FCC and ISED Test Report

Reelables, Inc.
Model: N-Label

In accordance with FCC 47 CFR Part 27, FCC CFR 47 Part 2 and ISED RSS-130 and ISED RSS-GEN (LTE NB-IOT)

Prepared for: Reelables, Inc.
113 Cherry St. 76660,
Seattle,
Washington
United States 98104

FCC ID: 2A7TQRN0001 IC: 33042-RN0001

COMMERCIAL-IN-CONFIDENCE

Document 75961990-08 Issue 02

SIGNATURE			
S. MA			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	21 January 2025

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 27, FCC CFR 47 Part 2 and ISED RSS-130 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Thomas Biddlecombe	21 January 2025	
Testing	George Williams	21 January 2025	Gwilliams

FCC Accreditation
492497/UK2010 Octagon House, Fareham Test Laboratory

ISED Accreditation
12669A/UK0003 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 27: 2023, FCC CFR 47 Part 2: 2023, ISED RSS-130: Issue 2 (02-2019) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.

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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	06 January 2025
2	Update to FCC ID, Antenna Gain, Device Category and Output Power	21 January 2025

Table 1

1.2 Introduction

Applicant	Reelables, Inc
Manufacturer	Reelables Europe, Ltd.
Model Number(s)	N-Label
Serial Number(s)	60504
Hardware Version(s)	5.61
Software Version(s)	1.11
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 27: 2023 FCC CFR 47 Part 2: 2023 ISED RSS-130: Issue 2 (02-2019) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	15018
Date	11-July-2024
Date of Receipt of EUT	11-December-2024
Start of Test	11-December-2024
Finish of Test	16-December-2024
Name of Engineer(s)	Thomas Biddlecombe and George Williams
Related Document(s)	ANSI C63.26: 2015 KDB 971168 D01 v03r01

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 27, FCC CFR 47 Part 2 and ISED RSS-130 and ISED RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 27	Part 2	RSS-130	RSS-GEN			
Configuration and Mode: LTE FDD B13							
2.1	27.50	2.1046	4.6	6.12	Maximum Conducted Output Power	Pass	ANSI C63.26: 2015
2.2		2.1047(d)	4.2		Modulation Characteristics	Pass	
2.3		2.1049		6.7	Occupied Bandwidth	Pass	ANSI C63.26: 2015
2.4	27.53	2.1051	4.7		Spurious Emissions at Band Edge	Pass	ANSI C63.26: 2015
2.5	27.53	2.1053	4.7	6.13	Radiated Spurious Emissions	Pass	ANSI C63.26: 2015
2.6	27.54	2.1055	4.5	6.11	Frequency Stability	Pass	ANSI C63.26: 2015

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment including the technologies the product supports)*	The N-Label from Reelables is an NB-IoT cellular device in the form factor of a thin 4x8" shipping label. It tracks the location of parcels and cargo using cell tower positioning and WiFi SSID scanning only. The intended use is a stickable label to corrugated paper cartons or other shippable containers. The N-Label comprises the following wireless technologies: NB-IoT, Bluetooth, WiFi (RX scan only) and NFC (passive).		
Manufacturer:	Reelables Europe, Ltd		
Model:	N-Label		
Part Number:	N0001		
Hardware Version:	5.61		
Software Version:	1.11		
FCC ID of the product under test – see guidance here		FCC:2A7TQRN0001	
IC ID of the product under test – see guidance here		IC:33042-RN0001	
Device Category	Mobile ☐	Portable ☒	Fixed ☐
Equipment is fitted with an Audio Low Pass Filter		Yes ☐	No ☒

Table 3

Intentional Radiators

Technology	NB-IoT Band 13	NB-IoT Band 12	NB-IoT Band 5	Bluetooth Low Energy
Frequency Range (MHz to MHz)	777MHz-787MHz	698MHz-716MHz	824MHz-849MHz	2400MHz-2483.5MHz
Conducted Declared Output Power (dBm)	10dBm	20dBm	18dBm	2.5dBm
Antenna Gain (dBi)	-0.4	-0.43	-2.07	2.14
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	200KHz	200KHz	200KHz	1, 2
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	QPSK BPSK	QPSK BPSK	QPSK BPSK	GFSK
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)				1M00GXW, 2M00GXW
Bottom Frequency (MHz)	777.0	701.5	826.5	2402
Middle Frequency (MHz)	782.0	707.5	836.5	2440
Top Frequency (MHz)	787.0	713.5	846.5	2480

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2483.5MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	699MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

Table 5

AC Power Source

AC supply frequency:	NA	Hz
Voltage	NA	V
Max current:	NA	A
Single Phase ☐ Three Phase ☐		

Table 6

DC Power Source

Nominal voltage:	NA	V
Extreme upper voltage:	NA	V
Extreme lower voltage:	NA	V
Max current:	NA	A

Table 7

Battery Power Source

Voltage:	4.5	V
End-point voltage:	2.2	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☒ Zinc-carbon Please detail:	Zn-MnO2 coated battery	

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☒

Table 9

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	50	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)	0.9	dB

Table 11

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	PIFA	Gain	See above	dBi
External antenna ☐	Type:		Gain		dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☐ Non-standard Antenna Jack ☐ All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.					

Table 12

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

Table 13

I hereby declare that the information supplied is correct and complete.

Name: Brian Krejcarek
Position held: CEO
Date: January 16, 2025

1.5 Product Information

1.5.1 Technical Description

The N-Label from Reelables is an NB-IoT cellular device in the form factor of a thin 4x8” shipping label. It tracks the location of parcels and cargo using cell tower positioning and WiFi SSID scanning only. The intended use is a stickable label to corrugated paper cartons or other shippable containers. The N-Label comprises the following wireless technologies: NB-IoT, Bluetooth, WiFi (RX scan only) and NFC (passive).

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: N-Label, Serial Number: 60504			
0	As supplied by the customer	Not Applicable	Not Applicable
1	Unit has been modified with an SMA connector to become a conducted sample	Customer	11-December-2024
2	Sample modified with extra cables to adjust the input voltage	George Williams	16-December-2024

Table 14

1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: LTE FDD B13		
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Occupied Bandwidth	Thomas Biddlecombe	UKAS
Spurious Emissions at Band Edge	Thomas Biddlecombe	UKAS
Frequency Stability	Thomas Biddlecombe and George Williams	UKAS
Modulation Characteristics	Thomas Biddlecombe	UKAS
Radiated Spurious Emissions	George Williams	UKAS

Table 15

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 27.50
FCC 47 CFR Part 2.1046
ISED RSS-130 Clause 4.6
ISED RSS-GEN Clause 6.12

2.1.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 1

2.1.3 Date of Test

12-December-2024

2.1.4 Test Method

The test was performed in accordance with KDB 971168 D01 v03r01, Clause 5.2.2.

The ERP was calculated using the following formula:
Average Power (conducted) + Antenna Gain (-0.40dBi) – 2.15dB (conversion from EIRP to ERP).

EUT was powered by 3x 1.5V battery cells.

2.1.5 Environmental Conditions

Ambient Temperature	19.1 °C
Relative Humidity	34.1 %

2.1.6 Test Results

LTE FDD B13

UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	Average Power (dBm)	ERP (dBm)	PAPR (dB)
23205	779.5	π/2-BPSK	3.75	1	0	0	9.809	7.259	4.30
23205	779.5	π/2-BPSK	3.75	1	47	0	10.423	7.873	4.33
23205	779.5	π/2-BPSK	15	1	0	0	11.261	8.711	3.58
23205	779.5	π/2-BPSK	15	1	11	0	10.398	7.848	3.59
23205	779.5	π/4-QPSK	3.75	1	0	3	9.974	7.424	3.76
23205	779.5	π/4-QPSK	3.75	1	47	3	10.439	7.889	3.79
23205	779.5	π/4-QPSK	15	1	0	3	10.980	8.43	3.50
23205	779.5	π/4-QPSK	15	1	11	3	11.605	9.055	3.47
23205	779.5	QPSK	15	3	0	5	11.069	8.519	5.63
23205	779.5	QPSK	15	3	6	5	11.049	8.499	6.04
23205	779.5	QPSK	15	6	0	5	12.191	9.641	6.65
23205	779.5	QPSK	15	6	6	5	12.846	10.296	6.58
23205	779.5	QPSK	15	12	0	5	11.524	8.974	6.04

Table 16 - Maximum Conducted Output Power, Bottom Channel

UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	Average Power (dBm)	ERP (dBm)	PAPR (dB)
23255	784.5	π/2-BPSK	3.75	1	0	0	9.622	7.072	5.03
23255	784.5	π/2-BPSK	3.75	1	47	0	10.255	7.705	4.14
23255	784.5	π/2-BPSK	15	1	0	0	11.171	8.621	3.60
23255	784.5	π/2-BPSK	15	1	11	0	10.512	7.962	3.62
23255	784.5	π/4-QPSK	3.75	1	0	3	9.668	7.118	3.75
23255	784.5	π/4-QPSK	3.75	1	47	3	10.305	7.755	3.77
23255	784.5	π/4-QPSK	15	1	0	3	11.029	8.479	3.50
23255	784.5	π/4-QPSK	15	1	11	3	11.390	8.84	3.51
23255	784.5	QPSK	15	3	0	5	10.842	8.292	5.83
23255	784.5	QPSK	15	3	6	5	10.665	8.115	5.88
23255	784.5	QPSK	15	6	0	5	11.548	8.998	6.53
23255	784.5	QPSK	15	6	6	5	12.274	9.724	6.45
23255	784.5	QPSK	15	12	0	5	11.483	8.933	5.87

Table 17 - Maximum Conducted Output Power, Top Channel

FCC 47 CFR Part 27, Limit Clause 50

Clause	Requirement
27.50 (b)(9)	Control stations and mobile stations transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands and fixed stations transmitting in the 787-788 MHz and 805-806 MHz bands are limited to 30 watts ERP.

Table 18 - FCC Part 27 Limit

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

ISED RSS-130, Limit Clause 4.6

The transmitter output power shall be measured in terms of average power. In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

Clause	Requirement
4.6.3	The e.r.p. shall not exceed 30 watts for mobile equipment and outdoor fixed subscriber equipment. The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Table 19 - RSS-130 Limit

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Directional Coupler	Krytar	1850	58	-	TU
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5420	12	06-Jun-2025
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	12	23-May-2025
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	6558	12	29-Nov-2025

Table 20

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.2 Occupied Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 2.1049
ISED RSS-GEN 6.7

2.2.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 1

2.2.3 Date of Test

12-December-2024

2.2.4 Test Method

The test was performed in accordance with KDB 971168 D01 v03r01, Clause 4.1.

EUT was powered by 3x 1.5V battery cells.

2.2.5 Environmental Conditions

Ambient Temperature	19.1 °C
Relative Humidity	34.1 %

2.2.6 Test Results

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UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	26 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
23205	779.5	π/2-BPSK	15	1	0	0	176.0	156.43
23205	779.5	π/4-QPSK	15	1	0	3	160.3	138.51
23205	779.5	QPSK	15	12	0	5	221.3	190.52

Table 21 - Emission Bandwidth, Bottom Channel

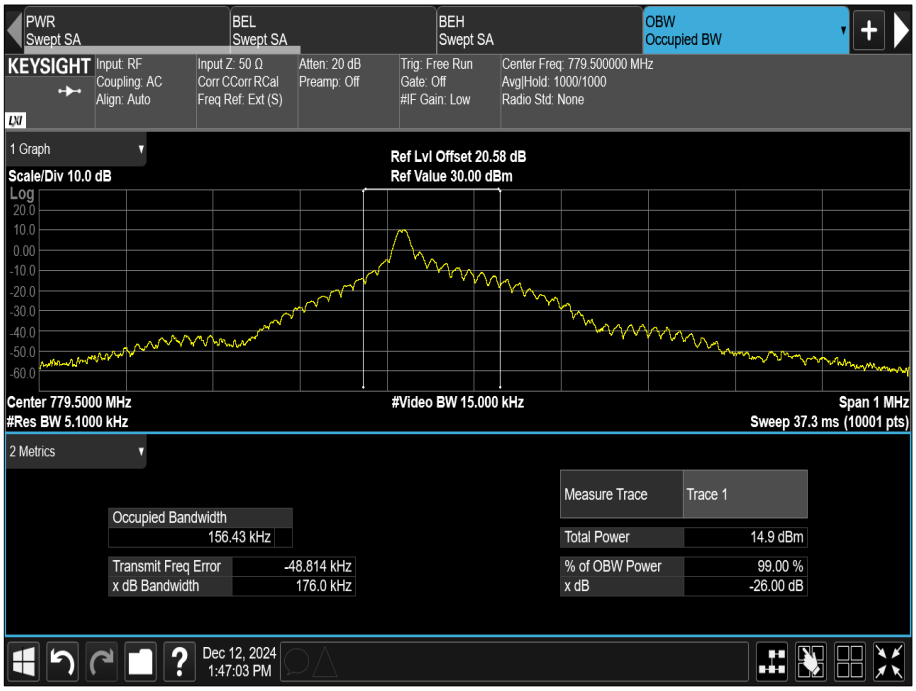

Figure 1 - Emission Bandwidth, 779.5 MHz, Modulation: π/2-BPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 0

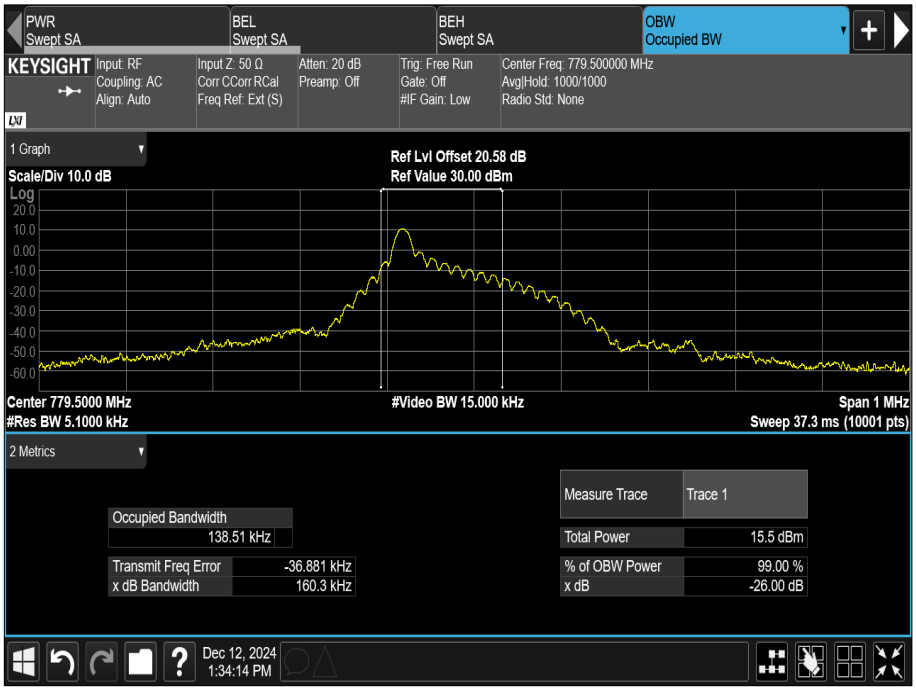

Figure 2 - Emission Bandwidth, 779.5 MHz, Modulation: π/4-QPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 0

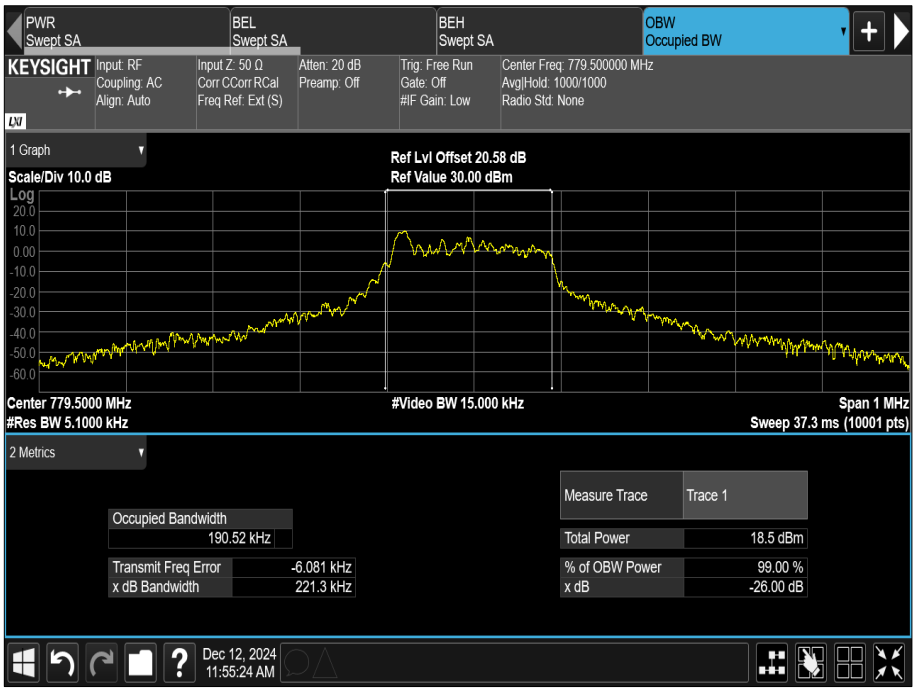

Figure 3 - Emission Bandwidth, 779.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 12, Start Sub-Carrier: 0

UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	26 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
23225	784.5	π/2-BPSK	15	1	0	0	174.7	153.96
23225	784.5	π/4-QPSK	15	1	0	3	160.0	137.64
23225	784.5	QPSK	15	12	0	5	223.3	190.13

Table 22 - Emission Bandwidth, Top Channel

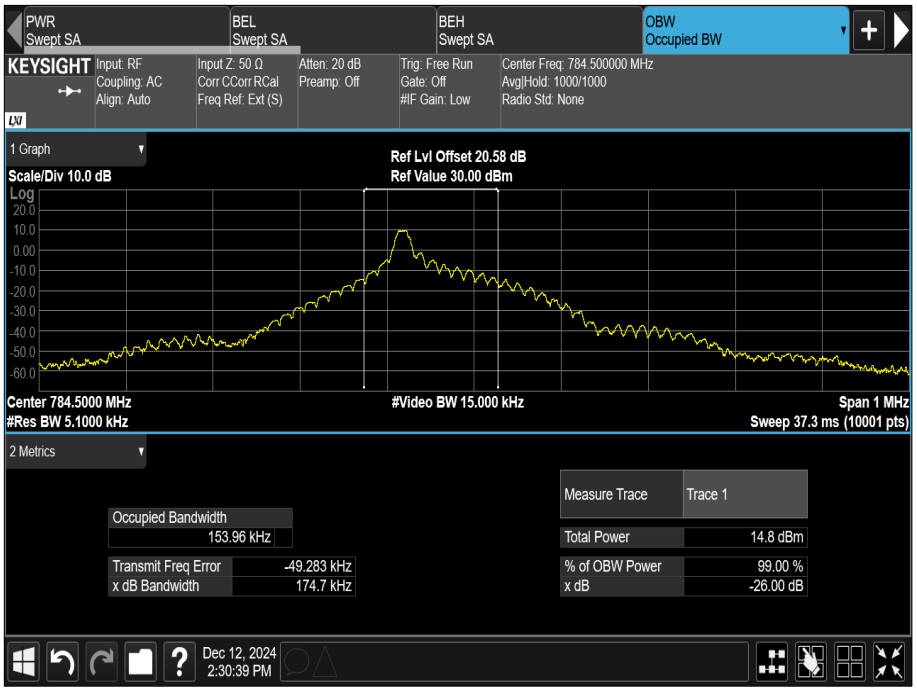

Figure 4 - Emission Bandwidth, 784.5 MHz, Modulation: π/2-BPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 0

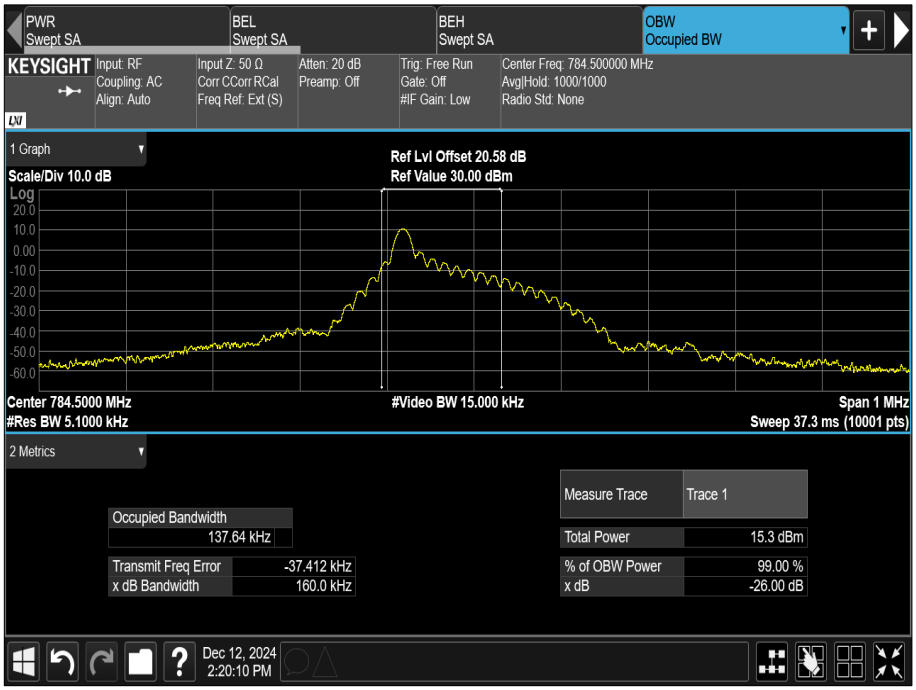

Figure 5 - Emission Bandwidth, 784.5 MHz, Modulation: π/4-QPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 0

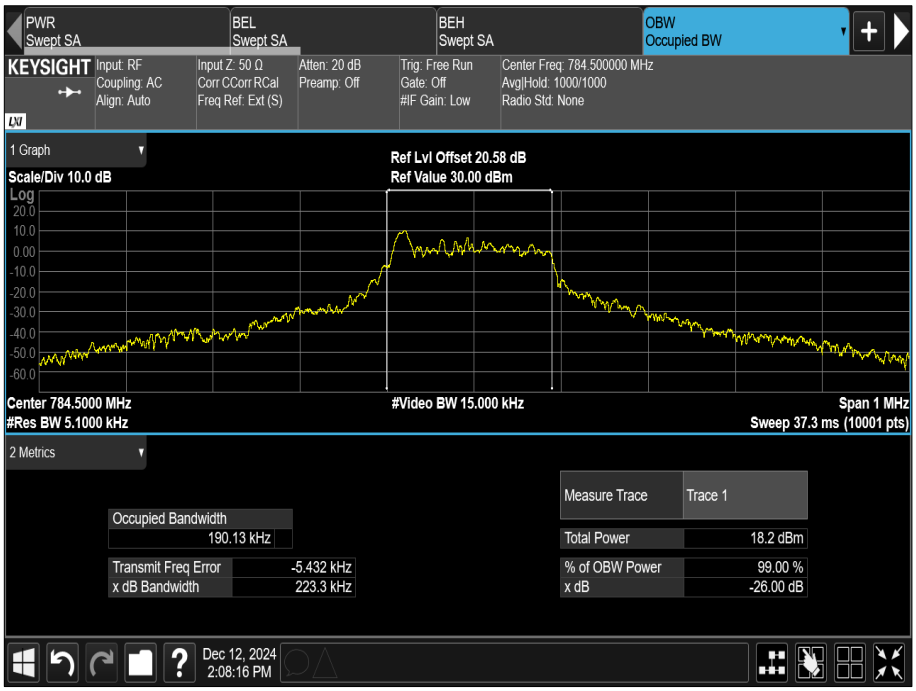

Figure 6 - Emission Bandwidth, 784.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 12, Start Sub-Carrier: 0

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Directional Coupler	Krytar	1850	58	-	TU
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5420	12	06-Jun-2025
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	12	23-May-2025
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	6558	12	29-Nov-2025

Table 23

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.3 Spurious Emissions at Band Edge

2.3.1 Specification Reference

FCC 47 CFR Part 27.53
FCC 47 CFR Part 2.1051
ISED RSS-130 Clause 4.7
ISED RSS-GEN Clause 6.13

2.3.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 1

2.3.3 Date of Test

12-December-2024

2.3.4 Test Method

The test was performed in accordance with KDB 971168 D01 v03r01, Clause 6.

EUT was powered by 3x 1.5V battery cells.

2.3.5 Environmental Conditions

Ambient Temperature	19.1 °C
Relative Humidity	34.1 %

2.3.6 Test Results

LTE FDD B13

UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	Level (dBm)
23205	779.5	π/2-BPSK	3.75	1	0	0	-38.87
23205	779.5	π/2-BPSK	15	1	0	0	-38.93
23205	779.5	QPSK	15	3	0	5	-30.31
23205	779.5	QPSK	15	12	0	5	-33.04

Table 24 - Lower Band Edge Results

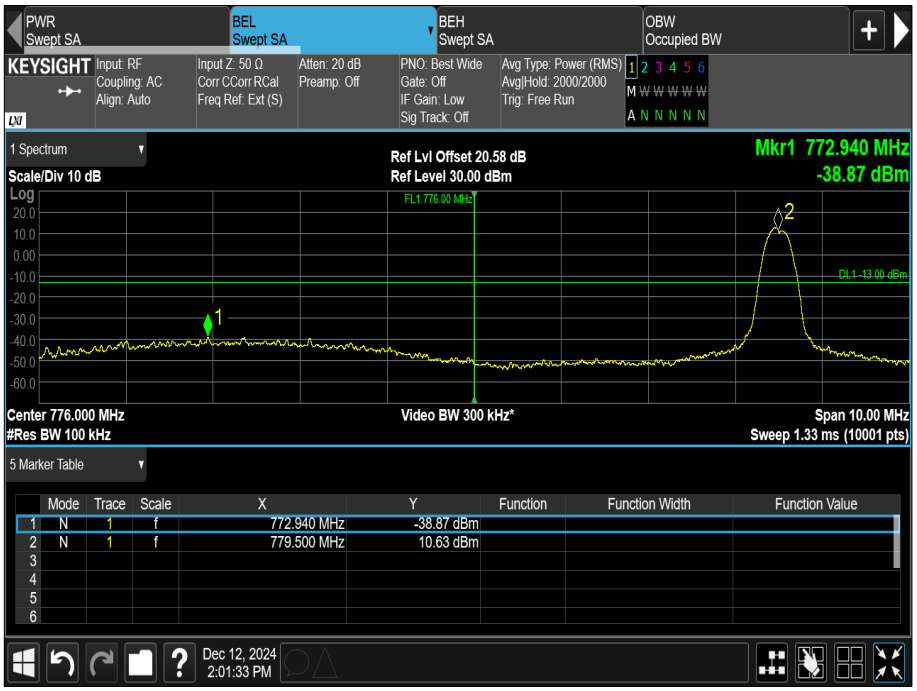

Figure 7 - Lower Band Edge, 779.5 MHz, Modulation: π/2-BPSK, SCS: 3.75 kHz, Tone Number: 1, Start Sub-Carrier: 0

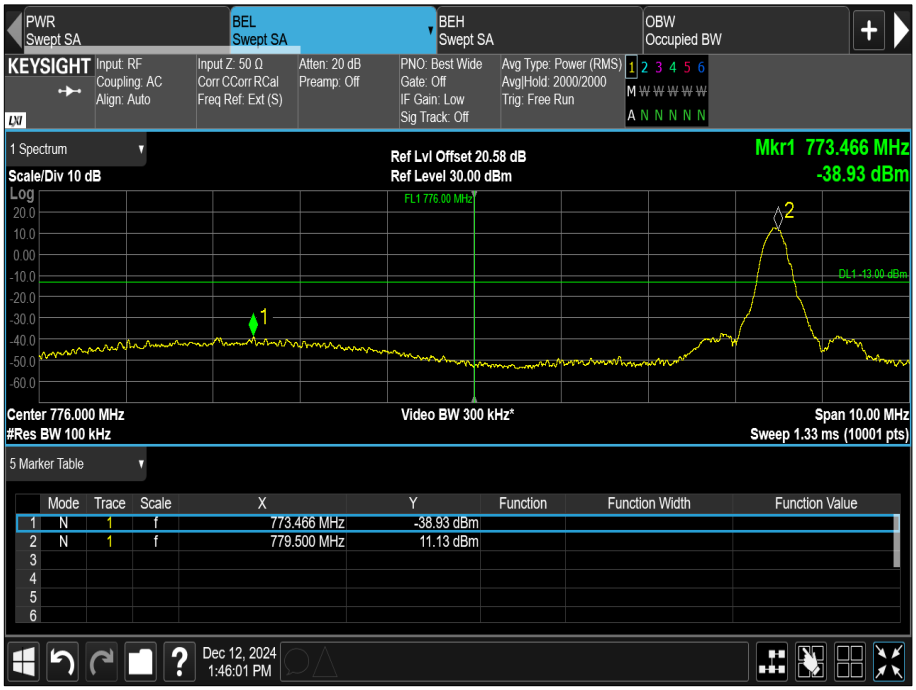

Figure 8 - Lower Band Edge, 779.5 MHz, Modulation: π/2-BPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 0

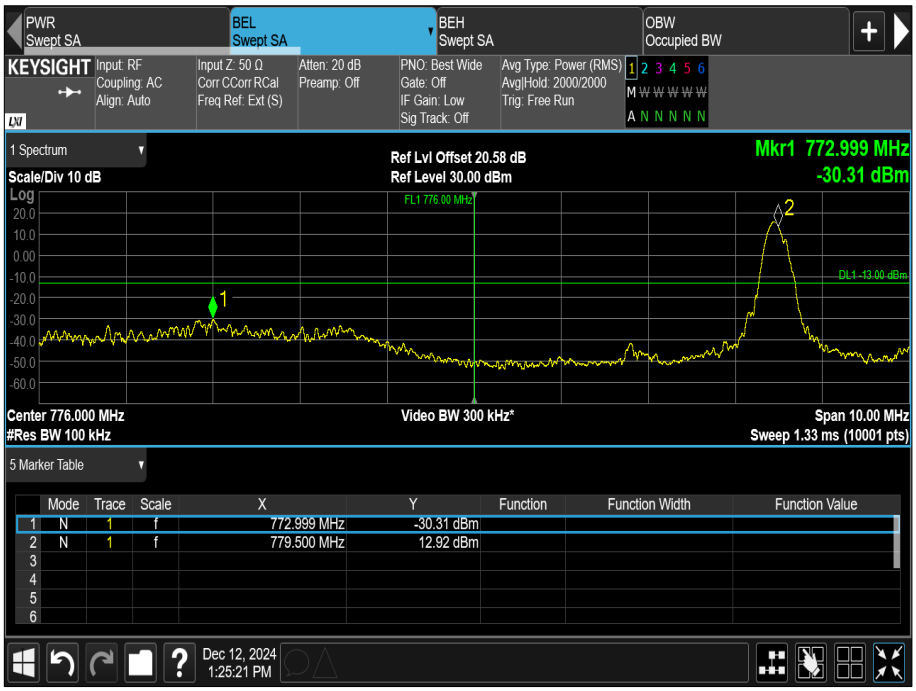

Figure 9 - Lower Band Edge, 779.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 3, Start Sub-Carrier: 0

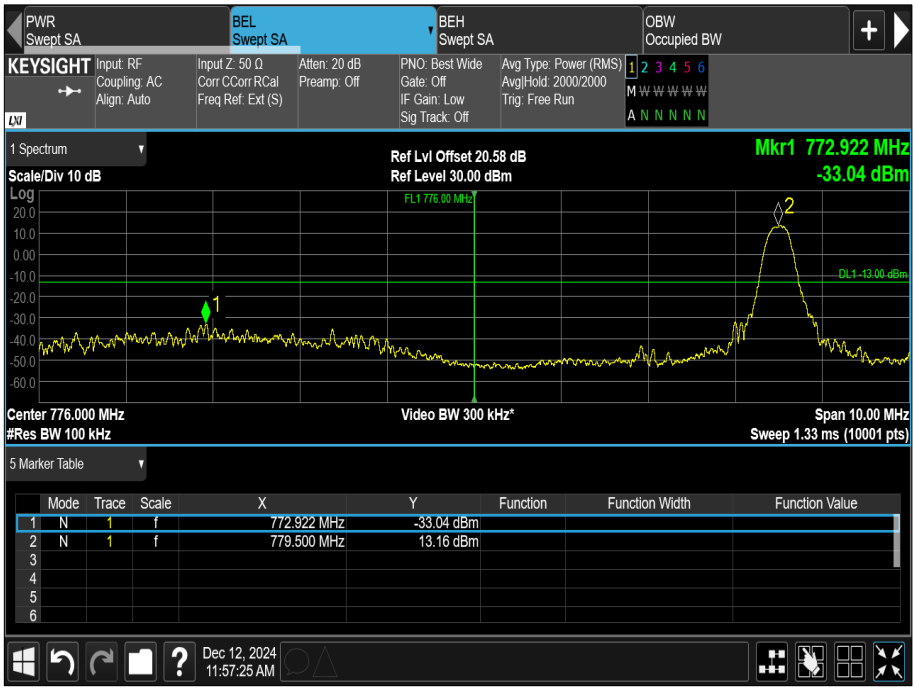

Figure 10 - Lower Band Edge, 779.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 12, Start Sub-Carrier: 0

UARFCN	Frequency (MHz)	Modulation	SCS (kHz)	Tone Number	Start Sub-Carrier	MCS	Level (dBm)
23255	784.5	π/2-BPSK	3.75	1	47	0	-39.20
23255	784.5	π/2-BPSK	15	1	11	0	-38.29
23255	784.5	QPSK	15	3	6	5	-29.68
23255	784.5	QPSK	15	12	0	5	-33.16

Table 25 - Upper Band Edge Results

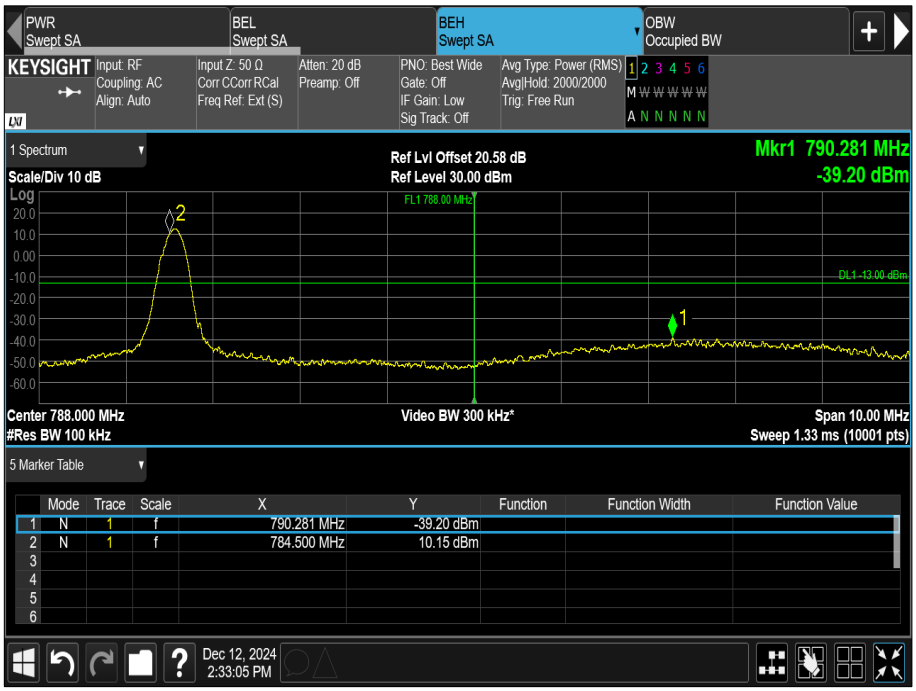

Figure 11 - Upper Band Edge, 784.5 MHz, Modulation: π/2-BPSK, SCS: 3.75 kHz, Tone Number: 1, Start Sub-Carrier: 47

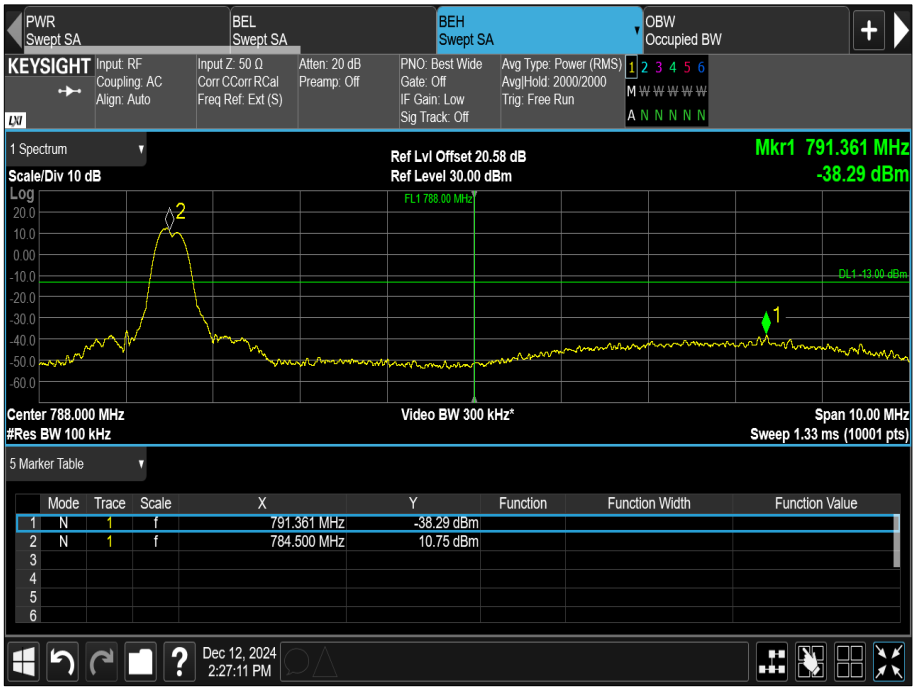

Figure 12 - Upper Band Edge, 784.5 MHz, Modulation: π/2-BPSK, SCS: 15 kHz, Tone Number: 1, Start Sub-Carrier: 11

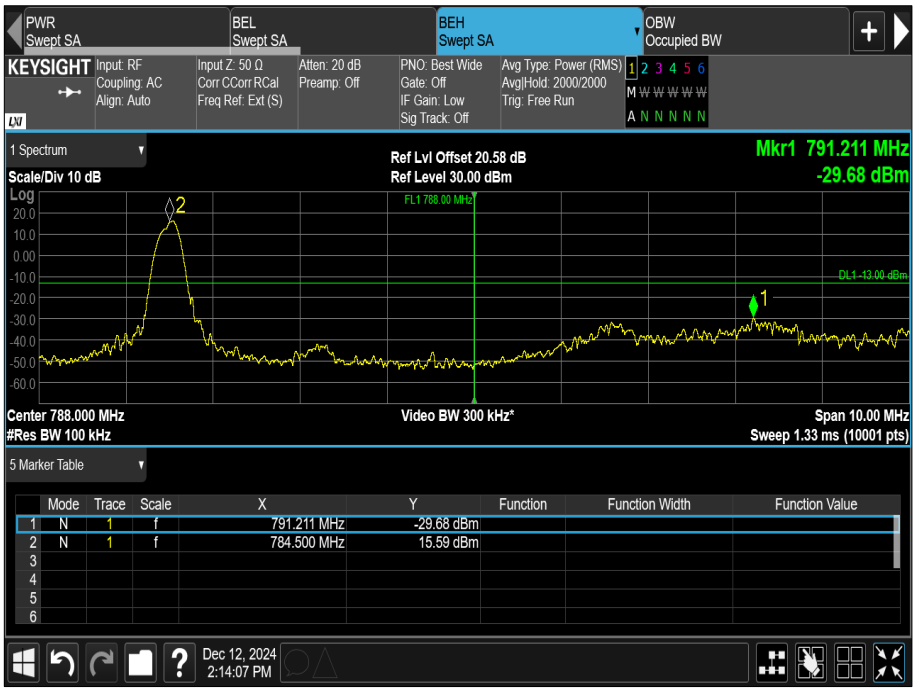

Figure 13 - Upper Band Edge, 784.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 3, Start Sub-Carrier: 6

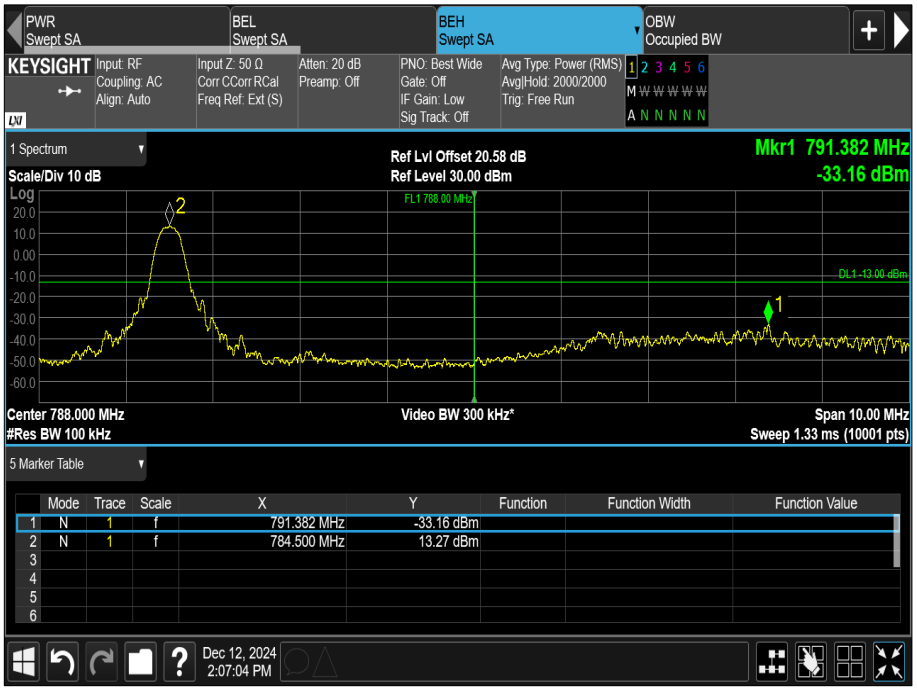

Figure 14 - Upper Band Edge, 784.5 MHz, Modulation: QPSK, SCS: 15 kHz, Tone Number: 12, Start Sub-Carrier: 0

FCC 47 CFR Part 27, Limit Clause 27.53

Clause	Requirement
27.53(c)(2)	On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB

Table 26 - FCC Part 27 Limit

Clause	Requirement
4.7.1 and 4.7.2	The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least: 76 + 10 log10 p (watts), dB, for base and fixed equipment and 65 + 10 log10 p (watts), dB, for mobile and portable equipment. The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

Table 27 - ISED RSS-130 Limit

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Directional Coupler	Krytar	1850	58	-	TU
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5420	12	06-Jun-2025
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	12	23-May-2025
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	6558	12	29-Nov-2025

Table 28

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.4 Frequency Stability

2.4.1 Specification Reference

FCC 47 CFR Part 27.54
FCC 47 CFR Part 2.1055
ISED RSS-130 Clause 4.5
ISED RSS-GEN Clause 6.11

2.4.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 2

2.4.3 Date of Test

12-December-2024 to 16-December-2024

2.4.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.6 and the provisions of RSS-GEN clause 6.11.

The measurement function of a spectrum analyser was used to measure the 99% occupied bandwidth as per ANSI C63.26 clause 5.4.4. The lower and upper boundaries were recorded to ensure the remained within the allocated frequency block.

EUT was powered by a DC PSU.

2.4.5 Environmental Conditions

Ambient Temperature	19.1 - 19.7 °C
Relative Humidity	34.1 - 45.3 %

2.4.6 Test Results

Voltage	779.5 MHz			784.5 MHz		
	F_{LOWER} (MHz)	F_{UPPER} (MHz)	Error (ppm)	F_{LOWER} (MHz)	F_{UPPER} (MHz)	Error (ppm)
2.2	779.3987	779.5146	-55.566	784.4010	784.5569	-26.841
4.5	779.3986	779.5158	-54.935	784.4005	784.5562	-27.604

Table 29 - Frequency Stability Under Voltage Variations

Temperature	779.5 MHz			784.5 MHz		
	F_{LOWER} (MHz)	F_{UPPER} (MHz)	Error (ppm)	F_{LOWER} (MHz)	F_{UPPER} (MHz)	Error (ppm)
50 °C	779.3986	779.5177	-53.691	784.4002	784.5575	-26.954
40 °C	779.3987	779.5164	-54.467	784.4007	784.5579	-26.384
30 °C	779.3995	779.5129	-56.213	784.4009	784.5564	-27.226
20 °C	779.3992	779.5120	-56.962	784.3998	784.5575	-27.177
10 °C	779.3992	779.5113	-57.441	784.4004	784.5552	-28.311
0 °C	779.3993	779.5125	-56.621	784.4001	784.5551	-28.598
-10 °C	779.3988	779.5129	-56.645	784.4001	784.5567	-27.572
-20 °C	779.3983	779.5141	-56.190	784.3998	784.5558	-28.331
-30 °C	Transmitter shut down					

Table 30 - Frequency Stability Under Temperature Variations

FCC 47 CFR Part 27, Limit Clause 27.54

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorised bands of operation.

ISED RSS-130, Limit Clause 4.5

For equipment that is capable of transmitting numerous channels simultaneously for different applications (e.g. LTE and narrowband – Internet of Things (IoT)), the occupied bandwidth shall be the bandwidth representing the sum of the occupied bandwidths of these channels.

The frequency stability shall be sufficient to ensure that the occupied bandwidth remains within each frequency block range when tested at the temperature and supply voltage variations specified in RSS-GEN.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Directional Coupler	Krytar	1850	58	-	TU
Multimeter	Iso-tech	IDM101	2418	12	26-Jul-2025
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
Meter & T/C	R.S Components	Meter 615-8206 & Type K T/C	3612	12	25-Sep-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5420	12	06-Jun-2025
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	12	23-May-2025
Climatic Chamber	Weiss Technik	TempEvent T/180/40/3	5894	12	15-Aug-2024
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	6558	12	29-Nov-2025

Table 31

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.5 Modulation Characteristics

2.5.1 Specification Reference

FCC 47 CFR Part 2.1047 (d)
RSS-130 Clause 4.2

2.5.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 1

2.5.3 Date of Test

12-December-2024

2.5.4 Test Method

The test was performed in accordance with KDB 971168 D01 v03r01, Clause 3.

EUT was powered by 3x 1.5V battery cells.

2.5.5 Environmental Conditions

Ambient Temperature	19.1 °C
Relative Humidity	34.1 %

2.5.6 Test Results

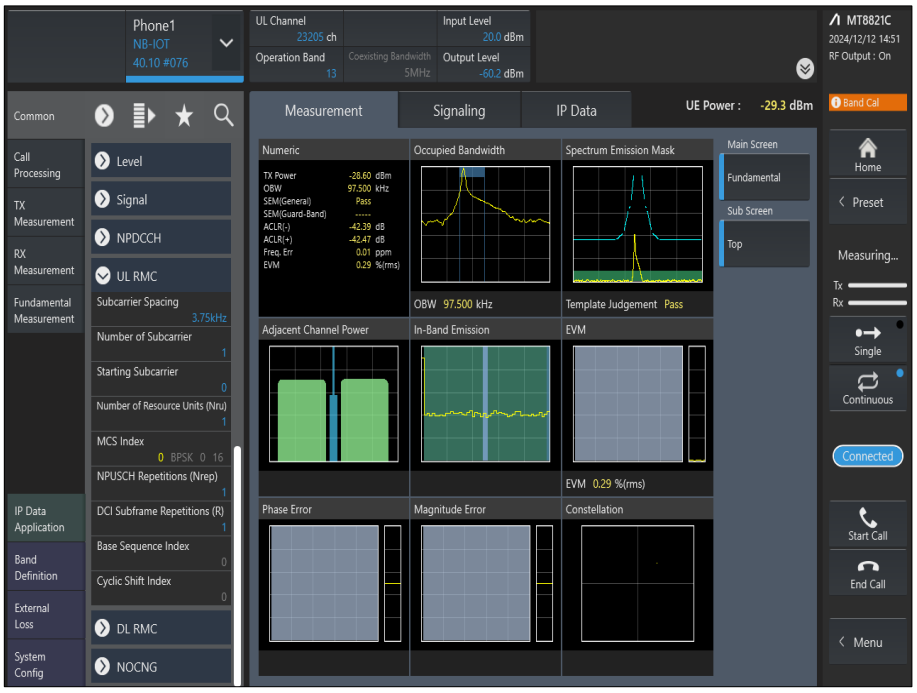

Figure 15 - π/2-BPSK MCS0

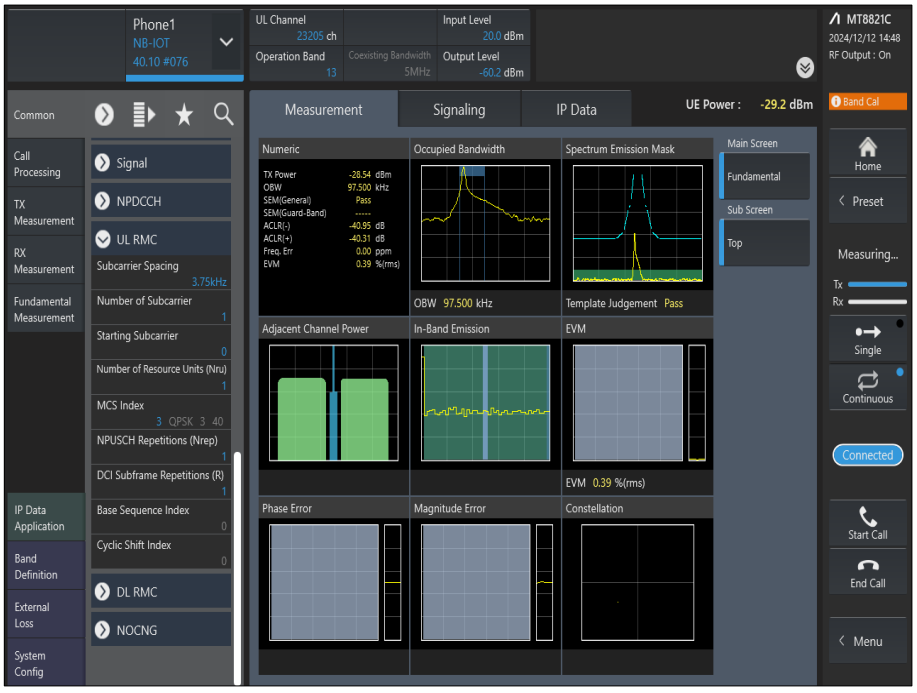

Figure 16 - π/4-QPSK MCS3

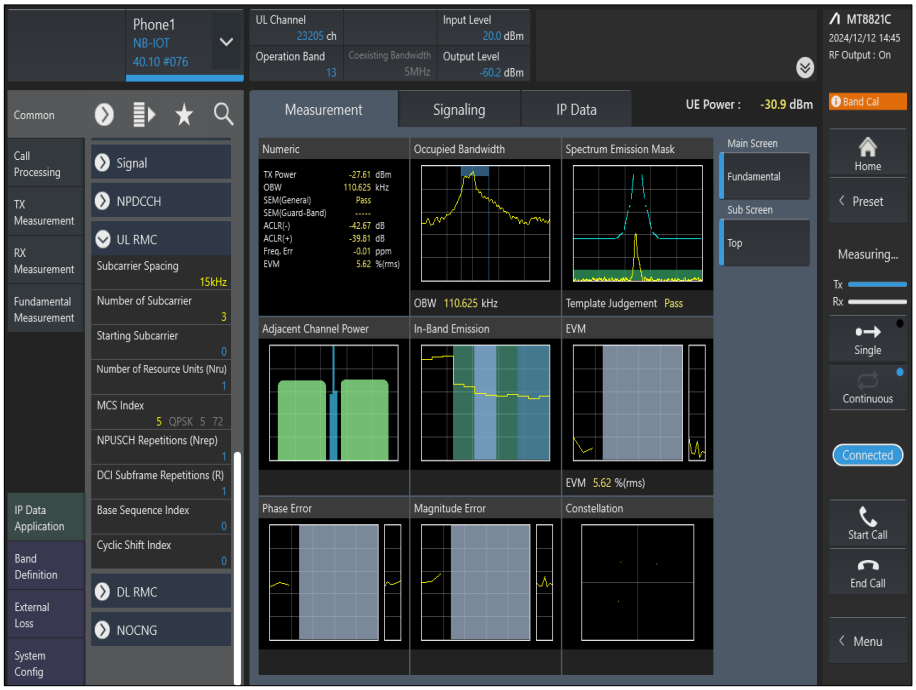

Figure 17 - QPSK MCS5

FCC 47 CFR Part 2, Limit Clause 2.1047 (d)

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

RSS-130, Limit Clause 4.2

Equipment certified under this standard shall employ digital modulation.

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Directional Coupler	Krytar	1850	58	-	TU
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5420	12	06-Jun-2025
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	12	23-May-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	6558	12	29-Nov-2025

Table 32

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

2.6 Radiated Spurious Emissions

2.6.1 Specification Reference

FCC 47 CFR Part 27.53
FCC 47 CFR Part 2.1053
ISED RSS-130 Clause 4.7
ISED RSS-GEN Clause 6.13

2.6.2 Equipment Under Test and Modification State

S/N: 60504 - Modification State 0

2.6.3 Date of Test

11-December-2024

2.6.4 Test Method

A preliminary profile of the Radiated Spurious Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Testing was performed in accordance with ANSI C63.26, Clause 5.5.
Prescans and final measurements were performed using the direct field strength method.
Field strength measurements were performed and then converted to Equivalent Power Measurements in accordance with ANSI C63.26, Clause 5.2.7 equation c)

Example calculation:
E (dBuV/m) + 20log(d) - 104.8 = EIRP (dBm) where (d) is the measurement distance.
82.2 (dBuV/m) + 20log(3) – 104.8 = EIRP (dBm)
-13.0 = EIRP (dBm)

2.6.1 Example Test Setup Diagram

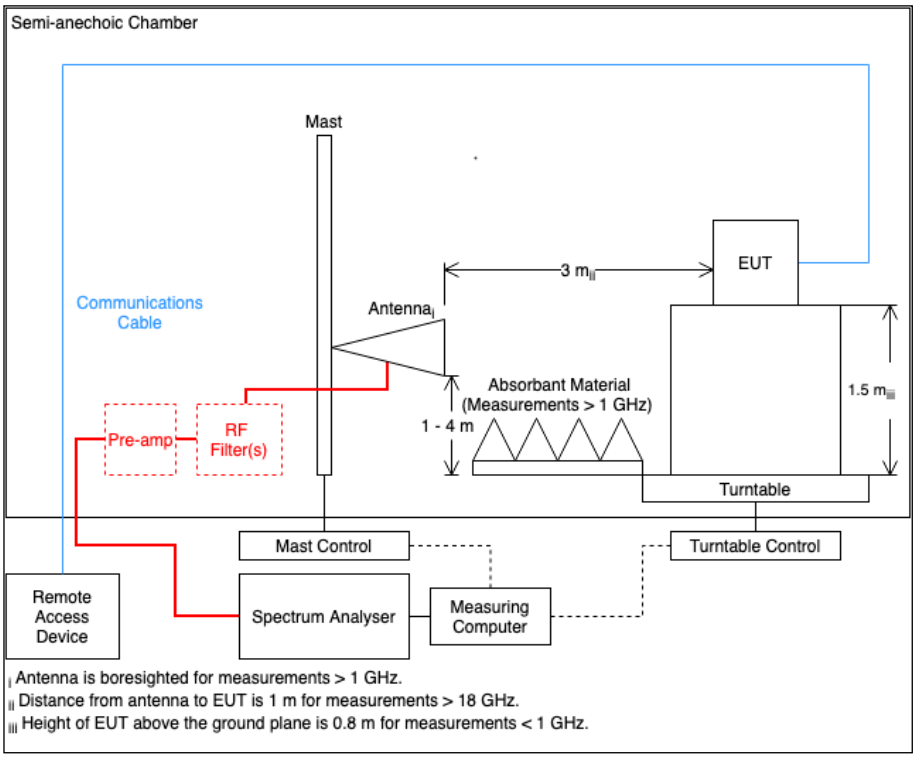

Figure 18

2.6.2 Environmental Conditions

Ambient Temperature	23.6 °C
Relative Humidity	32.4 %

2.6.3 Test Results

LTE FDD B13

Frequency (MHz)	Level (dBm)	Angle	Height	Polarisation	Orientation
1558.785	-45.63*	228	160	Horizontal	X
1558.860	-41.25*	70	191	Vertical	X
1558.880	-41.53*	165	150	Horizontal	Y
1558.930	-45.84*	50	253	Vertical	Y
1558.910	-41.50*	215	301	Horizontal	Z

Table 33 - 779.5 MHz

No other emissions were detected within 10 dB of the limit.

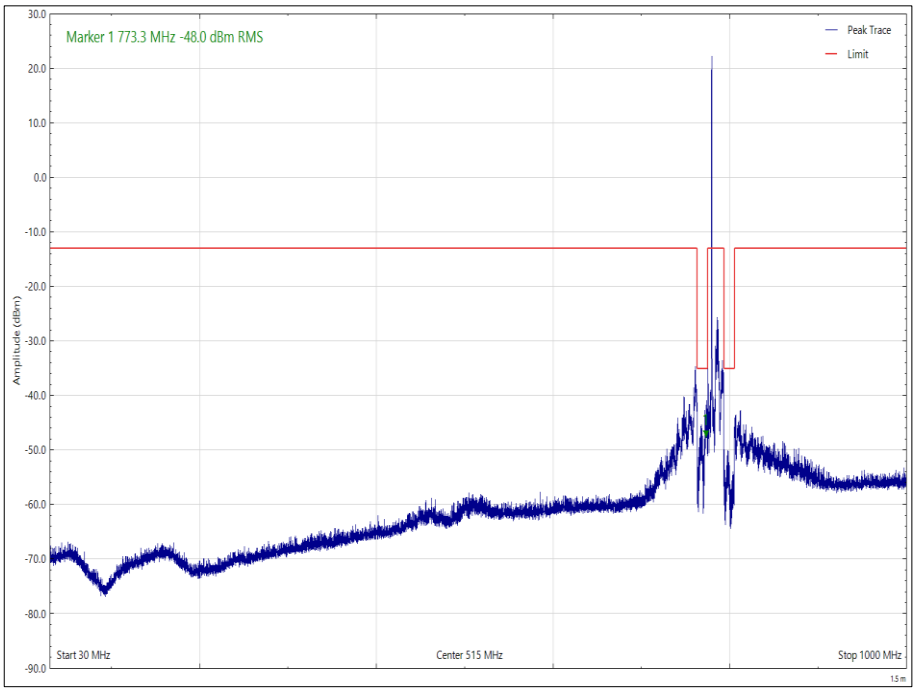

Figure 19 - 779.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation X, Bottom Channel

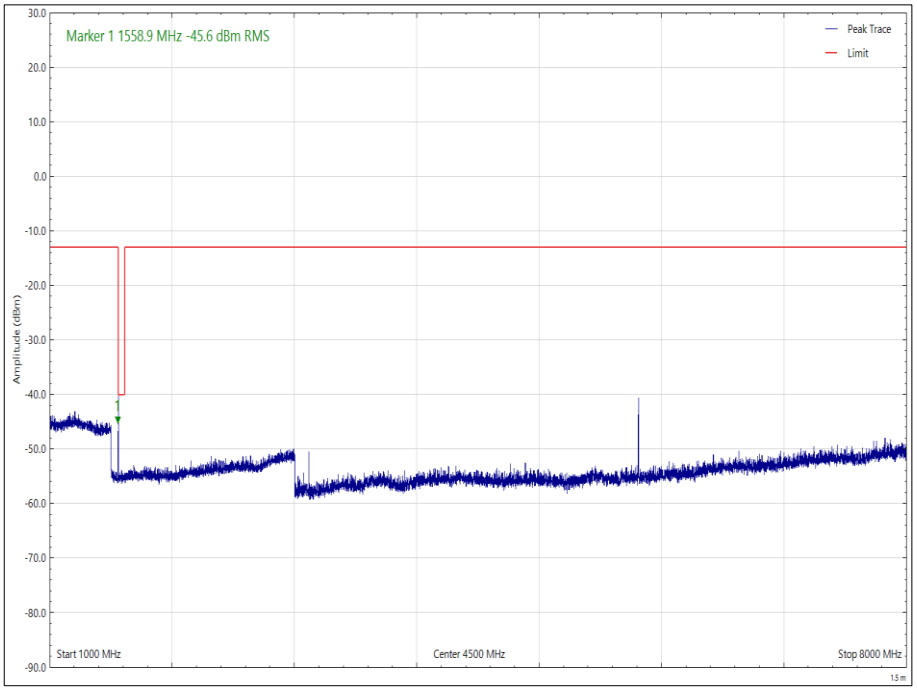

Figure 20 - 779.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation X, Bottom Channel

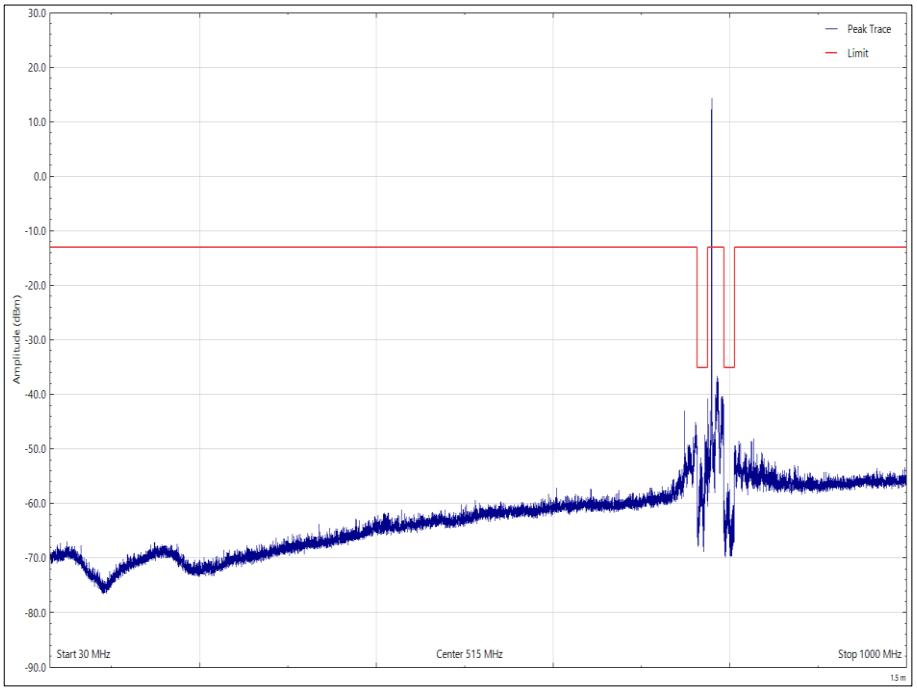

Figure 21 - 779.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation X, Bottom Channel

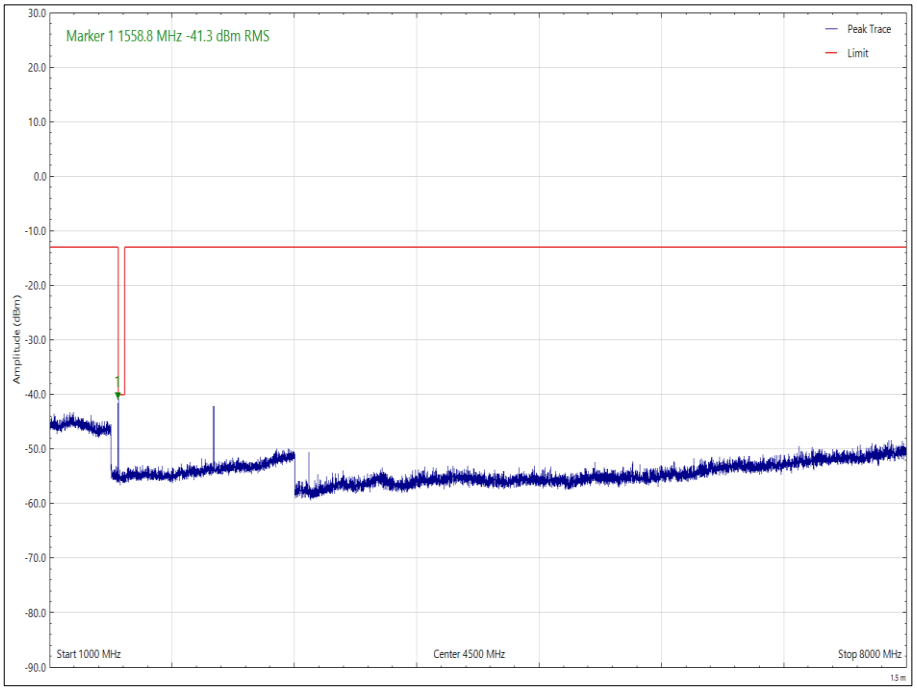

Figure 22 - 779.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation X, Bottom Channel

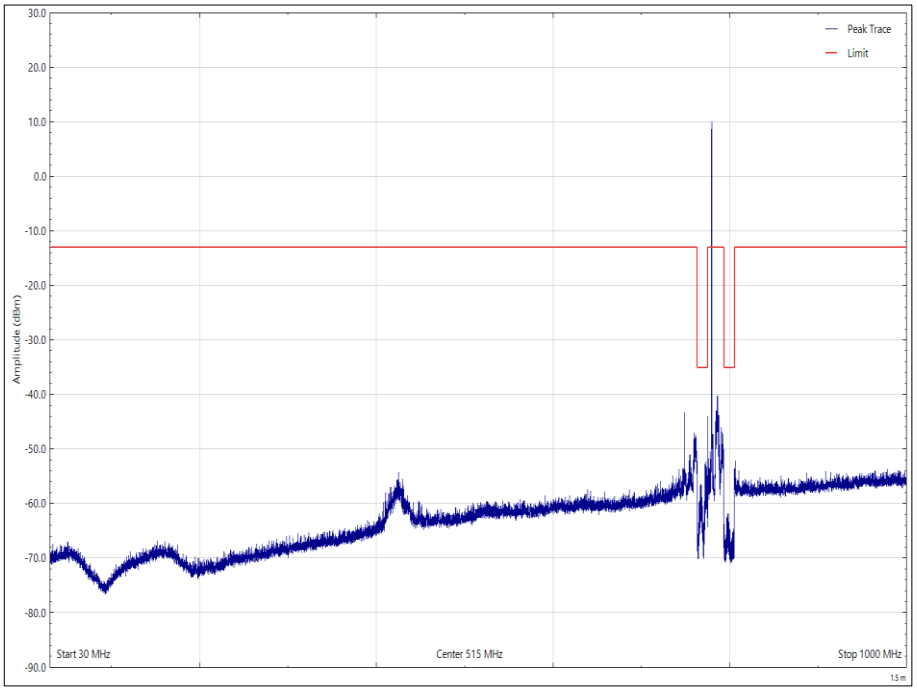

Figure 23 - 779.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation Y, Bottom Channel

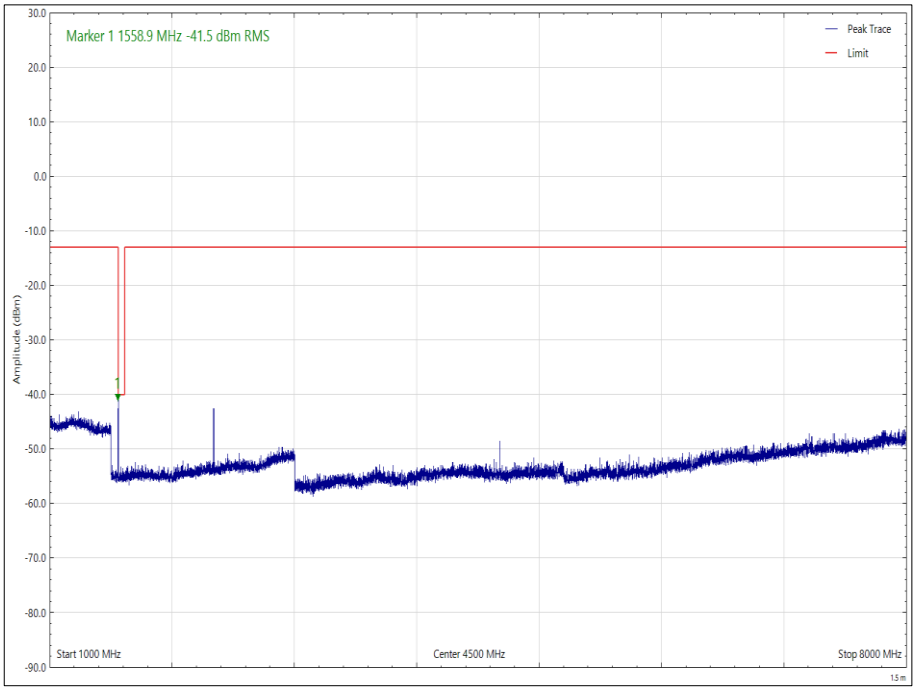

Figure 24 - 779.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation Y, Bottom Channel

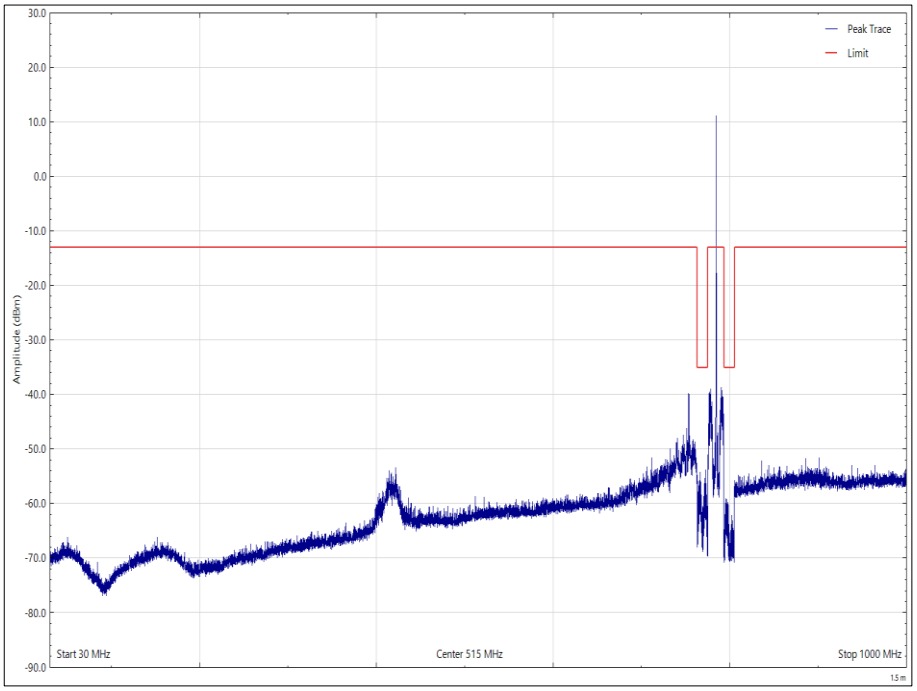

Figure 25 - 779.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation Y, Bottom Channel

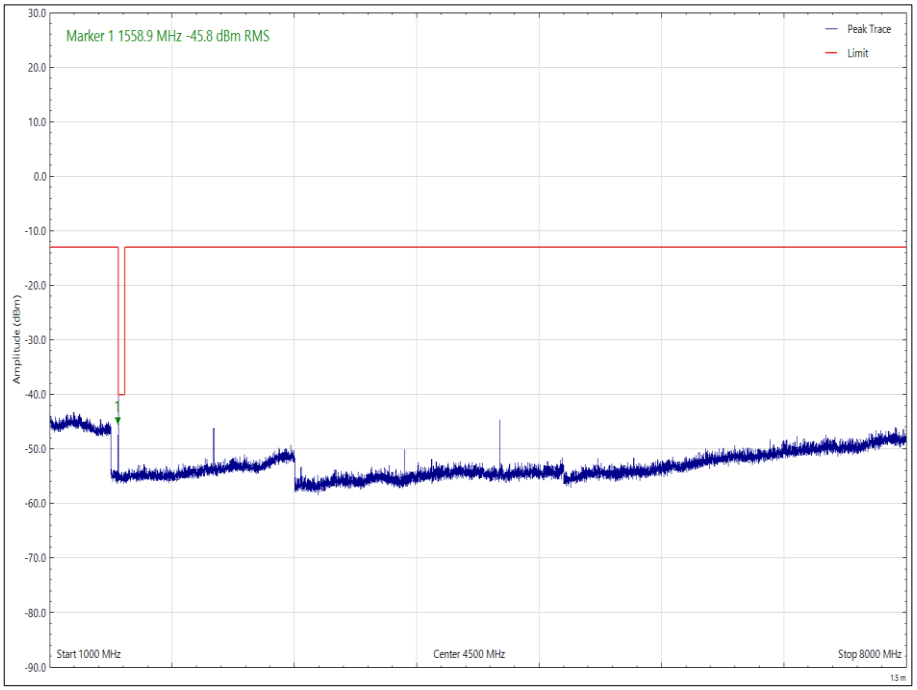

Figure 26 - 779.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation Y, Bottom Channel

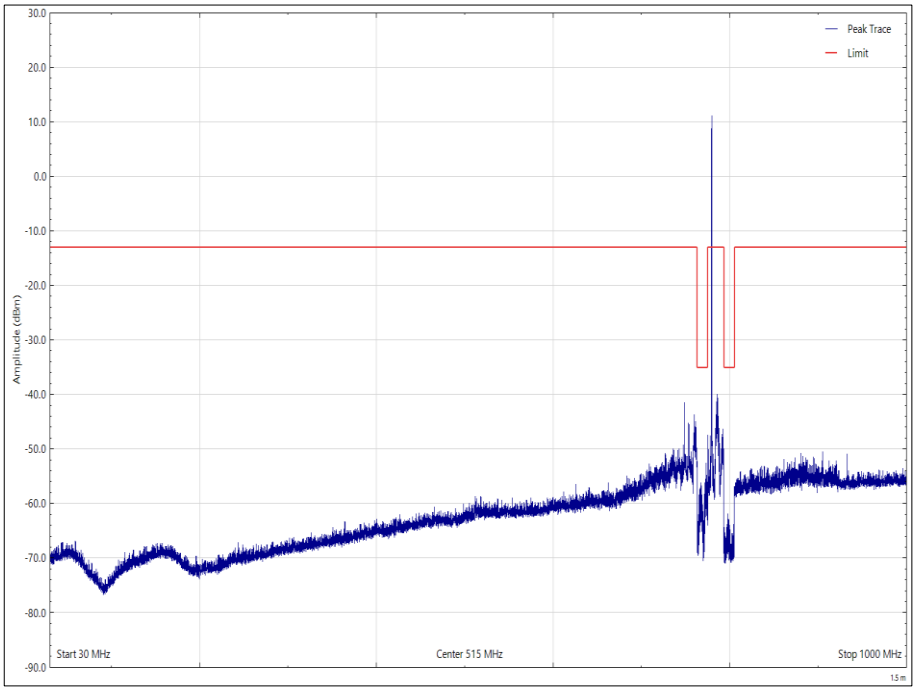

Figure 27 - 779.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation Z, Bottom Channel

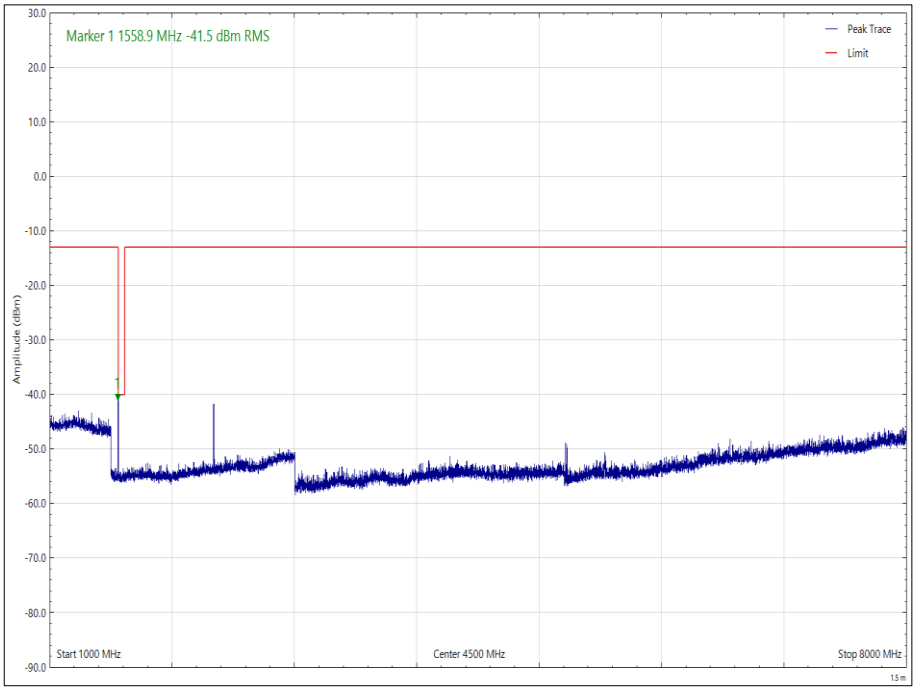

Figure 28 - 779.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation Z, Bottom Channel

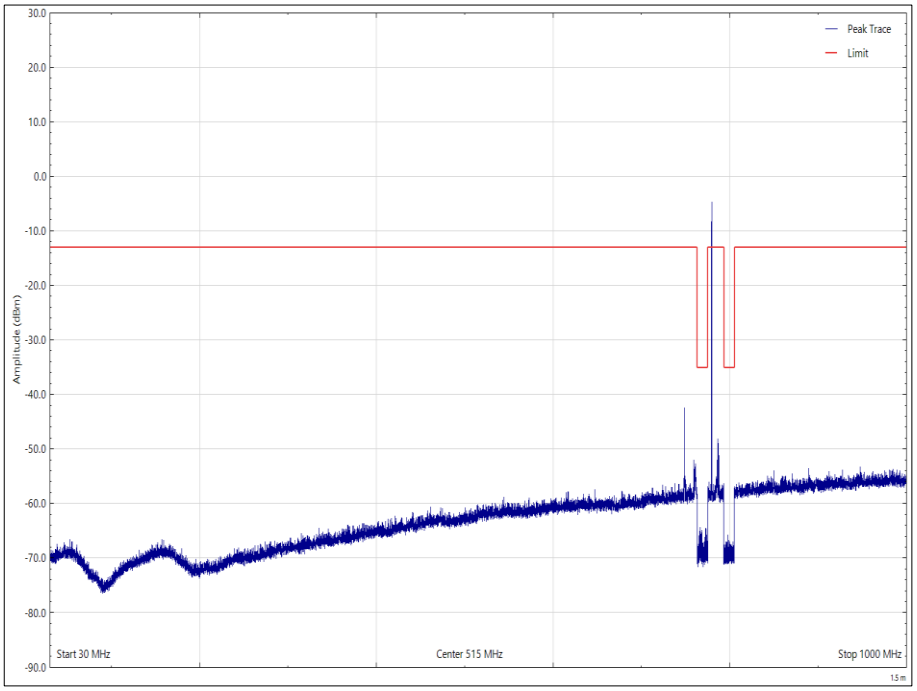

Figure 29 - 779.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation Z, Bottom Channel

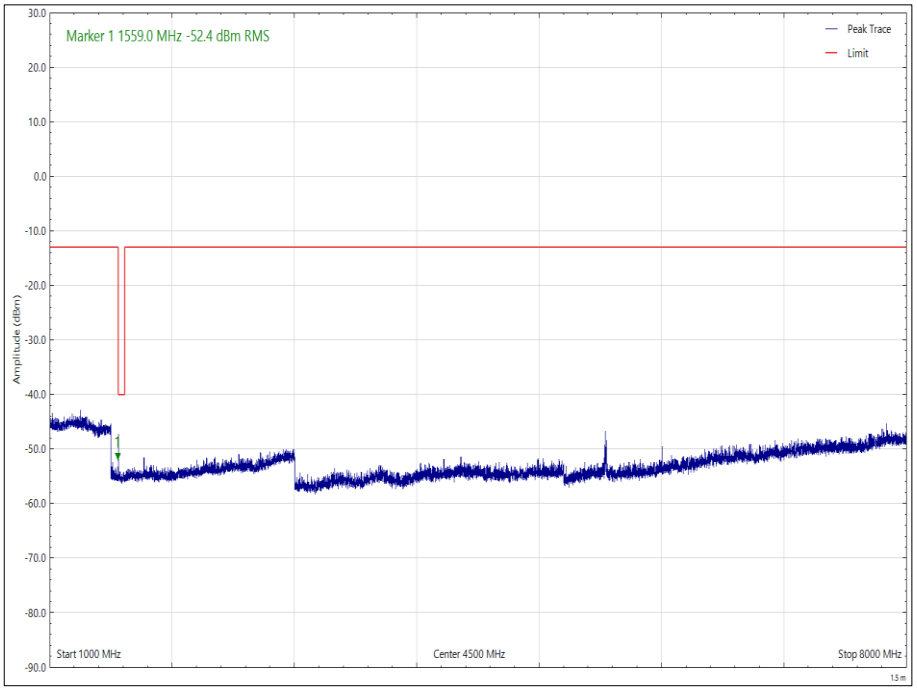

Figure 30 - 779.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation Z, Bottom Channel

Frequency (MHz)	Level (dBm)	Angle	Height	Polarisation	Orientation
1569.060	-46.13	220	150	Horizontal	X
1569.095	-41.00	159	152	Horizontal	Y
1569.125	-45.10	74	150	Vertical	Y
1569.055	-42.15	266	187	Horizontal	Z

Table 34 - 784.5 MHz

No other emissions were detected within 10 dB of the limit.

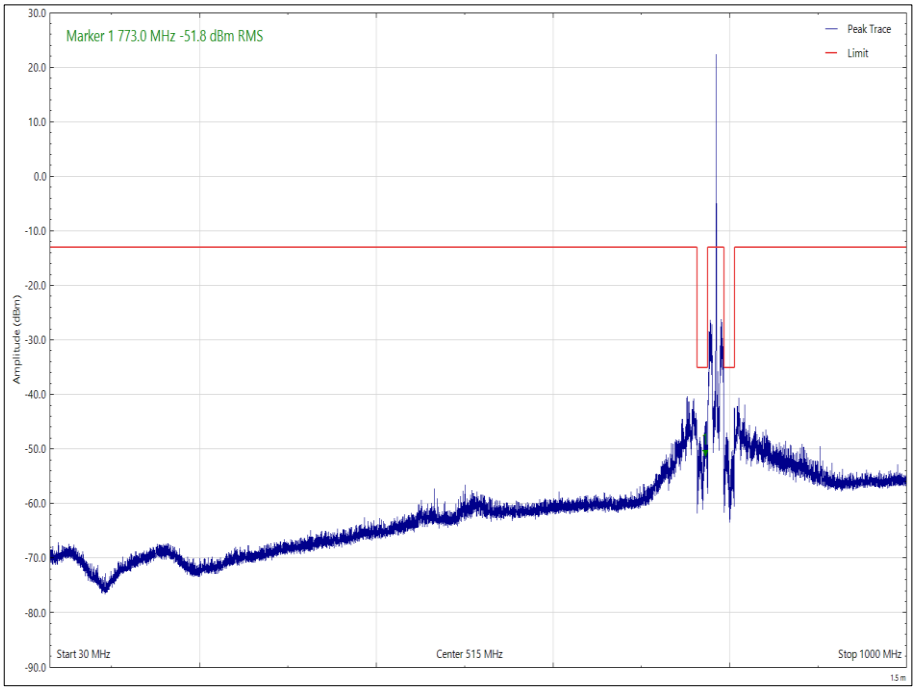

Figure 31 - 784.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation X, Top Channel

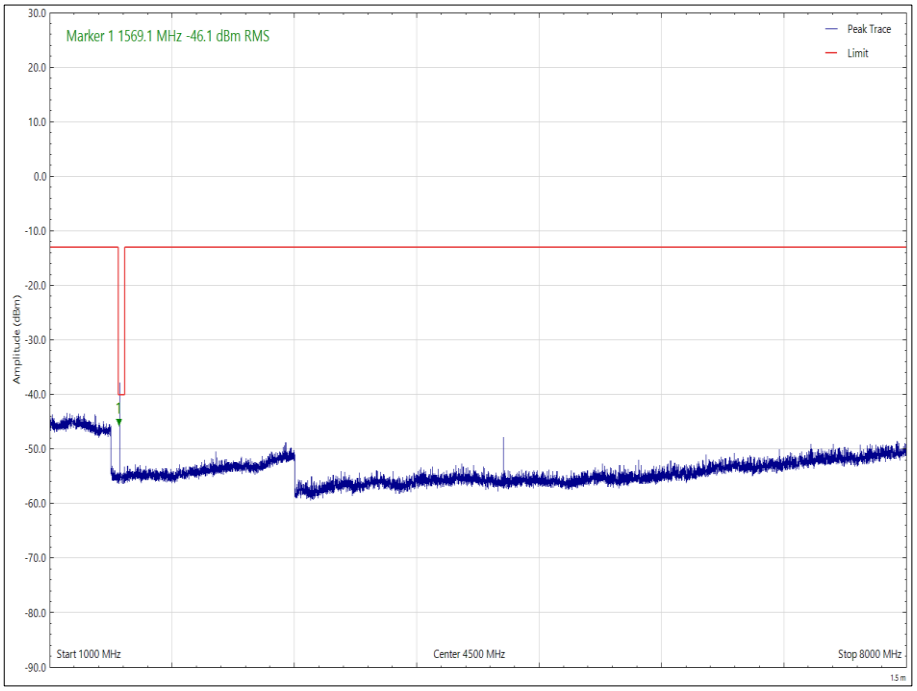

Figure 32 - 784.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation X, Top Channel

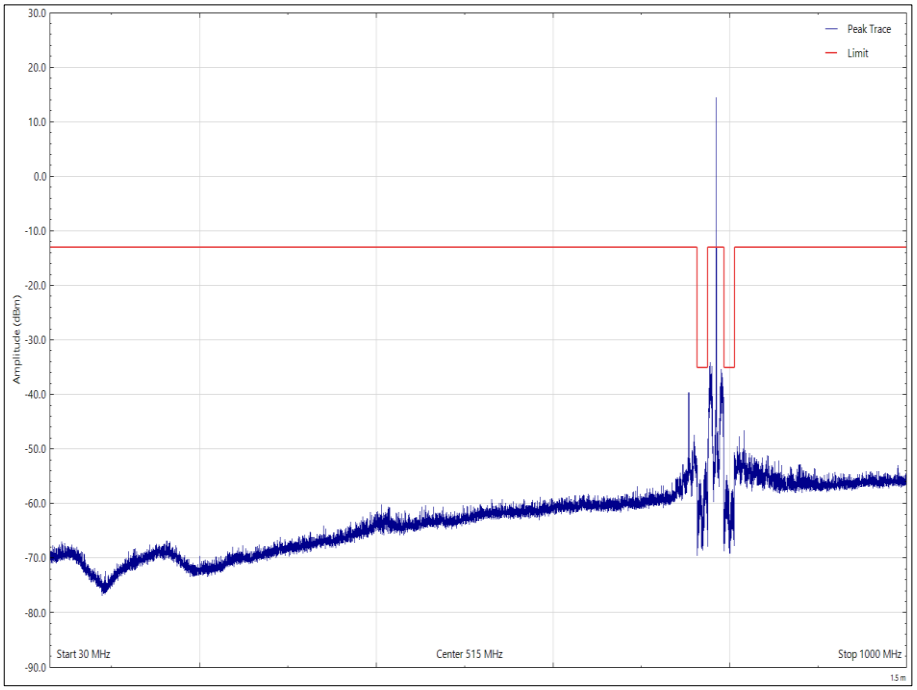

Figure 33 - 784.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation X, Top Channel

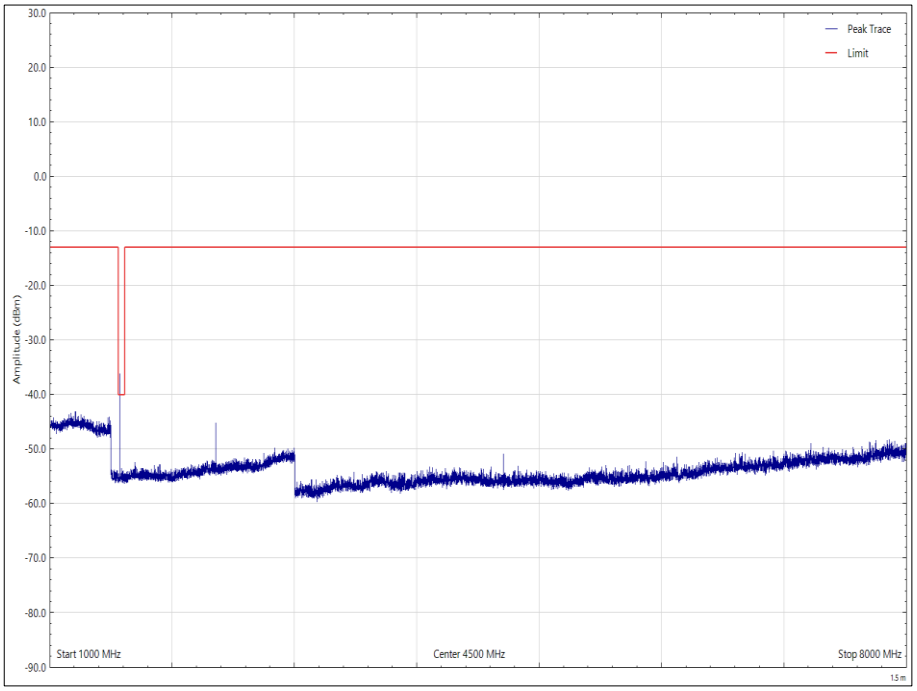

Figure 34 - 784.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation X, Top Channel

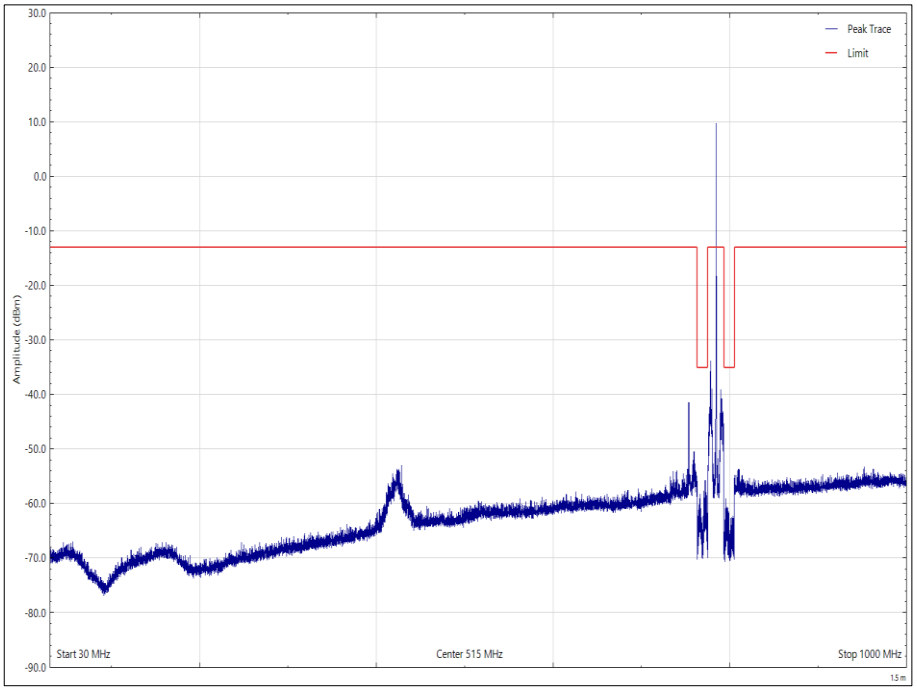

Figure 35 - 784.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation Y, Top Channel

Figure 36 - 784.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation Y, Top Channel

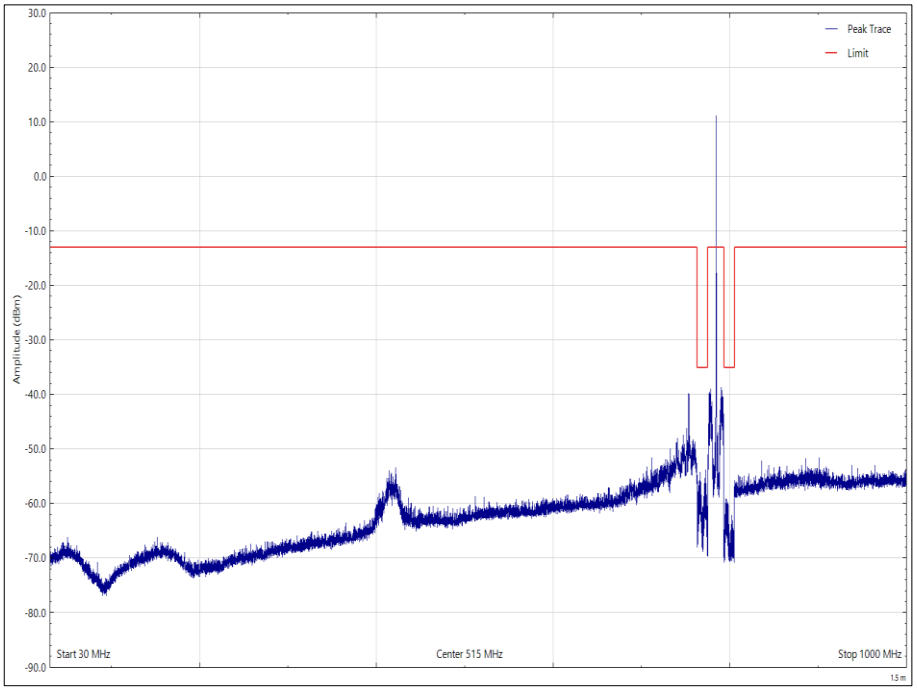

Figure 37 - 784.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation Y, Top Channel

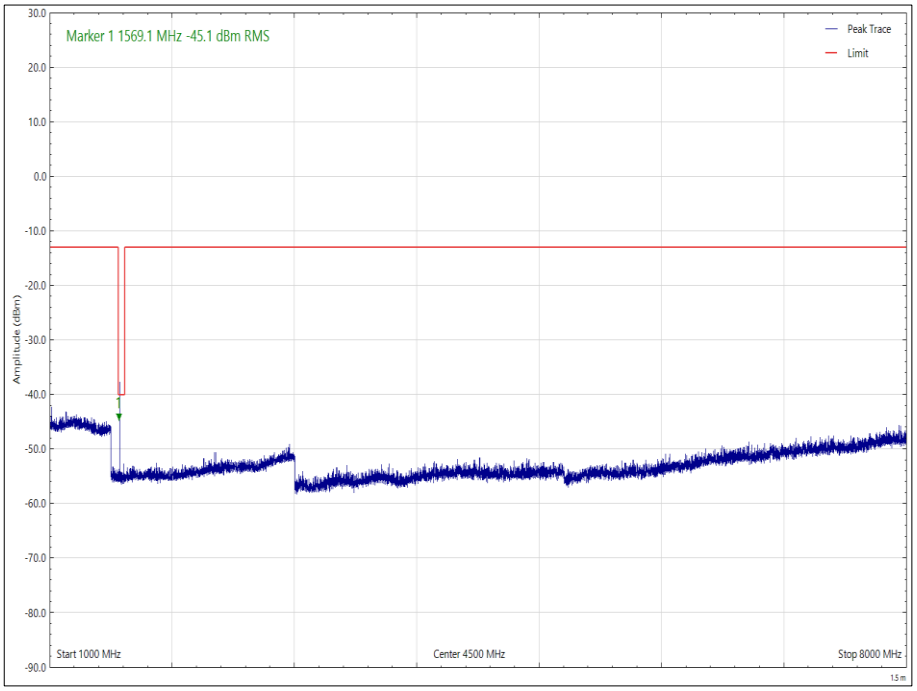

Figure 38 - 784.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation Y, Top Channel

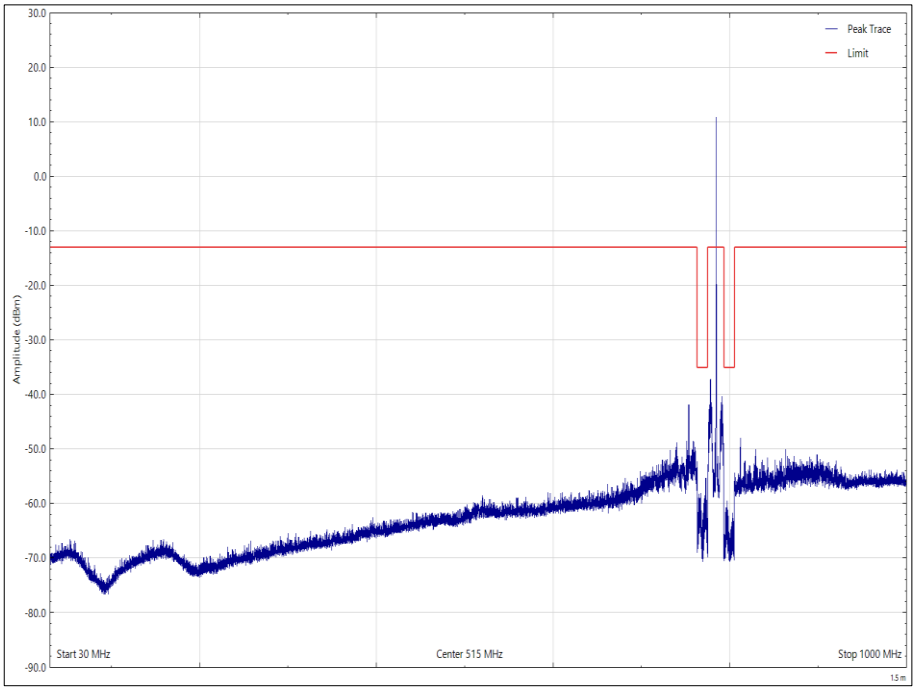

Figure 39 - 784.5 MHz - 30 MHz to 1 GHz, Horizontal, Orientation Z, Top Channel

Figure 40 - 784.5 MHz - 1 GHz to 8 GHz, Horizontal, Orientation Z, Top Channel

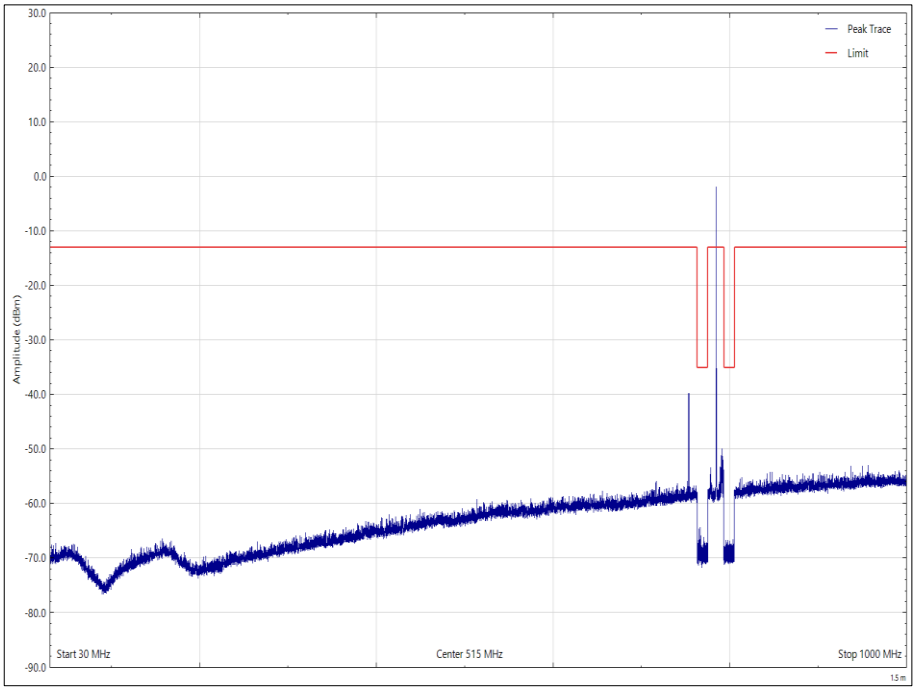

Figure 41 - 784.5 MHz - 30 MHz to 1 GHz, Vertical, Orientation Z, Top Channel

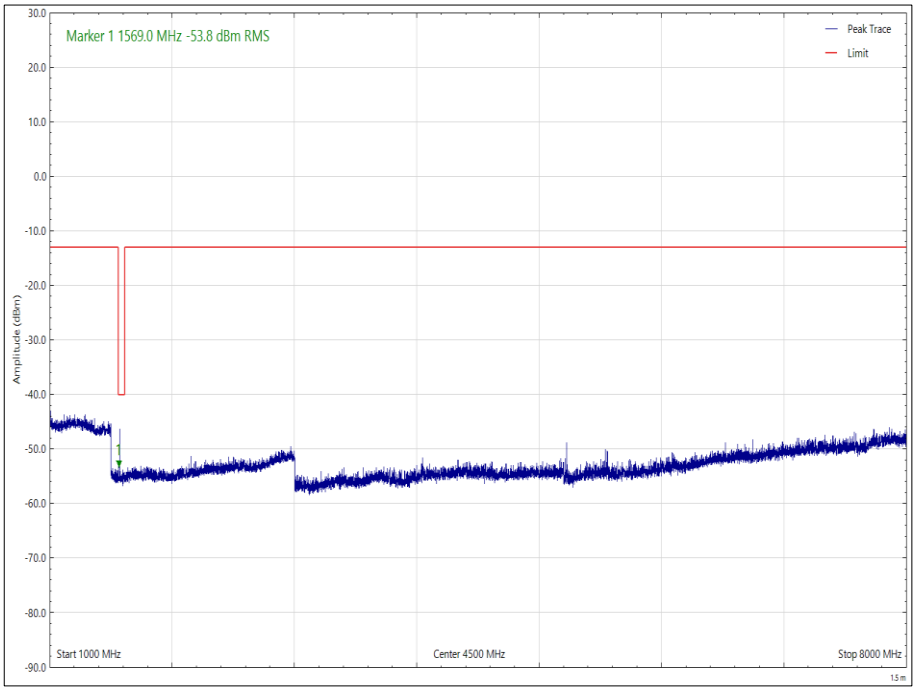

Figure 42 - 784.5 MHz - 1 GHz to 8 GHz, Vertical, Orientation Z, Top Channel

*The emissions recorded here are compared against the -13 limit due to being outside the band 1559-1610 MHz because subcarriers 0-5 are active, if these were on 6-12 the measured value would be compared against -40dBm/MHz and have been included here to demonstrate compliance with the lower of the two limits.

FCC 47 CFR Part 27, Limit Clause 27.53

Clause	Requirement
27.53(c)(2)	On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB

Table 35 - FCC Part 27 Limit

Clause	Requirement
4.7.1 and 4.7.2	The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least: 76 + 10 log10 p (watts), dB, for base and fixed equipment and 65 + 10 log10 p (watts), dB, for mobile and portable equipment. The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

Table 36 - ISED RSS-130 Limit

2.6.4 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
3m Semi-Anechoic Chamber	Rainford	RF Chamber 5	1545	36	23-Apr-2027
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	Hygropalm 0	3028	12	12-Aug-2025
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	18-Apr-2025
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	14-Jul-2025
4dB Attenuator	Pasternack	PE7047-4	4935	12	31-Jul-2025
High Pass filter	Wainwright	WHKX12-1290-1500-18000-80SS	4962	12	14-Jun-2025
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	5215	12	14-Jul-2025
Pre-amplifier (30 dB, 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	09-Apr-2025
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5514	12	23-May-2025
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	23-May-2025
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	26-Jul-2025
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	15-Aug-2025
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
Cable (SMA to SMA 1m)	Junkosha	MWX221/B	5998	12	23-Oct-2025
Humidity & Temperature meter	R.S Components	1364	6149	12	12-Aug-2025
Cable (N to N 8m)	Junkosha	MWX221-08000NMSNMS/B	6331	12	17-Feb-2025
Wireless Connectivity Test Set	Anritsu	MT8862A-002	6524	12	14-Oct-2025
Spectrum Analyser	Anritsu	MT8821C	6542	12	28-Jun-2025
Radio Communications Analyser	Anritsu	MT8821C	6543	12	29-May-2025
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	6635	24	13-Jun-2025

Table 37

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs

Figure 43 - 30 MHz to 1 GHz

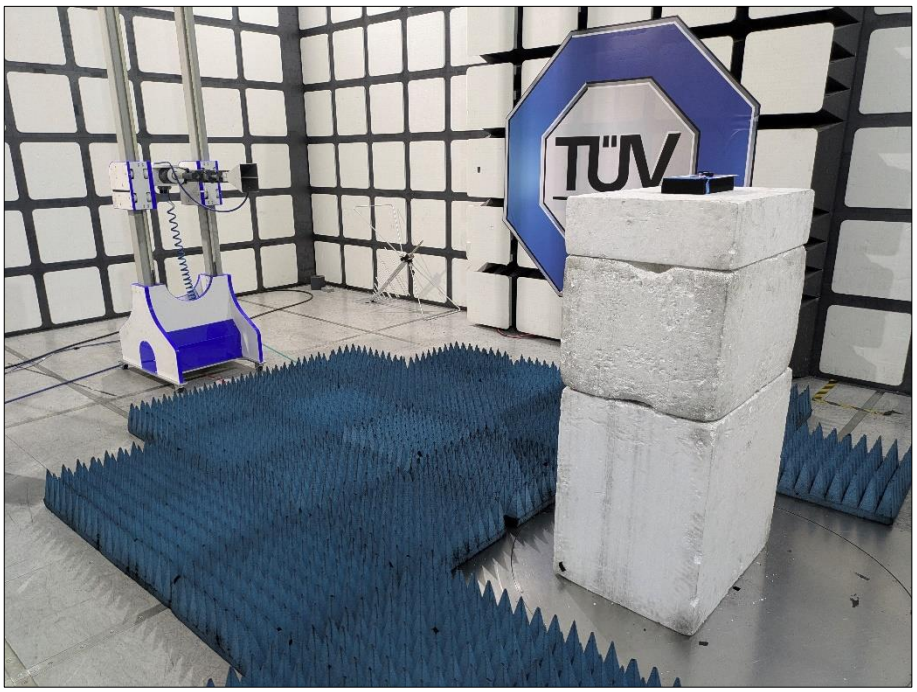

Figure 44 - 1GHz to 8 GHz

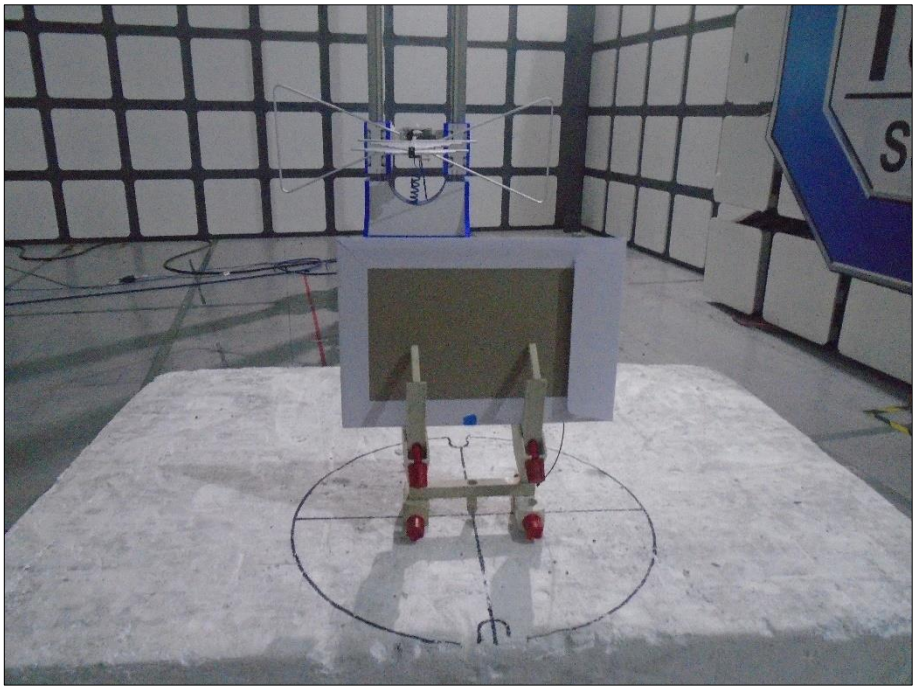

Figure 45 – EUT Orientation, X Plane

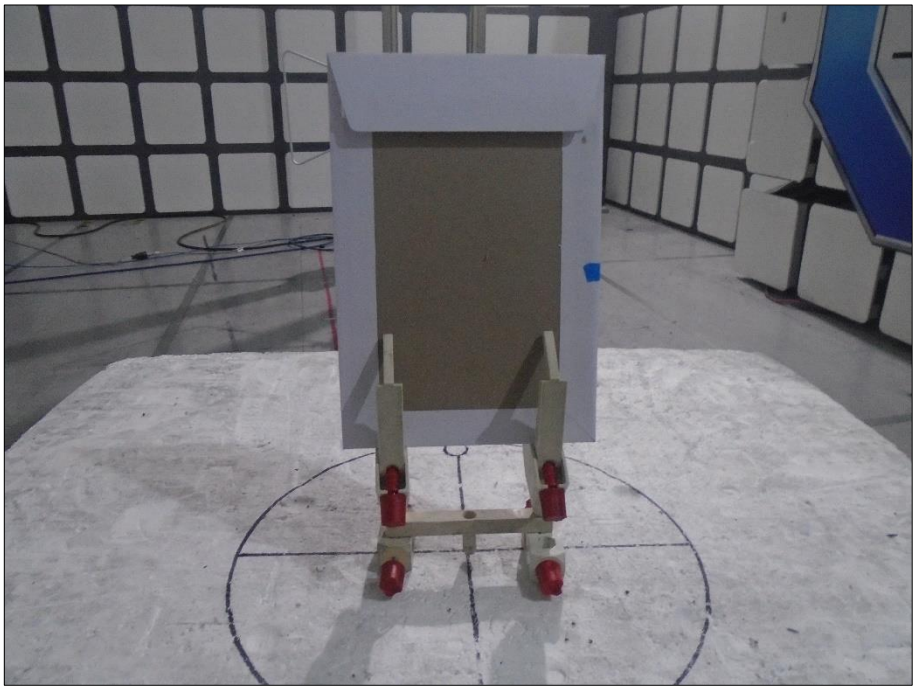

Figure 46 – EUT Orientation, Y Plane

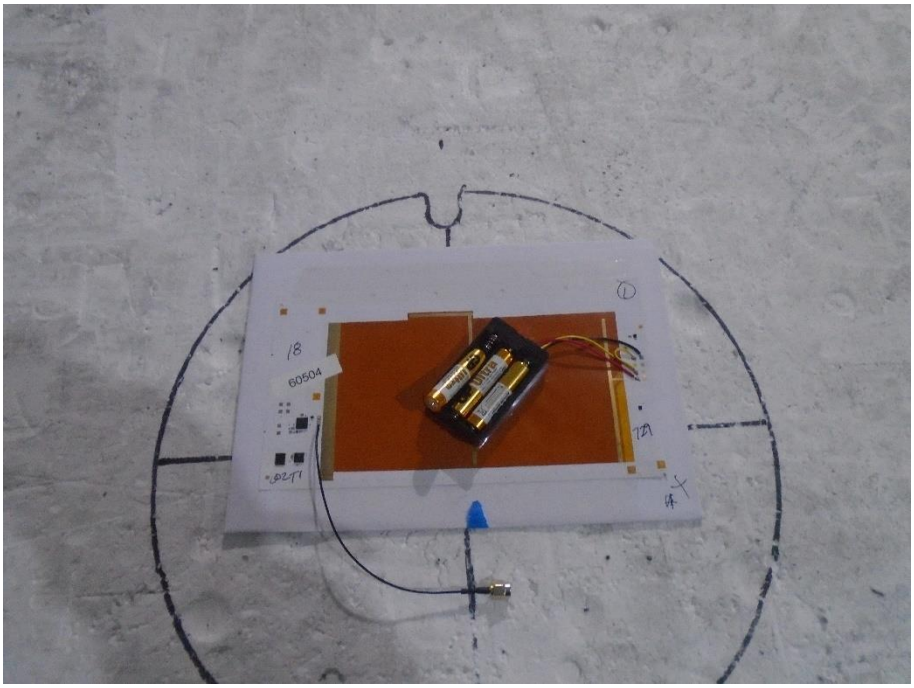

Figure 47 – EUT Orientation, Z Plane

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	±3.2 dB
Occupied Bandwidth	±4.505 kHz
Spurious Emissions at Band Edge	±3.454 dB
Frequency Stability	±4.334 kHz
Modulation Characteristics	-
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 38

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.