CERTIFICATION TEST REPORT

Report Number. : 4790558569-E10V3

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

Model : SM-A236V

FCC ID : A3LSMA236V

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

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

Date Of Issue:
2022-11-28

Prepared by:
UL Korea, Ltd.
26th floor, 152, Teheran-ro, Gangnam-gu Seoul, 06236, Korea

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

IAS ACCREDITED Testing Laboratory
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2022-11-11	Initial issue	Sungeun Lee
V2	2022-11-18	Updated to address TCB's question	Sungeun Lee
V3	2022-11-28	Updated to address TCB's question	Sungeun Lee

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS ... 5

2. TEST METHODOLOGY ... 6

3. FACILITIES AND ACCREDITATION ... 6

4. CALIBRATION AND UNCERTAINTY ... 7

4.1. MEASURING INSTRUMENT CALIBRATION ... 7

4.2. SAMPLE CALCULATION ... 7

4.3. MEASUREMENT UNCERTAINTY ... 7

4.4. DECISION RULE ... 7

5. EQUIPMENT UNDER TEST ... 8

5.1. DESCRIPTION OF EUT ... 8

5.2. MAXIMUM OUTPUT POWER ... 9

5.3. WORST-CASE ORIENTATION ... 11

5.4. DESCRIPTION OF TEST SETUP ... 12

6. TEST AND MEASUREMENT EQUIPMENT ... 15

7. SUMMARY TABLE ... 16

8. LIMITS AND CONDUCTED RESULTS ... 17

8.1. OCCUPIED BANDWIDTH ... 17

8.1.1. OCCUPIED BANDWIDTH RESULTS ... 18

8.2. EQUIVALENT ISOTROPIC RADIATED POWER ... 35

8.2.1. EIRP Results ... 36

8.3. BAND EDGE EMISSIONS ... 40

8.3.1. BAND EDGE WORST CASE RESULT ... 42

8.4. Radiated Spurious and Harmonic Emissions ... 58

8.4.1. RADIATED SPURIOUS AND HARMONIC EMISSIONS RESULT ... 60

8.5. FREQUENCY STABILITY ... 98

8.5.1. FREQUENCY STABILITY RESULTS ... 99

Appendix A ... 100

1. Accreditation Scope ... 100

2. VDI Mixer Certificate Report ... 101

2.1. Model : N9029AV15, S/N : SAX693 ... 101

2.2. Model : N9029AV10, S/N : SAX597 ... 105

2.3. Model : N9029AV06, S/N : SAX789 ... 109

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

2.4. Model : N9029AV04, S/N : SAX791 113

3. CMI Horn Antenna gain 117

3.1. HO22R (33 GHz – 50 GHz) 117

3.1. HO15R (50 GHz – 75 GHz) 119

3.2. HO10R (75 GHz – 110 GHz) 121

3.3. HO06R (110 GHz – 170 GHz) 123

3.4. HO04R (170 GHz – 260 GHz) 125

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

UL Korea, Ltd. Confidential

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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 and NFC

MODEL NUMBER: SM-A236V

SERIAL NUMBER: 664a1251dd347ece, 664a12509e347ece, 664a124c2d347ece (Radiated), 664a1250a5347ece (Conducted);

DATE TESTED: 2022-10-10 ~ 2022-11-03;

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:

Seokhwan Hong
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Sungeun Lee
Suwon Lab Engineer
UL Korea, Ltd.

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of 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 v01r02
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(3m semi-anechoic chamber)
☒ Chamber 2(3m semi-anechoic chamber)
☐ Chamber 3(3m semi-anechoic chamber)
☐ Chamber 4(3m Full-anechoic chamber)
☒ Chamber 5(3m Full-anechoic chamber)

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.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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	3.02 dB
Radiated Disturbance, 30 MHz to 1 GHz	4.05 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.78 dB
Radiated Disturbance, Above 18 GHz	5.58 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 2, Clause 4.4.3 in IEC Guide 115:2021.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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 and NFC.
This test report addresses the 5G NR operational mode.

The EUT has an array antenna configuration. 1 patches, placed on the EUT(denoted as K patch). The patch antennas is comprised of two separate antenna feeds - one for horizontal and one for vertical polarization and 1 × 5 dual-polarized patch arrays.

Antenna	Name
Module 0	K Patch

The EUT supports up to 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, pi/2-BPSK, 16-QAM, and 64-QAM modulations.

Different Beam IDs are supported, each corresponding to a different position in space for 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.

Manufacturer provided the Beam ID settings that yield the highest EIRP for each antenna by the EIRP Simulation tool. These Beam ID settings were used for all tests. All tests were performed in a non-signaling, stand-alone mode of operation.

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

5.2. MAXIMUM OUTPUT POWER

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

Module 0 / Band n261

FCC Part 30								
Band	Frequency Range [MHz]	Antenna	BandWidth [MHz]	CCs Active	Mode	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n261	27500 - 28350	Module 0	50	1CC	SISO	QPSK	28.20	660.39
					SISO-Dual	QPSK	**29.22**	**835.99**
					SISO	pi/2-BPSK	28.89	774.11
					SISO	16QAM	26.95	494.88
					SISO	64QAM	24.71	295.67
					MIMO	QPSK	25.10	323.67
				2CC	SISO	QPSK	25.70	371.71
					SISO-Dual	QPSK	23.31	214.24
					SISO	pi/2-BPSK	**25.79**	**379.40**
					SISO	16QAM	24.29	268.60
					SISO	64QAM	22.19	165.69
					MIMO	QPSK	21.19	131.49
			100	1CC	SISO	QPSK	28.14	651.78
					SISO-Dual	QPSK	**28.31**	**677.64**
					SISO	pi/2-BPSK	28.29	673.91
					SISO	16QAM	26.13	410.11
					SISO	64QAM	23.56	226.88
					MIMO	QPSK	24.79	301.23
				2CC	SISO	QPSK	25.31	339.63
					SISO-Dual	QPSK	23.87	243.89
					SISO	pi/2-BPSK	**25.31**	**339.86**
					SISO	16QAM	23.69	233.72
					SISO	64QAM	21.62	145.14
					MIMO	QPSK	21.46	139.96

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0 / Band n260

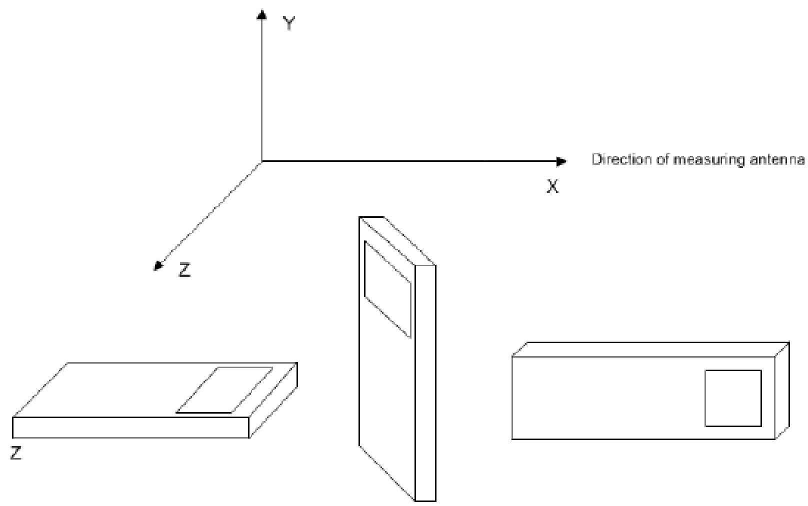
FCC Part 30								
Band	Frequency Range [MHz]	Antenna	BandWidth [MHz]	CCs Active	Mode	Modulation	Radiated	
							Avg [dBm]	Avg [mW]
n260	37000 - 40000	Module 0	50	1CC	SISO	QPSK	28.59	722.77
					SISO-Dual	QPSK	**28.64**	**731.14**
					SISO	pi/2-BPSK	28.09	643.43
					SISO-Dual	16QAM	25.85	384.68
					SISO-Dual	64QAM	23.52	224.65
					MIMO	QPSK	25.34	342.14
				2CC	SISO	QPSK	23.87	243.61
					SISO-Dual	QPSK	22.83	192.00
					SISO	pi/2-BPSK	**23.99**	**250.84**
					SISO	16QAM	22.44	175.23
					SISO	64QAM	20.29	106.83
					MIMO	QPSK	21.03	126.88
			100	1CC	SISO	QPSK	27.83	606.18
					SISO-Dual	QPSK	**27.99**	**629.94**
					SISO	pi/2-BPSK	27.85	609.54
					SISO	16QAM	25.18	329.69
					SISO-Dual	64QAM	23.28	212.67
					MIMO	QPSK	25.14	326.51
				2CC	SISO	QPSK	**25.50**	**354.65**
					SISO-Dual	QPSK	24.58	287.01
					SISO	pi/2-BPSK	25.48	353.26
					SISO	16QAM	23.88	244.40
					SISO	64QAM	21.91	155.35
					MIMO	QPSK	21.21	132.01

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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, pi/2-BPSK, 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 Roll, where is applicable. The final optimum position resulting in the highest EIRP for the frequency or band under investigation is placed on an open air fixture allowing no blockage of the signal as measured by the receiving antenna.



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.

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacture**	**Model**	**Serial Number**	**FCC ID**
Charger	SAMSUNG	EP-TA800	R37N3MAH988DK3	N/A
Data Cable	SAMSUNG	EP-DN980	GH39-02115A BWE	N/A
Earphone	SAMSUNG	GH59-15055A	EHS64AVFWE	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	1.0 m	N/A
2	Audio	2	Mini-jack	Unshielded	0.7 m	N/A

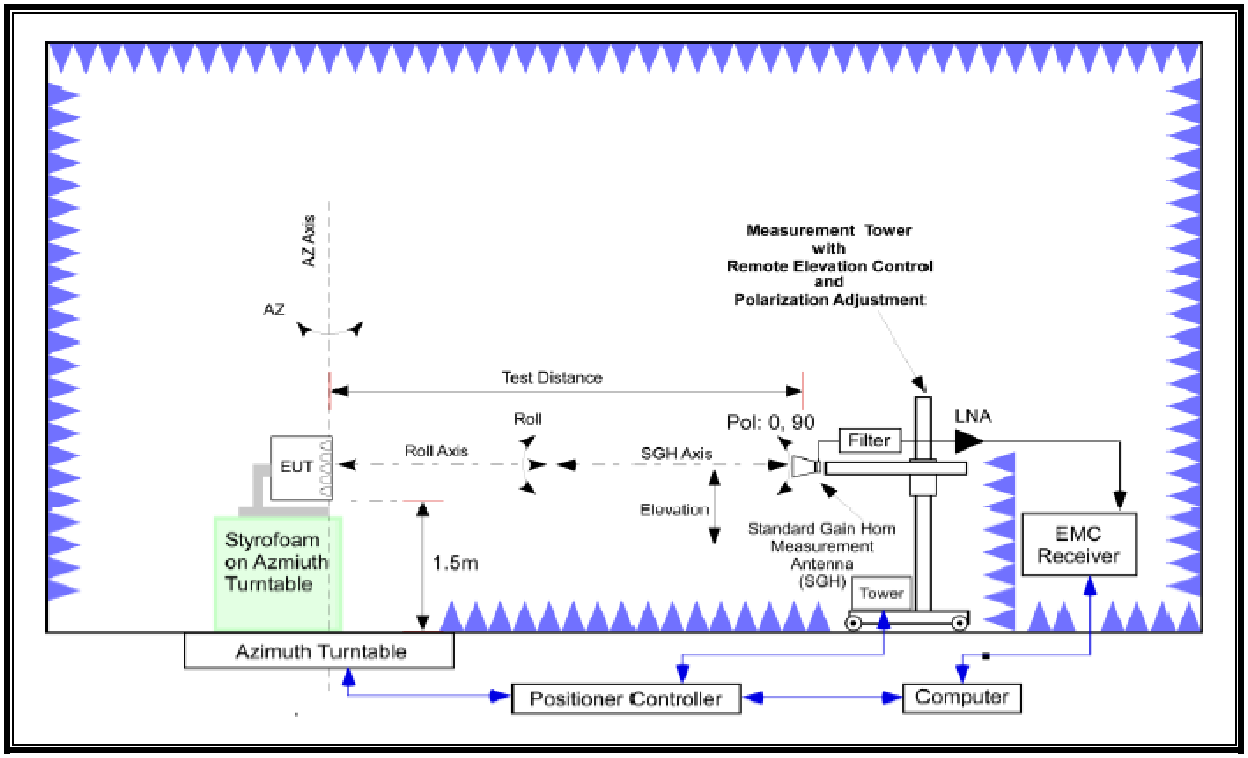
TEST SETUP

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.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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.



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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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.

The field strength E is calculated E (dBμV/m) = Spectrum Analyzer Channel Power Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107.
EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in meter.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	2024-08-15
Antenna, Horn, 18 GHz	ETS	3117	00168724	2024-08-04
Antenna, Horn, 40 GHz	ETS	3116C	00227907	2023-01-15
Preamplifier, 1000 MHz	Sonoma	310N	351741	2023-08-02
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	2023-08-01
EMI Test Receive, 40 GHz	R&S	ESU40	100457	2023-07-29
High Pass Filter 3GHz	Micro-Tronics	HPM17543	015	2022-08-02
Signal Analyzer, 44 GHz	KEYSIGHT	N9030A	MY54170614	2023-08-03
Signal Analyzer, 50 GHz	KEYSIGHT	N9040B	MY60080268	2023-01-19
SA Extension Module	VDI	N9029AV15	SAX693	2023-01-18
SA Extension Module	VDI	N9029AV10	SAX597	2023-01-16
SA Extension Module	VDI	N9029AV06	SAX789	2023-01-16
SA Extension Module	VDI	N9029AV04	SAX791	2023-01-15
Antenna	CMI, Inc.	HO22R	UL22002	2023-02-24
Antenna	CMI, Inc.	HO15R	UL15002	2023-02-24
Antenna	CMI, Inc.	HO10R	UL10002	2023-02-24
Antenna	CMI, Inc.	HO06R	UL06002	2023-02-24
Antenna	CMI, Inc.	HO04R	UL04002	2023-02-24
Temperature Chamber	ESPEC	SH-642	93001109	2023-08-01
UL Software				
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

8. LIMITS AND CONDUCTED RESULTS

8.1. 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 v01r02 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd*.*

8.1.1. OCCUPIED BANDWIDTH RESULTS

OBW Result - Module 0

Antenna	Band	BandWidth [MHz]	CCs Active	Modulation	OBW [MHz]
Module 0	n261	50	1CC	pi/2-BPSK	46.09
				QPSK	**46.35**
				16QAM	46.14
				64QAM	46.01
			2CC	pi/2-BPSK	95.33
				QPSK	**95.69**
				16QAM	95.53
				64QAM	95.28
		100	1CC	pi/2-BPSK	94.58
				QPSK	94.57
				16QAM	94.13
				64QAM	**94.64**
			2CC	pi/2-BPSK	194.97
				QPSK	**196.19**
				16QAM	195.74
				64QAM	195.66
	n260	50	1CC	pi/2-BPSK	**46.23**
				QPSK	46.20
				16QAM	45.89
				64QAM	45.88
			2CC	pi/2-BPSK	**95.81**
				QPSK	95.78
				16QAM	95.59
				64QAM	95.52
		100	1CC	pi/2-BPSK	94.54
				QPSK	94.33
				16QAM	94.13
				64QAM	**94.60**
			2CC	pi/2-BPSK	195.64
				QPSK	195.16
				16QAM	194.33
				64QAM	**196.59**

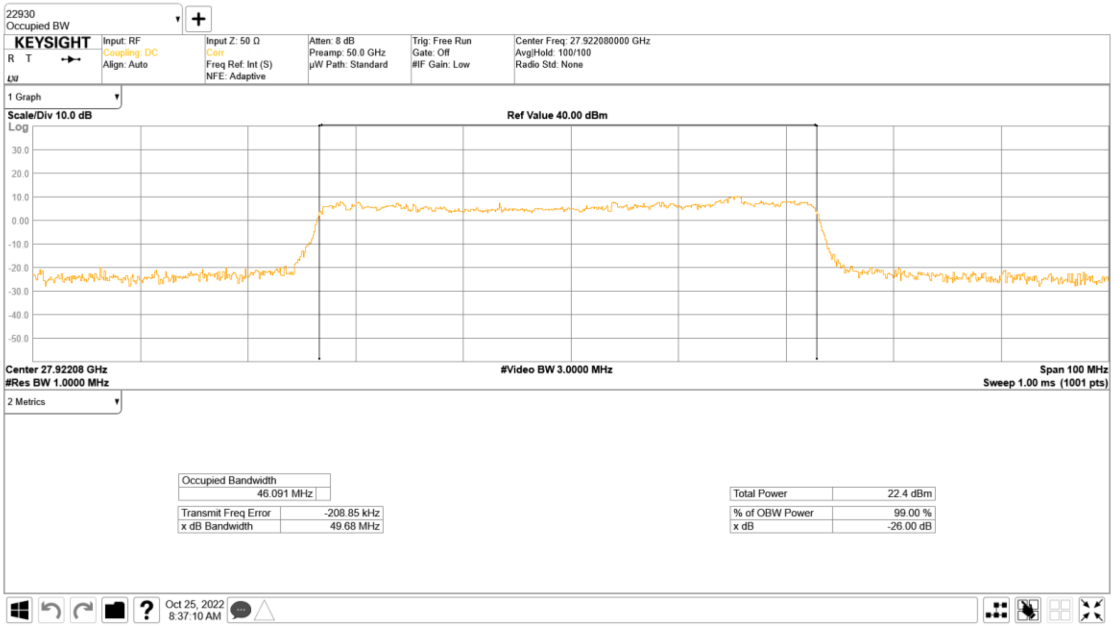
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n261

M 0

n261

BW 50MHz

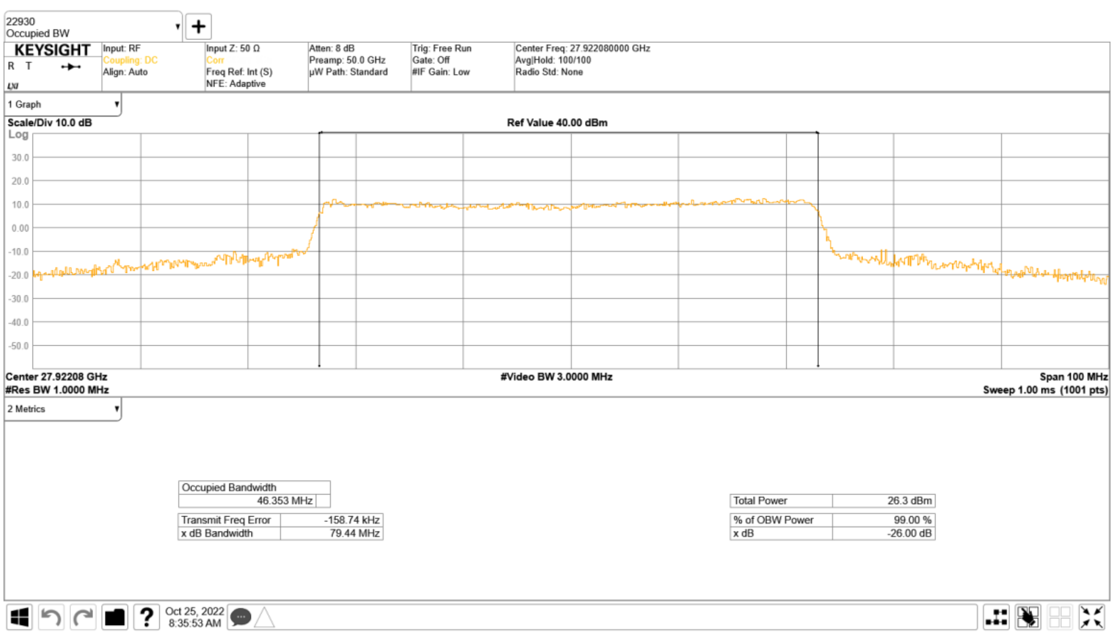


1CC / BPSK / Mid channel

M 0

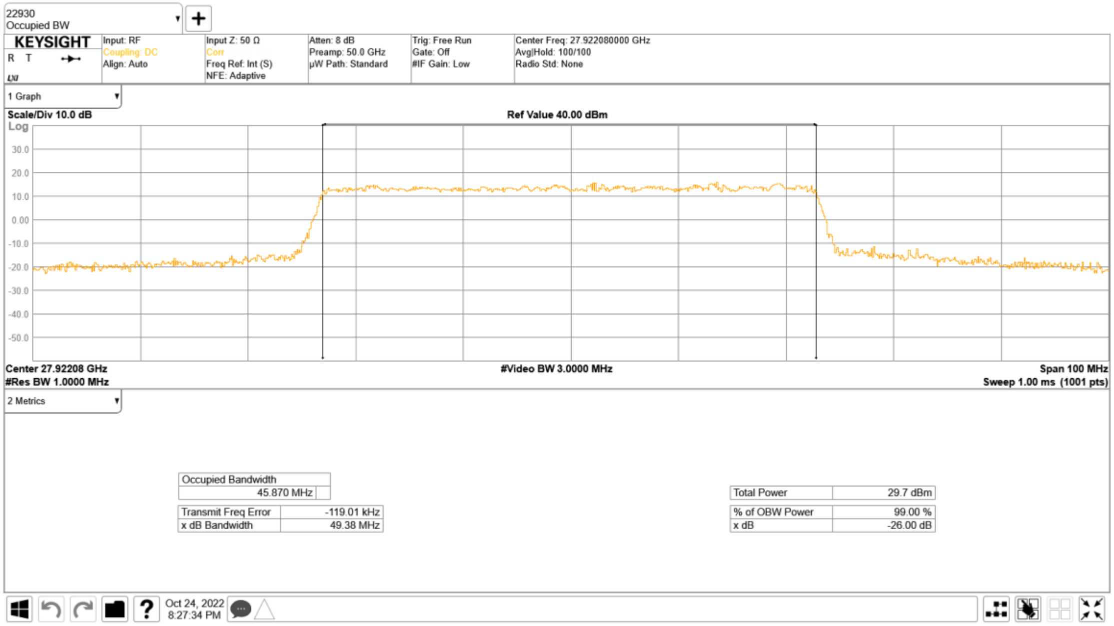
n261

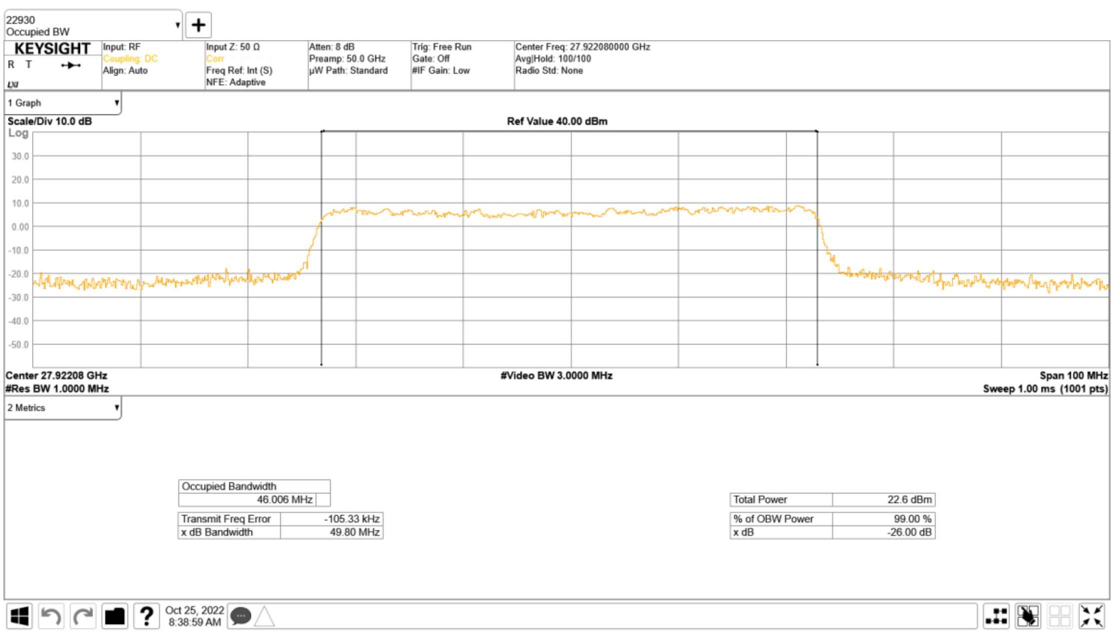
BW 50MHz



1CC / QPSK / Mid channel

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

<table>
<tr>
<td>M 0
n261
BW
50MHz</td>
<td>


1CC / 16QAM / Mid channel
</td>
</tr>
<tr>
<td>M 0
n261
BW
50MHz</td>
<td>


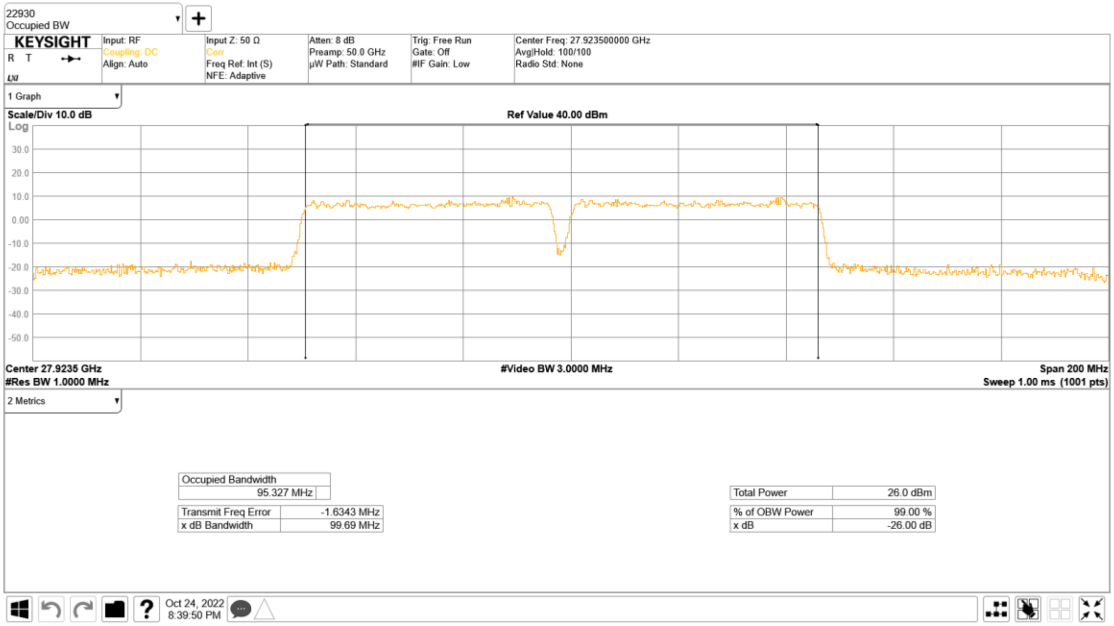
1CC / 64QAM / Mid channel
</td>
</tr>
</table>

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

BW 50MHz

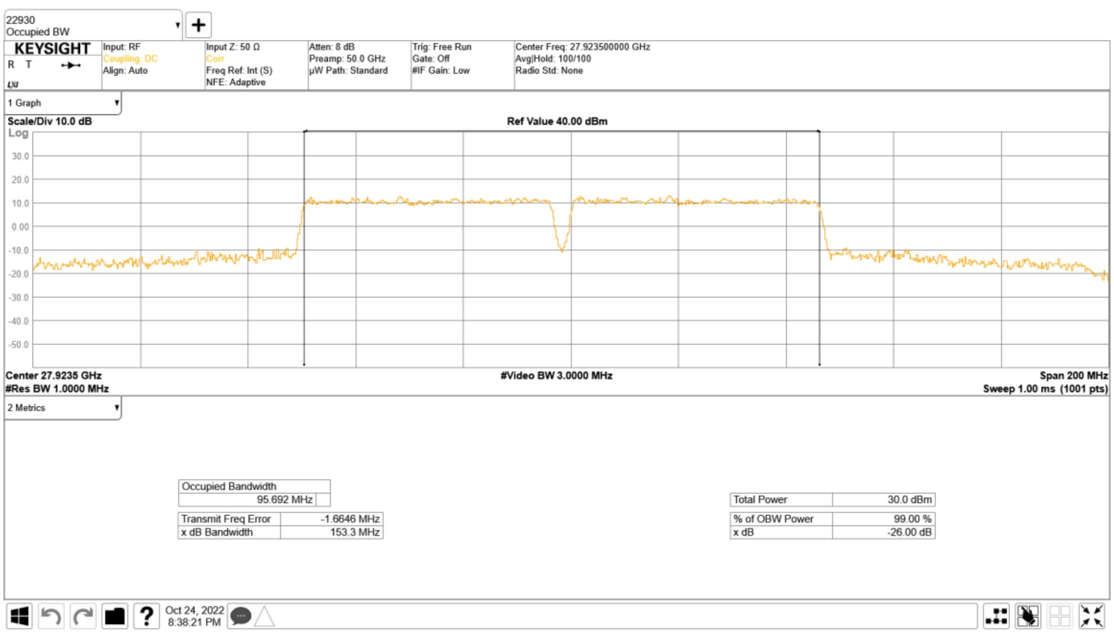


2CC / BPSK / Mid channel

M 0

n261

BW 50MHz



2CC / QPSK / Mid channel

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

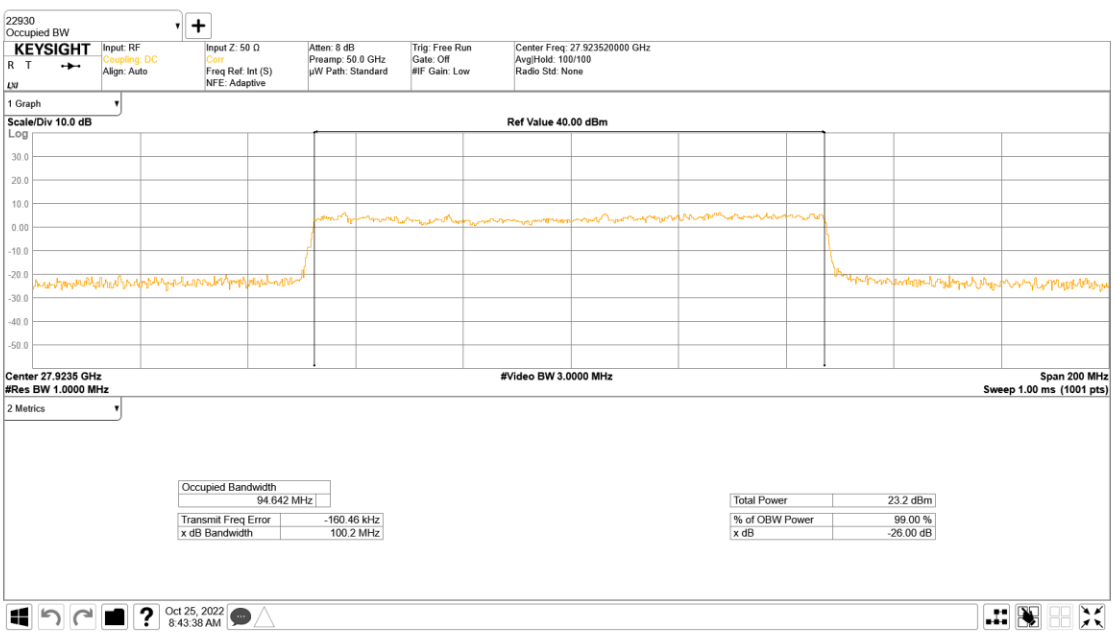
BW
50MHz

2CC / 16QAM / Mid channel

M 0

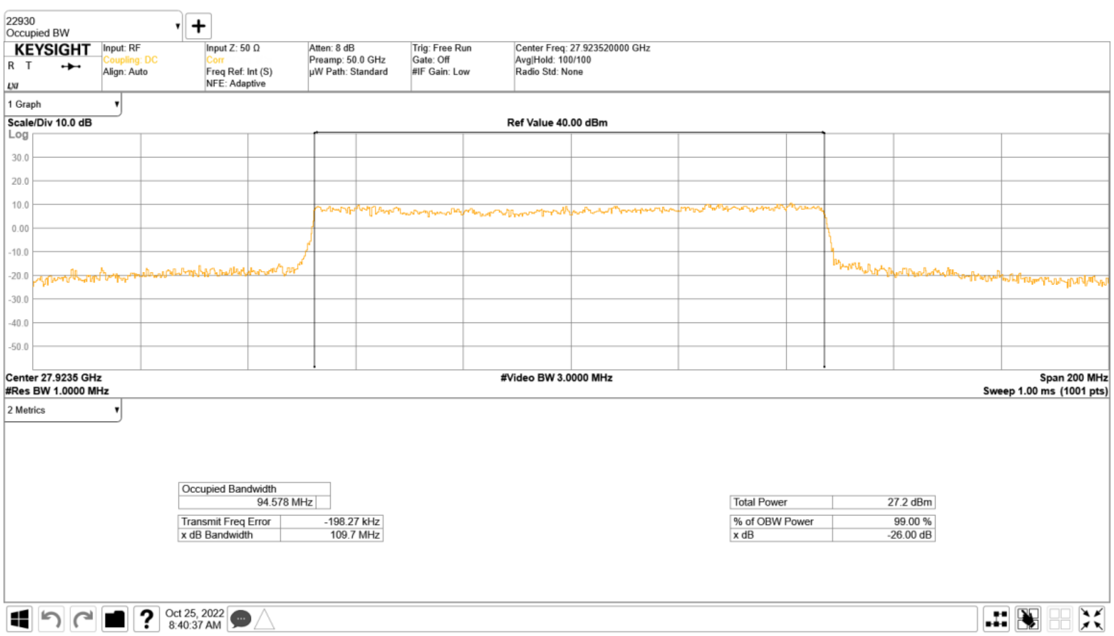
n261

BW
50MHz

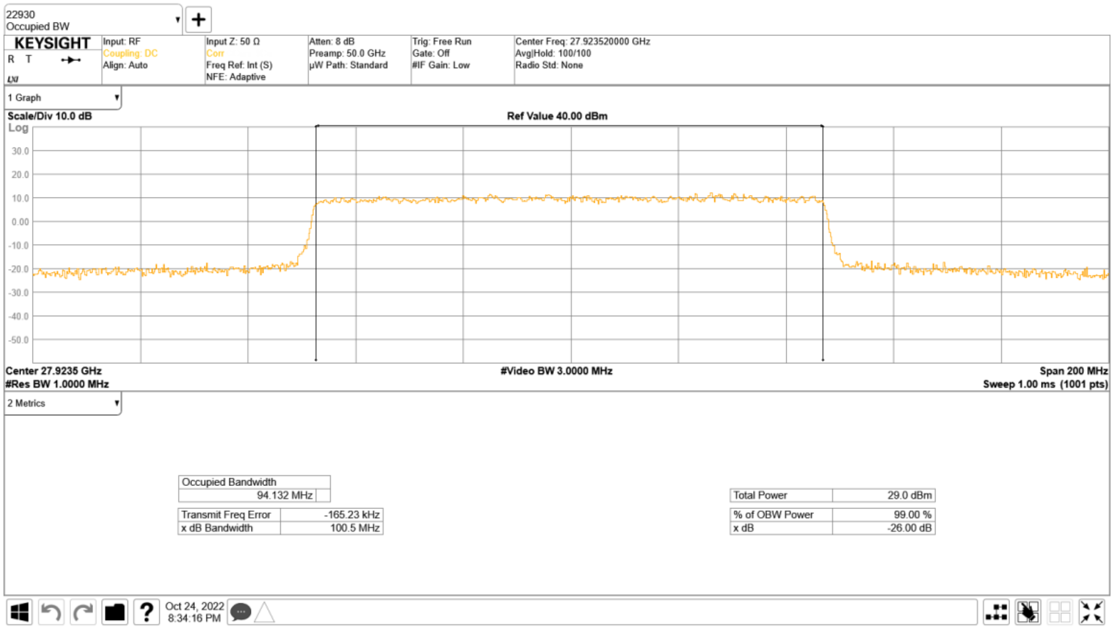
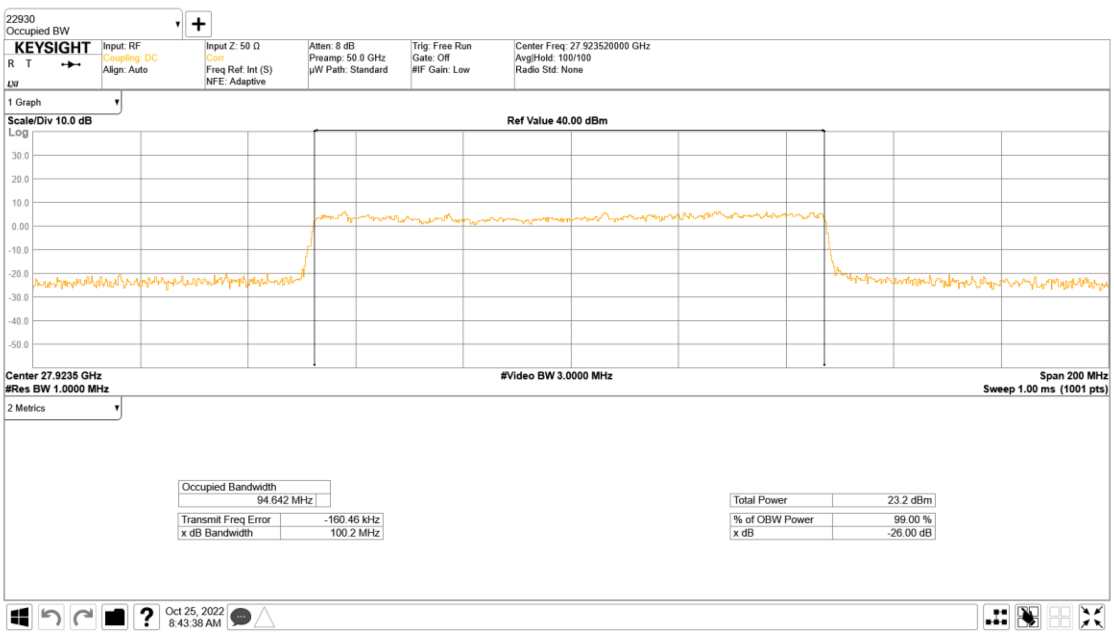


2CC / 64QAM / Mid channel

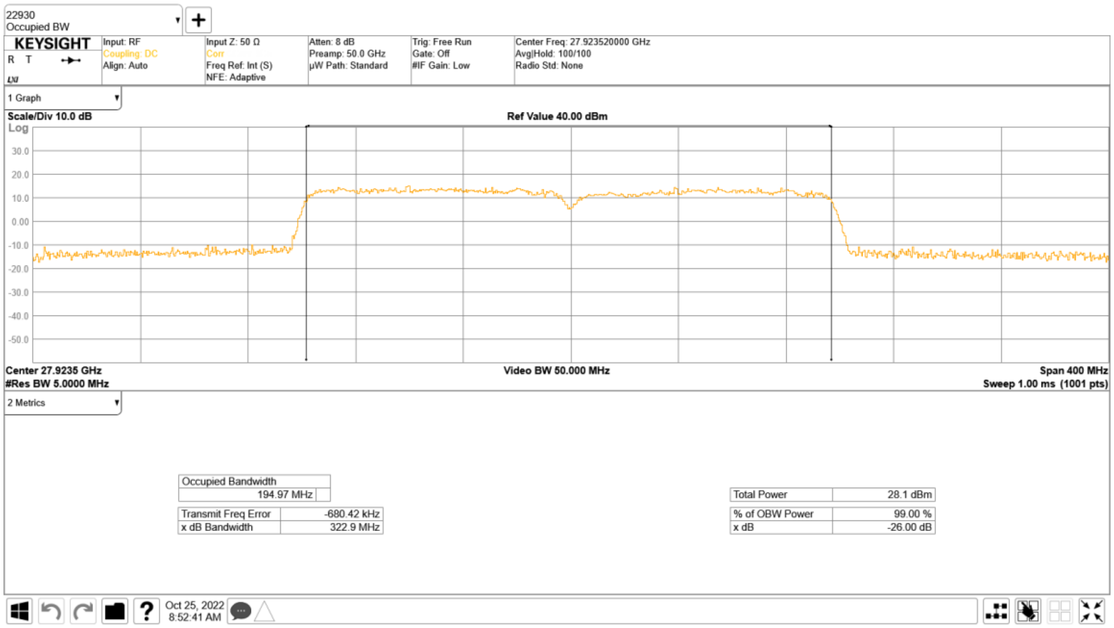
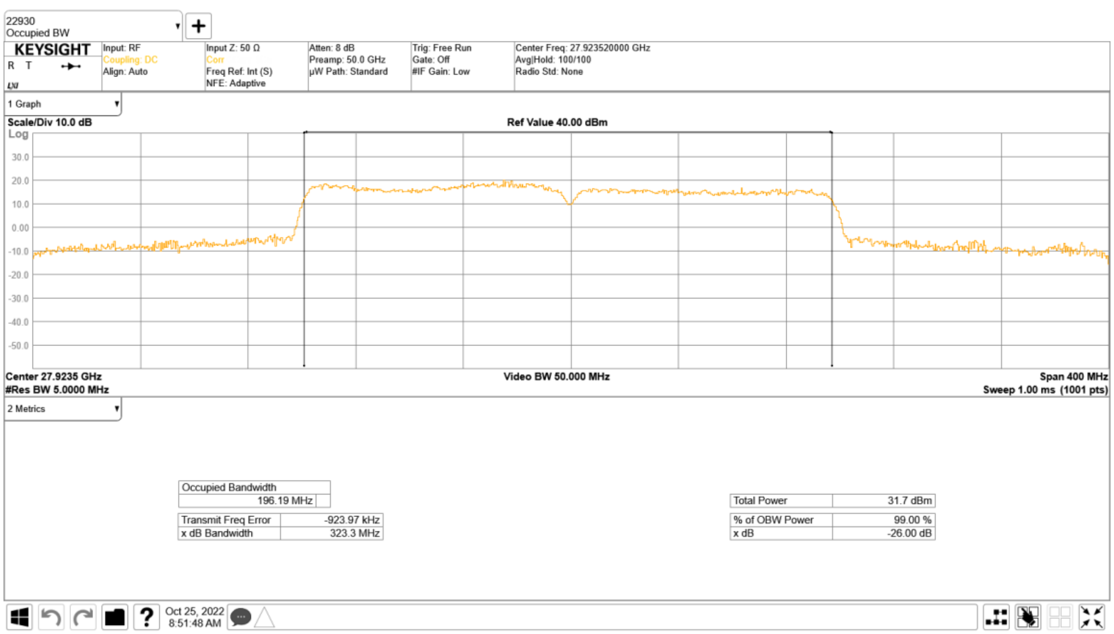
UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_30(04)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n261 BW 100MHz	 1CC / BPSK / Mid channel
M 0 n261 BW 100MHz	 1CC / QPSK / Mid channel

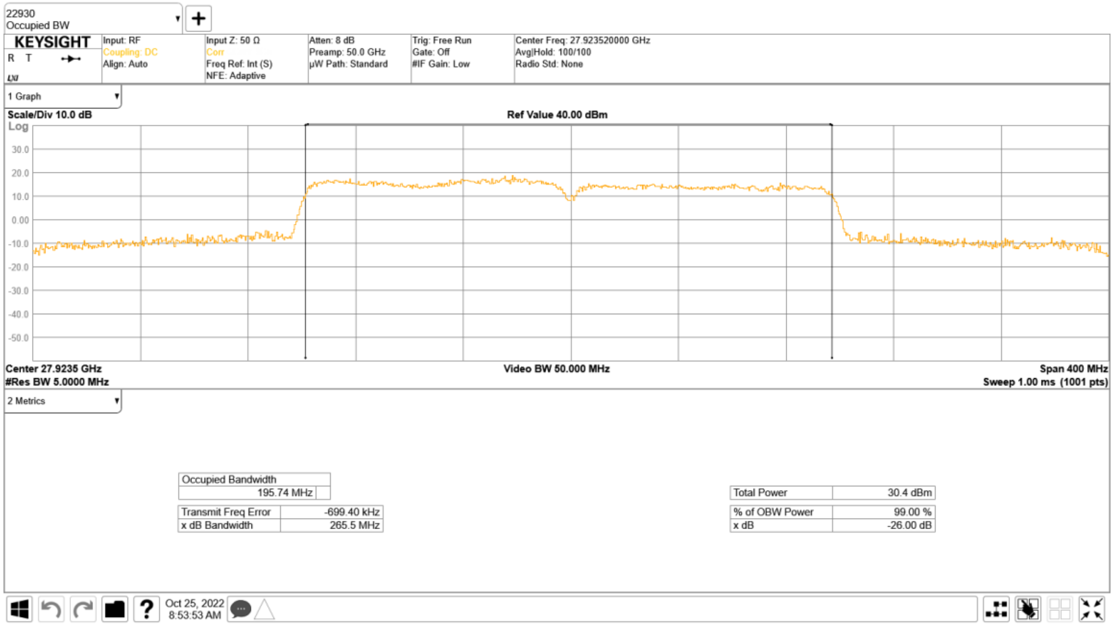
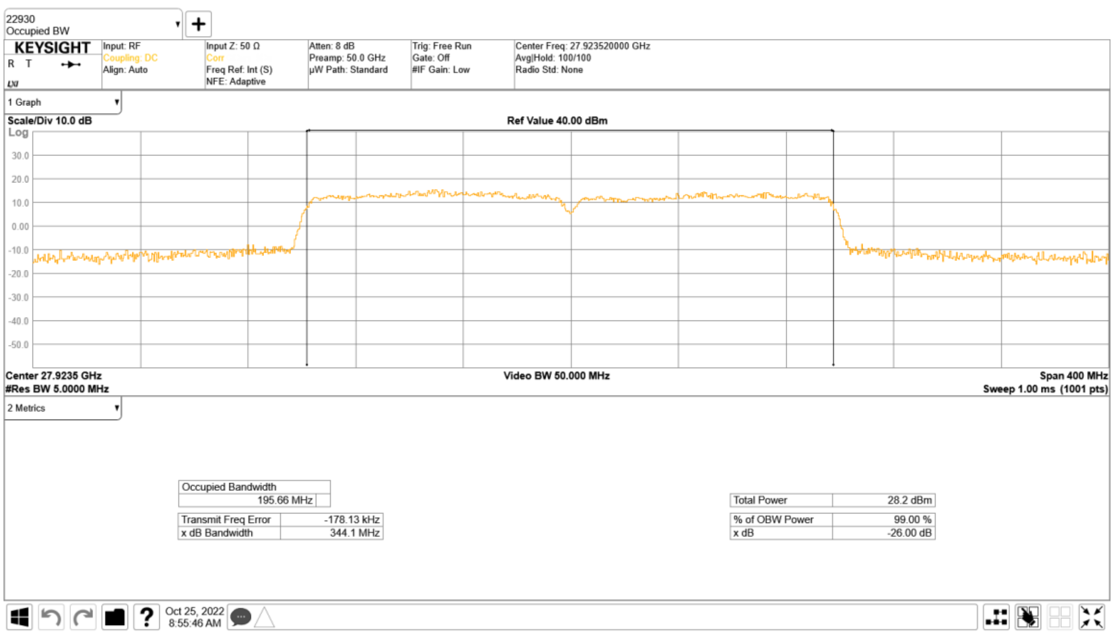
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n261 BW 100MHz	 1CC / 16QAM / Mid channel
M 0 n261 BW 100MHz	 1CC / 64QAM / Mid channel

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n261 BW 100MHz	 2CC / BPSK / Mid channel
M 0 n261 BW 100MHz	 2CC / QPSK / Mid channel

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n261 BW 100MHz	 2CC / 16QAM / Mid channel
M 0 n261 BW 100MHz	 2CC / 64QAM / Mid channel

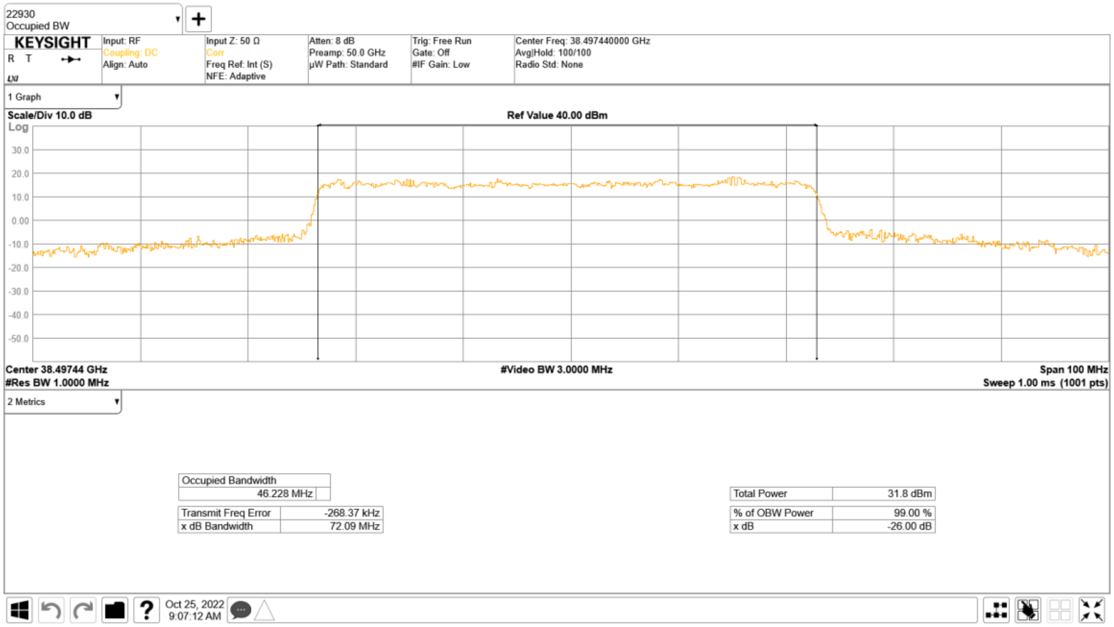
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n260

M 0

n260

BW 50MHz

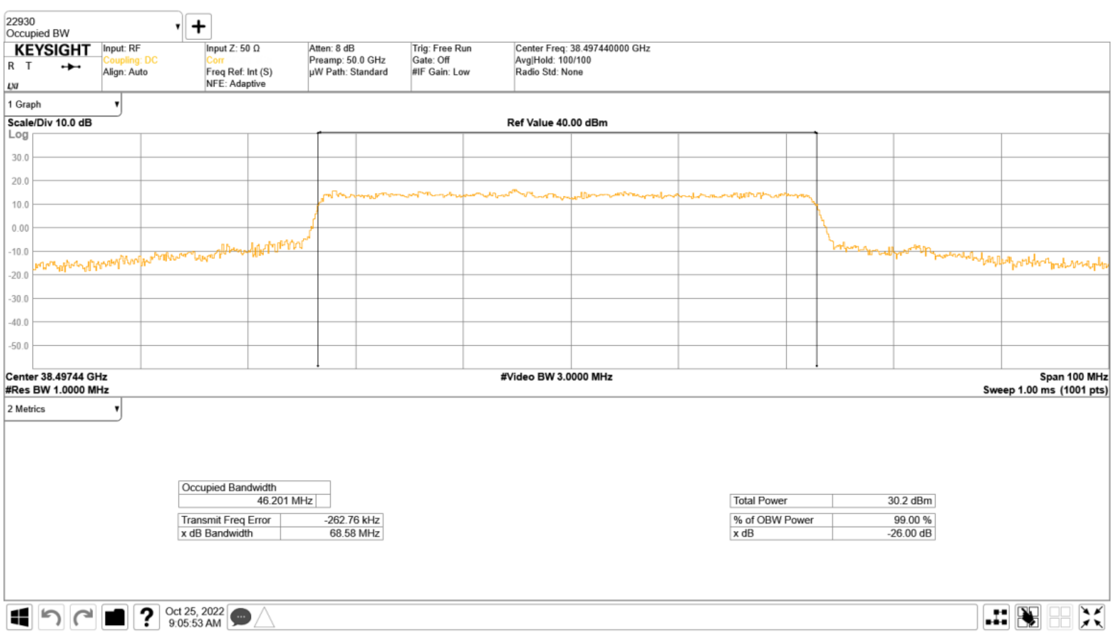


1CC / BPSK / Mid channel

M 0

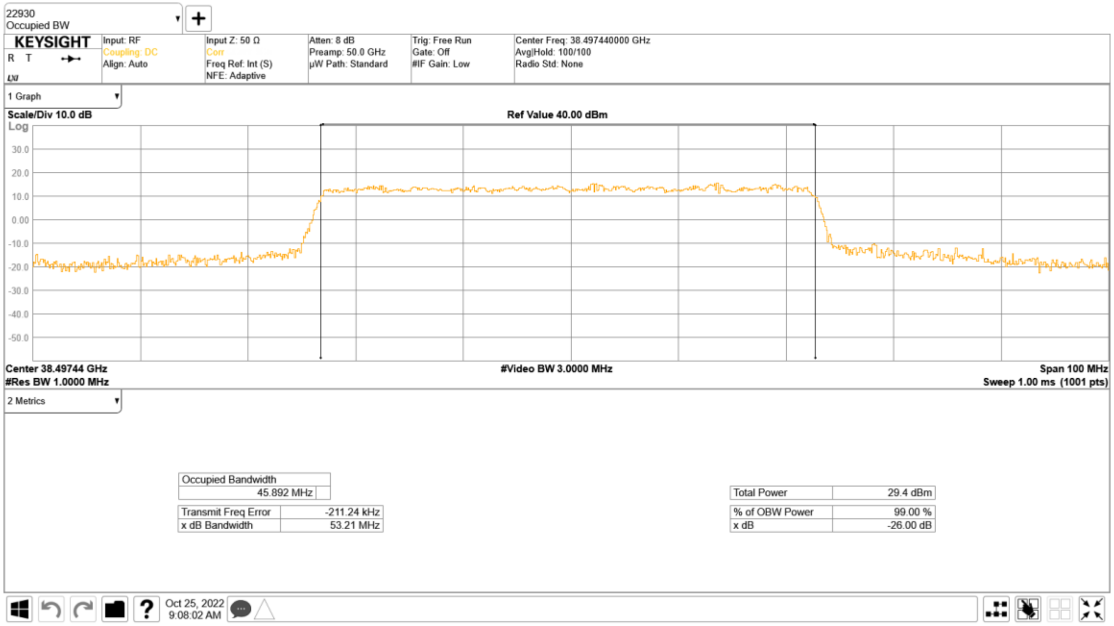
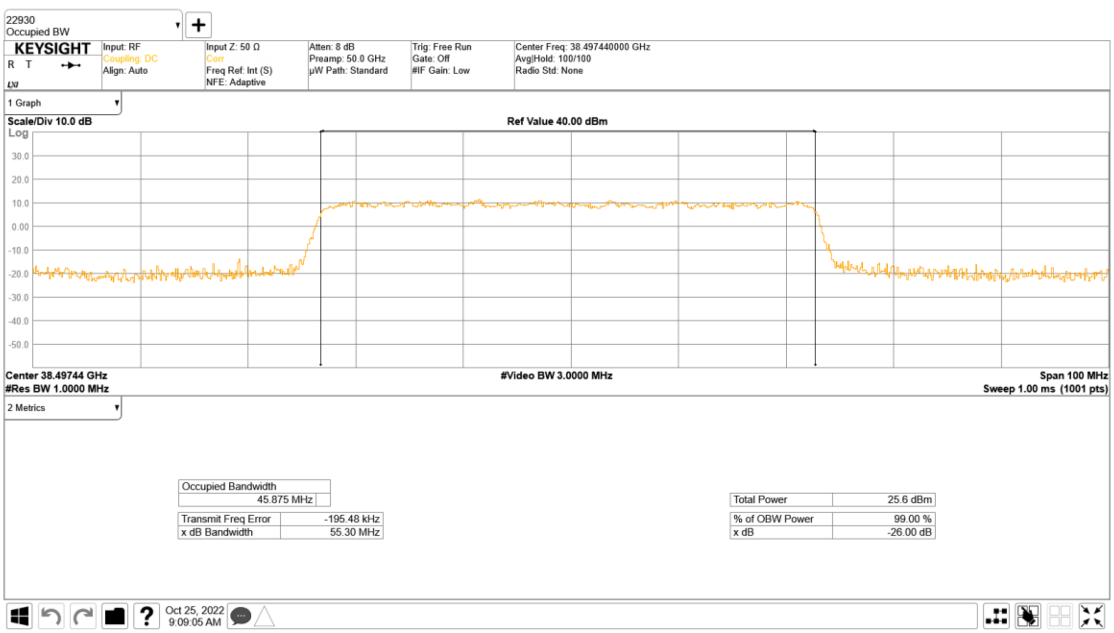
n260

BW 50MHz



1CC / QPSK / Mid channel

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

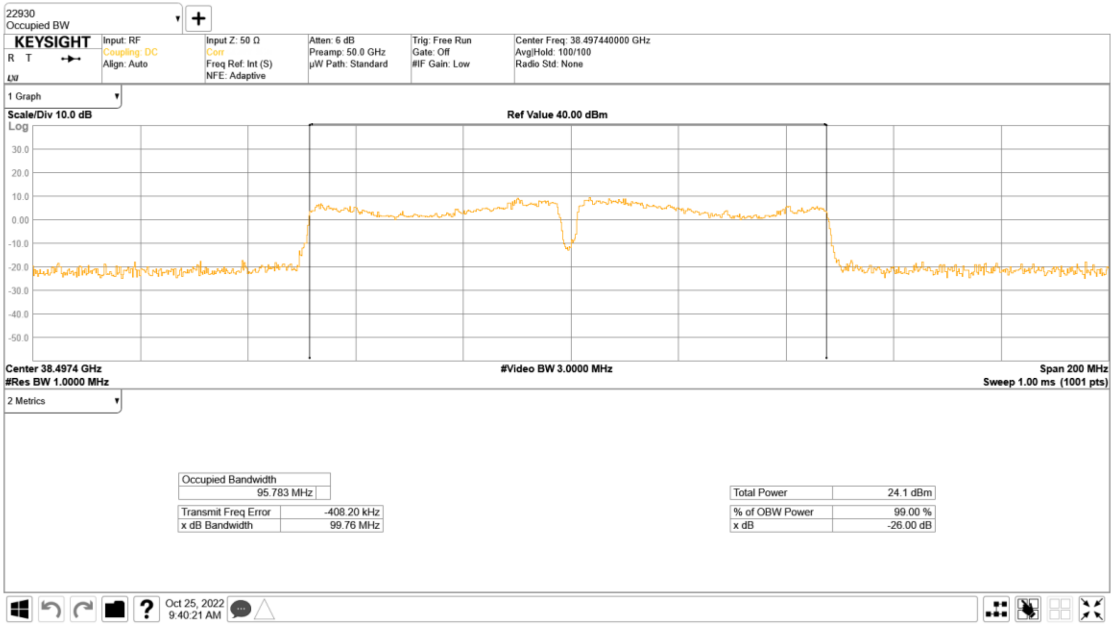
M 0 n260 BW 50MHz	 1CC / 16QAM / Mid channel
M 0 n260 BW 50MHz	 1CC / 64QAM / Mid channel

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n260

BW 50MHz

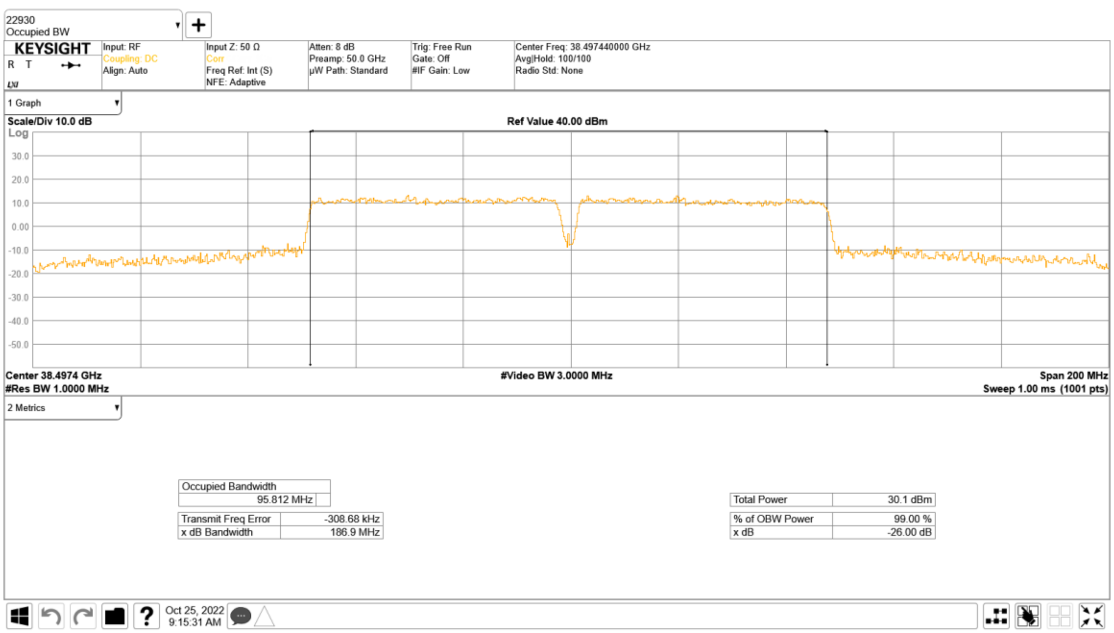


2CC / BPSK / Mid channel

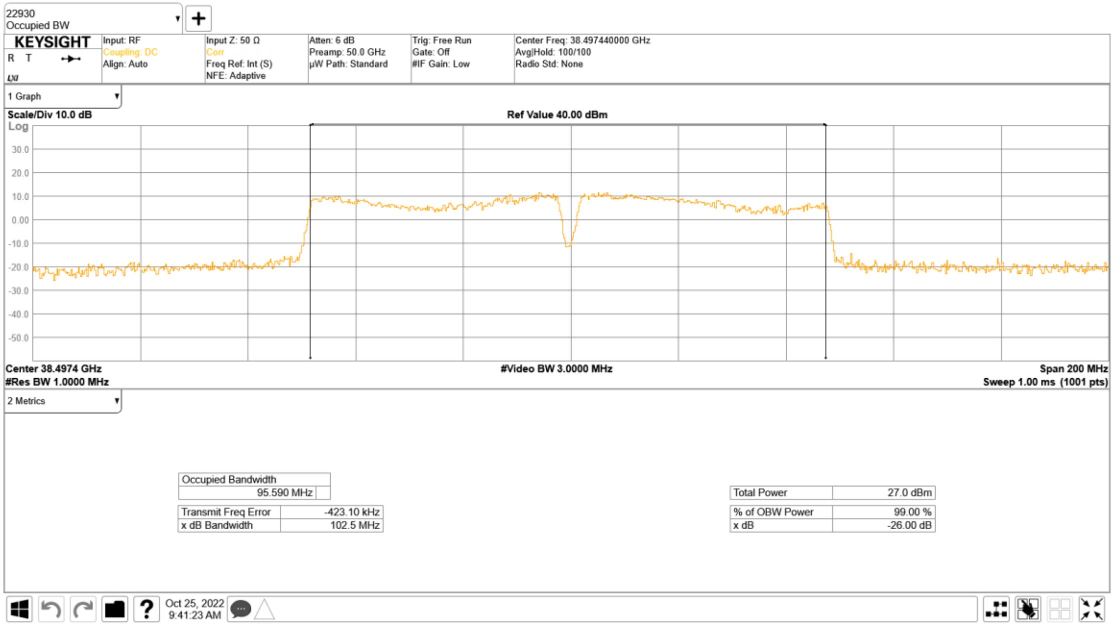
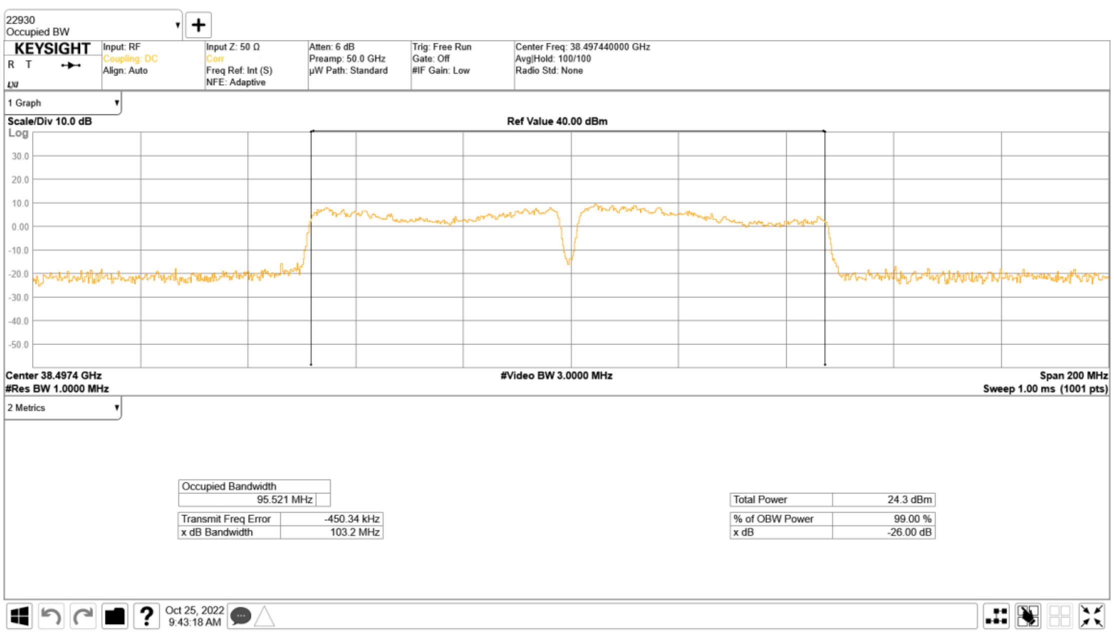
M 0

n260

BW 50MHz



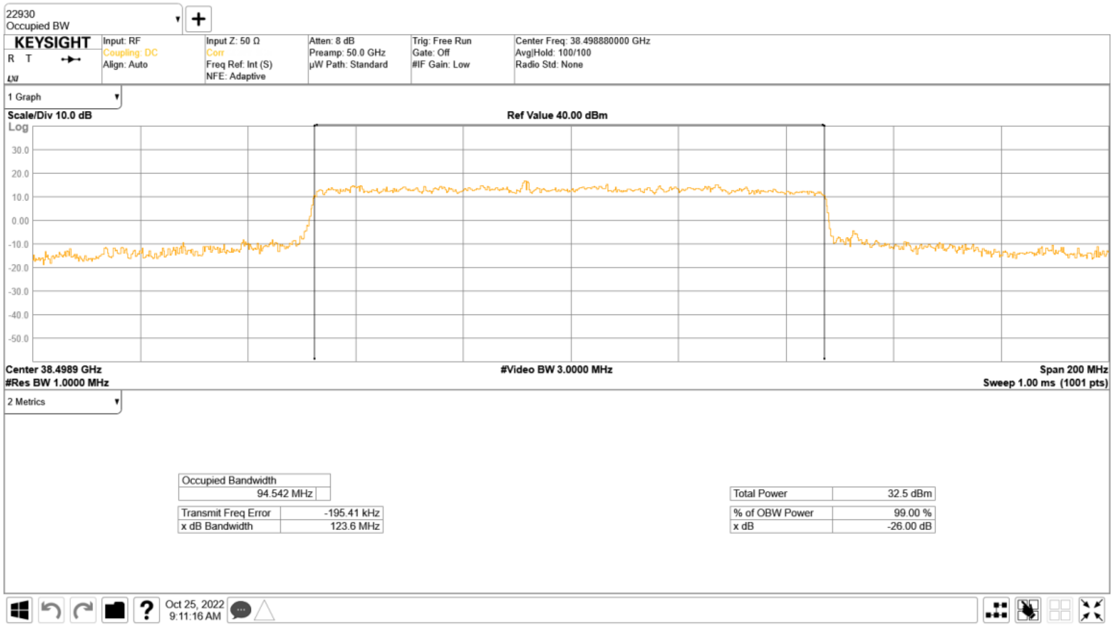
2CC / QPSK / Mid channel

M 0 n260 BW 50MHz	 2CC / 16QAM / Mid channel
M 0 n260 BW 50MHz	 2CC / 64QAM / Mid channel

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

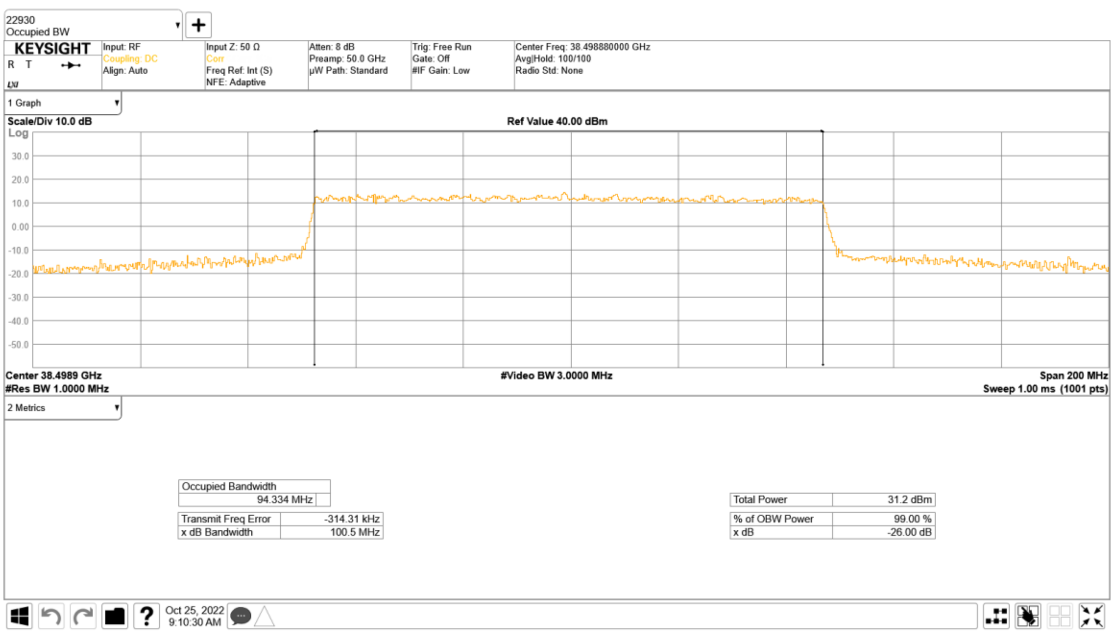
<table>
<tr>
<td>M 0

n260

BW
100MHz</td>
<td>

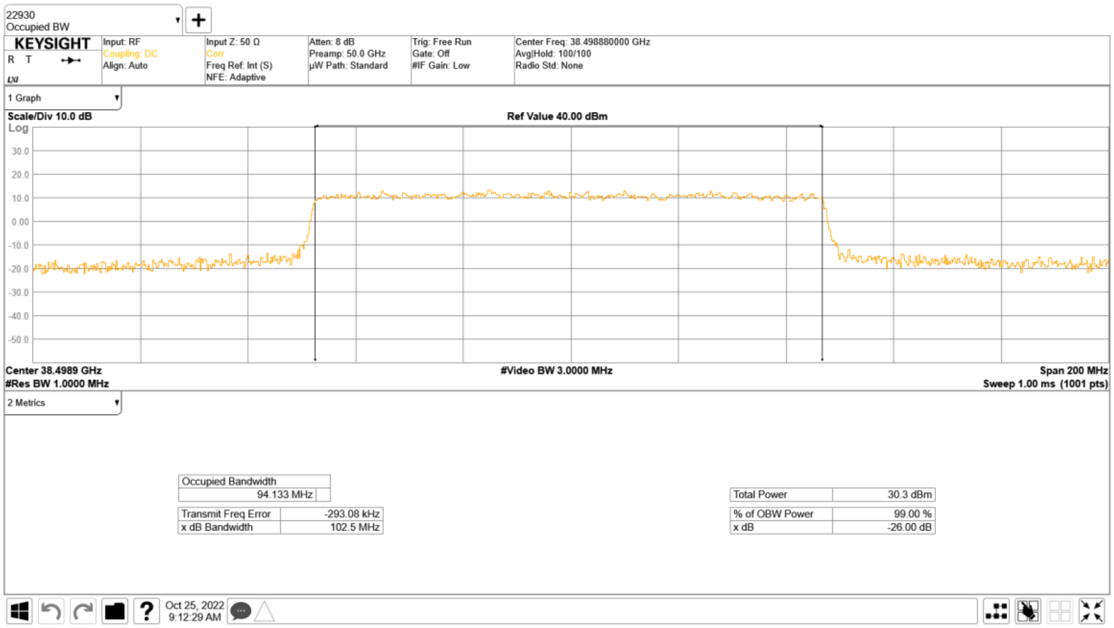
1CC / BPSK / Mid channel</td>
</tr>
<tr>
<td>M 0

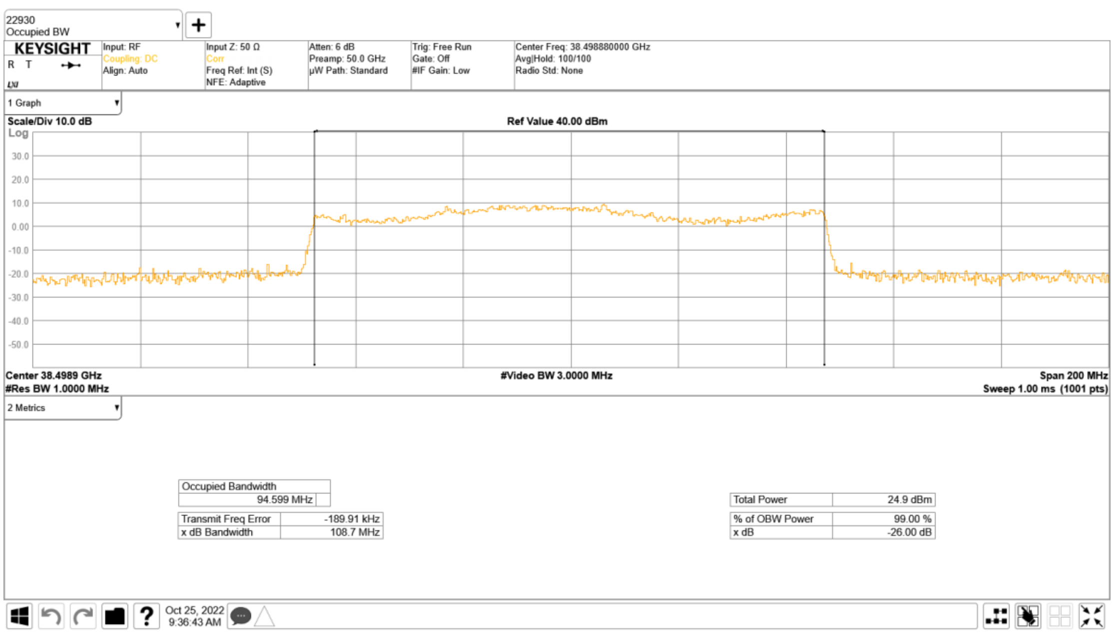
n260

BW
100MHz</td>
<td>

1CC / QPSK / Mid channel</td>
</tr>
</table>

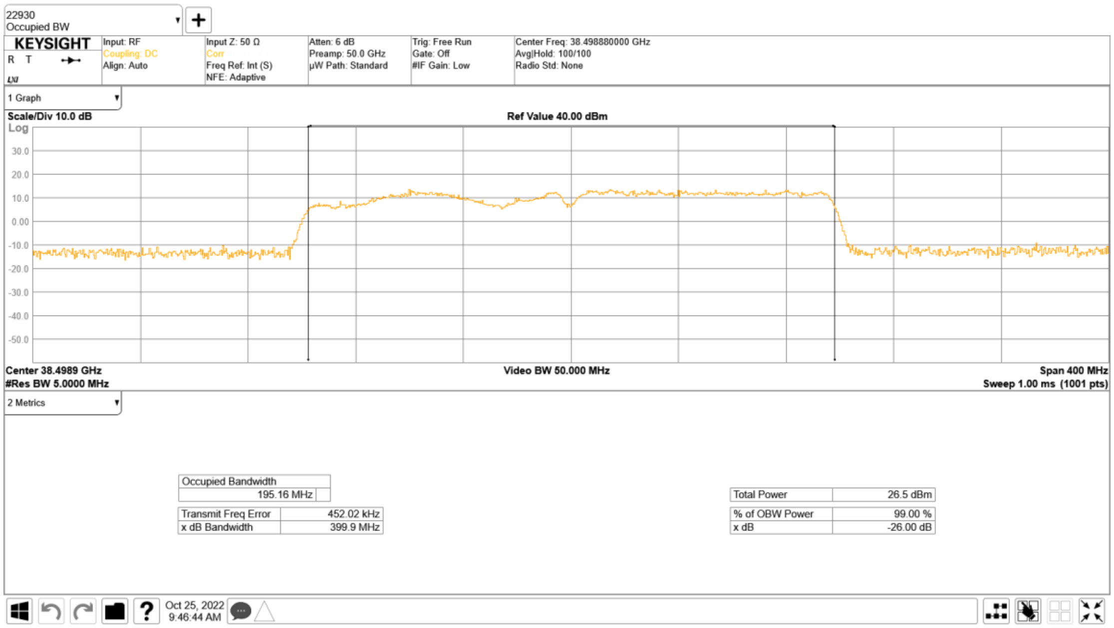
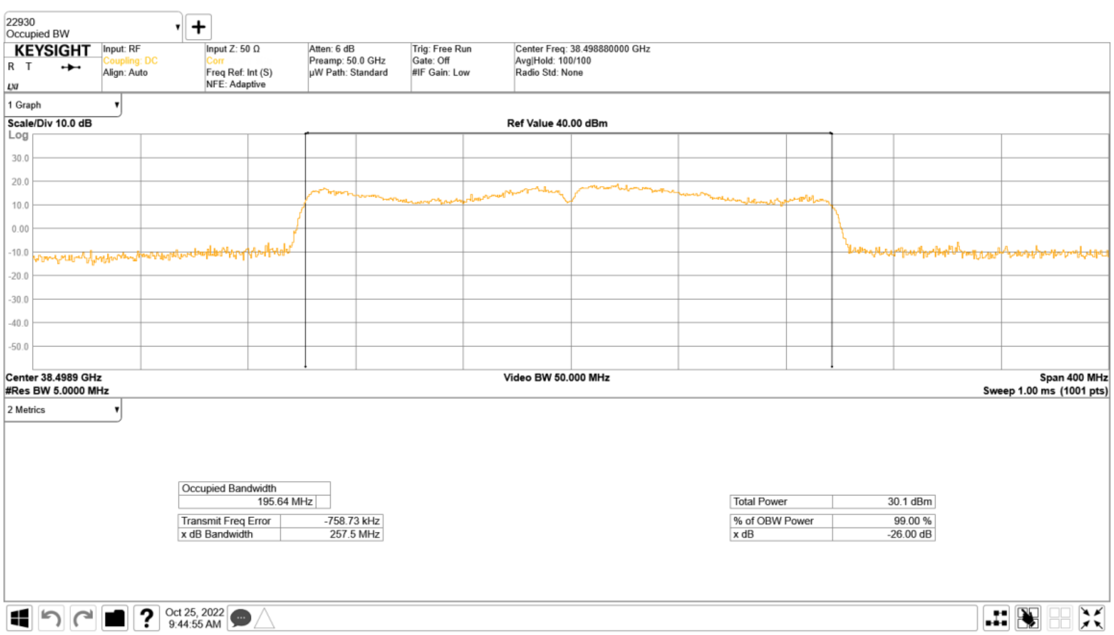
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

<table>
<tr>
<td>M 0
n260
BW
100MHz</td>
<td>

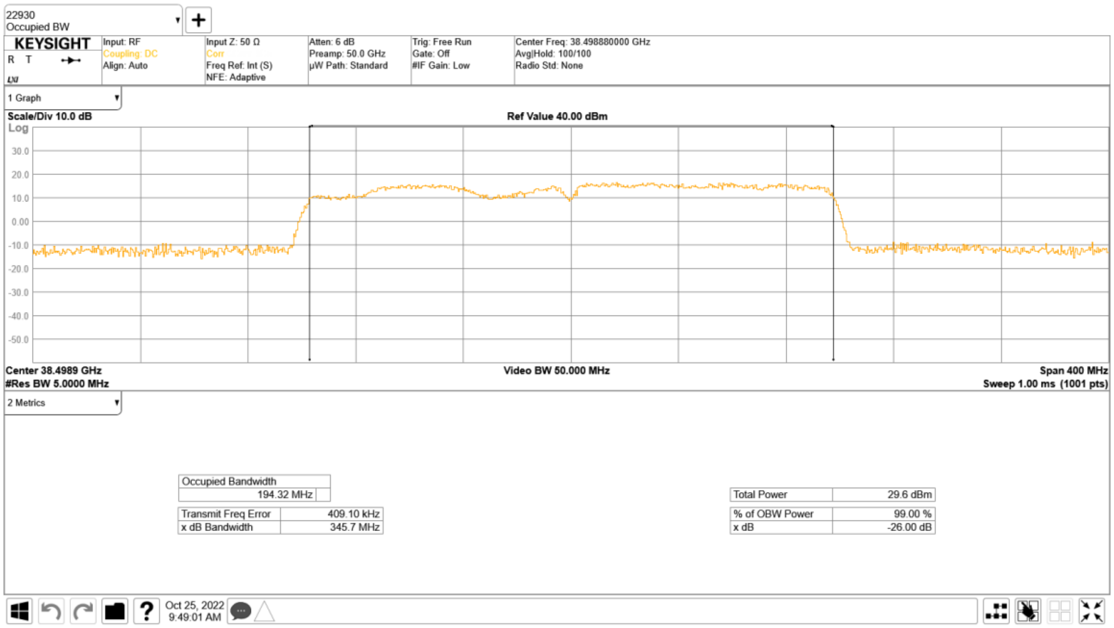
1CC / 16QAM / Mid channel</td>
</tr>
<tr>
<td>M 0
n260
BW
100MHz</td>
<td>

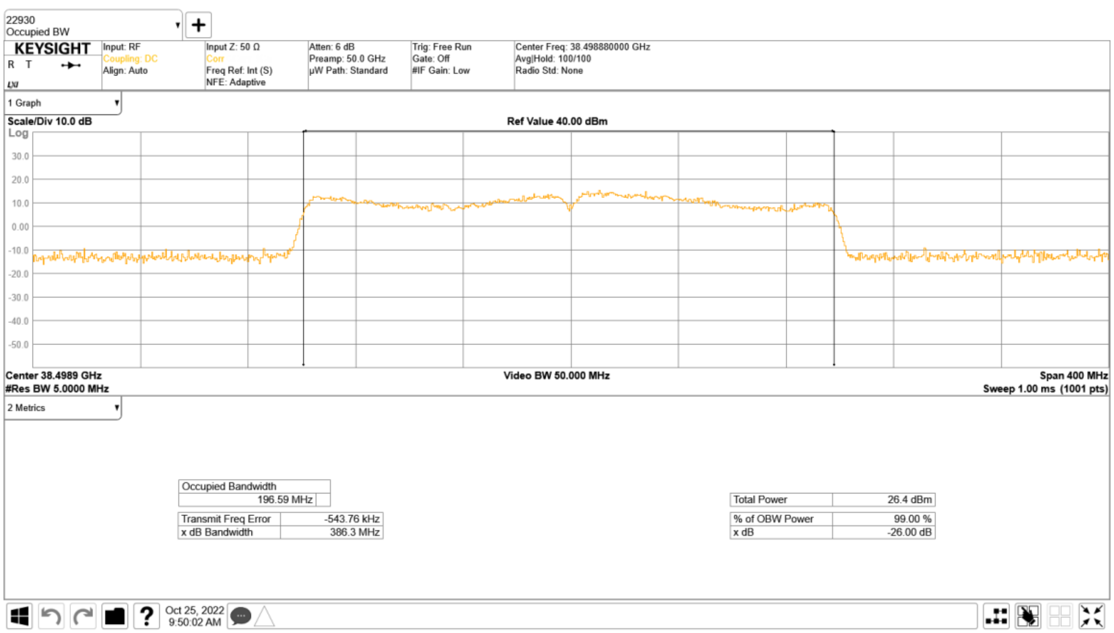
1CC / 64QAM / Mid channel</td>
</tr>
</table>

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n260 BW 100MHz	 2CC / BPSK / Mid channel
M 0 n260 BW 100MHz	 2CC / QPSK / Mid channel

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

<table>
<tr>
<td>M 0
n260
BW
100MHz</td>
<td>


2CC / 16QAM / Mid channel
</td>
</tr>
<tr>
<td>M 0
n260
BW
100MHz</td>
<td>


2CC / 64QAM / Mid channel
</td>
</tr>
</table>

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

8.2. 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 over 100 sweeps

(KDB 842590 D01 Upper Microwave Flexible Use Service v01r02 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.

For K patch antenna was pi/2-BPSK, QPSK, 16QAM and 64QAM modulations were all investigated in SISO, SISO-Dual and MIMO configurations. Full data is provided for those combinations. Single RB (highest power) and full RB allocations were measured, but worst RB allocation was reported.

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.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

RESULTS

8.2.1. EIRP Results

Module 0, Band n261, 50M BW

NR Band	Antenna	BW(MHz)	CCs	Mod	Tx Type	Freq(MHz)	Beam ID	Beam Pol	Ant Pol	RB	Result(dBm)
n261	Ant K	50	1CC	QPSK	SISO	27534.84	144	H	V	1_15	**28.20**
n261	Ant K	50	1CC	QPSK	SISO	27922.08	140	H	V	1_15	27.37
n261	Ant K	50	1CC	QPSK	SISO	28319.52	140	H	V	1_15	27.02
n261	Ant K	50	1CC	BPSK	SISO	27534.84	144	H	V	1_15	28.89
n261	Ant K	50	1CC	16QAM	SISO	27534.84	144	H	V	1_15	26.95
n261	Ant K	50	1CC	64QAM	SISO	27534.84	144	H	V	1_15	24.71
n261	Ant K	50	1CC	QPSK	SISO	27534.84	144	H	V	32_0	**25.63**
n261	Ant K	50	1CC	QPSK	SISO	27922.08	140	H	V	32_0	24.31
n261	Ant K	50	1CC	QPSK	SISO	28319.52	140	H	V	32_0	25.27
n261	Ant K	50+50	2CC	QPSK	SISO	27534.84	144	H	V	32_0	25.70
n261	Ant K	50+50	2CC	BPSK	SISO	27534.84	144	H	V	32_0	25.79
n261	Ant K	50+50	2CC	16QAM	SISO	27534.84	144	H	V	32_0	24.29
n261	Ant K	50+50	2CC	64QAM	SISO	27534.84	144	H	V	32_0	22.19
n261	Ant K	50	1CC	QPSK	SISO-Dual	27534.84	16/144	H+V	V	1_15	28.22
n261	Ant K	50	1CC	QPSK	SISO-Dual	27922.08	12/140	H+V	V	1_15	26.49
n261	Ant K	50	1CC	QPSK	SISO-Dual	28319.52	9/137	H+V	H	1_15	**29.22**
n261	Ant K	50	1CC	BPSK	SISO-Dual	28319.52	9/137	H+V	H	1_15	28.67
n261	Ant K	50	1CC	16QAM	SISO-Dual	28319.52	9/137	H+V	H	1_15	26.90
n261	Ant K	50	1CC	64QAM	SISO-Dual	28319.52	9/137	H+V	H	1_15	23.95
n261	Ant K	50	1CC	QPSK	MIMO	28319.52	9/137	H+V	H	1_15	25.10
n261	Ant K	50	1CC	BPSK	MIMO	28319.52	9/137	H+V	H	1_15	24.93
n261	Ant K	50	1CC	16QAM	MIMO	28319.52	9/137	H+V	H	1_15	24.87
n261	Ant K	50	1CC	64QAM	MIMO	28319.52	9/137	H+V	H	1_15	22.52
n261	Ant K	50	1CC	QPSK	SISO-Dual	27534.84	16/144	H+V	V	32_0	25.14
n261	Ant K	50	1CC	QPSK	SISO-Dual	27922.08	12/140	H+V	V	32_0	24.60
n261	Ant K	50	1CC	QPSK	SISO-Dual	28319.52	9/137	H+V	H	32_0	**25.33**
n261	Ant K	50+50	2CC	QPSK	SISO-Dual	28319.52	9/137	H+V	H	32_0	23.31
n261	Ant K	50+50	2CC	BPSK	SISO-Dual	28319.52	9/137	H+V	H	32_0	23.36
n261	Ant K	50+50	2CC	16QAM	SISO-Dual	28319.52	9/137	H+V	H	32_0	21.90
n261	Ant K	50+50	2CC	64QAM	SISO-Dual	28319.52	9/137	H+V	H	32_0	19.55
n261	Ant K	50+50	2CC	QPSK	MIMO	28292.16	9/137	H+V	H	32_0	21.19
n261	Ant K	50+50	2CC	BPSK	MIMO	28292.16	9/137	H+V	H	32_0	21.38
n261	Ant K	50+50	2CC	16QAM	MIMO	28292.16	9/137	H+V	H	32_0	19.61
n261	Ant K	50+50	2CC	64QAM	MIMO	28292.16	9/137	H+V	H	32_0	17.12

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n261, 100M BW

NR Band	Antenna	BW(MHz)	CCs	OFDM	Tx Type	Freq(MHz)	Beam ID	Beam Pol	Ant Pol	RB	Result(dBm)
n261	Ant K	100	1CC	QPSK	SISO	27559.32	144	H	V	1_32	28.11
n261	Ant K	100	1CC	QPSK	SISO	27923.52	140	H	V	1_32	27.67
n261	Ant K	100	1CC	QPSK	SISO	28292.16	140	H	V	1_32	**28.14**
n261	Ant K	100	1CC	BPSK	SISO	28292.16	140	H	V	1_32	28.29
n261	Ant K	100	1CC	16QAM	SISO	28292.16	140	H	V	1_32	26.13
n261	Ant K	100	1CC	64QAM	SISO	28292.16	140	H	V	1_32	23.56
n261	Ant K	100	1CC	QPSK	SISO	27559.32	144	H	V	64_0	**25.70**
n261	Ant K	100	1CC	QPSK	SISO	27923.52	140	H	V	64_0	25.38
n261	Ant K	100	1CC	QPSK	SISO	28292.16	140	H	V	64_0	25.10
n261	Ant K	100+100	2CC	QPSK	SISO	28292.16	140	H	V	64_0	25.31
n261	Ant K	100+100	2CC	BPSK	SISO	28292.16	140	H	V	64_0	25.31
n261	Ant K	100+100	2CC	16QAM	SISO	28292.16	140	H	V	64_0	23.69
n261	Ant K	100+100	2CC	64QAM	SISO	28292.16	140	H	V	64_0	21.62
n261	Ant K	100	1CC	QPSK	SISO-Dual	27559.32	16/144	H+V	V	1_32	28.12
n261	Ant K	100	1CC	QPSK	SISO-Dual	27923.52	12/140	H+V	V	1_32	26.51
n261	Ant K	100	1CC	QPSK	SISO-Dual	28292.16	9/137	H+V	H	1_32	**28.31**
n261	Ant K	100	1CC	BPSK	SISO-Dual	28292.16	9/137	H+V	H	1_32	27.94
n261	Ant K	100	1CC	16QAM	SISO-Dual	28292.16	9/137	H+V	H	1_32	25.74
n261	Ant K	100	1CC	64QAM	SISO-Dual	28292.16	9/137	H+V	H	1_32	22.87
n261	Ant K	100	1CC	QPSK	MIMO	28292.16	9/137	H+V	H	1_32	24.79
n261	Ant K	100	1CC	BPSK	MIMO	28292.16	9/137	H+V	H	1_32	23.68
n261	Ant K	100	1CC	16QAM	MIMO	28292.16	9/137	H+V	H	1_32	23.38
n261	Ant K	100	1CC	64QAM	MIMO	28292.16	9/137	H+V	H	1_32	21.60
n261	Ant K	100	1CC	QPSK	SISO-Dual	27559.32	16/144	H+V	V	64_0	**25.83**
n261	Ant K	100	1CC	QPSK	SISO-Dual	27923.52	12/140	H+V	V	64_0	24.80
n261	Ant K	100	1CC	QPSK	SISO-Dual	28292.16	9/137	H+V	H	64_0	23.09
n261	Ant K	100+100	2CC	QPSK	SISO-Dual	28292.16	9/137	H+V	H	64_0	23.87
n261	Ant K	100+100	2CC	BPSK	SISO-Dual	28292.16	9/137	H+V	H	64_0	24.00
n261	Ant K	100+100	2CC	16QAM	SISO-Dual	28292.16	9/137	H+V	H	64_0	22.42
n261	Ant K	100+100	2CC	64QAM	SISO-Dual	28292.16	9/137	H+V	H	64_0	20.29
n261	Ant K	100+100	2CC	QPSK	MIMO	28292.16	9/137	H+V	H	66_0	21.46
n261	Ant K	100+100	2CC	BPSK	MIMO	28292.16	9/137	H+V	H	66_0	17.15
n261	Ant K	100+100	2CC	16QAM	MIMO	28292.16	9/137	H+V	H	66_0	19.85
n261	Ant K	100+100	2CC	64QAM	MIMO	28292.16	9/137	H+V	H	66_0	17.30

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n260, 50M BW

NR Band	Antenna	BW(MHz)	CCs	Mod	Tx Type	Freq(MHz)	Beam ID	Beam Pol	Ant Pol	RB	Result(dBm)
n260	Ant K	50	1CC	QPSK	SISO	37027.32	138	H	H	1_15	26.65
n260	Ant K	50	1CC	QPSK	SISO	38497.44	138	H	H	1_15	**28.59**
n260	Ant K	50	1CC	QPSK	SISO	39966.24	12	V	V	1_15	25.56
n260	Ant K	50	1CC	BPSK	SISO	38497.44	138	H	H	1_15	28.09
n260	Ant K	50	1CC	16QAM	SISO	38497.44	138	H	H	1_15	25.54
n260	Ant K	50	1CC	64QAM	SISO	38497.44	138	H	H	1_15	22.70
n260	Ant K	50	1CC	QPSK	SISO	37027.32	138	H	H	32_0	21.99
n260	Ant K	50	1CC	QPSK	SISO	38497.44	138	H	H	32_0	**24.32**
n260	Ant K	50	1CC	QPSK	SISO	39966.24	12	V	V	32_0	22.01
n260	Ant K	50+50	2CC	QPSK	SISO	38497.44	138	H	H	32_0	23.87
n260	Ant K	50+50	2CC	BPSK	SISO	38497.44	138	H	H	32_0	23.99
n260	Ant K	50+50	2CC	16QAM	SISO	38497.44	138	H	H	32_0	22.44
n260	Ant K	50+50	2CC	64QAM	SISO	38497.44	138	H	H	32_0	20.29
n260	Ant K	50	1CC	QPSK	SISO-Dual	37027.32	10/138	H+V	H	1_15	26.66
n260	Ant K	50	1CC	QPSK	SISO-Dual	38497.44	9/137	H+V	V	1_15	**28.64**
n260	Ant K	50	1CC	QPSK	SISO-Dual	39966.24	9/137	H+V	H	1_30	27.18
n260	Ant K	50	1CC	BPSK	SISO-Dual	38497.44	9/137	H+V	V	1_15	27.64
n260	Ant K	50	1CC	16QAM	SISO-Dual	38497.44	9/137	H+V	V	1_15	25.85
n260	Ant K	50	1CC	64QAM	SISO-Dual	38497.44	9/137	H+V	V	1_15	23.52
n260	Ant K	50	1CC	QPSK	MIMO	38497.44	9/137	H+V	V	1_15	25.34
n260	Ant K	50	1CC	BPSK	MIMO	38497.44	9/137	H+V	V	1_15	26.89
n260	Ant K	50	1CC	16QAM	MIMO	38497.44	9/137	H+V	V	1_15	23.49
n260	Ant K	50	1CC	64QAM	MIMO	38497.44	9/137	H+V	V	1_15	20.86
n260	Ant K	50	1CC	QPSK	SISO-Dual	37027.32	10/138	H+V	H	32_0	23.61
n260	Ant K	50	1CC	QPSK	SISO-Dual	38497.44	9/137	H+V	V	32_0	**24.29**
n260	Ant K	50	1CC	QPSK	SISO-Dual	39966.24	9/137	H+V	H	32_0	22.27
n260	Ant K	50+50	2CC	QPSK	SISO-Dual	38497.44	9/137	H+V	V	32_0	22.83
n260	Ant K	50+50	2CC	BPSK	SISO-Dual	38497.44	9/137	H+V	V	32_0	22.95
n260	Ant K	50+50	2CC	16QAM	SISO-Dual	38497.44	9/137	H+V	V	32_0	21.39
n260	Ant K	50+50	2CC	64QAM	SISO-Dual	38497.44	9/137	H+V	V	32_0	19.31
n260	Ant K	50+50	2CC	QPSK	MIMO	38497.44	9/137	H+V	V	32_0	21.03
n260	Ant K	50+50	2CC	BPSK	MIMO	38497.44	9/137	H+V	V	32_0	16.94
n260	Ant K	50+50	2CC	16QAM	MIMO	38497.44	9/137	H+V	V	32_0	19.68
n260	Ant K	50+50	2CC	64QAM	MIMO	38497.44	9/137	H+V	V	32_0	16.77

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n260, 100M BW

NR Band	Antenna	BW(MHz)	CCs	OFDM	Tx Type	Freq(MHz)	Beam ID	Beam Pol	Ant Pol	RB	Result(dBm)
n260	Ant K	100	1CC	QPSK	SISO	37051.8	138	H	H	1_32	25.85
n260	Ant K	100	1CC	QPSK	SISO	38498.88	138	H	H	1_32	**27.83**
n260	Ant K	100	1CC	QPSK	SISO	39949.92	12	V	V	1_32	25.93
n260	Ant K	100	1CC	BPSK	SISO	38498.88	138	H	H	1_32	27.85
n260	Ant K	100	1CC	16QAM	SISO	38498.88	138	H	H	1_32	25.18
n260	Ant K	100	1CC	64QAM	SISO	38498.88	138	H	H	1_32	23.10
n260	Ant K	100	1CC	QPSK	SISO	37051.8	138	H	H	64_0	23.26
n260	Ant K	100	1CC	QPSK	SISO	38498.88	138	H	H	64_0	**24.72**
n260	Ant K	100	1CC	QPSK	SISO	39949.92	12	V	V	64_0	23.57
n260	Ant K	100+100	2CC	QPSK	SISO	38498.88	138	H	H	64_0	25.50
n260	Ant K	100+100	2CC	BPSK	SISO	38498.88	138	H	H	64_0	25.48
n260	Ant K	100+100	2CC	16QAM	SISO	38498.88	138	H	H	64_0	23.88
n260	Ant K	100+100	2CC	64QAM	SISO	38498.88	138	H	H	64_0	21.91
n260	Ant K	100	1CC	QPSK	SISO-Dual	37051.8	10/138	H+V	H	1_32	**27.99**
n260	Ant K	100	1CC	QPSK	SISO-Dual	38498.88	9/137	H+V	V	1_32	27.77
n260	Ant K	100	1CC	QPSK	SISO-Dual	39949.92	9/137	H+V	H	1_1	27.23
n260	Ant K	100	1CC	BPSK	SISO-Dual	37051.8	10/138	H+V	H	1_32	27.50
n260	Ant K	100	1CC	16QAM	SISO-Dual	37051.8	10/138	H+V	H	1_32	24.94
n260	Ant K	100	1CC	64QAM	SISO-Dual	37051.8	10/138	H+V	H	1_32	23.28
n260	Ant K	100	1CC	QPSK	MIMO	37051.8	10/138	H+V	H	1_32	25.14
n260	Ant K	100	1CC	BPSK	MIMO	37051.8	10/138	H+V	H	1_32	27.17
n260	Ant K	100	1CC	16QAM	MIMO	37051.8	10/138	H+V	H	1_32	23.23
n260	Ant K	100	1CC	64QAM	MIMO	37051.8	10/138	H+V	H	1_32	21.36
n260	Ant K	100	1CC	QPSK	SISO-Dual	37051.8	10/138	H+V	H	64_0	**24.84**
n260	Ant K	100	1CC	QPSK	SISO-Dual	38498.88	9/137	H+V	V	64_0	24.10
n260	Ant K	100	1CC	QPSK	SISO-Dual	39949.92	9/137	H+V	H	64_0	24.83
n260	Ant K	100+100	2CC	QPSK	SISO-Dual	37051.8	10/138	H+V	H	64_0	24.58
n260	Ant K	100+100	2CC	BPSK	SISO-Dual	37051.8	10/138	H+V	H	64_0	24.67
n260	Ant K	100+100	2CC	16QAM	SISO-Dual	37051.8	10/138	H+V	H	64_0	23.03
n260	Ant K	100+100	2CC	64QAM	SISO-Dual	37051.8	10/138	H+V	H	64_0	20.86
n260	Ant K	100+100	2CC	QPSK	MIMO	37051.8	10/138	H+V	H	66_0	21.21
n260	Ant K	100+100	2CC	BPSK	MIMO	37051.8	10/138	H+V	H	66_0	21.14
n260	Ant K	100+100	2CC	16QAM	MIMO	37051.8	10/138	H+V	H	66_0	19.63
n260	Ant K	100+100	2CC	64QAM	MIMO	37051.8	10/138	H+V	H	66_0	17.05

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

8.3. 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 v01r02 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 were measured as EIRP for direct comparison to the 30.203 TRP limit to demonstrate compliance.

pi/2-BPSK, QPSK, 16QAM and 64QAM modulations were all investigated in SISO, SISO-Dual and MIMO configurations. The highest band edge emissions were for the SISO-Dual antenna configuration consistent with this also being the configuration with the highest EIRP. The SISO-Dual configuration was, therefore, use for the final band-edge measurements. Additional measurements were made on the MIMO configuration as it has a wider bandwidth than the SISO-DUAL configuration. The worst results were reported for each modulation.

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.

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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)
Module 0	Low	H	8.60
		V	8.69
	High	H	8.23
		V	8.48

EUT Antenna gain (n260)			
Antenna	Channel	Beam Pol	Gain (dBi)
Module 0	Low	H	9.26
		V	8.85
	High	H	9.12
		V	9.78

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

Band edge emission was initially tested without correction for antenna gain.

[Note] If the result exceeds the limit or the margin is less than 1 dB, then calculate TRP versus EIRP for the signal analyzer's offset by subtracting the manufacturer-supplied antenna gain from the signal analyzer's offset.

<u>RESULTS</u>
See the following pages.

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

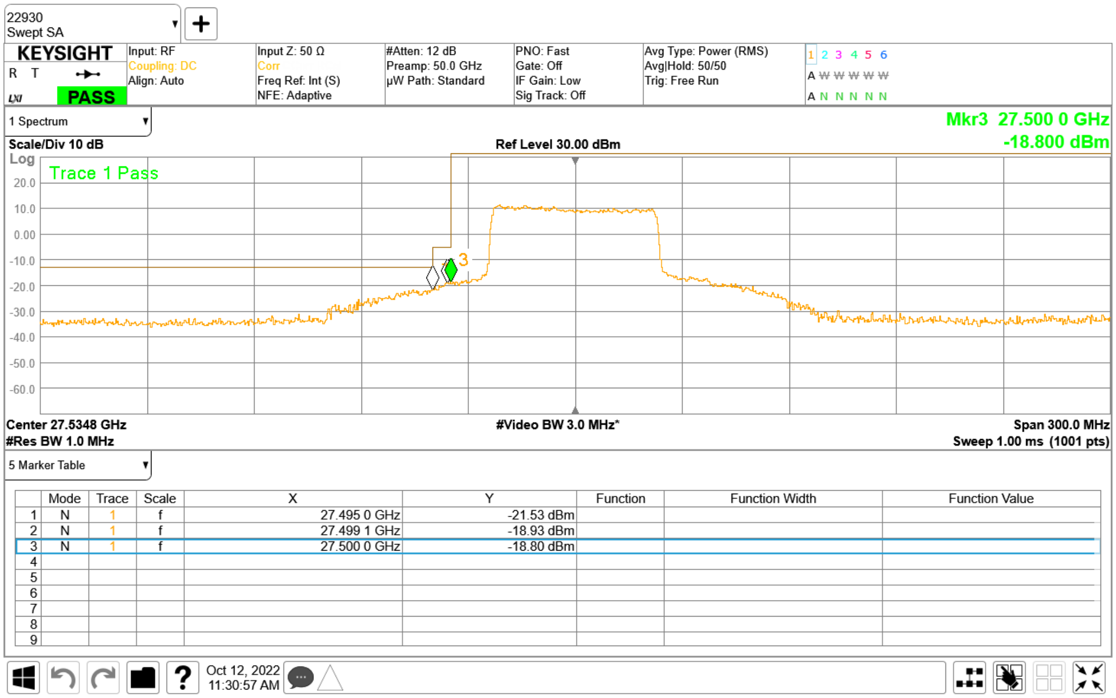
8.3.1. BAND EDGE WORST CASE RESULT

Module 0, Band n261

M 0

n261

BW 50MHz

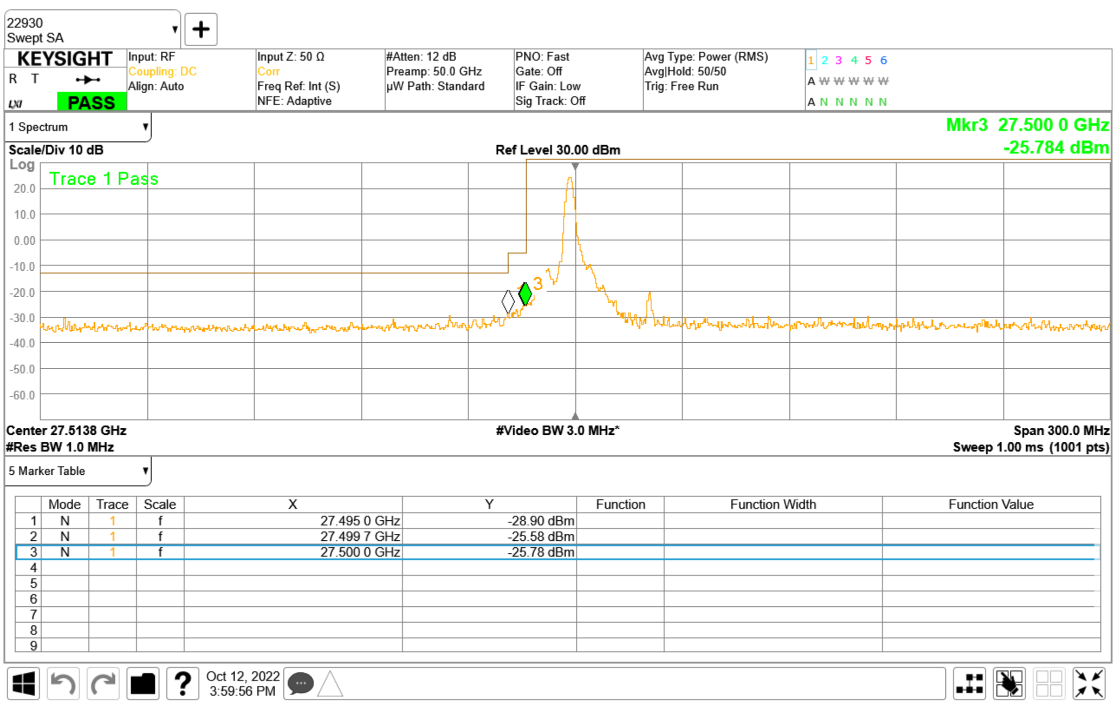


1CC / SISO-Dual / QPSK / Low channel / Full RB

M 0

n261

BW 50MHz



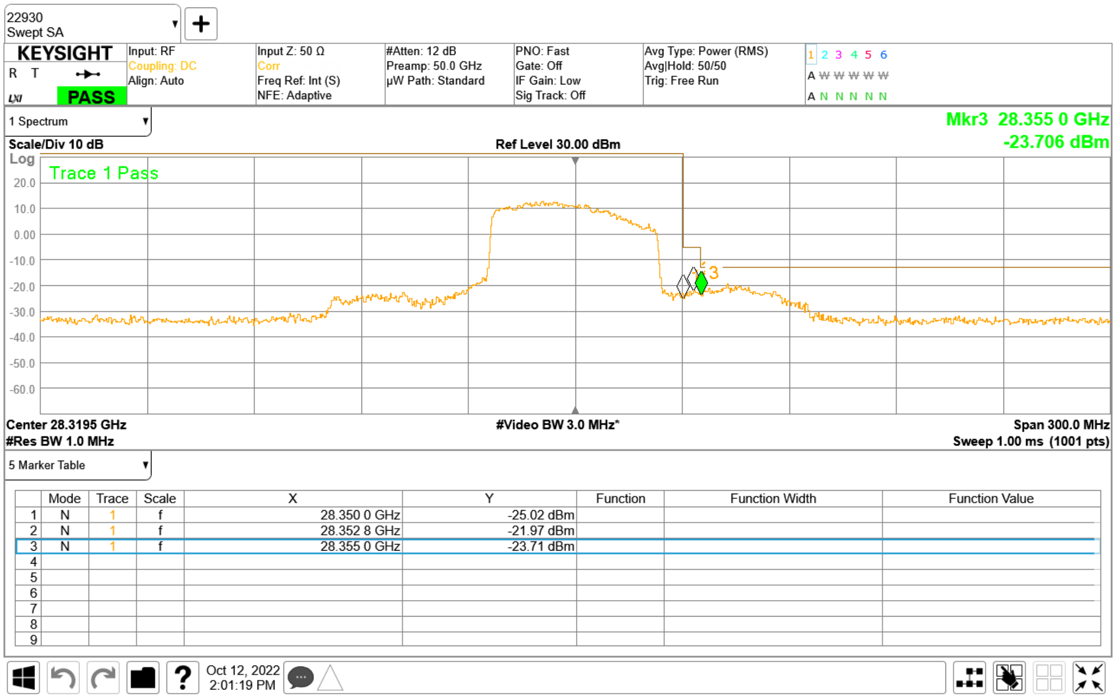
1CC / SISO-Dual / 16QAM / Low channel / 1 RB

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

BW 50MHz

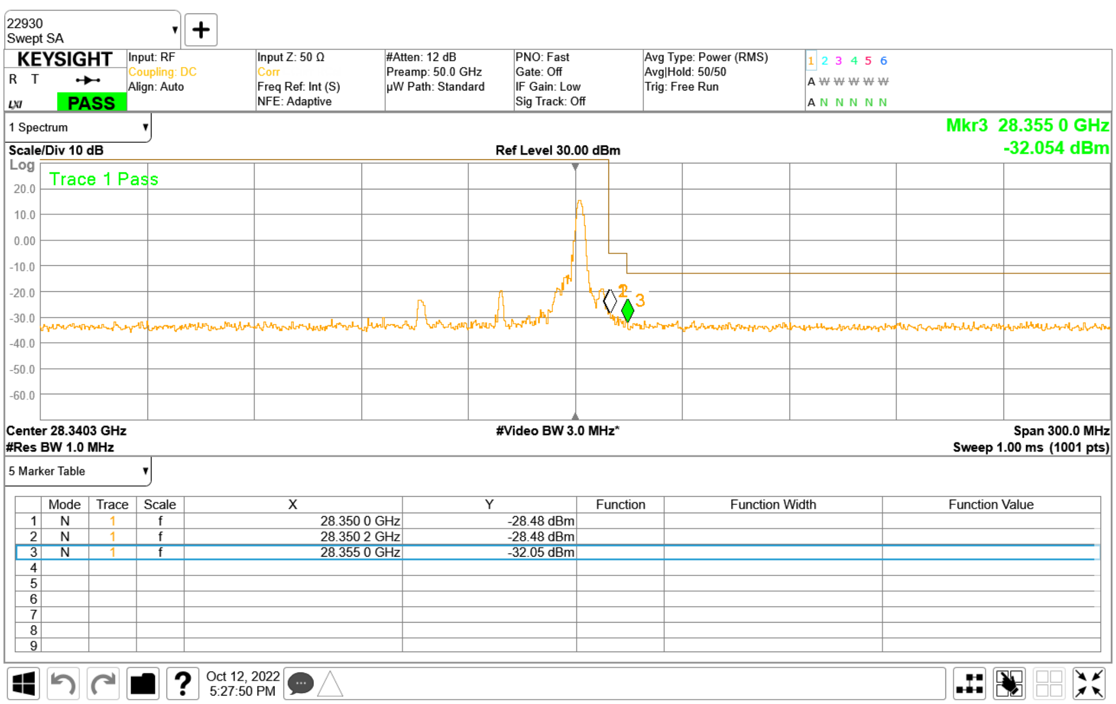


1CC / SISO-Dual / QPSK / High channel / Full RB

M 0

n261

BW 50MHz



1CC / SISO-Dual / 16QAM / High channel / 1 RB

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

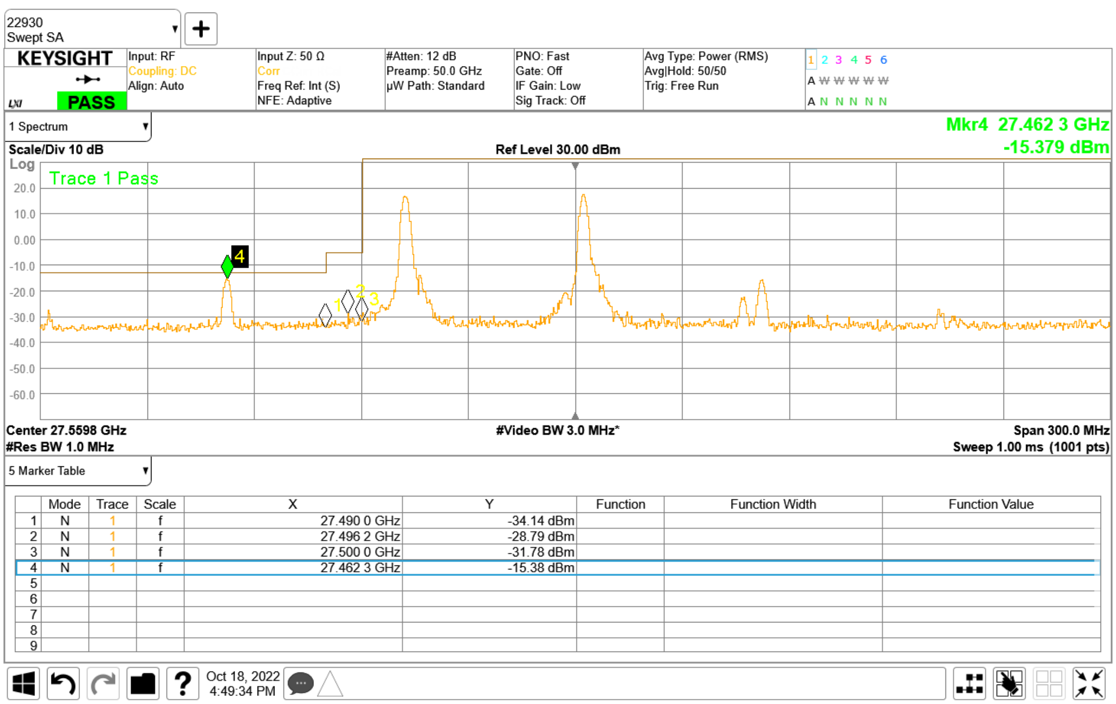
BW 50MHz

2CC / SISO-Dual / QPSK / Low channel / Full RB

M 0

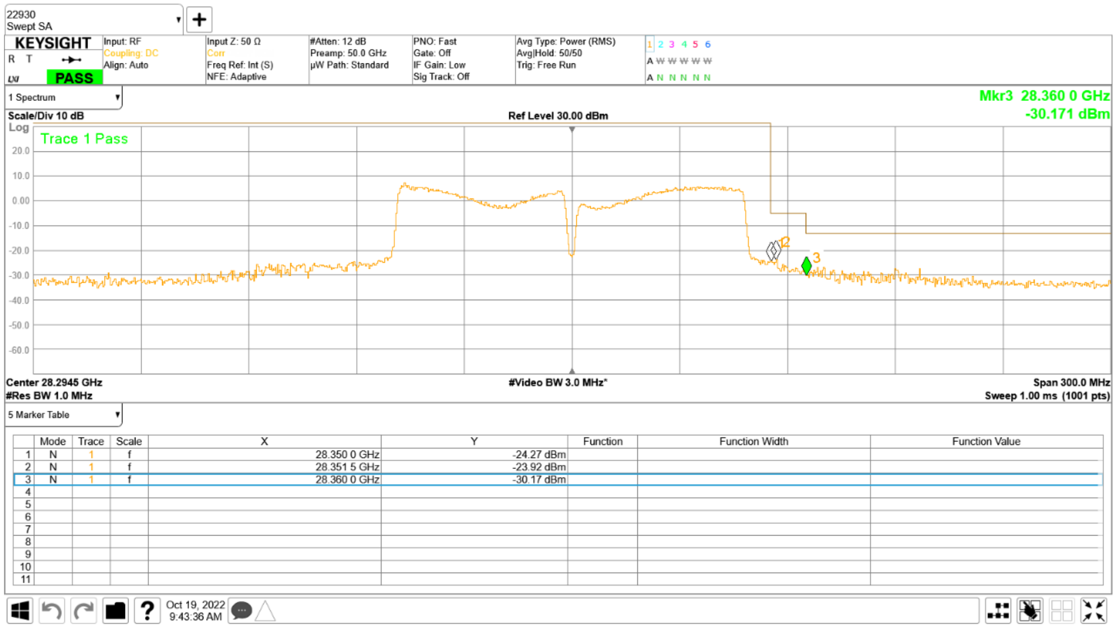
n261

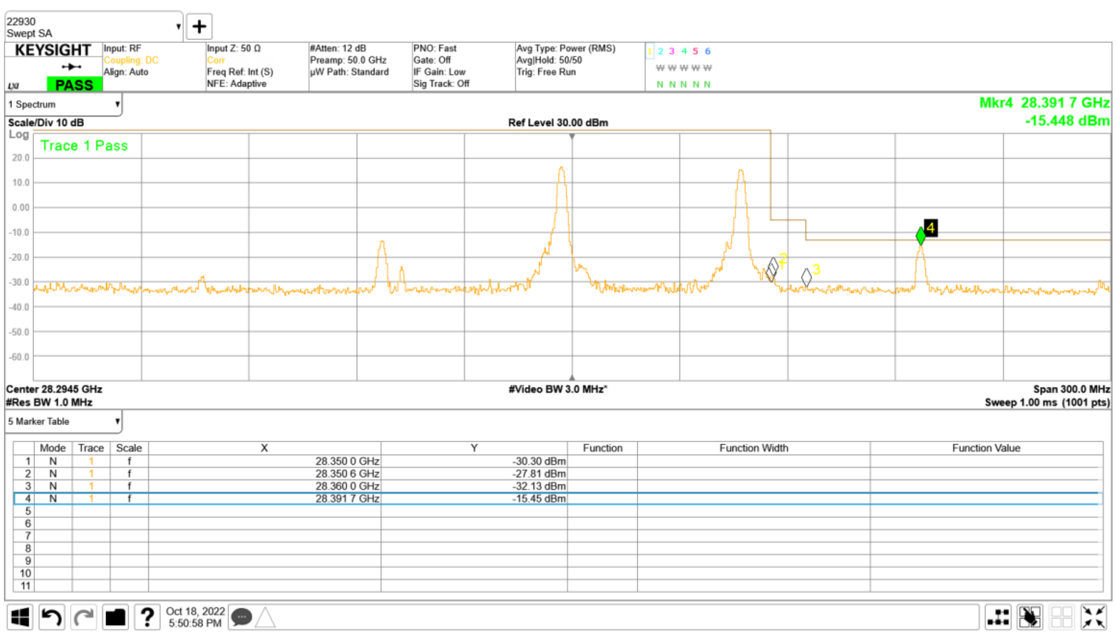
BW 50MHz



2CC / SISO-Dual / 16QAM / Low channel / 1 RB

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

<table>
<tr><td>M 0
n261
BW
50MHz</td><td>

2CC / MIMO / QPSK / High channel / Full RB</td></tr>
<tr><td>M 0
n261
BW
50MHz</td><td>

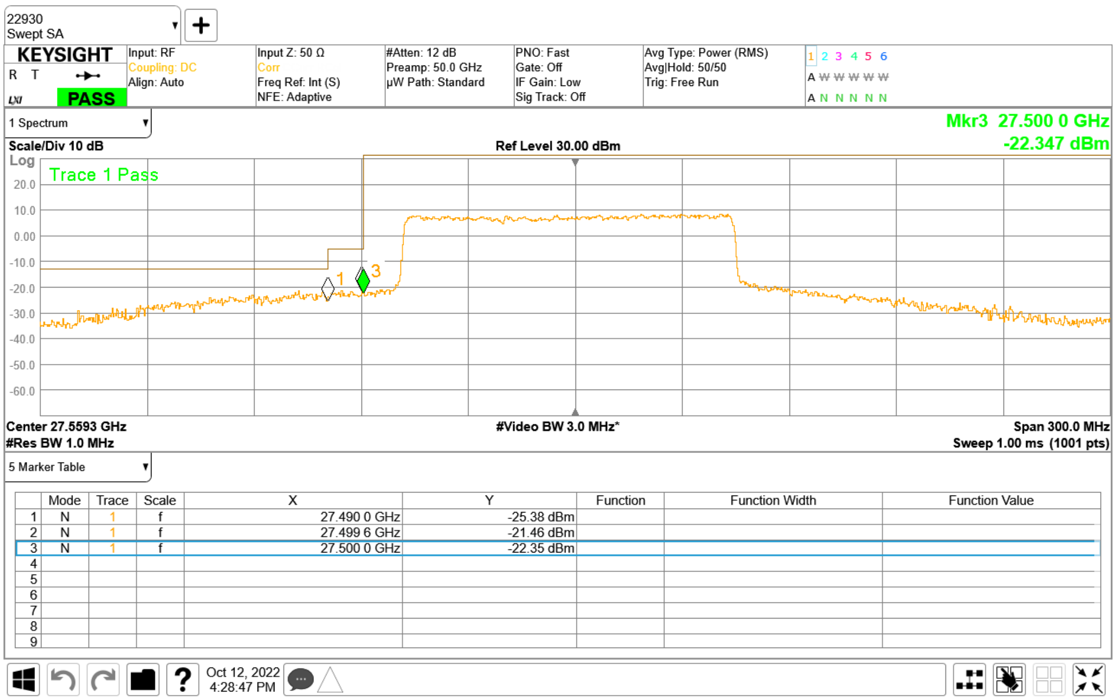
2CC SISO-Dual / 16QAM / High channel / 1 RB</td></tr>
</table>

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

BW 100MHz

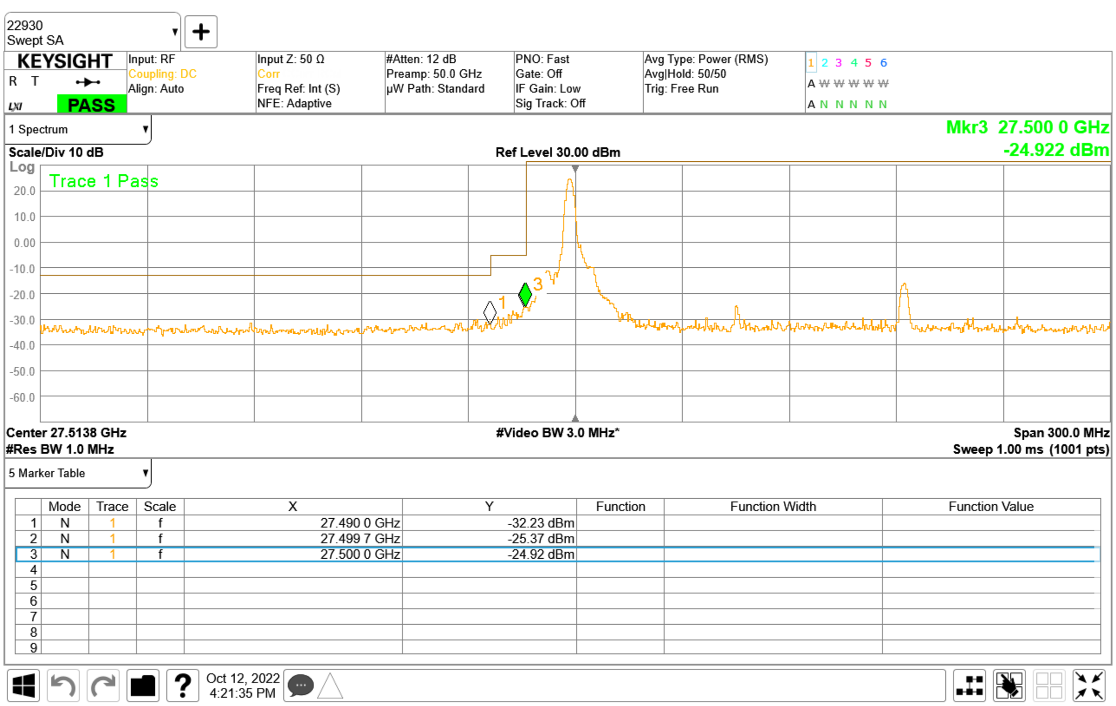


1CC / SISO-Dual / QPSK / Low channel / Full RB

M 0

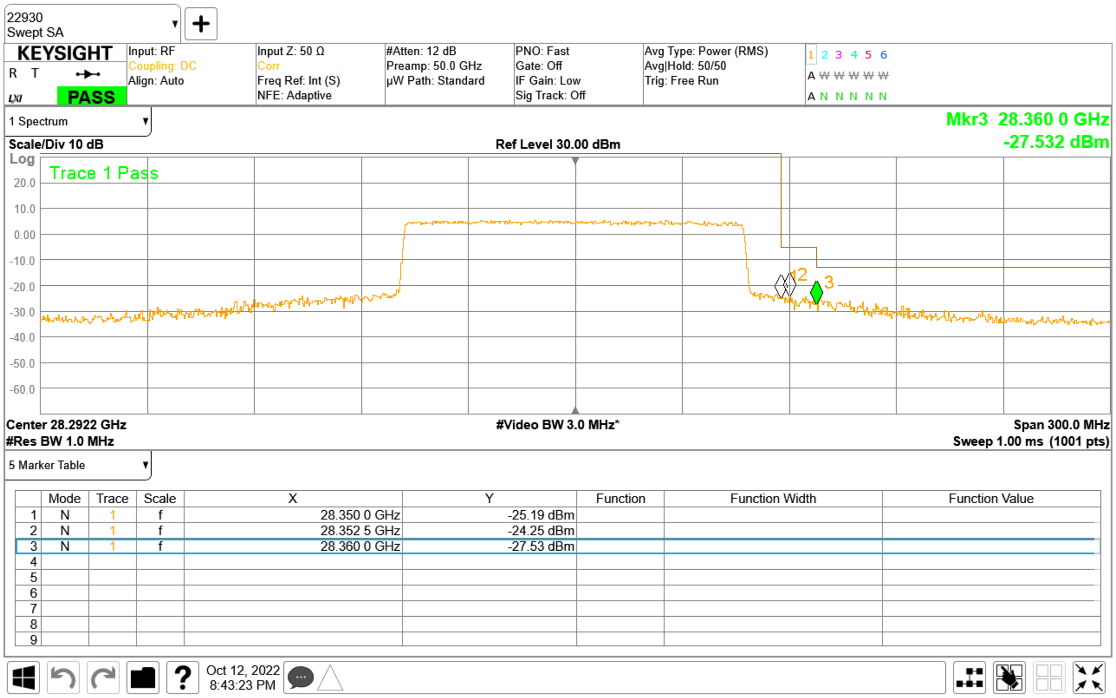
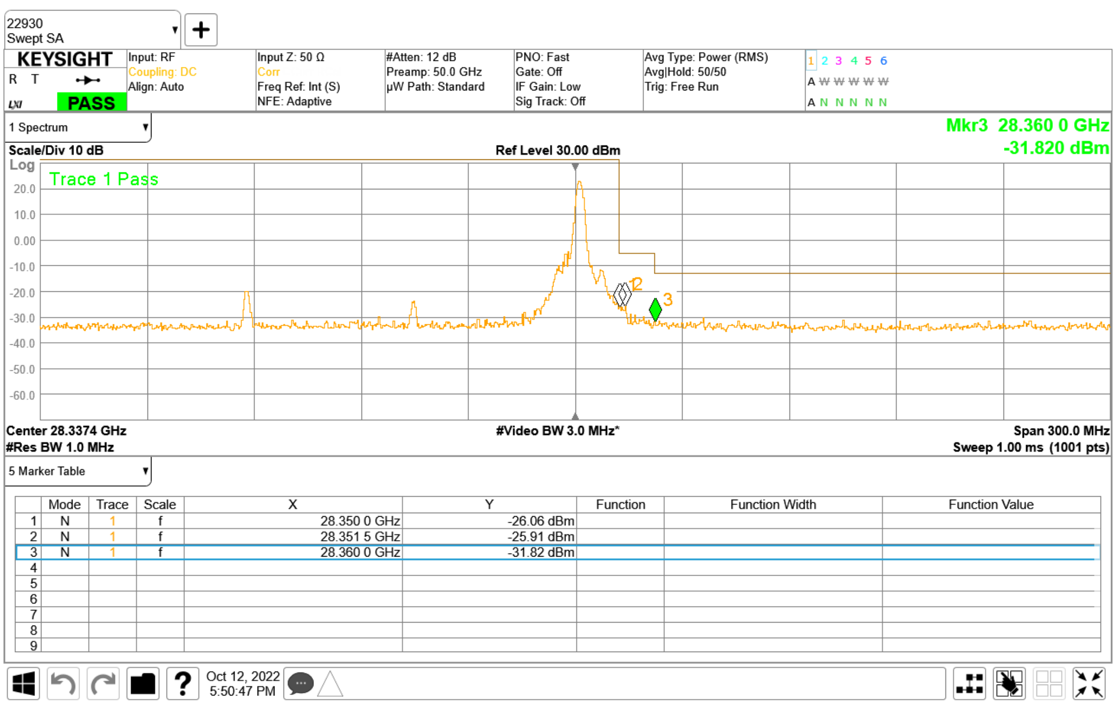
n261

BW 100MHz



1CC / SISO-Dual / QPSK / Low 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

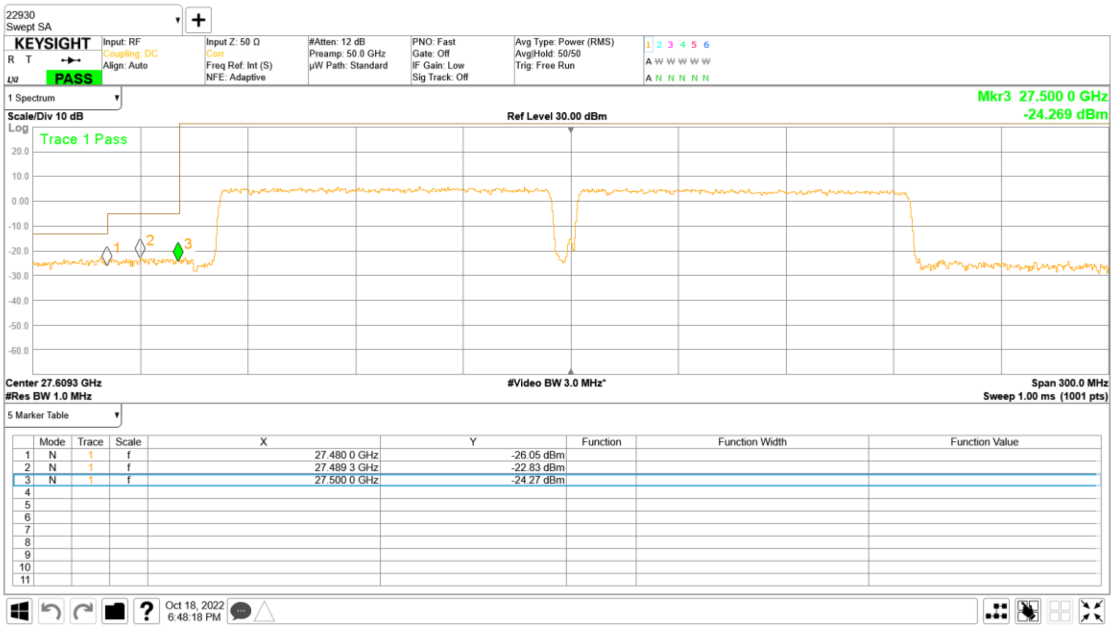
M 0 n261 BW 100MHz	 1CC / SISO-Dual / QPSK / High channel / Full RB
M 0 n261 BW 100MHz	 1CC / MIMO / 16QAM / High channel / 1 RB

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n261

BW 100MHz

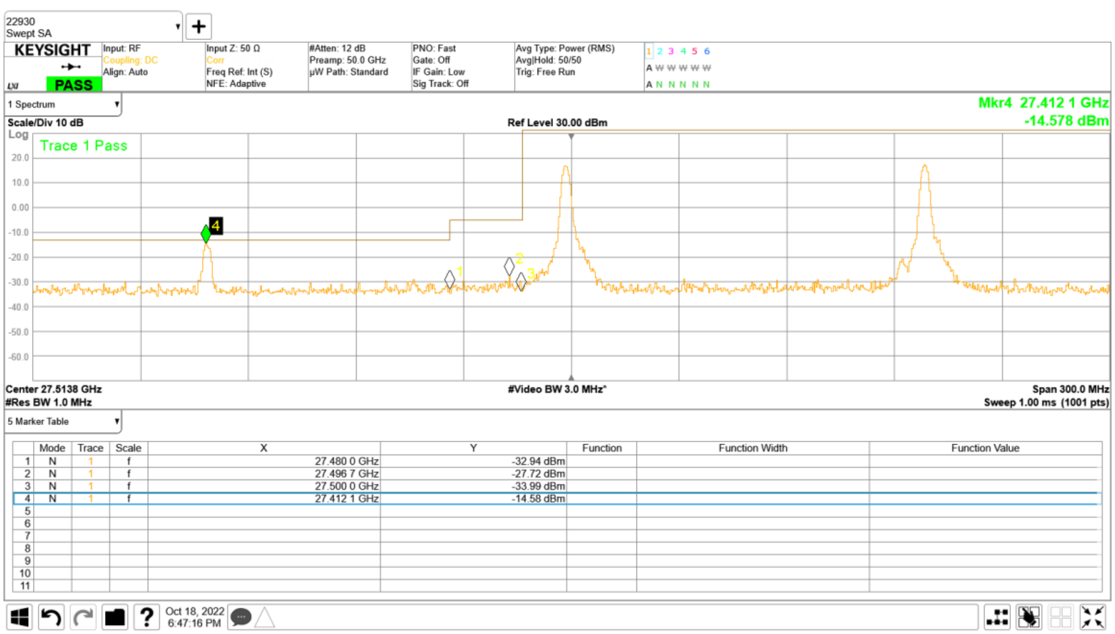


2CC/ SISO-Dual / QPSK / Low channel / Full RB

M 0

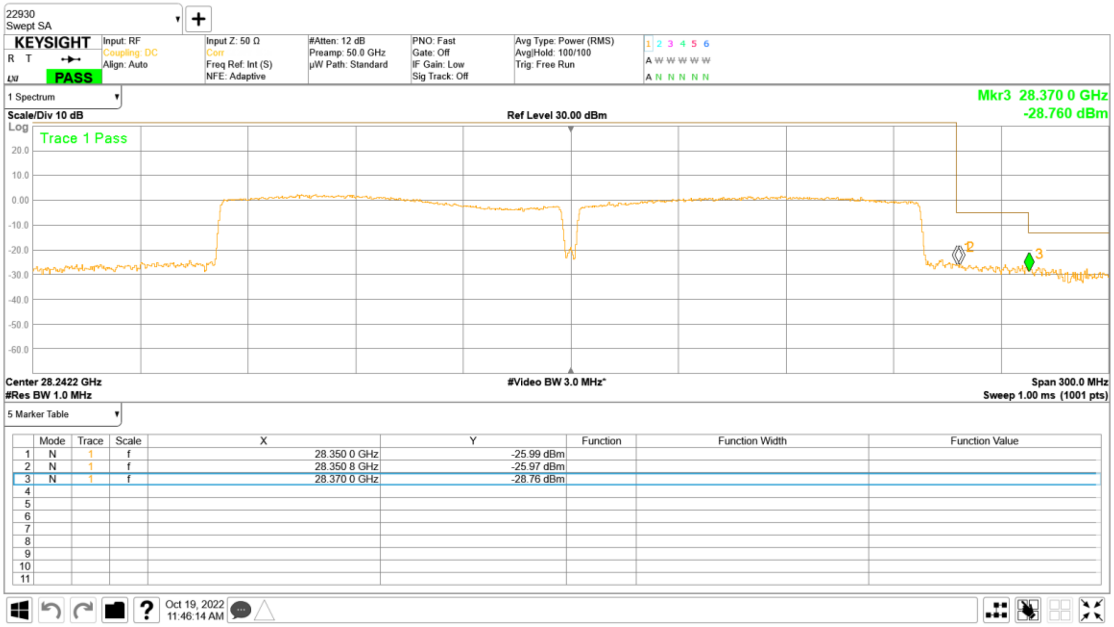
n261

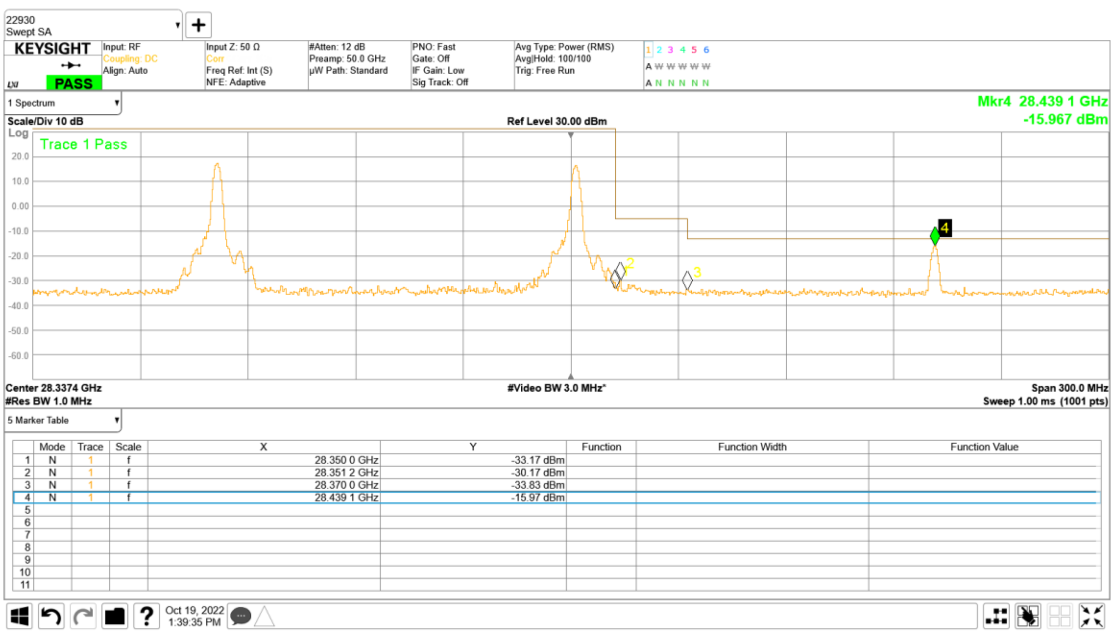
BW 100MHz



2CC / SISO-Dual / 16QAM / Low 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

<table>
<tr>
<td>M 0
n261
BW
100MHz</td>
<td>

2CC / MIMO / QPSK / High channel / Full RB</td>
</tr>
<tr>
<td>M 0
n261
BW
100MHz</td>
<td>

2CC / SISO-Dual / QPSK / High channel / 1 RB</td>
</tr>
</table>

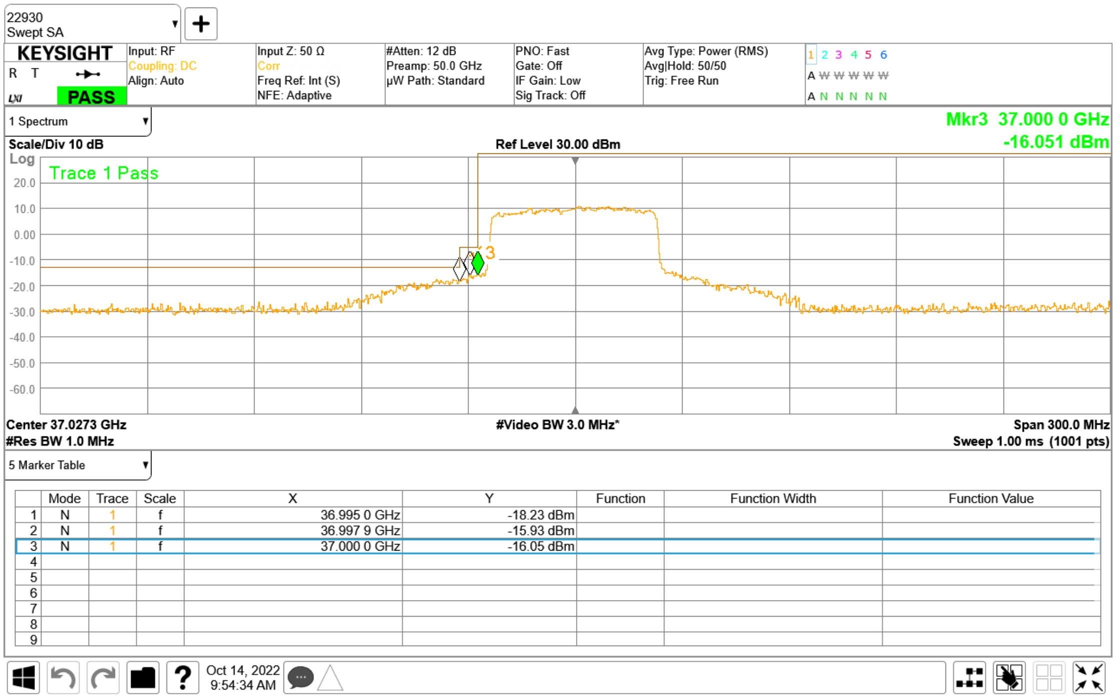
UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_30(04)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Module 0, Band n260

M 0

n260

BW 50MHz

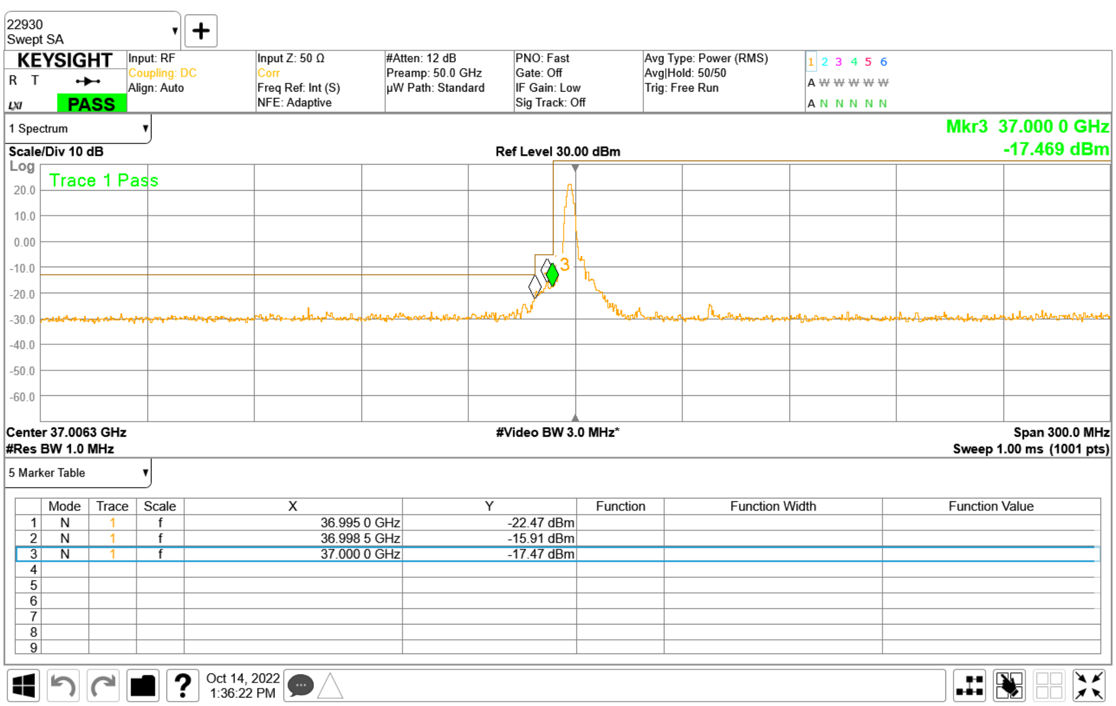


1CC / SISO-Dual / QPSK / Low channel / Full RB

M 0

n260

BW 50MHz



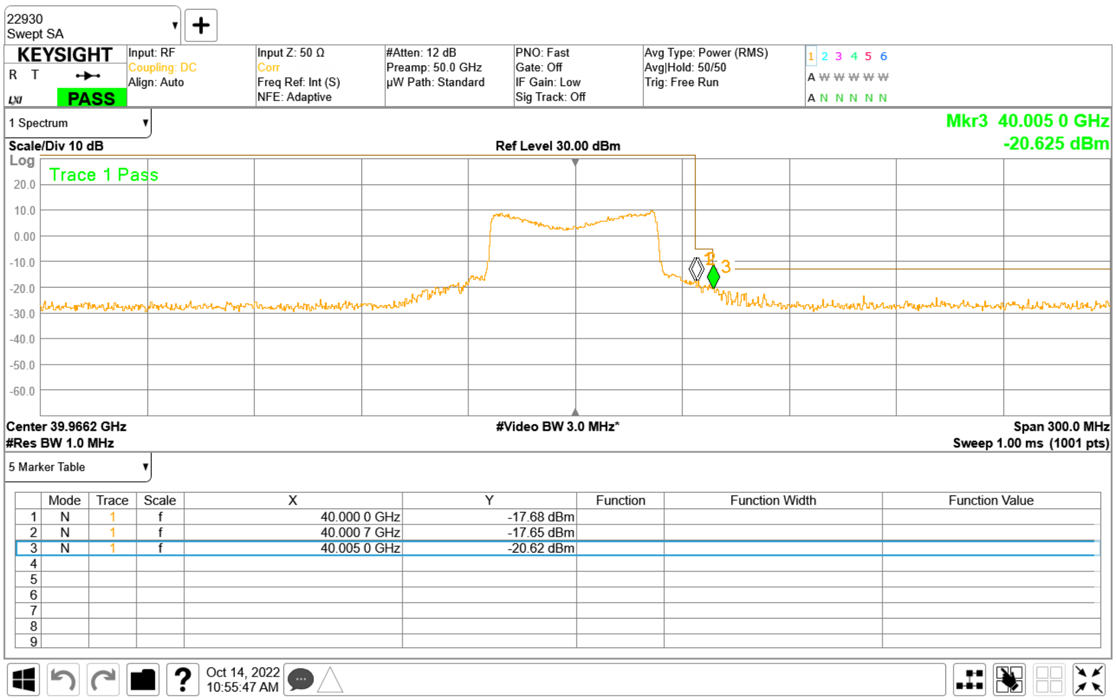
1CC / SISO-Dual / QPSK / Low channel / 1 RB

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n260

BW 50MHz

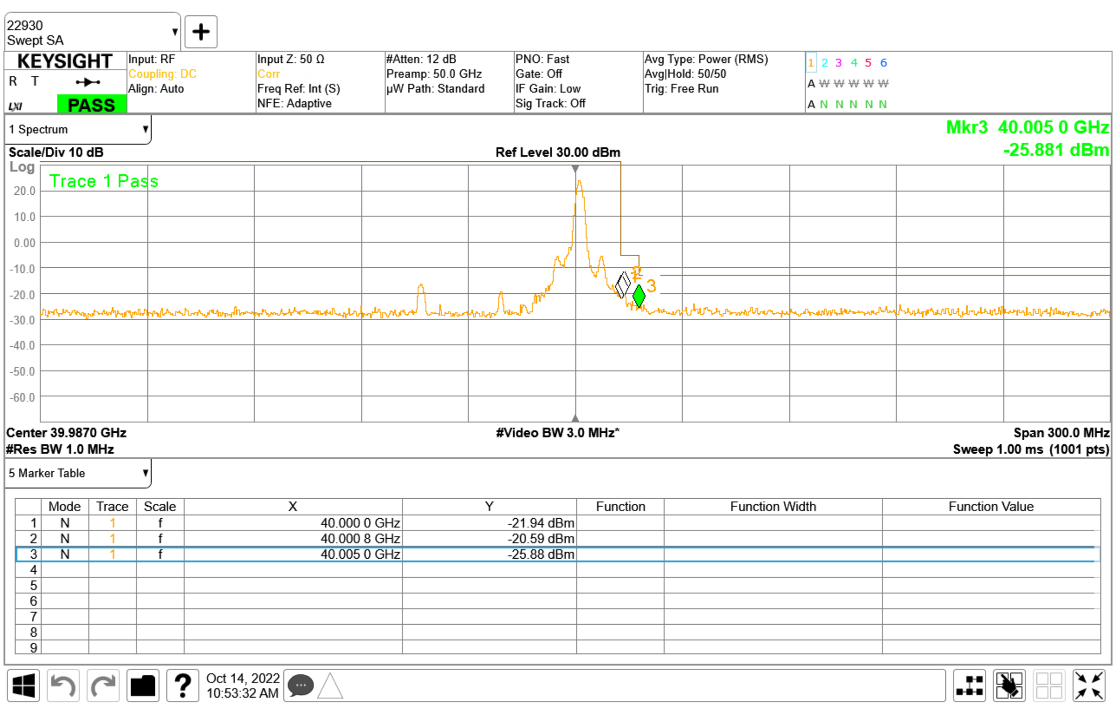


1CC / MIMO / QPSK / High channel / Full RB

M 0

n260

BW 50MHz



1CC / SISO-Dual / 16QAM / 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n260

BW 50MHz

2CC / SISO-Dual / 16QAM / Low channel / Full RB

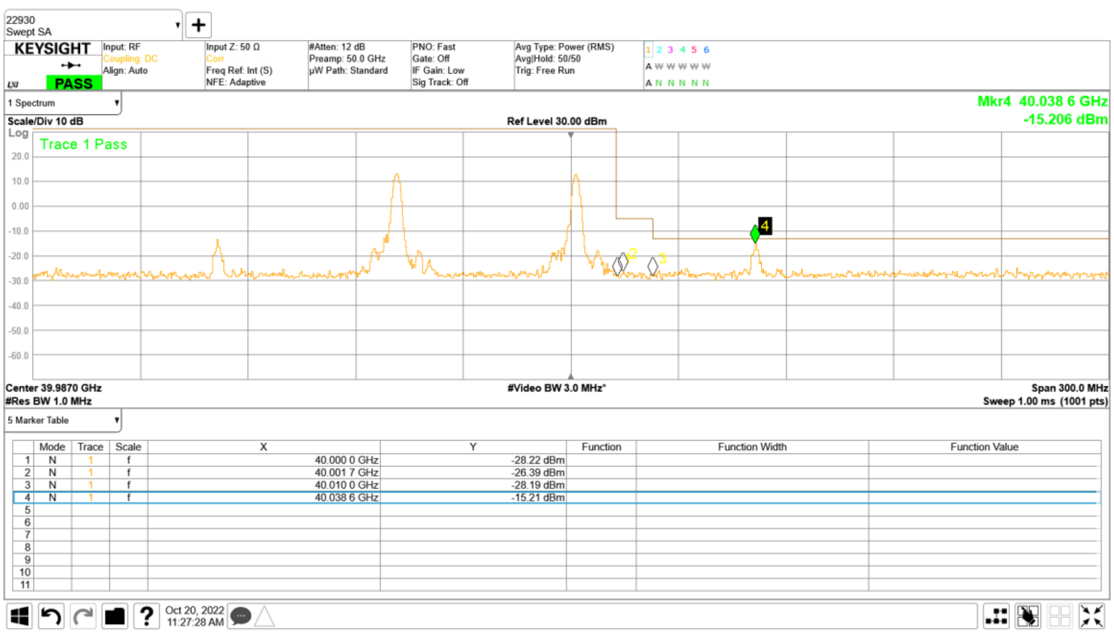
M 0

n260

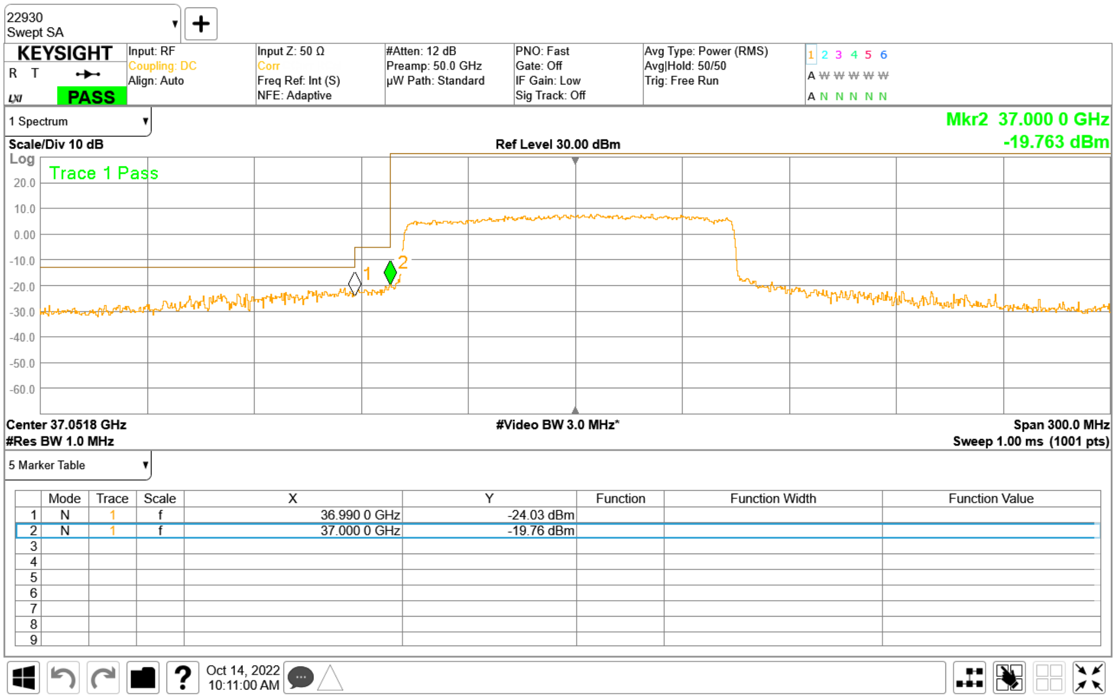
BW 50MHz

2CC / SISO-Dual / 16QAM / Low channel / 1 RB

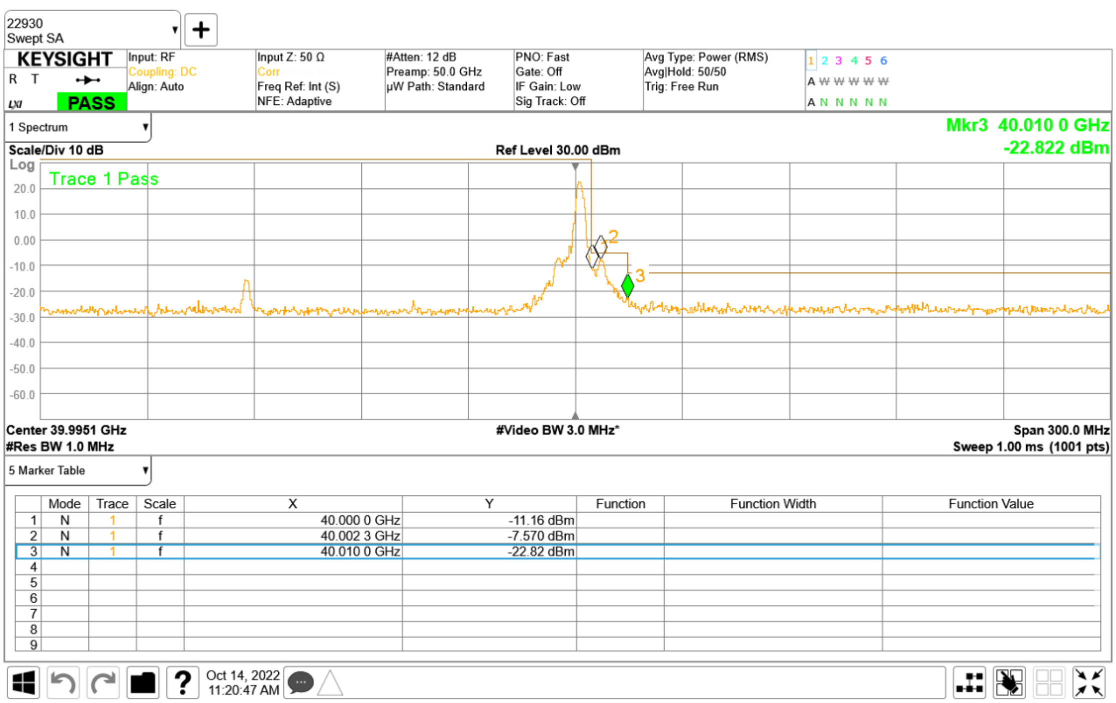
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n260 BW 50MHz	 2CC / MIMO / QPSK / High channel / Full RB
M 0 n260 BW 50MHz	 2CC / SISO-Dual / 16QAM / 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n260 BW 100MHz	 1CC / SISO-Dual / QPSK / Low channel / Full RB
M 0 n260 BW 100MHz	 1CC / SISO-Dual / QPSK / Low 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

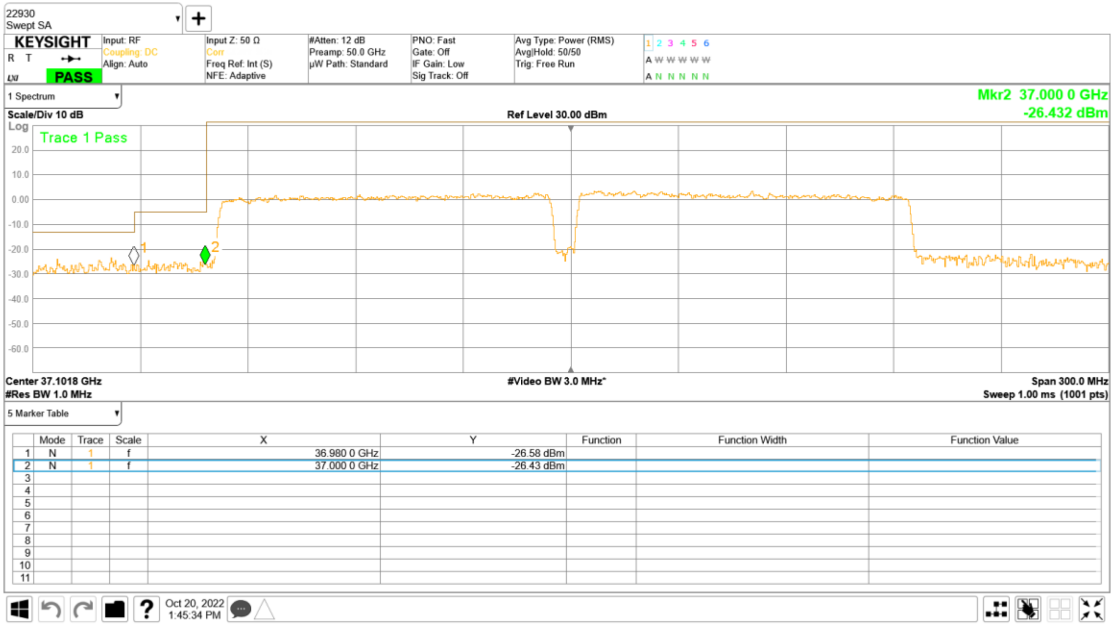
M 0 n260 BW 100MHz	 1CC / MIMO / 16QAM / High channel / Full RB
M 0 n260 BW 100MHz	 1CC / SISO-Dual / 16QAM / High channel / 1 RB

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0

n260

BW
100MHz

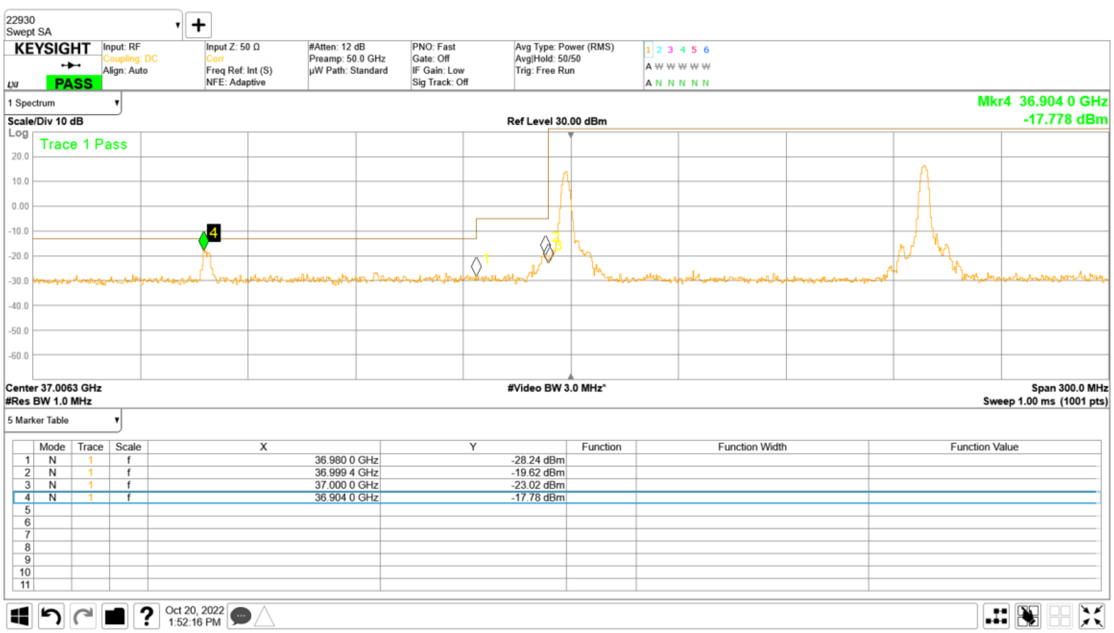


2CC / SISO-Dual / QPSK / Low channel / Full RB

M 0

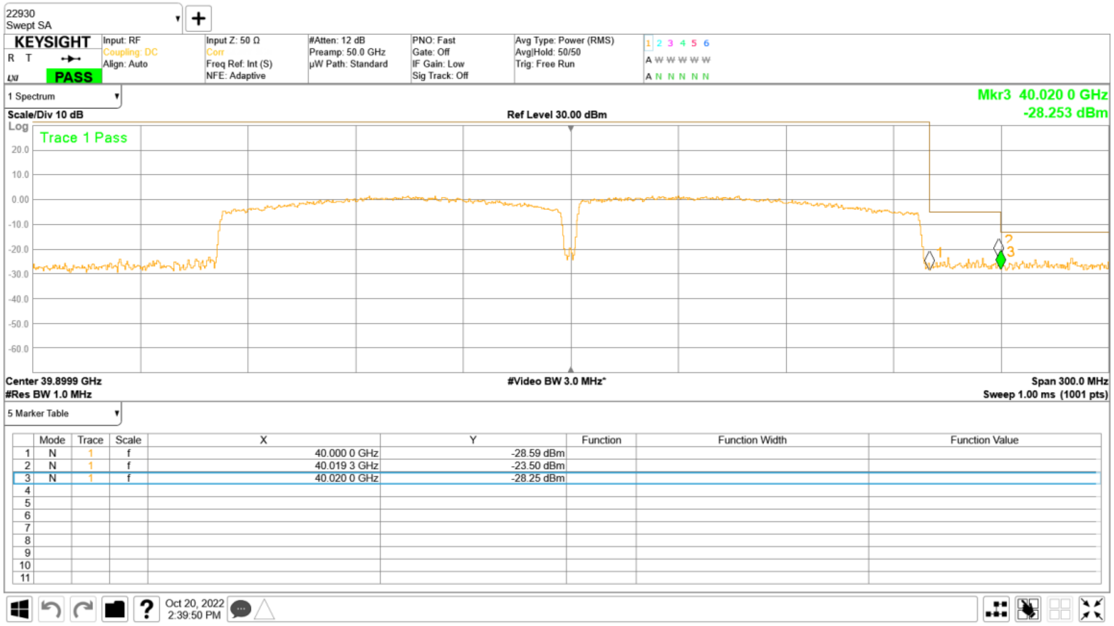
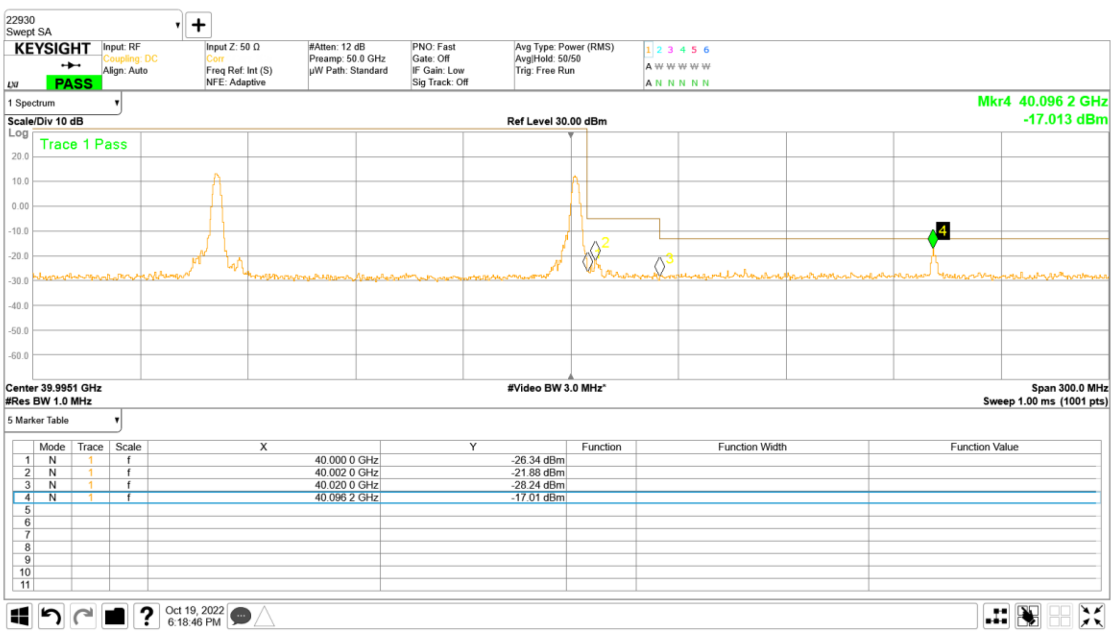
n260

BW
100MHz



2CC / SISO-Dual / 16QAM / Low 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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

M 0 n260 BW 100MHz	 2CC / MIMO / 16QAM / High channel / Full RB
M 0 n260 BW 100MHz	 2CC / SISO / 16QAM / High channel / 1 RB

UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

8.4. 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 v01r02 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.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

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.

pi/2-BPSK, QPSK, 16QAM and 64QAM modulations were all investigated in SISO, SISO-Dual and MIMO configurations. The highest spurious emissions were for the SISO-Dual antenna configuration consistent with this also being the configuration with the highest EIRP. The SISO-Dual configuration was, therefore, use for the final emission 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 – 27.5 GHz, 28.35 - 40 GHz and 50 – 75 GHz.

Band n260 RSE reported only mid channel because no emissions were detected above noise floor.

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, B5, B12, B13, B14 and B66.

There was no discernible difference in the spurious emission levels when using different LTE anchor bands. Thus, LTE Band 2 was used as a representative anchor band for EN-DC investigations.

RESULTS

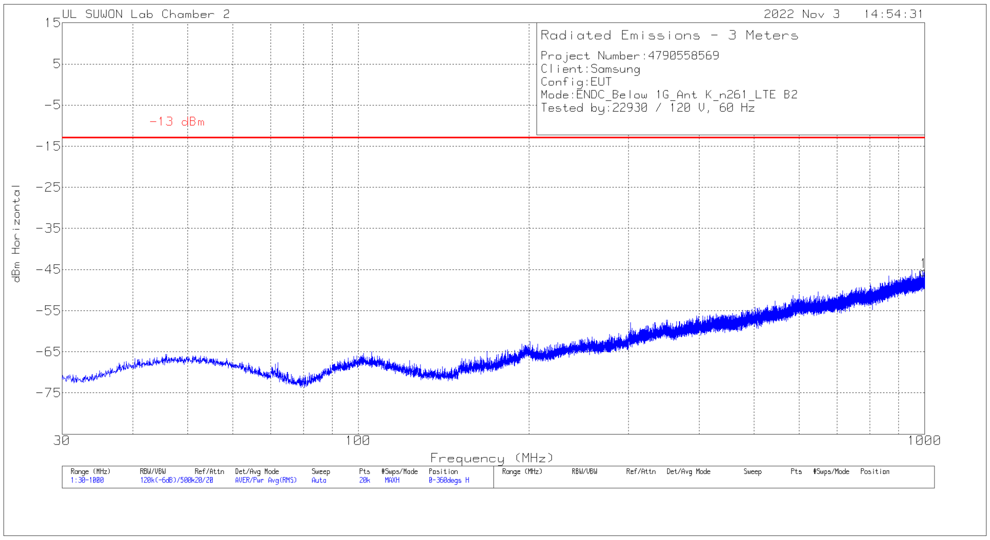
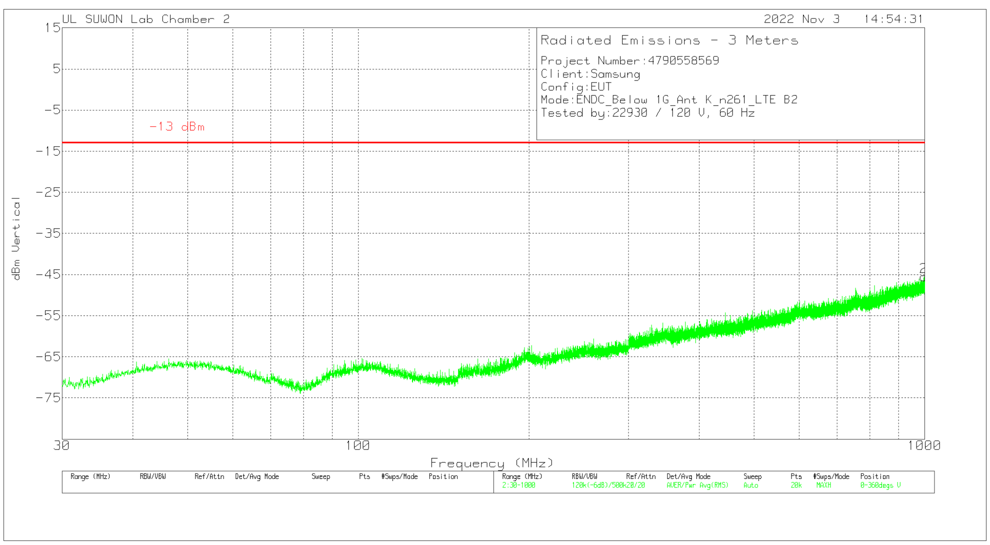
See the following pages.

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
UL Korea, Ltd. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

8.4.1. RADIATED SPURIOUS AND HARMONIC EMISSIONS RESULT

Module 0 / n261

30 – 1000 MHz Result

M 0 n261	 Mid Channel / Horizontal
M 0 n261	 Mid Channel / Vertical

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBm)	Det	VULB9163_749	Below 1G(dB)	Conversion Factor[dB]	Corrected Reading dBm	-13 dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	997.8261	-60.68	RMS	27.9	-24.6	11.8	-45.58	-13	-32.58	0-360	100	H
2	997.2926	-60.51	RMS	27.8	-24.6	11.8	-45.51	-13	-32.51	0-360	100	V

RMS - RMS detection

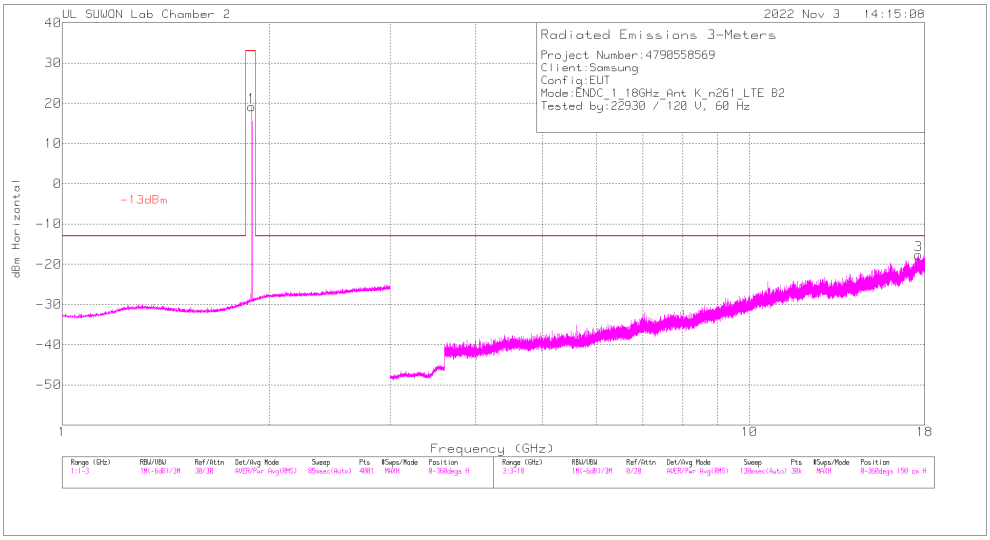
No emissions were detected above noise floor this antenna and band. Thus reported mid channel data.

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

1 – 18 GHz Result

M 0

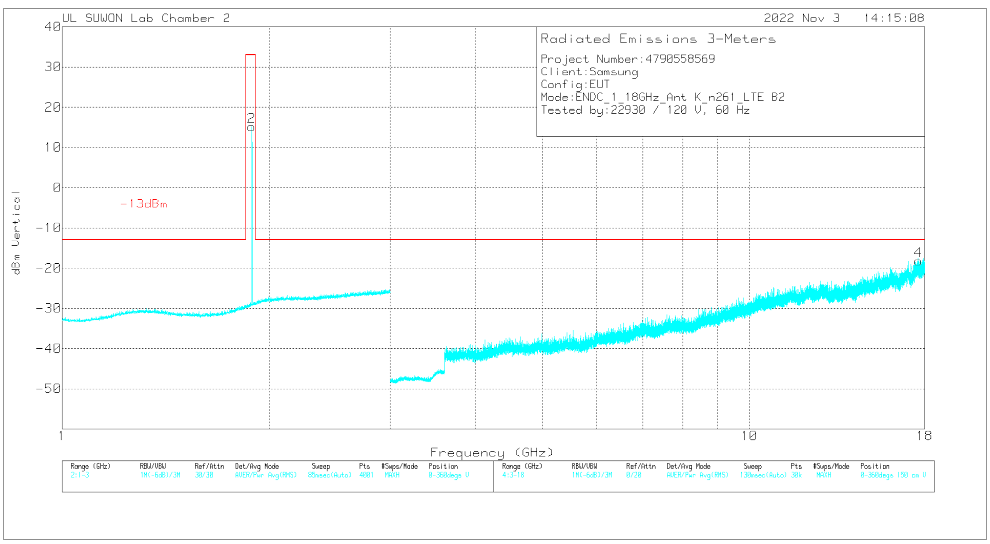
n261



Mid Channel / Horizontal

M 0

n261



Mid Channel / Vertical

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	3117_00168724	10dB_ATT[dB]	Conversion Factor[dB]	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.889	-3.03	RMS	30.6	-20.2	11.8	19.17	33	-13.83	0-360	150	H
2	1.889	-7.01	RMS	30.6	-20.2	11.8	15.19	33	-17.81	0-360	150	V
3	17.6185	-63.64	RMS	41.6	-7.4	11.8	-17.64	-13	-4.64	0-360	150	H
4	17.6185	-64.15	RMS	41.6	-7.4	11.8	-18.15	-13	-5.15	0-360	150	V

RMS - RMS detection

** Marker 1 and 2 were the fundamental signal of LTE Band 2 that was used as a representative anchor band for EN-DC investigations.
No emissions were detected above noise floor this antenna and band. Thus reported mid channel data.

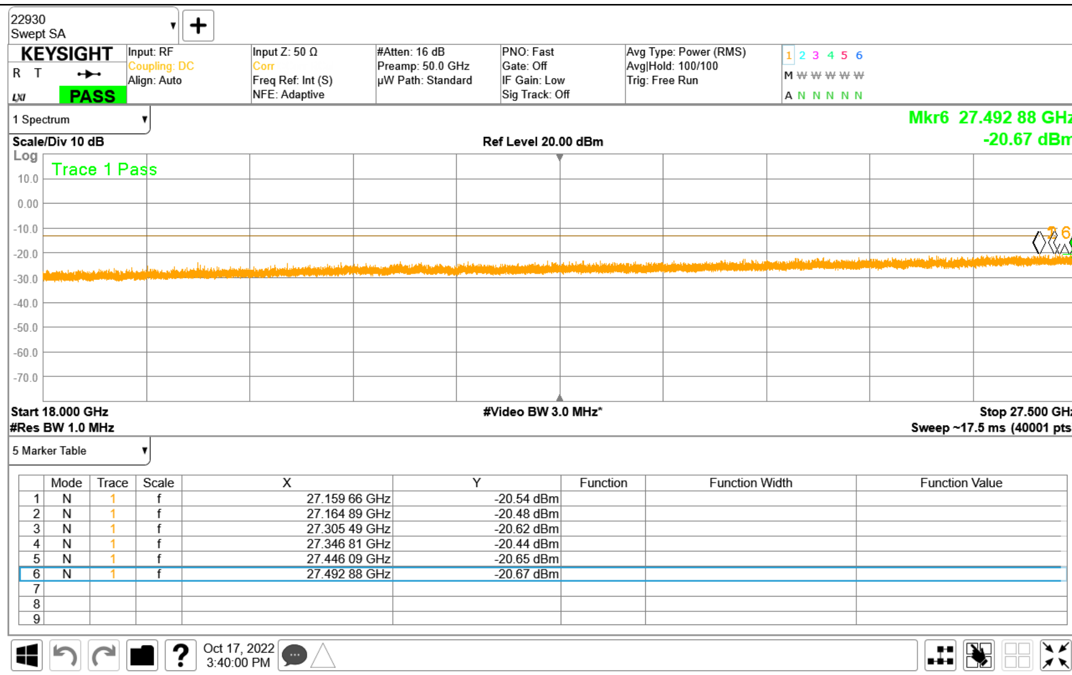
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

18 – 27.5 GHz

M 0

n261

BW 50MHz

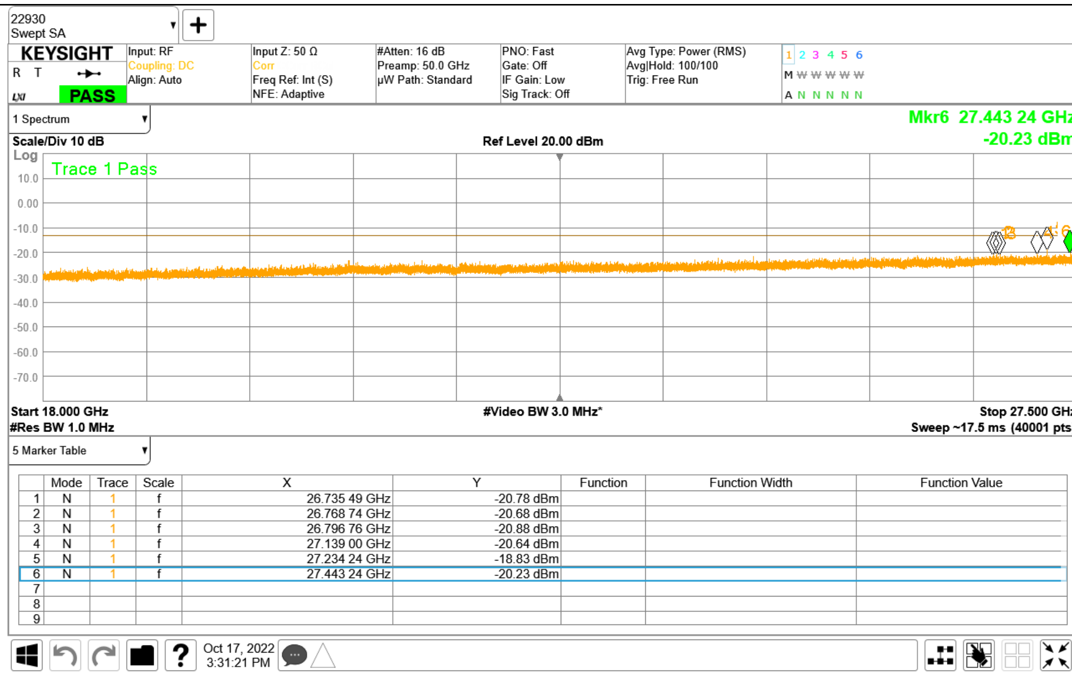


Mid Channel / Horizontal

M 0

n261

BW 50MHz



Mid Channel / Vertical

No emissions were detected above noise floor this antenna and band. Thus reported mid channel data.

This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.