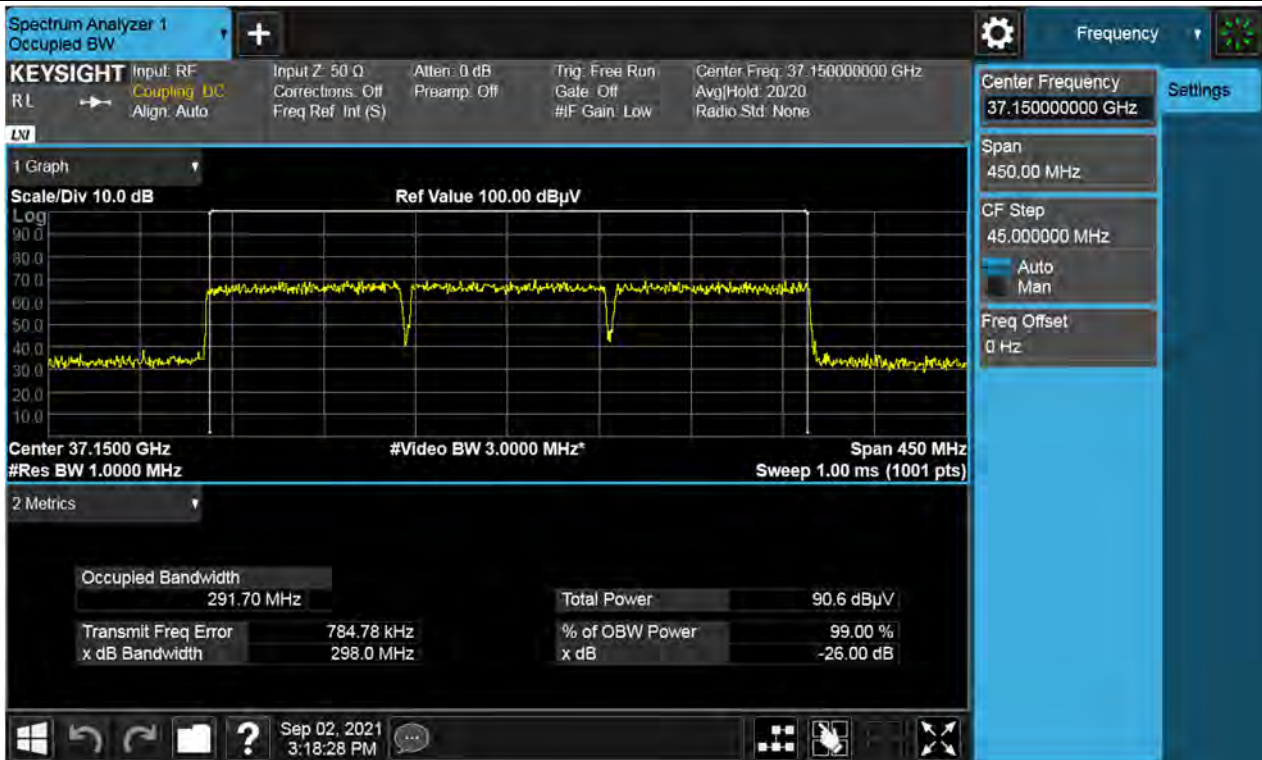
Antenna A / 3+1 cc / QPSK / Low_1



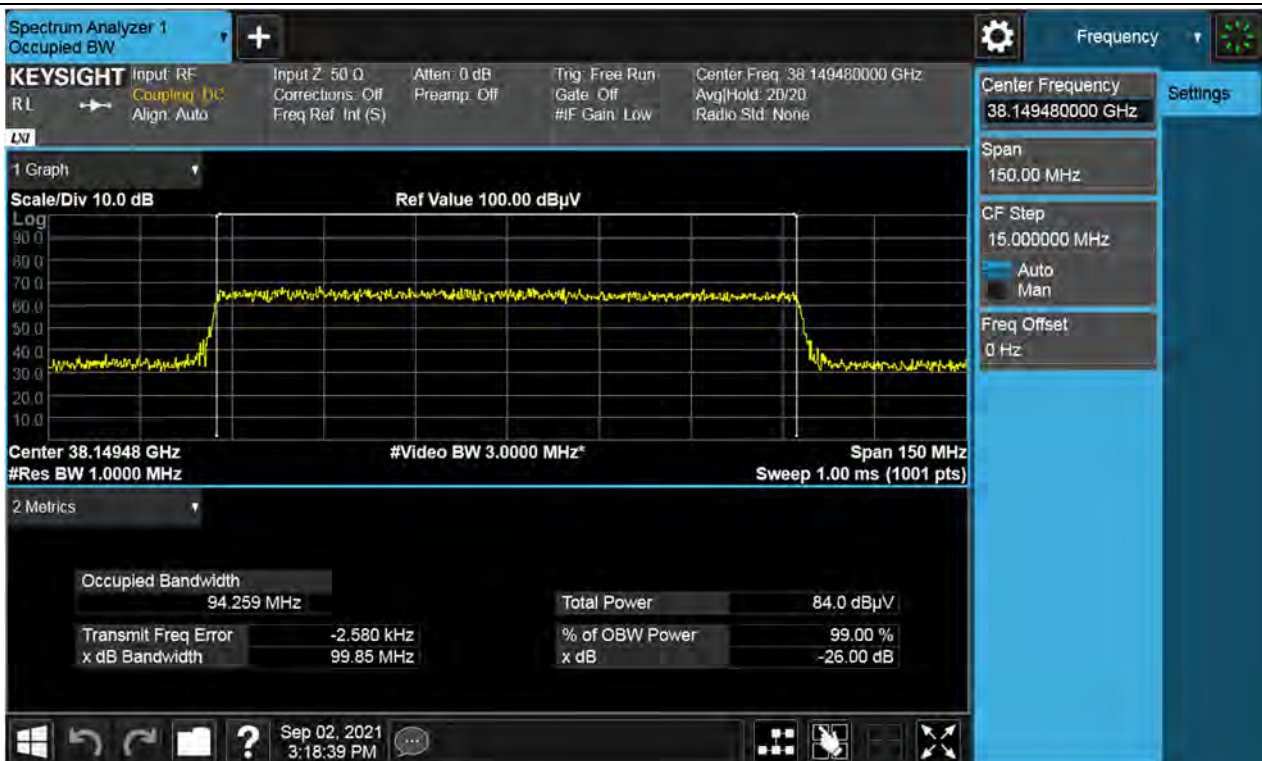
Antenna A / 3+1 cc / QPSK / Low_2



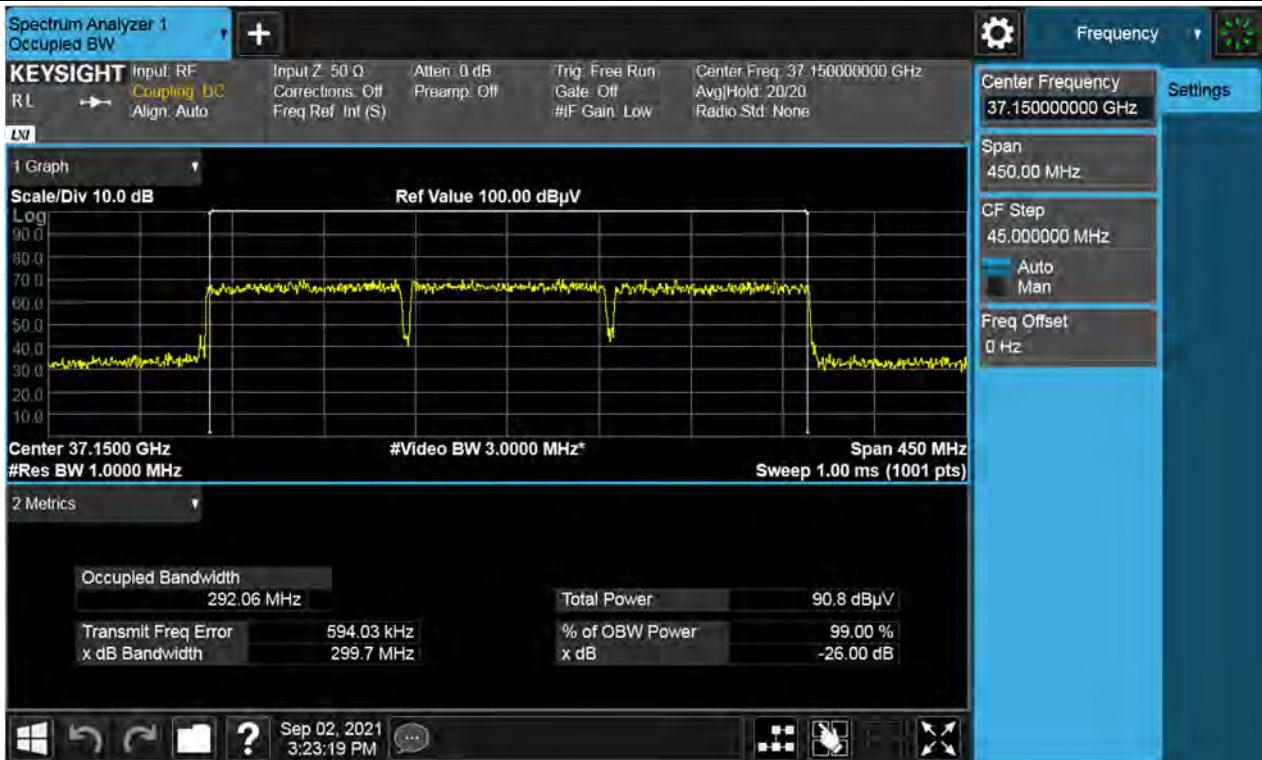
Antenna A / 3+1 cc / 16QAM / Low_1



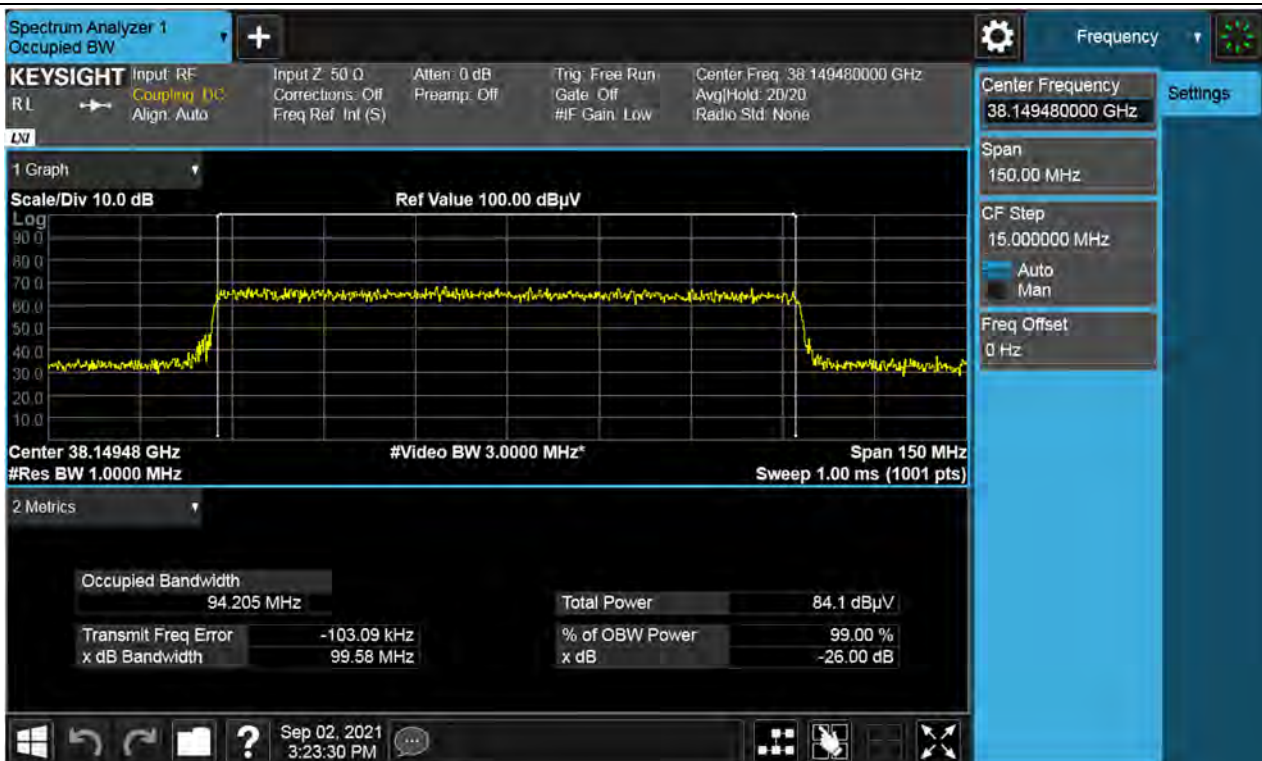
Antenna A / 3+1 cc / 16QAM / Low_2



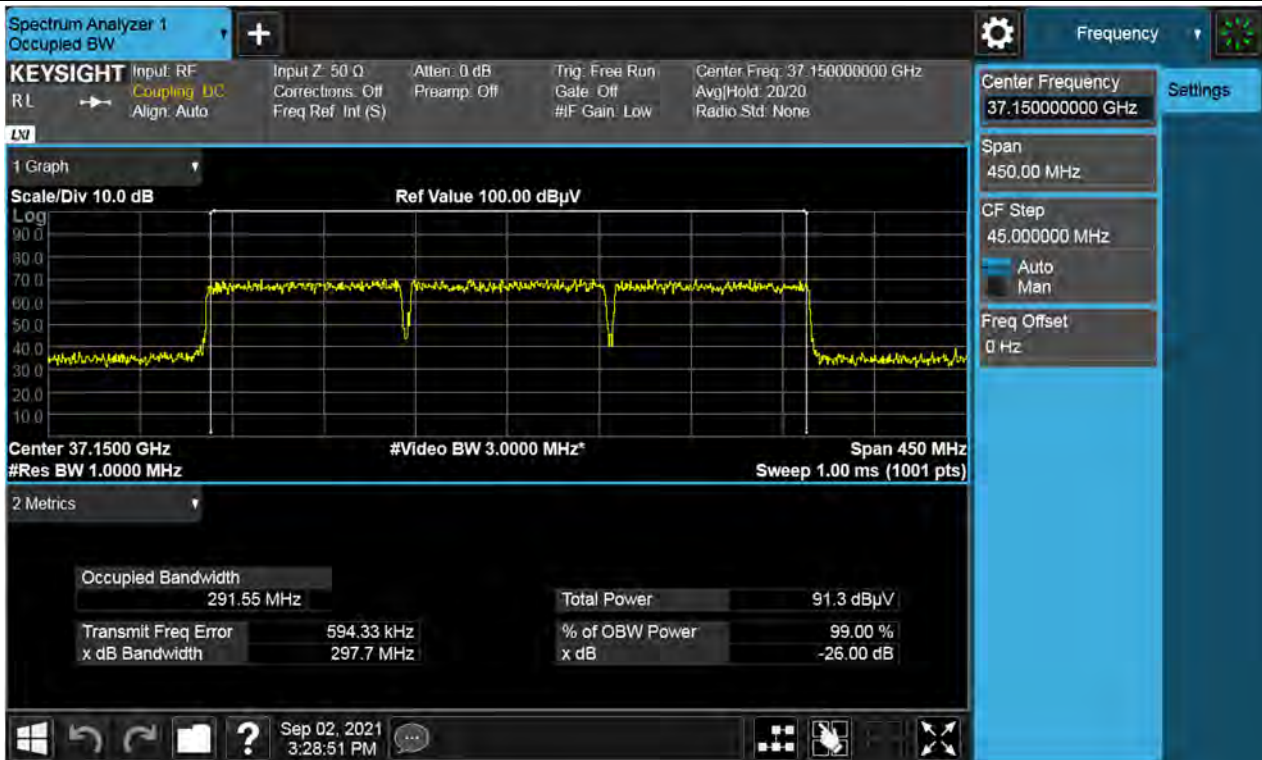
Antenna A / 3+1 cc / 64QAM / Low_1



Antenna A / 3+1 cc / 64QAM / Low_2



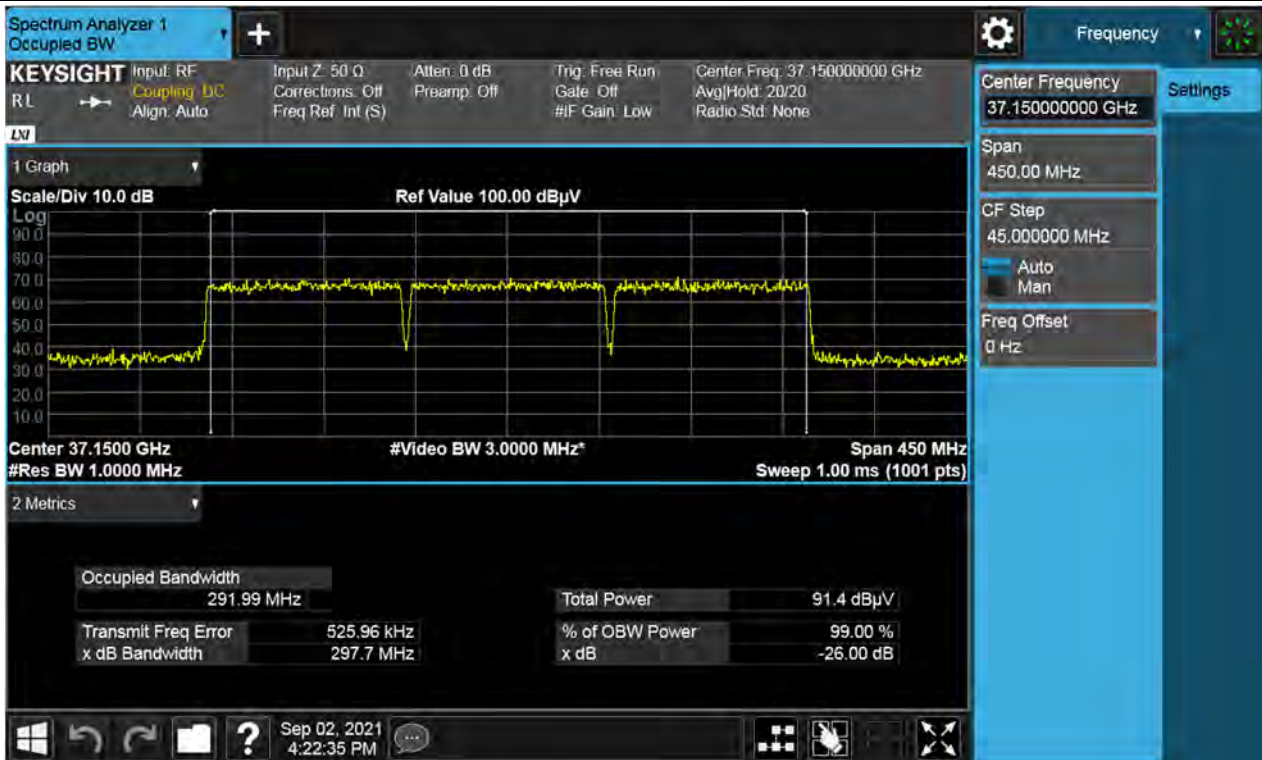
Antenna B / 3+1 cc / QPSK / Low_1



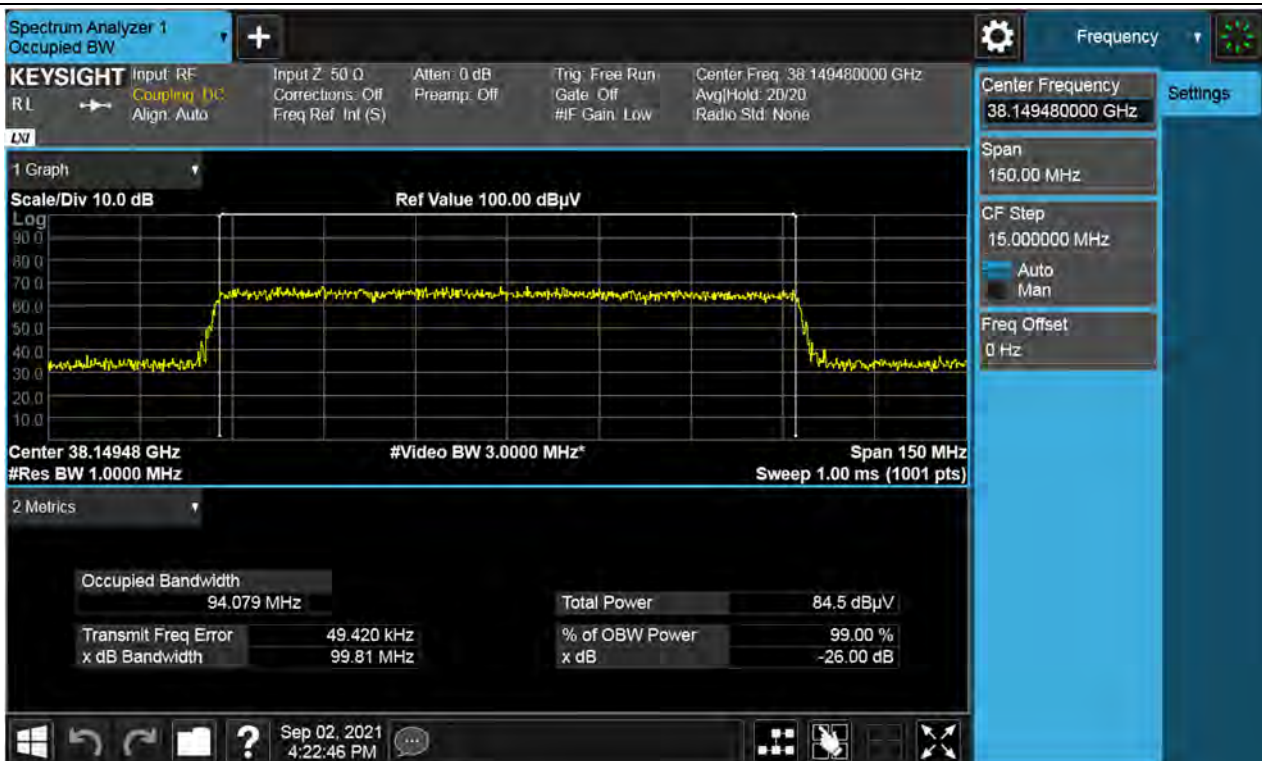
Antenna B / 3+1 cc / QPSK / Low_2



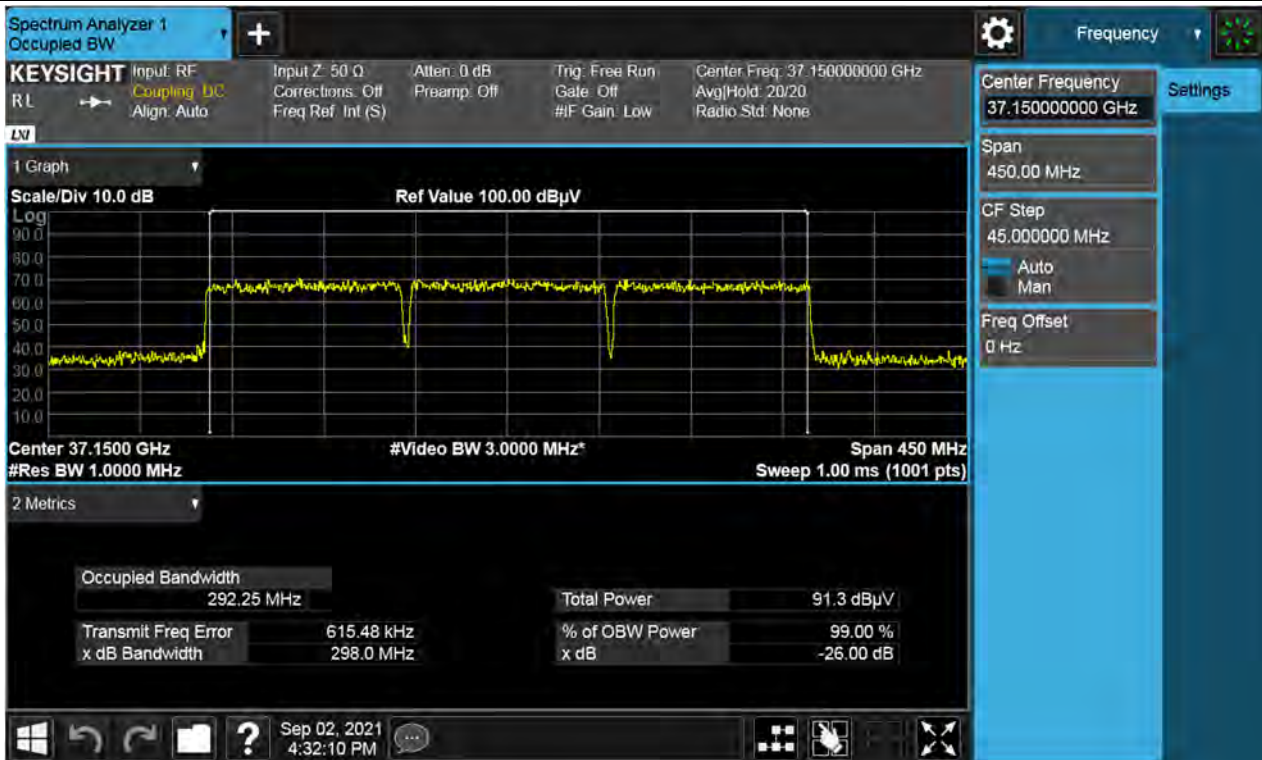
Antenna B / 3+1 cc / 16QAM / Low_1



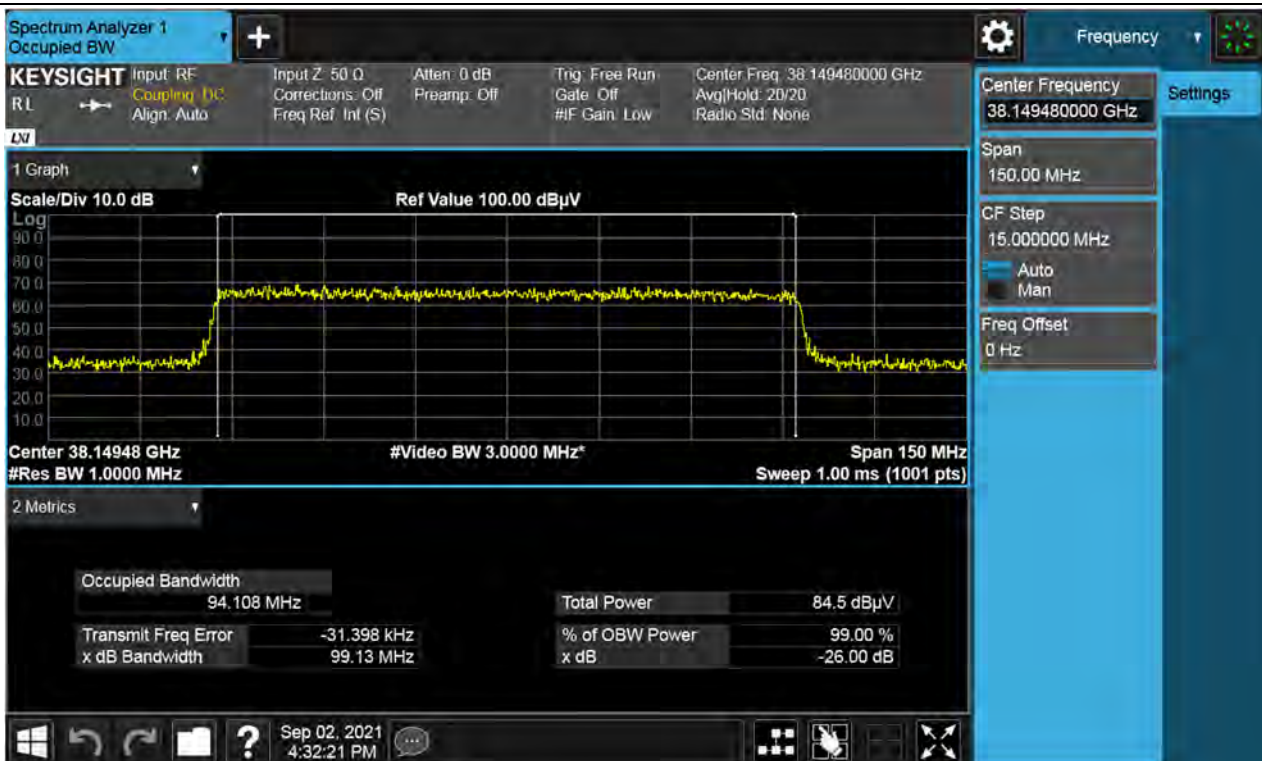
Antenna B / 3+1 cc / 16QAM / Low_2



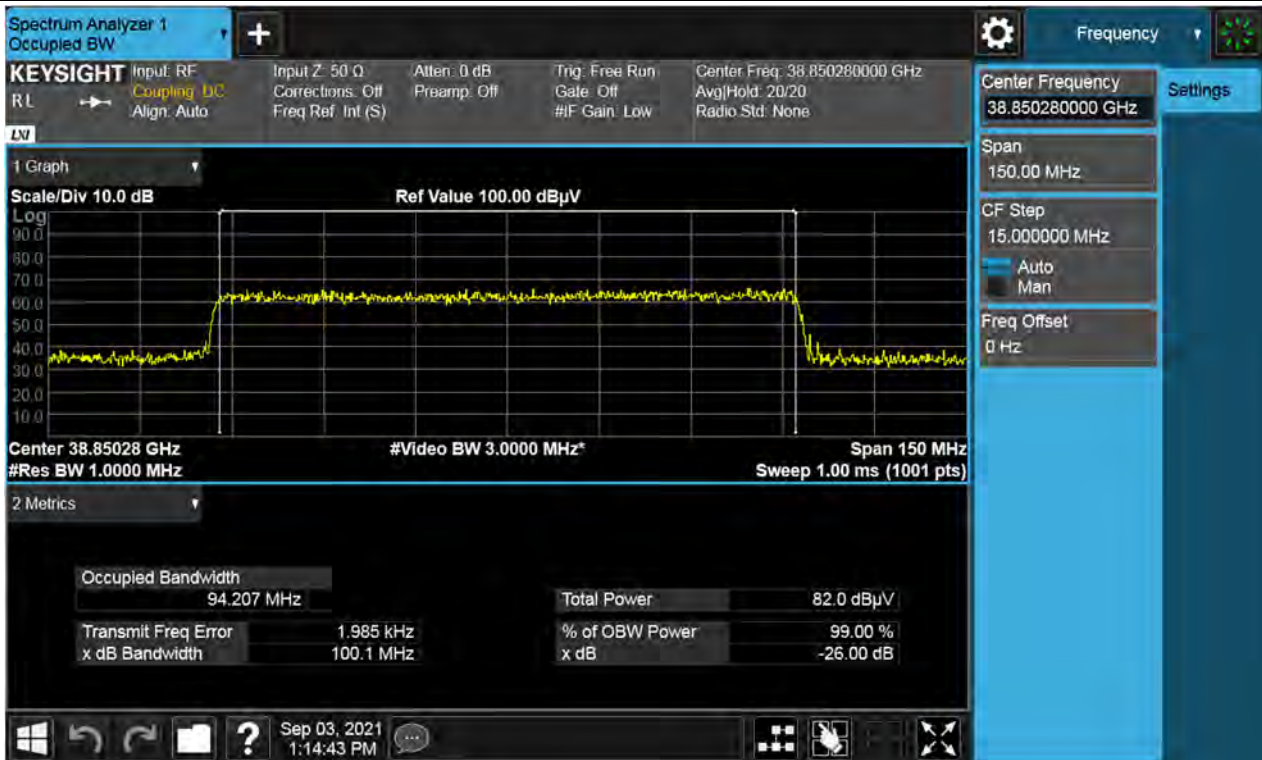
Antenna B / 3+1 cc / 64QAM / Low_1



Antenna B / 3+1 cc / 64QAM / Low_2



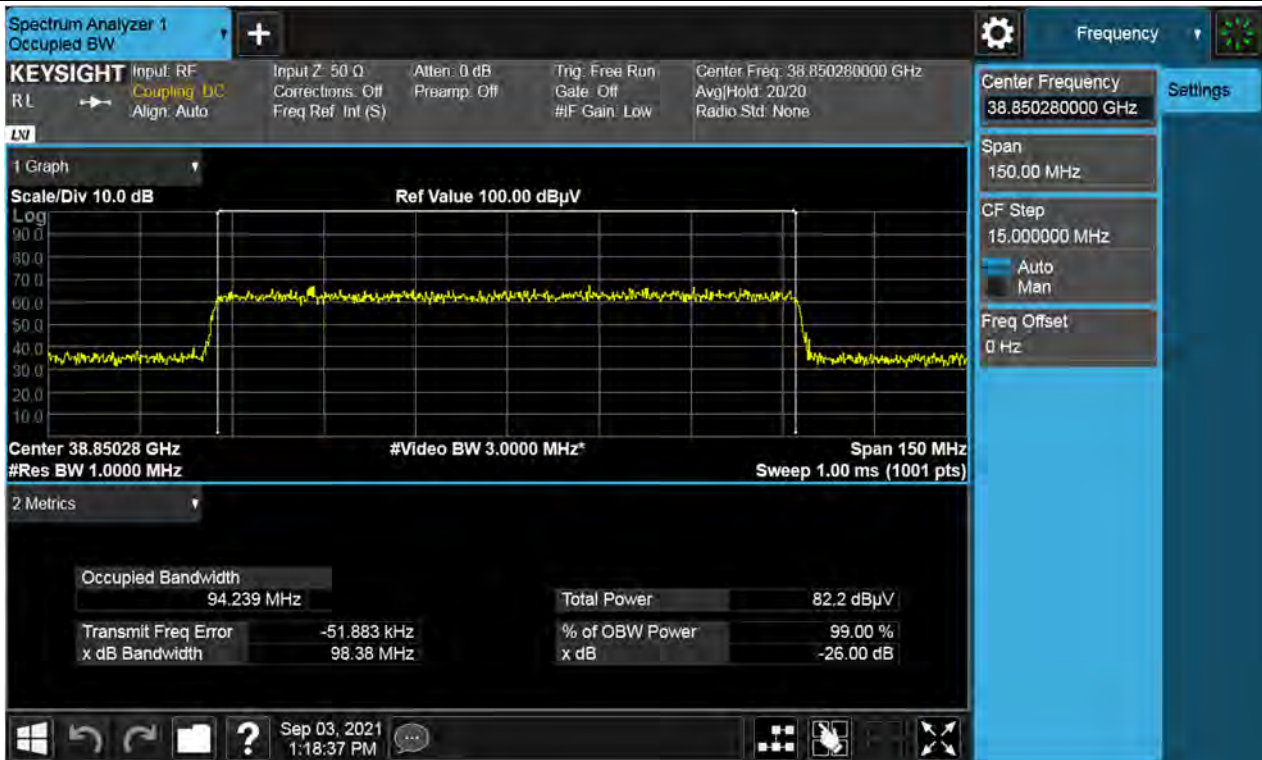
Antenna A / 1+3 cc / QPSK / High_1



Antenna A / 1+3 cc / QPSK / High_2



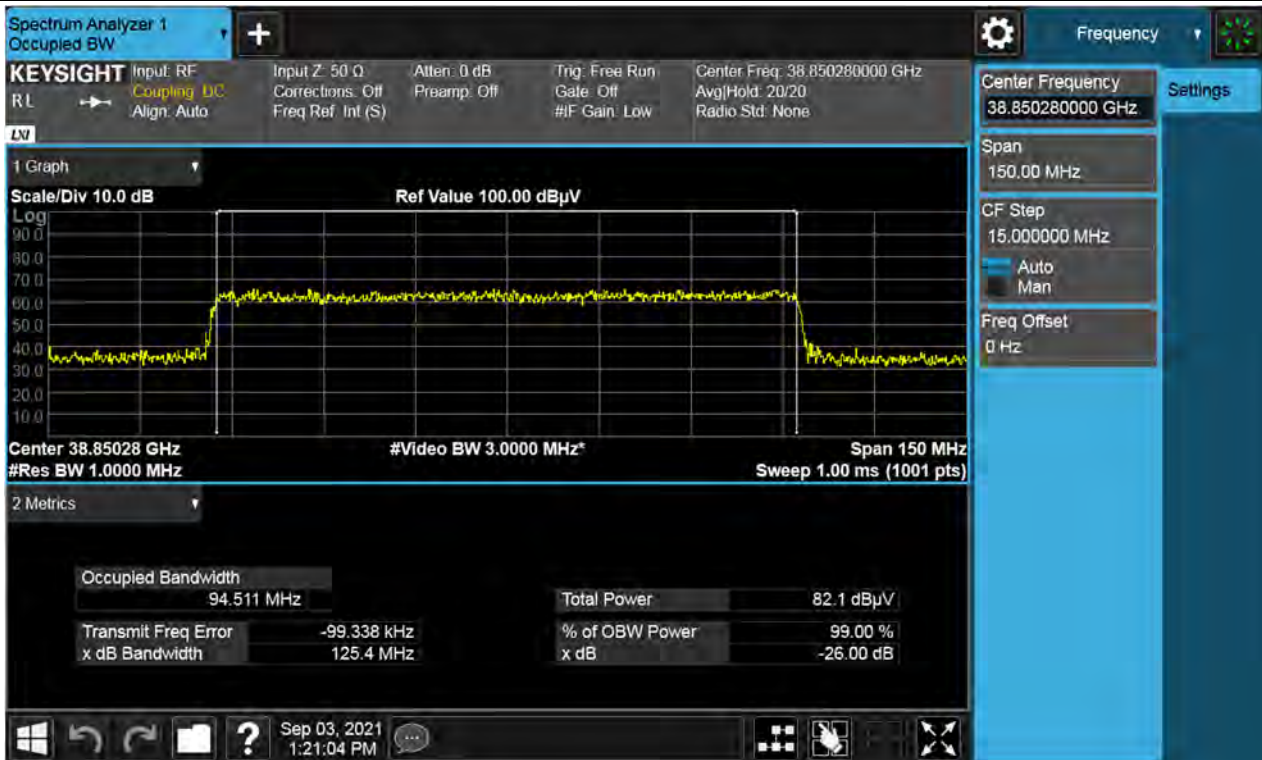
Antenna A / 1+3 cc / 16QAM / High_1



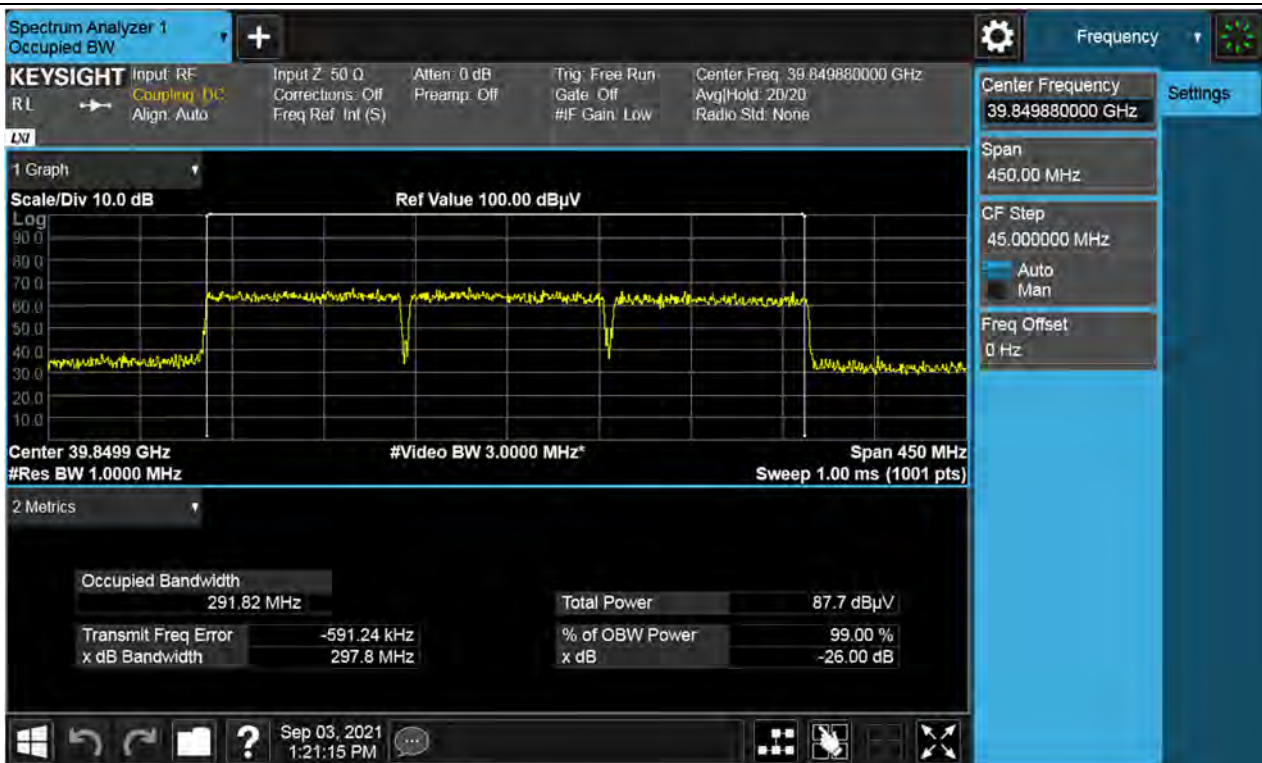
Antenna A / 1+3 cc / 16QAM / High_2



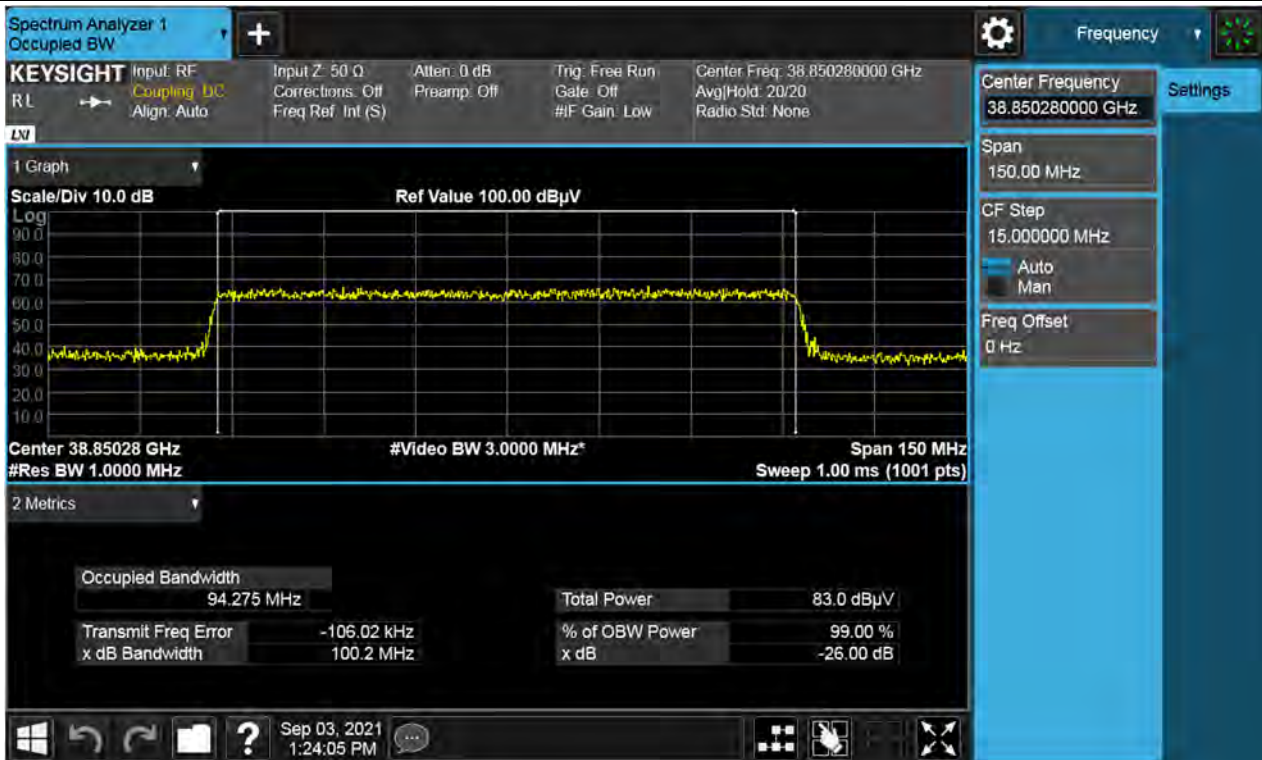
Antenna A / 1+3 cc / 64QAM / High_1



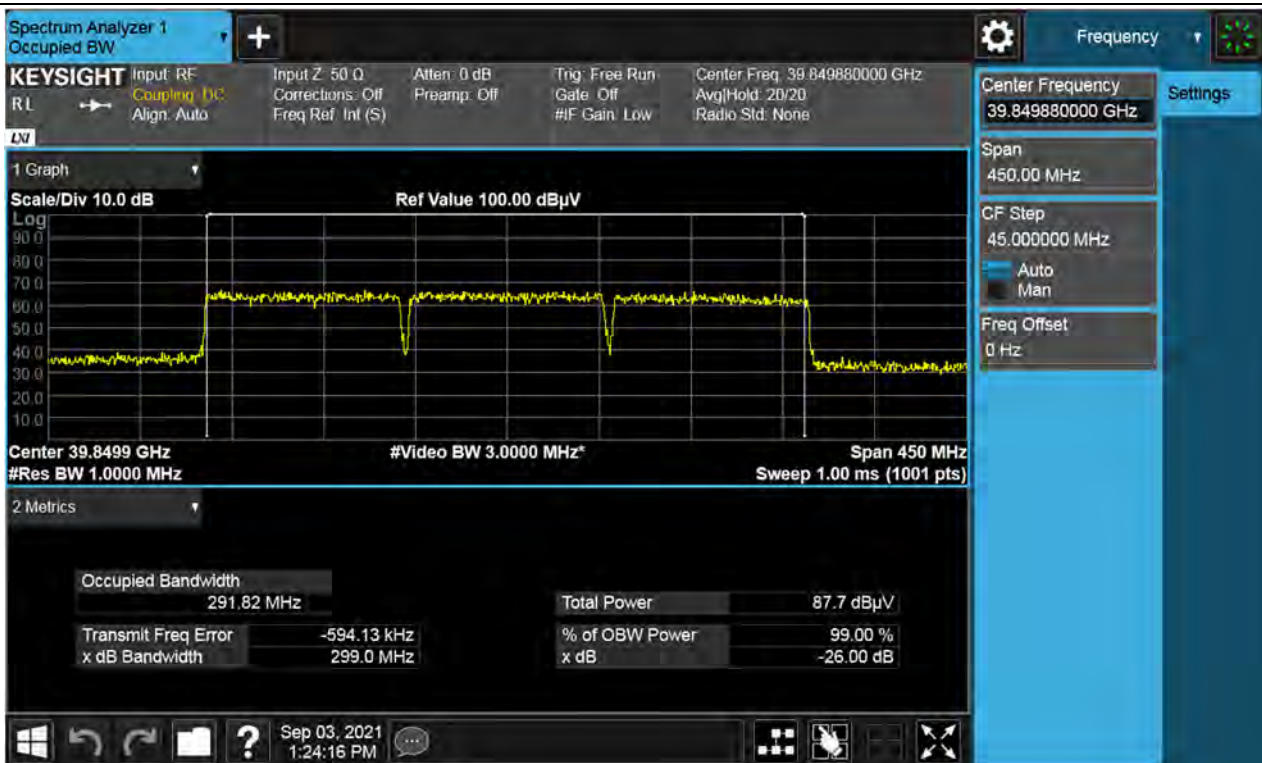
Antenna A / 1+3 cc / 64QAM / High_2



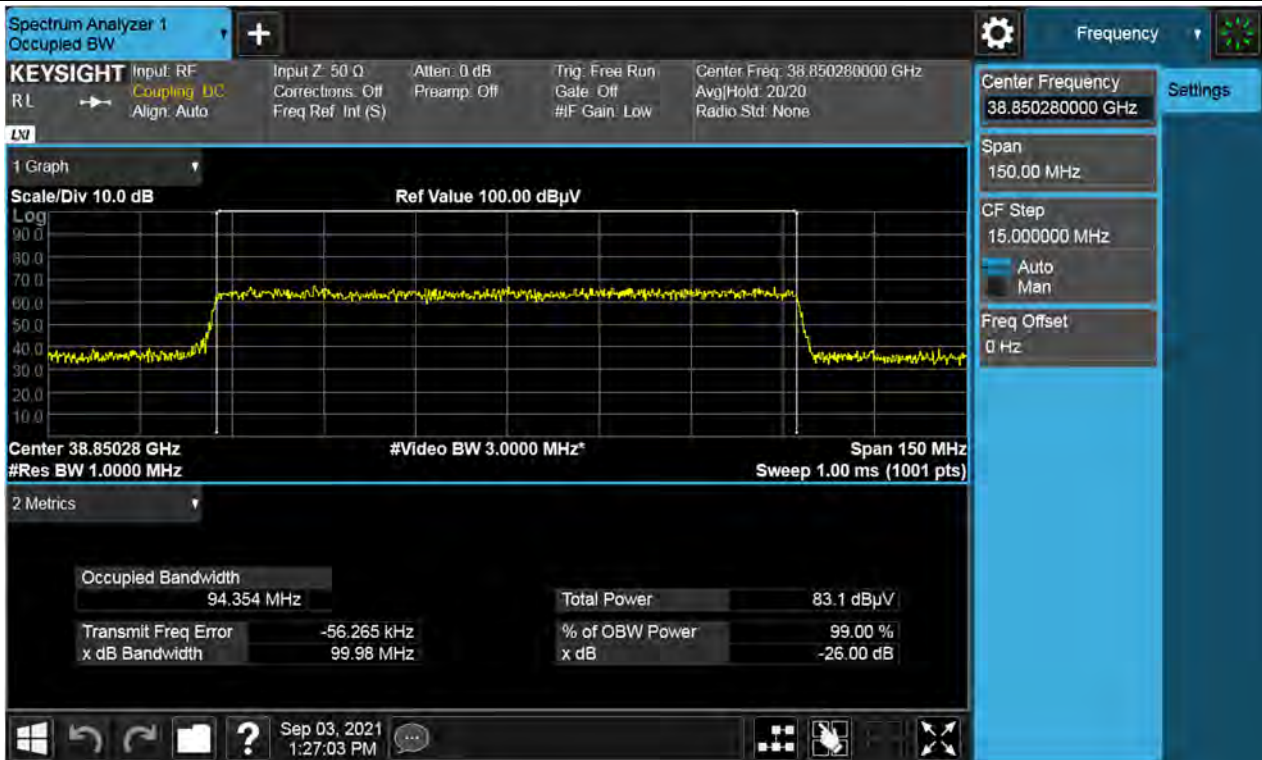
Antenna B / 1+3 cc / QPSK / High_1



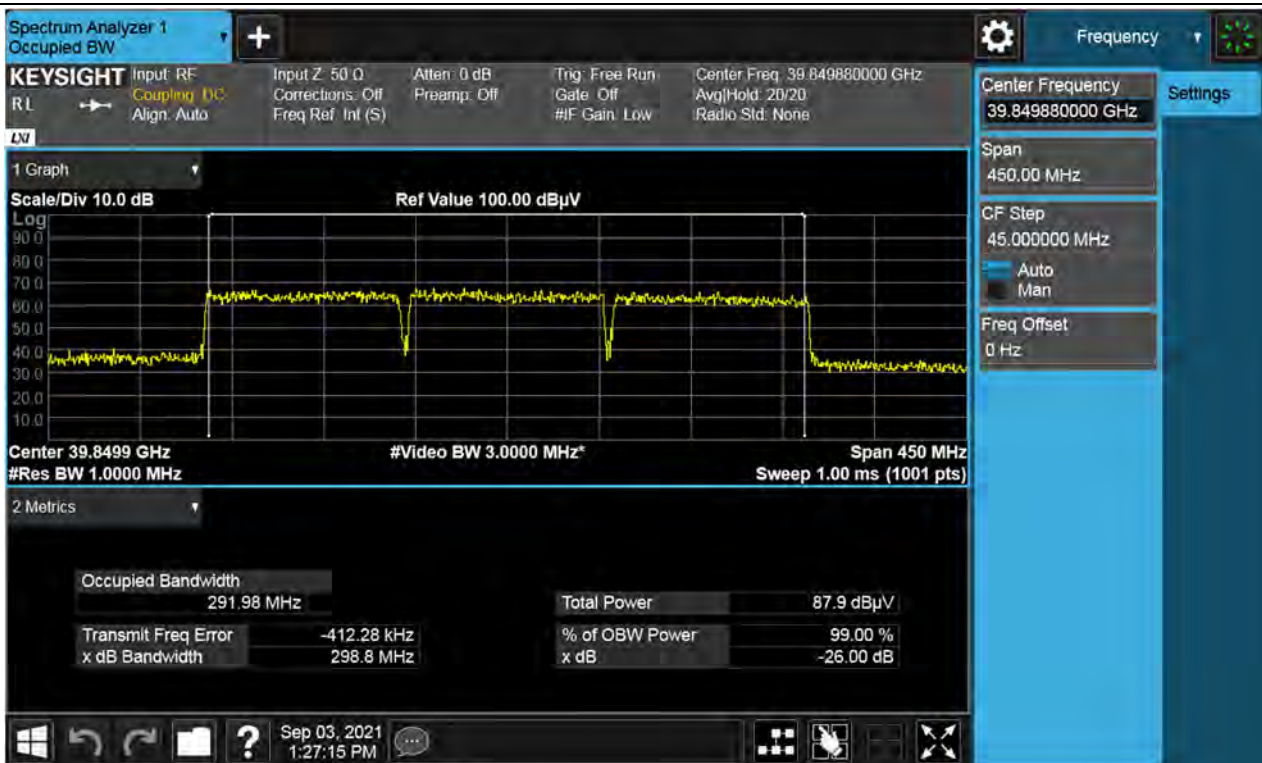
Antenna B / 1+3 cc / QPSK / High_2



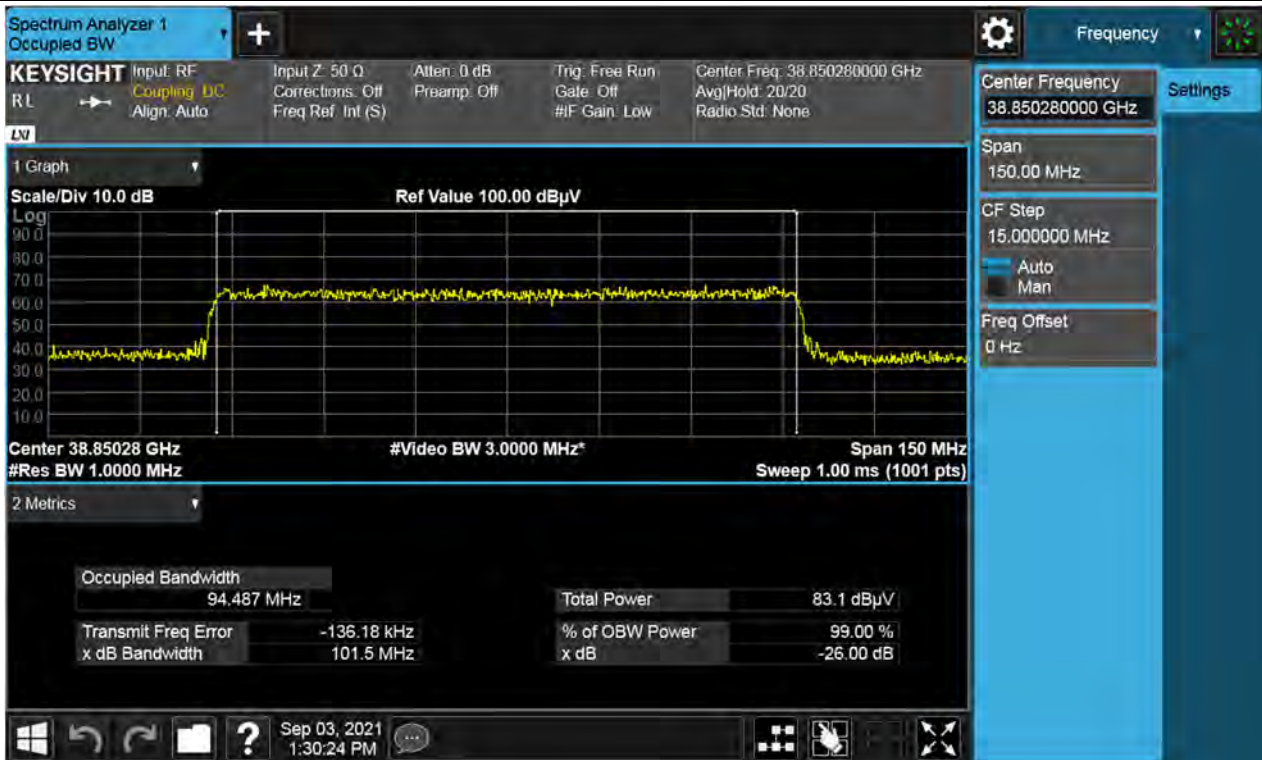
Antenna B / 1+3 cc / 16QAM / High_1



Antenna B / 1+3 cc / 16QAM / High_2



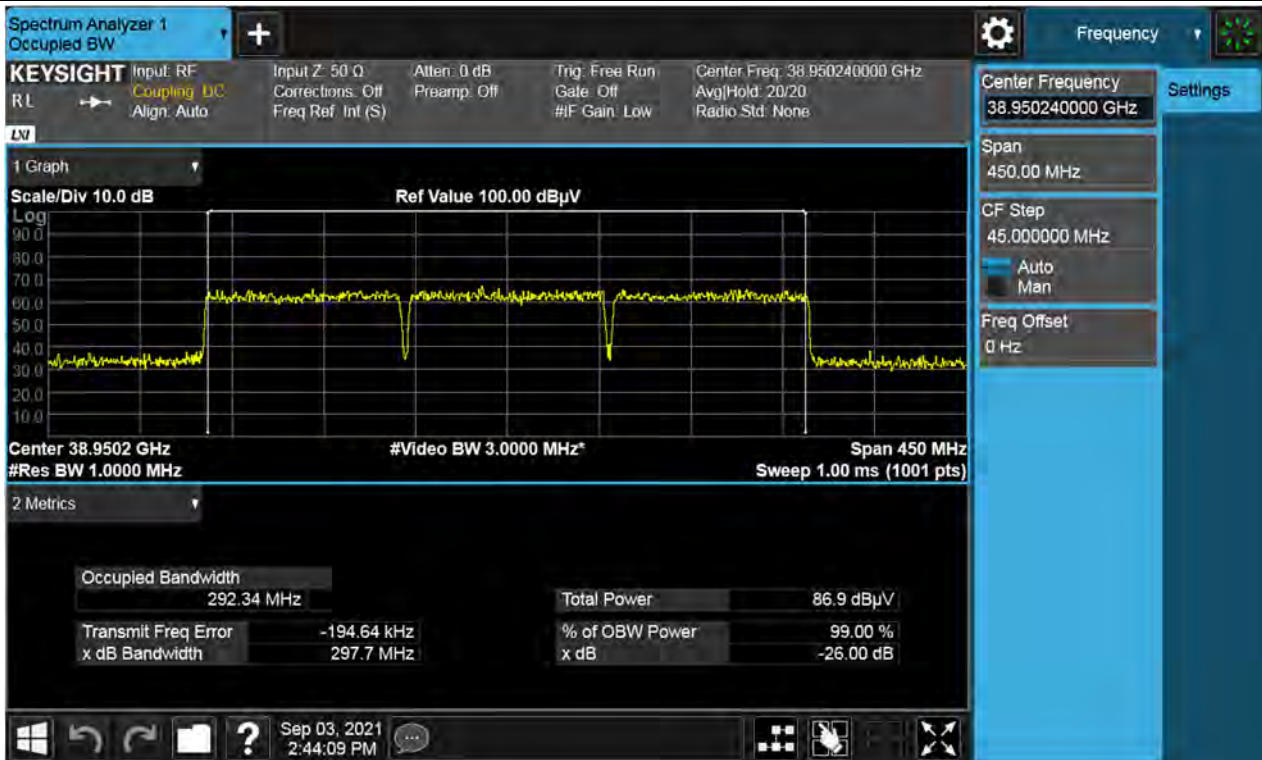
Antenna B / 1+3 cc / 64QAM / High_1



Antenna B / 1+3 cc / 64QAM / High_2



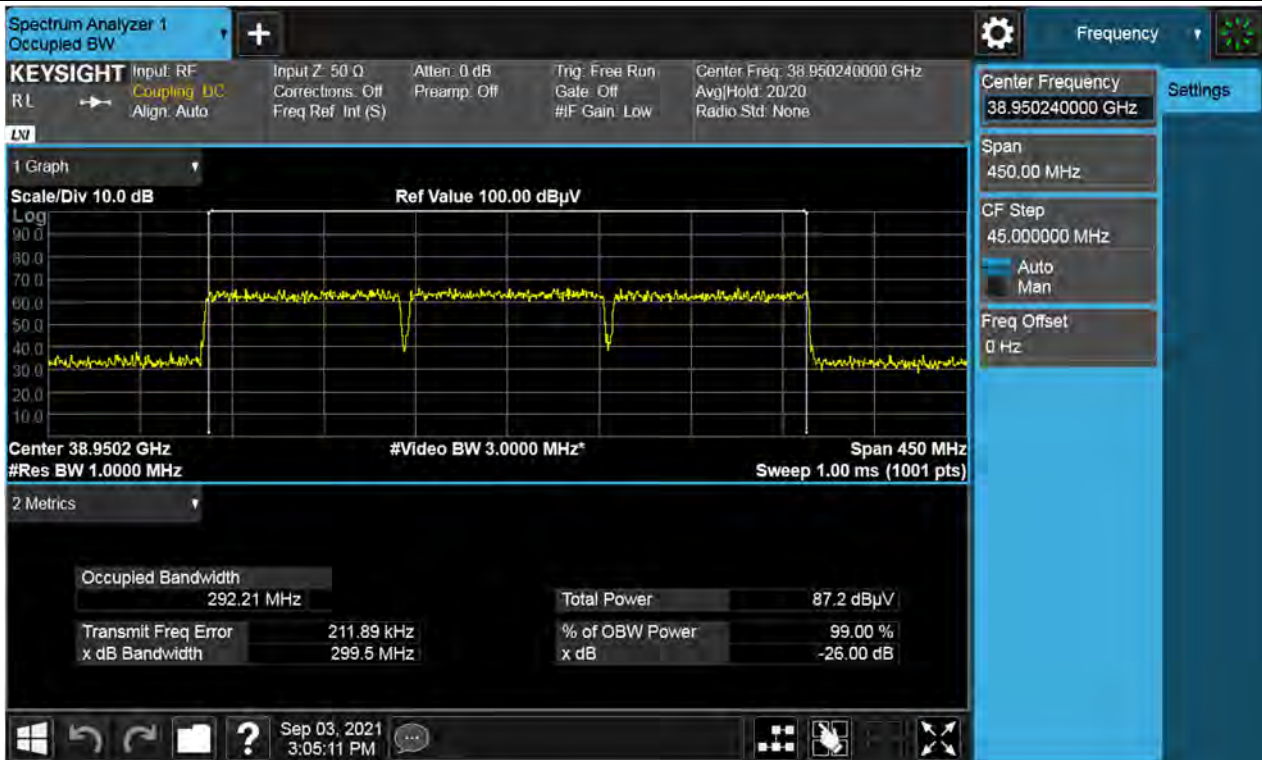
Antenna A / 3+1 cc / QPSK / High_1



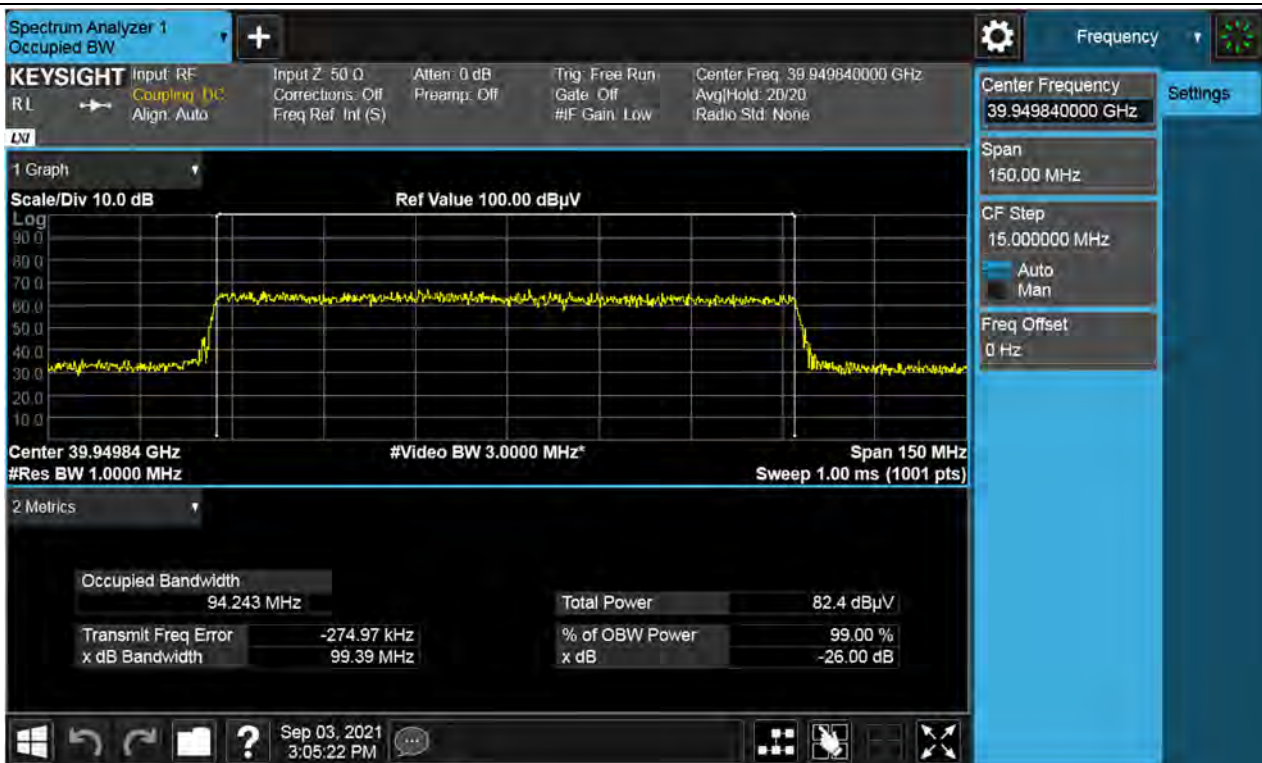
Antenna A / 3+1 cc / QPSK / High_2



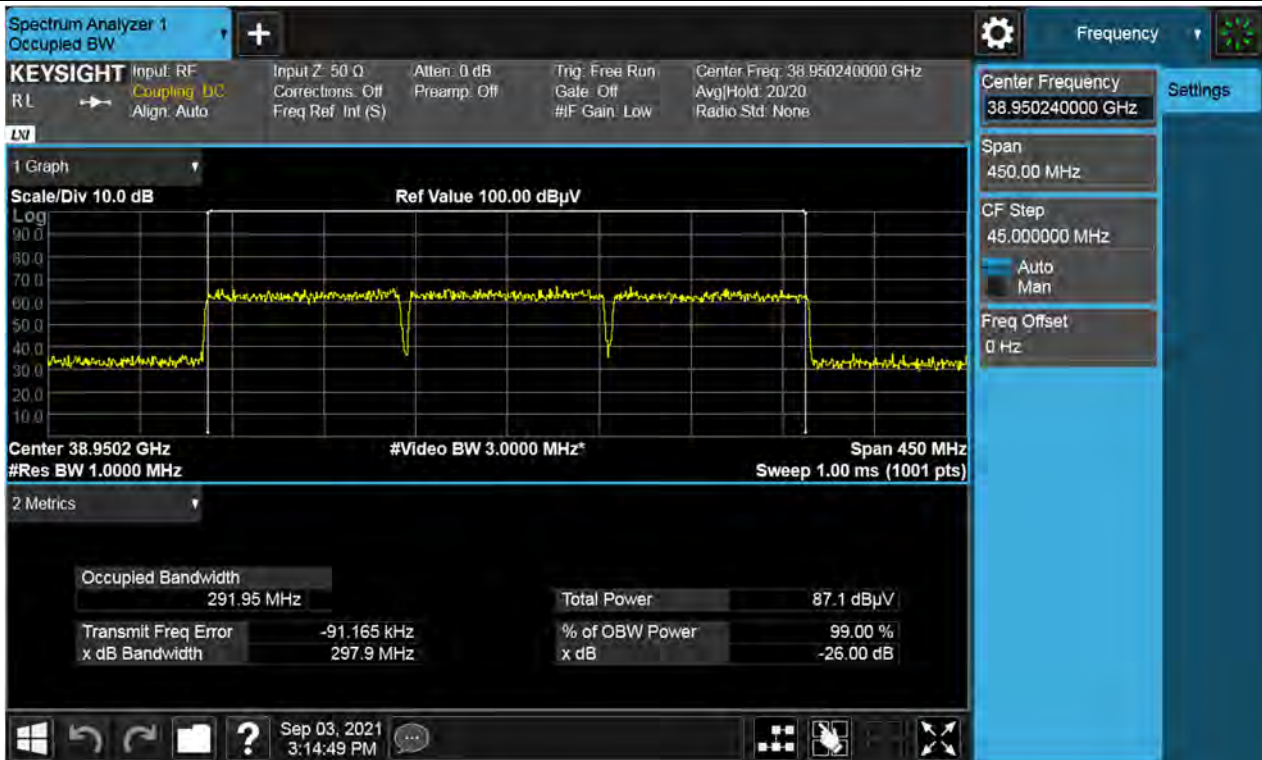
Antenna A / 3+1 cc / 16QAM / High_1



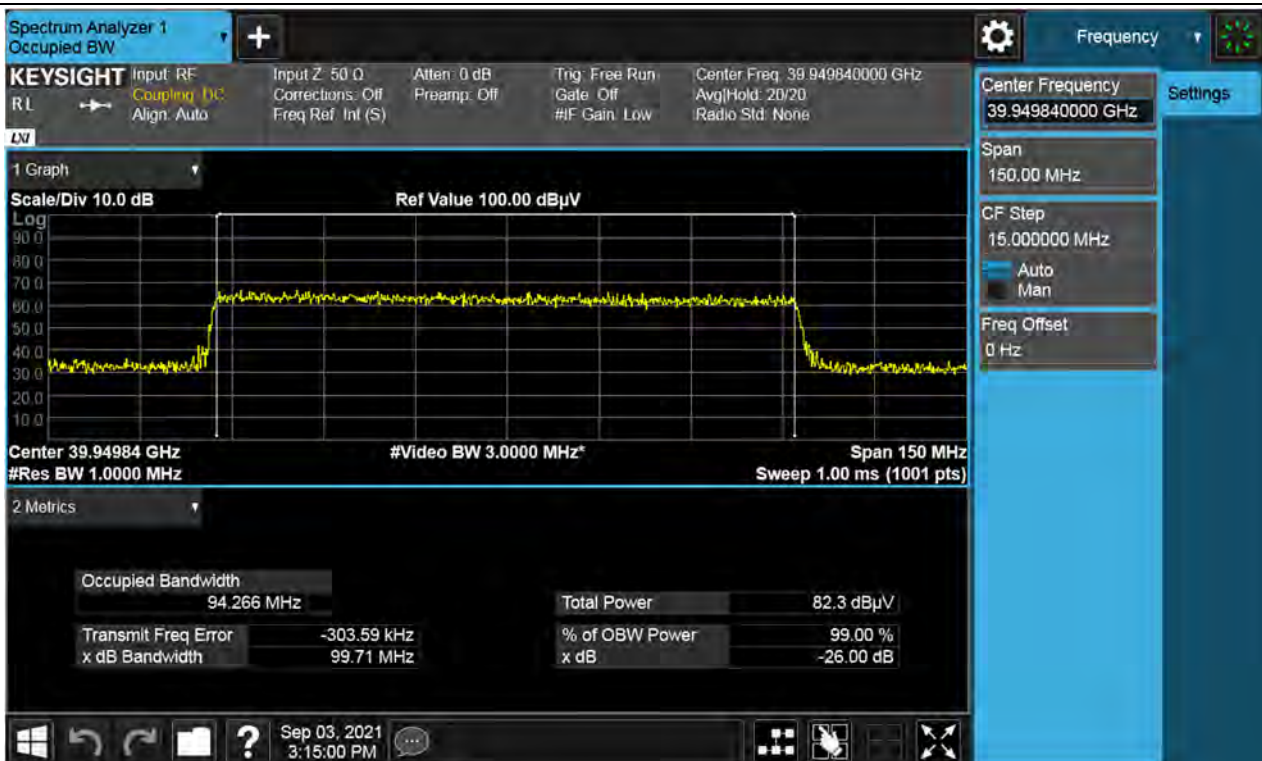
Antenna A / 3+1 cc / 16QAM / High_2



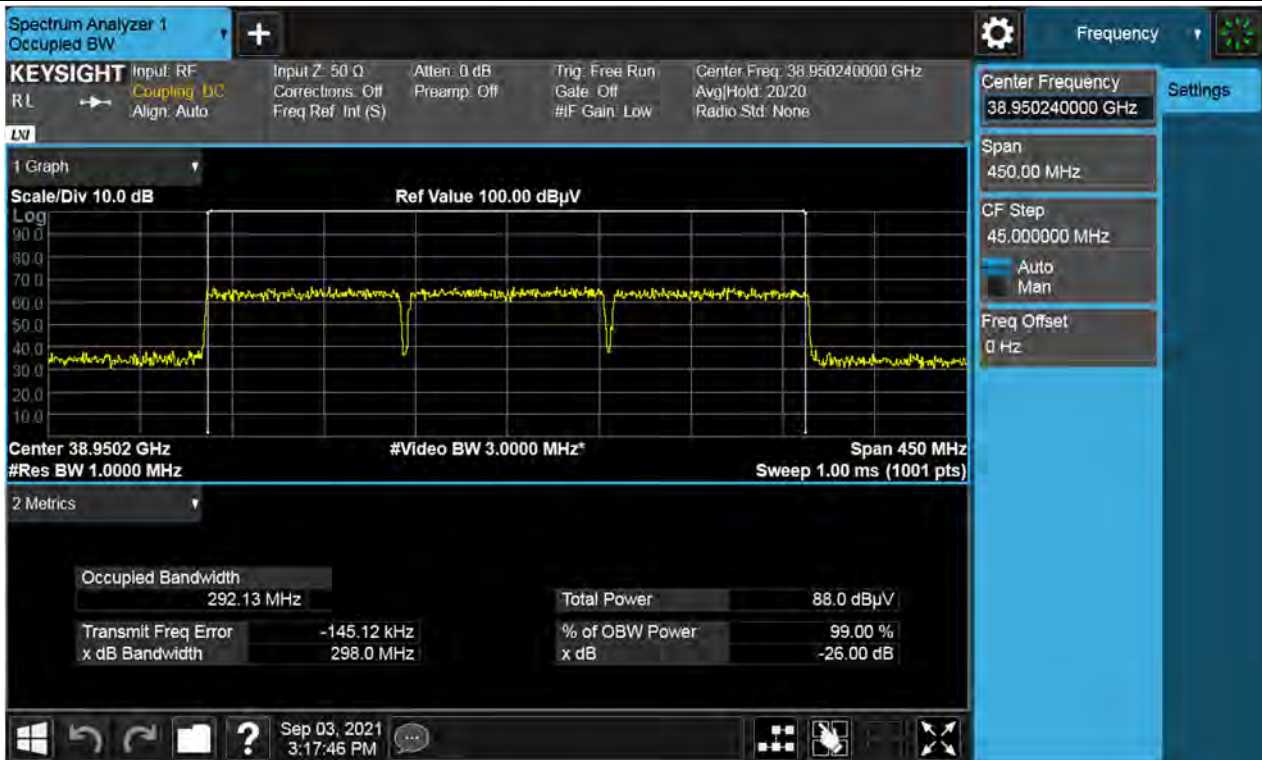
Antenna A / 3+1 cc / 64QAM / High_1



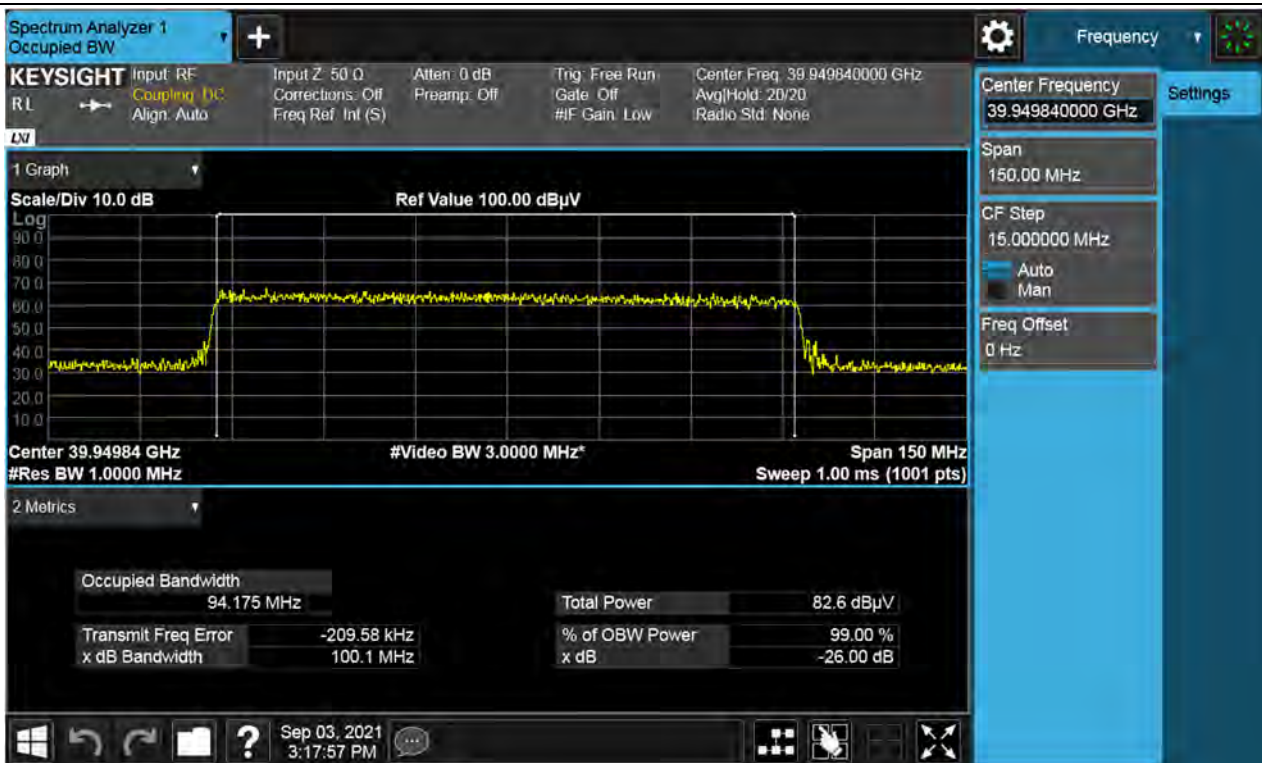
Antenna A / 3+1 cc / 64QAM / High_2



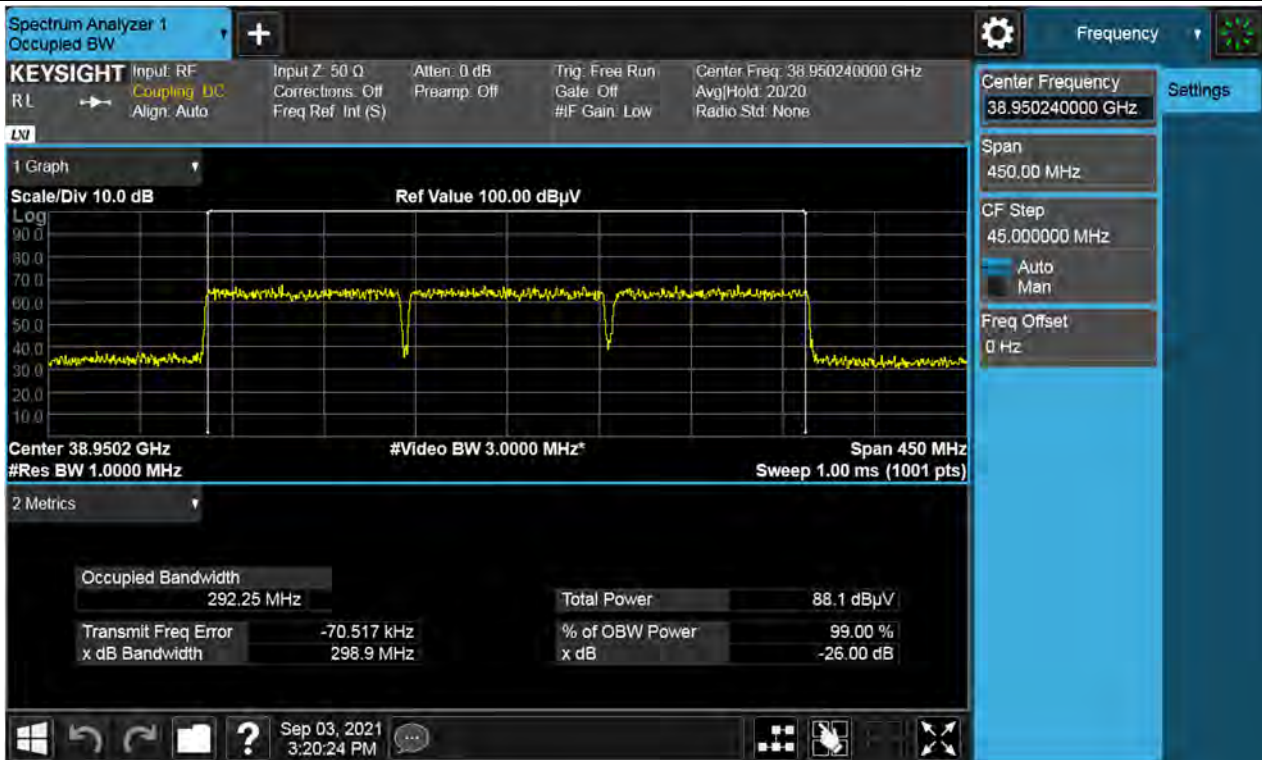
Antenna B / 3+1 cc / QPSK / High_1



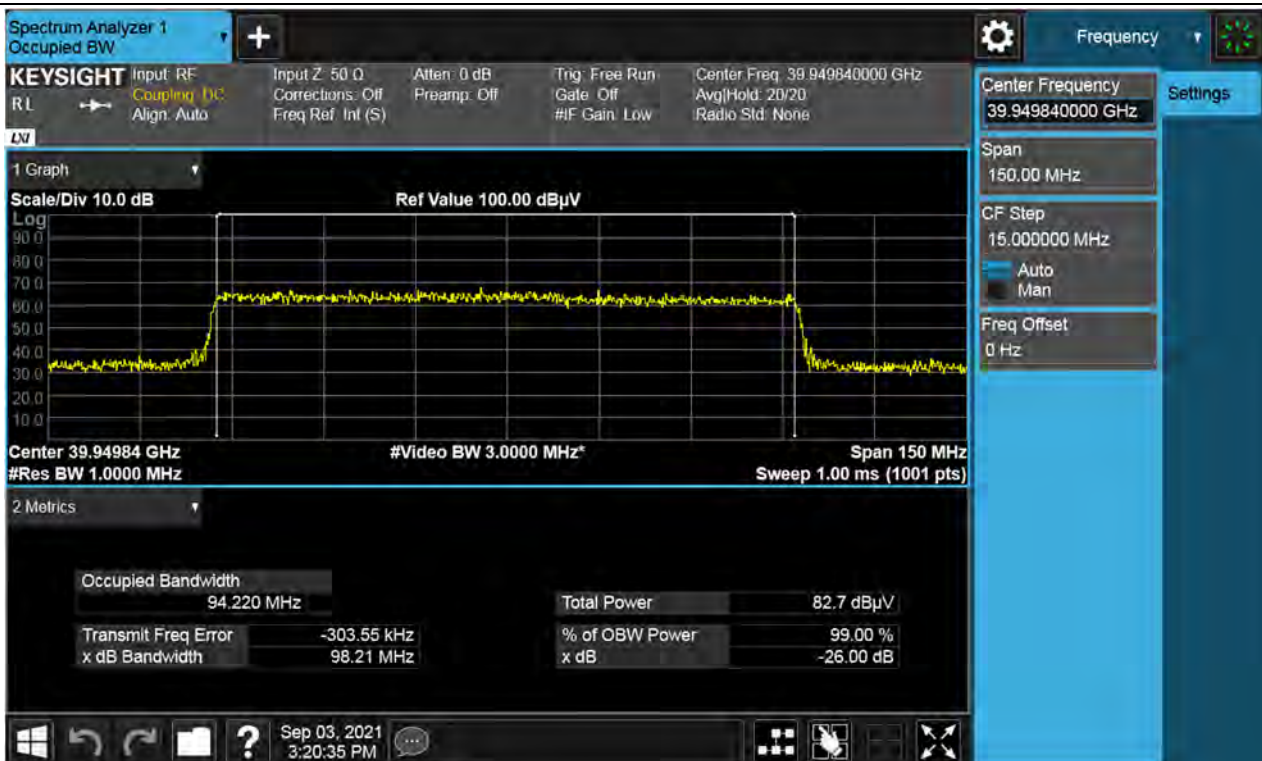
Antenna B / 3+1 cc / QPSK / High_2



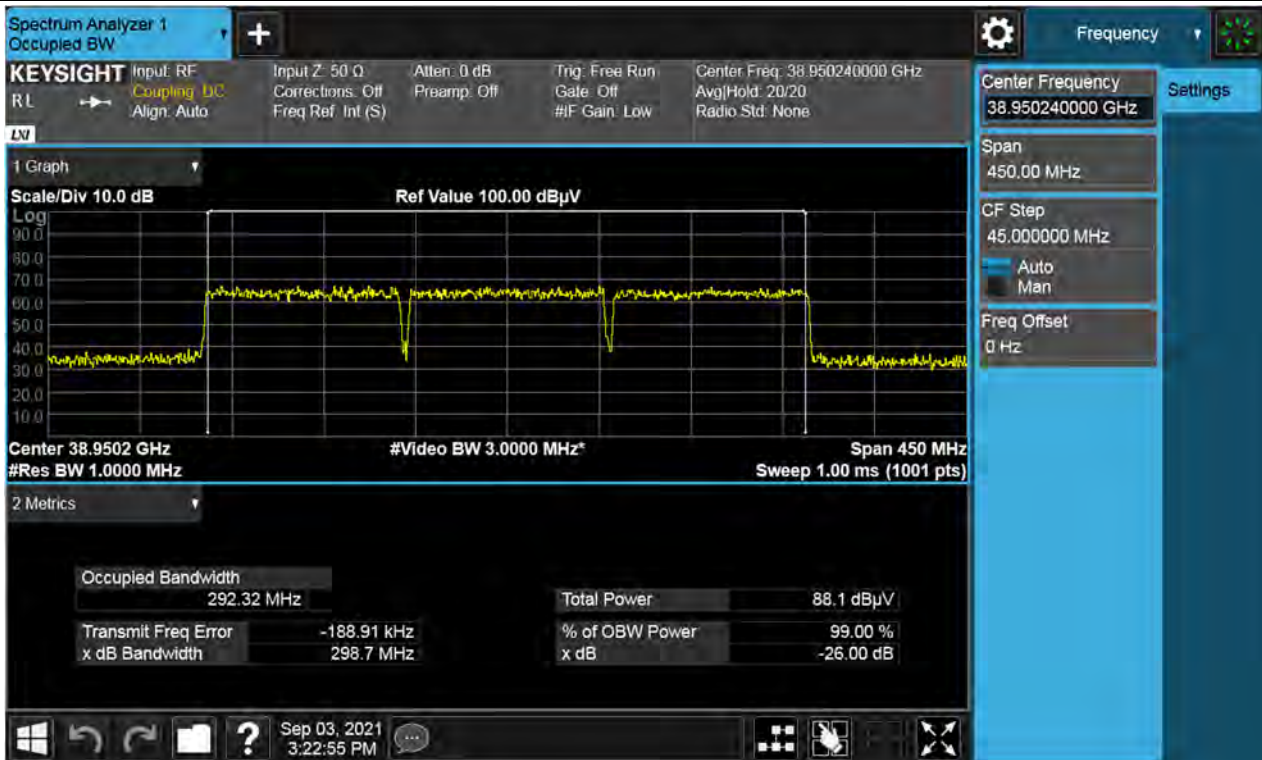
Antenna B / 3+1 cc / 16QAM / High_1



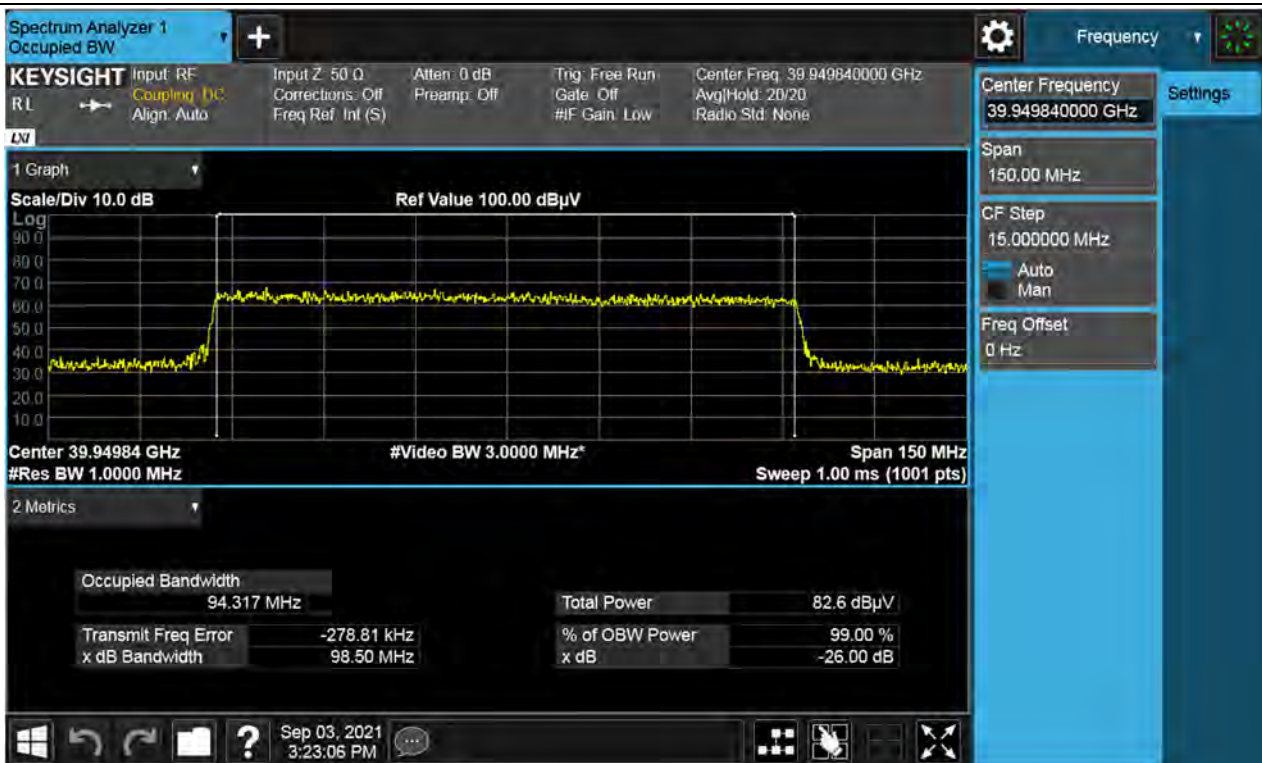
Antenna B / 3+1 cc / 16QAM / High_2



Antenna B / 3+1 cc / 64QAM / High_1



Antenna B / 3+1 cc / 64QAM / High_2



5.2. EIRP DENSITY

FCC Rules

Test Requirements:

§ 30.202 Power limits.

(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.

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

- a) Set span to $2 \times$ to $3 \times$ the OBW.
- b) Set RBW = 1% to 5% of the OBW.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
- e) Sweep time:
 - 1) Set = auto-couple, or
 - 2) Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ for single sweep (automation-compatible) measurement.
- f) Detector = power averaging (rms).
- g) Set sweep trigger to "free run."
- h) 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 time 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.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- j) Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission.

Note:

- 1) Test distance is determined to 1.5 m by far field condition; see test descriptions on page 8.
- 2) In this test, EUT is operated only measurement path is turned on and path has straight beamforming.
- 3) For 4 cc measurement, test is performed for all carriers of 100 MHz bandwidth, but recorded only maximum output level.
- 4) The angle of antenna is set as maximum radiated power conditions.
- 5) EIRP is calculated from measured value according to section 5.2.7 of ANSI C62.26-2015, and the formula is as follows.

$$\begin{aligned} EIRP (dBm) &= E (dB\mu V/m) + 20\log(3m) - 104.77 \\ &= E (dB\mu V/m) - 95.23 \end{aligned}$$

- 6) E (dB μ V/m) value is considered AFCL and Duty cycle factor and it as follow.

$$\begin{aligned} E \text{ (dB}\mu\text{V/m)} &= \text{measurement value (dB}\mu\text{V)} + \text{AFCL (37.05 GHz)} + \text{Duty cycle correction} \\ &= \text{measurement value (dB}\mu\text{V)} + 50.582 + 1.29 \end{aligned}$$

- 7) The output tolerance of the EUT in the specification is ± 4 dB and test result satisfies this condition.

- 8) Sample calculation:

Contiguous

$$\begin{aligned} 87.78 \text{ dB}\mu\text{V (measured Value)} - 6.021(\text{distance}) - 95.2 + 50.582(\text{AFCL}) + 1.29 (\text{Duty}) \\ = 38.43 \text{ dBm (Final EIRP)} \end{aligned}$$

- 9) All modes of operation and modulations were investigated. The test results included in this sections are worst case emission in each emission designator W7D, G7D.

Test Results:

Tabular Data of EIRP Density per path

1. Contiguous

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A	Hor.	1	Low	37.05004	QPSK	87.12	75	37.77
					16QAM	87.37		38.03
					64QAM	87.16		37.81
			Middle	38.49988	QPSK	85.72		37.60
					16QAM	85.60		37.48
					64QAM	85.22		37.10
			High	39.94984	QPSK	84.68		38.21
					16QAM	84.18		37.71
					64QAM	84.48		38.01
		4	Low	37.05004	QPSK	81.44		32.09
				37.05004	16QAM	81.40		32.05
				37.05004	64QAM	81.50		32.15
			Middle	38.54980	QPSK	79.76		31.57
				38.64976	16QAM	79.89		31.36
				38.64976	64QAM	79.84		31.32
			High	39.84988	QPSK	78.03		31.28
				39.64996	16QAM	78.07		31.00
				39.64996	64QAM	77.99		30.91

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
						(dBuV)		
B	Ver.	1	Low	37.05004	QPSK	87.71	75	38.37
					16QAM	87.56		38.21
					64QAM	87.78		38.43
			Middle	38.49988	QPSK	85.98		37.86
					16QAM	86.38		38.26
					64QAM	86.24		38.12
			High	39.94984	QPSK	83.34		36.87
					16QAM	83.11		36.64
					64QAM	83.13		36.66
		4	Low	37.05004	QPSK	82.17		32.82
				37.05004	16QAM	82.26		32.91
				37.05004	64QAM	81.98		32.63
			Middle	38.54980	QPSK	80.65		32.45
				38.64976	16QAM	80.74		32.21
				38.64976	64QAM	80.79		32.26
			High	39.64996	QPSK	78.03		30.96
				39.84988	16QAM	77.65		30.91
				39.84988	64QAM	77.86		31.12

Tabular Data of SUM EIRP Density

Ant.	CC	Channel	Modulation	Ant A EIRP (dBm/100 MHz)	Ant B EIRP (dBm/100 MHz)	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A+B	1	Low	QPSK	37.77	38.37	75	41.09
			16QAM	38.03	38.21		41.13
			64QAM	37.81	38.43		41.14
		Middle	QPSK	37.60	37.86		40.74
			16QAM	37.48	38.26		40.90
			64QAM	37.10	38.12		40.65
		High	QPSK	38.21	36.87		40.60
			16QAM	37.71	36.64		40.22
			64QAM	38.01	36.66		40.40
	4	Low	QPSK	32.09	32.82		35.48
			16QAM	32.05	32.91		35.51
			64QAM	32.15	32.63		35.41
		Middle	QPSK	31.57	32.45		35.04
			16QAM	31.36	32.21		34.82
			64QAM	31.32	32.26		34.83
		High	QPSK	31.28	30.96		34.13
			16QAM	31.00	30.91		33.97
			64QAM	30.91	31.12		34.03

2. Non-Contiguous

Tabular Data of EIRP Density per path

1+3

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A	45°	1+3	Low	37.05004	QPSK	80.48	37	31.13
				37.05004	16QAM	80.29		30.95
				37.05004	64QAM	80.42		31.08
			High	39.84988	QPSK	78.59		31.93
				39.74992	16QAM	78.37		31.49
				39.74992	64QAM	78.35		31.37
B	135°		Low	37.05004	QPSK	81.38		32.04
				37.05004	16QAM	81.33		31.98
				37.05004	64QAM	81.44		32.10
			High	39.84988	QPSK	79.05		32.31
				39.84988	16QAM	78.90		32.16
				39.84988	64QAM	78.75		32.01

3+1

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A	45°	3+1	Low	37.15000	QPSK	80.85	37	31.94
				37.15000	16QAM	81.10		32.19
				37.15000	64QAM	81.27		32.36
			High	38.95024	QPSK	77.43		29.42
				38.95024	16QAM	77.71		29.71
				38.95024	64QAM	77.49		29.48
B	135°		Low	37.15000	QPSK	81.63		32.72
				37.15000	16QAM	81.53		32.62
				37.15000	64QAM	81.63		32.71
			High	38.85028	QPSK	78.29		30.12
				38.95024	16QAM	78.48		30.47
				38.95024	64QAM	78.31		30.31

Tabular Data of SUM EIRP Density

Ant.	CC	Channel	Modulation	Ant A EIRP (dBm/100 MHz)	Ant B EIRP (dBm/100 MHz)	Limit (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A+B	1+3	Low	QPSK	31.13	31.94	37	34.56
			16QAM	30.95	32.19		34.62
			64QAM	31.08	32.36		34.78
		High	QPSK	31.93	29.42		33.86
			16QAM	31.49	29.71		33.70
			64QAM	31.37	29.48		33.54
	3+1	Low	QPSK	32.04	32.72		35.40
			16QAM	31.98	32.62		35.32
			64QAM	32.10	32.71		35.43
		High	QPSK	32.31	30.12		34.36
			16QAM	32.16	30.47		34.41
			64QAM	32.01	30.31		34.25

Plot Data of EIRP Density Tabular per path

Antenna A / 1cc / QPSK / Low



Antenna A / 1cc / 16QAM / Low



Antenna A / 1cc / 64QAM / Low



Antenna A / 1cc / QPSK / Middle



Antenna A / 1cc / 16QAM / Middle



Antenna A / 1cc / 64QAM / Middle



Antenna A / 1cc / QPSK / High



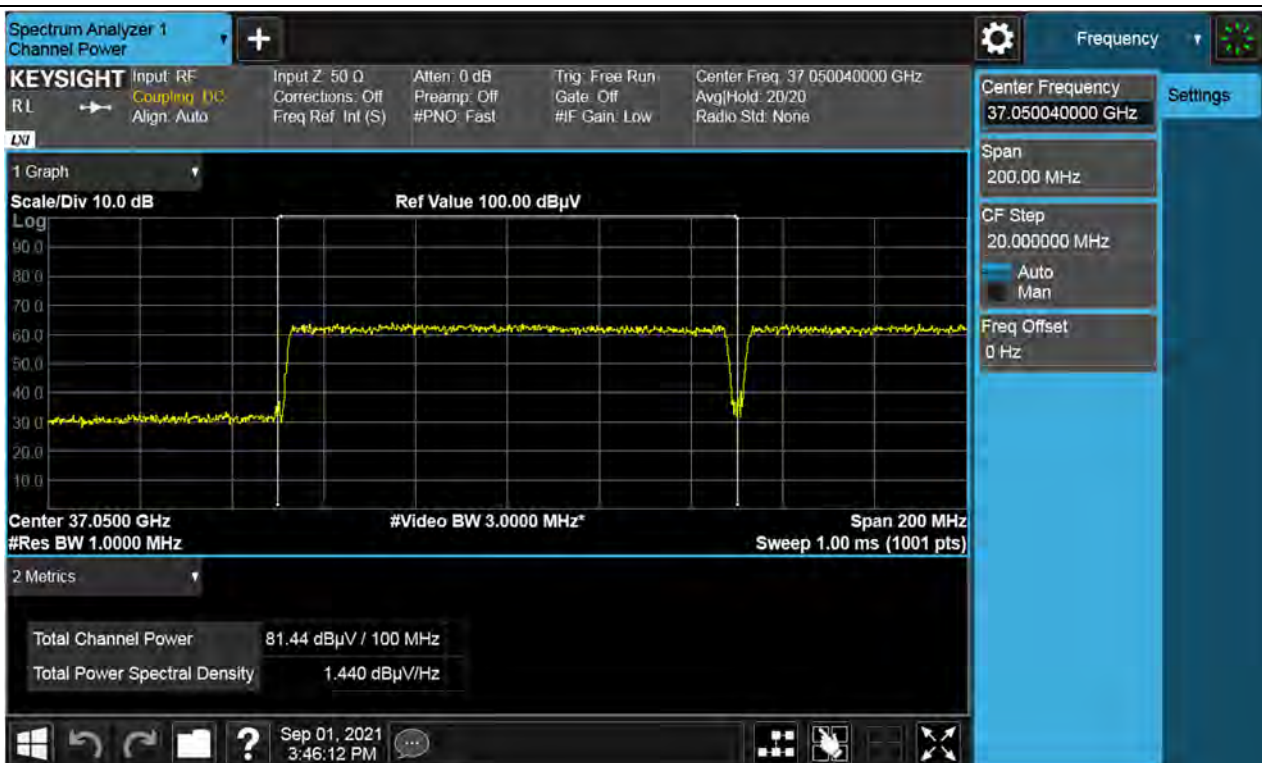
Antenna A / 1cc / 16QAM / High



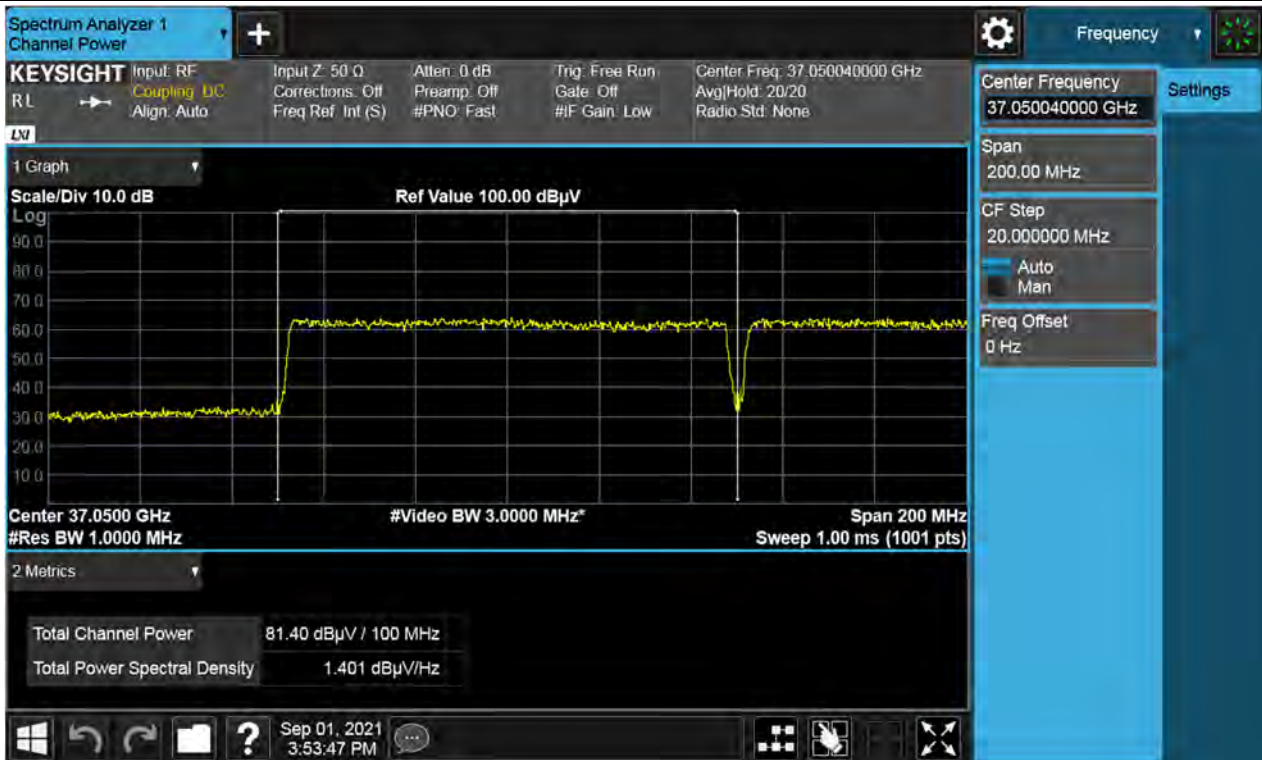
Antenna A / 1cc / 64QAM / High



Antenna A / 4cc / QPSK / Low



Antenna A / 4cc / 16QAM / Low



Antenna A / 4cc / 64QAM / Low



Antenna A / 4cc / QPSK / Middle



Antenna A / 4cc / 16QAM / Middle



Antenna A / 4cc / 64QAM / Middle



Antenna A / 4cc / QPSK / High



Antenna A / 4cc / 16QAM / High



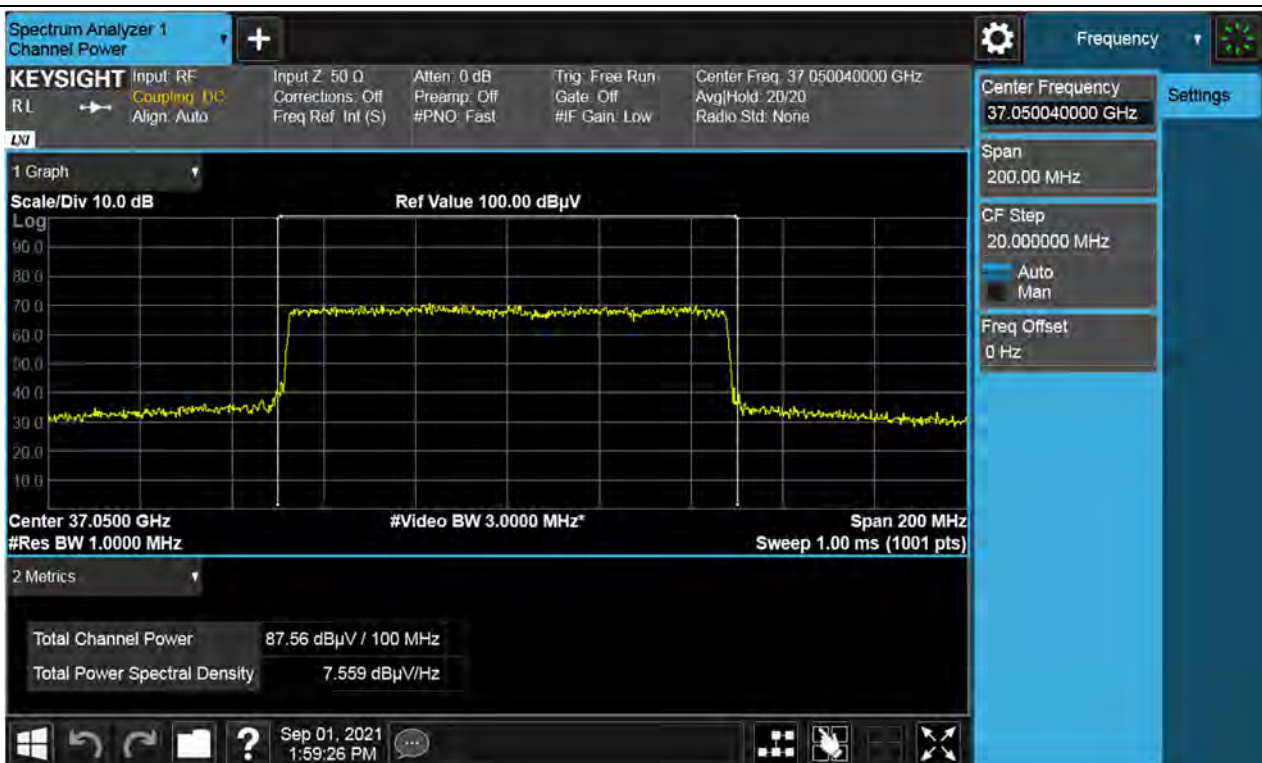
Antenna A / 4cc / 64QAM / High



Antenna B / 1cc / QPSK / Low



Antenna B / 1cc / 16QAM / Low



Antenna B / 1cc / 64QAM / Low



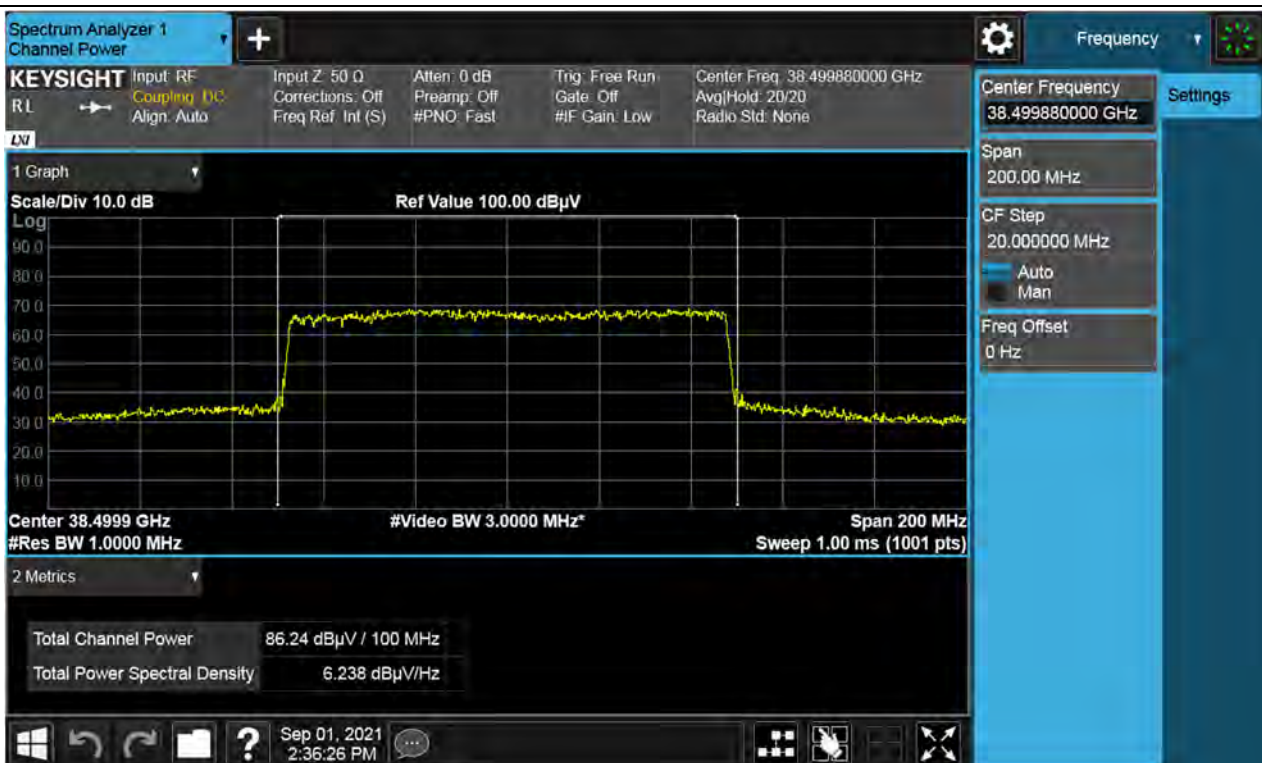
Antenna B / 1cc / QPSK / Middle



Antenna B / 1cc / 16QAM / Middle



Antenna B / 1cc / 64QAM / Middle



Antenna B / 1cc / QPSK / High



Antenna B / 1cc / 16QAM / High



Antenna B / 1cc / 64QAM / High



Antenna B / 4cc / QPSK / Low



Antenna B / 4cc / 16QAM / Low



Antenna B / 4cc / 64QAM / Low



Antenna B / 4cc / QPSK / Middle



Antenna B / 4cc / 16QAM / Middle



Antenna B / 4cc / 64QAM / Middle



Antenna B / 4cc / QPSK / High



Antenna B / 4cc / 16QAM / High



Antenna B / 4cc / 64QAM / High



Antenna A / 1+3 cc / QPSK / Low



Antenna A / 1+3 cc / 16QAM / Low



Antenna A / 1+3 cc / 64QAM / Low



Antenna A / 1+3 cc / QPSK / High



Antenna A / 1+3 cc / 16QAM / High



Antenna A / 1+3 cc / 64QAM / High



Antenna B / 1+3 cc / QPSK / Low



Antenna B / 1+3 cc / 16QAM / Low



Antenna B / 1+3 cc / 64QAM / Low



Antenna B / 1+3 cc / QPSK / High



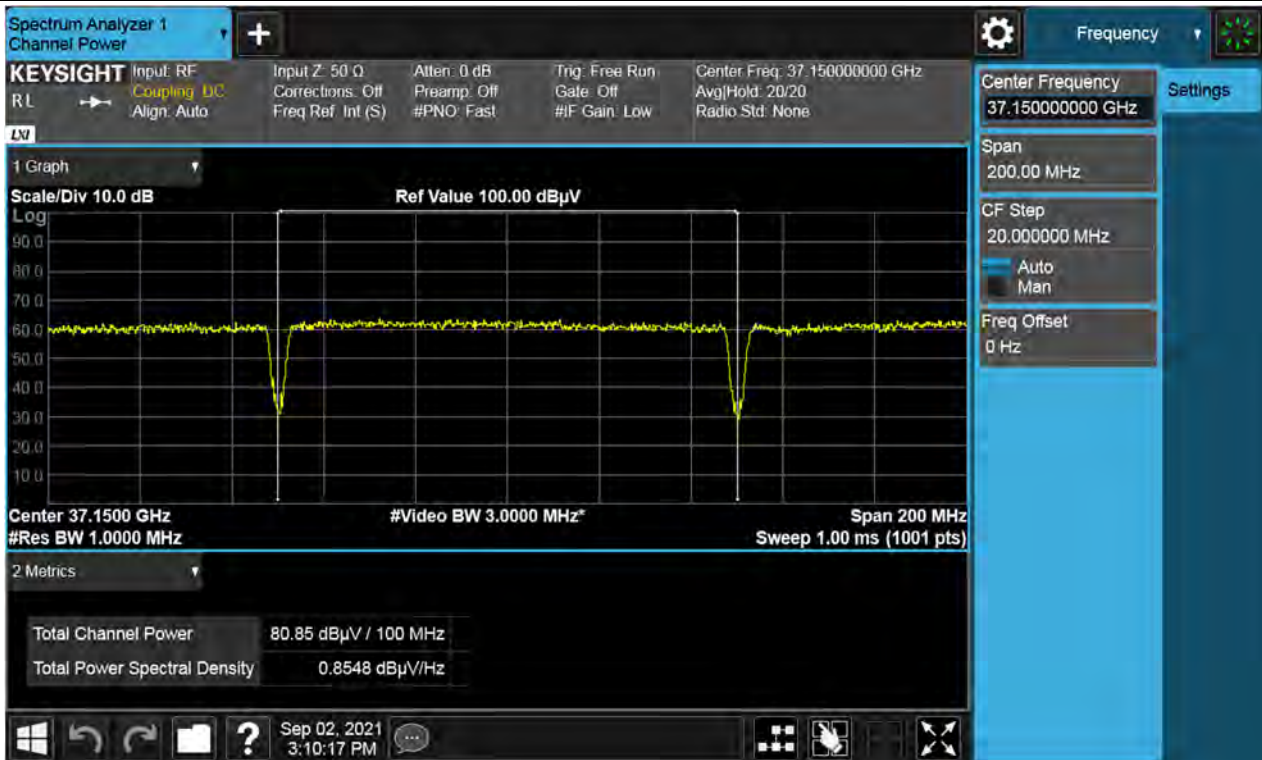
Antenna B / 1+3 cc / 16QAM / High



Antenna B / 1+3 cc / 64QAM / High



Antenna A / 3+1 cc / QPSK / Low



Antenna A / 3+1 cc / 16QAM / Low



Antenna A / 3+1 cc / 64QAM / Low



Antenna A / 3+1 cc / QPSK / High



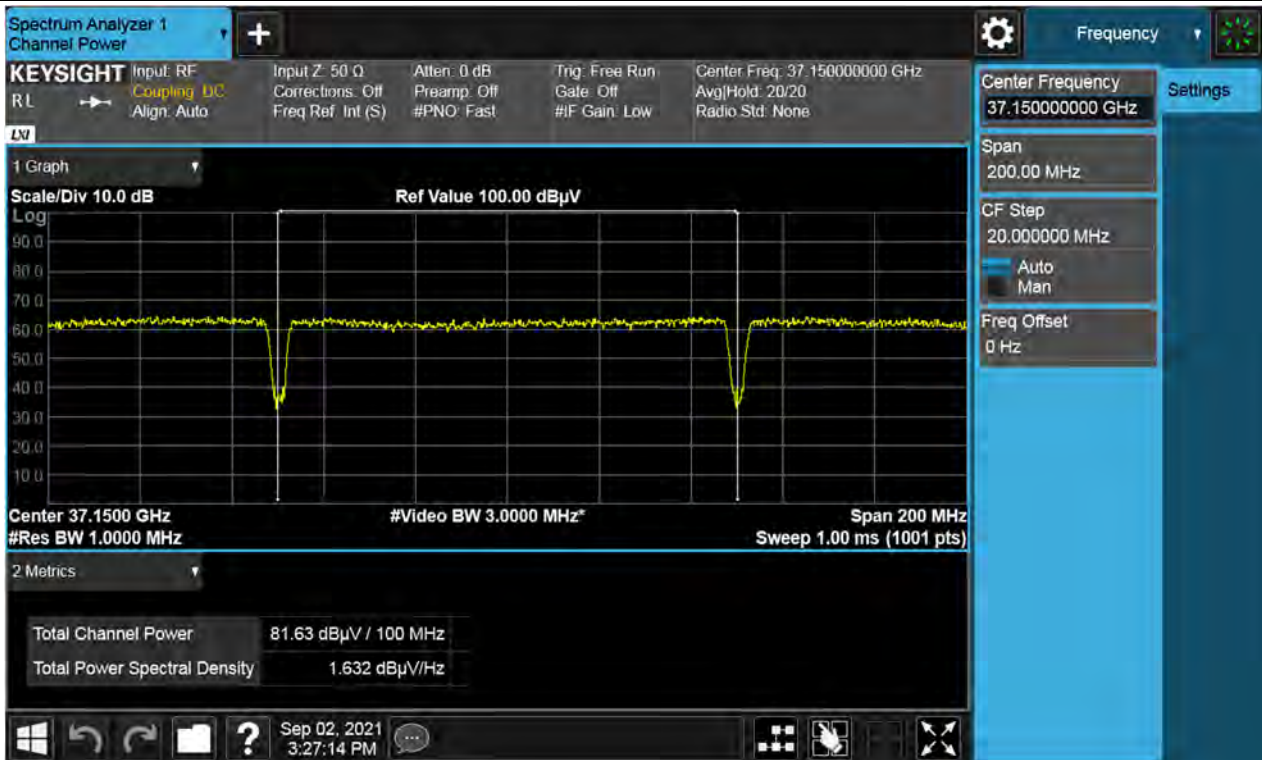
Antenna A / 3+1 cc / 16QAM / High



Antenna A / 3+1 cc / 64QAM / High



Antenna B / 3+1 cc / QPSK / Low



Antenna B / 3+1 cc / 16QAM / Low



Antenna B / 3+1 cc / 64QAM / Low



Antenna B / 3+1 cc / QPSK / High



Antenna B / 3+1 cc / 16QAM / High



Antenna B / 3+1 cc / 64QAM / High



5.3. EQUIVALENT ISOTROPIC RADIATED POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

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

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

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

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

- a) Set span to $2 \times$ to $3 \times$ the OBW.
- b) Set RBW = 1% to 5% of the OBW.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
- e) Sweep time:
 - 1) Set = auto-couple, or
 - 2) Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ for single sweep (automation-compatible) measurement.
- f) Detector = power averaging (rms).
- g) Set sweep trigger to "free run."
- h) 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 time 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.
- i) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- j) Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission.

Note:

- 1) Basic test conditions are same as EIRP test on page 24.
- 2) Same 400 MHz bandwidth applies for 1cc and 4 cc.
- 3) Final conducted power is calculated as follows

$$\text{Conducted Power (dBm)} = \text{EIRP (dBm)} - \text{Antenna Gain (dBi)}$$

- 4) Antenna Gain of the above formula was applied from actual measurement data of the radiation pattern document.

- 5) Sample calculation

Antenna A, 4cc, Low, QPSK:

Contiguous

$$\begin{aligned} &86.93 \text{ dB}\mu\text{V (measured)} - 6.021 \text{ (distance)} - 95.2 + 50.582(\text{AFCL}) + 1.29 \text{ (Duty)} \\ &= 37.58 \text{ dBm (Final conducted output power)} \end{aligned}$$

Antenna B, 4cc, Low, QPSK:

Contiguous

$$\begin{aligned} &87.82 \text{ dB}\mu\text{V (measured)} - 6.021 \text{ (distance)} - 95.2 + 50.582(\text{AFCL}) + 1.29 \text{ (Duty)} \\ &= 38.47 \text{ dBm (Final conducted output power)} \end{aligned}$$

· *Contiguous*

Total Output Power (1cc, Low, QPKS):

Conversion dBm to mW (Antenna A)

$$10^{(37.58 \text{ dBm} / 10)} = 5727.96 \text{ mW}$$

Conversion dBm to mW (Antenna B)

$$10^{(38.47 \text{ dBm} / 10)} = 7030.72 \text{ mW}$$

Sum each antenna power

$$5727.96 \text{ mW (Ant.A)} + 7030.72 \text{ mW (Ant.B)} = 12758.68 \text{ mW}$$

Conversion mW to dBm

$$10\text{LOG}(12758.68 \text{ mW}) = 41.06 \text{ dBm}$$

Test Results:
Tabular Data of Equivalent Isotropic Radiated Power
1. Contiguous

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	45°	1	Low	37.05004	QPSK	86.33	36.99
					16QAM	86.43	37.09
					64QAM	86.52	37.18
			Middle	38.49988	QPSK	84.92	36.79
					16QAM	84.53	36.40
					64QAM	84.43	36.31
			High	39.94984	QPSK	83.70	37.23
					16QAM	83.52	37.05
					64QAM	83.86	37.39
		4	Low	37.19998	QPSK	86.93	37.58
					16QAM	87.00	37.66
					64QAM	87.08	37.73
			Middle	38.49982	QPSK	85.20	37.08
					16QAM	85.25	37.13
					64QAM	85.11	36.99
			High	39.79990	QPSK	83.73	37.26
					16QAM	83.63	37.16
					64QAM	83.51	37.04

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
B	135°	1	Low	37.05004	QPSK	87.13	37.79
					16QAM	87.54	38.20
					64QAM	86.84	37.49
			Middle	38.49988	QPSK	85.40	37.28
					16QAM	84.95	36.83
					64QAM	84.95	36.83
			High	39.94984	QPSK	82.45	35.98
					16QAM	82.38	35.91
					64QAM	82.12	35.65
		4	Low	37.19998	QPSK	87.82	38.47
					16QAM	87.58	38.24
					64QAM	87.38	38.04
			Middle	38.49982	QPSK	85.79	37.66
					16QAM	85.79	37.67
					64QAM	85.78	37.66
			High	39.79990	QPSK	83.48	37.01
					16QAM	83.25	36.78
					64QAM	83.31	36.84

Tabular Data of Conducted SUM Output Power

Antenna	CC	Channel	Mod.	Ant. A (dBm)	Ant. B (dBm)	Result (dBm)
A+B	1	Low	QPSK	36.99	37.79	40.42
			16QAM	37.09	38.20	40.69
			64QAM	37.18	37.49	40.35
		Middle	QPSK	36.79	37.28	40.05
			16QAM	36.40	36.83	39.63
			64QAM	36.31	36.83	39.59
		High	QPSK	37.23	35.98	39.66
			16QAM	37.05	35.91	39.53
			64QAM	37.39	35.65	39.62
	4	Low	QPSK	37.58	38.47	41.06
			16QAM	37.66	38.24	40.97
			64QAM	37.73	38.04	40.90
		Middle	QPSK	37.08	37.66	40.39
			16QAM	37.13	37.67	40.42
			64QAM	36.99	37.66	40.35
		High	QPSK	37.26	37.01	40.15
			16QAM	37.16	36.78	39.98
			64QAM	37.04	36.84	39.95

2. Non-Contiguous

1+3

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	45°	1+3	Low	37.59976	QPSK	85.51	36.55
					16QAM	85.54	36.59
					64QAM	85.56	36.60
			High	39.40006	QPSK	83.09	35.59
					16QAM	83.08	35.58
					64QAM	82.84	35.34
B	135°		Low	37.59976	QPSK	85.85	36.90
					16QAM	85.99	37.03
					64QAM	86.16	37.21
			High	39.40006	QPSK	83.19	35.69
					16QAM	83.19	35.69
					64QAM	83.39	35.88

3+1

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	45°	3+1	Low	37.59976	QPSK	85.90	36.95
					16QAM	86.34	37.39
					64QAM	86.29	37.34
			High	39.40006	QPSK	82.67	35.17
					16QAM	83.12	35.61
					64QAM	82.93	35.42
B	135°		Low	37.59976	QPSK	86.96	38.01
					16QAM	86.75	37.80
					64QAM	86.87	37.92
			High	39.40006	QPSK	83.65	36.15
					16QAM	83.71	36.20
					64QAM	83.65	36.15

Tabular Data of Conducted Output Power for MIMO

Antenna	CC	Channel	Mod.	Ant. A (dBm)	Ant. B (dBm)	Result (dBm)
A+B	1+3	Low	QPSK	36.55	36.90	39.74
			16QAM	36.59	37.03	39.83
			64QAM	36.60	37.21	39.93
		High	QPSK	35.59	35.69	38.65
			16QAM	35.58	35.69	38.65
			64QAM	35.34	35.88	38.63
	3+1	Low	QPSK	36.95	38.01	40.52
			16QAM	37.39	37.80	40.61
			64QAM	37.34	37.92	40.65
		High	QPSK	35.17	36.15	38.70
			16QAM	35.61	36.20	38.93
			64QAM	35.42	36.15	38.81

Plot Data of Equivalent Isotropic Radiated Power

Antenna A / 1cc / QPSK / Low



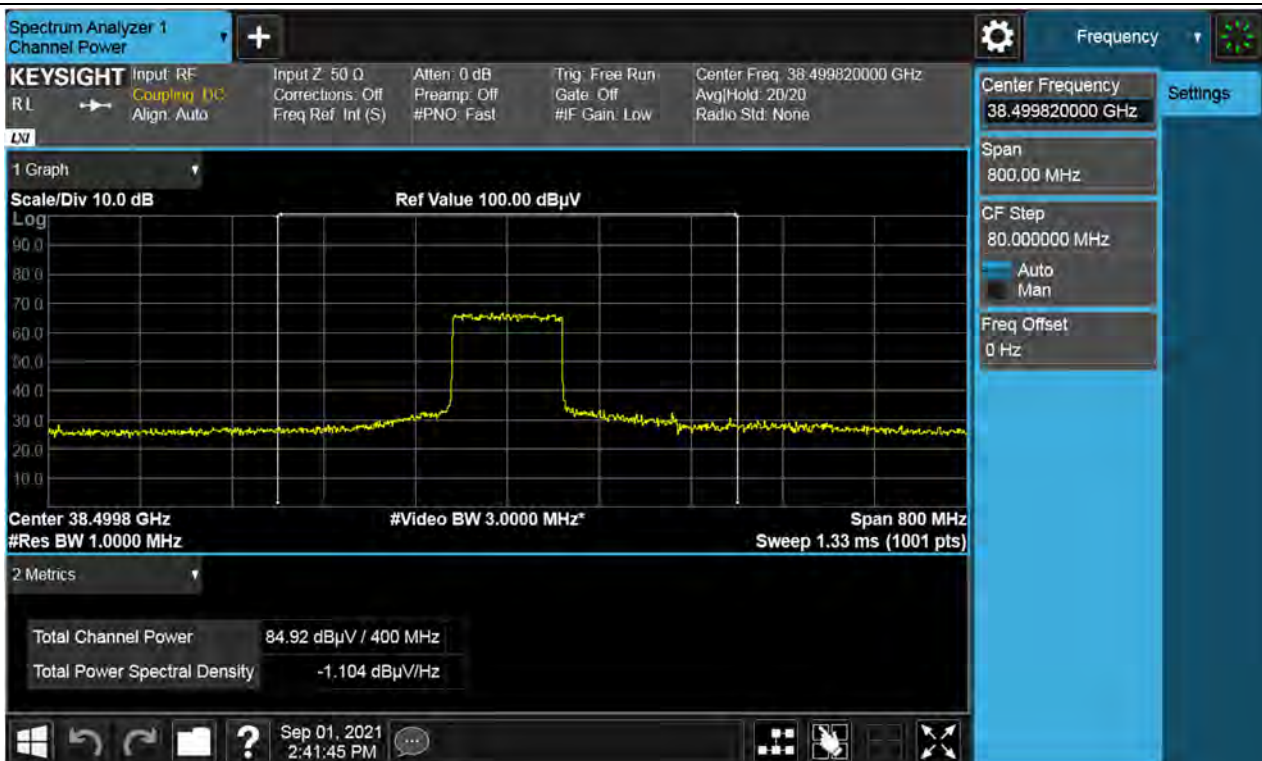
Antenna A / 1cc / 16QAM / Low



Antenna A / 1cc / 64QAM / Low



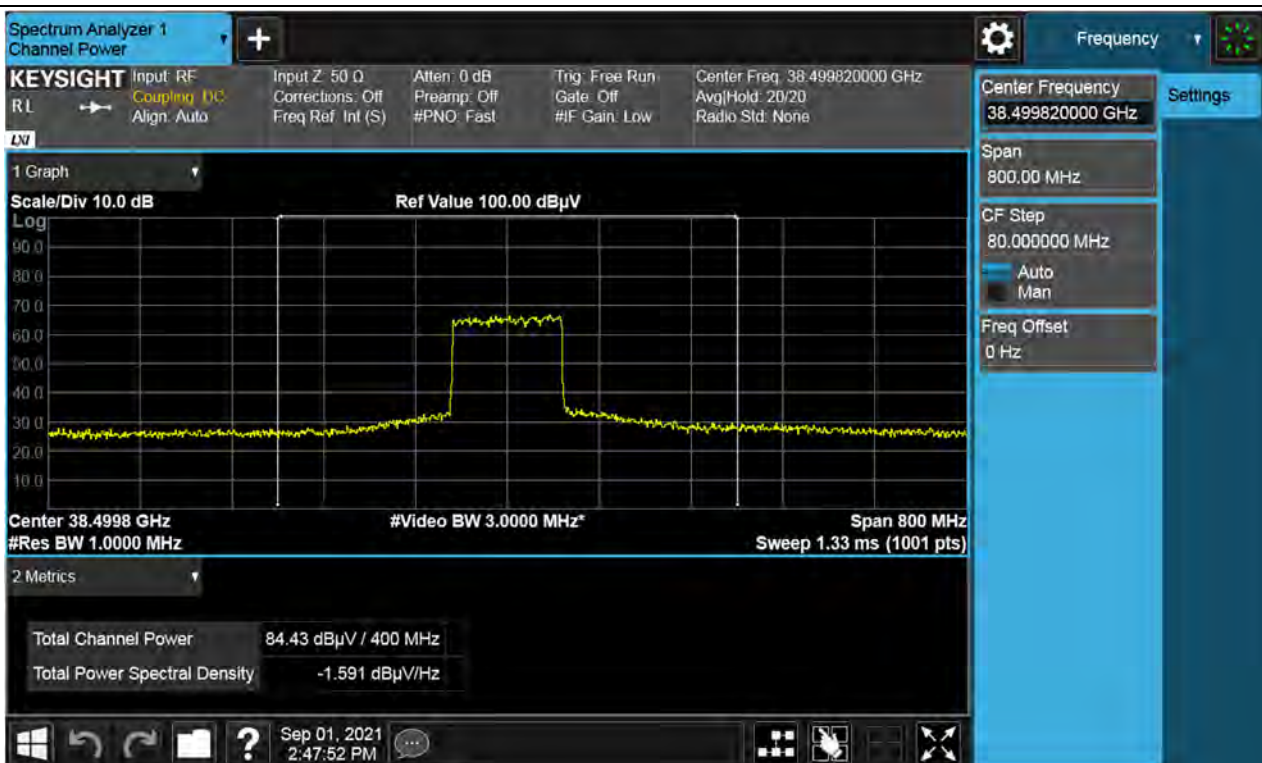
Antenna A / 1cc / QPSK / Middle



Antenna A / 1cc / 16QAM / Middle



Antenna A / 1cc / 64QAM / Middle



Antenna A / 1cc / QPSK / High



Antenna A / 1cc / 16QAM / High

