CERTIFICATION TEST REPORT

Report Number. : 4789424849-E9V4

Applicant : SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Model : SM-A716V

FCC ID : A3LSMA716V

EUT Description : GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC

Test Standard(s) : FCC CFR47 PART 30 Mobile Transmitter (5GM)

Date Of Issue:
June 16, 2020

Prepared by:
UL Korea, Ltd.
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Suwon Test Site: UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
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IAS ACCREDITED
Testing Laboratory
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	06/09/20	Initial issue	Seokhwan Hong
V2	06/11/20	Updated to address TCB's question	Seokhwan Hong
V3	06/15/20	Updated to address TCB's question	Seokhwan Hong
V4	06/16/20	Updated to address TCB's question	Seokhwan Hong

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218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC

MODEL NUMBER: SM-A716V

SERIAL NUMBER: R3CN20P2Q4P, R3CN20P2QWK, R3CN20P1C1B, R3CN20P1BVT, R3CN20P1BYV

DATE TESTED: MAY 04, 2020 – JUN 09, 2020;

APPLICABLE STANDARDS

STANDARD	TEST RESULTS
FCC PART 30 Mobile Transmitter (5GM)	Pass

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Seokhwan Hong
Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 30.
3. ANSI C63.26-2015
4. KDB 842590 D01 Upper Microwave Flexible Use Service v01r01
5. KDB 971168 D01 Power Meas License Digital Systems v03r01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do,16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro
☐ Chamber 1
☒ Chamber 2
☐ Chamber 3
☒ mmWave Chamber 1

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength[dBuV/m] = PXA reading with EUT worst orientation (dBm) + Antenna Factor(dBuV/m) + cable loss(dB) + 107

EIRP[dBm] = PXA reading with EUT worst orientation (dBm) + Path loss (dB) – cable loss(between the SG and substitution antenna) + Substitution Antenna Factor (dBi)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.35 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.49 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.82 dB
Radiated Disturbance, Above 18 GHz	5.49 dB

Uncertainty figures are valid to a confidence level of 95%.

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedure 1, Clause 4.4.2 in IEC Guide 115:2007.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC. This test report addresses the 5G NR operational mode.

The EUT has an array antenna configuration. 4 patches, placed on the left and right side (denoted as K patch and L Patch).
Each of the patch antennas is comprised of two separate antenna feeds - one for horizontal and one for vertical polarization. Only one array antenna can be active at a time.

Antenna	Name
Antenna 1	K Patch
Antenna 2	L Patch

The EUT supports up to 8CC for DL, and 2CC for UL. For each CC, the EUT supports both 50MHz bandwidth and 100MHz bandwidth.
For modulation, the EUT supports a subcarrier spacing (SCS) of 120kHz with two transmission schemes, CP-OFDM and DFT-s-OFDM, with QPSK, 16-QAM, and 64-QAM modulations.

Different Beam IDs are supported, each corresponding to a different position in space for each antenna. During testing, FTM (Factory Test Mode) was used to operate the transmitter.
MIMO operation was achieved by enabling two Beam IDs at the same time: one is from the list of H Beam IDs and other is from the list of V Beam IDs.

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5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum average radiated EIRP output powers as follows:

Ant 1 / Band n261

FCC Part 30								
Band	Frequency Range [MHz]	Antenna	Mode	BandWidth [MHz]	CCs Active	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n261	27500 - 28350	Antenna 1	SISO	50	1	QPSK	22.21	166.34
		Antenna 1	SISO	50	1	16QAM	21.60	144.54
		Antenna 1	SISO	50	1	64QAM	18.53	71.29
		Antenna 1	MIMO	50	1	QPSK	**24.05**	**254.10**
		Antenna 1	MIMO	50	1	16QAM	22.54	179.47
		Antenna 1	MIMO	50	1	64QAM	20.14	103.28
		Antenna 1	SISO	50	2	QPSK	19.82	95.94
		Antenna 1	SISO	50	2	16QAM	19.36	86.30
		Antenna 1	SISO	50	2	64QAM	17.54	56.75
		Antenna 1	MIMO	50	2	QPSK	21.91	155.24
		Antenna 1	MIMO	50	2	16QAM	20.31	107.40
		Antenna 1	MIMO	50	2	64QAM	17.94	62.23
		Antenna 1	SISO	100	1	QPSK	22.76	188.80
		Antenna 1	SISO	100	1	16QAM	21.59	144.21
		Antenna 1	SISO	100	1	64QAM	20.31	107.40
		Antenna 1	MIMO	100	1	QPSK	22.96	197.70
		Antenna 1	MIMO	100	1	16QAM	20.94	124.17
		Antenna 1	MIMO	100	1	64QAM	17.95	62.37
		Antenna 1	SISO	100	2	QPSK	19.34	85.90
		Antenna 1	SISO	100	2	16QAM	18.77	75.34
		Antenna 1	SISO	100	2	64QAM	17.18	52.24
		Antenna 1	MIMO	100	2	QPSK	20.38	109.14
		Antenna 1	MIMO	100	2	16QAM	18.73	74.64
		Antenna 1	MIMO	100	2	64QAM	16.21	41.78

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Ant 1 / Band n260

FCC Part 30								
Band	Frequency Range [MHz]	Antenna	Mode	BandWidth [MHz]	CCs Active	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n260	37000 - 40000	Antenna 1	SISO	50	1	QPSK	22.88	194.09
		Antenna 1	SISO	50	1	16QAM	21.35	136.46
		Antenna 1	SISO	50	1	64QAM	19.03	79.98
		Antenna 1	MIMO	50	1	QPSK	**24.14**	**259.42**
		Antenna 1	MIMO	50	1	16QAM	23.23	210.38
		Antenna 1	MIMO	50	1	64QAM	20.31	107.40
		Antenna 1	SISO	50	2	QPSK	20.00	100.00
		Antenna 1	SISO	50	2	16QAM	19.69	93.11
		Antenna 1	SISO	50	2	64QAM	17.47	55.85
		Antenna 1	MIMO	50	2	QPSK	21.39	137.72
		Antenna 1	MIMO	50	2	16QAM	19.72	93.76
		Antenna 1	MIMO	50	2	64QAM	17.09	51.17
		Antenna 1	SISO	100	1	QPSK	23.06	202.30
		Antenna 1	SISO	100	1	16QAM	22.21	166.34
		Antenna 1	SISO	100	1	64QAM	19.40	87.10
		Antenna 1	MIMO	100	1	QPSK	23.67	232.81
		Antenna 1	MIMO	100	1	16QAM	23.01	199.99
		Antenna 1	MIMO	100	1	64QAM	19.79	95.28
		Antenna 1	SISO	100	2	QPSK	19.26	84.33
		Antenna 1	SISO	100	2	16QAM	18.65	73.28
		Antenna 1	SISO	100	2	64QAM	16.45	44.16
		Antenna 1	MIMO	100	2	QPSK	21.95	156.68
		Antenna 1	MIMO	100	2	16QAM	20.31	107.40
		Antenna 1	MIMO	100	2	64QAM	17.56	57.02

Ant 2 / Band n261

FCC Part 30								
Band	Frequency Range [MHz]	Antenna	Mode	BandWidth [MHz]	CCs Active	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n261	27500 - 28350	Antenna 2	SISO	50	1	QPSK	22.01	158.85
		Antenna 2	SISO	50	1	16QAM	21.46	139.96
		Antenna 2	SISO	50	1	64QAM	21.04	127.06
		Antenna 2	MIMO	50	1	QPSK	**24.43**	**277.33**
		Antenna 2	MIMO	50	1	16QAM	23.61	229.61
		Antenna 2	MIMO	50	1	64QAM	20.72	118.03
		Antenna 2	SISO	50	2	QPSK	19.93	98.40
		Antenna 2	SISO	50	2	16QAM	19.47	88.51
		Antenna 2	SISO	50	2	64QAM	17.59	57.41
		Antenna 2	MIMO	50	2	QPSK	21.81	151.71
		Antenna 2	MIMO	50	2	16QAM	20.32	107.65
		Antenna 2	MIMO	50	2	64QAM	17.83	60.67
		Antenna 2	SISO	100	1	QPSK	21.84	152.76
		Antenna 2	SISO	100	1	16QAM	21.46	139.96
		Antenna 2	SISO	100	1	64QAM	19.30	85.11
		Antenna 2	MIMO	100	1	QPSK	24.38	274.16
		Antenna 2	MIMO	100	1	16QAM	22.94	196.79
		Antenna 2	MIMO	100	1	64QAM	20.64	115.88
		Antenna 2	SISO	100	2	QPSK	20.45	110.92
		Antenna 2	SISO	100	2	16QAM	19.53	89.74
		Antenna 2	SISO	100	2	64QAM	17.73	59.29
		Antenna 2	MIMO	100	2	QPSK	21.44	139.32
		Antenna 2	MIMO	100	2	16QAM	19.85	96.61
		Antenna 2	MIMO	100	2	64QAM	17.37	54.58

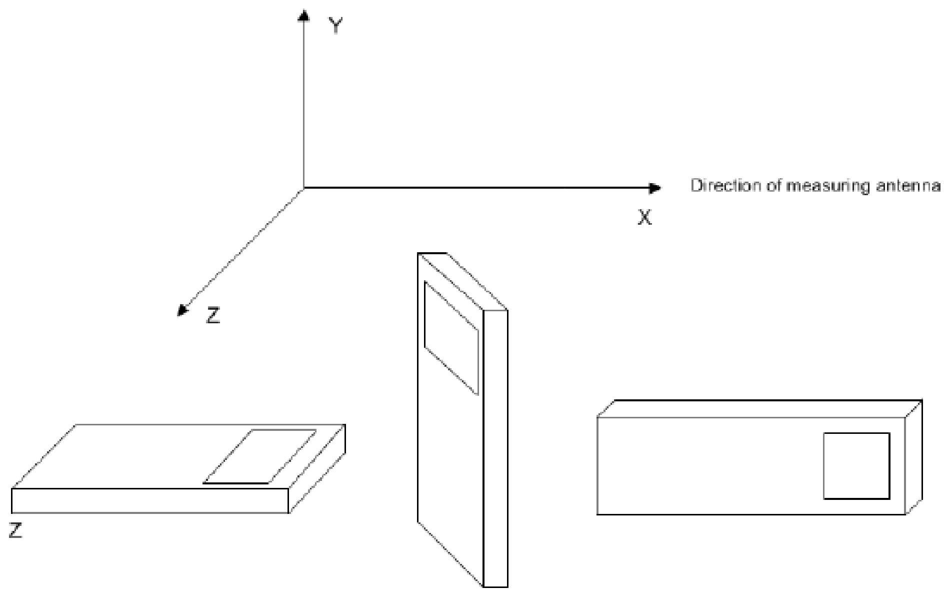
Ant 2 / Band n260

FCC Part 30								
Band	Frequency Range [MHz]	Antenna	Mode	BandWidth [MHz]	CCs Active	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n260	37000 - 40000	Antenna 2	SISO	50	1	QPSK	21.70	147.91
		Antenna 2	SISO	50	1	16QAM	21.16	130.62
		Antenna 2	SISO	50	1	64QAM	19.77	94.84
		Antenna 2	MIMO	50	1	QPSK	23.82	240.99
		Antenna 2	MIMO	50	1	16QAM	22.90	194.98
		Antenna 2	MIMO	50	1	64QAM	20.27	106.41
		Antenna 2	SISO	50	2	QPSK	19.83	96.16
		Antenna 2	SISO	50	2	16QAM	19.38	86.70
		Antenna 2	SISO	50	2	64QAM	16.94	49.43
		Antenna 2	MIMO	50	2	QPSK	21.16	130.62
		Antenna 2	MIMO	50	2	16QAM	19.75	94.41
		Antenna 2	MIMO	50	2	64QAM	17.09	51.17
		Antenna 2	SISO	100	1	QPSK	22.82	191.43
		Antenna 2	SISO	100	1	16QAM	22.28	169.04
		Antenna 2	SISO	100	1	64QAM	18.43	69.66
		Antenna 2	MIMO	100	1	QPSK	**24.26**	**266.69**
		Antenna 2	MIMO	100	1	16QAM	22.43	174.98
		Antenna 2	MIMO	100	1	64QAM	18.62	72.78
		Antenna 2	SISO	100	2	QPSK	17.30	53.70
		Antenna 2	SISO	100	2	16QAM	16.91	49.09
		Antenna 2	SISO	100	2	64QAM	14.81	30.27
		Antenna 2	MIMO	100	2	QPSK	21.11	129.12
		Antenna 2	MIMO	100	2	16QAM	19.76	94.62
		Antenna 2	MIMO	100	2	64QAM	16.95	49.55

5.3. WORST-CASE ORIENTATION

For all 5G NR FR2 Bands, the worst-case scenario for all measurements is based on the EIRP measurement investigation results. EIRP were measured on QPSK, 16QAM and 64QAM modulations. It was found that QPSK results were worst case. 16QAM and 64QAM is EIRP testing was performed using based on QPSK worst channel modulations to represent the worst case. However, the out of band emissions and spurious radiation were only performed on bandwidth and RB offset(with RB size 1) with the highest EIRP in QPSK.

The fundamental and radiated spurious emission were investigated in three orthogonal orientations X, Y and Z, it was determined that below orientation was worst-case orientation for each band.



Note : EIRP Simulation data for all Beam IDs was used to determine the worst case Beam ID for SISO operation and Beam ID pair for MIMO operation. These Beam ID’s were used for final measurements.

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5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Charger	SAMSUNG	EP-TA800	R37KAT21494SE3	N/A
Data Cable	SAMSUNG	EP-DA705BBE	N/A	N/A

I/O CABLE

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC Power	1	C Type	Shielded	1.0m	N/A

TEST SETUP

All testing was performed using FTM (Factory Test Mode) software at continuous Tx operation. When implemented out in the field, the EUT will operate with a maximum uplink configuration (i.e., a maximum uplink duty cycle of 100%). The FTM software was also used for the EUT operation in the ENDC mode.

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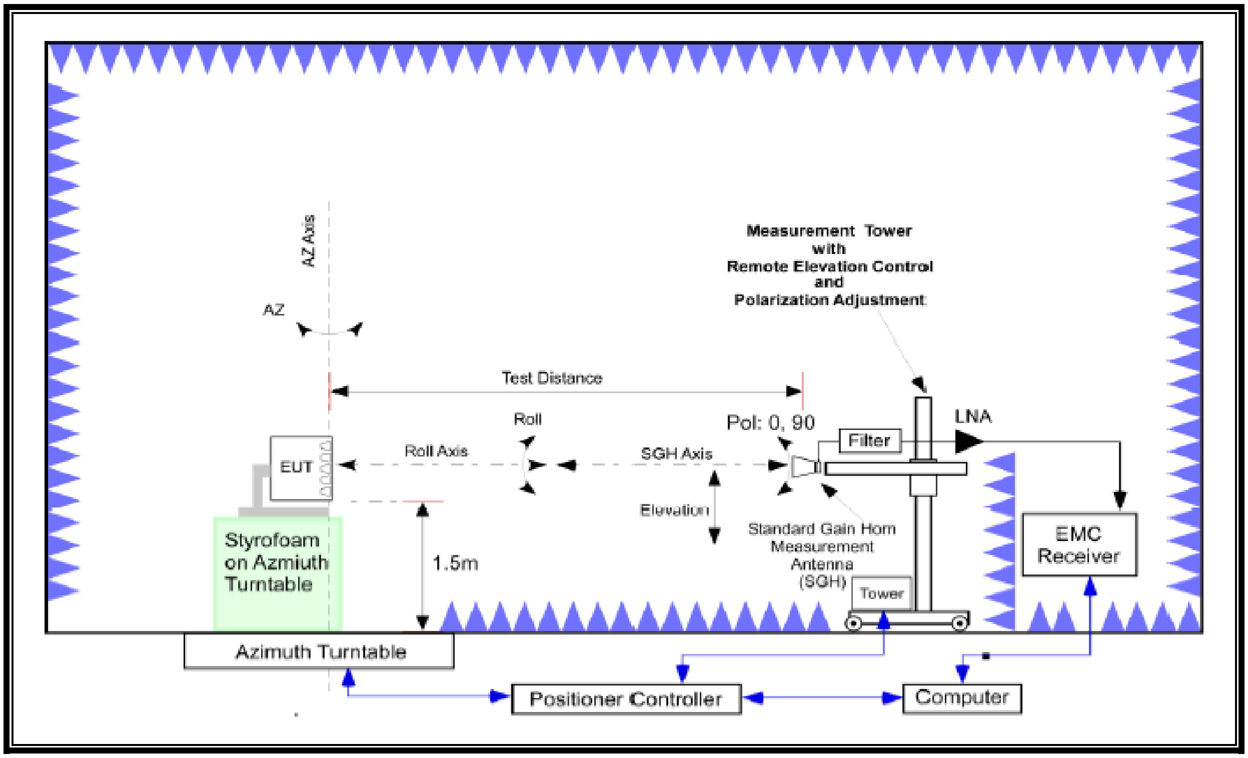
SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)

Radiated power (EIRP) measurements were performed in a full anechoic chamber (FAC) conforming to the site validation requirements of CISPR 16-1-4. Radiated spurious emission measurements from 30MHz - 18GHz were performed in a semi anechoic chamber (SAC) conforming to the site validation requirements of CISPR 16-1-4. A positioner was used to manipulate the EUT through several positions in space by rotating about the roll axis as shown in the figure below. The positioner was mounted on top of a turntable bringing the total EUT height to 1.5m.



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FAR-FIELD DISTANCE AND MEASUREMENT DISTANCE

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable.
The measurement antenna is in the far field of the EUT per formula $2D^2/\lambda$ where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, "D" is the largest dimension of the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Frequency Range(GHz)	Wavelength(m)	Far Field Distance(m)	Measurement Distance(m)
18-40	0.008	0.54	1.00 (EIRP and Band Edge = 3.00)
40-50	0.006	1.05	1.50
50-75	0.004	0.69	1.00
75-110	0.003	0.46	1.00
110-175	0.002	0.34	1.00
175-200	0.002	0.16	1.00

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst case polarization/positioning. It was determined that H=0 degree and V=90 degree are the worst case positions when the EUT was transmitting horizontally and vertically polarized beams, respectively.
The maximized power level is recorded using the spectrum analyzer “Channel Power” function with the integration bandwidth set to the emissions’ occupied bandwidth. The EIRP is calculated from the raw power level measured with the spectrum analyzer using the formulas shown below.

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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	**Manufacturer**	**Model**	**S/N**	**Cal Due**
Spectrum Analyzer	KEYSIGHT	N9040B	US57212313	01-22-21
Spectrum Analyzer	KEYSIGHT	N9030A	MY54490312	08-06-20
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100418	10-02-21
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	08-04-20
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	08-04-20
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	08-04-20
Antenna, Horn, 18 GHz	ETS	3115	00167211	08-04-20
Antenna, Horn, 18 GHz	ETS	3115	00161451	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00168724	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00205959	08-04-20
Antenna, Horn, 18 GHz	ETS	3117	00168717	08-04-20
DC Power Supply	Agilent / HP	E3640A	MY54226395	08-06-20
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-05-20
Preamplifier, 1000 MHz	Sonoma	310N	370599	08-05-20
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-05-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-06-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029169	08-06-20
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-06-20
Temperature & Humidity Chamber	ESPEC	PL-1J	15004769	08-05-20
Antenna, Horn, 40 GHz	ETS LINDGREN	3116C	00166155	08-14-20
Antenna, Horn, 40 GHz	ETS LINDGREN	3116C	00168645	10-02-21
Antenna, Horn, 33 to 50 GHz	CMI, Inc.	HO22R	UL22001	02-26-22
Antenna, Horn, 33 to 50 GHz	CMI, Inc.	HO22R	UL22002	02-26-22
Antenna, Horn, 50 to 75 GHz	CMI, Inc.	HO15R	UL15001	02-26-22
Antenna, Horn, 50 to 75 GHz	CMI, Inc.	HO15R	UL15002	02-26-22
Antenna, Horn, 75 to 110 GHz	CMI, Inc.	HO10R	UL10001	02-26-22
Antenna, Horn, 75 to 110 GHz	CMI, Inc.	HO10R	UL10002	02-26-22
Antenna, Horn, 110 to 170 GHz	CMI, Inc.	HO06R	UL06001	02-26-22
Antenna, Horn, 110 to 170 GHz	CMI, Inc.	HO06R	UL06002	02-26-22
Antenna, Horn, 170 to 260 GHz	CMI, Inc.	HO04R	UL04001	02-26-22
Antenna, Horn, 170 to 260 GHz	CMI, Inc.	HO04R	UL04002	02-26-22
EMI Test Receive, 40 GHz	Rohde & Schwarz	ESU40	100439	08-06-20
EMI Test Receive, 40 GHz	Rohde & Schwarz	ESU40	100457	08-06-20
SA Extension Module	Virginia Diodes Inc	N9029AV15	SAX486	01-22-21
SA Extension Module	Virginia Diodes Inc	N9029AV10	SAX388	01-22-21
SA Extension Module	Virginia Diodes Inc	N9029AV06	SAX483	01-22-21
SA Extension Module	Virginia Diodes Inc	N9029AV04	SAX487	01-22-21
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth	N/A	Radiated	Pass
2.1046, 30.202	Equivalent Isotropic Radiated Power	43 dBm		Pass
2.1051, 30.203	Out-of-Band Emissions at the Band Edge	-13 dBm/MHz for all out-of-band emissions, -5 dBm/MHz from the band edge up to 10% of the channel BW		Pass
2.1051, 30.203	Spurious Emission	-13 dBm/MHz for all out-of-band emissions		Pass
2.1055	Frequency Stabillity	Fundamental emissions stay within authorized frequency block		Pass

7. LIMITS AND CONDUCTED RESULTS

7.1. OCCUPIED BANDWIDTH

RULE PART(S)
FCC: §2.1049

LIMITS
For reporting purposes only

TEST PROCEDURE

Automatic bandwidth measurement function of the signal analyzer was used to measure 99% occupied.

a) RBW = 1 – 5% of OBW
b) VBW ≥ 3 x RBW
c) Detector = Peak
d) Trace mode = max hold
e) Sweep = auto couple
f) The trace was allowed to stabilize

(KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.3)
(ANSI C63.26-2015 Section 5.4.3)

Note
5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS
See the following pages.

UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_30(04)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

7.1.1. OCCUPIED BANDWIDTH RESULTS

ANT 1, Band n261

Ant 1

n261

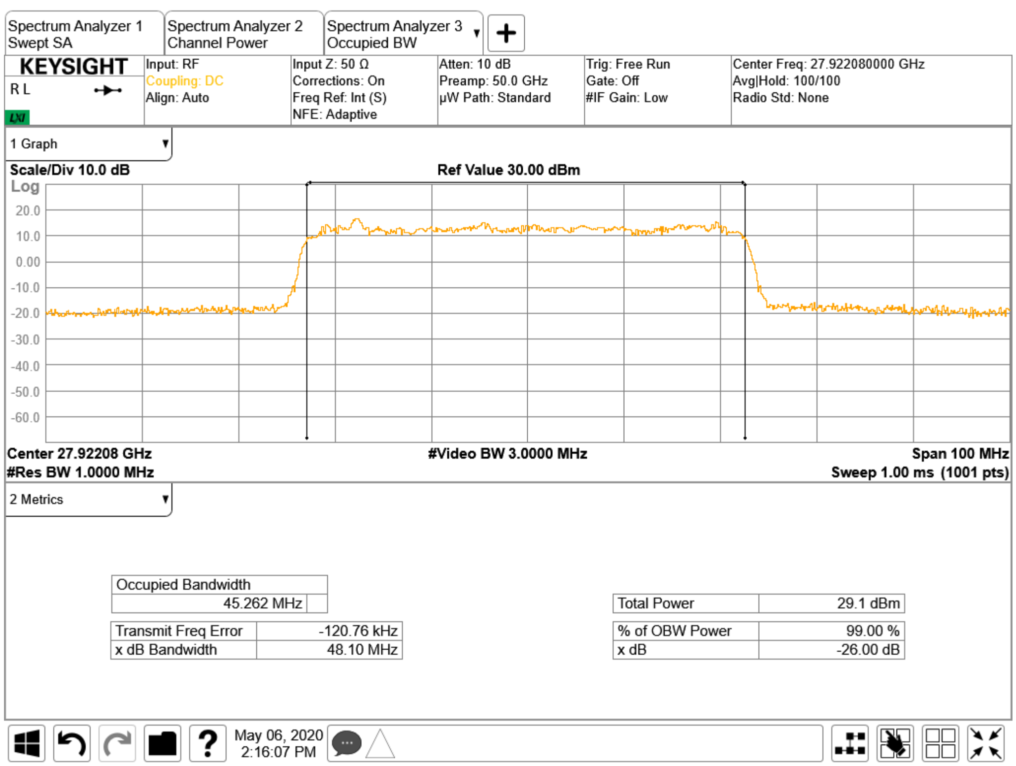
BW 50MHz

1CC / QPSK / Mid channel

Ant 1

n261

BW 50MHz

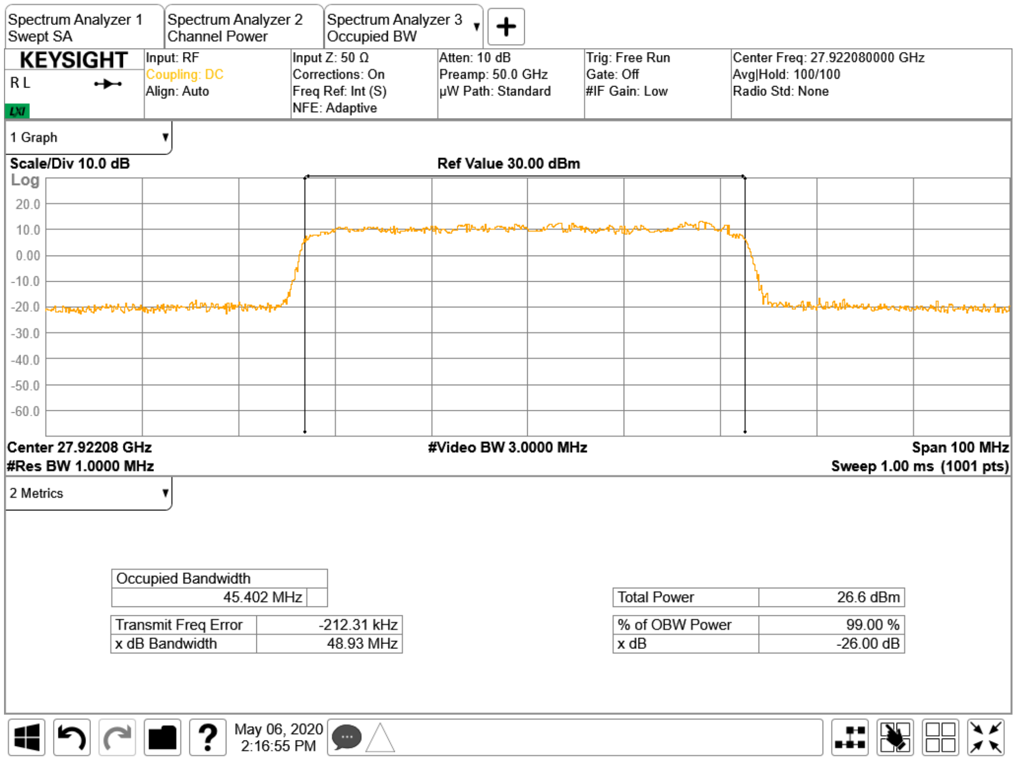


1CC / 16QAM / Mid channel

Ant 1

n261

BW
50MHz

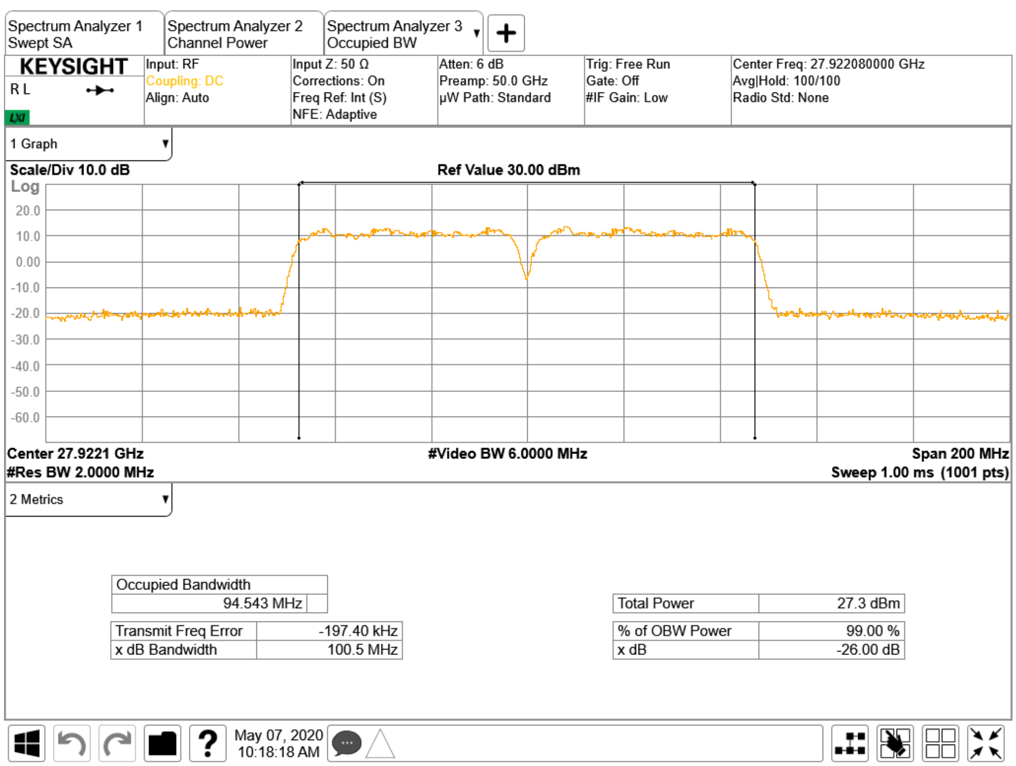


1CC / 64QAM / Mid channel

Ant 1

n261

BW
50MHz



2CC / QPSK / Mid channel

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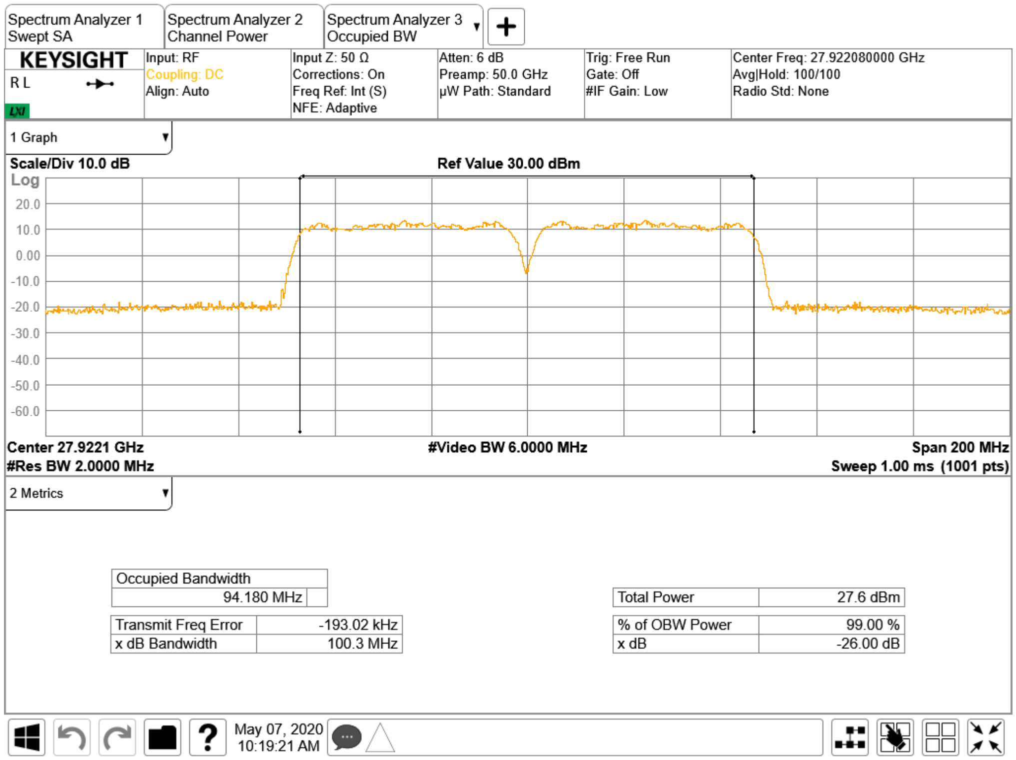
50MHz</td><td>

2CC / 16QAM / Mid channel</td></tr>
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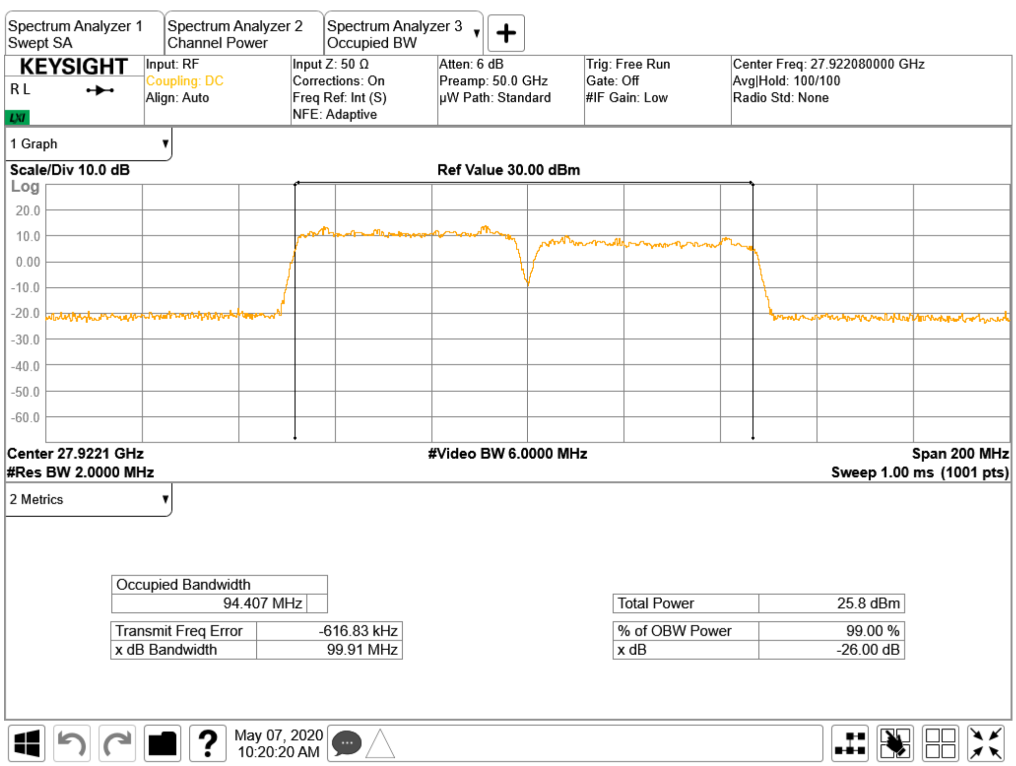
BW
50MHz</td><td>

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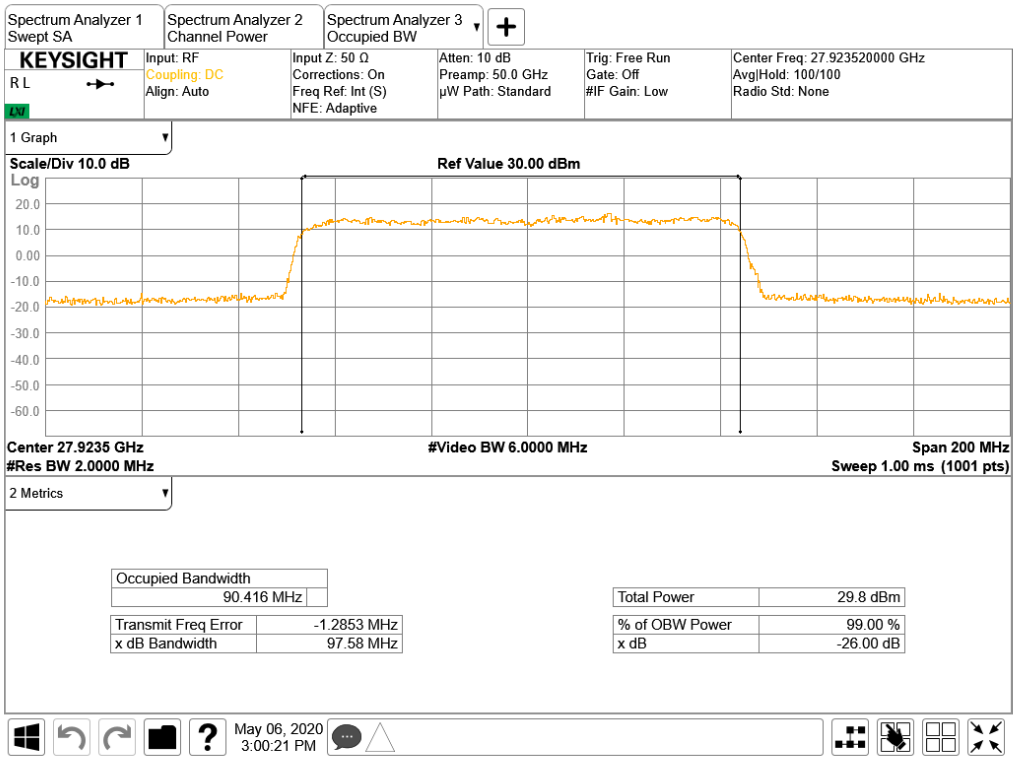
Ant 1

n261

BW 100MHz

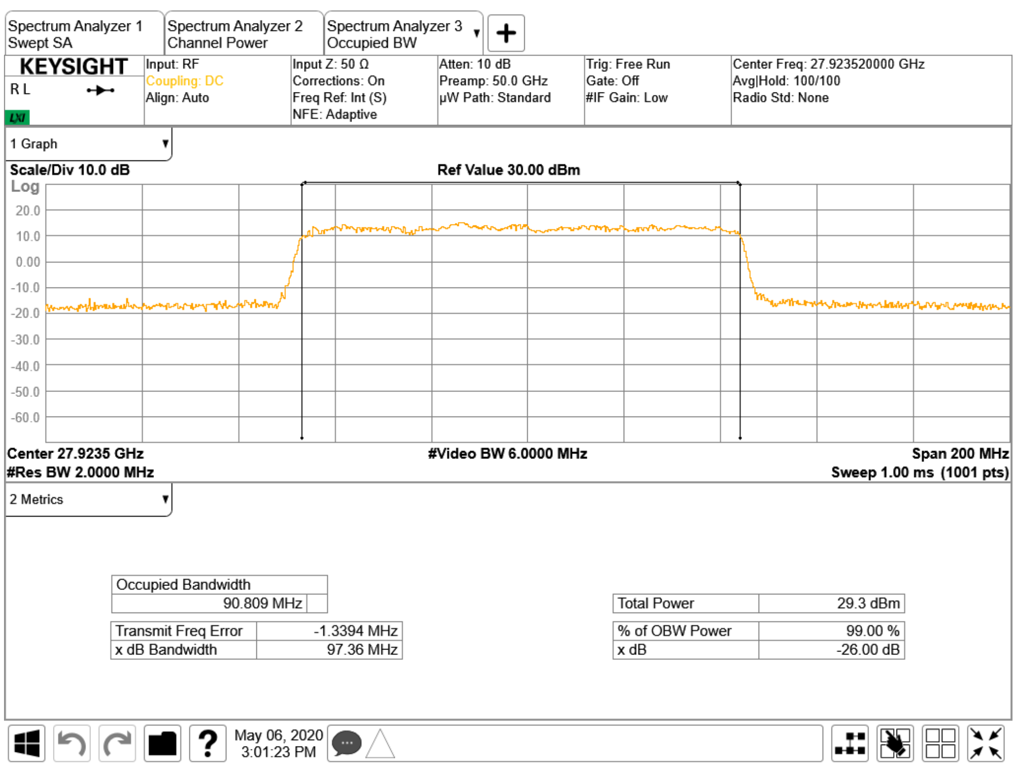


1CC / QPSK / Mid channel

Ant 1

n261

BW 100MHz



1CC / 16QAM / Mid channel

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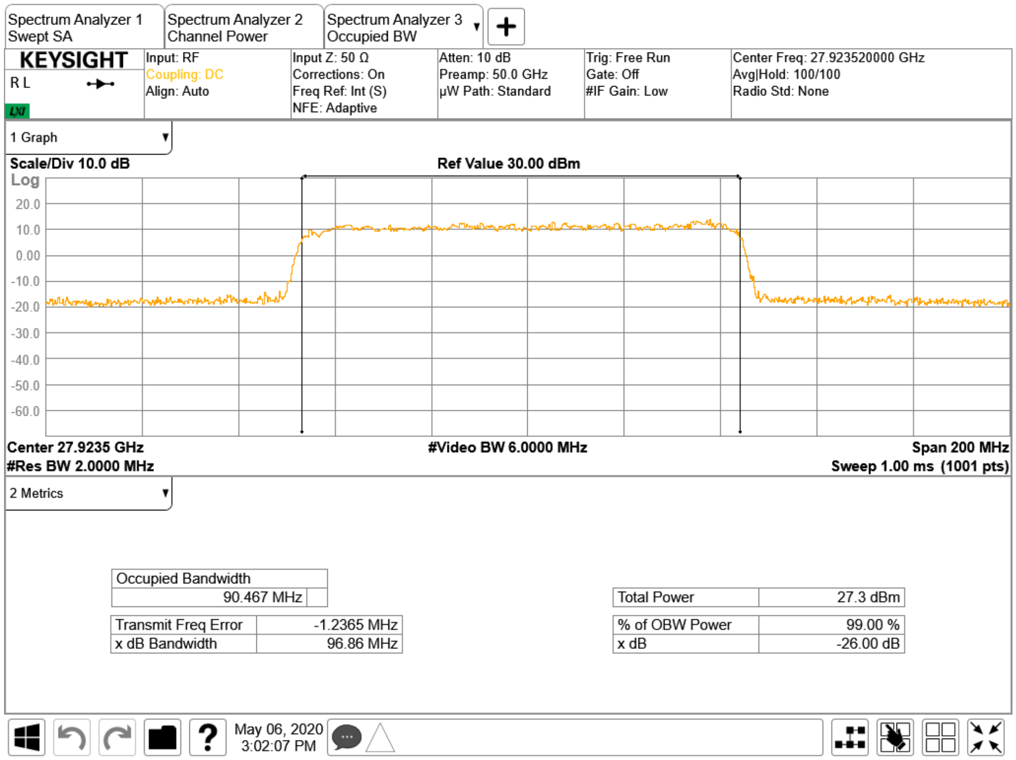
100MHz</td><td>

1CC / 64QAM / Mid channel</td></tr>
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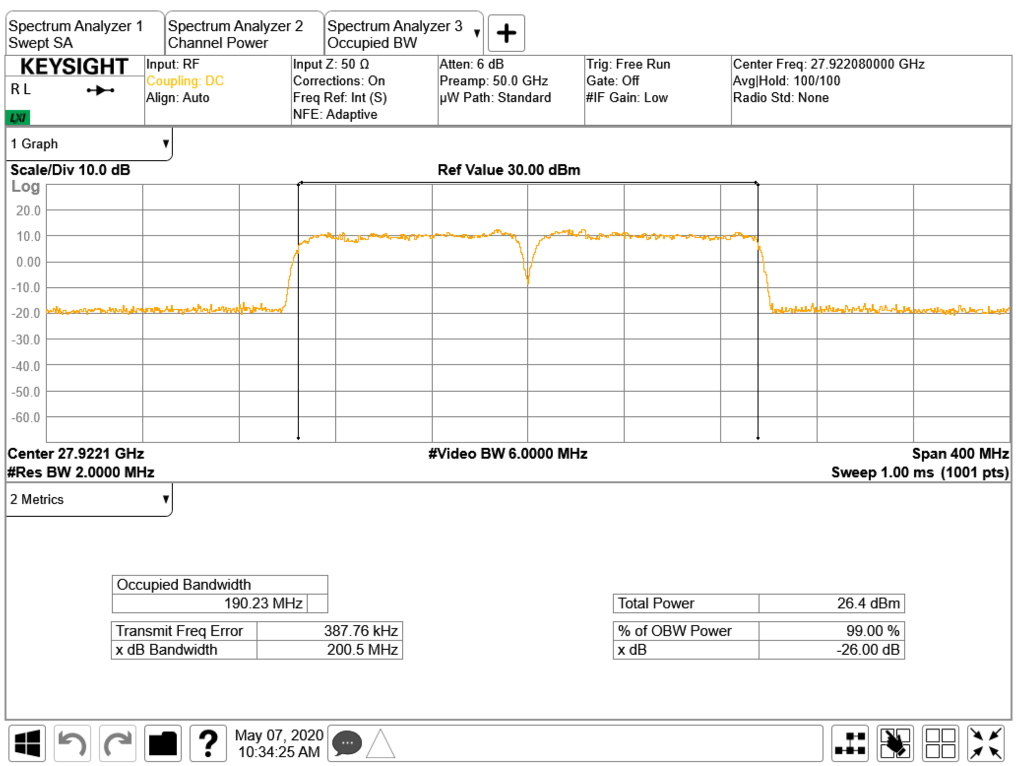
BW
100MHz</td><td>

2CC / QPSK / Mid channel</td></tr>
</table>

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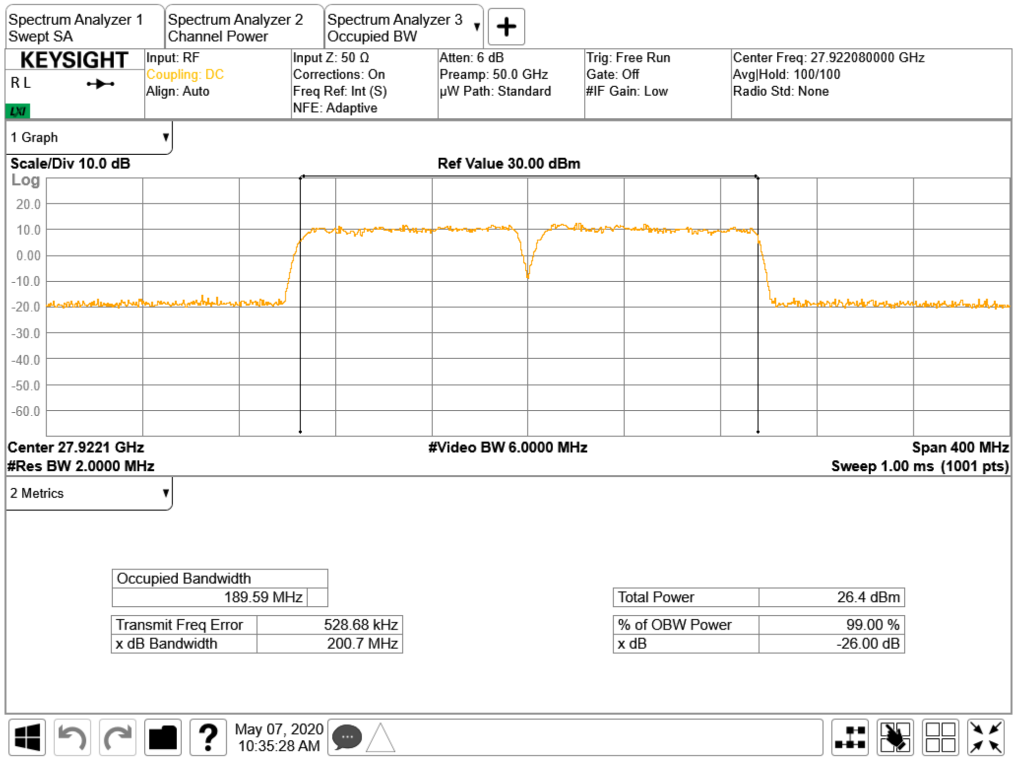
Ant 1

n261

BW 100MHz

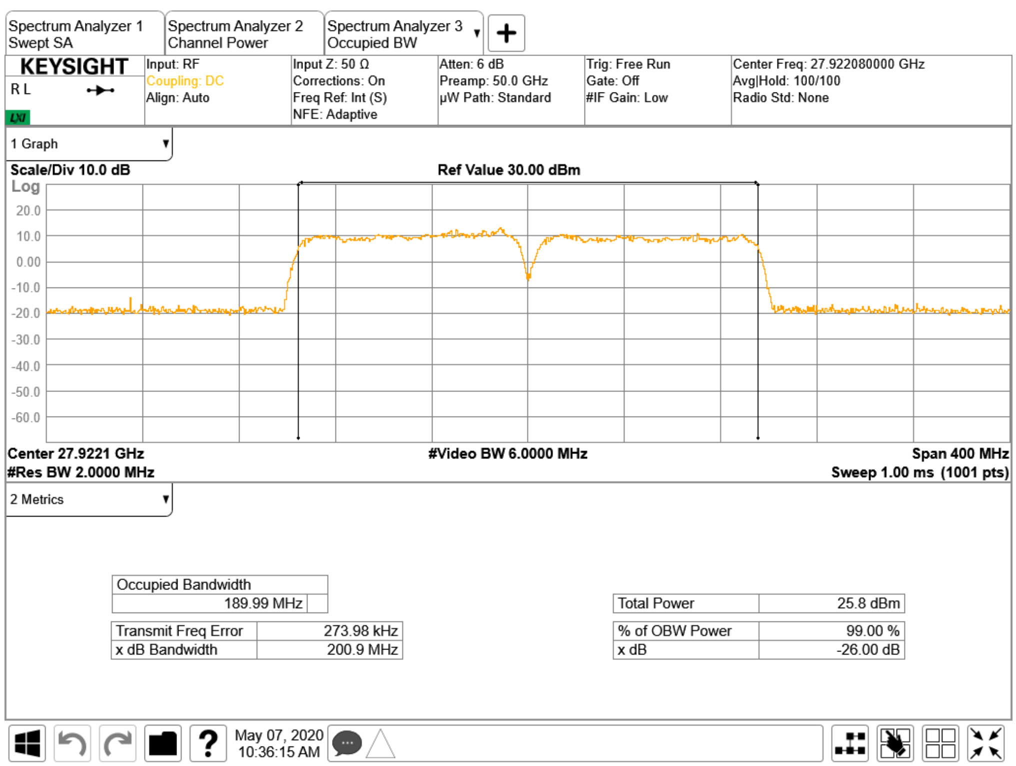


2CC / 16QAM / Mid channel

Ant 1

n261

BW 100MHz



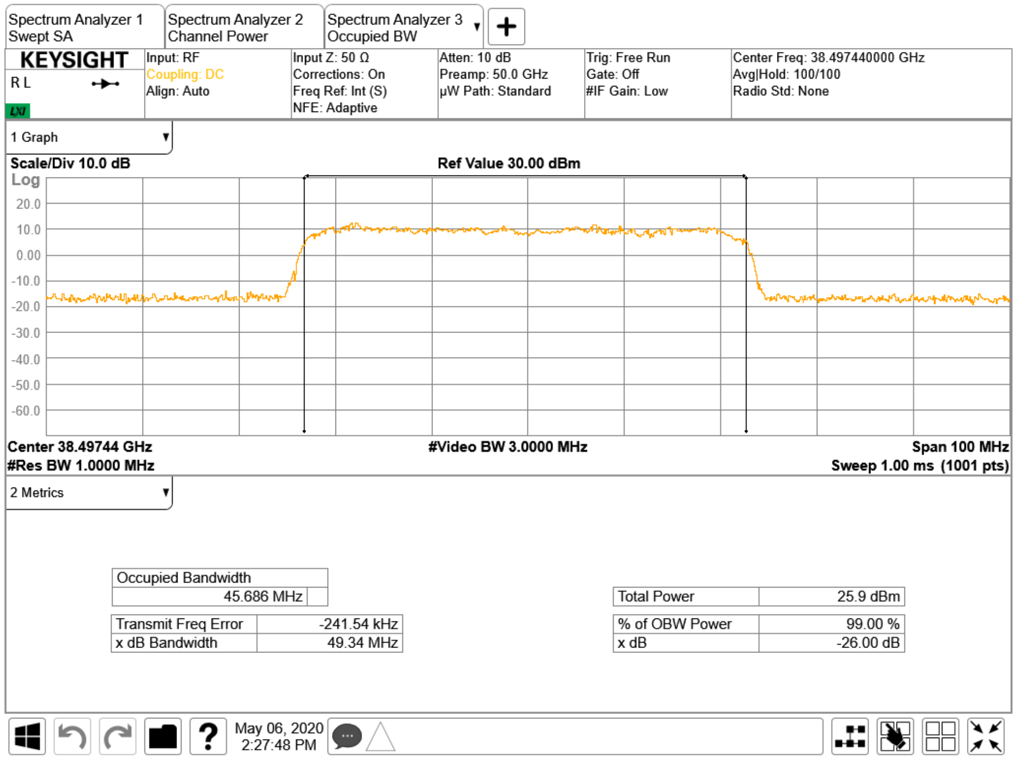
2CC / 64QAM / Mid channel

ANT 1, Band n260

Ant 1

n260

BW 50MHz

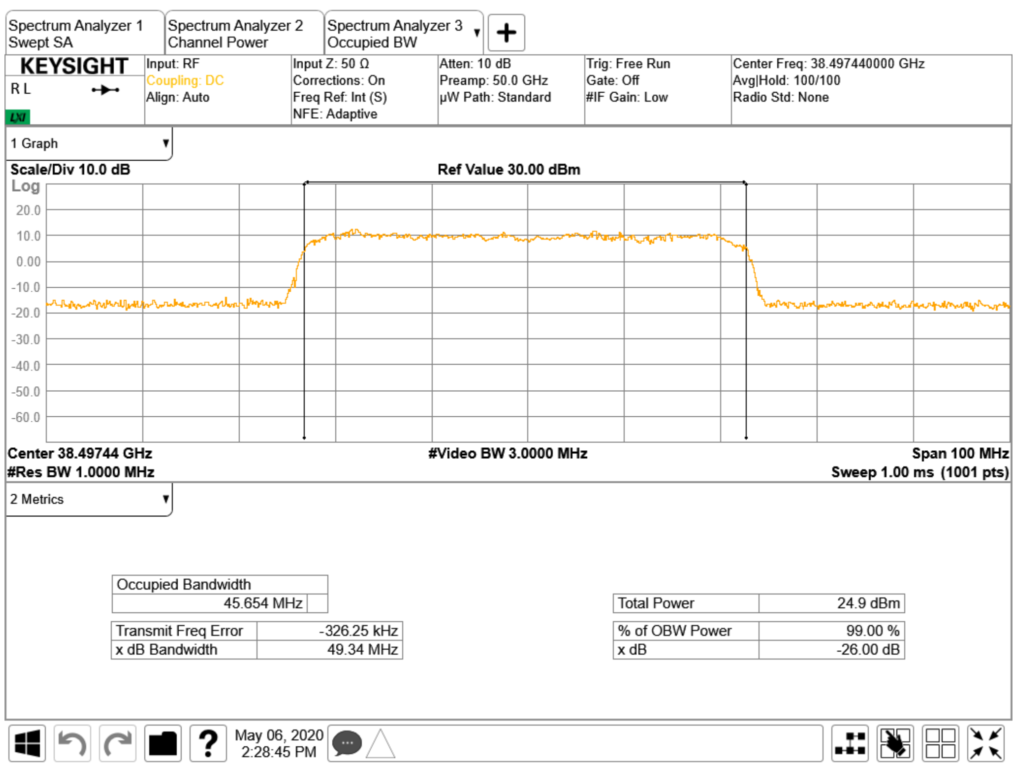


1CC / QPSK / Mid channel

Ant 1

n260

BW 50MHz

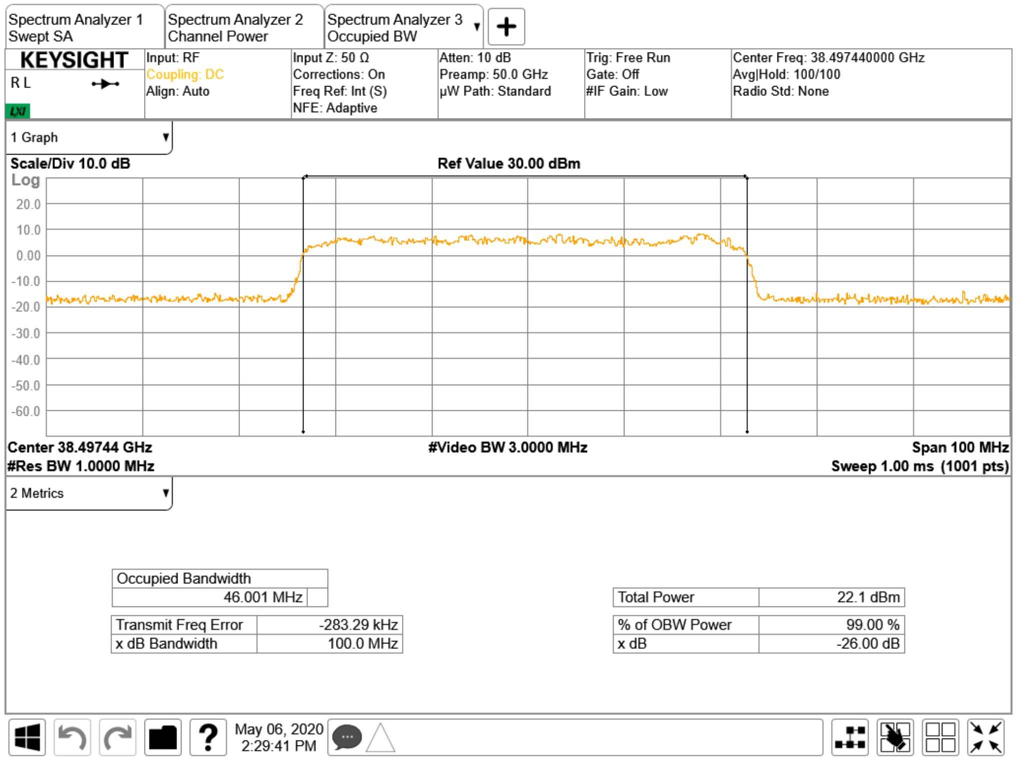


1CC / 16QAM / Mid channel

Ant 1

n260

BW 50MHz

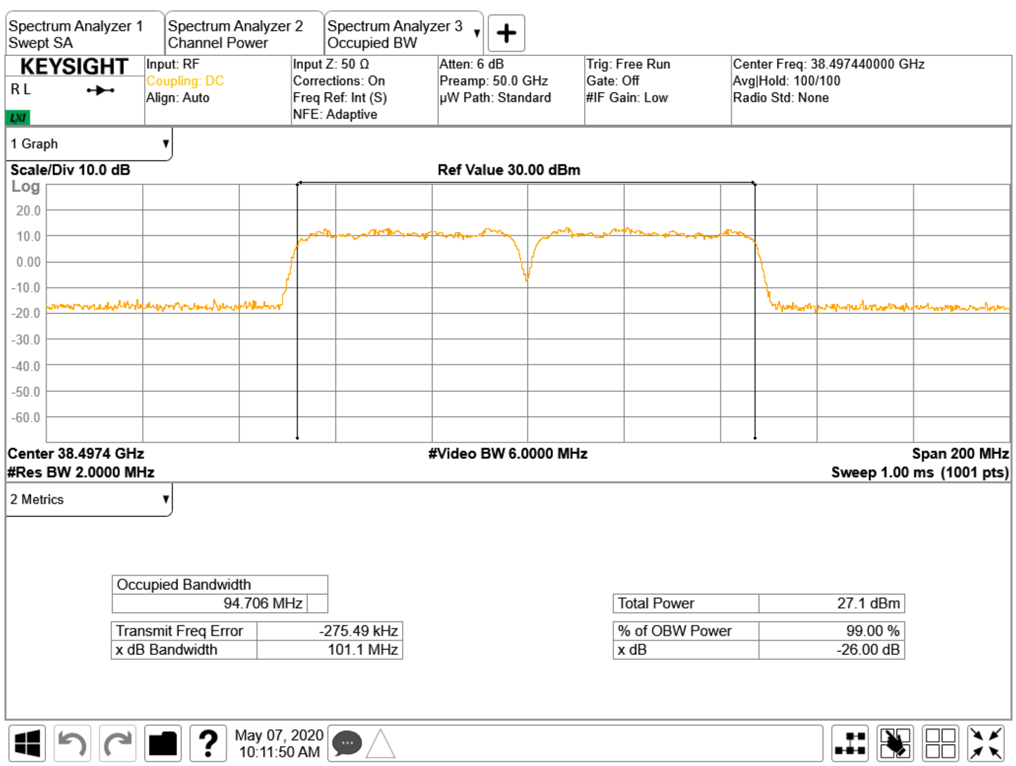


1CC / 64QAM / Mid channel

Ant 1

n260

BW 50MHz



2CC / QPSK / Mid channel

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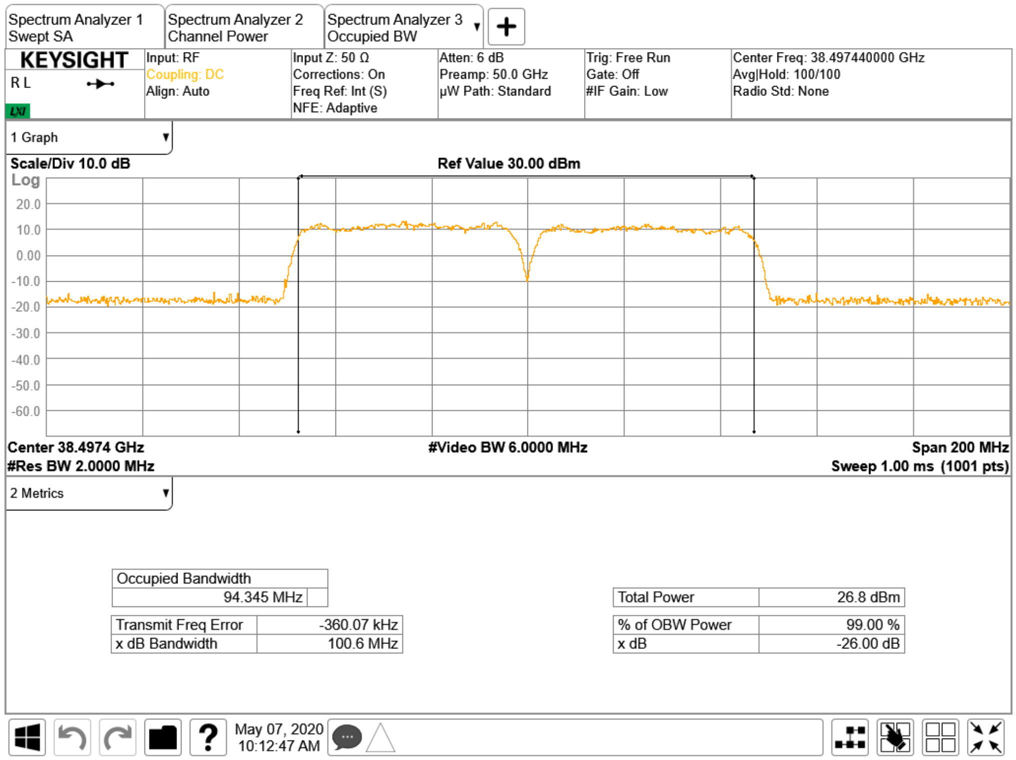
BW 50MHz</td><td>

2CC / 16QAM / Mid channel</td></tr>
<tr><td>Ant 1
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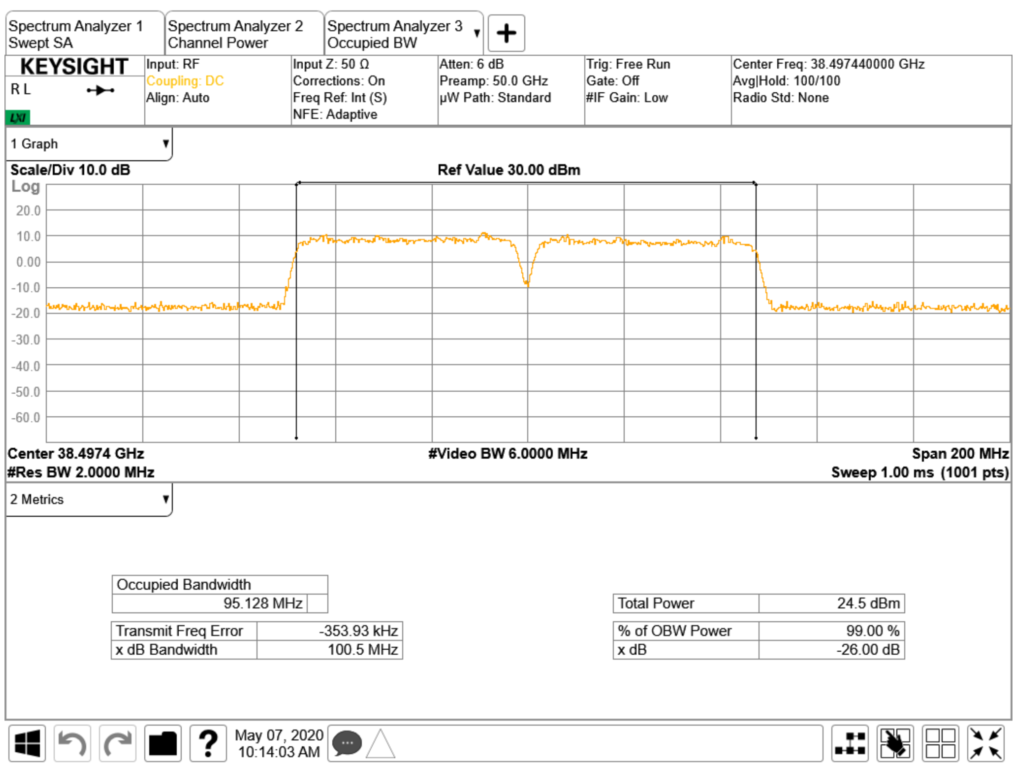
BW 50MHz</td><td>

2CC / 64QAM / Mid channel</td></tr>
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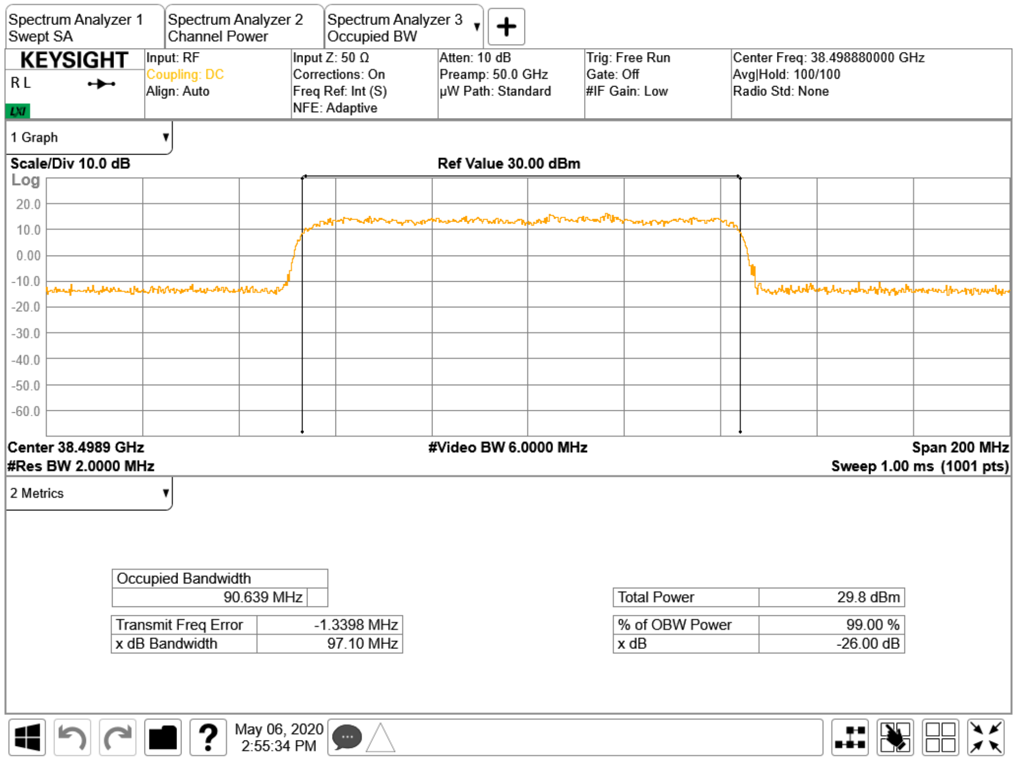
Ant 1

n260

BW 100MHz

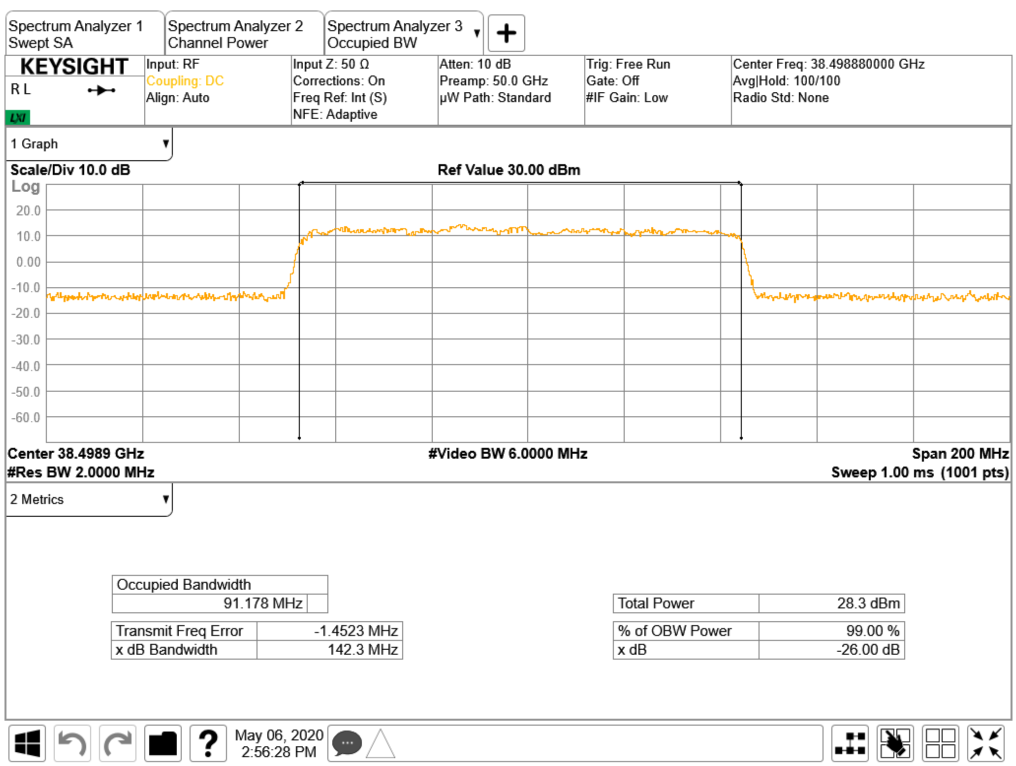


1CC / QPSK / Mid channel

Ant 1

n260

BW 100MHz

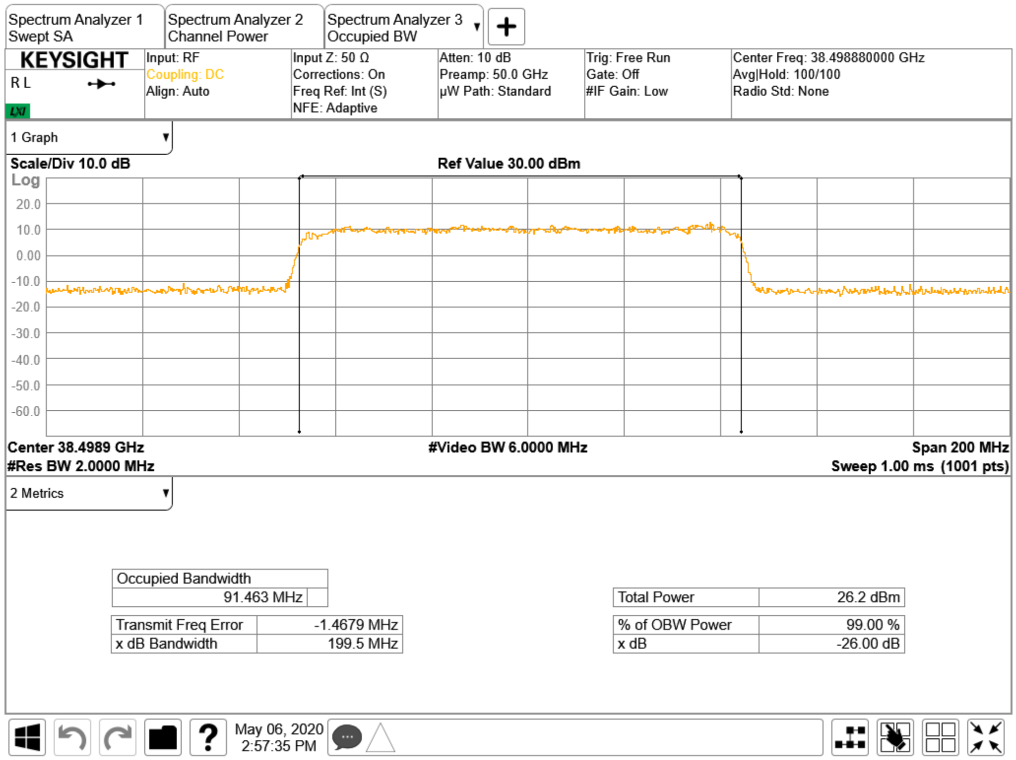


1CC / 16QAM / Mid channel

Ant 1

n260

BW 100MHz

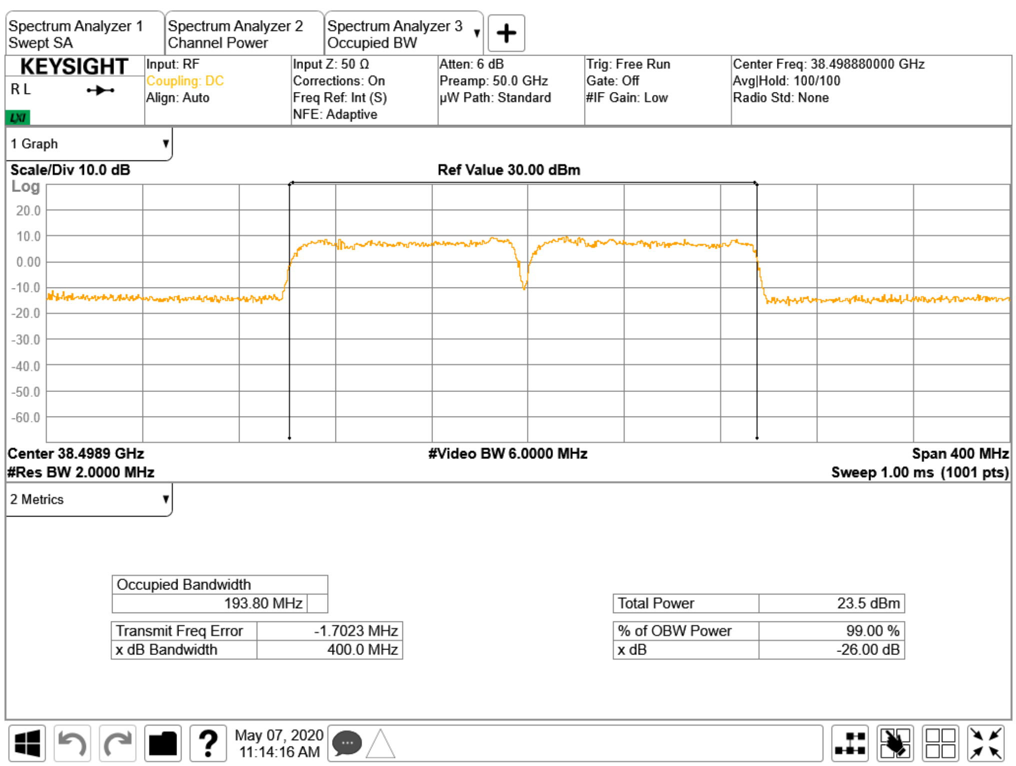


1CC / 64QAM / Mid channel

Ant 1

n260

BW 100MHz



2CC / QPSK / Mid channel

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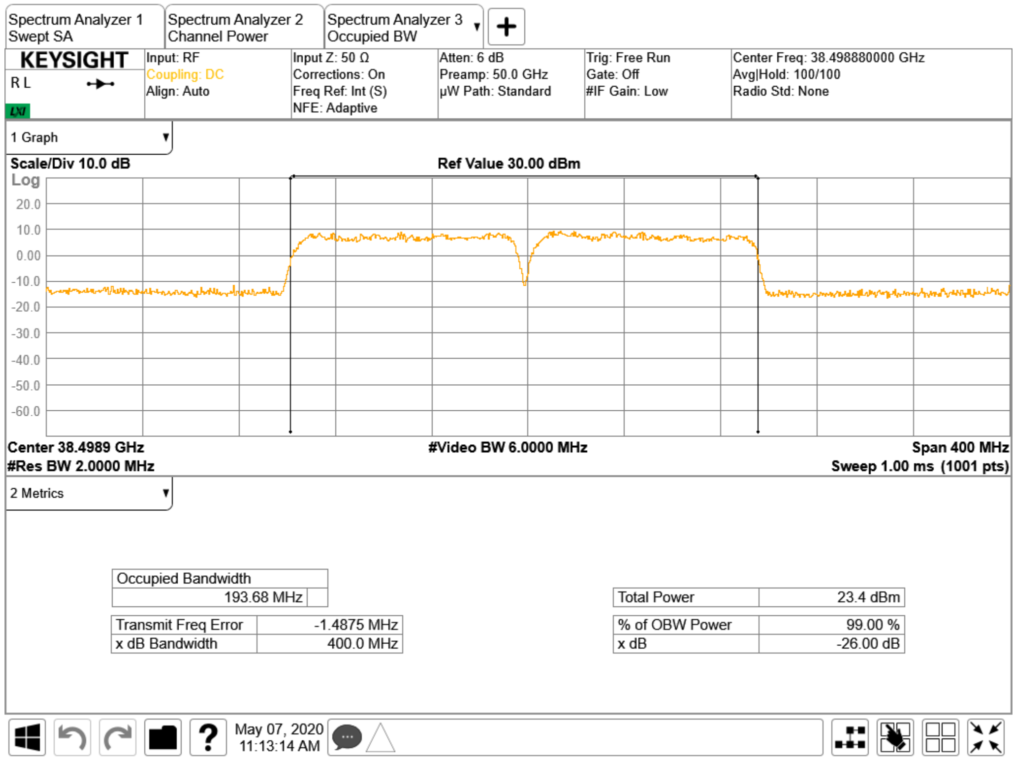
BW
100MHz</td><td>

2CC / 16QAM / Mid channel</td></tr>
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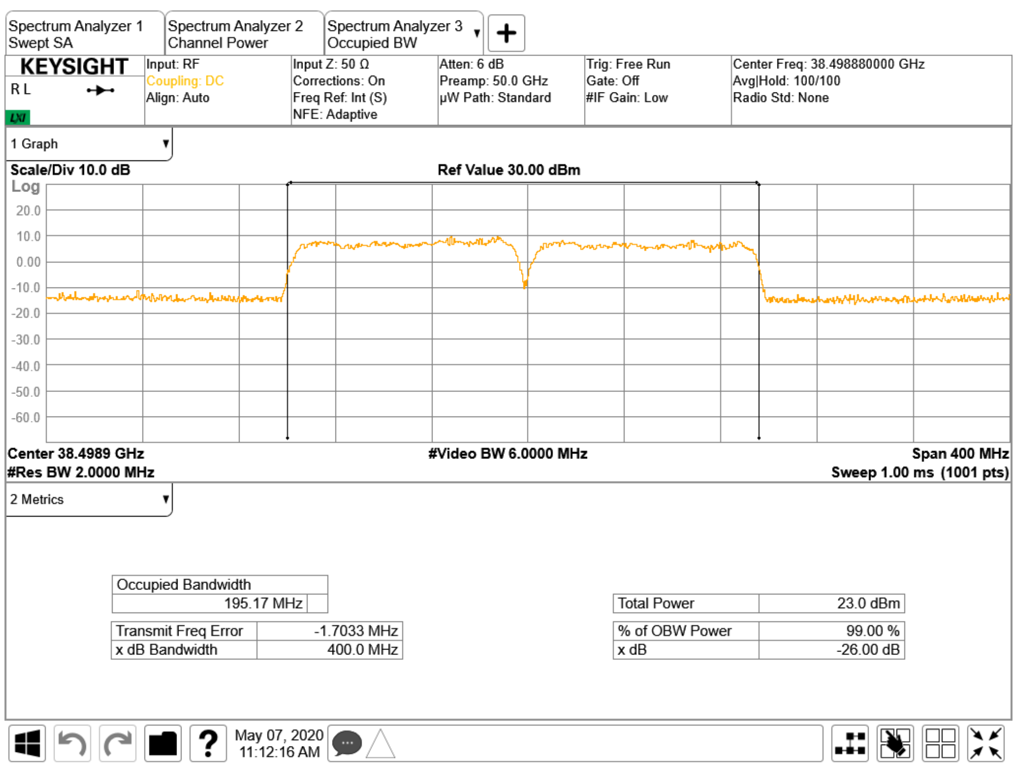
100MHz</td><td>

2CC / 64QAM / Mid channel</td></tr>
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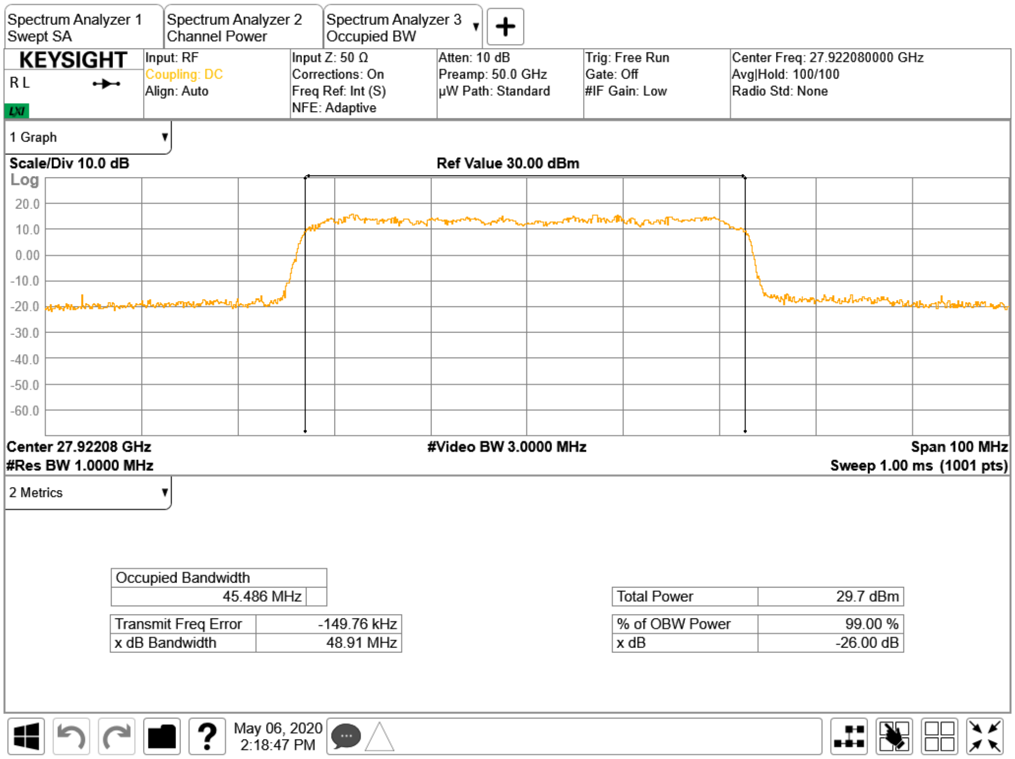
ANT 2, Band n261

Ant 2

n261

BW 50MHz

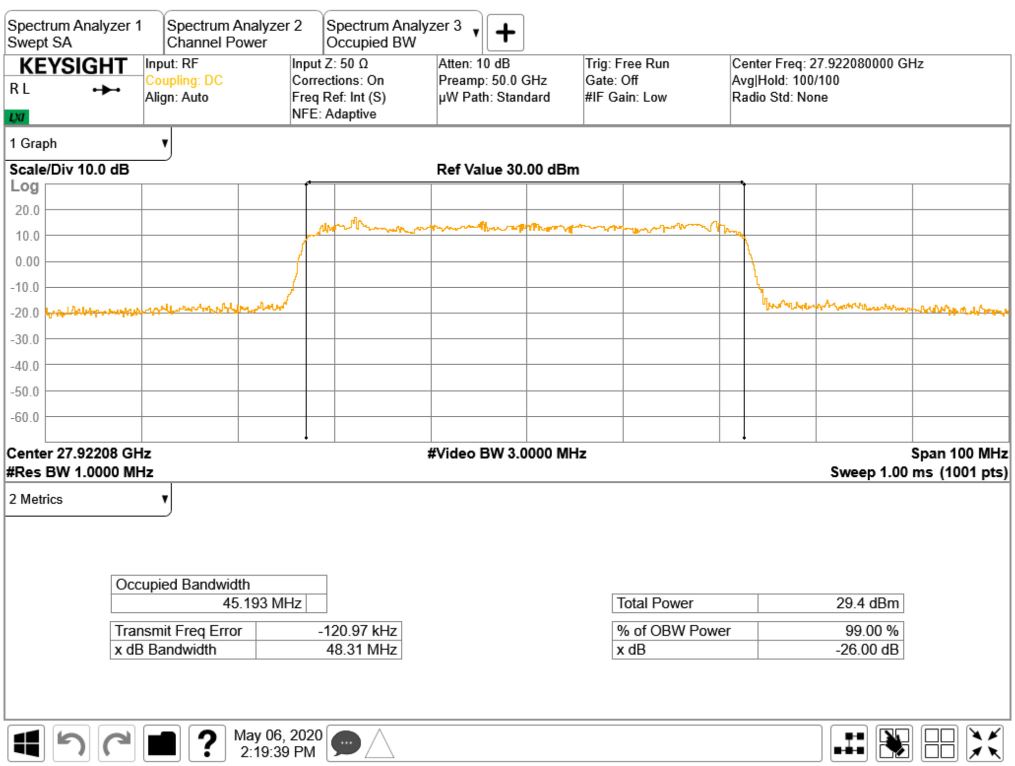


1CC / QPSK / Mid channel

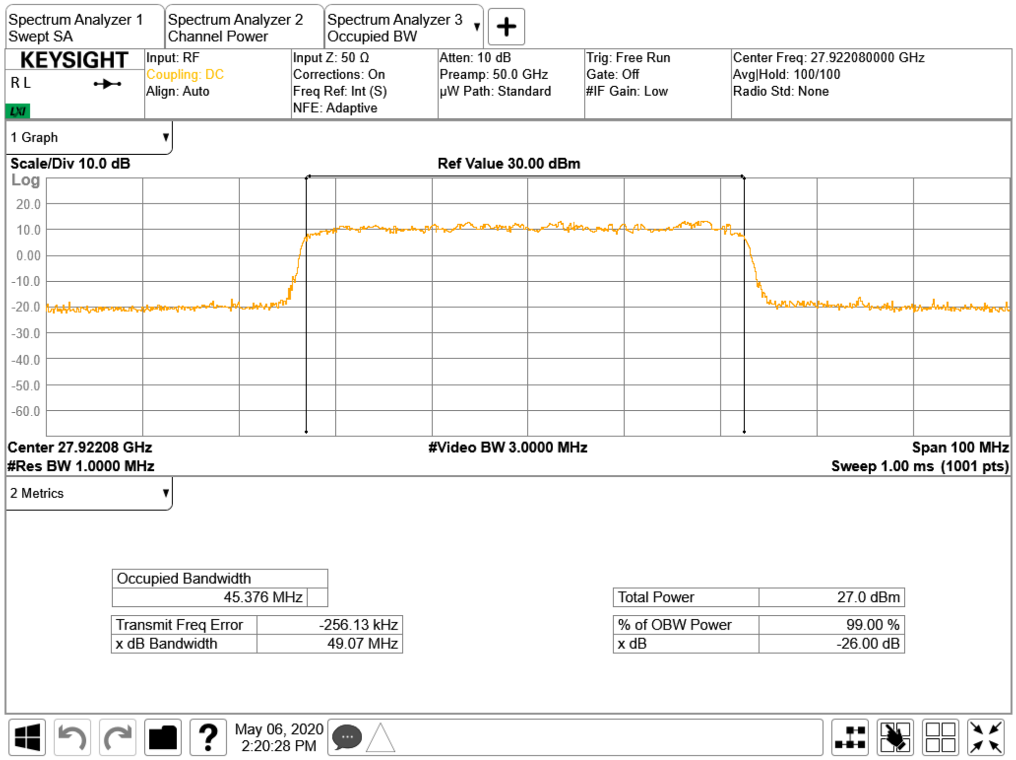
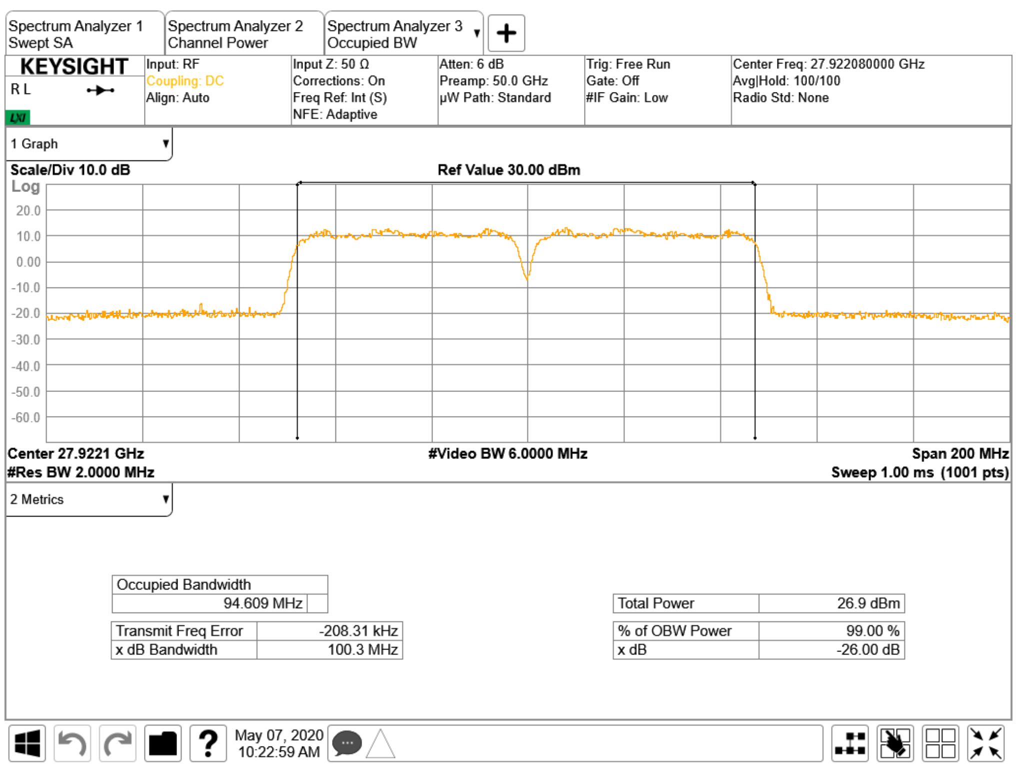
Ant 2

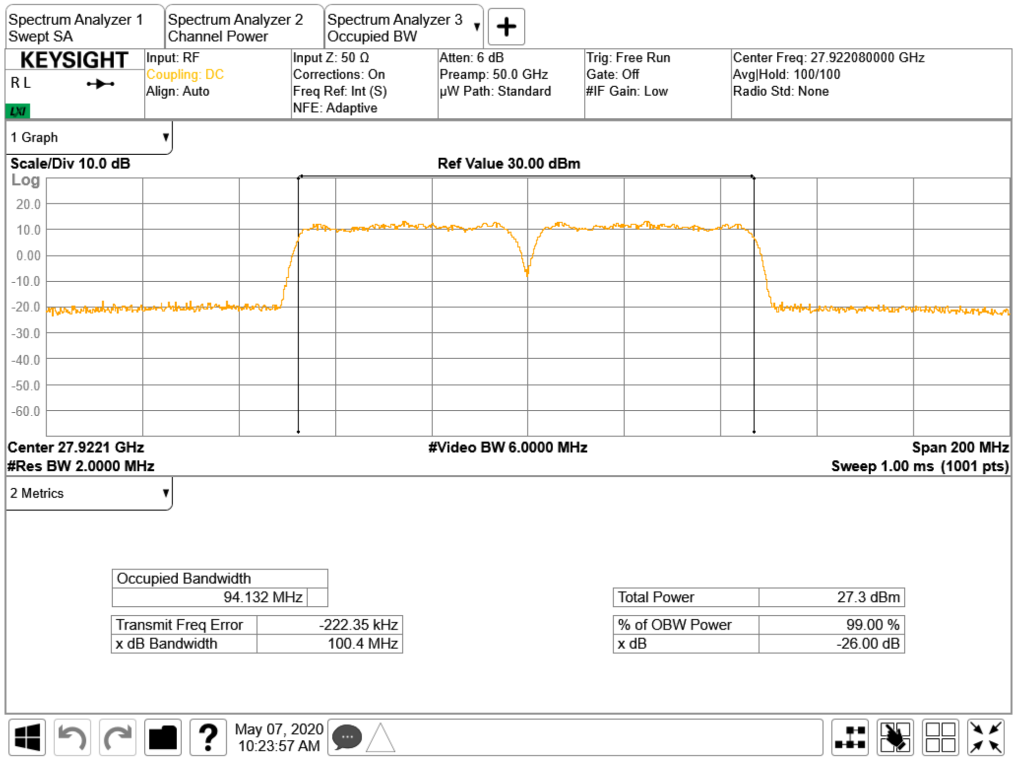
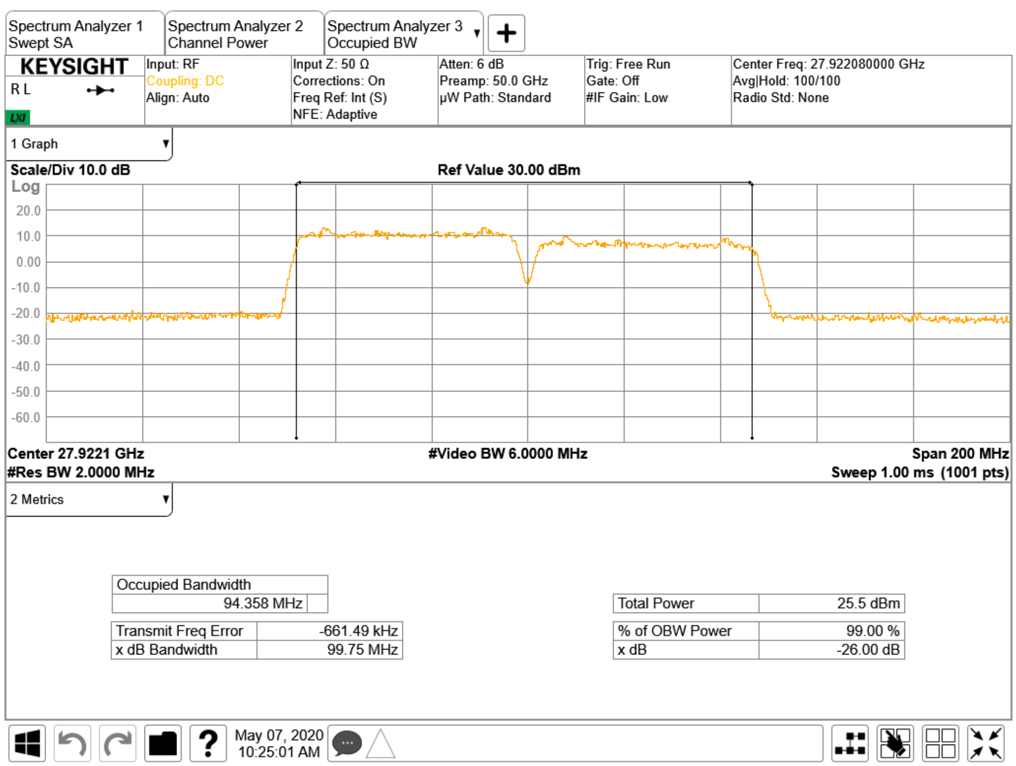
n261

BW 50MHz



1CC / 16QAM / Mid channel

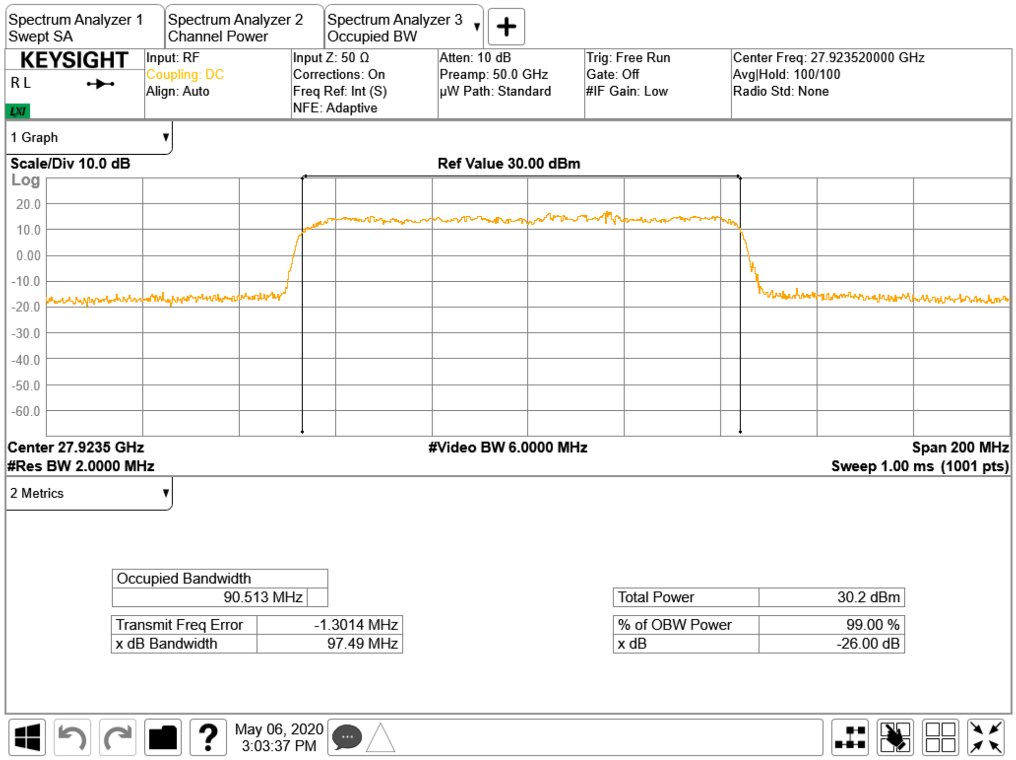
Ant 2 n261 BW 50MHz	 1CC / 64QAM / Mid channel
Ant 2 n261 BW 50MHz	 2CC / QPSK / Mid channel

Ant 2 n261 BW 50MHz	 2CC / 16QAM / Mid channel
Ant 2 n261 BW 50MHz	 2CC / 64QAM / Mid channel

Ant 2

n261

BW 100MHz

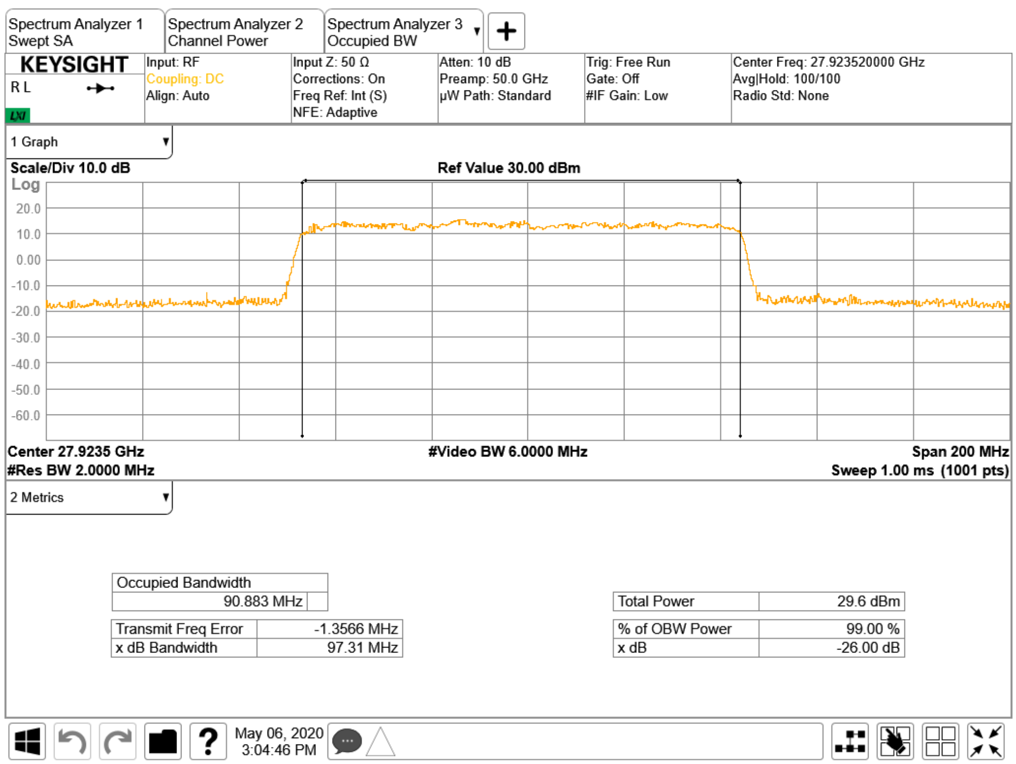


1CC / QPSK / Mid channel

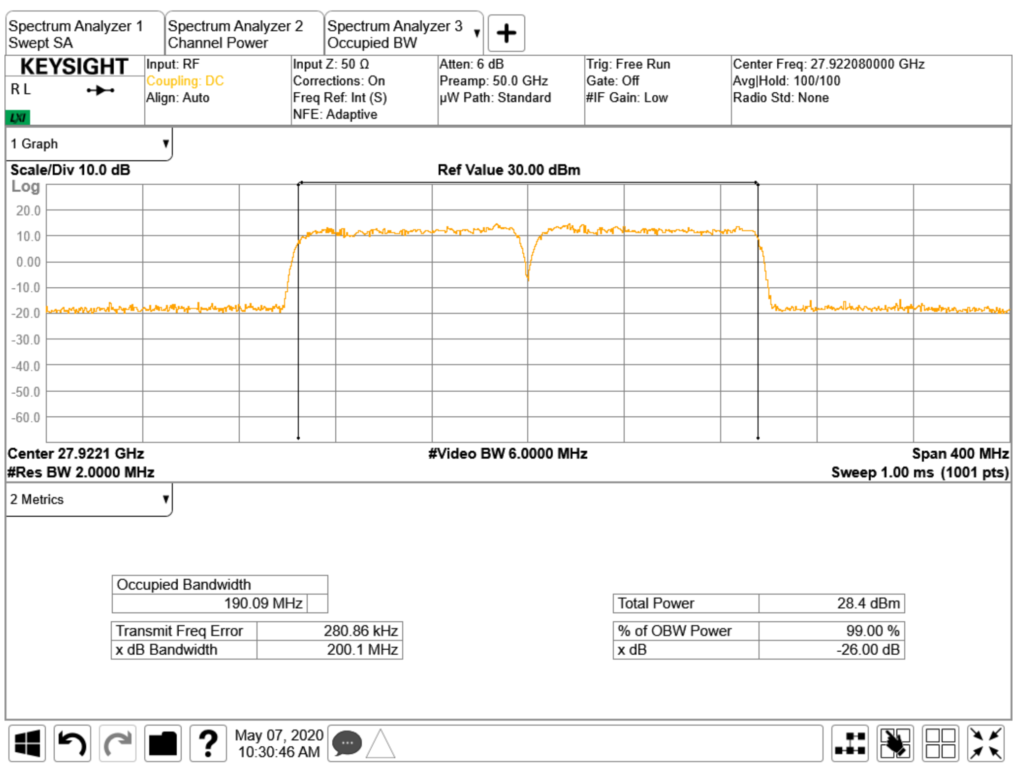
Ant 2

n261

BW 100MHz



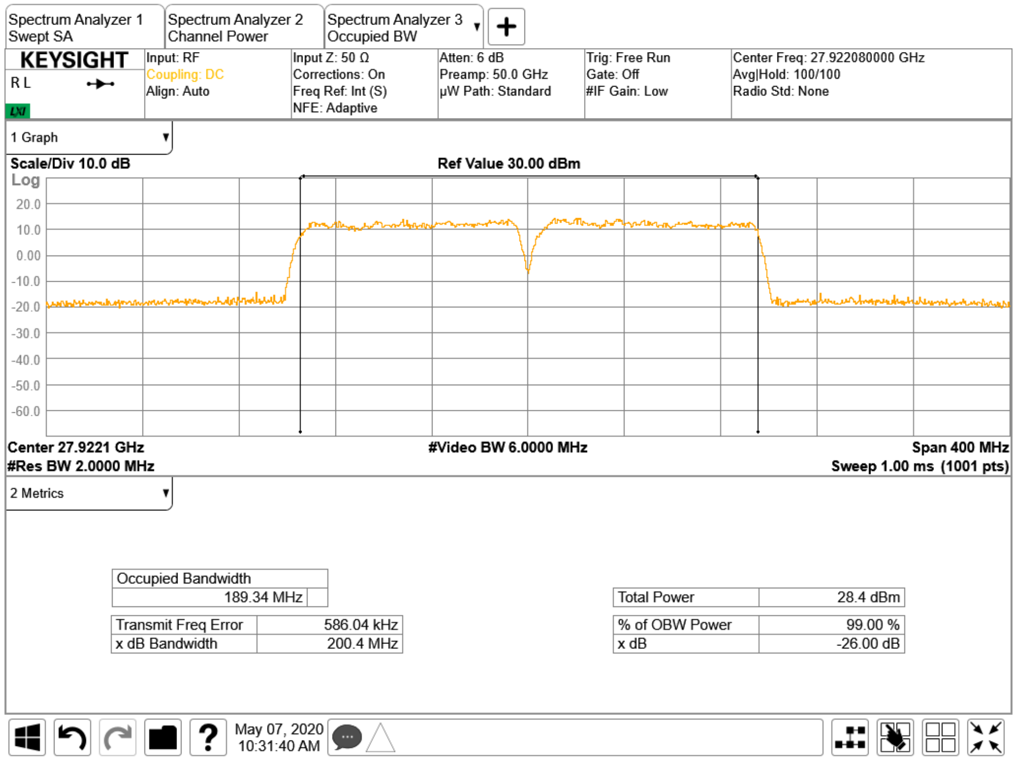
1CC / 16QAM / Mid channel

Ant 2 n261 BW 100MHz	 1CC / 64QAM / Mid channel
Ant 2 n261 BW 100MHz	 2CC / QPSK / Mid channel

Ant 2

n261

BW
100MHz

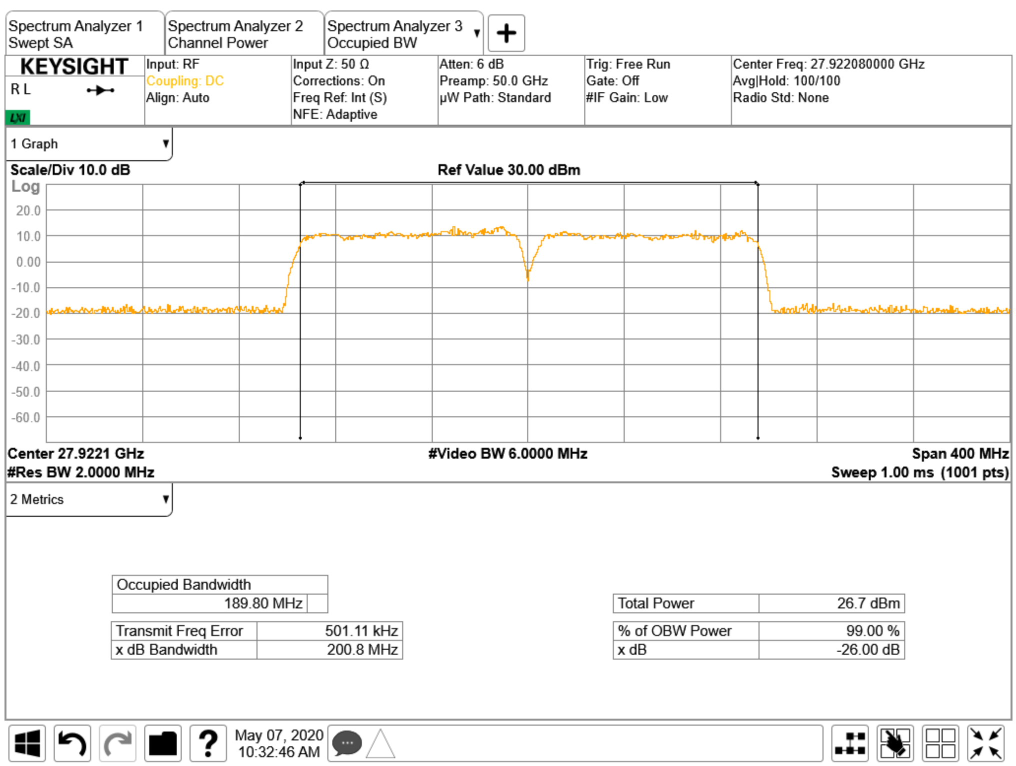


2CC / 16QAM / Mid channel

Ant 2

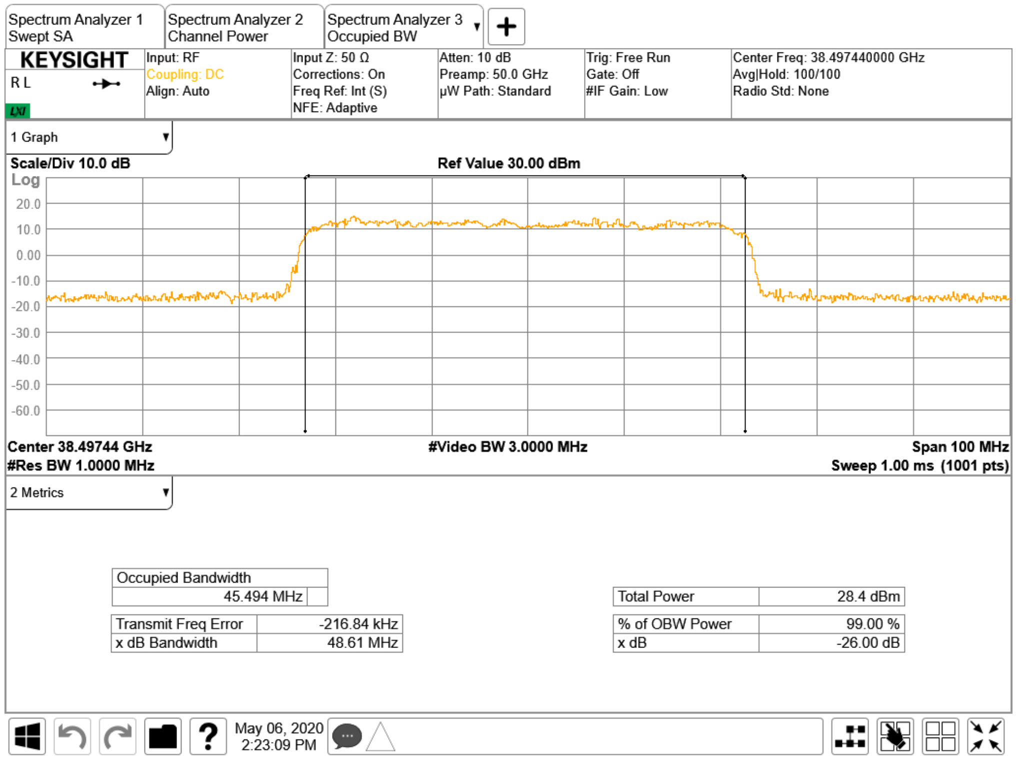
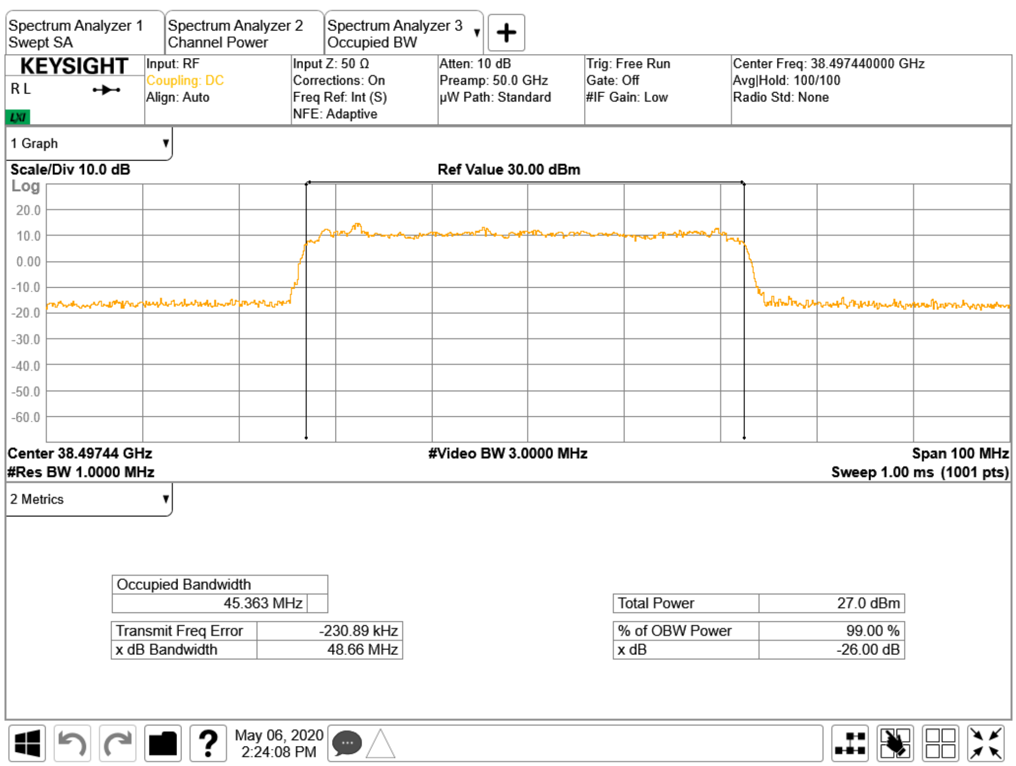
n261

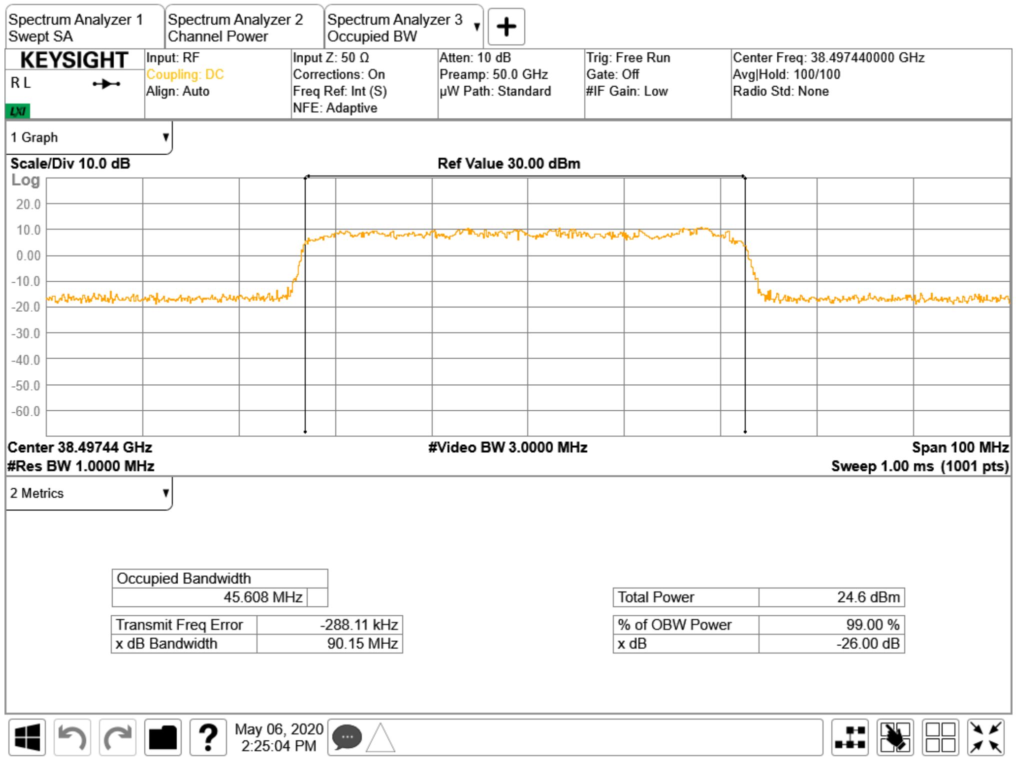
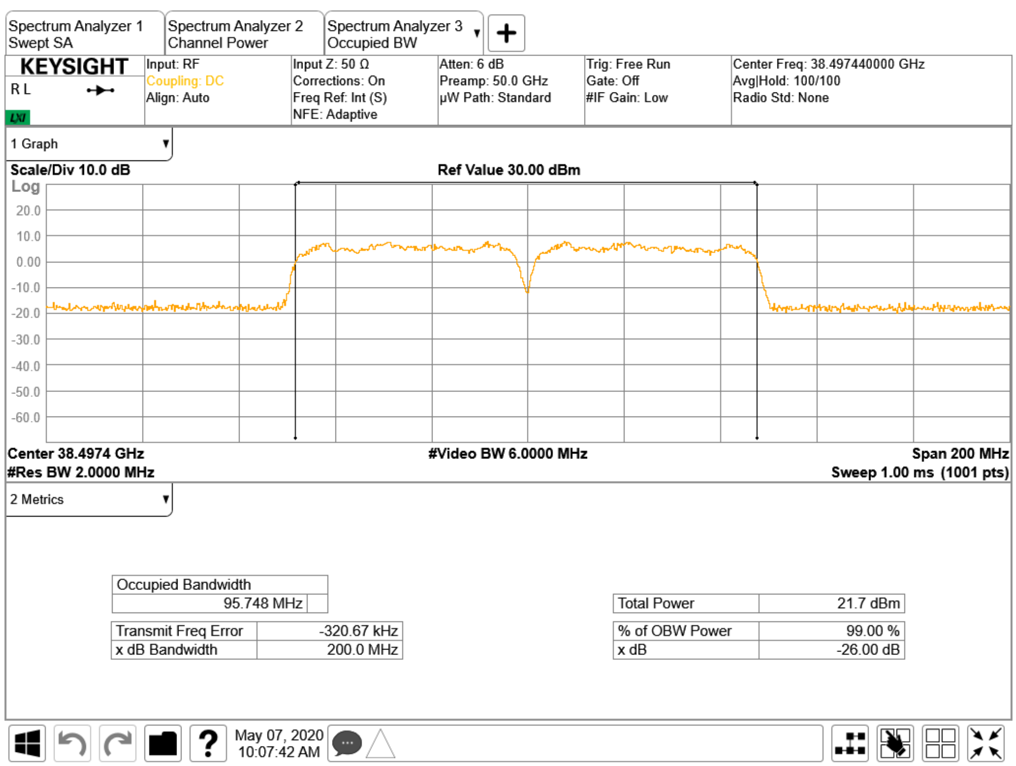
BW
100MHz

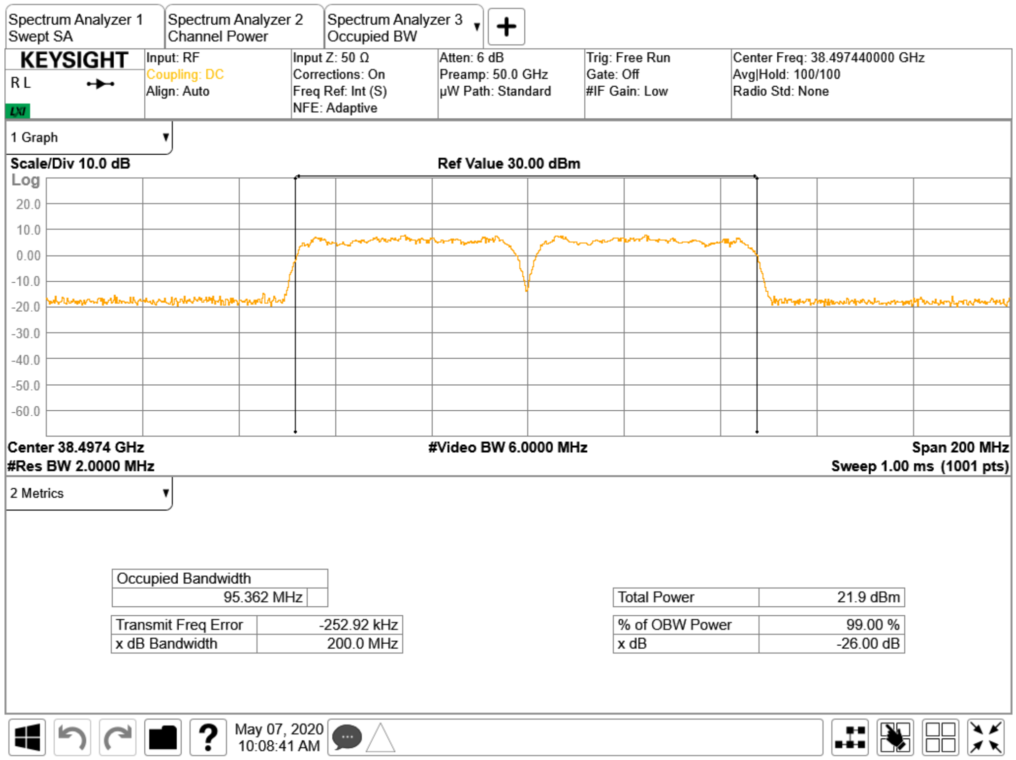
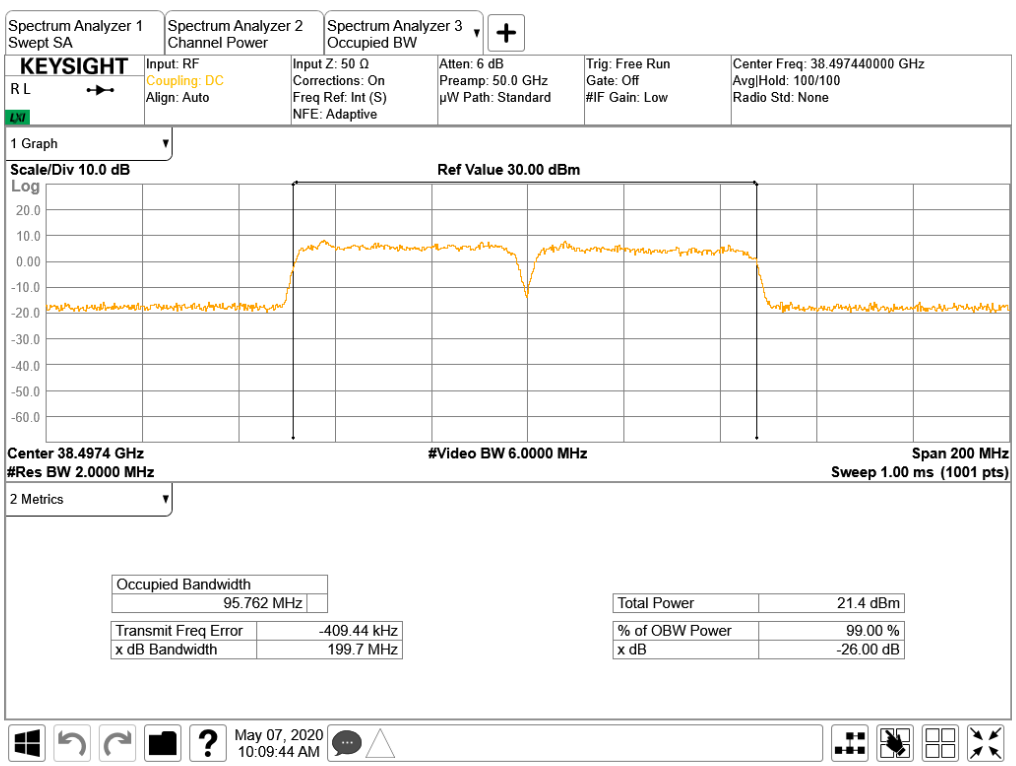


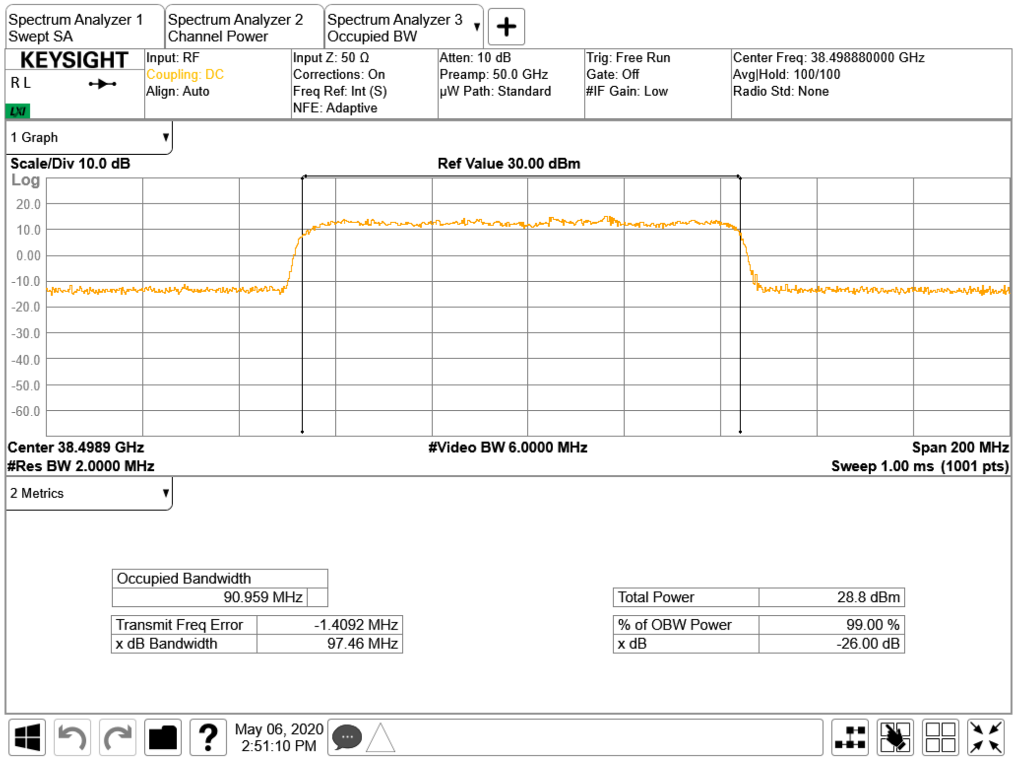
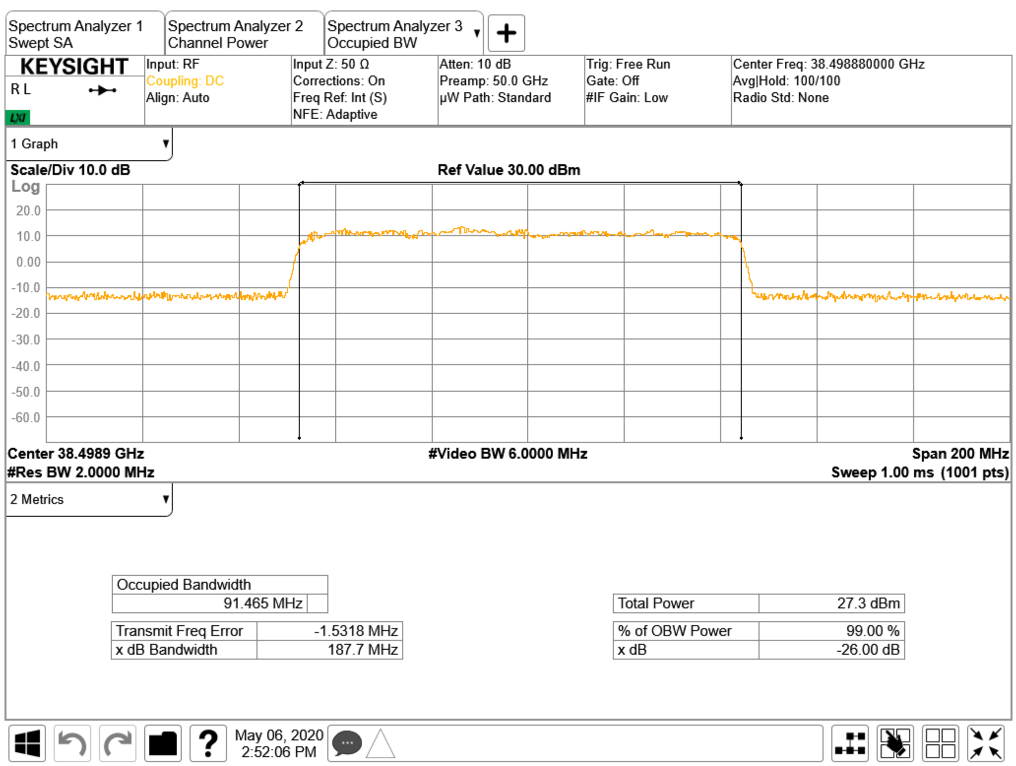
2CC / 64QAM / Mid channel

ANT 2, Band n260

Ant 2 n260 BW 50MHz	 1CC / QPSK / Mid channel
Ant 2 n260 BW 50MHz	 1CC / 16QAM / Mid channel

Ant 2 n260 BW 50MHz	 1CC / 64QAM / Mid channel
Ant 2 n260 BW 50MHz	 2CC / QPSK / Mid channel

Ant 2 n260 BW 50MHz	 2CC / 16QAM / Mid channel
Ant 2 n260 BW 50MHz	 2CC / 64QAM / Mid channel

Ant 2 n260 BW 100MHz	 1CC / QPSK / Mid channel
Ant 2 n260 BW 100MHz	 1CC / 16QAM / Mid channel

<table>
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n260
BW
100MHz</td><td>

1CC / 64QAM / Mid channel</td></tr>
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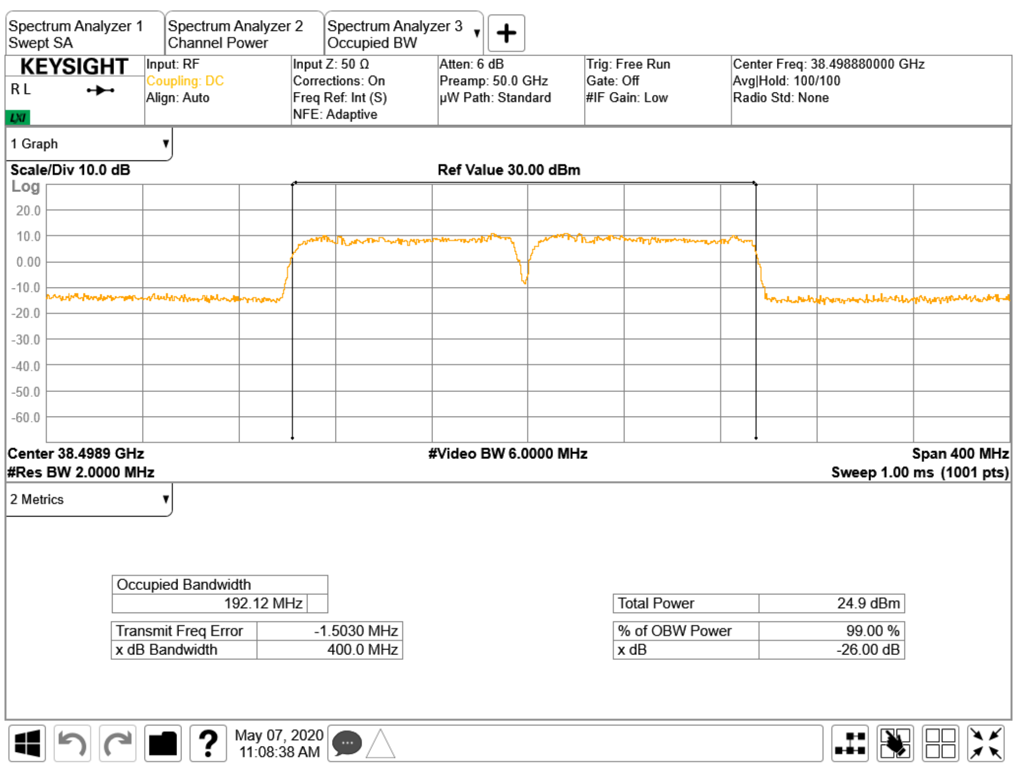
BW
100MHz</td><td>

2CC / QPSK / Mid channel</td></tr>
</table>

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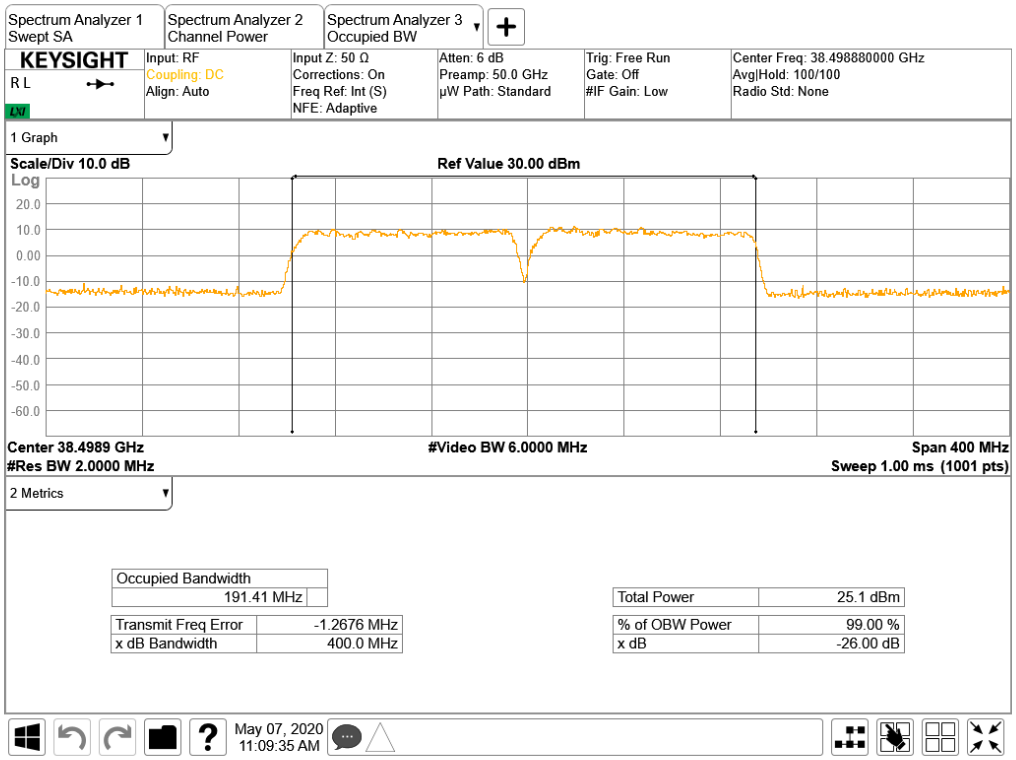
Ant 1

n260

BW 100MHz

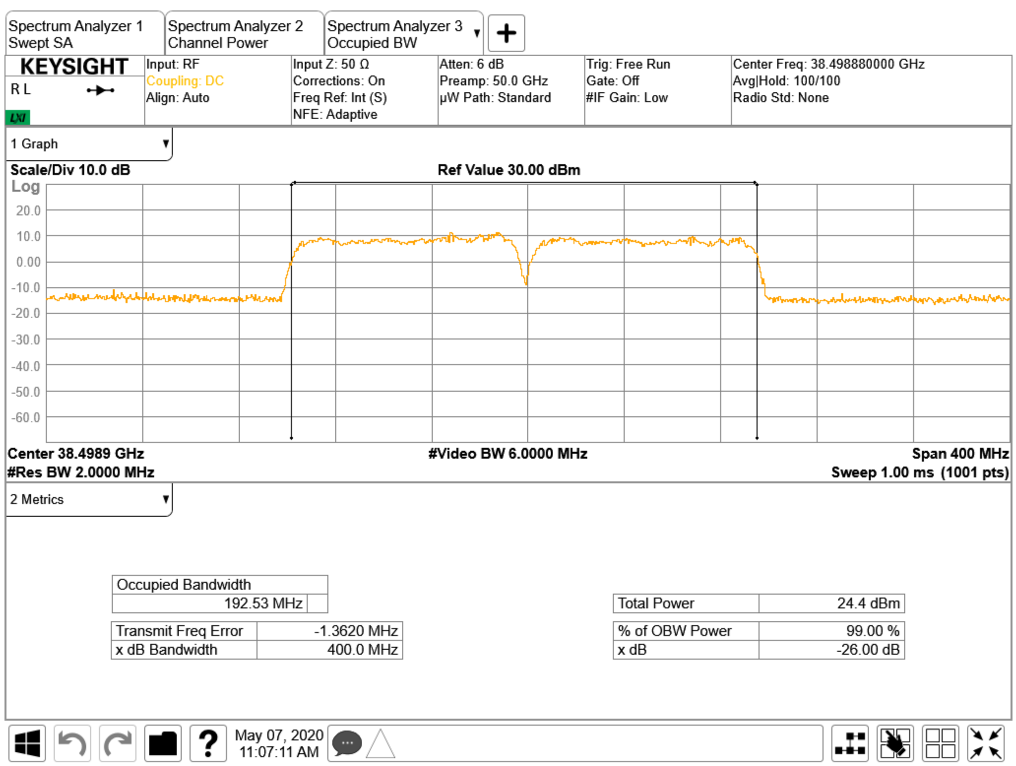


2CC / 16QAM / Mid channel

Ant 2

n260

BW 100MHz



2CC / 64QAM / Mid channel

7.2. EQUIVALENT ISOTROPIC RADIATED POWER

RULE PART(S)

FCC: §2.1046, §30.202

LIMITS

30.202 (b) - For mobile stations, the average power of the sum of all antenna elements is limited to a maximum EIRP of +43 dBm.

TEST PROCEDURE

Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.

a) RBW = 1 – 5% of the OBW, not to exceed 1MHz
b) VBW ≥ 3 x RBW
c) Span = 2x to 3x the OBW
d) number of measurement points in sweep > 2 x span / RBW
e) Sweep time = auto-couple
f) Detector = RMS
g) Trace mode = average

(KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.2)
(ANSI C63.26-2015 Section 5.2.4.4.1)

Note

EIRP measurements were taken at 3m test distance.

Elements within the same antenna array are correlated to produce beamforming array gain. Antenna arrays cannot be correlated with another antenna array. During testing, only one antenna array was active.

The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states:
EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in meter.
The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Channel Power Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst case polarization/positioning. It was determined that H=0 degree and V=90 degree are the worst case positions when the EUT was transmitting horizontally and vertically polarized beams, respectively.

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

See the following pages.

7.2.1. EIRP Results

ANT 1, Band n261

- EIRP Data (50M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27534.84	Low	1CC	H	QPSK	H	1/0	121	72	20.25
27534.84	Low	1CC	H	QPSK	V	1/0	142	80	**22.21**
27922.08	Mid	1CC	H	QPSK	H	1/31	114	34	21.00
27922.08	Mid	1CC	H	QPSK	V	1/31	136	69	21.87
28319.52	High	1CC	H	QPSK	H	1/0	108	72	21.35
28319.52	High	1CC	V	QPSK	V	1/0	140	88	21.67
27534.84	Low	1CC	H	16QAM	H	1/0	120	72	20.07
27534.84	Low	1CC	H	16QAM	V	1/0	140	79	21.60
27534.84	Low	1CC	H	64QAM	H	1/0	120	72	17.06
27534.84	Low	1CC	H	64QAM	V	1/0	140	79	18.53
27559.83	Low	2CC	H	QPSK	H	32/0	106	70	17.99
27559.83	Low	2CC	H	QPSK	V	32/0	146	81	19.82
27559.83	Low	2CC	H	16QAM	H	32/0	106	70	16.06
27559.83	Low	2CC	H	16QAM	V	32/0	146	81	19.36
27559.83	Low	2CC	H	64QAM	H	32/0	106	70	14.16
27559.83	Low	2CC	H	64QAM	V	32/0	146	81	17.54

- EIRP Data (50M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27534.84	Low	1CC	-	QPSK	H	1/16	128	34	19.60
27534.84	Low	1CC	-	QPSK	V	1/16	146	58	22.03
27922.08	Mid	1CC	-	QPSK	H	1/16	138	43	20.11
27922.08	Mid	1CC	-	QPSK	V	1/16	141	61	22.75
28319.52	High	1CC	-	QPSK	H	1/16	81	0	20.12
28319.52	High	1CC	-	QPSK	V	1/16	132	71	**24.05**
28319.52	High	1CC	-	16QAM	H	1/16	81	0	18.97
28319.52	High	1CC	-	16QAM	V	1/16	132	71	22.54
28319.52	High	1CC	-	64QAM	H	1/16	81	0	16.91
28319.52	High	1CC	-	64QAM	V	1/16	132	71	20.14
28294.53	High	2CC	-	QPSK	H	32/0	115	78	19.34
28294.53	High	2CC	-	QPSK	V	32/0	141	79	21.91
28294.53	High	2CC	-	16QAM	H	32/0	115	78	17.74
28294.53	High	2CC	-	16QAM	V	32/0	141	79	20.31
28294.53	High	2CC	-	64QAM	H	32/0	115	78	14.90
28294.53	High	2CC	-	64QAM	V	32/0	141	79	17.94

- EIRP Data (100M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27559.32	Low	1CC	H	QPSK	H	1/63	89	8	22.51
27559.32	Low	1CC	V	QPSK	V	1/63	125	65	22.42
27923.52	Mid	1CC	H	QPSK	H	1/63	124	40	**22.76**
27923.52	Mid	1CC	H	QPSK	V	1/63	148	70	21.76
28292.16	High	1CC	H	QPSK	H	1/32	107	50	22.32
28292.16	High	1CC	H	QPSK	V	1/0	143	59	21.92
27923.52	Mid	1CC	H	16QAM	H	1/63	116	25	21.59
27923.52	Mid	1CC	H	16QAM	V	1/63	150	68	20.21
27923.52	Mid	1CC	H	64QAM	H	1/63	116	25	20.31
27923.52	Mid	1CC	H	64QAM	V	1/63	150	68	18.86
27923.52	Mid	2CC	H	QPSK	H	64/0	118	59	17.99
27923.52	Mid	2CC	H	QPSK	V	64/0	150	71	19.34
27923.52	Mid	2CC	H	16QAM	H	64/0	118	59	17.88
27923.52	Mid	2CC	H	16QAM	V	64/0	150	71	18.77
27923.52	Mid	2CC	H	64QAM	H	64/0	118	59	16.25
27923.52	Mid	2CC	H	64QAM	V	64/0	150	71	17.18

- EIRP Data (100M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27559.32	Low	1CC	-	QPSK	H	1/33	136	42	19.36
27559.32	Low	1CC	-	QPSK	V	1/33	130	46	21.63
27923.52	Mid	1CC	-	QPSK	H	1/33	138	38	20.28
27923.52	Mid	1CC	-	QPSK	V	1/33	139	60	**22.96**
28292.16	High	1CC	-	QPSK	H	1/33	80	55	20.23
28292.16	High	1CC	-	QPSK	V	1/33	87	0	21.61
27923.52	Mid	1CC	-	16QAM	H	1/33	138	38	18.55
27923.52	Mid	1CC	-	16QAM	V	1/33	129	46	20.94
27923.52	Mid	1CC	-	64QAM	H	1/33	138	38	16.44
27923.52	Mid	1CC	-	64QAM	V	1/33	129	46	17.95
27923.52	Mid	2CC	-	QPSK	H	66/0	136	43	17.71
27923.52	Mid	2CC	-	QPSK	V	66/0	163	58	20.38
27923.52	Mid	2CC	-	16QAM	H	66/0	136	43	16.09
27923.52	Mid	2CC	-	16QAM	V	66/0	163	58	18.73
27923.52	Mid	2CC	-	64QAM	H	66/0	136	43	13.70
27923.52	Mid	2CC	-	64QAM	V	66/0	163	58	16.21

ANT 1, Band n260

- EIRP Data (50M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37027.32	Low	1CC	V	QPSK	H	1/31	181	90	17.01
37027.32	Low	1CC	V	QPSK	V	1/31	120	87	19.97
38497.44	Mid	1CC	H	QPSK	H	32/0	290	23	**22.88**
38497.44	Mid	1CC	V	QPSK	V	32/0	118	69	21.18
39966.24	High	1CC	V	QPSK	H	32/0	50	61	18.76
39966.24	High	1CC	H	QPSK	V	32/0	99	80	22.05
38497.44	Mid	1CC	H	16QAM	H	32/0	290	23	21.35
38497.44	Mid	1CC	H	16QAM	V	32/0	38	67	18.87
38497.44	Mid	1CC	H	64QAM	H	32/0	290	23	19.03
38497.44	Mid	1CC	H	64QAM	V	32/0	38	67	16.56
38497.44	Mid	2CC	H	QPSK	H	32/0	109	59	18.50
38497.44	Mid	2CC	H	QPSK	V	32/0	111	78	20.00
38497.44	Mid	2CC	H	16QAM	H	32/0	109	59	18.07
38497.44	Mid	2CC	H	16QAM	V	32/0	111	78	19.69
38497.44	Mid	2CC	H	64QAM	H	32/0	109	59	15.78
38497.44	Mid	2CC	H	64QAM	V	32/0	111	78	17.47

- EIRP Data (50M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37027.32	Low	1CC	-	QPSK	H	1/16	202	61	18.23
37027.32	Low	1CC	-	QPSK	V	1/16	176	72	19.79
38497.44	Mid	1CC	-	QPSK	H	1/16	110	32	23.80
38497.44	Mid	1CC	-	QPSK	V	1/16	118	76	**24.14**
39966.24	High	1CC	-	QPSK	H	1/16	119	63	23.04
39966.24	High	1CC	-	QPSK	V	1/16	127	70	23.37
38497.44	Mid	1CC	-	16QAM	H	1/16	110	30	22.82
38497.44	Mid	1CC	-	16QAM	V	1/16	118	76	23.23
38497.44	Mid	1CC	-	64QAM	H	1/16	110	30	19.50
38497.44	Mid	1CC	-	64QAM	V	1/16	118	76	20.31
38497.44	Mid	2CC	-	QPSK	H	32/0	99	22	21.27
38497.44	Mid	2CC	-	QPSK	V	32/0	115	63	21.39
38497.44	Mid	2CC	-	16QAM	H	32/0	99	22	19.65
38497.44	Mid	2CC	-	16QAM	V	32/0	115	63	19.72
38497.44	Mid	2CC	-	64QAM	H	32/0	99	22	17.09
38497.44	Mid	2CC	-	64QAM	V	32/0	115	63	17.03

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- EIRP Data (100M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37051.8	Low	1CC	H	QPSK	H	1/32	193	71	14.78
37051.8	Low	1CC	H	QPSK	V	1/63	201	76	18.57
38498.88	Mid	1CC	H	QPSK	H	1/63	102	63	21.08
38498.88	Mid	1CC	H	QPSK	V	1/63	105	68	22.61
39949.92	High	1CC	H	QPSK	H	1/63	108	70	22.30
39949.92	High	1CC	V	QPSK	V	1/32	317	54	**23.06**
39949.92	High	1CC	V	16QAM	H	1/32	70	0	20.87
39949.92	High	1CC	V	16QAM	V	1/32	317	54	22.21
39949.92	High	1CC	V	64QAM	H	1/32	70	0	17.90
39949.92	High	1CC	V	64QAM	V	1/32	317	54	19.40
39899.91	High	2CC	V	QPSK	H	64/0	115	54	17.30
39899.91	High	2CC	V	QPSK	V	64/0	121	60	19.26
39899.91	High	2CC	V	16QAM	H	64/0	115	54	16.71
39899.91	High	2CC	V	16QAM	V	64/0	121	60	18.65
39899.91	High	2CC	V	64QAM	H	64/0	115	54	14.62
39899.91	High	2CC	V	64QAM	V	64/0	121	60	16.45

- EIRP Data (100M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37051.8	Low	1CC	-	QPSK	H	1/33	189	62	16.95
37051.8	Low	1CC	-	QPSK	V	1/33	130	68	20.41
38498.88	Mid	1CC	-	QPSK	H	1/33	110	43	22.66
38498.88	Mid	1CC	-	QPSK	V	1/33	119	71	**23.67**
39949.92	High	1CC	-	QPSK	H	1/33	113	59	21.84
39949.92	High	1CC	-	QPSK	V	1/33	120	66	22.58
38498.88	Mid	1CC	-	16QAM	H	1/33	110	43	22.38
38498.88	Mid	1CC	-	16QAM	V	1/33	119	71	23.01
38498.88	Mid	1CC	-	64QAM	H	1/33	110	43	19.00
38498.88	Mid	1CC	-	64QAM	V	1/33	119	71	19.79
38498.88	Mid	2CC	-	QPSK	H	66/0	118	53	19.85
38498.88	Mid	2CC	-	QPSK	V	66/0	113	73	21.95
38498.88	Mid	2CC	-	16QAM	H	66/0	118	53	18.11
38498.88	Mid	2CC	-	16QAM	V	66/0	113	73	20.31
38498.88	Mid	2CC	-	64QAM	H	66/0	118	53	15.47
38498.88	Mid	2CC	-	64QAM	V	66/0	113	73	17.56

ANT 2, Band n261

- EIRP Data (50M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27534.84	Low	1CC	V	QPSK	H	32/0	235	82	19.76
27534.84	Low	1CC	H	QPSK	V	32/0	241	67	21.65
27922.08	Mid	1CC	V	QPSK	H	1/31	260	74	20.86
27922.08	Mid	1CC	H	QPSK	V	1/16	235	75	**22.01**
28319.52	High	1CC	V	QPSK	H	1/31	254	43	21.10
28319.52	High	1CC	V	QPSK	V	32/0	228	84	18.34
27922.08	Mid	1CC	H	16QAM	H	1/16	257	77	17.53
27922.08	Mid	1CC	H	16QAM	V	1/16	235	75	21.46
27922.08	Mid	1CC	H	64QAM	H	1/16	257	77	17.04
27922.08	Mid	1CC	H	64QAM	V	1/16	235	75	21.04
27922.08	Mid	2CC	H	QPSK	H	32/0	216	80	17.84
27922.08	Mid	2CC	H	QPSK	V	32/0	223	66	19.93
27922.08	Mid	2CC	H	16QAM	H	32/0	216	80	16.01
27922.08	Mid	2CC	H	16QAM	V	32/0	223	66	19.47
27922.08	Mid	2CC	H	64QAM	H	32/0	216	80	14.04
27922.08	Mid	2CC	H	64QAM	V	32/0	223	66	17.59

- EIRP Data (50M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27534.84	Low	1CC	-	QPSK	H	1/16	236	81	22.03
27534.84	Low	1CC	-	QPSK	V	1/16	223	86	**24.43**
27922.08	Mid	1CC	-	QPSK	H	1/16	243	68	22.43
27922.08	Mid	1CC	-	QPSK	V	1/16	233	69	24.05
28319.52	High	1CC	-	QPSK	H	1/16	249	63	22.60
28319.52	High	1CC	-	QPSK	V	1/16	243	73	23.82
27534.84	Low	1CC	-	16QAM	H	1/16	236	81	20.63
27534.84	Low	1CC	-	16QAM	V	1/16	223	86	23.61
27534.84	Low	1CC	-	64QAM	H	1/16	231	81	17.85
27534.84	Low	1CC	-	64QAM	V	1/16	223	86	20.72
27559.83	Low	2CC	-	QPSK	H	32/0	241	69	20.33
27559.83	Low	2CC	-	QPSK	V	32/0	219	85	21.81
27559.83	Low	2CC	-	16QAM	H	32/0	241	69	18.71
27559.83	Low	2CC	-	16QAM	V	32/0	219	85	20.32
27559.83	Low	2CC	-	64QAM	H	32/0	241	69	16.11
27559.83	Low	2CC	-	64QAM	V	32/0	219	85	17.83

- EIRP Data (50M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27559.32	Low	1CC	V	QPSK	H	1/0	245	84	20.76
27559.32	Low	1CC	H	QPSK	V	1/0	200	81	21.03
27923.52	Mid	1CC	V	QPSK	H	64/0	251	76	19.86
27923.52	Mid	1CC	H	QPSK	V	64/0	232	73	**21.84**
28292.16	High	1CC	V	QPSK	H	64/0	243	57	21.37
28292.16	High	1CC	H	QPSK	V	64/0	323	68	20.38
27923.52	Mid	1CC	H	16QAM	H	64/0	236	84	17.00
27923.52	Mid	1CC	H	16QAM	V	64/0	232	73	21.46
27923.52	Mid	1CC	H	64QAM	H	64/0	236	84	14.94
27923.52	Mid	1CC	H	64QAM	V	64/0	232	73	19.30
27923.52	Mid	2CC	H	QPSK	H	64/0	225	48	20.45
27923.52	Mid	2CC	H	QPSK	V	64/0	221	70	20.02
27923.52	Mid	2CC	H	16QAM	H	64/0	225	48	17.66
27923.52	Mid	2CC	H	16QAM	V	64/0	221	70	19.53
27923.52	Mid	2CC	H	64QAM	H	64/0	225	48	15.91
27923.52	Mid	2CC	H	64QAM	V	64/0	221	70	17.73

- EIRP Data (100M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
27559.32	Low	1CC	-	QPSK	H	1/33	245	82	21.58
27559.32	Low	1CC	-	QPSK	V	1/33	224	88	24.32
27923.52	Mid	1CC	-	QPSK	H	1/33	240	79	22.85
27923.52	Mid	1CC	-	QPSK	V	1/33	231	85	23.58
28292.16	High	1CC	-	QPSK	H	1/33	240	75	23.18
28292.16	High	1CC	-	QPSK	V	1/33	226	80	**24.38**
28292.16	High	1CC	-	16QAM	H	1/33	240	75	21.46
28292.16	High	1CC	-	16QAM	V	1/33	226	80	22.94
28292.16	High	1CC	-	64QAM	H	1/33	240	75	19.96
28292.16	High	1CC	-	64QAM	V	1/33	226	80	20.64
28242.15	High	2CC	-	QPSK	H	66/0	249	74	20.63
28242.15	High	2CC	-	QPSK	V	66/0	223	80	21.44
28242.15	High	2CC	-	16QAM	H	66/0	249	74	18.96
28242.15	High	2CC	-	16QAM	V	66/0	223	80	19.85
28242.15	High	2CC	-	64QAM	H	66/0	249	74	16.43
28242.15	High	2CC	-	64QAM	V	66/0	223	80	17.37

ANT 2, Band n260

- EIRP Data (50M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37027.32	Low	1CC	V	QPSK	H	1/31	168	86	18.25
37027.32	Low	1CC	H	QPSK	V	1/31	200	67	17.15
38497.44	Mid	1CC	H	QPSK	H	1/0	228	51	19.66
38497.44	Mid	1CC	V	QPSK	V	1/0	234	77	21.52
39966.24	High	1CC	H	QPSK	H	1/31	236	84	18.10
39966.24	High	1CC	V	QPSK	V	1/16	277	47	**21.70**
39966.24	High	1CC	H	16QAM	H	1/16	303	84	15.30
39966.24	High	1CC	H	16QAM	V	1/16	277	47	21.16
39966.24	High	1CC	H	64QAM	H	1/16	303	84	11.34
39966.24	High	1CC	H	64QAM	V	1/16	234	70	19.77
39941.25	High	2CC	V	QPSK	H	32/0	109	59	19.83
39941.25	High	2CC	V	QPSK	V	32/0	117	53	19.74
39941.25	High	2CC	H	16QAM	H	32/0	109	59	18.56
39941.25	High	2CC	H	16QAM	V	32/0	117	53	19.38
39941.25	High	2CC	H	64QAM	H	32/0	109	59	16.16
39941.25	High	2CC	H	64QAM	V	32/0	117	53	16.94

- EIRP Data (50M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37027.32	Low	1CC	-	QPSK	H	1/16	251	0	16.43
37027.32	Low	1CC	-	QPSK	V	1/16	203	70	19.65
38497.44	Mid	1CC	-	QPSK	H	1/16	177	89	16.00
38497.44	Mid	1CC	-	QPSK	V	1/16	233	67	**23.82**
39966.24	High	1CC	-	QPSK	H	1/16	275	8	23.28
39966.24	High	1CC	-	QPSK	V	1/16	278	66	19.37
38497.44	Mid	1CC	-	16QAM	H	1/16	177	89	15.81
38497.44	Mid	1CC	-	16QAM	V	1/16	233	67	22.90
38497.44	Mid	1CC	-	64QAM	H	1/16	177	89	13.26
38497.44	Mid	1CC	-	64QAM	V	1/16	233	67	20.27
38497.44	Mid	2CC	-	QPSK	H	32/0	247	54	20.46
38497.44	Mid	2CC	-	QPSK	V	32/0	246	62	21.16
38497.44	Mid	2CC	-	16QAM	H	32/0	247	54	19.11
38497.44	Mid	2CC	-	16QAM	V	32/0	246	62	19.75
38497.44	Mid	2CC	-	64QAM	H	32/0	247	54	16.33
38497.44	Mid	2CC	-	64QAM	V	32/0	246	62	17.09

- EIRP Data (100M BW / SISO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37051.8	Low	1CC	H	QPSK	H	1/63	197	54	15.70
37051.8	Low	1CC	V	QPSK	V	1/63	224	71	19.30
38498.88	Mid	1CC	V	QPSK	H	64/0	241	62	20.92
38498.88	Mid	1CC	V	QPSK	V	64/0	241	67	21.56
39949.92	High	1CC	H	QPSK	H	1/32	276	7	21.41
39949.92	High	1CC	H	QPSK	V	1/0	234	77	**22.82**
39949.92	High	1CC	H	16QAM	H	1/0	276	7	20.84
39949.92	High	1CC	H	16QAM	V	1/0	234	77	22.28
39949.92	High	1CC	H	64QAM	H	1/0	276	7	17.43
39949.92	High	1CC	H	64QAM	V	1/0	234	77	18.43
39899.91	High	2CC	H	QPSK	H	64/0	233	52	17.29
39899.91	High	2CC	H	QPSK	V	64/0	235	68	17.30
39899.91	High	2CC	H	16QAM	H	64/0	233	52	16.91
39899.91	High	2CC	H	16QAM	V	64/0	235	68	16.90
39899.91	High	2CC	H	64QAM	H	64/0	233	52	14.81
39899.91	High	2CC	H	64QAM	V	64/0	235	68	14.74

- EIRP Data (100M BW / MIMO)

Frequency	Channel	CCs	Beam pol.	Mod	Ant pol.	RB	X-axis	Y-axis	EIRP(dBm)
37051.8	Low	1CC	-	QPSK	H	1/33	284	43	17.46
37051.8	Low	1CC	-	QPSK	V	1/33	199	76	19.31
38498.88	Mid	1CC	-	QPSK	H	1/33	274	3	**24.26**
38498.88	Mid	1CC	-	QPSK	V	1/33	288	39	19.35
39949.92	High	1CC	-	QPSK	H	1/33	260	0	21.75
39949.92	High	1CC	-	QPSK	V	1/33	241	69	22.52
38498.88	Mid	1CC	-	16QAM	H	1/33	227	2	22.43
38498.88	Mid	1CC	-	16QAM	V	1/33	288	39	18.74
38498.88	Mid	1CC	-	64QAM	H	1/33	227	2	18.62
38498.88	Mid	1CC	-	64QAM	V	1/33	288	39	15.12
38498.88	Mid	2CC	-	QPSK	H	66/0	246	53	20.14
38498.88	Mid	2CC	-	QPSK	V	66/0	244	61	21.11
38498.88	Mid	2CC	-	16QAM	H	66/0	246	53	18.79
38498.88	Mid	2CC	-	16QAM	V	66/0	244	61	19.76
38498.88	Mid	2CC	-	64QAM	H	66/0	246	53	16.08
38498.88	Mid	2CC	-	64QAM	V	66/0	244	61	16.95

7.3. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §2.1051, §30.203

LIMITS

30.203 (a) - The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

TEST PROCEDURE

a) RBW = 1MHz
b) VBW ≥ 3 x RBW
c) number of measurement points in sweep > 2 x span / RBW
d) Sweep time = auto-couple
e) Detector = RMS
f) Trace mode = average

(KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.4.2.5)
(ANSI C63.26-2015 Section 5 and 6.4)

NOTE

Band Edge emissions were measured at a 3 meter distance.

Band Edge measurements in this section are shown as equivalent conductive powers for direct comparison to the 30.203 limit. The condutive power at the band edge is calculated by subtracting the gain of the EUT's antenna from the measured EIRP level. Antenna Gain information is shown on the following page.

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The spectrum analyzer for each measurement shows an offset value that was determined using the measurement antenna factor, cable loss, far field measurement distance, and EUT antenna gain. A sample calculation is shown below.

Sample Analyzer Offset Calculation (at 30GHz)
Measurement Antenna Factor = 46.90dB/m
Cable Loss = 2.53dB
EUT Antenna Gain = 8.22dBi
Analyzer Offset (dB) = AF (dB/m) + CL (dB) + 107 + 20log10(D) – 104.8dB – Gain (dBi), where D = 3m
= 46.90dB/m + 2.53dB + 107 + 20log10(3m) – 104.8dB – 8.22dBi
= 52.95dB

Antenna gain Information at the Band Edge

The following antenna gain information is provided to demonstrate the antenna performance of the 27.5 – 28.35GHz and 37 – 40GHz band. These antenna gains were subtracted from the measured EIRP levels at the lower and upper band edge frequencies to determine an equivalent conductive power that was compared directly with the §30.203 limits.

EUT Antenna gain (n261)			
Antenna	Channel	Beam Pol	Gain (dBi)
ANT1	Low	H	8.53
		V	8.55
	High	H	8.29
		V	8.04
ANT2	Low	H	8.67
		V	8.72
	High	H	8.67
		V	8.22

EUT Antenna gain (n260)			
Antenna	Channel	Beam Pol	Gain (dBi)
ANT1	Low	H	8.3
		V	8.22
	High	H	9.07
		V	9.86
ANT2	Low	H	7.43
		V	7.98
	High	H	9.47
		V	10.58

The antenna gain listed is worst value, including Out of band, and this gain value applied to the band edge test.

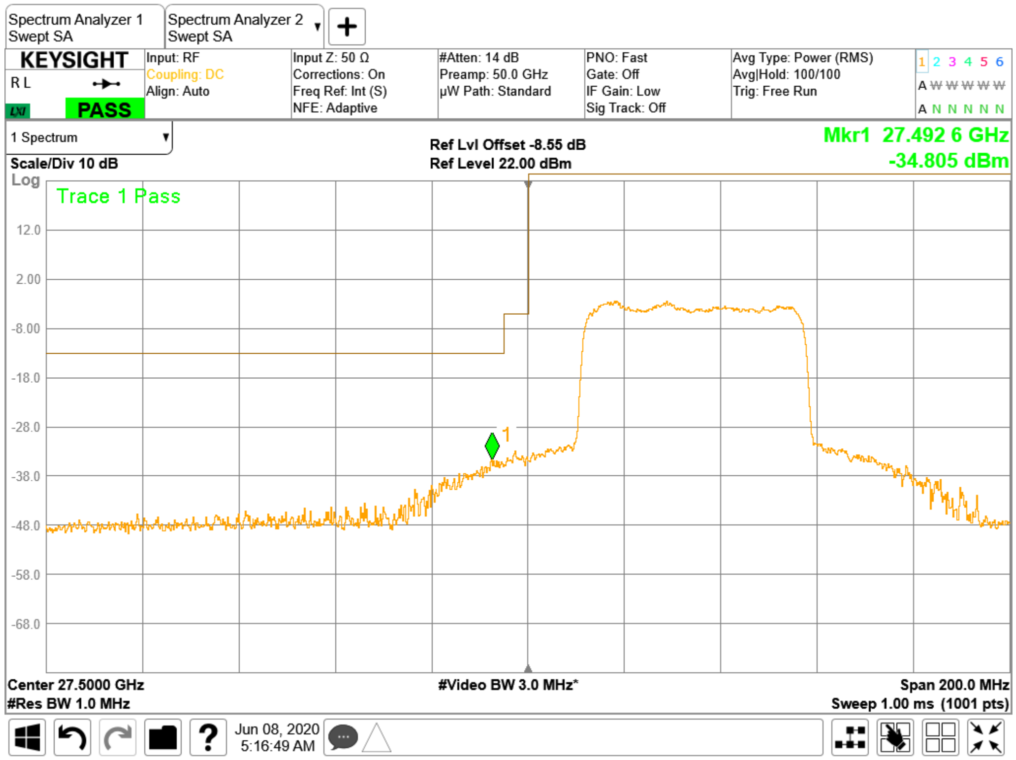
EUT antenna gain is corrected to offset in the signal analyzer.

RESULTS

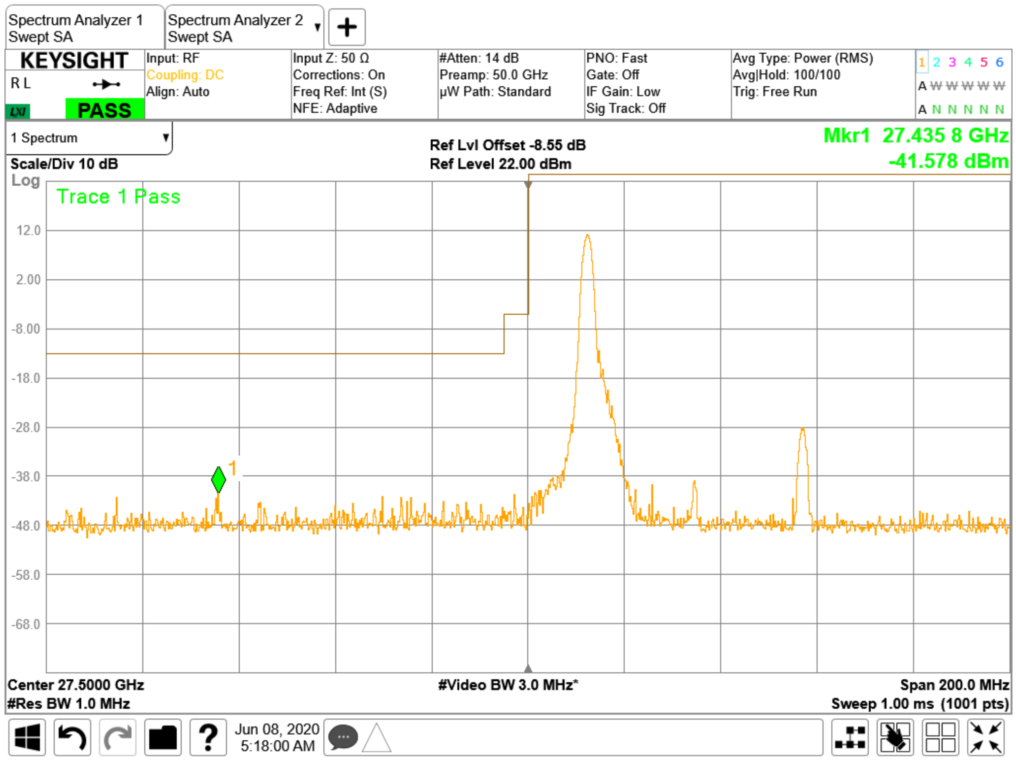
See the following pages.

7.3.1. BAND EDGE RESULT

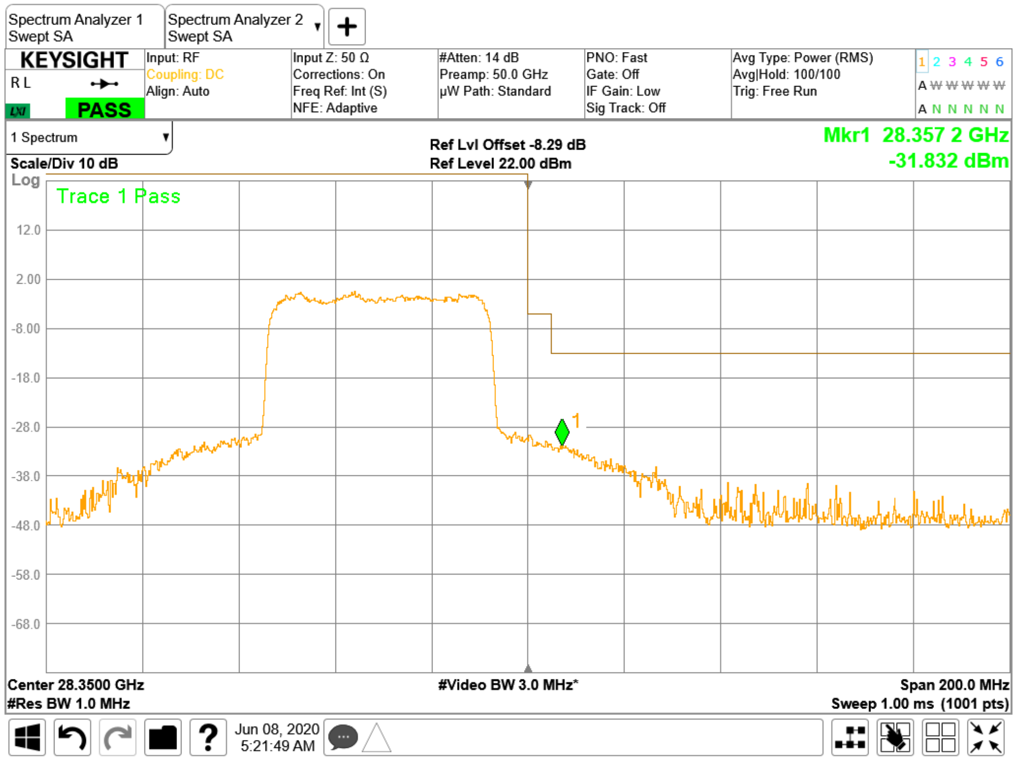
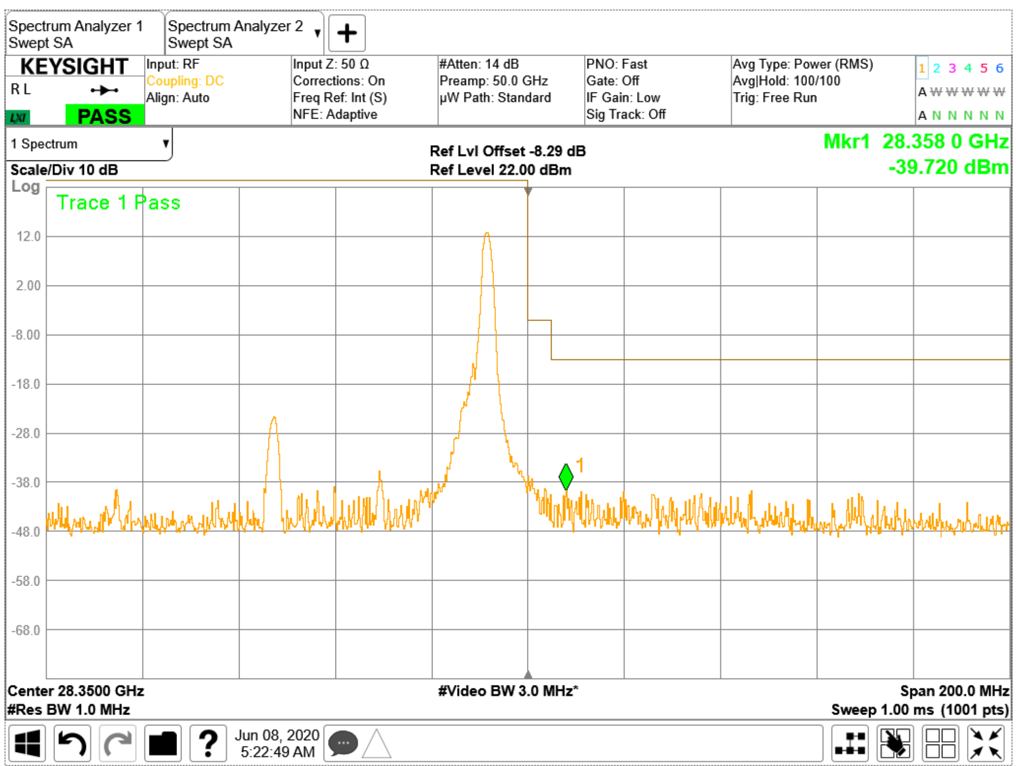
ANT 1, Band n261, MIMO

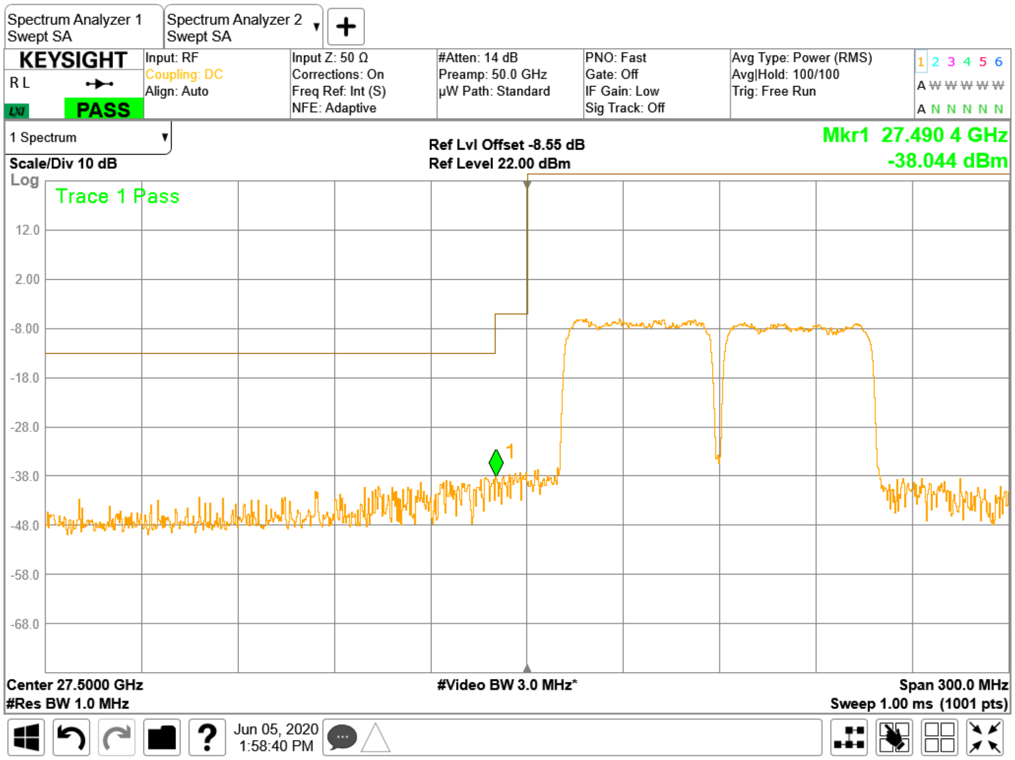
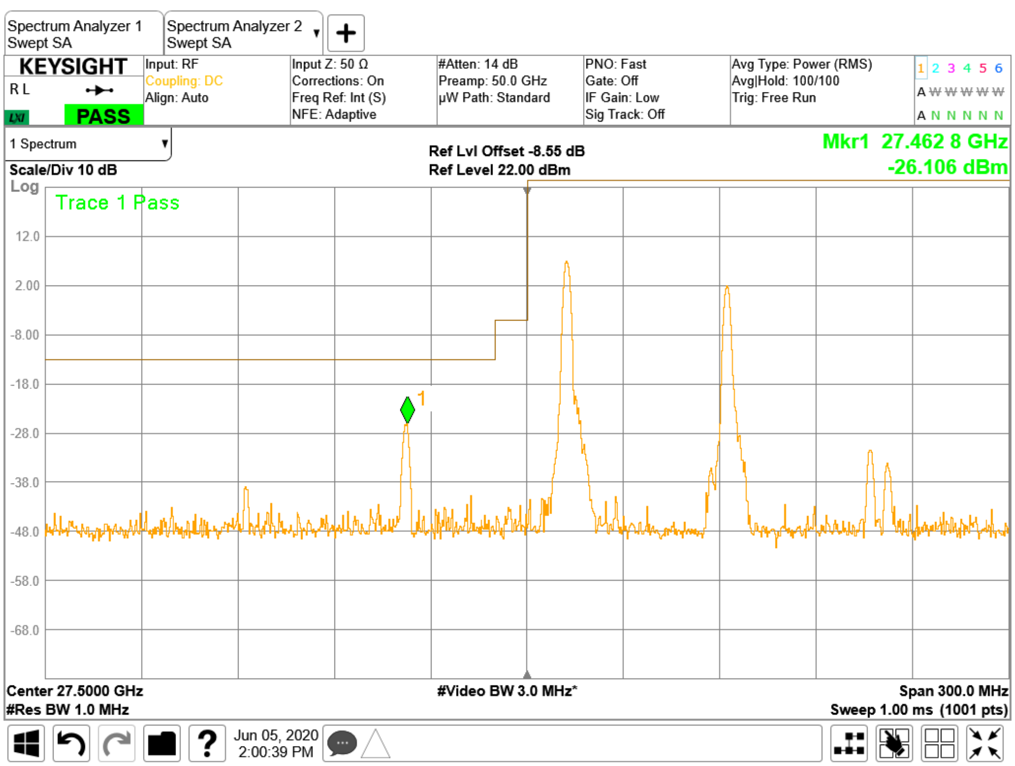


Ant 1 n261 BW 50MHz MIMO	1CC / QPSK / Low channel / Full RB



Ant 1 n261 BW 50MHz MIMO	1CC / QPSK / Low channel / 1 RB

Ant 1 n261 BW 50MHz MIMO	 1CC / QPSK / High channel / Full RB
Ant 1 n261 BW 50MHz MIMO	 1CC / QPSK / High channel / 1 RB

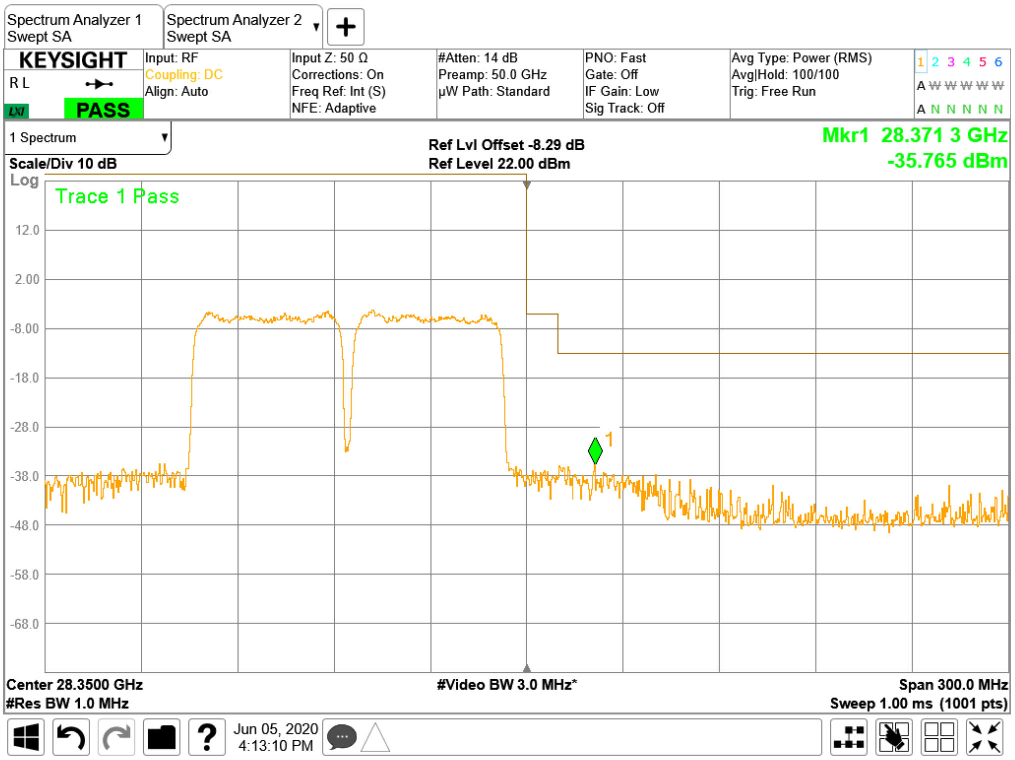
Ant 1 n261 BW 50MHz MIMO	 2CC / QPSK / Low channel / Full RB
Ant 1 n261 BW 50MHz MIMO	 2CC / QPSK / Low channel / 1 RB

Ant 1

n261

BW 50MHz

MIMO



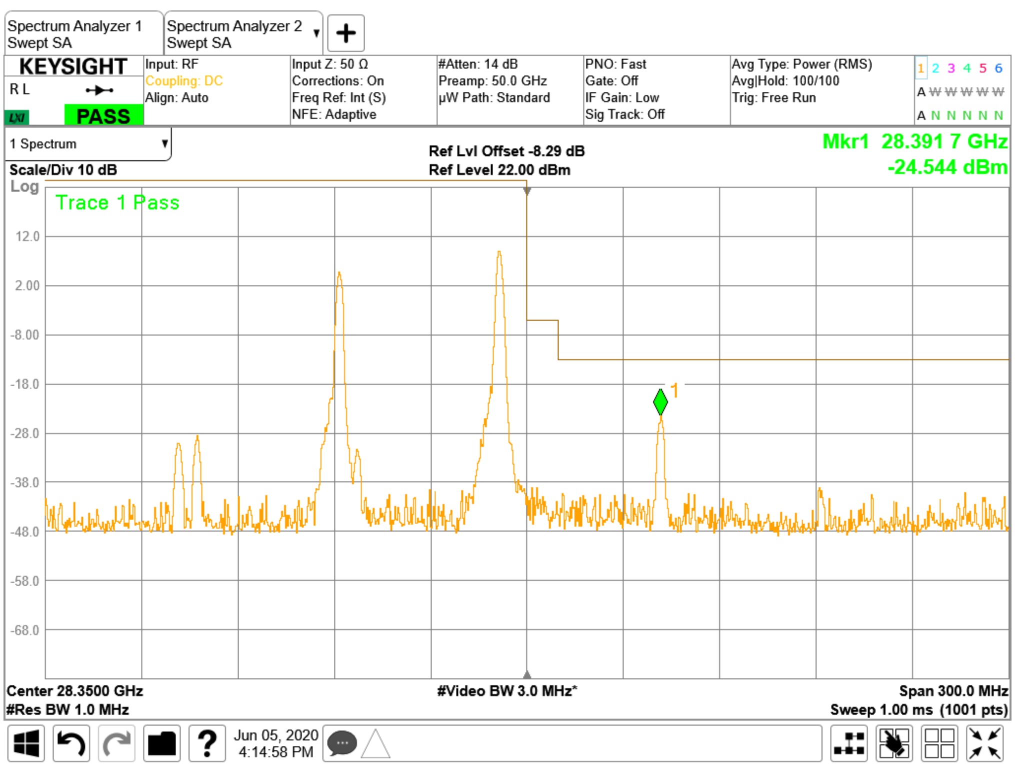
2CC / QPSK / High channel / Full RB

Ant 1

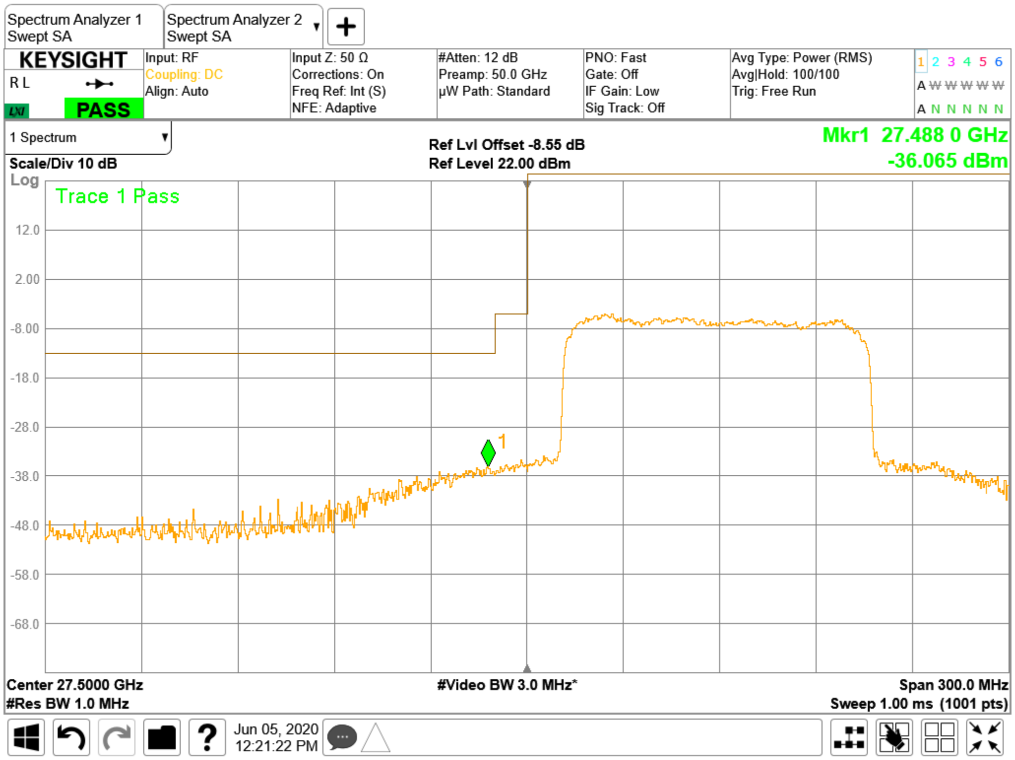
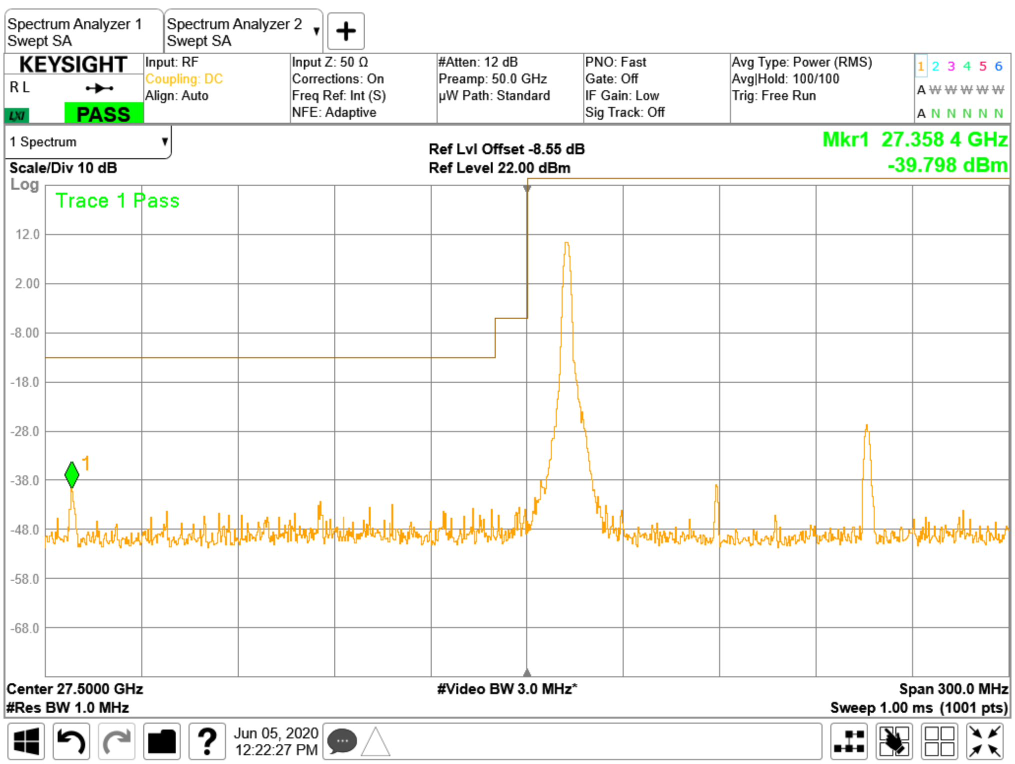
n261

BW 50MHz

MIMO



2CC / QPSK / High channel / 1 RB

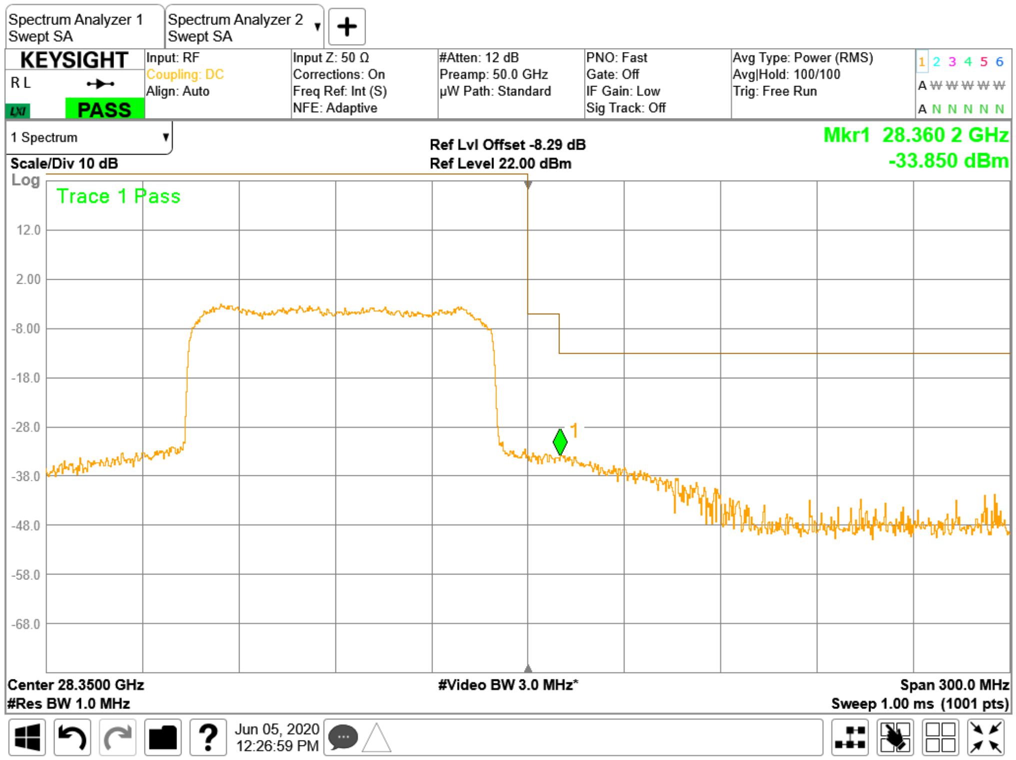
Ant 1 n261 BW 100MHz MIMO	 1CC / QPSK / Low channel / Full RB
Ant 1 n261 BW 100MHz MIMO	 1CC / QPSK / Low channel / 1 RB

Ant 1

n261

BW 100MHz

MIMO



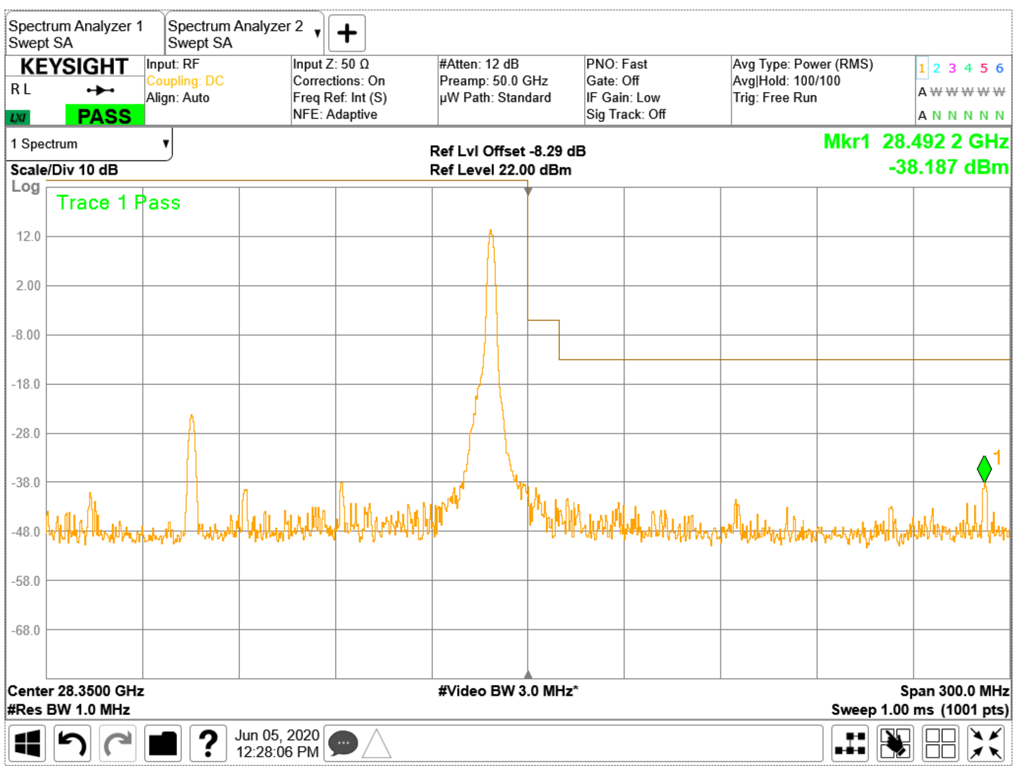
1CC / QPSK / High channel / Full RB

Ant 1

n261

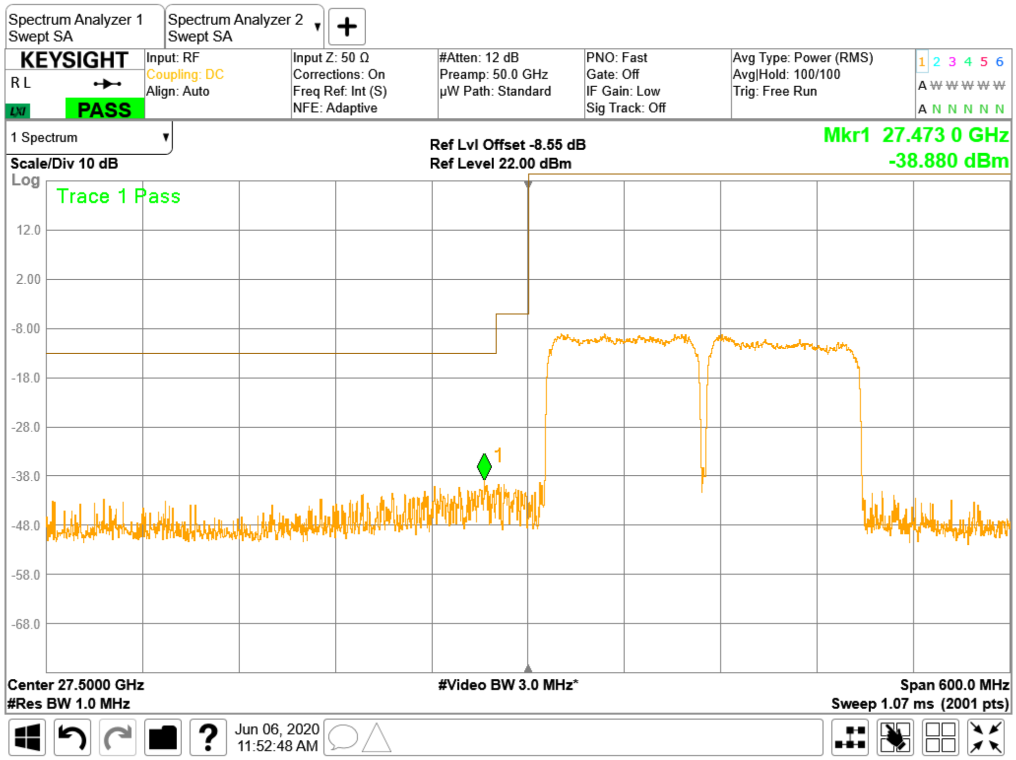
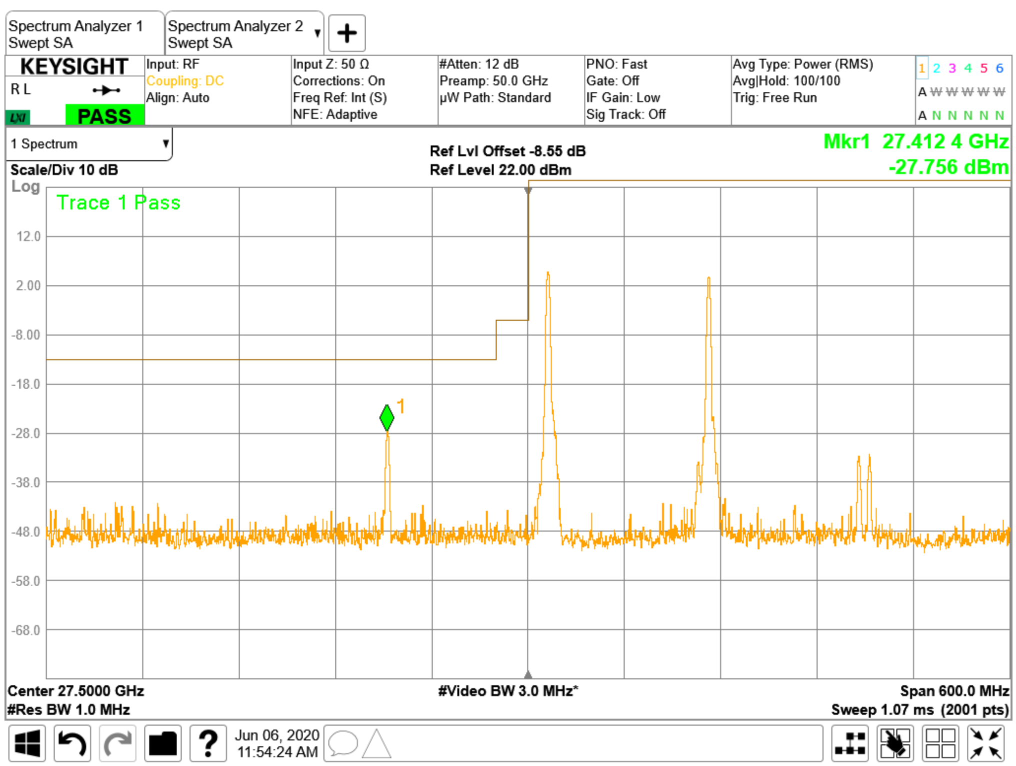
BW 100MHz

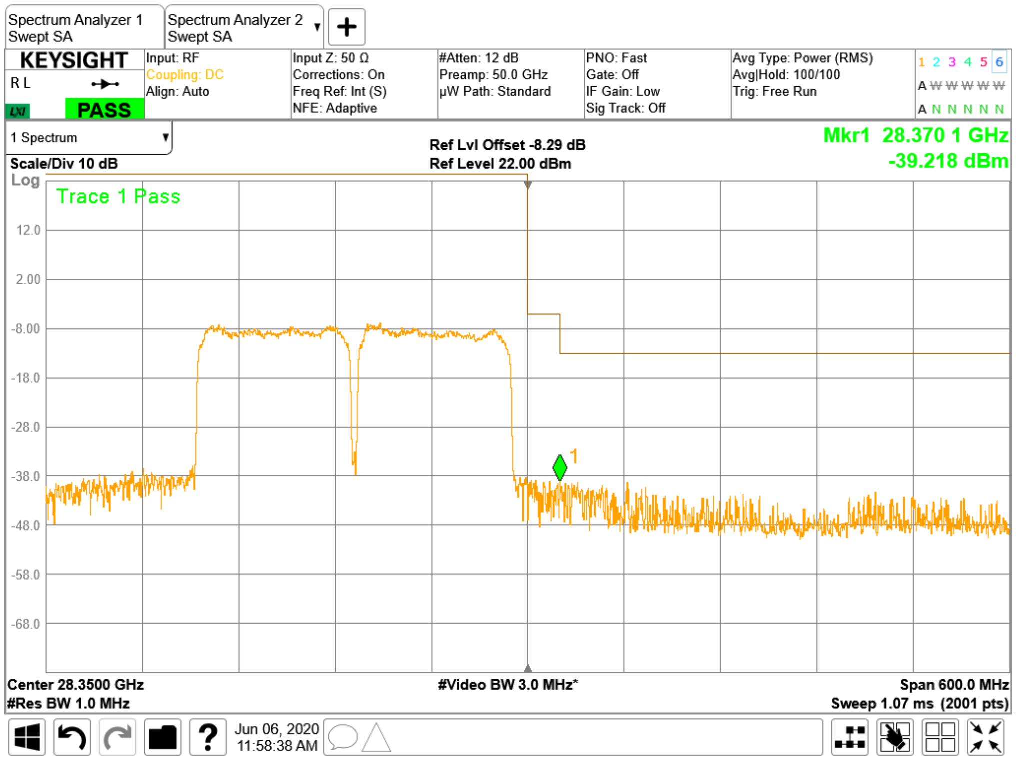
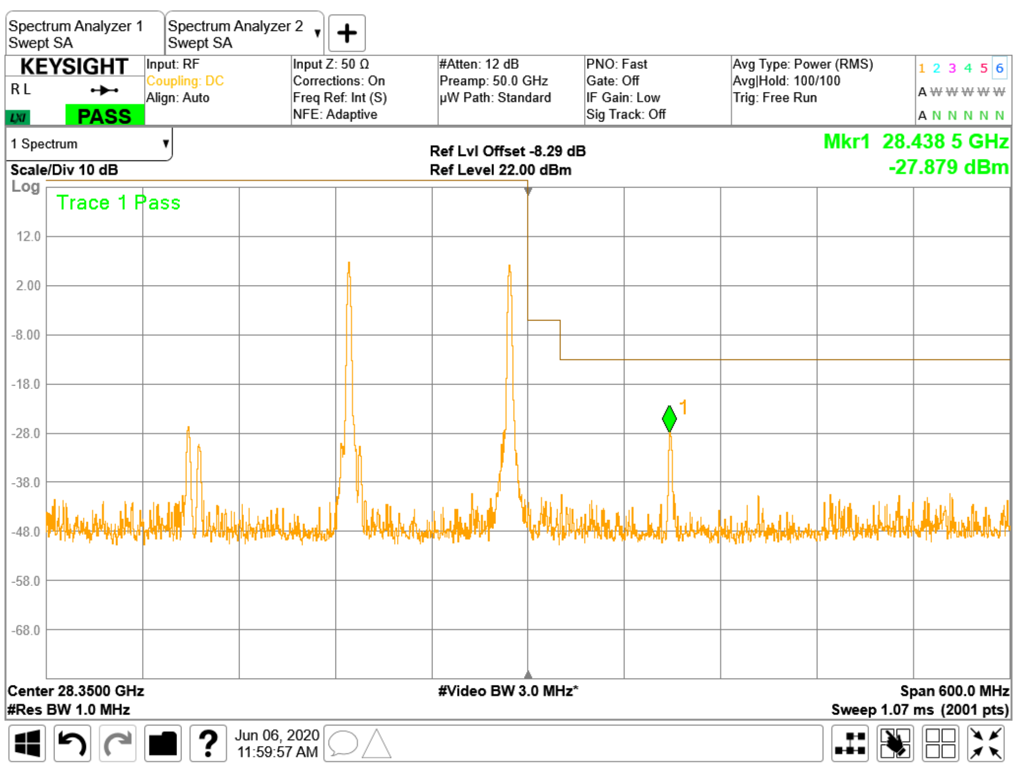
MIMO



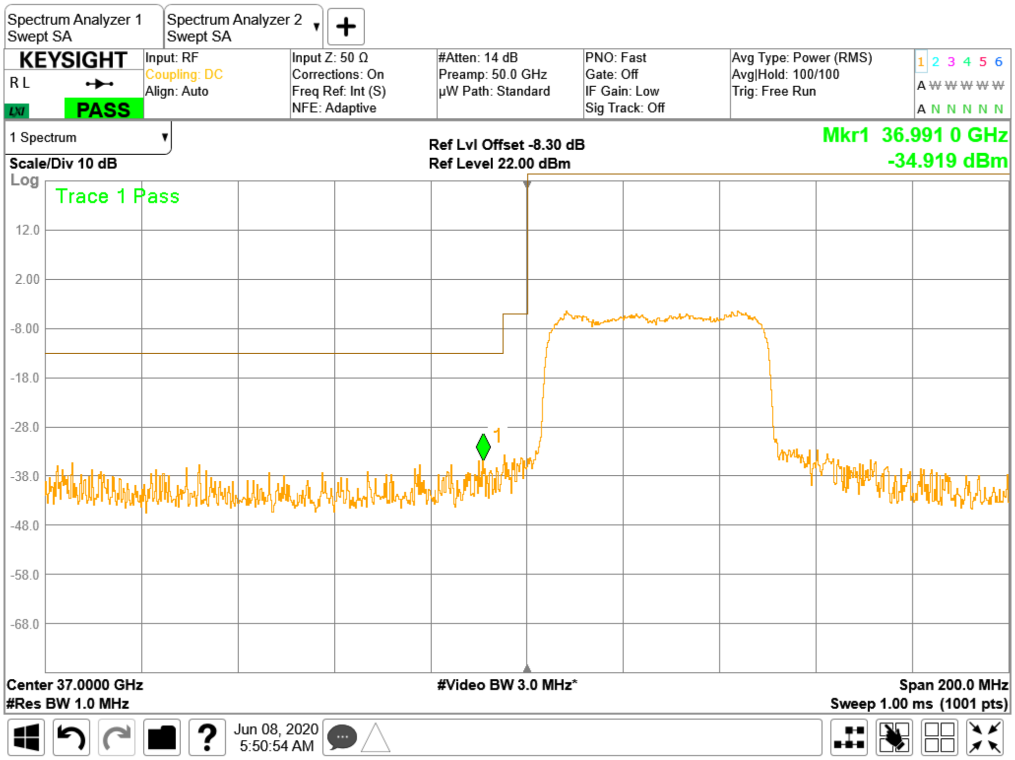
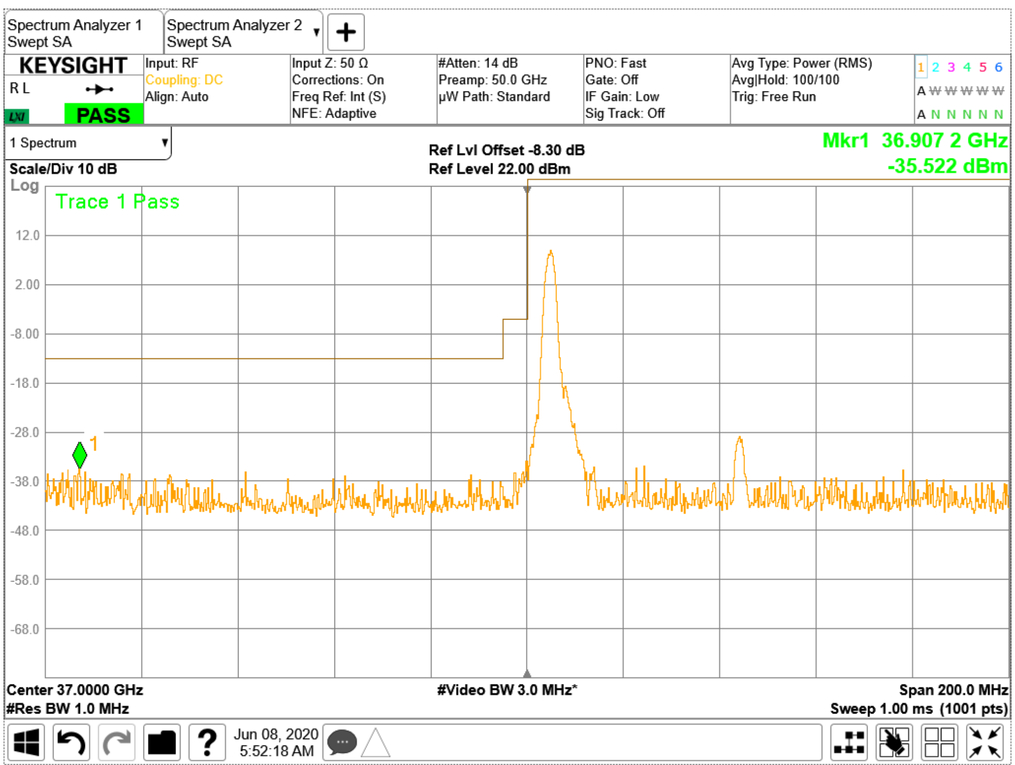
1CC / QPSK / High channel / 1 RB

UL Korea, Ltd. Suwon Laboratory
FORM ID: FCC_30(04)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

Ant 1 n261 BW 100MHz MIMO	 2CC / QPSK / Low channel / Full RB
Ant 1 n261 BW 100MHz MIMO	 2CC / QPSK / Low channel / 1 RB

Ant 1 n261 BW 100MHz MIMO	 2CC / QPSK / High channel / Full RB
Ant 1 n261 BW 100MHz MIMO	 2CC / QPSK / High channel / 1 RB

ANT 1, Band n260 MIMO

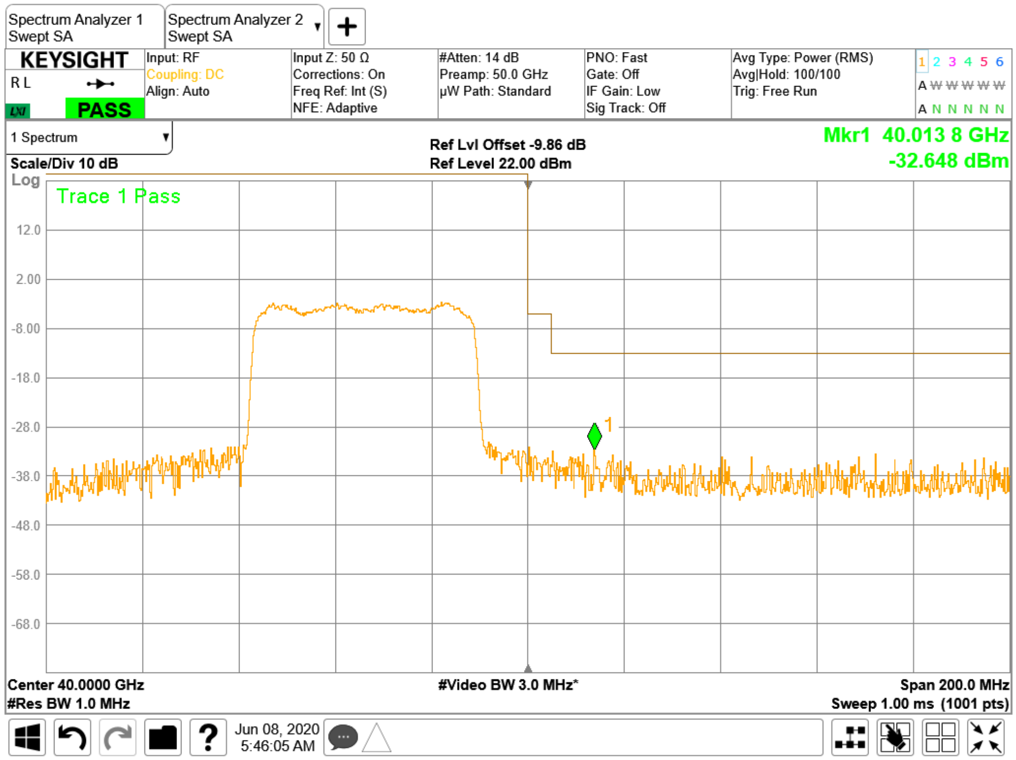
Ant 1 n260 BW 50MHz MIMO	 1CC / QPSK / Low channel / Full RB
Ant 1 n260 BW 50MHz MIMO	 1CC / QPSK / Low channel / 1 RB

Ant 1

n260

BW 50MHz

MIMO



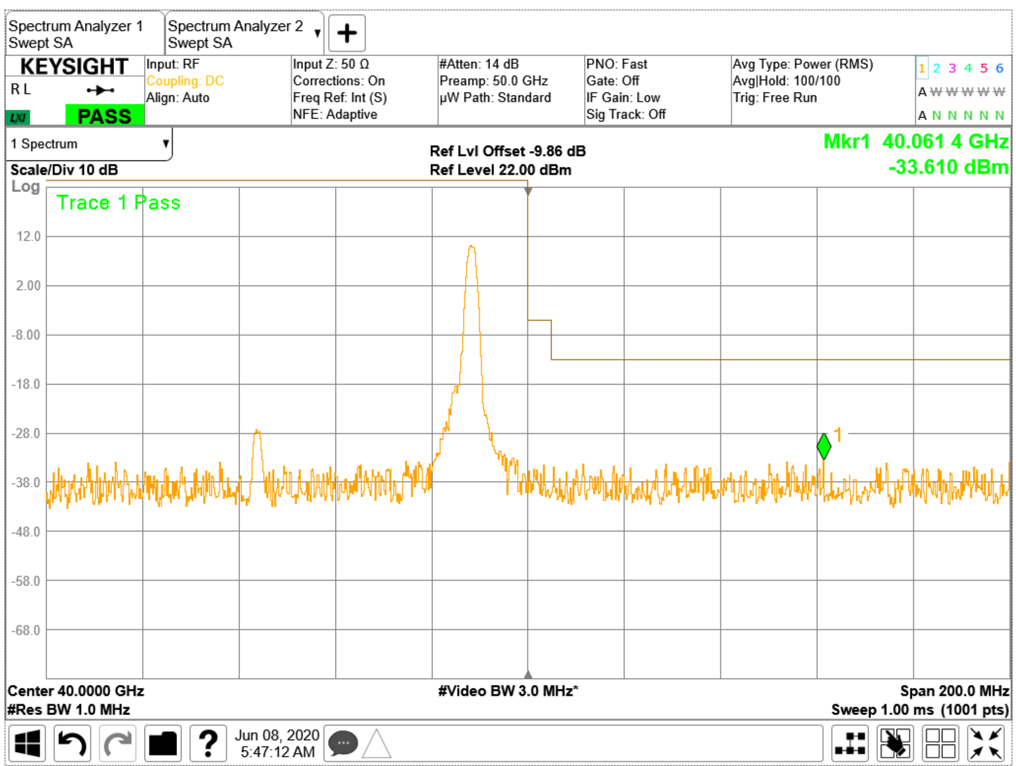
1CC / QPSK / High channel / Full RB

Ant 1

n260

BW 50MHz

MIMO



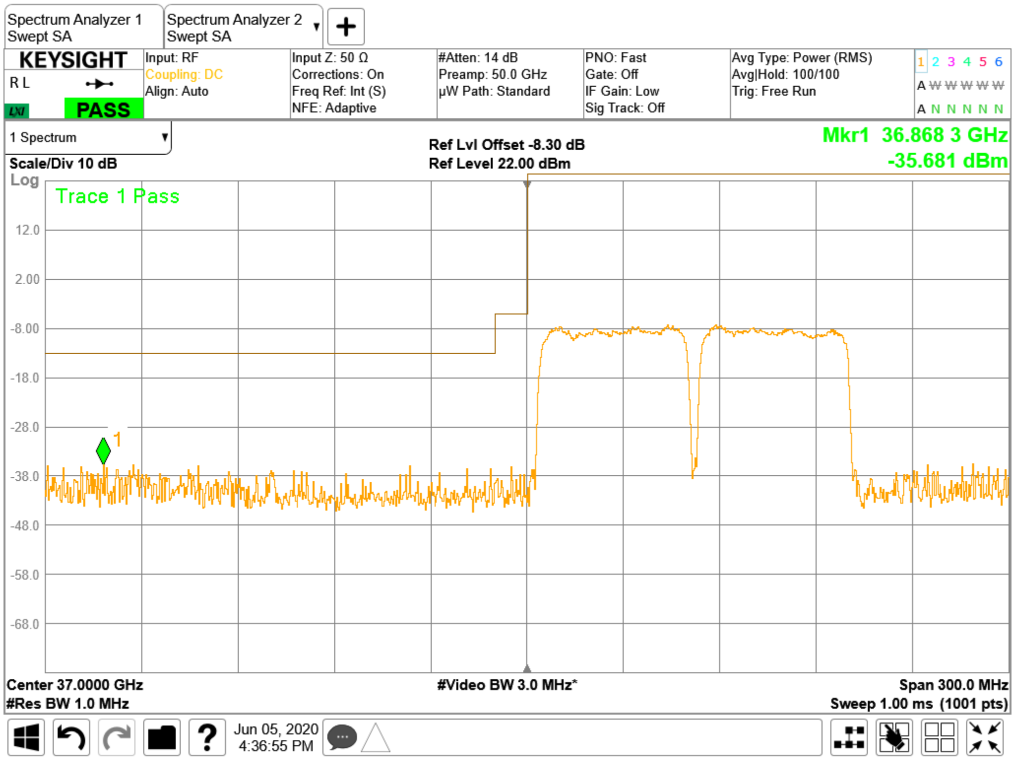
1CC / QPSK / High channel / 1 RB

Ant 1

n260

BW 50MHz

MIMO



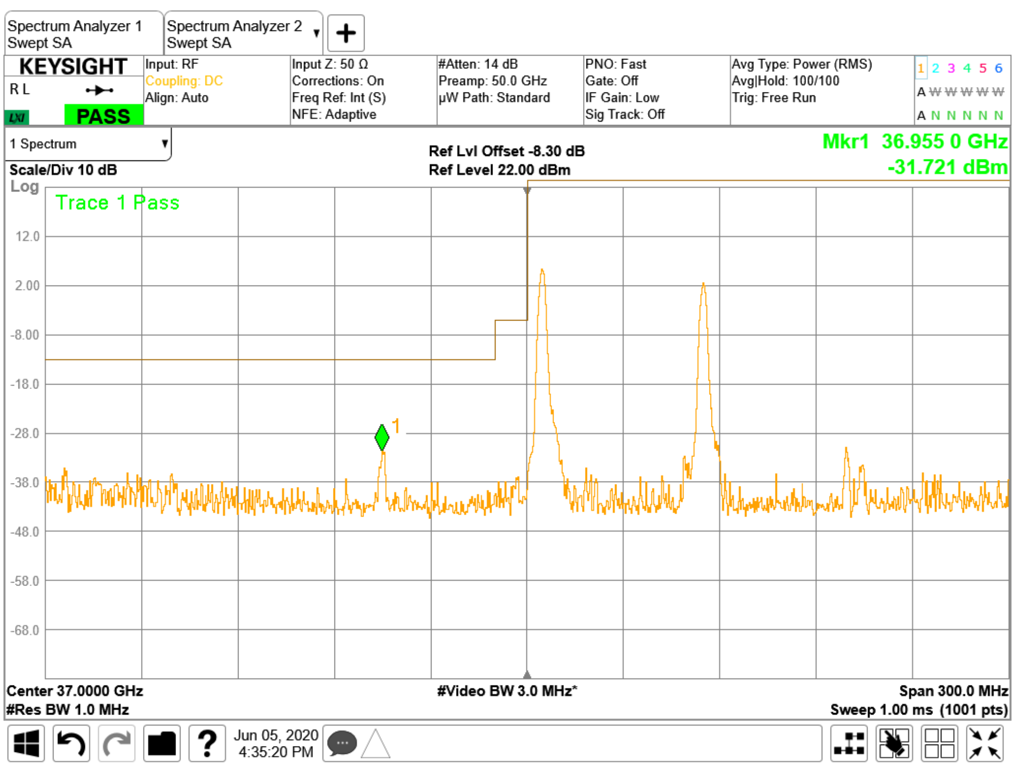
2CC / QPSK / Low channel / Full RB

Ant 1

n260

BW 50MHz

MIMO



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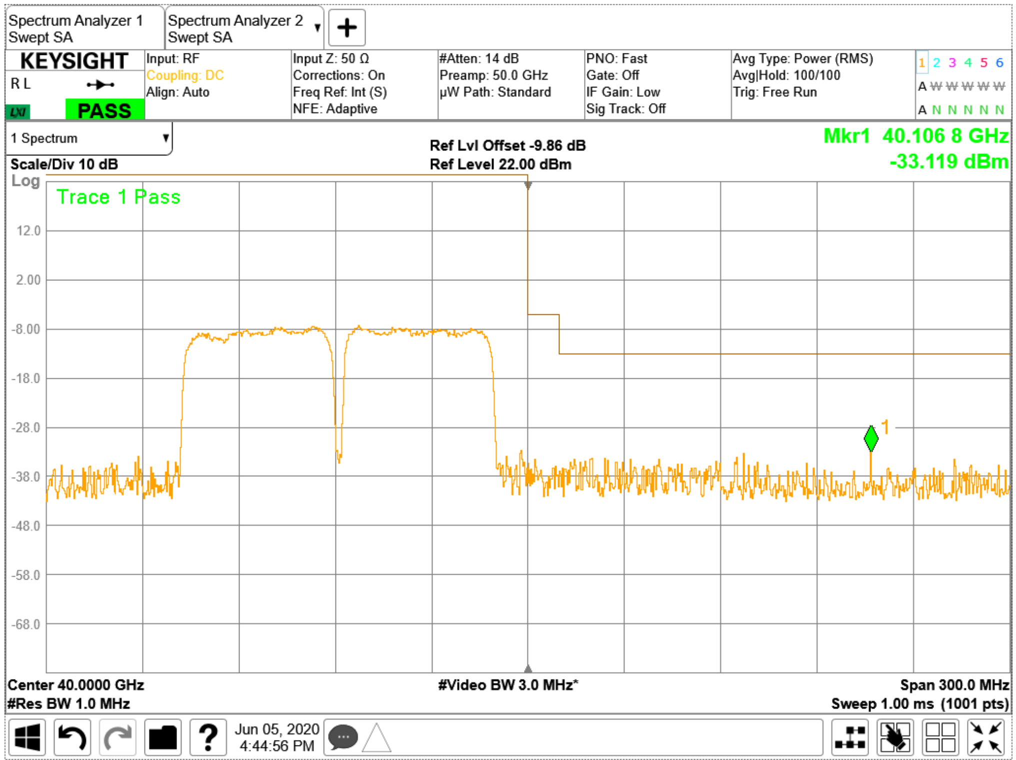
Ant 1

n260

BW 50MHz

MIMO



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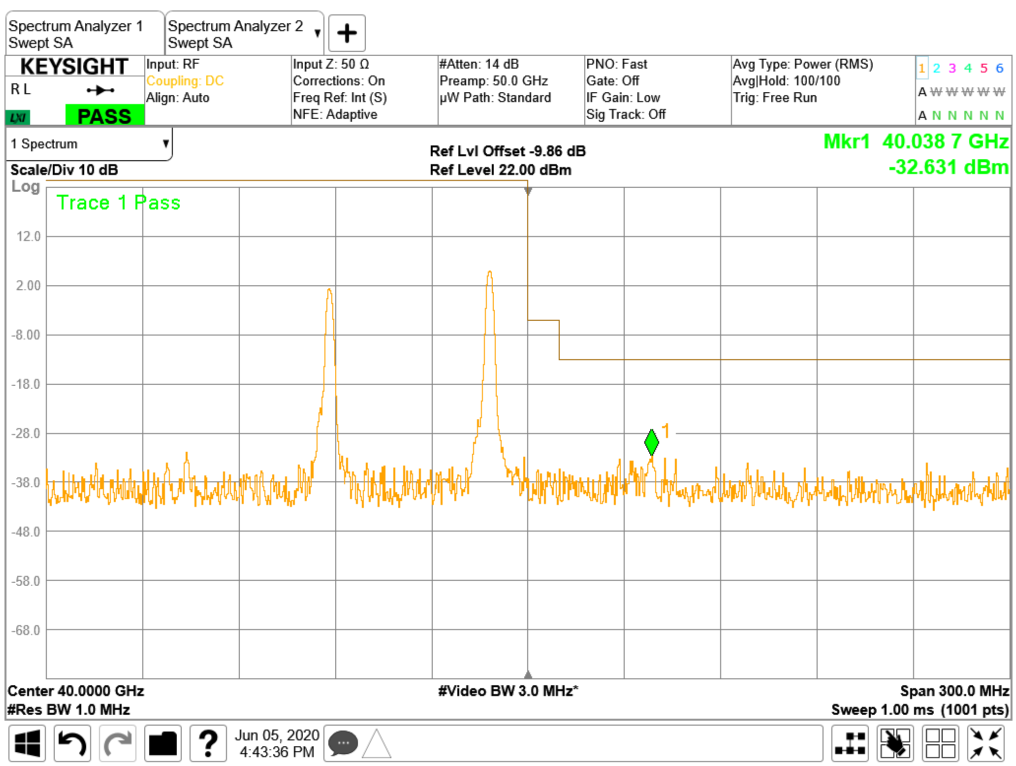
Ant 1

n260

BW 50MHz

MIMO



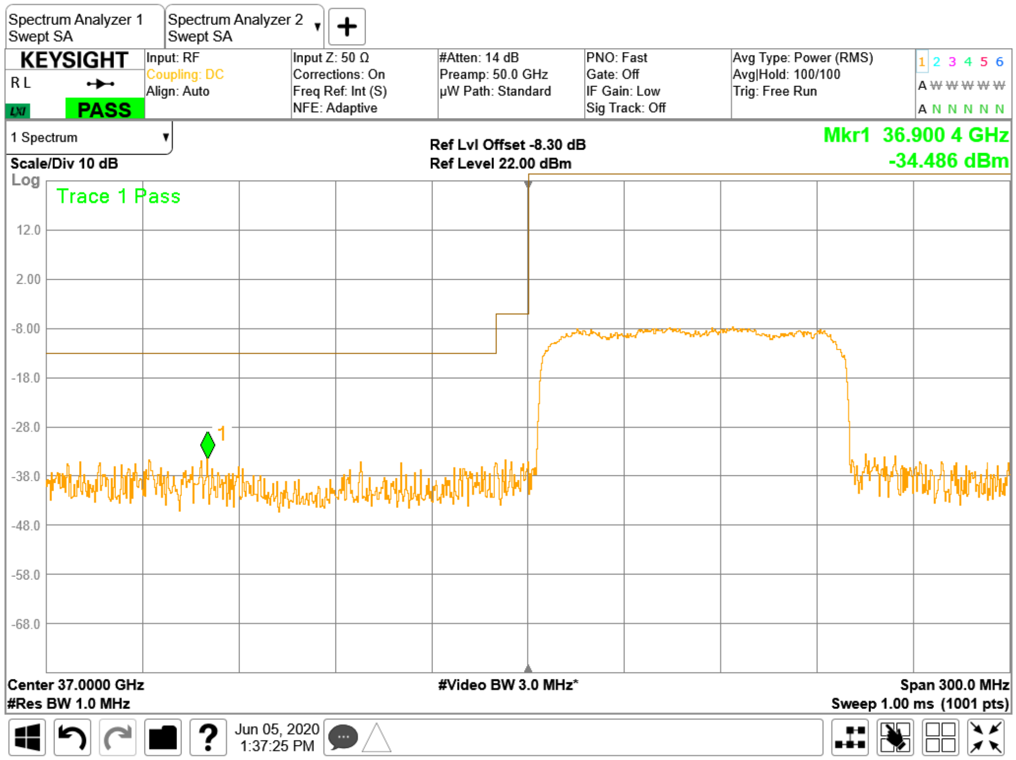
2CC / QPSK / High channel / 1 RB

Ant 1

n260

BW 100MHz

MIMO



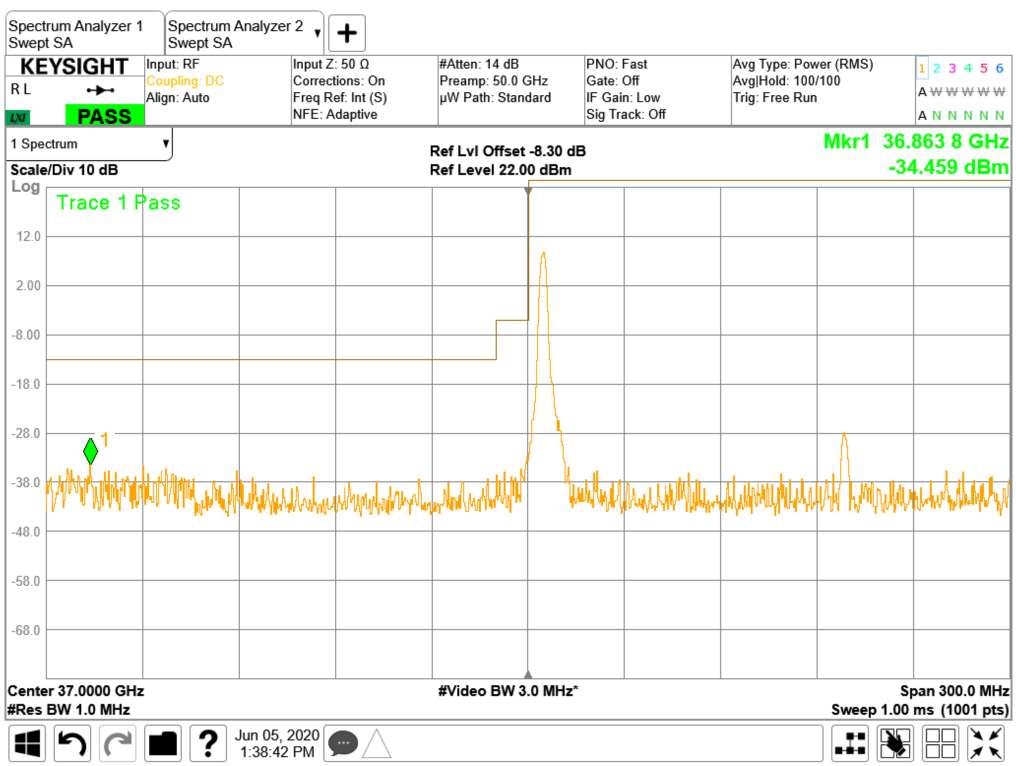
1CC / QPSK / Low channel / Full RB

Ant 1

n260

BW 100MHz

MIMO



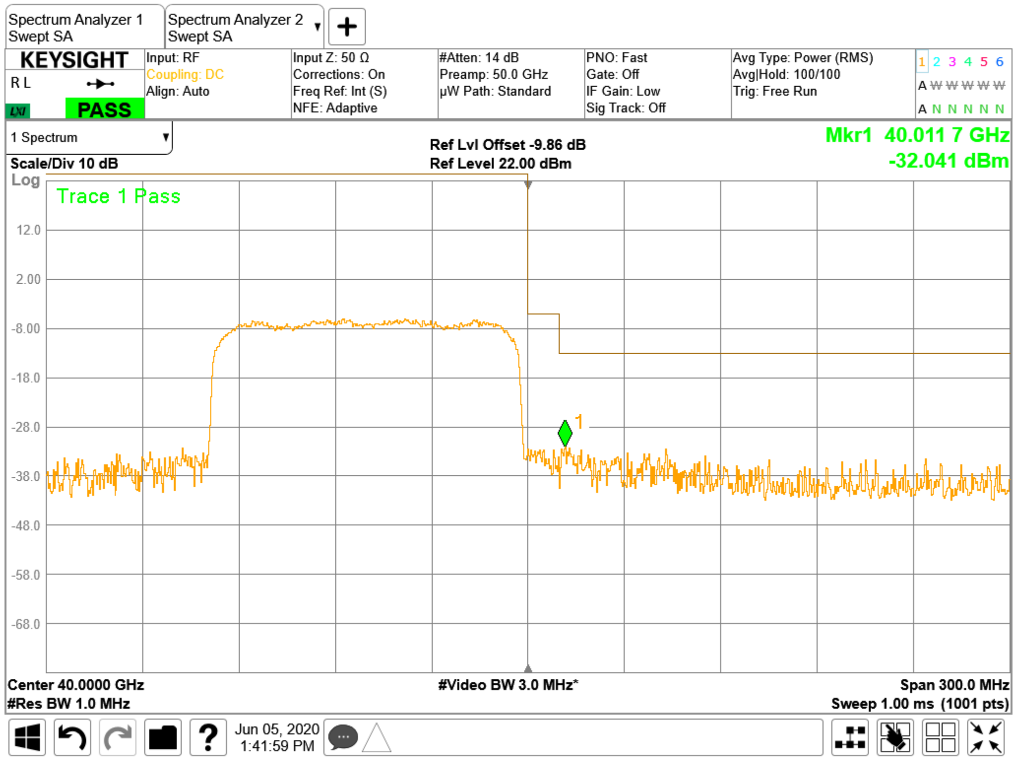
1CC / QPSK / Low channel / 1 RB

Ant 1

n260

BW 100MHz

MIMO



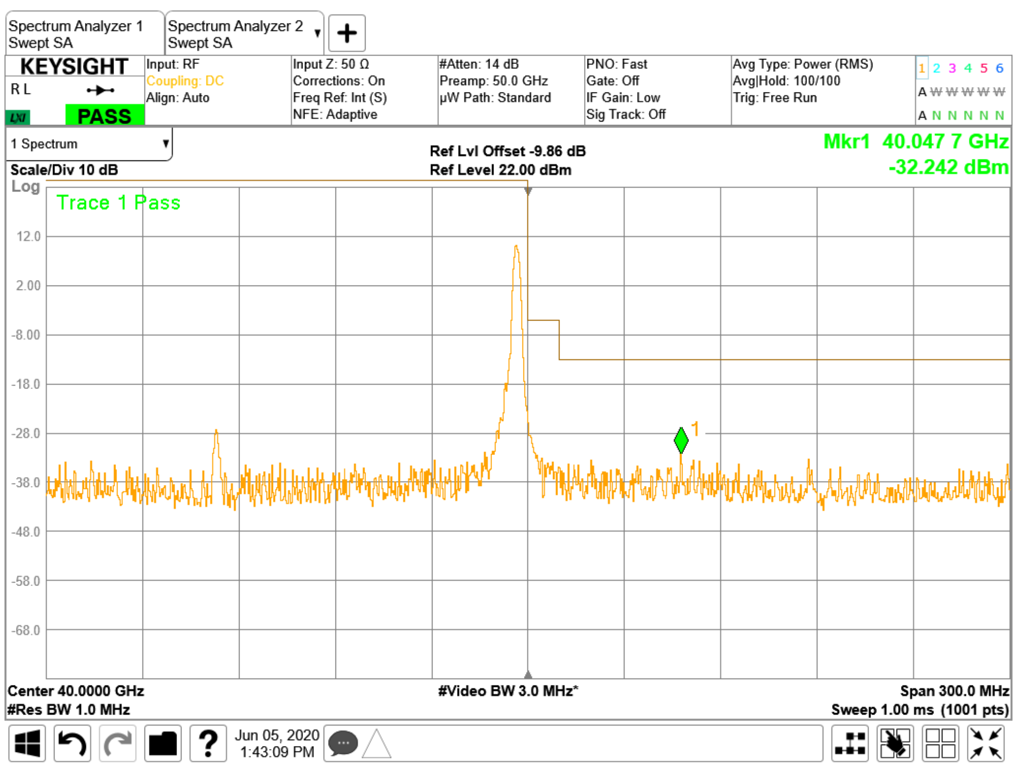
1CC / QPSK / High channel / Full RB

Ant 1

n260

BW 100MHz

MIMO



1CC / QPSK / High channel / 1 RB

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n260

BW
100MHz

MIMO</td>
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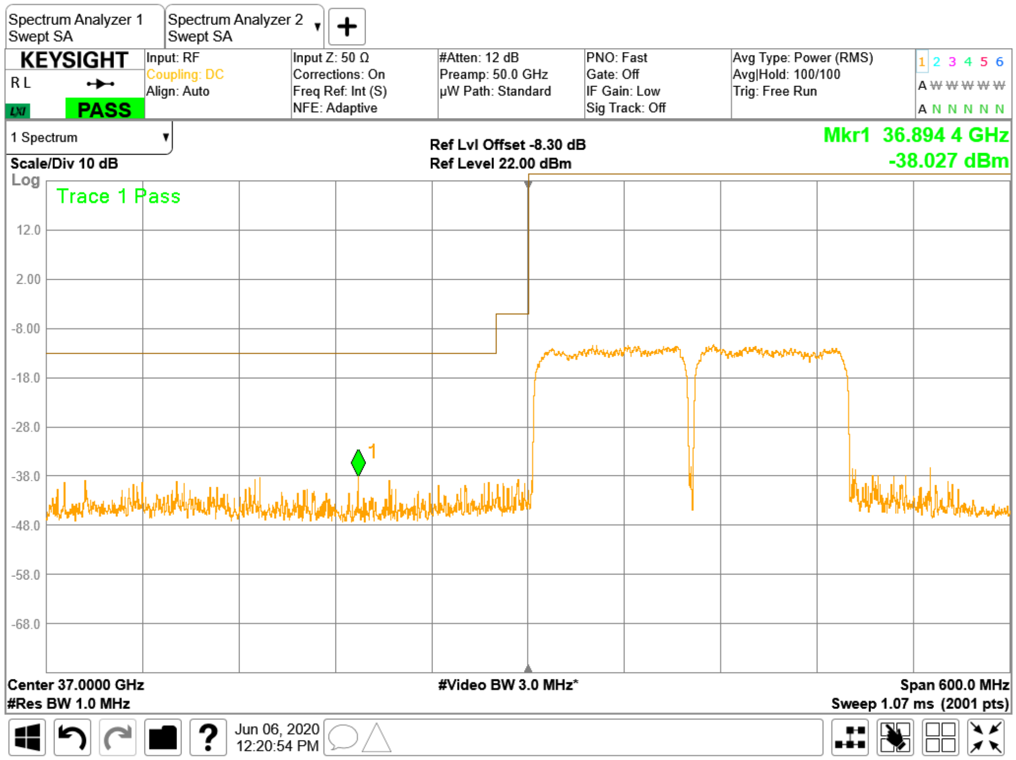

2CC / QPSK / Low channel / Full RB

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BW
100MHz

MIMO</td>
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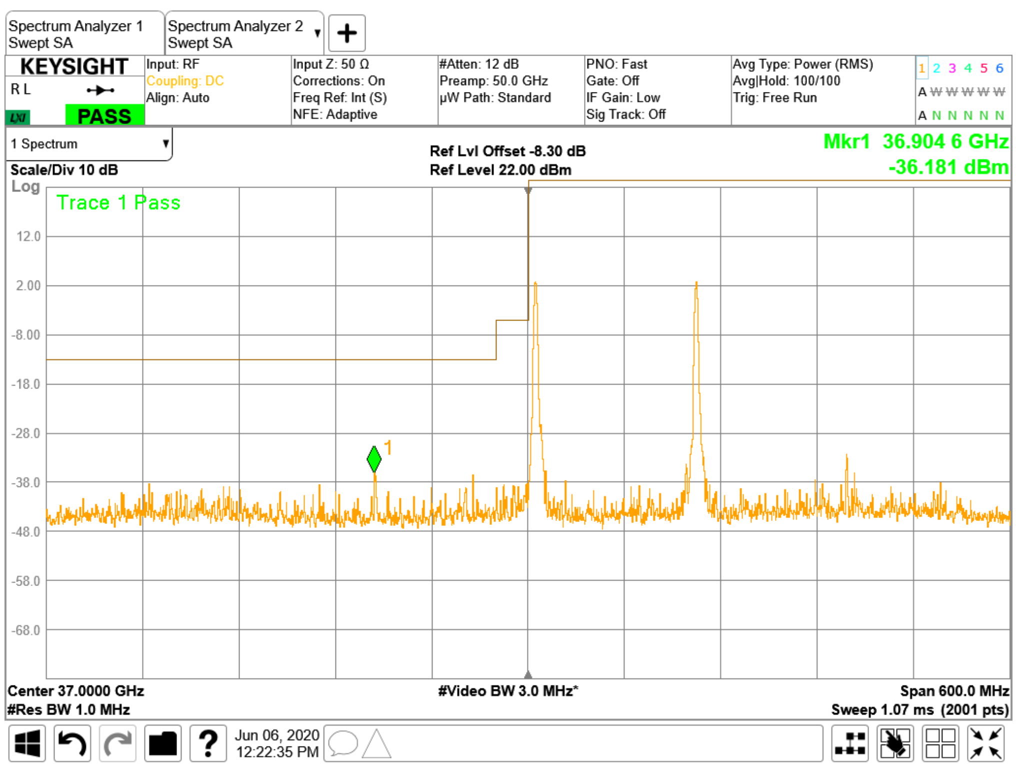

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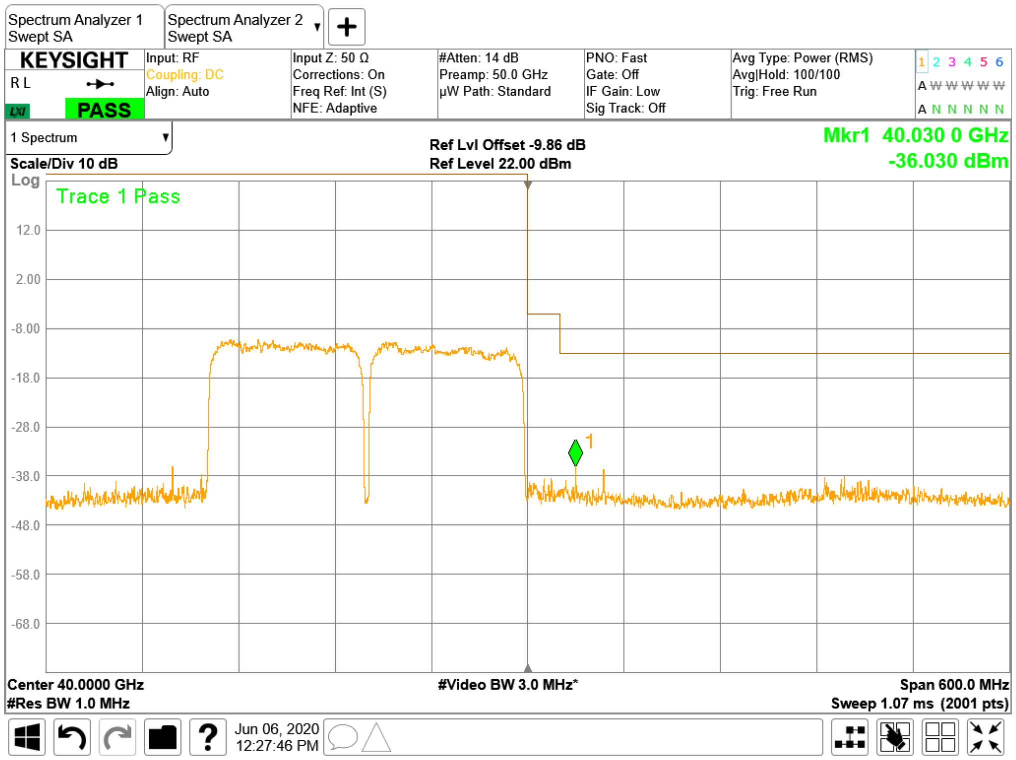
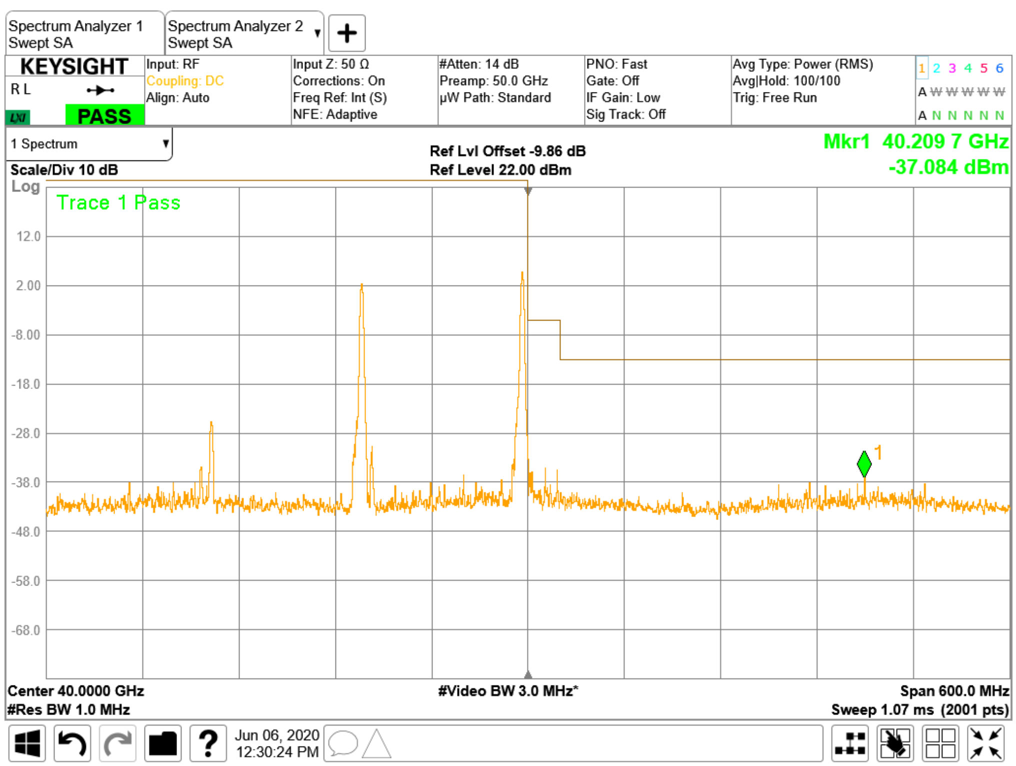
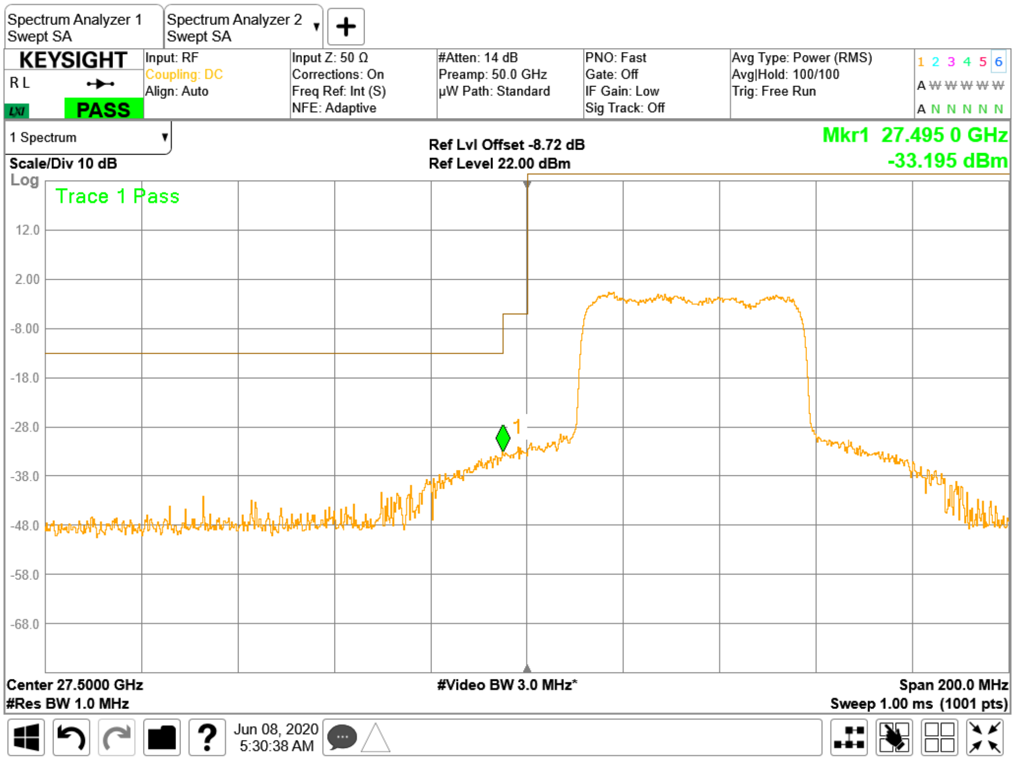
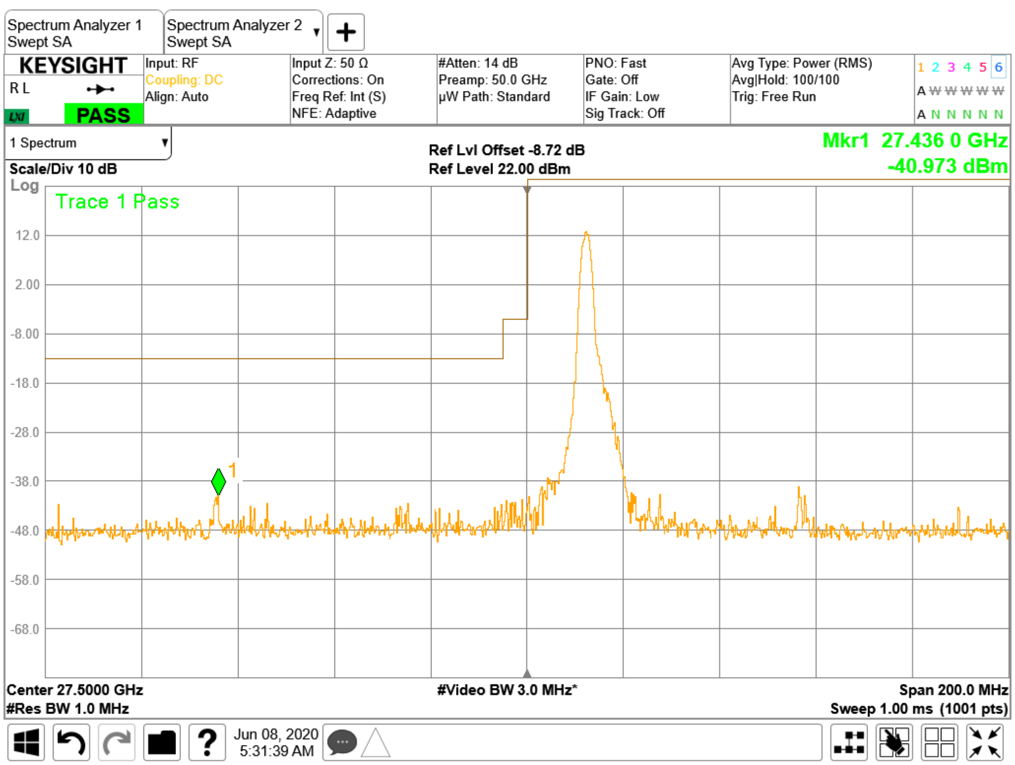
Ant 1 n260 BW 100MHz MIMO	 2CC / QPSK / High channel / Full RB
Ant 1 n260 BW 100MHz MIMO	 2CC / QPSK / High channel / 1 RB

ANT 2, Band n261, MIMO

Ant 2 n261 BW 50MHz MIMO	 1CC / QPSK / Low channel / Full RB
Ant 2 n261 BW 50MHz MIMO	 1CC / QPSK / Low channel / 1 RB

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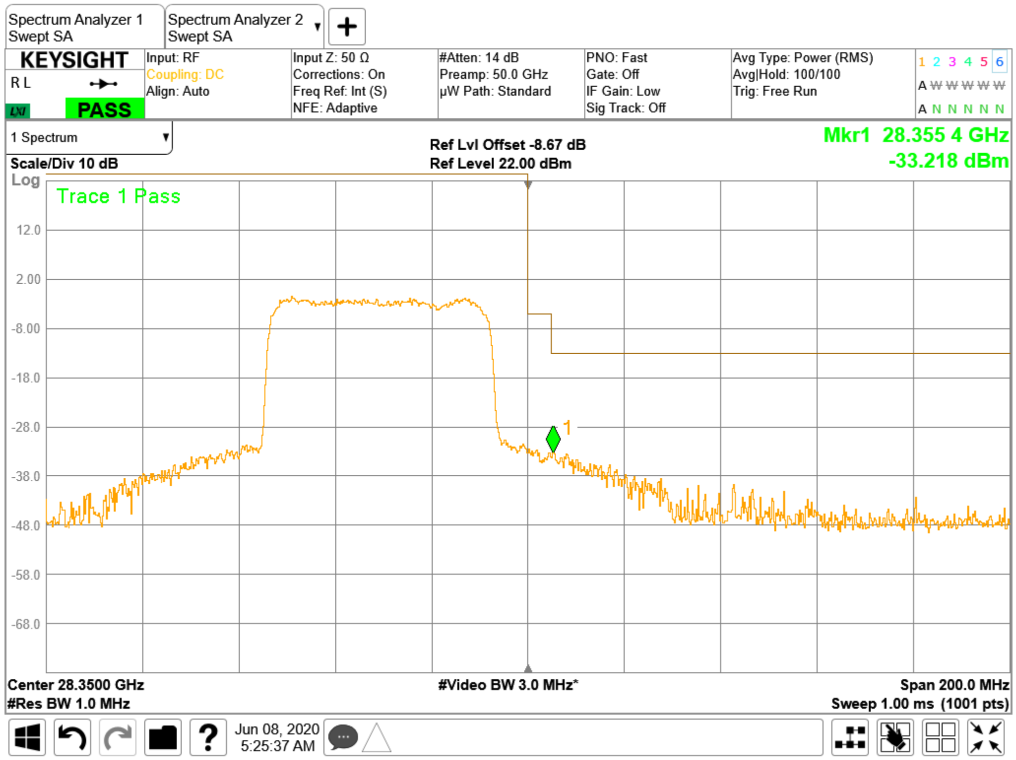
BW
50MHz
MIMO</td><td>

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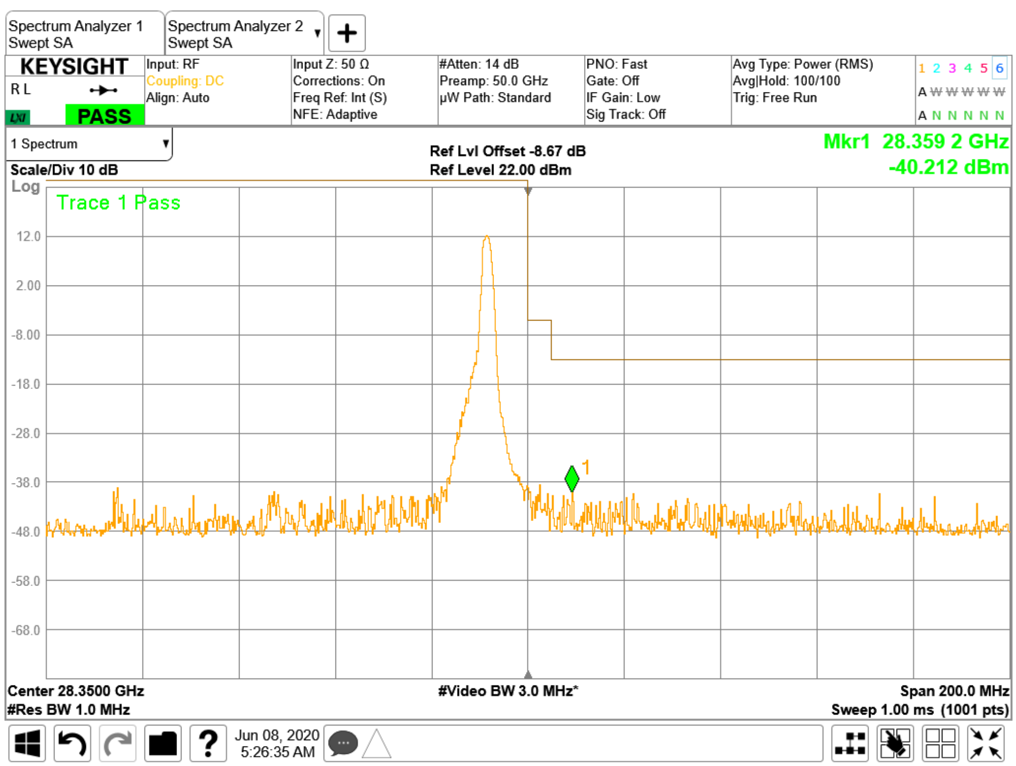
MIMO</td><td>

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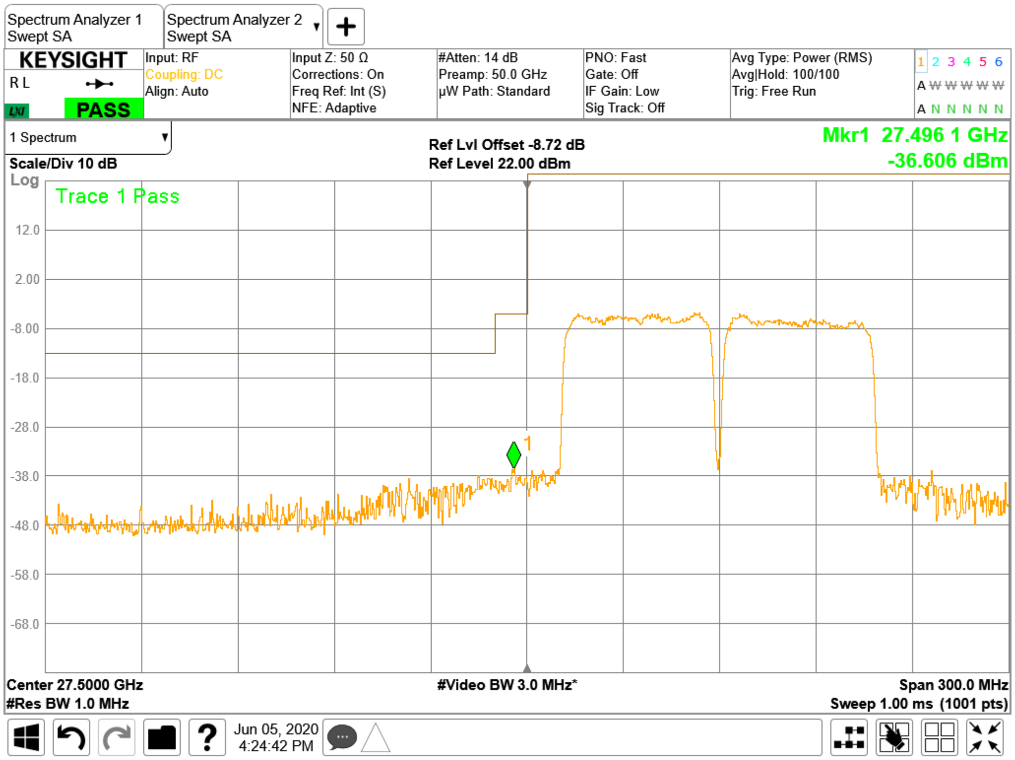
Ant 2

n261

BW 50MHz

MIMO



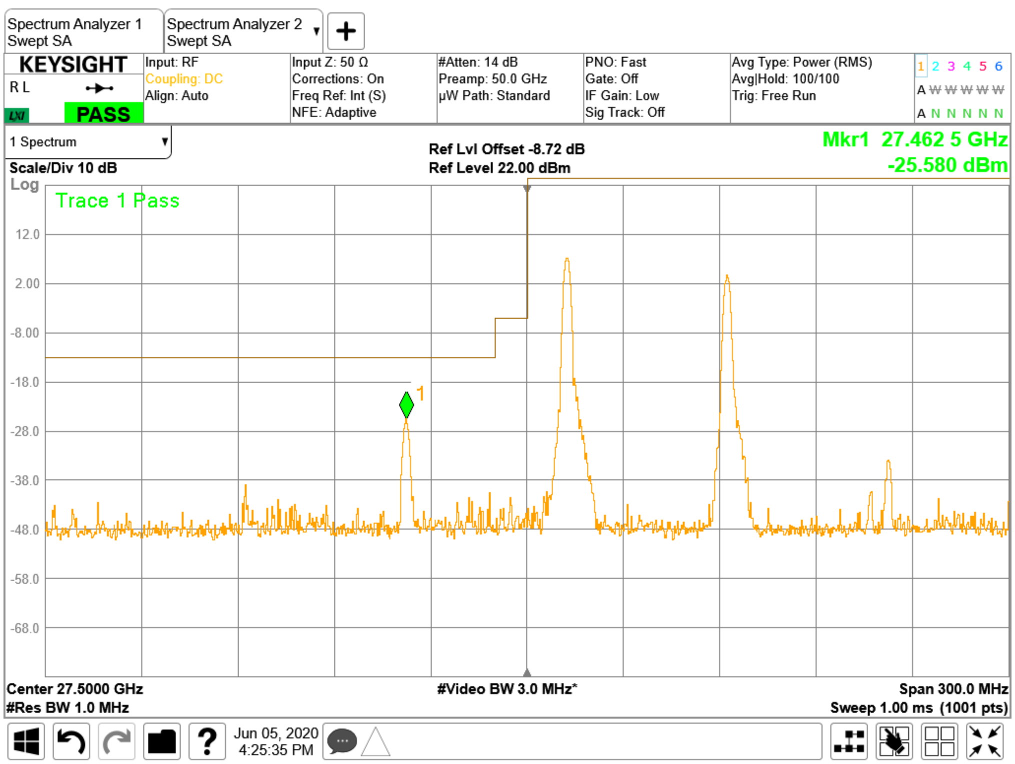
2CC / QPSK / Low channel / Full RB

Ant 2

n261

BW 50MHz

MIMO



2CC / QPSK / Low channel / 1 RB

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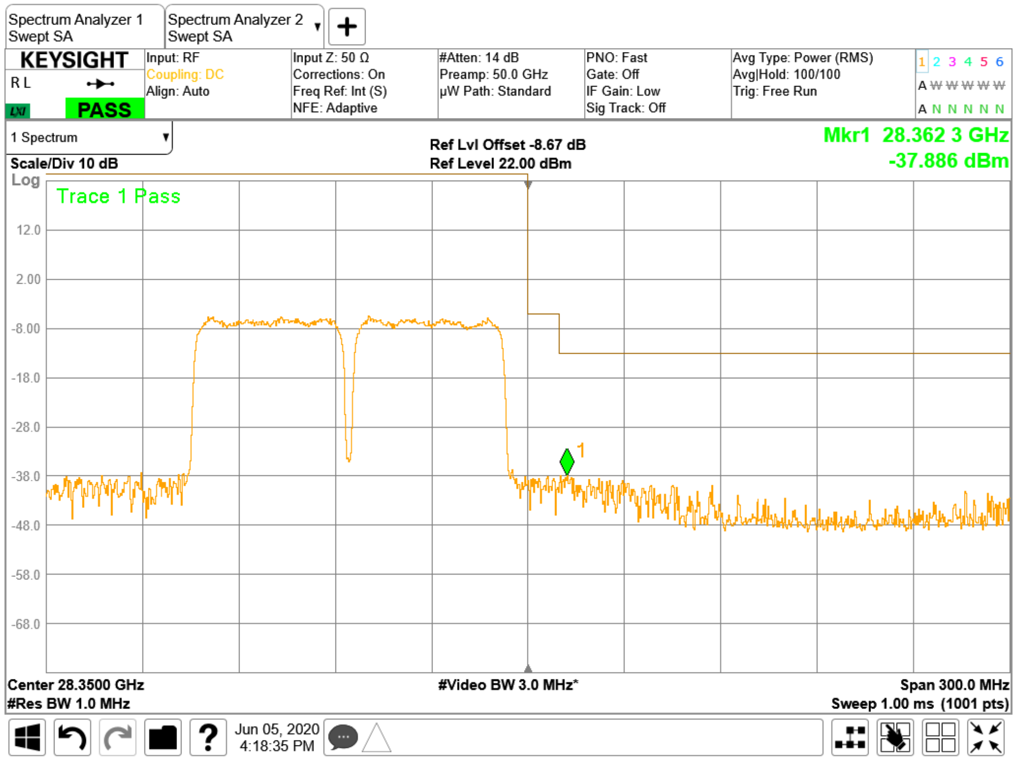
BW 50MHz
MIMO</td><td>

2CC / QPSK / High channel / Full RB</td></tr>
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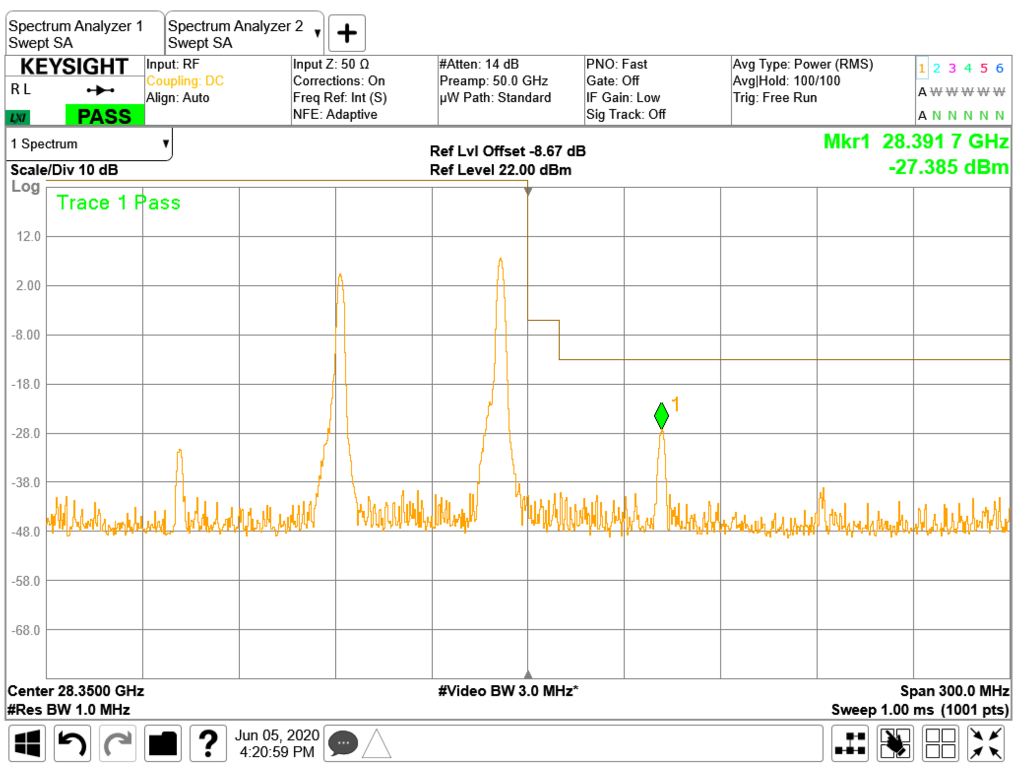
BW 50MHz
MIMO</td><td>

2CC / QPSK / High channel / 1 RB</td></tr>
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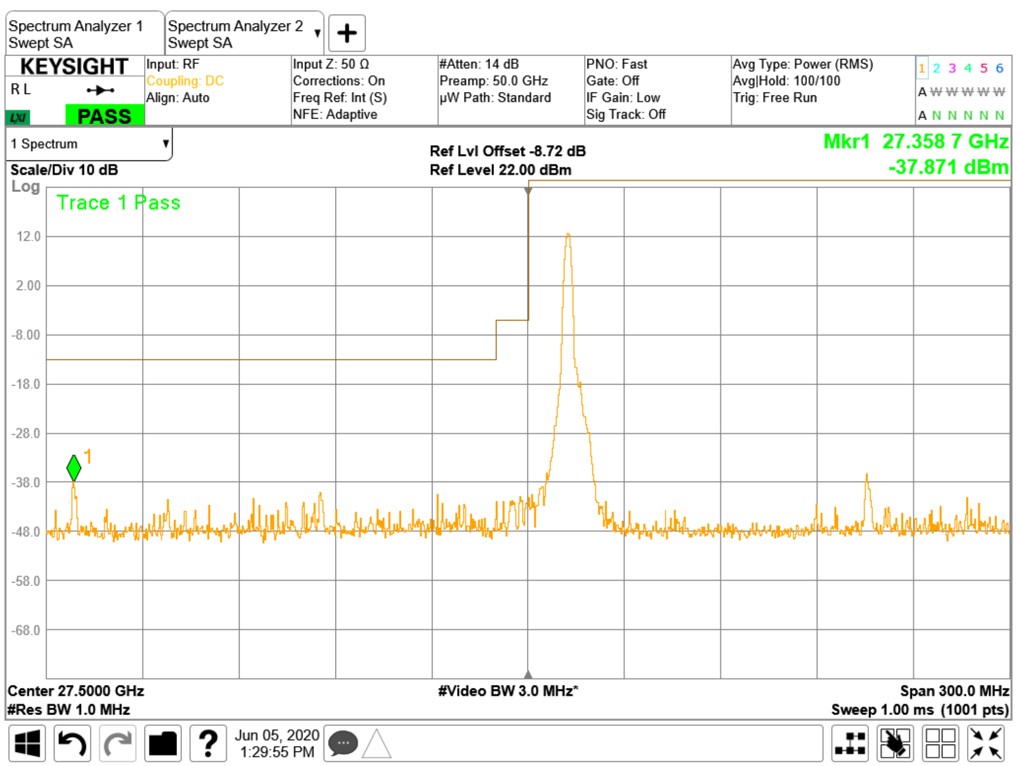
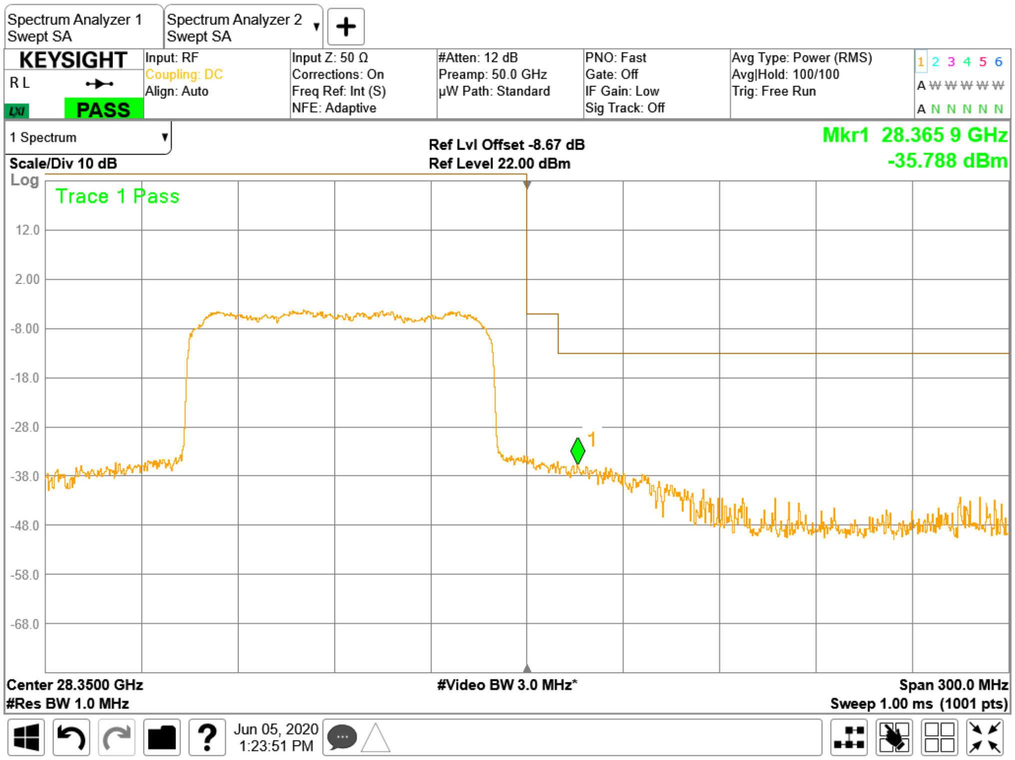
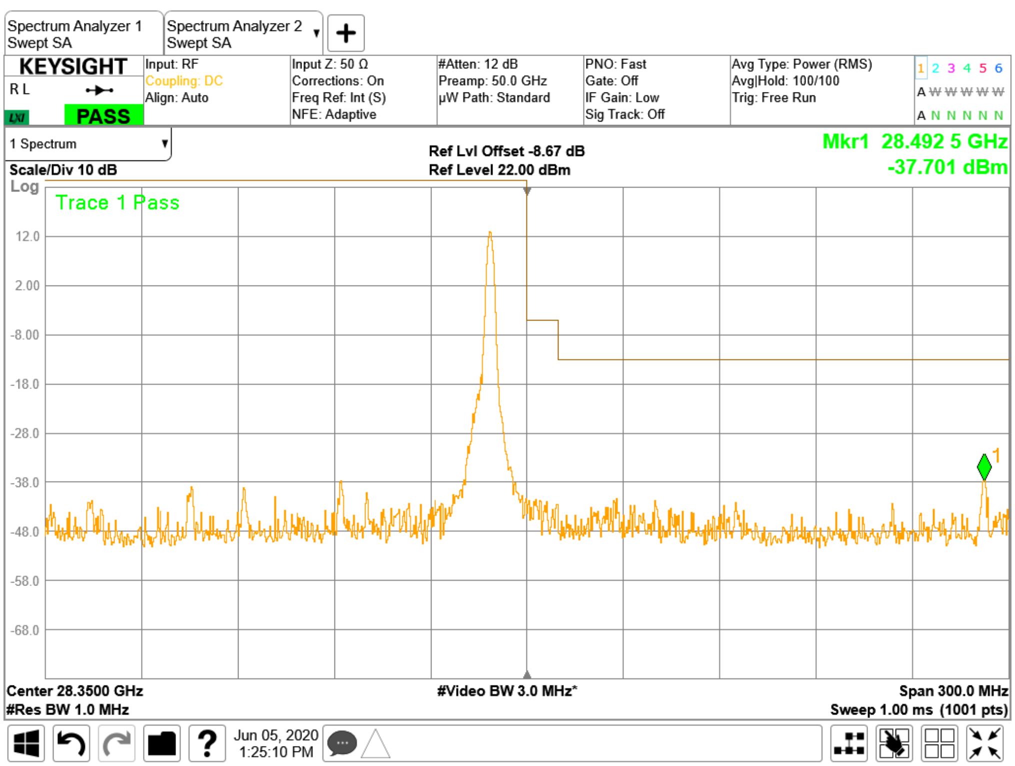
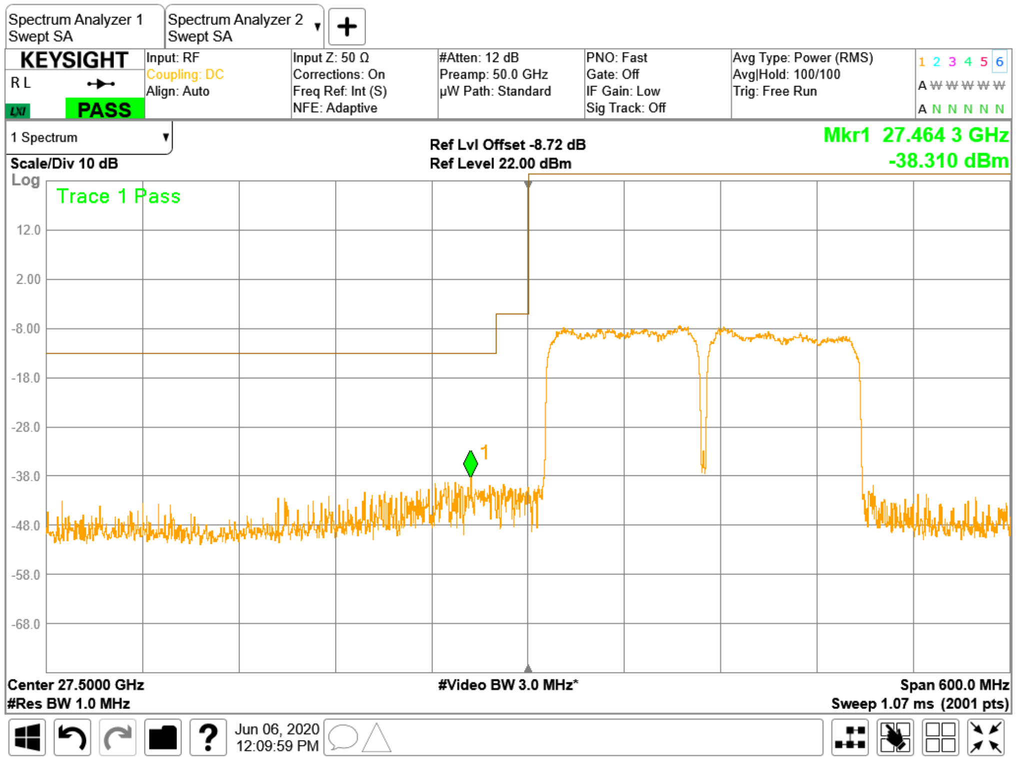
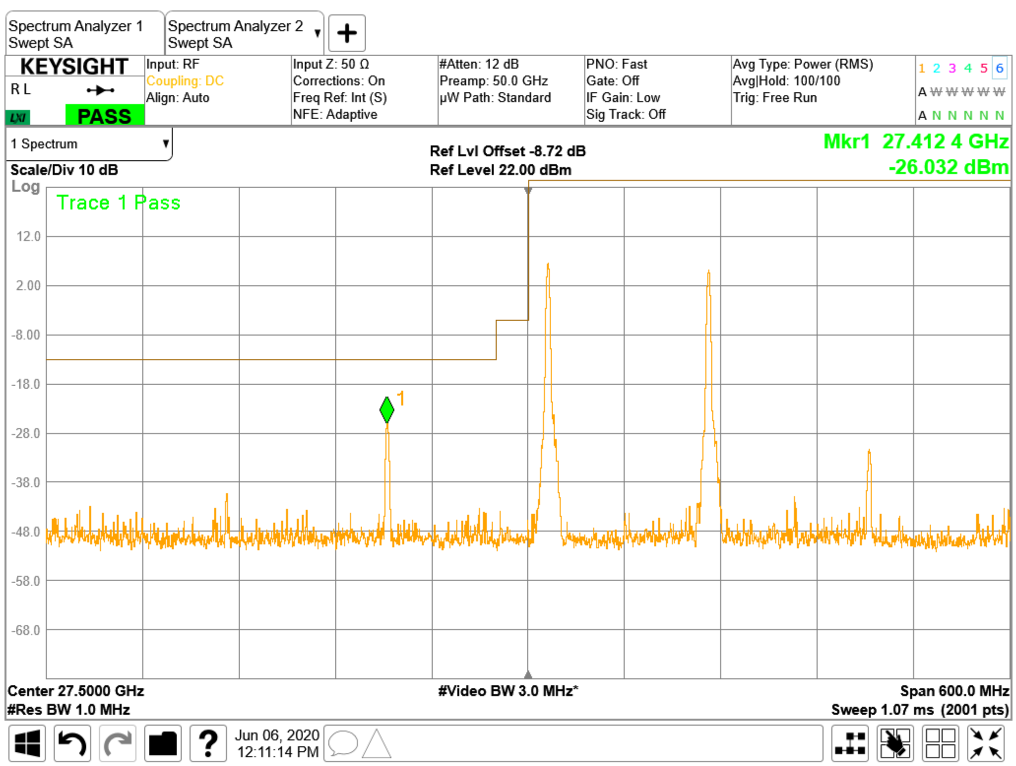
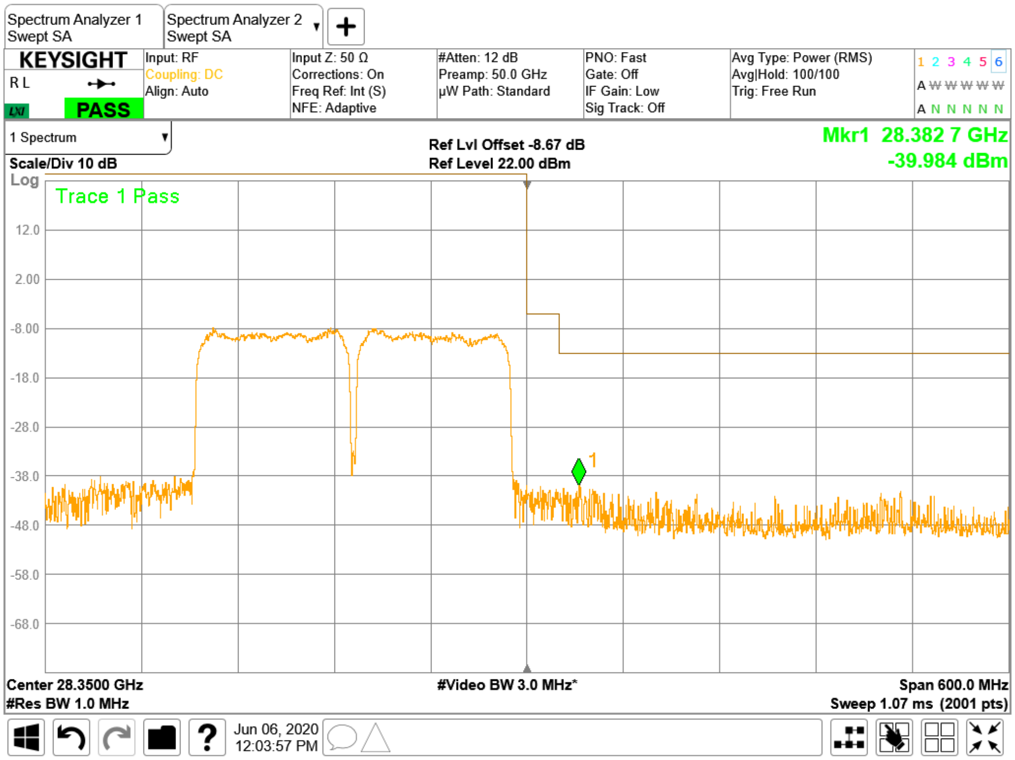
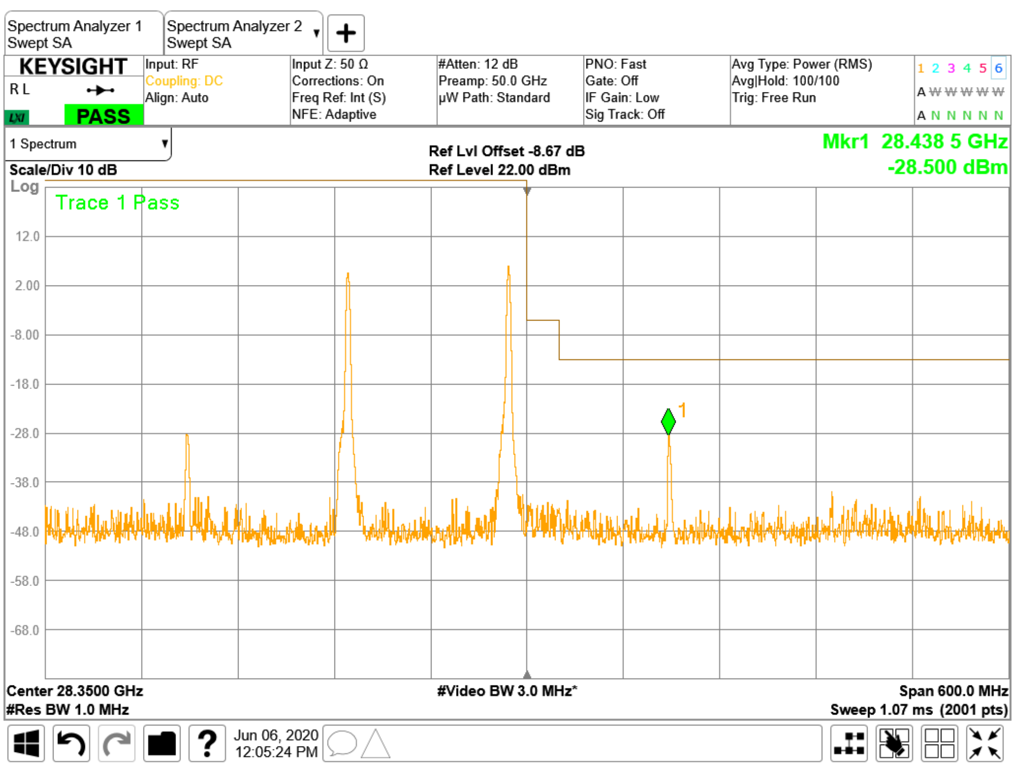
Ant 2 n261 BW 100MHz MIMO	 1CC / QPSK / Low channel / Full RB
Ant 2 n261 BW 100MHz MIMO	 1CC / QPSK / Low channel / 1 RB

Ant 2 n261 BW 100MHz MIMO	 1CC / QPSK / High channel / Full RB
Ant 2 n261 BW 100MHz MIMO	 1CC / QPSK / High channel / 1 RB

Ant 2 n261 BW 100MHz MIMO	 2CC / QPSK / Low channel / Full RB
Ant 2 n261 BW 100MHz MIMO	 2CC / QPSK / Low channel / 1 RB

Ant 2 n261 BW 100MHz MIMO	 2CC / QPSK / High channel / Full RB
Ant 2 n261 BW 100MHz MIMO	 2CC / QPSK / High channel / 1 RB

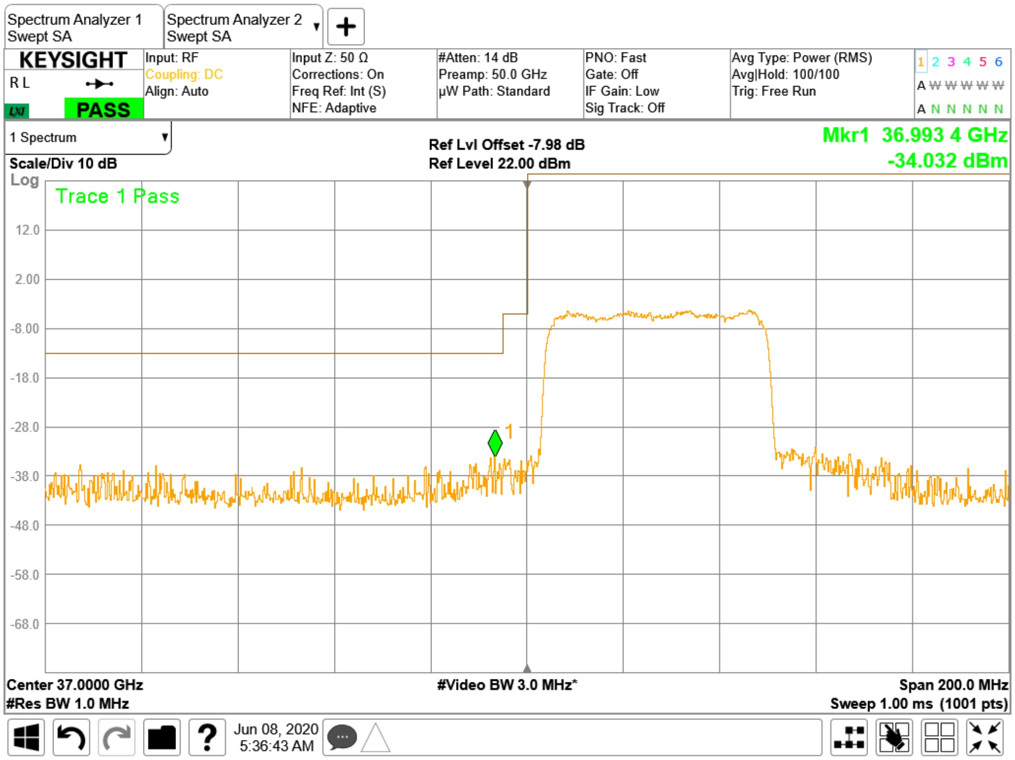
ANT 2, Band n260, MIMO

Ant 2

n260

BW 50MHz

MIMO



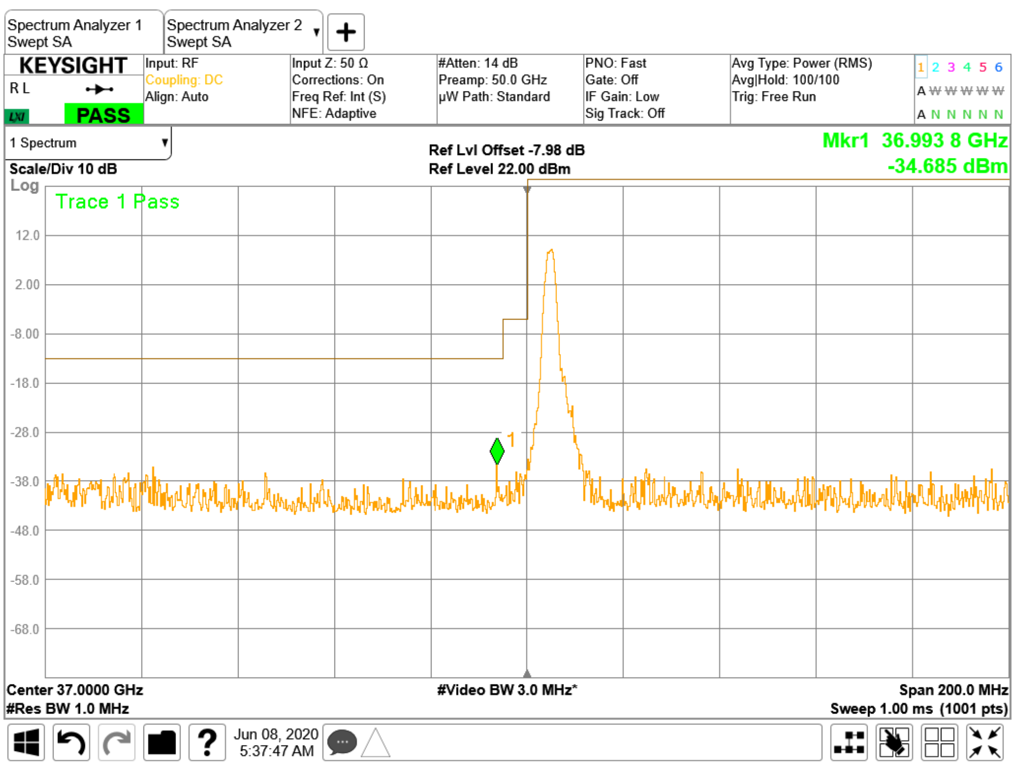
1CC / QPSK / Low channel / Full RB

Ant 2

n260

BW 50MHz

MIMO



1CC / QPSK / Low channel / 1 RB

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n260
BW 50MHz
MIMO</td>
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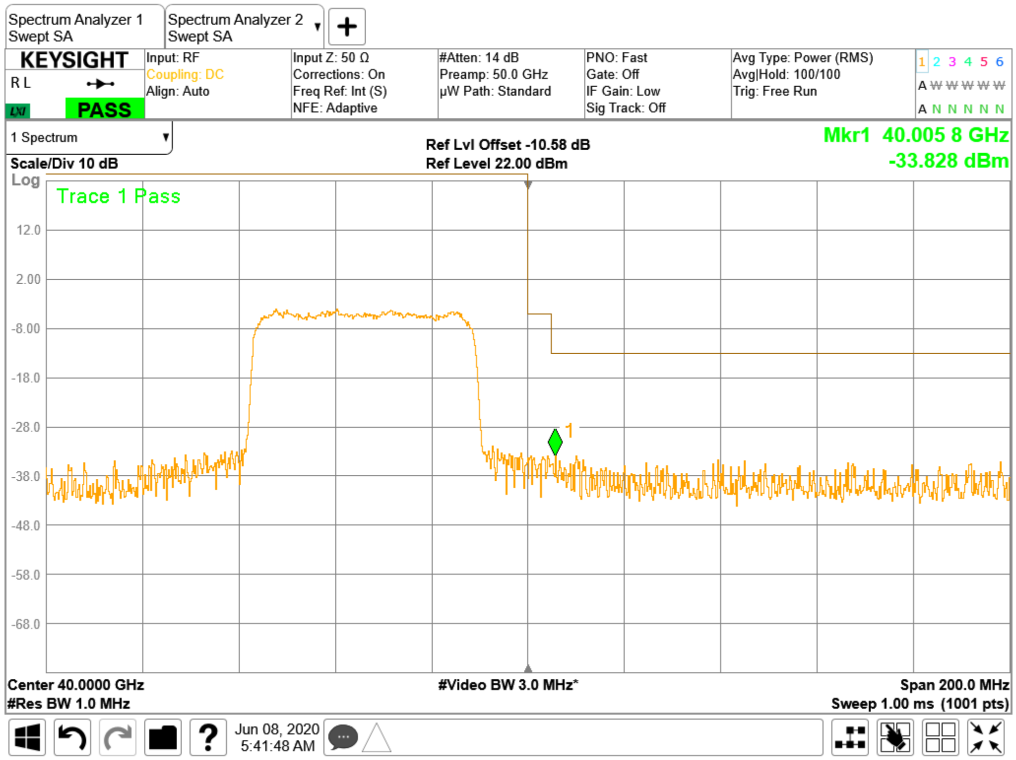

1CC / QPSK / High channel / Full RB
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n260
BW 50MHz
MIMO</td>
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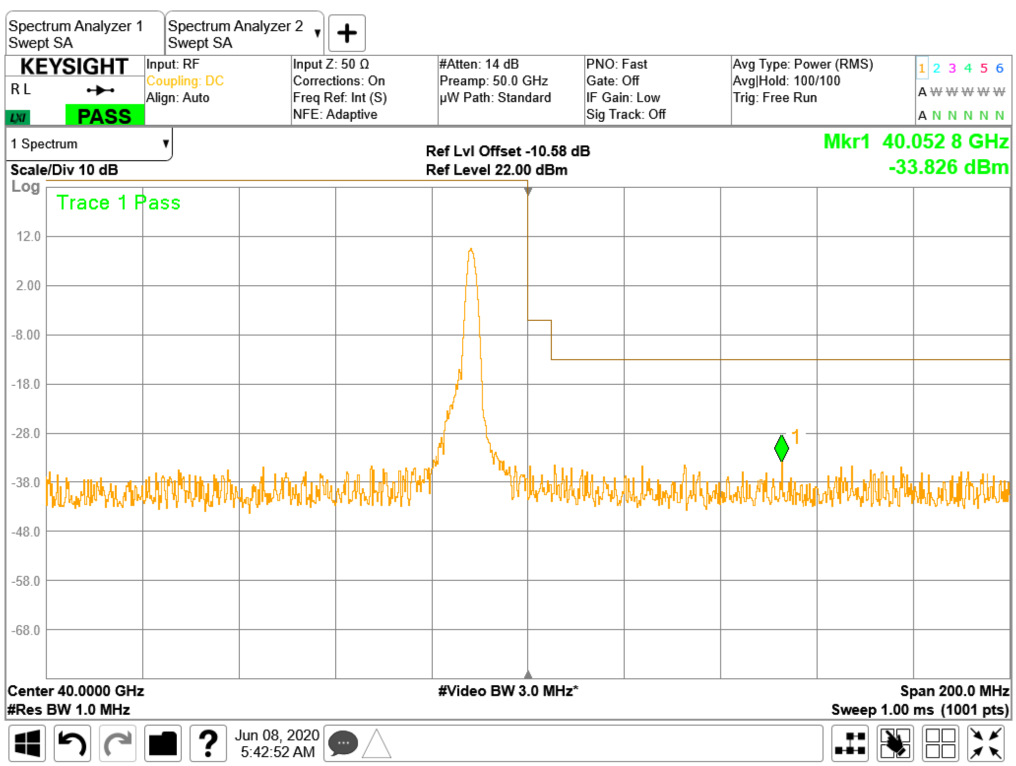

1CC / QPSK / High channel / 1 RB
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n260
BW 50MHz
MIMO</td>
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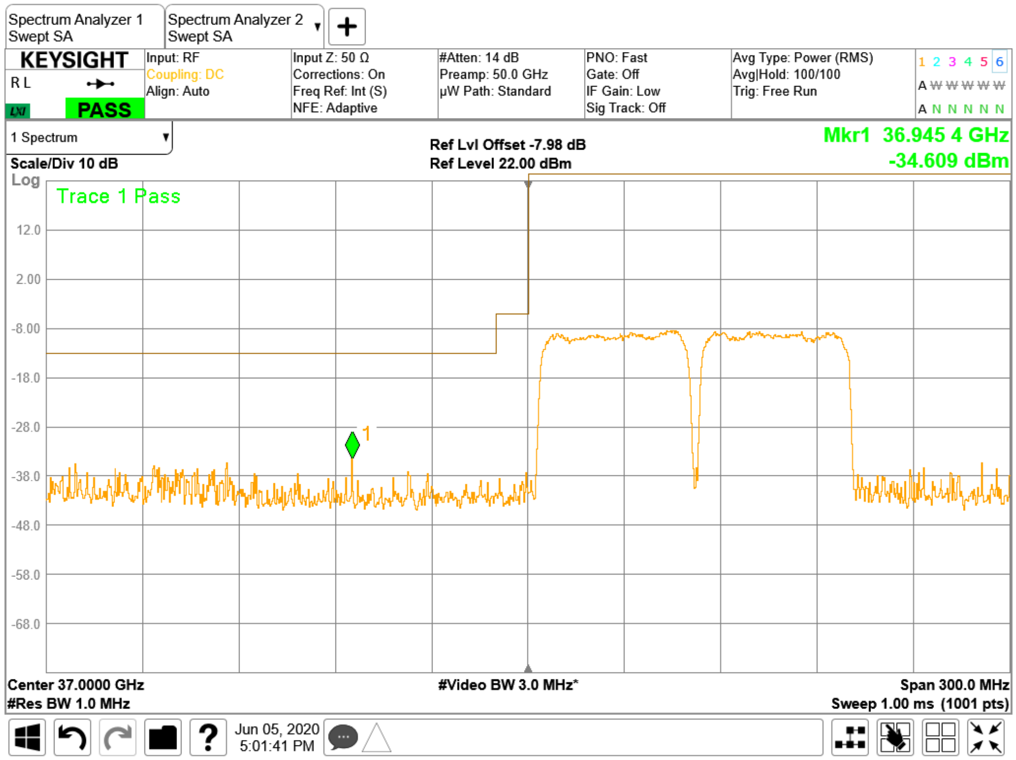

2CC / QPSK / Low channel / Full RB
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n260
BW 50MHz
MIMO</td>
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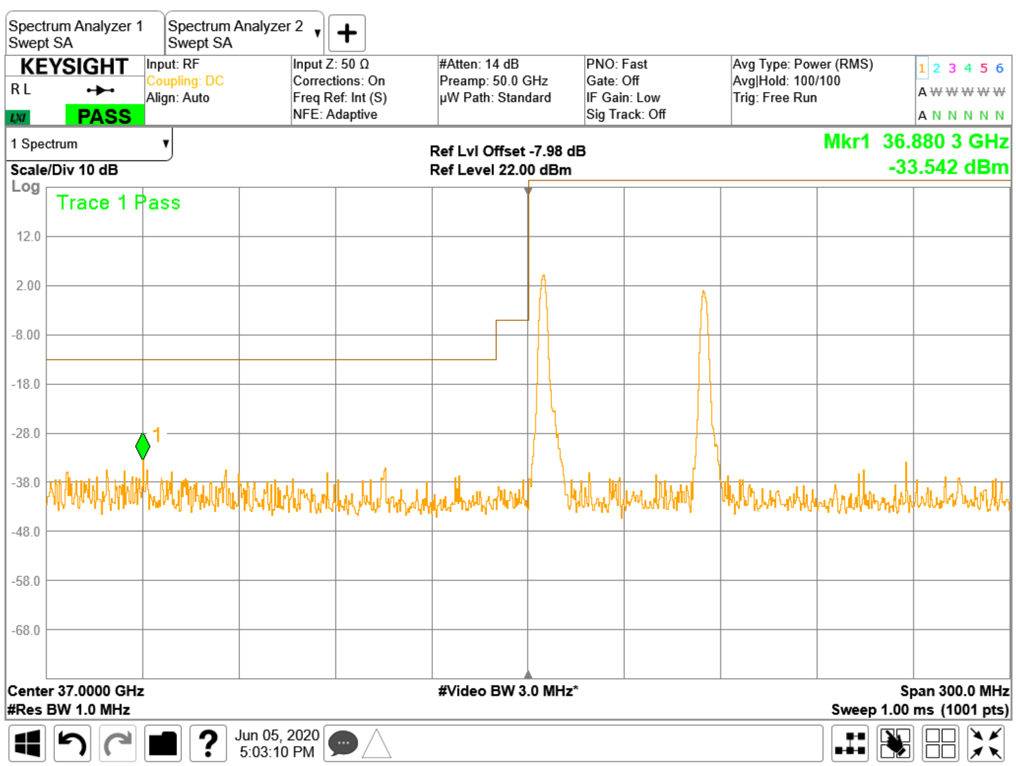

2CC / QPSK / Low channel / 1 RB
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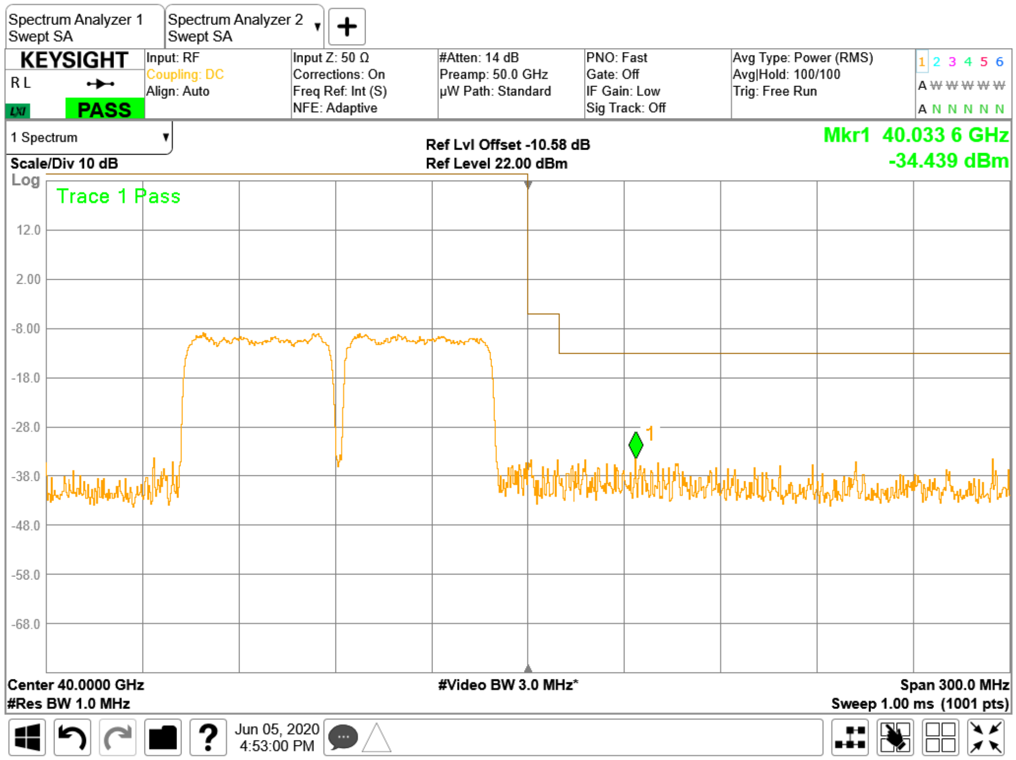
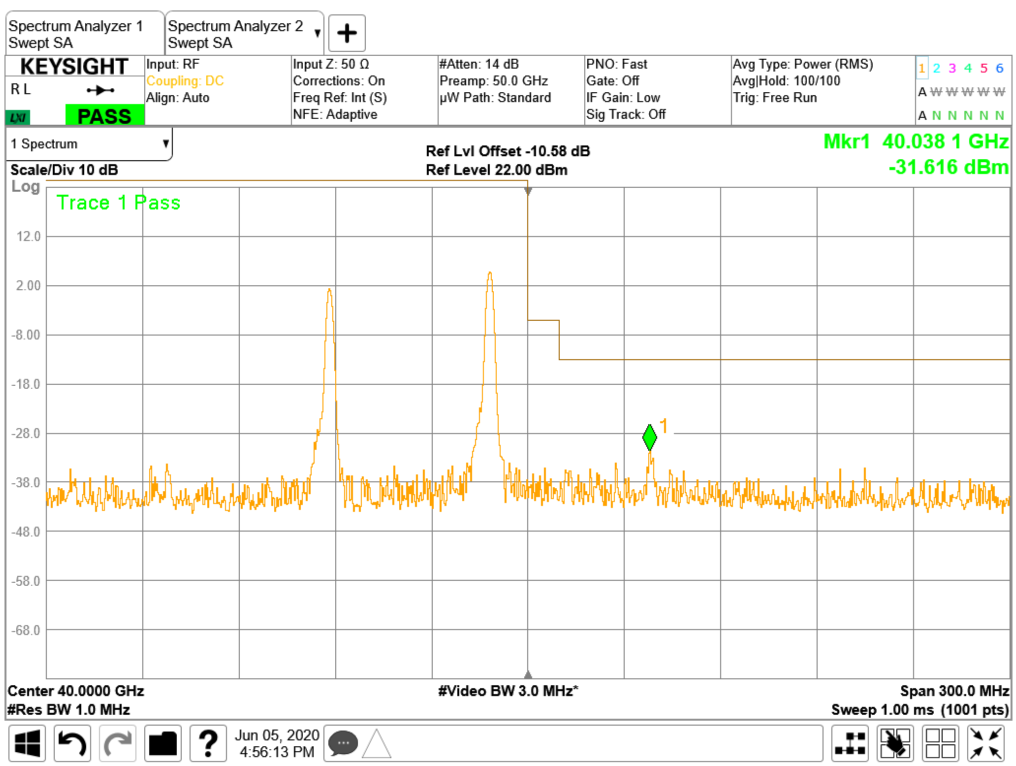
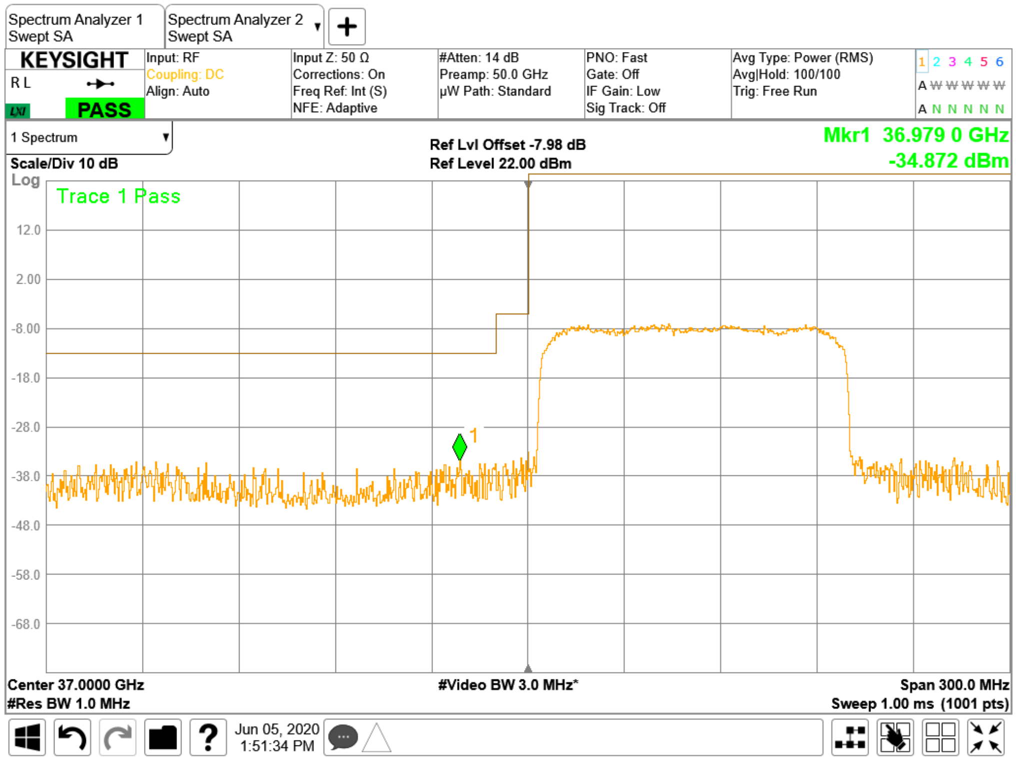
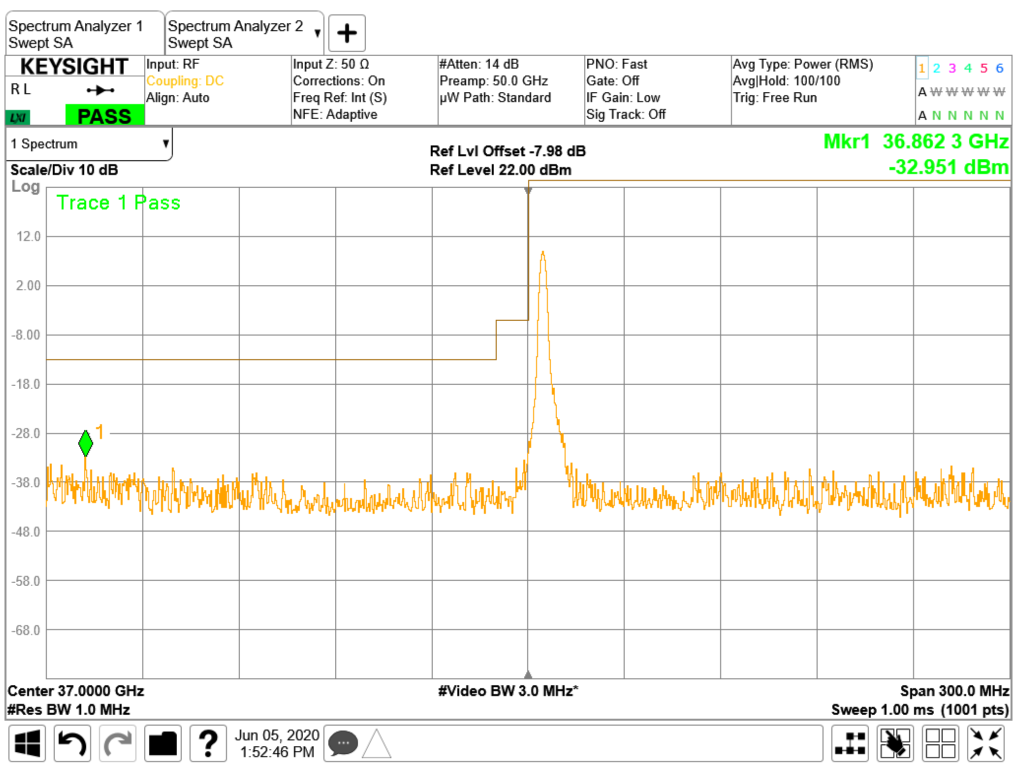
Ant 2 n260 BW 50MHz MIMO	 2CC / QPSK / High channel / Full RB
Ant 2 n260 BW 50MHz MIMO	 2CC / QPSK / High channel / 1 RB

Ant 2 n260 BW 100MHz MIMO	 1CC / QPSK / Low channel / Full RB
Ant 2 n260 BW 100MHz MIMO	 1CC / QPSK / Low channel / 1 RB

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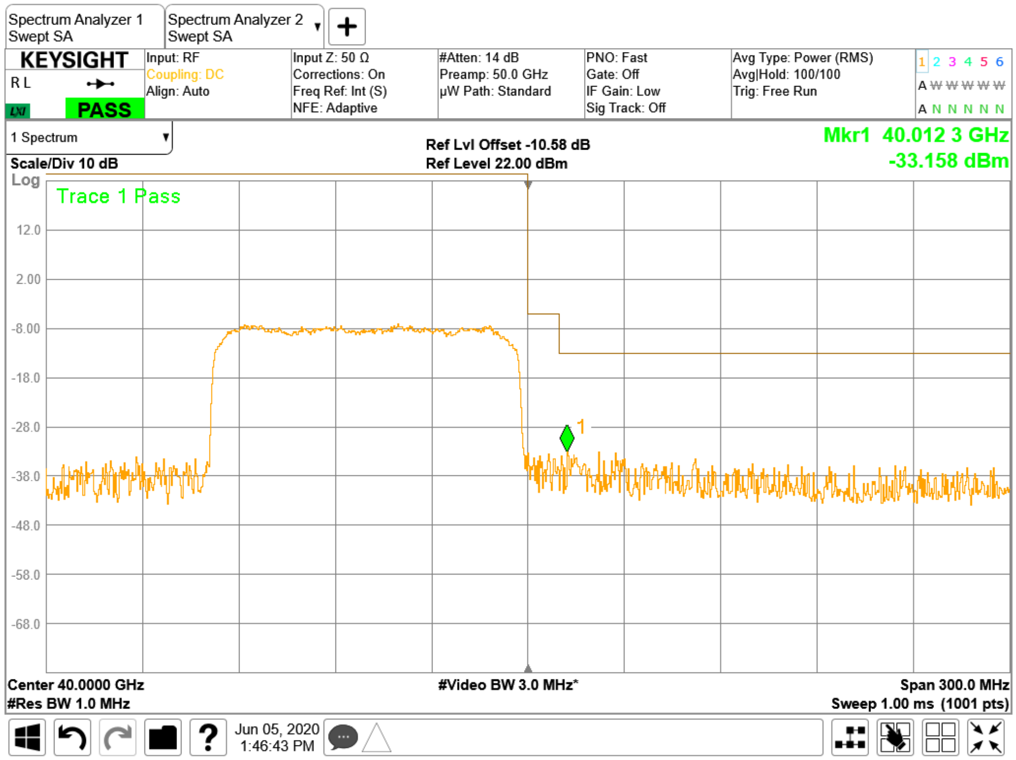
<td>

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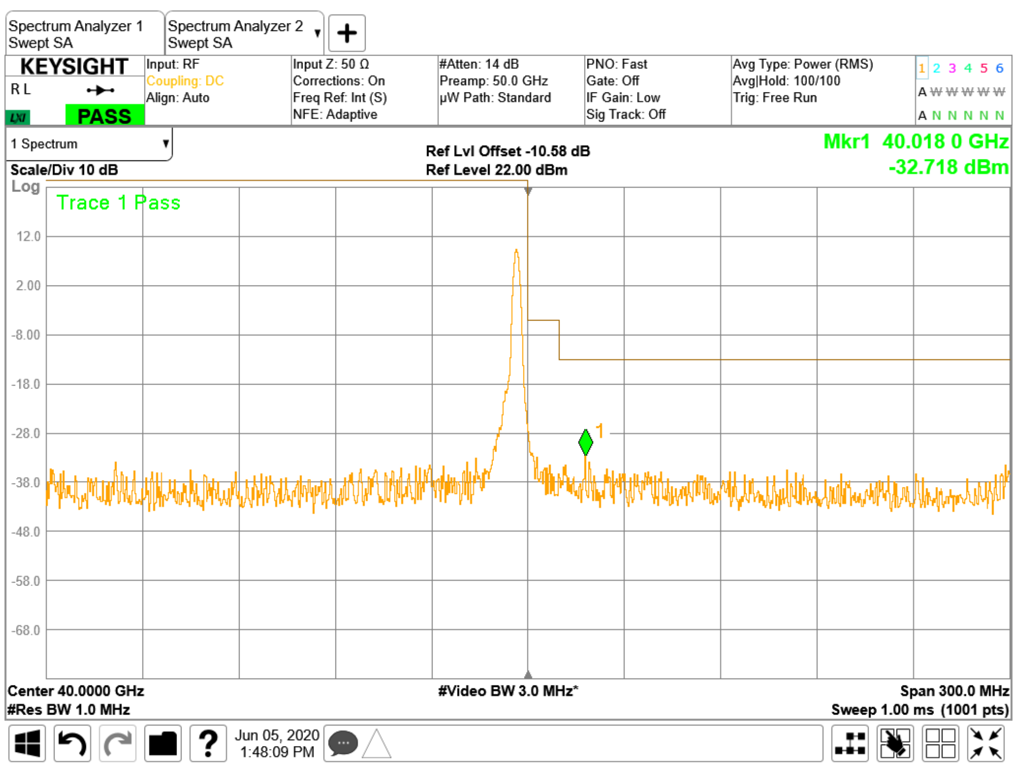
<td>

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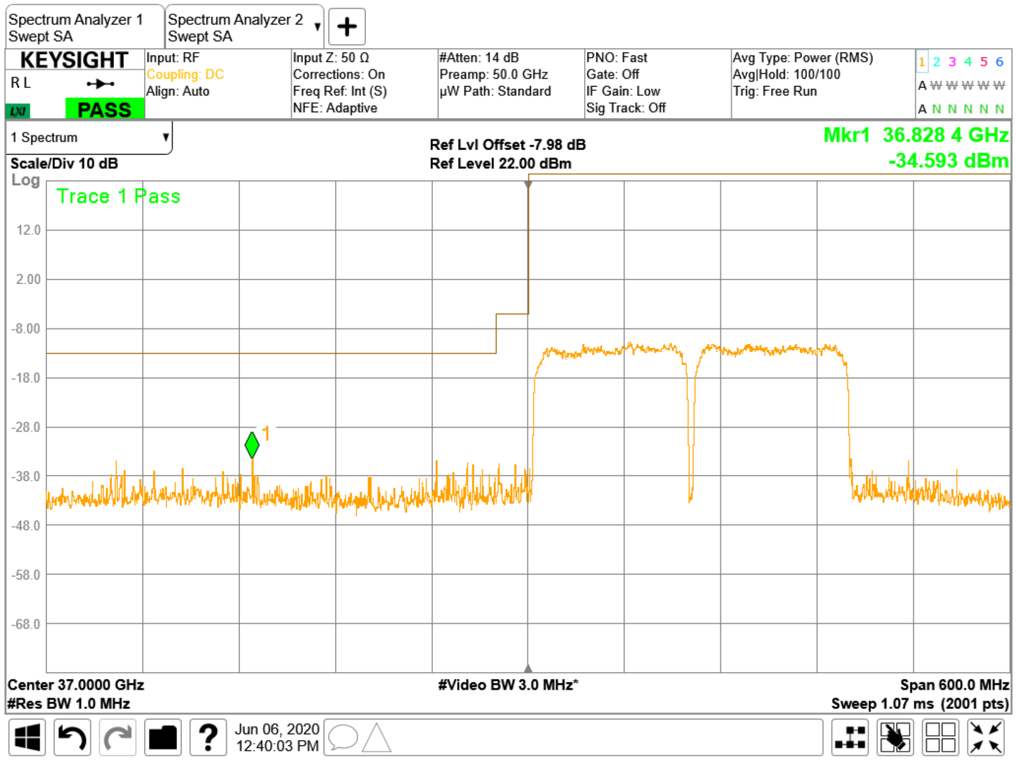
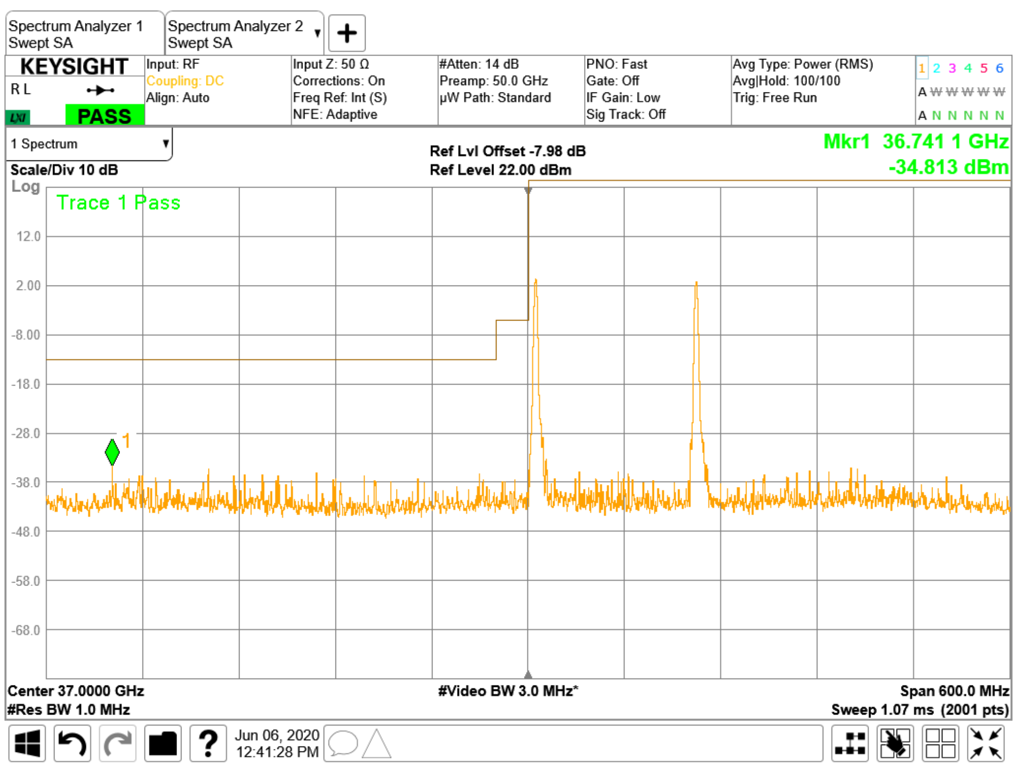
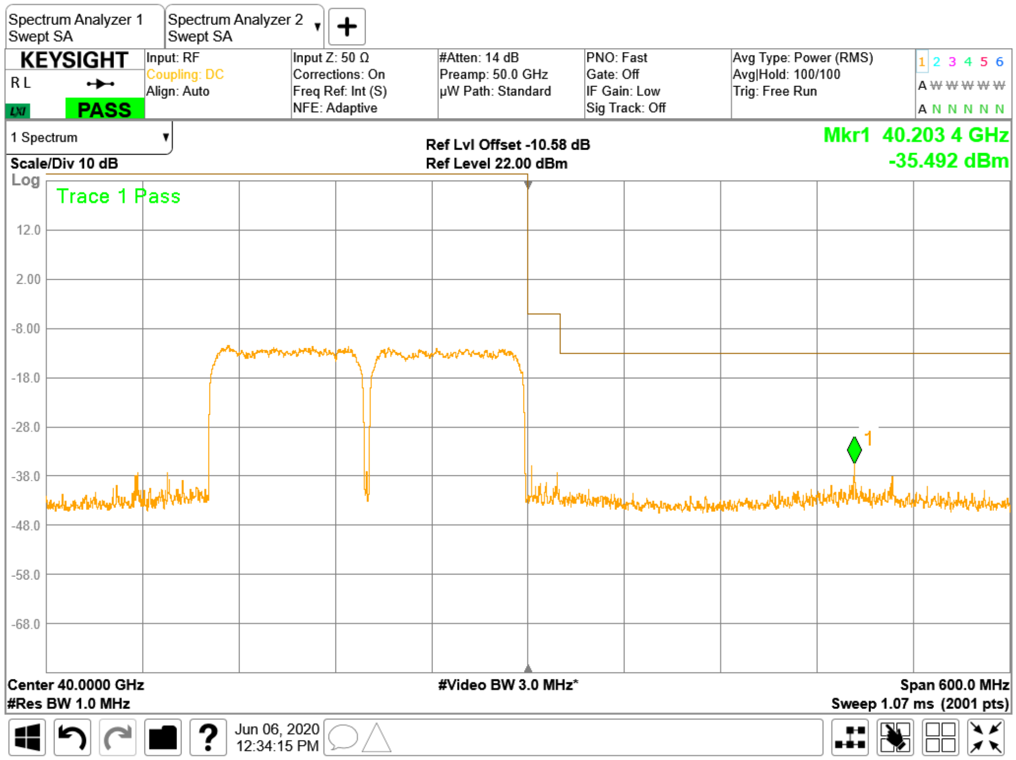
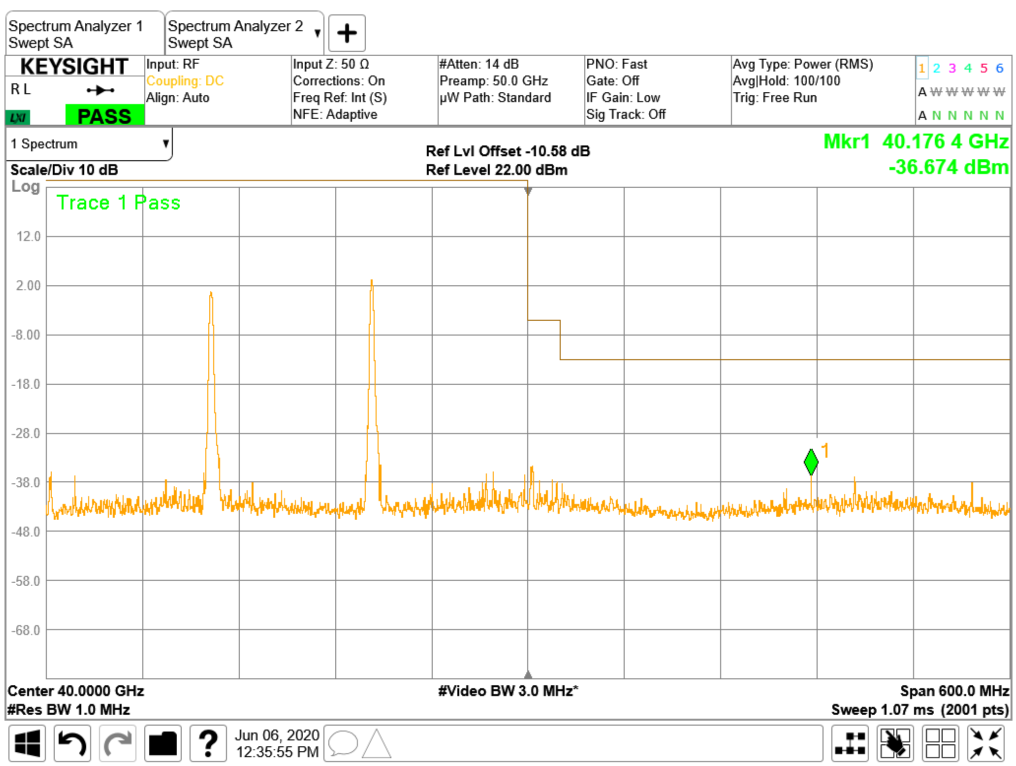
Ant 2 n260 BW 100MHz MIMO	 2CC / QPSK / Low channel / Full RB
Ant 2 n260 BW 100MHz MIMO	 2CC / QPSK / Low channel / 1 RB

Ant 2 n260 BW 100MHz MIMO	 2CC / QPSK / High channel / Full RB
Ant 2 n260 BW 100MHz MIMO	 2CC / QPSK / High channel / 1 RB

7.4. Radiated Spurious and Harmonic Emissions

RULE PART(S)

FCC: §2.1051, §30.203

LIMITS

30.203 - (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower.

TEST PROCEDURE

a) Start frequency was set to 30MHz and stop frequency was set to 100 GHz for n261 and 200GHz for n260.
b) Set the RBW = 100kHz for emission below 1GHz and 1MHz for emissions above 1GHz
c) Set VBW ≥ 3 × RBW;
d) Detector = RMS;
e) Trace mode = trace average;
f) Sweep time = auto couple;
g) Number of sweep points ≥ 2 x Span/RBW

(KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.4.2 and Section 4.4.3)
(ANSI C63.26-2015 Section 5.7.4)

NOTE

The EUT was tested in three orthogonal planes and in all possible test configurations and positioning.

All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.

The plots from 1-200GHz show corrected average EIRP levels. Plots below 1GHz are corrected field strength levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. For measurements > 50GHz, Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

Sample Analyzer Offset Calculation (1 - 50GHz, test distance = 1m)
EIRP (dBm) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107 + 20log(D) − 104.8
All factors except spectrum analyzer level are applied as correction factors each band in the analyzer.

Sample Analyzer Offset Calculation (50 - 200GHz, test distance = 1m)
EIRP (dBm) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107 + 20log(D) − 104.8
All factors except spectrum analyzer level are applied as correction factors each band in the analyzer.

Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, D is the largest dimension of the measurement antenna.

Frequency Range(GHz)	Wavelength(m)	Far Field Distance(m)	Measurement Distance(m)
18-40	0.008	0.54	1.00 (EIRP and Band Edge = 3.00)
40-50	0.006	1.05	1.50
50-75	0.004	0.69	1.00
75-110	0.003	0.46	1.00
110-175	0.002	0.34	1.00
175-200	0.002	0.16	1.00

All emissions from 18GHz - 50GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions above 50GHz were measured using a harmonic mixer with the spectrum analyzer.

All RSE's were measured with 1CC. It was determined that adding more CC's causes the overall amplitude of just 1CC to decrease, therefore, 1CC is the worst case for the purposes of spurious emissions measurements.

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Band n261 RSE reported only mid channel because no emissions were detected above noise floor except 18 - 27.4 GHz and 28.45 - 40 GHz.

Band n260 RSE reported only mid channel because no emissions were detected above noise floor except 40.1 - 50 GHz.

All RSE’s were investigated in EN-DC mode and with 802.11 chipset active. It was determined that there is no new emission introduced by EN-DC mode, or the 802.11 chipset. For EN-DC mode, n261 and n260 use LTE B2, B2, B5, B13 and B66.

There was no discernible difference in the spurious emission levels when using different LTE anchor bands. Thus, LTE Band 66 was used as a representative anchor band for EN-DC investigations.

RESULTS

See the following pages.