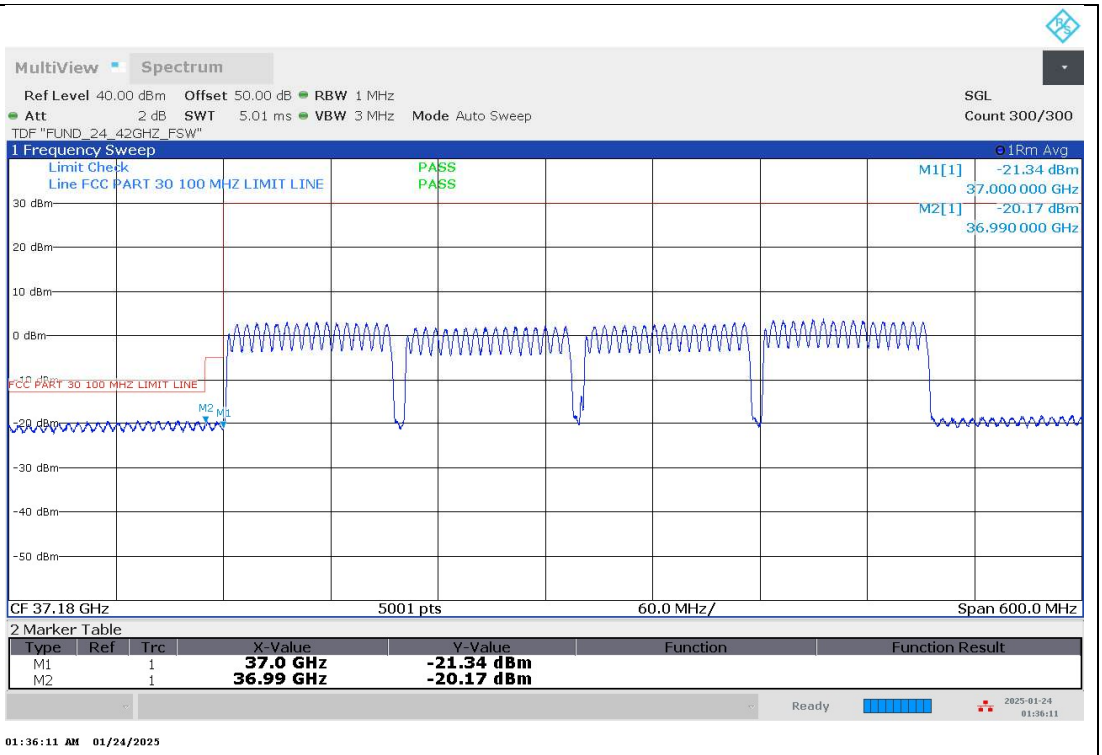
Ant M

n260

BW 100MHz

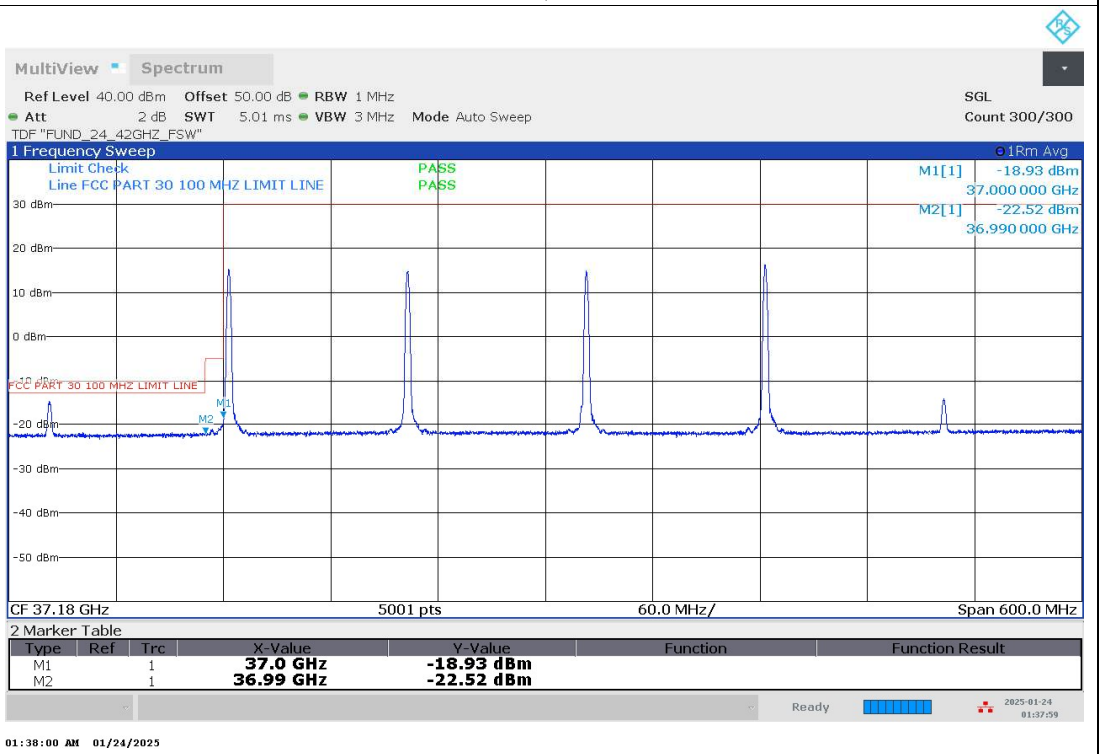


4CC / DFT-s / SISO-Dual / QPSK / Low channel / Full RB

Ant M

n260

BW 100MHz



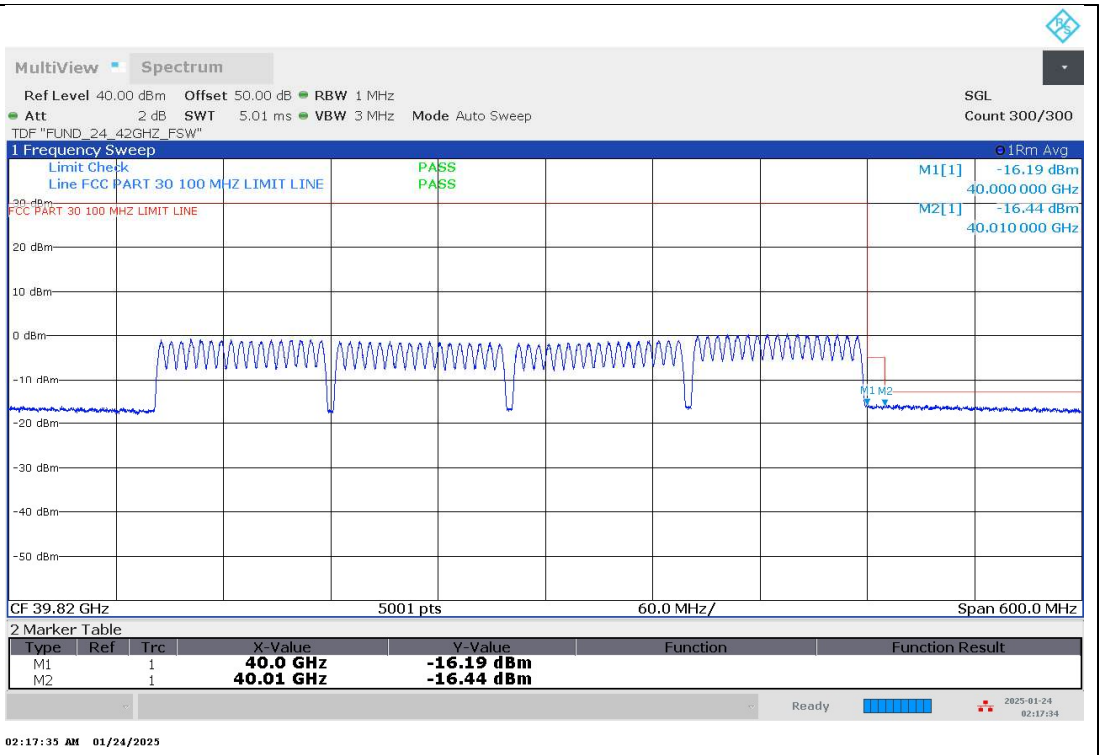
4CC / DFT-s / SISO-Dual / QPSK / Low channel / 1 RB

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
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.

Ant M

n260

BW 100MHz

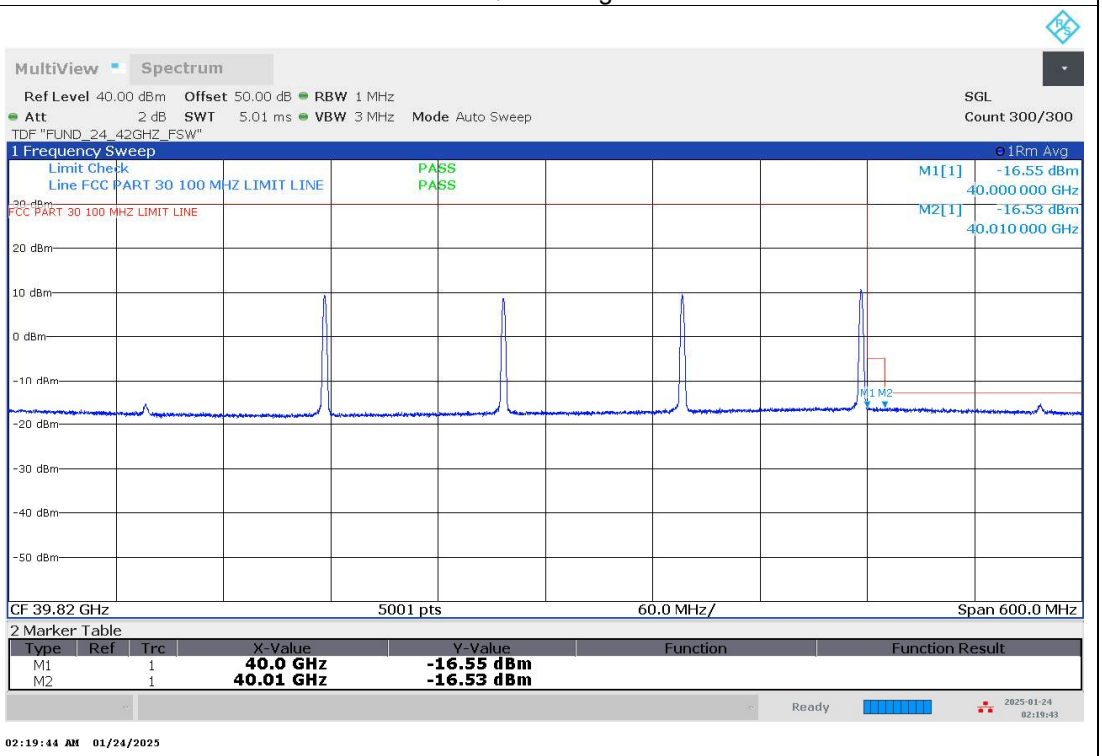


4CC / CP / MIMO / QPSK / High channel / Full RB

Ant M

n260

BW 100MHz



4CC / DFT-s / SISO-Dual / QPSK / High channel / 1 RB

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
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. 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.
30.203(d)(1) - for licensees operating mobile equipment in the 24.25-24.45 GHz or 24.75-25.25 GHz bands, the maximum conducted output power or the total radiated power of emissions in any 200 MHz of the 23.6-24.0 GHz band shall not exceed −29 dBW.

TEST PROCEDURE

a) Start frequency was set to 30MHz and stop frequency was set to 100 GHz for n258, 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.

Where the measured EIRP results exceed the TRP limit, a TRP measurement was performed. Otherwise, the EIRP results are compared with the §30.203 TRP limit to demonstrate compliance.

Test Limit calculation for 30.203(d)(1)(24.25-24.45 GHz or 24.75-25.25 GHz bands)
Total radiated power of emissions in any 200 MHz of the 23.6-24.0 GHz band shall not exceed −29 dBW.
For -29 dBW / 200MHz = 1dBm / 200MHz, By RBW compensation 10*log (1/200) = -23.01 dB
= - 22dBm / MHz (Test Limit)
Also, all emission results meet the limits of -35 dBW / 200MHz in 30.203(d)(2) (After September 1, 2027).

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

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

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 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
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 for n258, n261 and n260 band by Low, Mid and High Channel 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, QPSK was set for final test as the worst-case modulation. 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.

All Waveforms (CP-OFDM vs DFT-s OFDM) were investigated and DFT-s OFDM was determined as the worst-case used for test.

All RSE's were investigated in each frequency range of all supported Band(n258, n261 and n 260) and reported for the worst channel data. where no significant emissions were observed the EUT, Only mid channel is reported.

All RSE’s were investigated in simultaneous mode and with 802.11 chipset active. It was determined that there is no notable emission introduced by simultaneous mode.
For EN-DC mode n258 band uses LTE B2, B5, B12, B66 and B71, n261 band uses LTE B2, B5, B12, B13, B48 and B66. And n260 band uses LTE B2, B5, B12, B13, B14, B30, B48 and B66.
For NR-DC mode n258 band uses FR1 n25, n41, n66 and n77, n261 band uses FR1 n2, n5, n25, n41, n48, n66, n71 and n77. And n260 band uses FR1 n2, n5, n14, n25, n30, n41, n48, n66, n71 and n77.

LTE and FR1 anchor bands support default configuration, TX hopping configuration, and Antenna Switching Diversity (ASDiv) configuration. All configurations were investigated. The device supports either Tx Device Hopping or ASDIV conditions, with only the Tx trigger being different between these methods. There was no discernible difference in the spurious emission levels when using different LTE and FR1 anchor bands or different antenna switching methods. Thus, LTE Band 66 and n77 have been tested as representative anchor bands for EN-DC and NR-DC modes.

RESULTS

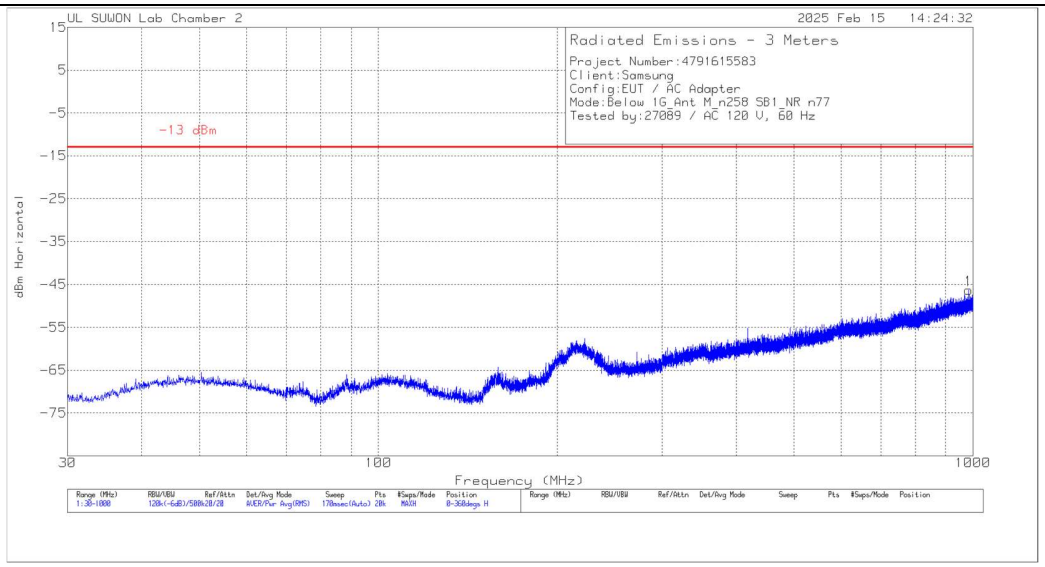
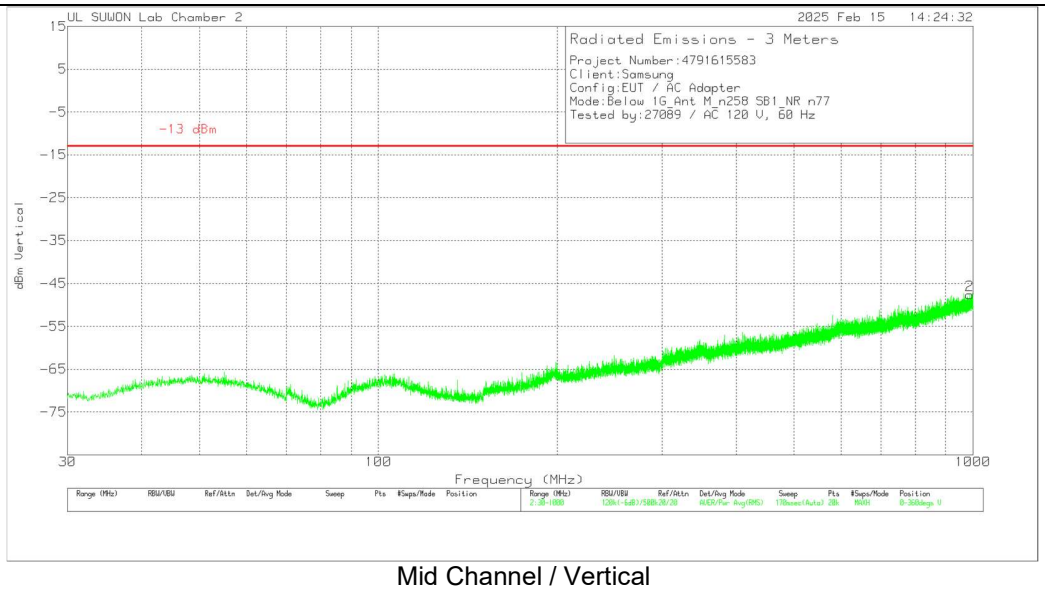
See the following pages.

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

Antenna 1 / Ant M / n258 SB1

30 – 1000 MHz Result

Ant M n258 SB1	 Mid Channel / Horizontal
Ant M n258 SB1	 Mid Channel / Vertical

Trace Markers

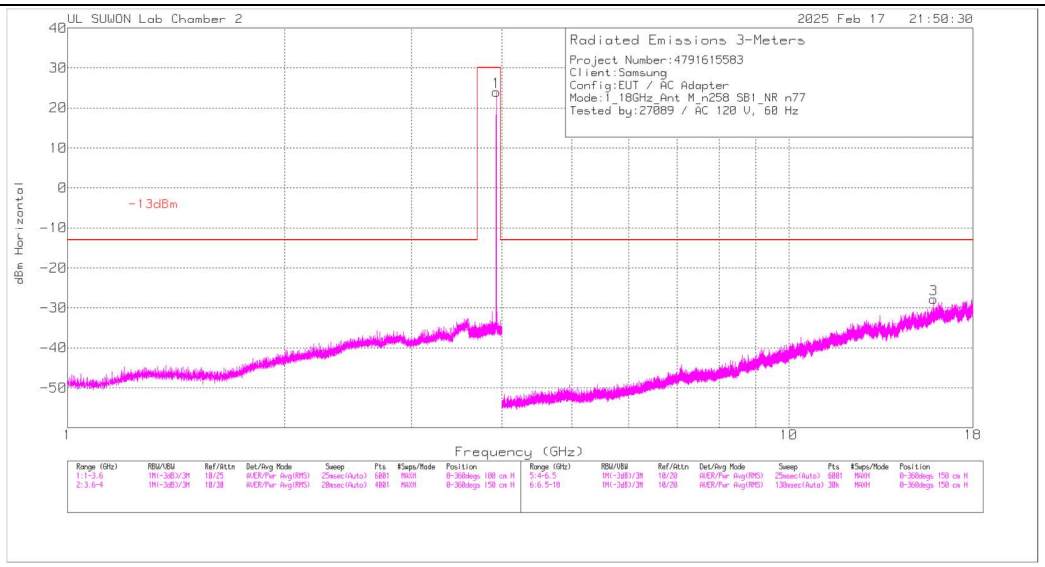
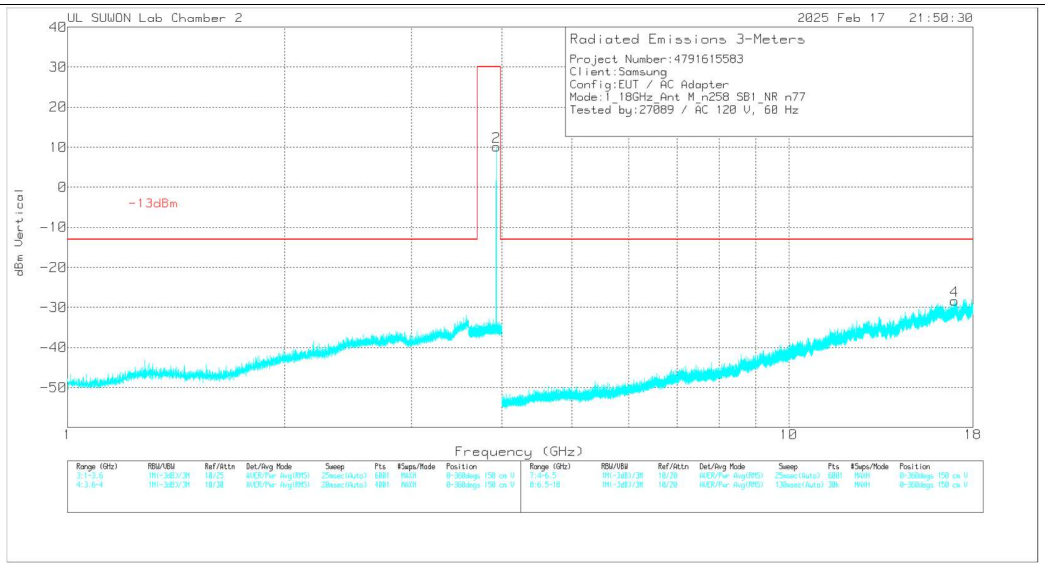
Marker	Frequency (MHz)	Meter Reading (dBm)	Det	Antenna Correction Factor(dB/m)	Loss(dB)	Conversion Factor[dB]	Corrected Reading dBm	Limit [dBm]	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	982.8887	-59.09	RMS	28.1	-27.1	11.8	-46.29	-13	-33.29	0-360	200	H
2	986.9625	-60.54	RMS	28.1	-27	11.8	-47.64	-13	-34.64	0-360	300	V

RMS - RMS detection

No emissions were detected above noise floor this antenna and band.

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

1 – 18 GHz Result

Ant M n258 SB1	 Mid Channel / Horizontal
Ant M n258 SB1	 Mid Channel / Vertical

Trace Markers

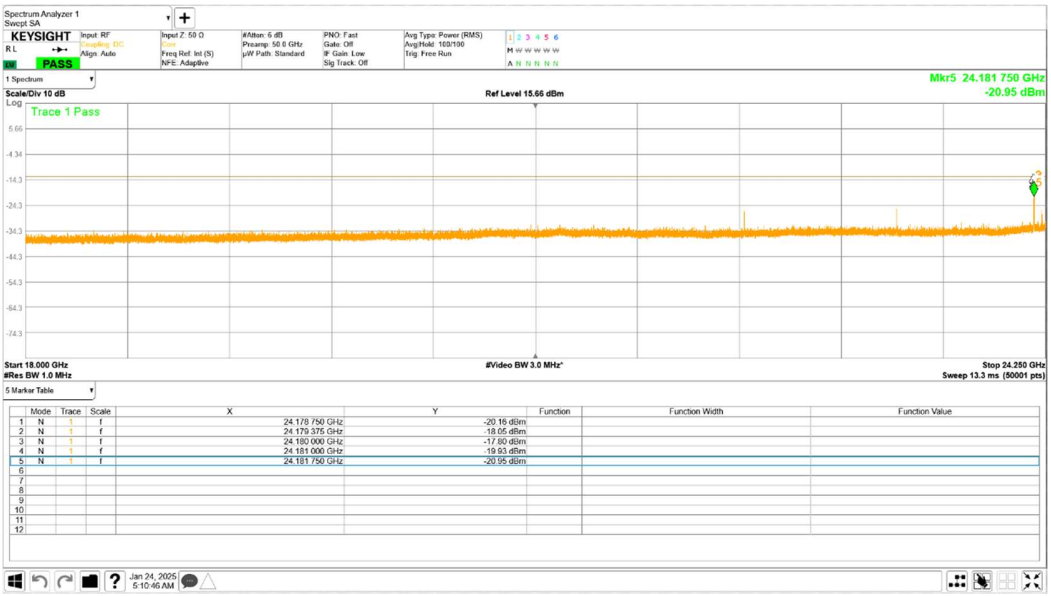
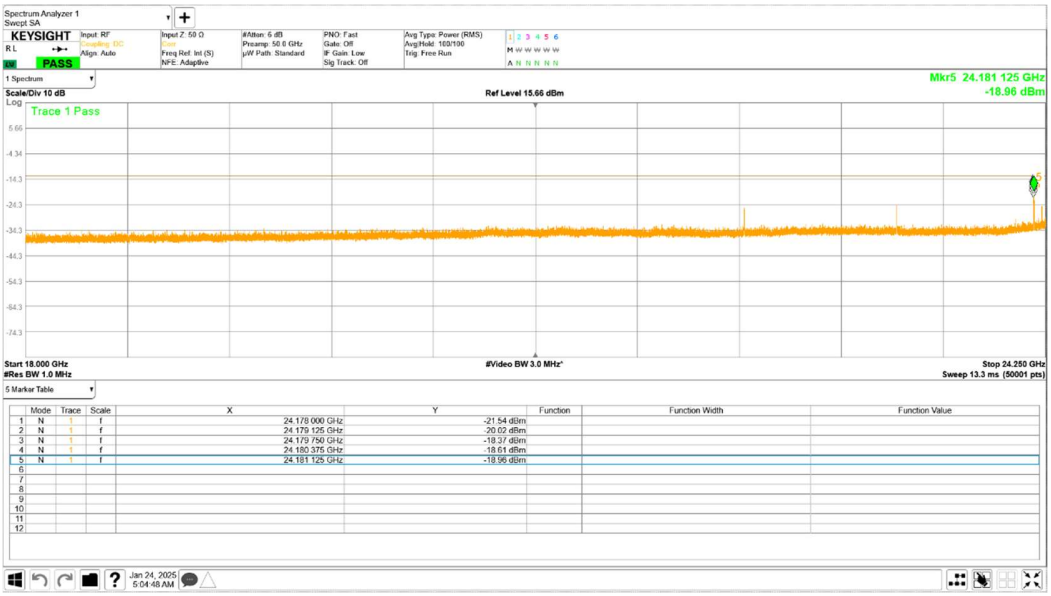
Marker	Frequency (MHz)	Meter Reading (dBm)	Det	Antenna Correction Factor(dB/m)	Loss(dB)	Conversion Factor[dB]	Corrected Reading dBm	Limit [dBm]	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
**1	3.9304	1.87	RMS	33.2	-22.9	11.8	23.97	30	-6.03	0-360	150	H
**2	3.9304	-11.92	RMS	33.2	-22.9	11.8	10.18	30	-19.82	0-360	150	V
3	15.8837	-60.65	RMS	40.4	-19.4	11.8	-27.85	-13	-14.85	0-360	150	H
4	16.98191	-62.23	RMS	41	-18.9	11.8	-28.33	-13	-15.33	0-360	150	V

RMS - RMS detection

** Marker 1 and 2 were the fundamental signal of 5GNR Band 77 that was used as a representative anchor band for NR-DC investigations.
No emissions were detected above the noise floor which was at least 20dB below the specification limit.

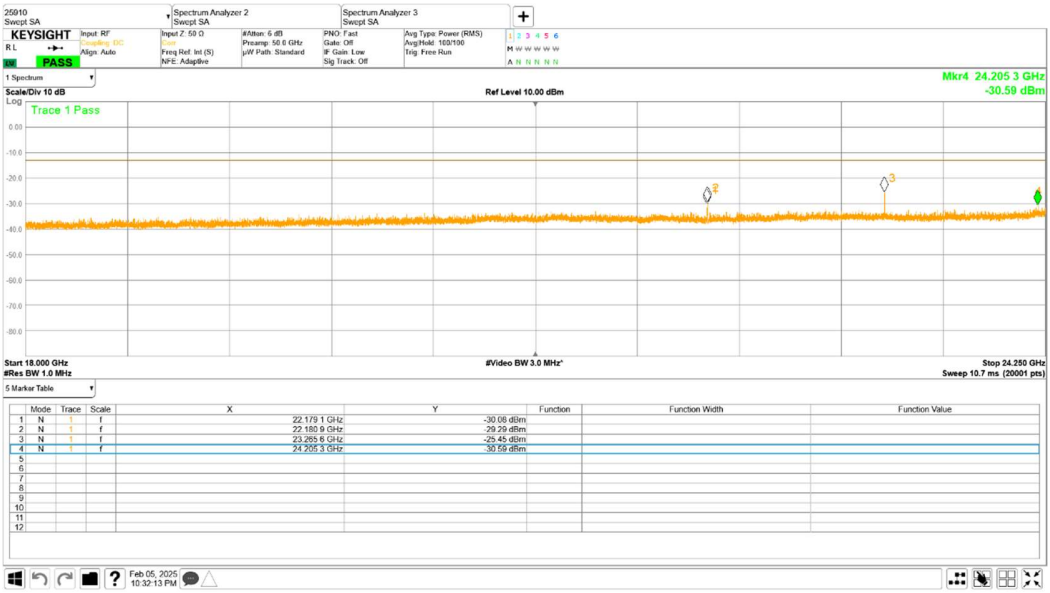
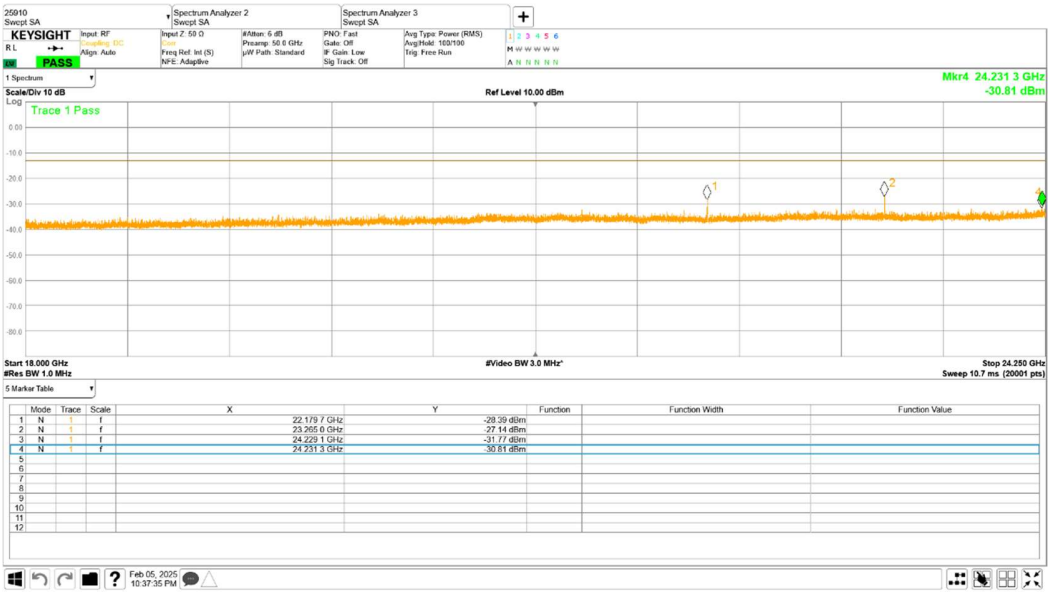
UL KOREA LTD. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

18 – 24.25 GHz

Ant M n258 SB1 BW 50MHz	 Low Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 Low Channel / Vertical

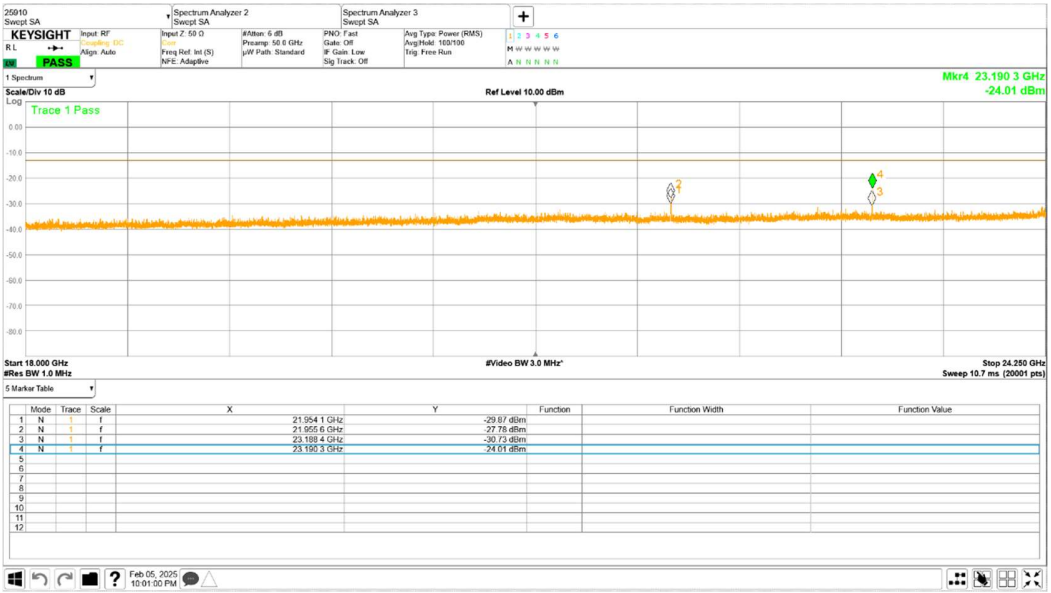
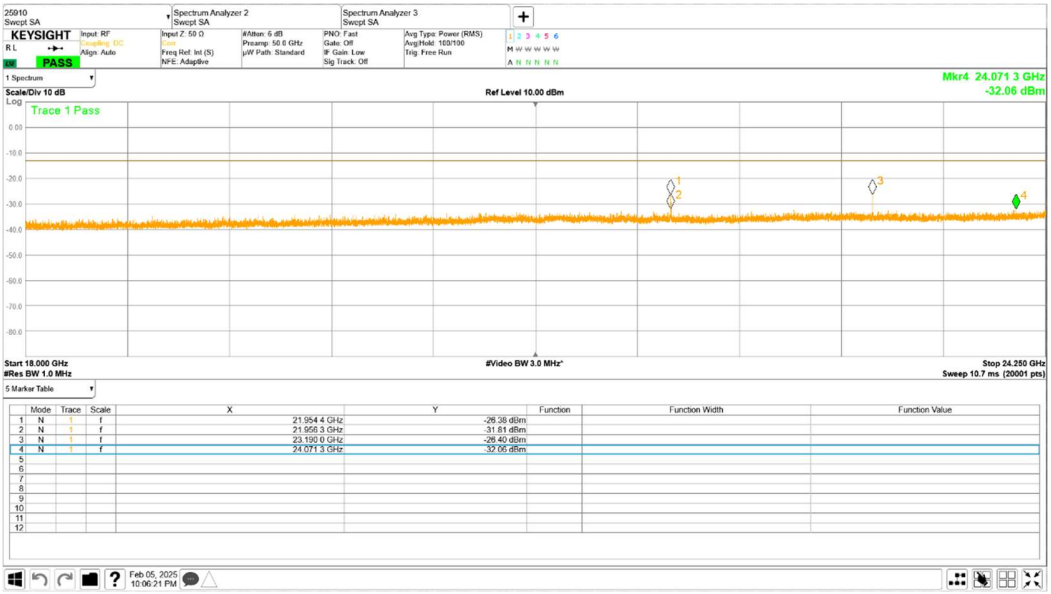
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 50MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 Mid Channel / Vertical

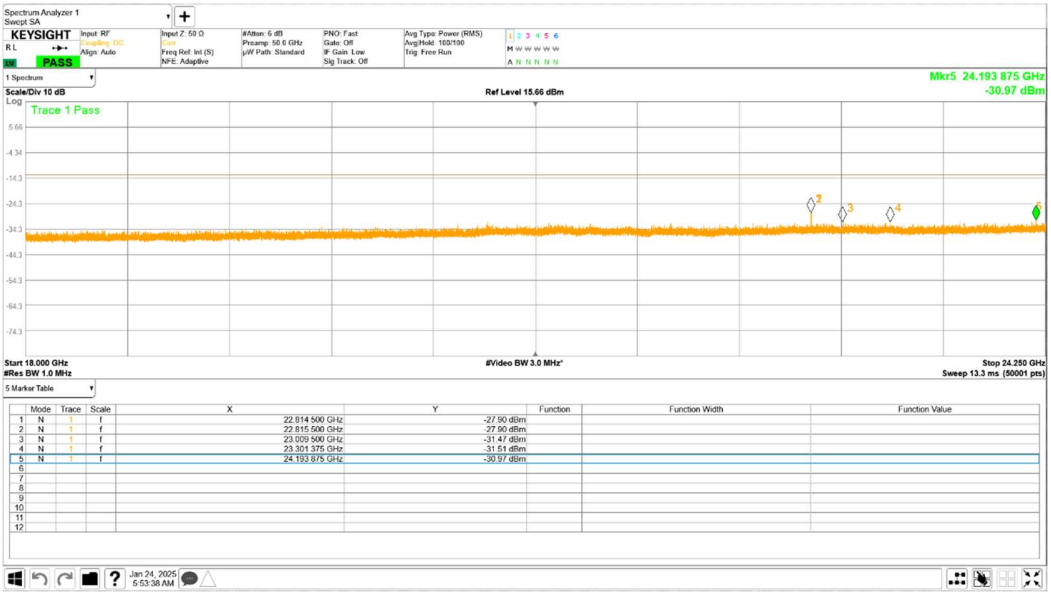
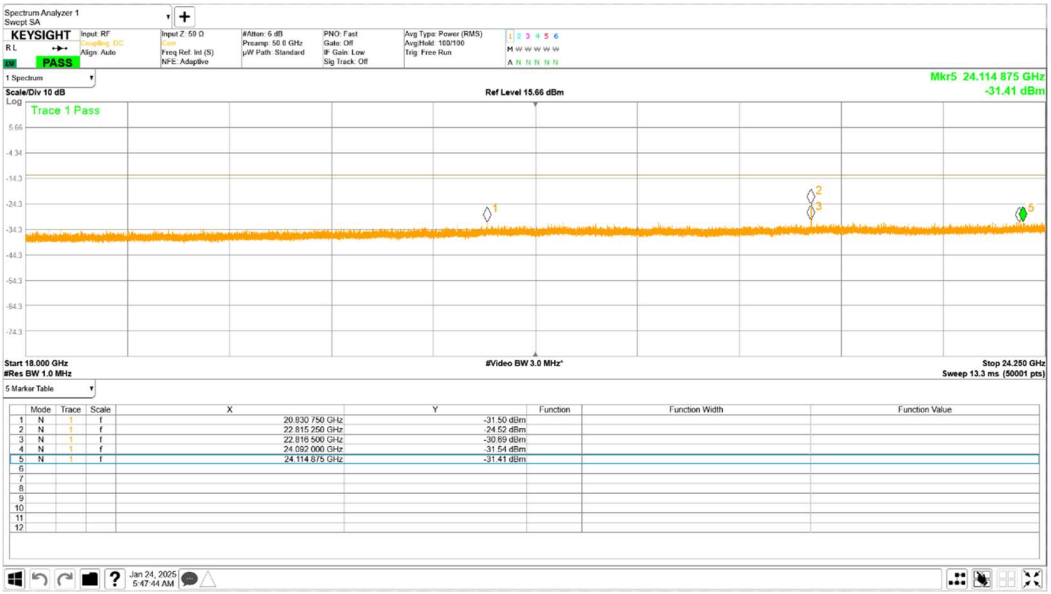
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 50MHz	 High Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 High Channel / Vertical

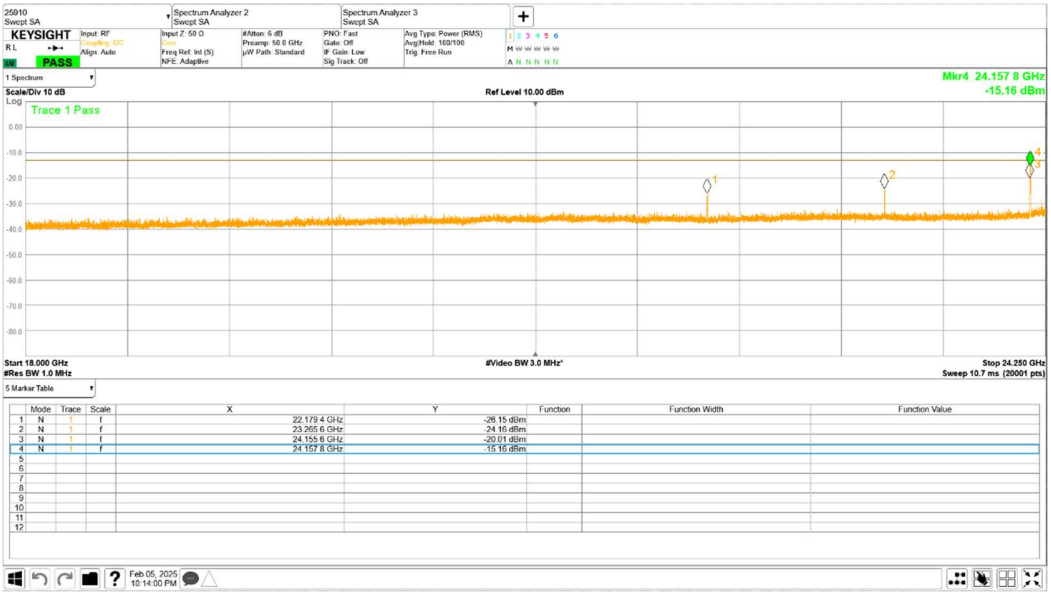
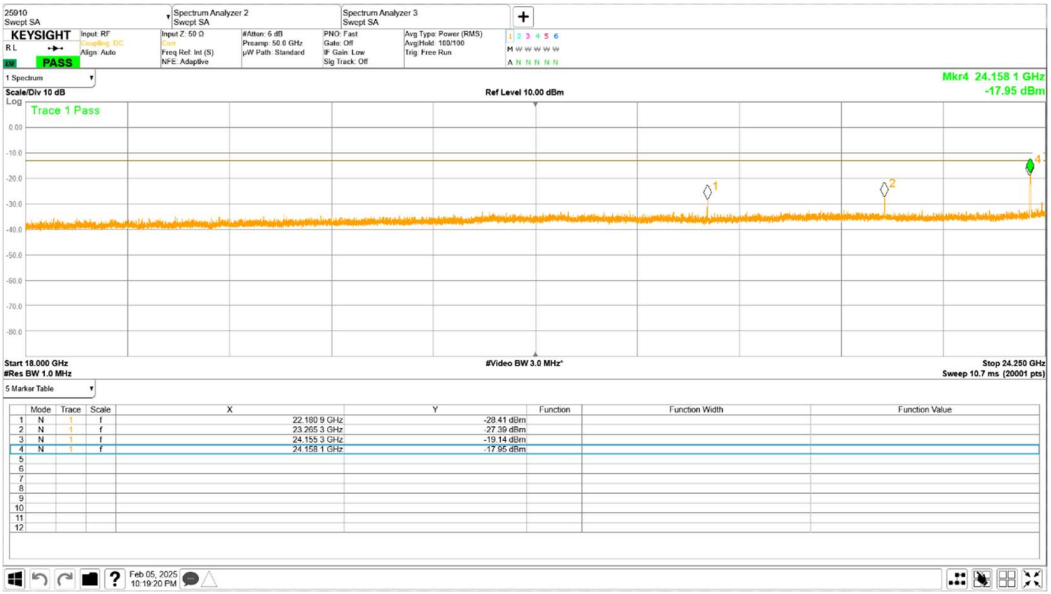
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
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.

Ant M n258 SB1 BW 100MHz	 Low Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 Low Channel / Vertical

Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

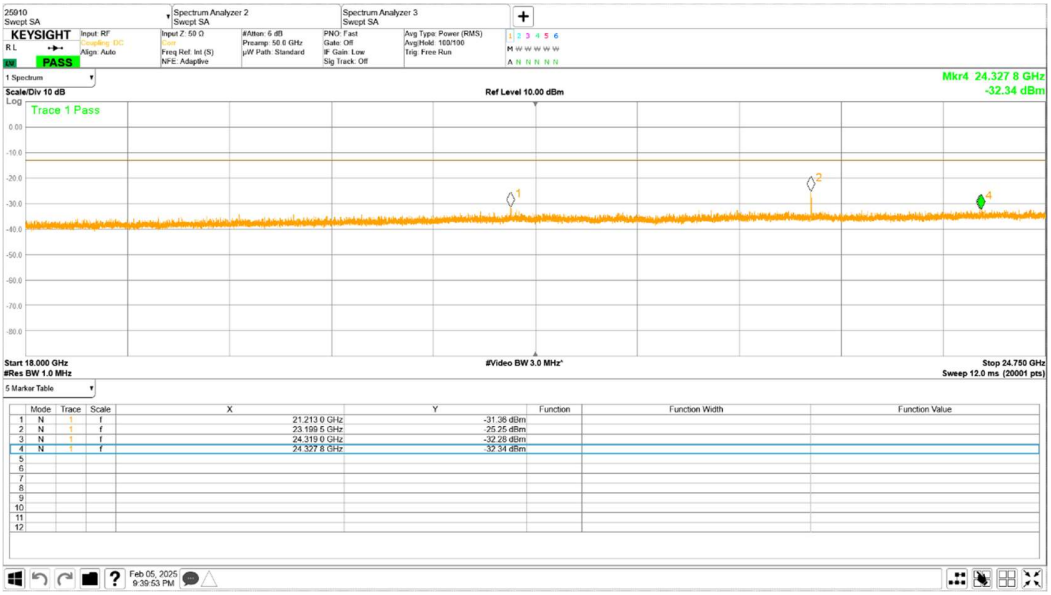
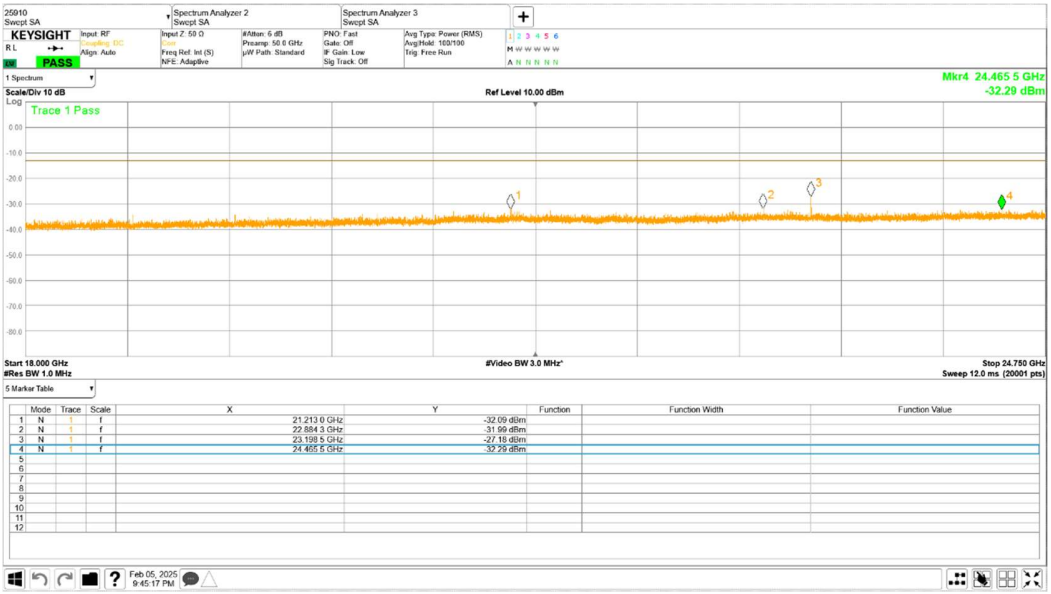
Ant M n258 SB1 BW 100MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 Mid Channel / Vertical

Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

Final Measurement Data Table

Frequency [GHz]	Bandwidth [MHz]	EUT Beam	Modulation	Ant pol [H/V]	X-Axis [degree]	Y-Axis [degree]	EIRP [dBm]	Limit [dBm]	Margin [dB]
24.158	100	SISO-Dual	QPSK	H	233.9	31.0	-25.13	-13	12.13

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
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.

Ant M n258 SB1 BW 100MHz	 High Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 High Channel / Vertical

Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

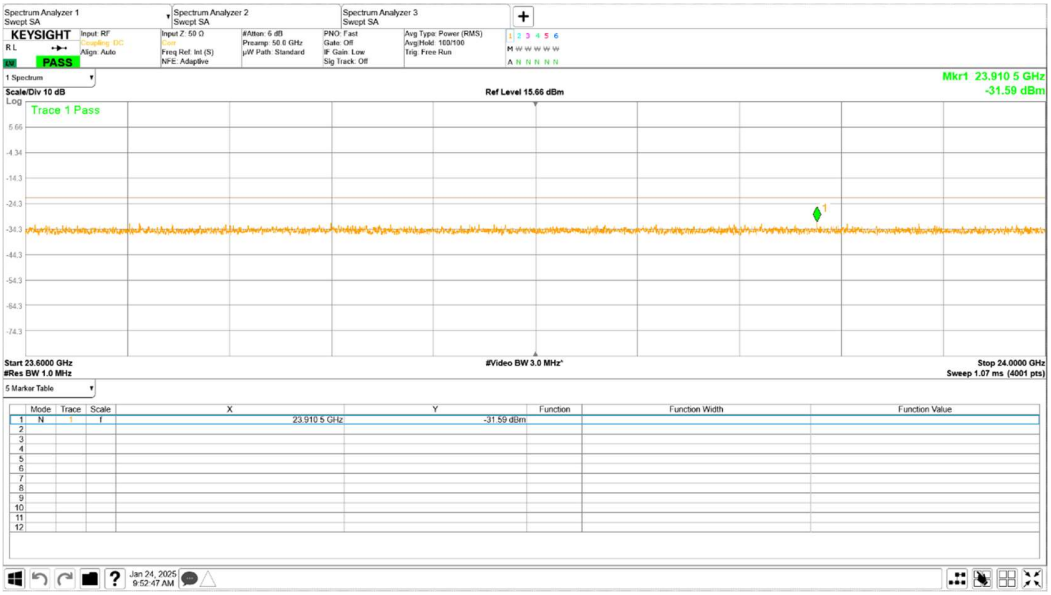
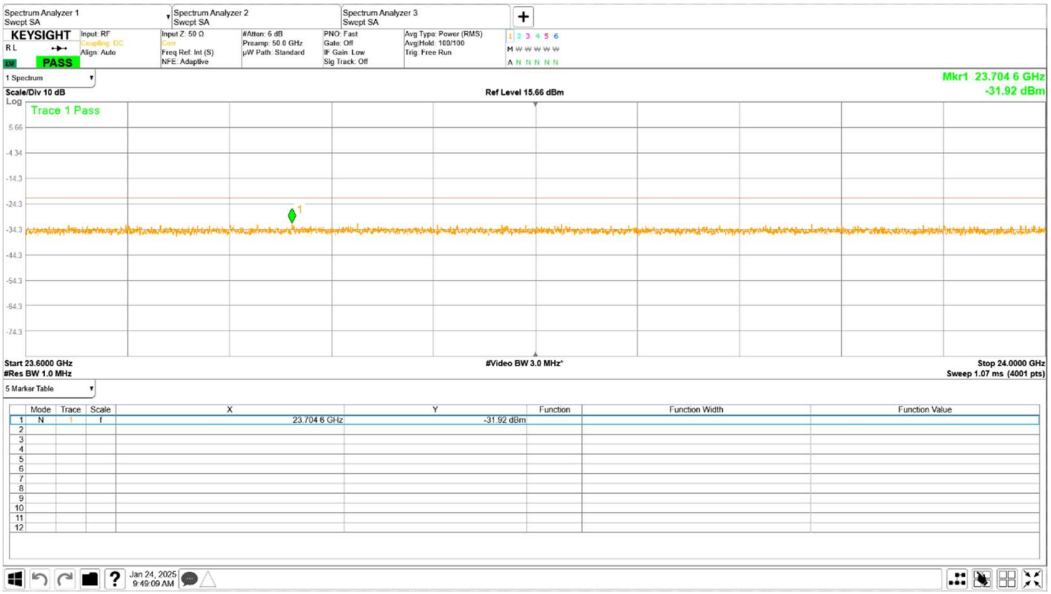
UL KOREA LTD. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

23.6 – 24 GHz Result

Ant M n258 SB1 BW 50MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 Mid Channel / Vertical

All channels were investigated, but no emission above the noise floor was detected.

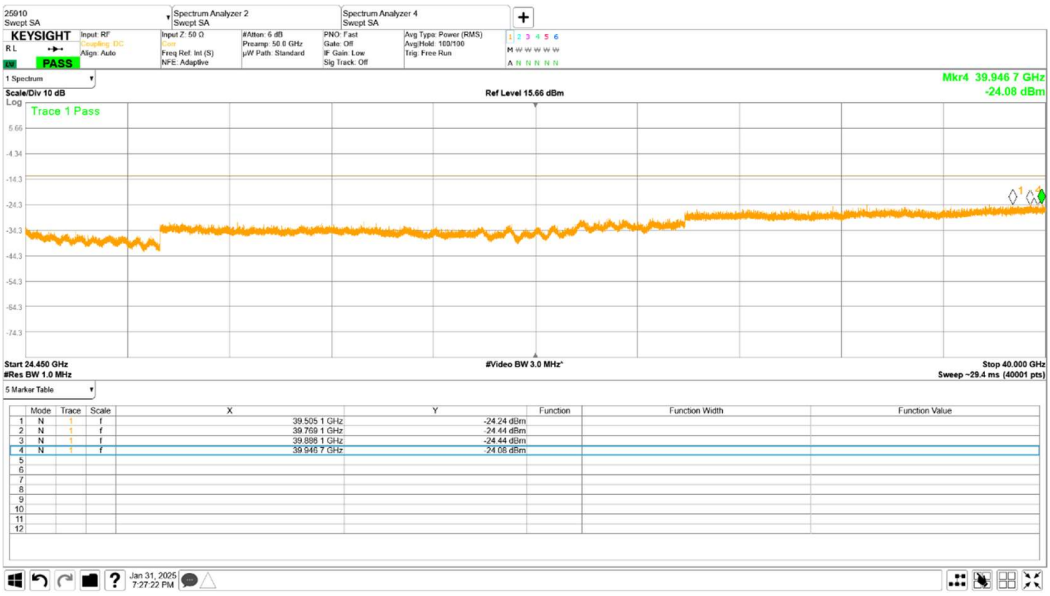
UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433
UL KOREA LTD. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

Ant M n258 SB1 BW 100MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 Mid Channel / Vertical

All channels were investigated, but no emission above the noise floor was detected.

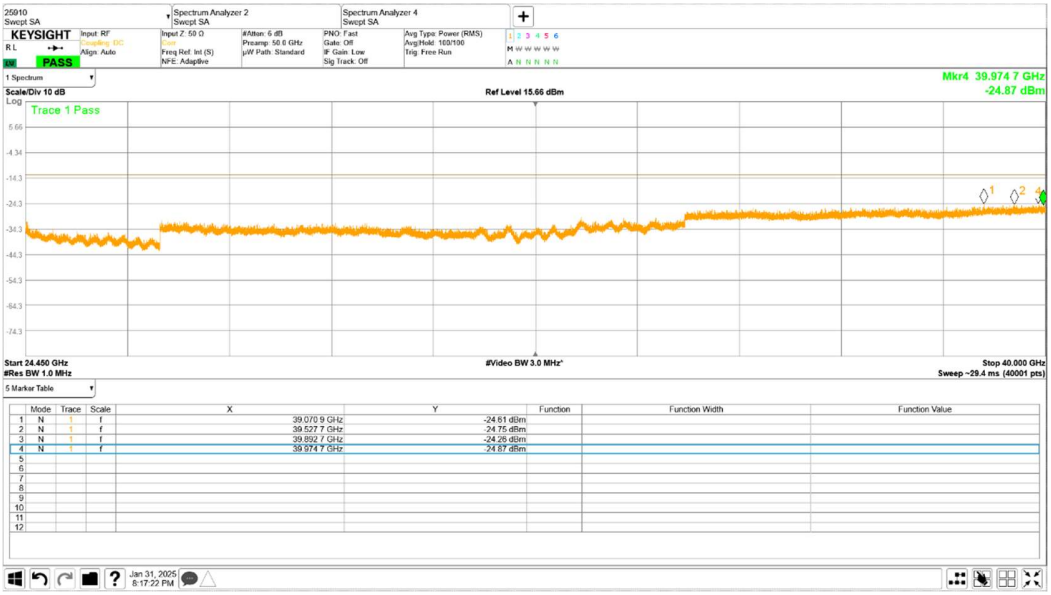
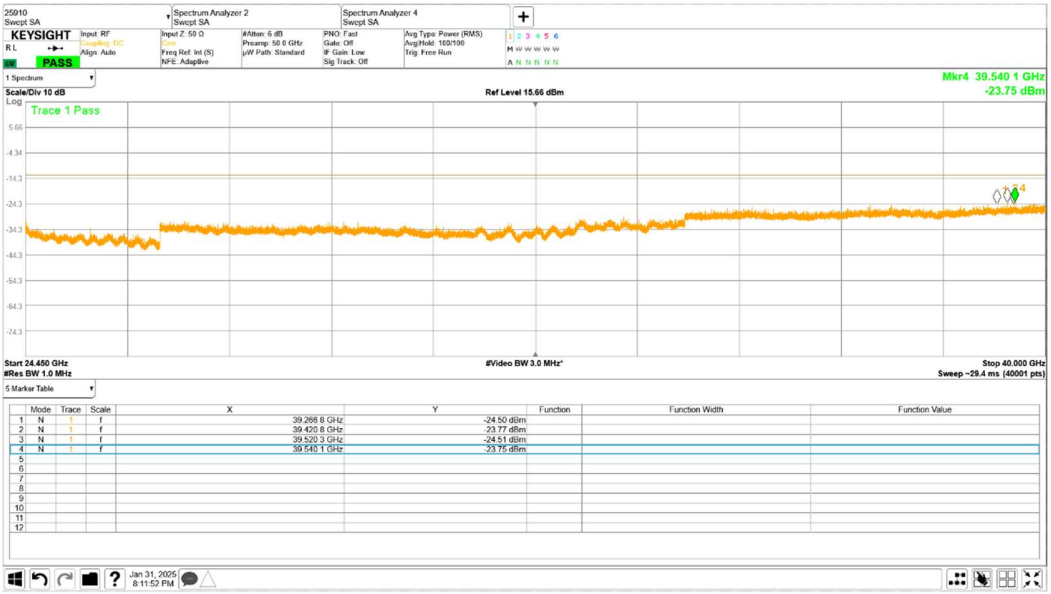
UL KOREA LTD. Suwon Laboratory FORM ID: FCC_30(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433
UL KOREA LTD. Confidential
This report shall not be reproduced except in full, without the written approval of UL Korea, Ltd.

24.45 – 40 GHz Result

Ant M n258 SB1 BW 50MHz	 Low Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 Low Channel / Vertical

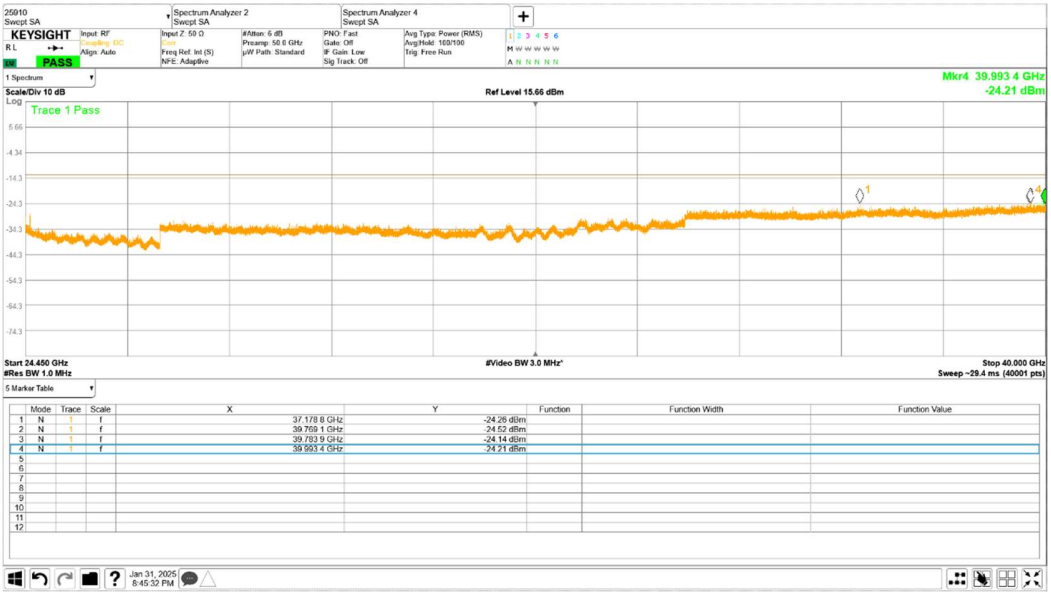
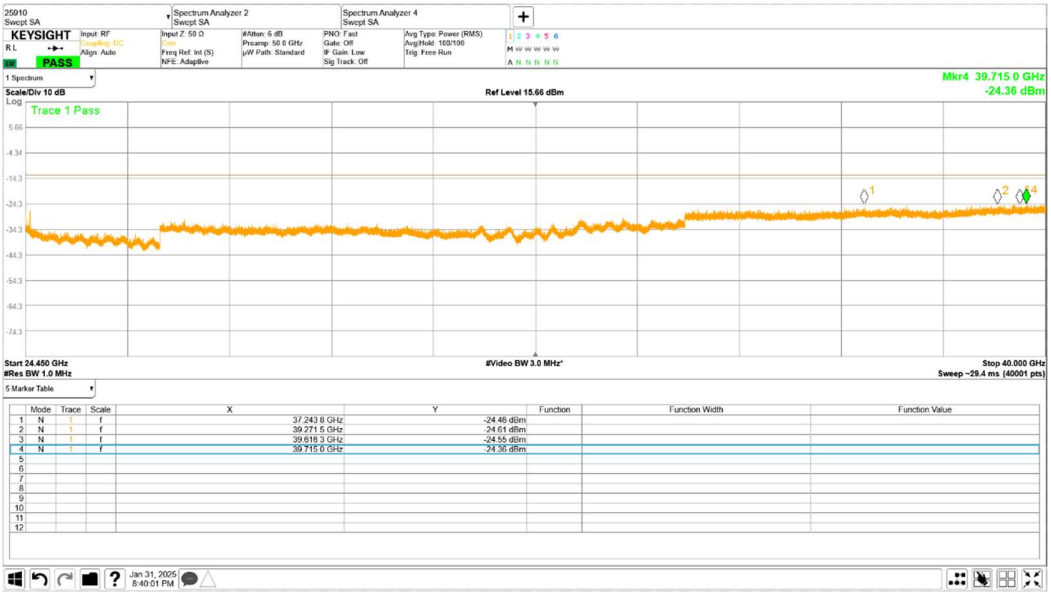
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 50MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 Mid Channel / Vertical

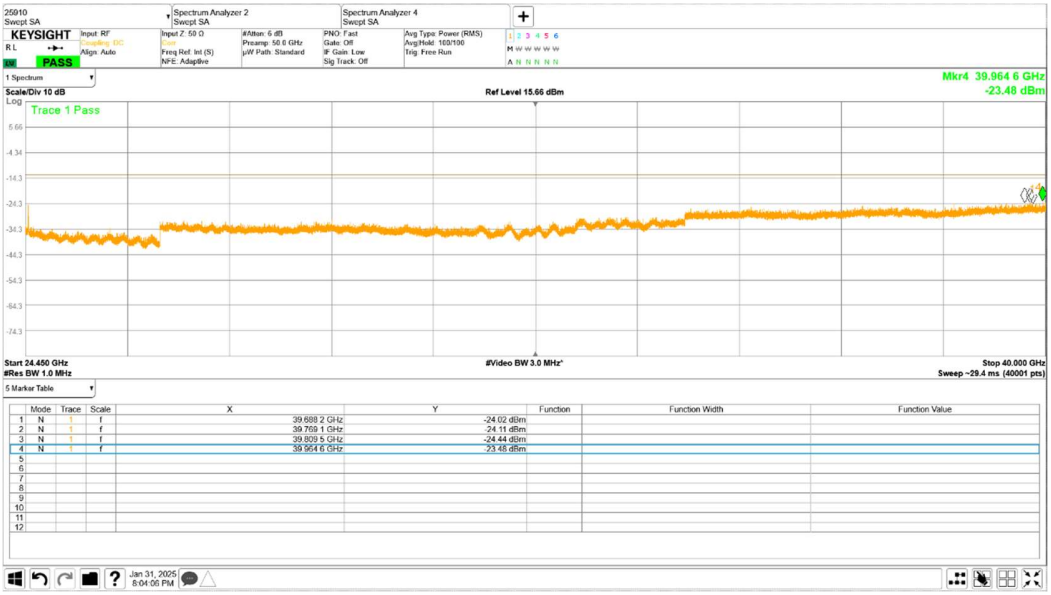
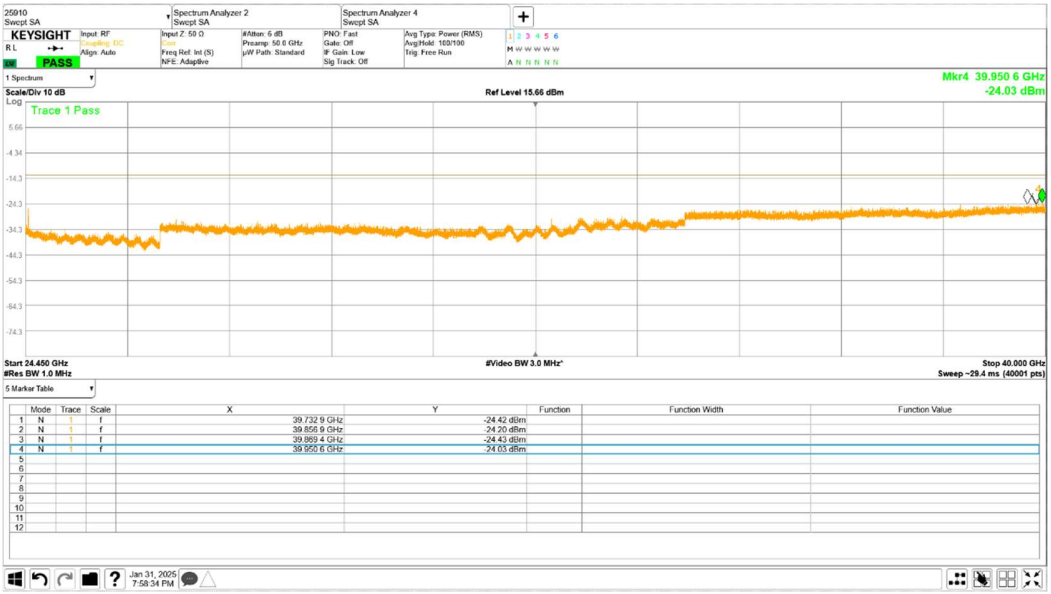
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 50MHz	 High Channel / Horizontal
Ant M n258 SB1 BW 50MHz	 High Channel / Vertical

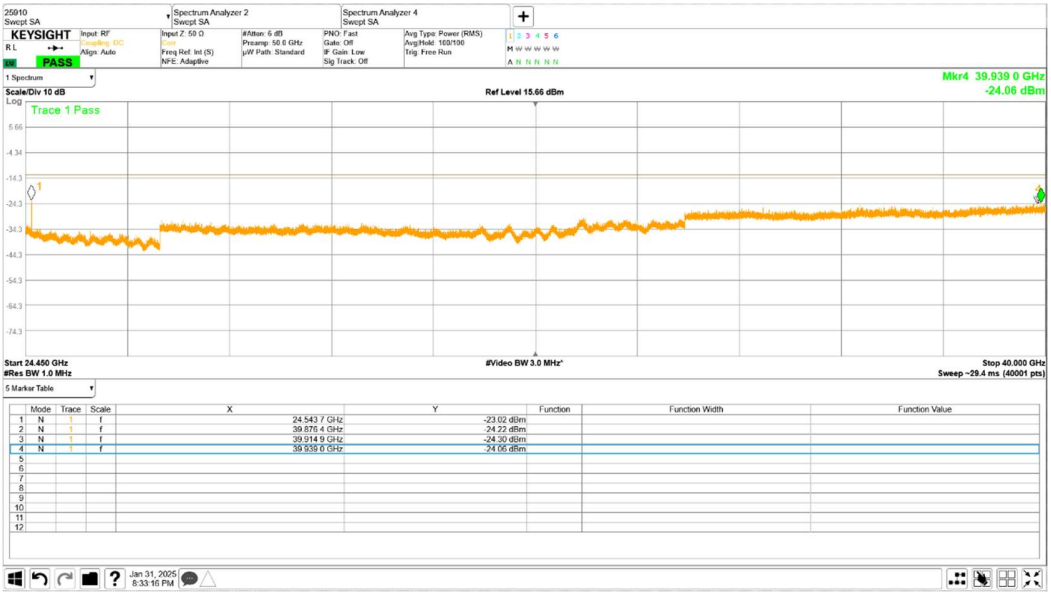
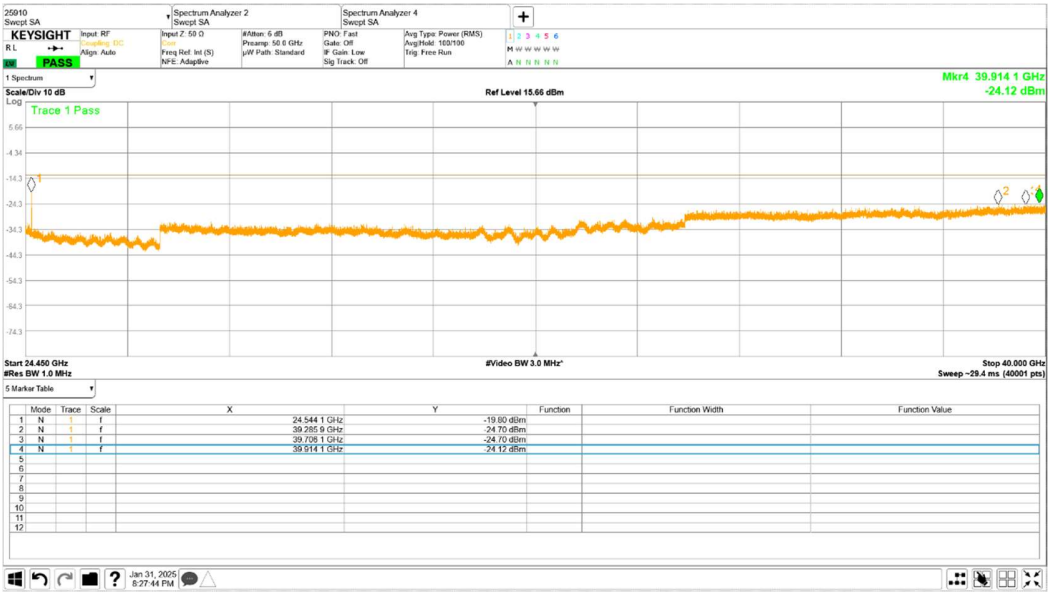
Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 100MHz	 Low Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 Low Channel / Vertical

Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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

Ant M n258 SB1 BW 100MHz	 Mid Channel / Horizontal
Ant M n258 SB1 BW 100MHz	 Mid Channel / Vertical

Note. If the margin of the pre-scan result is less than 3dB, the final measurement is performed for the identified spurious emissions.

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