FCC and ISED Test Report

Kineis SAS
Model: KIM2-HW1-FW1

In accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2, ISED RSS-170 and ISED RSS-GEN (UHF)

Prepared for: Kineis SAS
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31520, FRANCE

FCC ID: 2A96E-KIM2-HW1FW1 IC ID: 30247-KIM2HW1FW1

COMMERCIAL-IN-CONFIDENCE

Document 75958442-01 Issue 01

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SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Matthew Russell	Chief Engineer	Authorised Signatory	20 December 2023

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 25, FCC 47 CFR Part 2 and ISED RSS-170 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	Pier-Angelo Lorusso	20 December 2023	
	Thomas Biddlecombe	20 December 2023	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED Accreditation
12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 25, 2022 FCC 47 CFR Part 2, 2021 ISED RSS-170, Issue 4 (09-2022) and ISED RSS-GEN:) Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.

ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

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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	20-December-2023

Table 1

1.2 Introduction

Applicant	Kineis SAS
Manufacturer	Kineis SAS
Model Number(s)	KIM2-HW1-FW1
Serial Number(s)	KIM2102306203378 KIM2102306203379 KIM2102306203315
Hardware Version(s)	HW1.x
Software Version(s)	FW1.x
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 25, (2022) FCC 47 CFR Part 2, (2021) ISED RSS-170 Issue 4 (09-2022) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	PO-23-01028
Date	28-April-2023
Date of Receipt of EUT	13-October-2023 and 05-July-2023
Start of Test	17-October-2023
Finish of Test	05-December-2023
Name of Engineer(s)	Pier-Angelo Lorusso, George Williams and Thomas Biddlecombe
Related Document(s)	ANSI C63.26 (2015)

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 25, FCC 47 CFR Part 2 and ISED RSS-170 and ISED RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 2	Part 25	RSS-GEN	RSS-170			
Configuration and Mode: 400MHz - Whip dipole							
2.1	2.1046	25.204	6.12	5.5	Equivalent Isotropic Radiated Power	Pass	ANSI C63.26 (2015)
2.2	2.1053	25.202(f)	6.13	5.8	Radiated Spurious Emissions	Pass	ANSI C63.26 (2015)
Configuration and Mode: 400 MHz - PCB coil							
2.1	2.1046	25.204	6.12	5.5	Equivalent Isotropic Radiated Power	Pass	ANSI C63.26 (2015)
2.2	2.1053	25.202(f)	6.13	5.8	Radiated Spurious Emissions	Pass	ANSI C63.26 (2015)
Configuration and Mode: 400 MHz Transmitter							
2.3	-	-	-	-	Modulation Characteristics	Declaration	
2.4	2.1049	-	6.7	-	Occupied Bandwidth	Pass	ANSI C63.26 (2015)
2.5	2.1051	25.202 (f)	6.13	5.8	Spurious Emissions at Antenna Terminals	Pass	ANSI C63.26 (2015)
2.6	2.1055	25.202(d)	6.11	5.3	Frequency Tolerance	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)*	This is a telecommunication module, dedicated to Kinéis protocol. Uplink and downlink able (ground <-> satellites).		
Manufacturer:	Kinéis		
Model:	KIM2-HW1-FW1		
Part Number:	KIM2102306xxxxxx		
Hardware Version:	HW1.x		
Software Version:	FW1.x		
FCC ID of the product under test – see guidance here		2A96E-KIM2-HW1FW1	
IC ID of the product under test – see guidance here		30247-KIM2HW1FW1	
Device Category	Mobile ☒	Portable ☐	Fixed ☐
Equipment is fitted with an Audio Low Pass Filter		Yes ☐	No ☒

Table 3

Intentional Radiators

Technology	KINEIS				
Frequency Range (MHz to MHz)	399.9-400.05MHz 401-403MHz				
Conducted Declared Output Power (dBm)	27 dBm				
Antenna Gain (dBi)	2 ; 0 dBi				
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	4kHz				
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	BPSK				
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	1K60G7D 800H G7D				
Bottom Frequency (MHz)	399.91 MHz				
Middle Frequency (MHz)					
Top Frequency (MHz)	402.99 MHz				

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	402.99MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	16.369MHz
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

Table 6

Single Phase ☐ Three Phase ☐

DC Power Source

Nominal voltage:	3.6	V
Extreme upper voltage:	5	V
Extreme lower voltage:	3.3	V
Max current:	0.8	A

Table 7

Battery Power Source

Voltage:	NA	V
End-point voltage:	NA	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☐ Please detail:		

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☒ No ☐

Table 9

Temperature

Minimum temperature:	-40	°C
Maximum temperature:	+85	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)	NA	dB

Table 11

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☒			State impedance	50	Ohm
Integral antenna ☐	Type:		Gain		dBi

External antenna ☒	Type:	Whip dipole PCB Coil	Gain	2 0	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:	Analog Devices	Part Number:	ADALM-PLUTO

Table 13

Model:	ADALM-PLUTO	Country of Origin:	CHINA

Table 14

I hereby declare that the information supplied is correct and

complete. Name: GAMONAL Vincent
Position held: TEST & VALIDATION ENGINEER
Date: 2023-06-12

1.5 Product Information

1.5.1 Technical Description

This is a telecommunication module, dedicated to Kinéis protocol. Uplink and downlink able (ground <-> satellites).

1.5.2 Additional Technical information

The Model: KIM2 SN3-15 (1) unit houses the KIM2-HW1-FW1 which consists of 3 samples referred to as RF 28 Board (S/N: KIM2102306203378), RF 29 Board (S/N: KIM2102306203379) and RF 15 Board (S/N: KIM2102306203315).

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: KIM2-HW1-FW1, Serial Number: KIM2102306203378			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: KIM2-HW1-FW1, Serial Number: KIM2102306203379			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: KIM2-HW1-FW1, Serial Number: KIM2102306203315			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 15

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: 400 MHz Transmitter		
Occupied Bandwidth	Thomas Biddlecombe	UKAS
Spurious Emissions at Antenna Terminals	Thomas Biddlecombe	UKAS
Frequency Tolerance	Thomas Biddlecombe	UKAS
Configuration and Mode: 400MHz - Whip dipole		
Equivalent Isotropic Radiated Power	Pier-Angelo Lorusso	UKAS
Radiated Spurious Emissions	Pier-Angelo Lorusso	UKAS
Configuration and Mode: 400 MHz - PCB coil		
Equivalent Isotropic Radiated Power	Pier-Angelo Lorusso	UKAS
Radiated Spurious Emissions	Pier-Angelo Lorusso, George Williams	UKAS

Table 16

Office Address:

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

2 Test Details

2.1 Equivalent Isotropic Radiated Power

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046
FCC 47 CFR Part 25, Clause 25.204
ISED RSS-GEN, Clause 6.12
ISED RSS-170, Clause 5.5

2.1.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203379 - Modification State 0

2.1.3 Date of Test

19-October-2023

2.1.4 Test Method

The EUT was placed on a remotely controlled turntable within a semi-anechoic chamber. Measurements of the fundamental was obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations.

The EUT was powered from a DC Power Supply with 3.6 V DC nominal.

Testing was performed in accordance with ANSI C63.26, Clause 5.2.4.3 and 5.2.7.

The Average Power and Power Spectral Density measurements in a 4 kHz bandwidth were performed in accordance with ANSI C63.26, clause 5.2.4.3 (Average-PSD).

The RBW was configured to 10 kHz and therefore no reference level offset / correction factor was required to show the result as 4 kHz bandwidth.

Total EIRP measurements were performed in accordance with ANSI C63.26, clause 5.2.4.3 (average power with Duty Cycle Correction Factor).

Field strength measurements were performed and then converted to Equivalent Power Measurements in accordance with ANSI C63.26, Clause 5.2.7 equation (d)

Example calculation:

EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.

The measurement distance was 3m.

2.1.5 Environmental Conditions

Ambient Temperature	19.3 °C
Relative Humidity	38.6 %

2.1.6 Test Results

400MHz - Whip dipole

EIRP (dBm/4kHz)		
399.91 MHz	N/A MHz	402.99 MHz
30.47	-	30.88

Table 17 - EIRP/4 kHz Results Table

399.91 MHz		N/A MHz		402.99 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
30.47	1.47	-	-	30.88	1.88

Table 18 - EIRP Results Table

400 MHz - PCB coil

EIRP (dBm/4kHz)		
399.91 MHz	N/A MHz	402.99 MHz
27.78	-	28.46

Table 19 - EIRP/4 kHz Results Table

399.91 MHz		N/A MHz		402.99 MHz	
EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)	EIRP (dBm)	Δ from rated power (dB)
27.78	0.78	-	-	28.46	1.46

Table 20 - EIRP Results Table

FCC 47 CFR Part 25, Limit Clause 25.204

+40 dBW in any 4 kHz band for $\theta \leq 0°$
+40 + 3θ dBW in any 4 kHz band for $0° < \theta \leq 5°$
For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

ISED RSS-170, Limit Clause 5.3

The application for MES certification shall state the MES e.i.r.p. that is necessary for satisfactory communication. The maximum permissible e.i.r.p. will be the stated necessary e.i.r.p. plus a 2 dB margin. If a detachable antenna is used, the certification application shall state the recommended antenna type and manufacturer, the antenna gain and the maximum transmitter output power at the antenna terminal.

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Dual Power Supply Unit	Hewlett Packard	6253A	292	-	O/P Mon
True RMS Multimeter	Fluke	179	4007	12	18-Nov-2023
Test Receiver	Rohde & Schwarz	ESW44	5084	12	31-Aug-2024
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	20-Apr-2024
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5518	12	14-Apr-2024
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	5522	12	14-Apr-2024
Antenna (Tri-log, 30 MHz to 1 GHz)	Schwarzbeck	VULB 9168	5942	24	03-Feb-2024
Attenuator (4 dB)	Pasternack	PE7074-4	6202	24	16-Jul-2024

Table 21

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

2.2 Radiated Spurious Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1053
FCC 47 CFR Part 25, Clause 25.202(f)
ISED RSS-GEN, Clause 6.13
ISED RSS-170, Clause 5.8

2.2.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203379 - Modification State 0

2.2.3 Date of Test

19-October-2023 to 05-Dec-2023

2.2.4 Test Method

Radiated Spurious Emissions were 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.

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 (d)

Example calculation:
EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.
EIRP (dBm) = 82.2 (dBuV/m) + 20log(3) – 104.8
-13.0 = EIRP (dBm)

*NOTE 1:

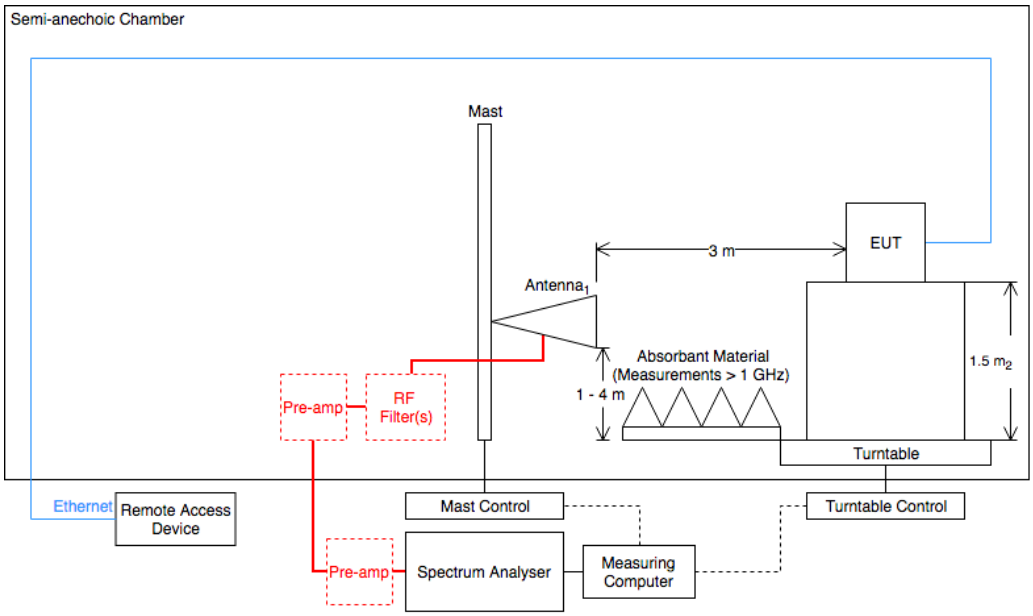
Due to the emissions being intermittent in nature, a peak measurement was taken and a Duty Cycle Correction Factor (DCCF) was applied. For each of these emissions, the total pulse width (in milliseconds) was taken, being the summation of the widths in the case that multiple pulses were detected during a single period of the transmit signal.

The pulse width was then divided by the total period of the transmit signal to give the duty cycle of the emission. The final DCCF was then calculated as 10*Log(1/emission duty cycle), and this value was then subtracted from the peak value to give an averaged result.

Example Calculation:
Taken from the 399.91 MHz, Horizontal Polarization, Z-Plane result
Measured Value: 13.86 dBm
Pulse 1 width: 0.921 ms
Pulse 2 width: 0.728 ms
Total Pulse width: 1.649 ms
Transmitter Period: 1004.079 ms
1.649/1004.079 = 0.001642 = Emission Duty Cycle
Duty Cycle Correction Factor = 10 * Log(1/0.001642) = 27.85 dB
Subtract DCCF from Peak Value: 13.86 - 27.85 = -13.99 dBm as the final emissions value.

Some emissions appear on the traces near the limit but do not have markers available, this was due to the emission pulse width being extremely narrow, (less than 30 µs) and as such would have been adjusted by at least 45 dB by the DCCF, meaning that they would have been compliant with the limit by a large margin and as such were not required to be measured.

2.2.5 Test Setup Diagram



1 Antenna is boresighted for measurements > 1 GHz.
2 Height from the EUT to ground is 0.8 m for measurements < 1 GHz.

Figure 1

2.2.6 Environmental Conditions

Ambient Temperature	22.8 - 26.0 °C
Relative Humidity	30.8 - 52.9 %

2.2.7 Test Results

400MHz - Whip dipole

Frequency (MHz)	Level (dBm)	Polarisation	Orientation
*			

Table 22 - 399.91 MHz, 30 MHz to 5GHz

*No emissions were found within 10 dB of the limit.

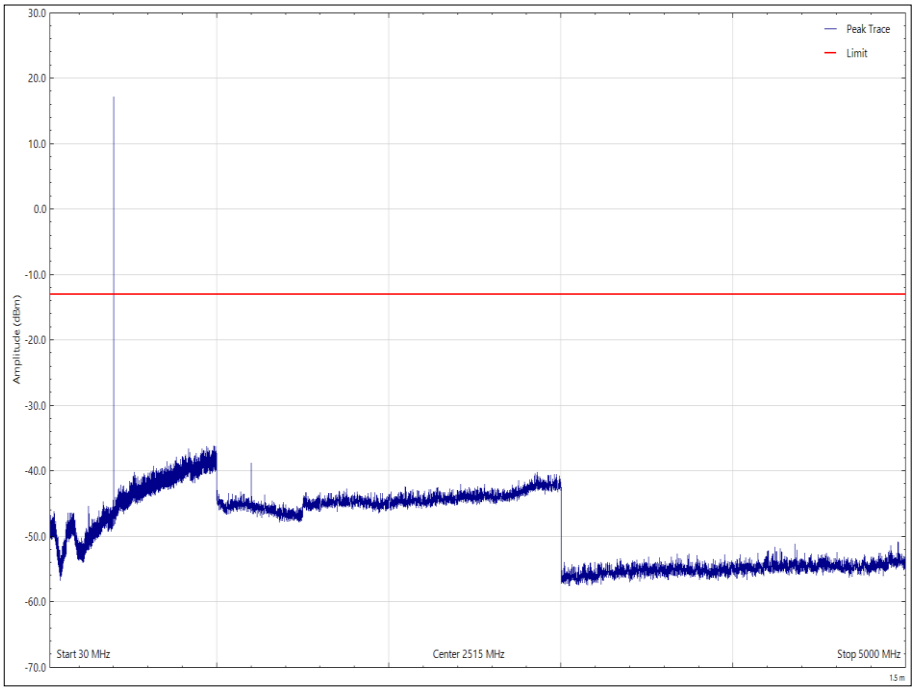


Figure 2 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, X Orientation

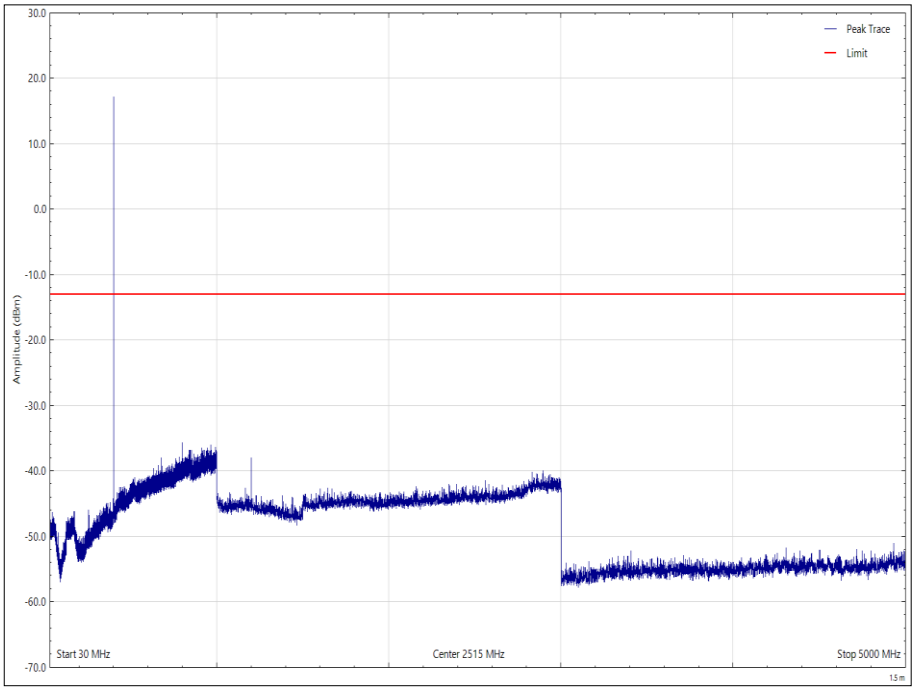


Figure 3 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, X Orientation

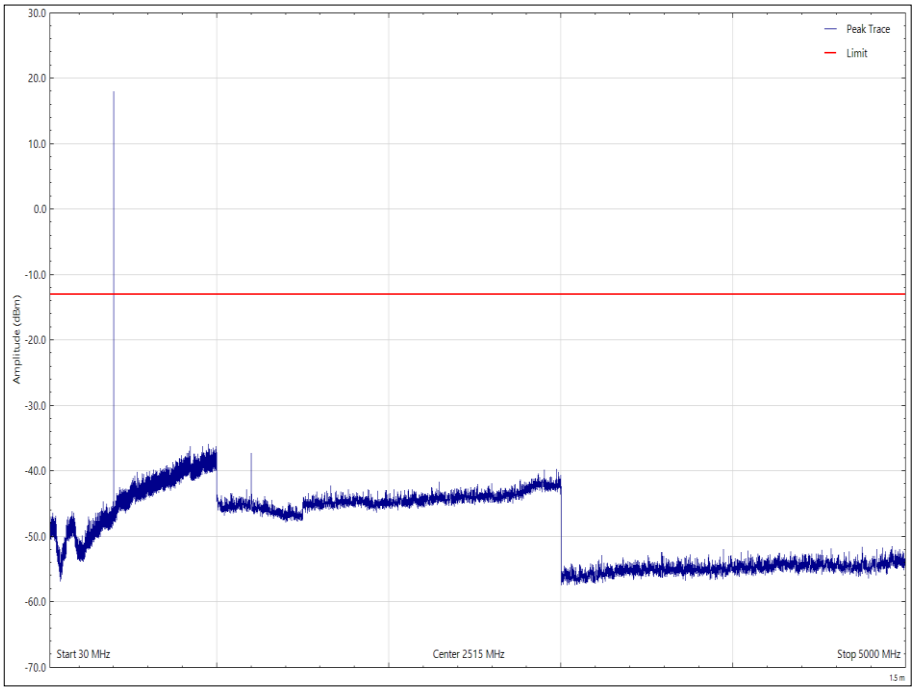


Figure 4 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, Y Orientation

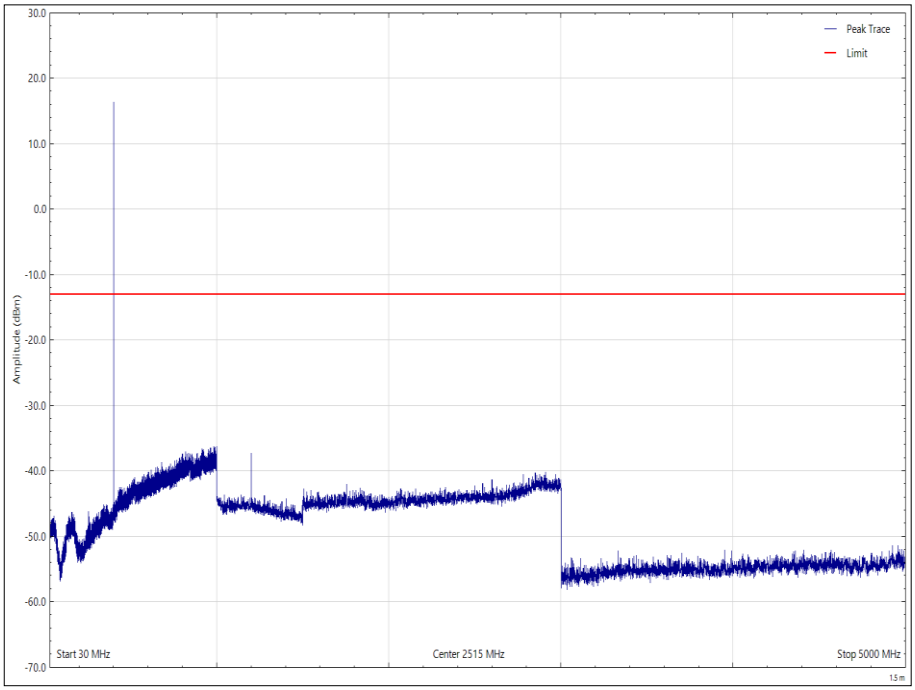


Figure 5 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, Y Orientation

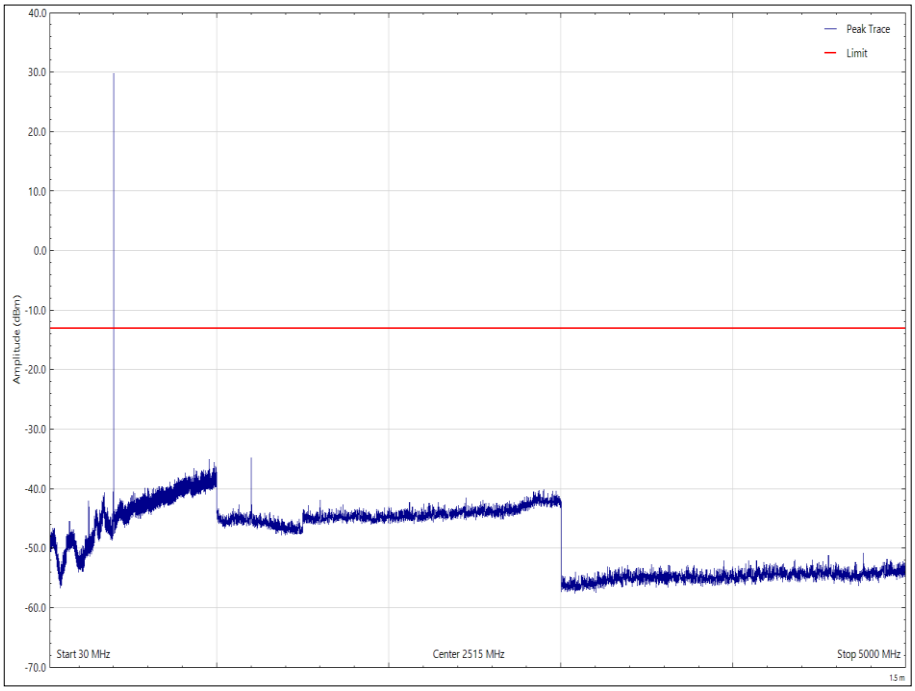


Figure 6 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, Z Orientation

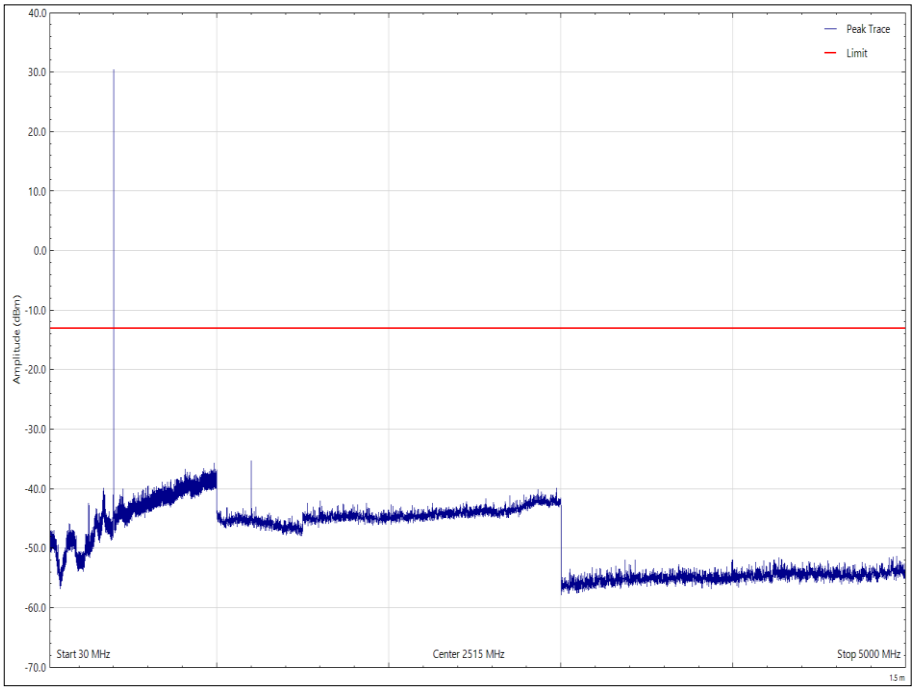


Figure 7 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, Z Orientation

Frequency (MHz)	Level (dBm)	Polarisation	Orientation
*			

Table 23 - 402.99 MHz, 30 MHz to 5GHz

*No emissions were found within 10 dB of the limit.

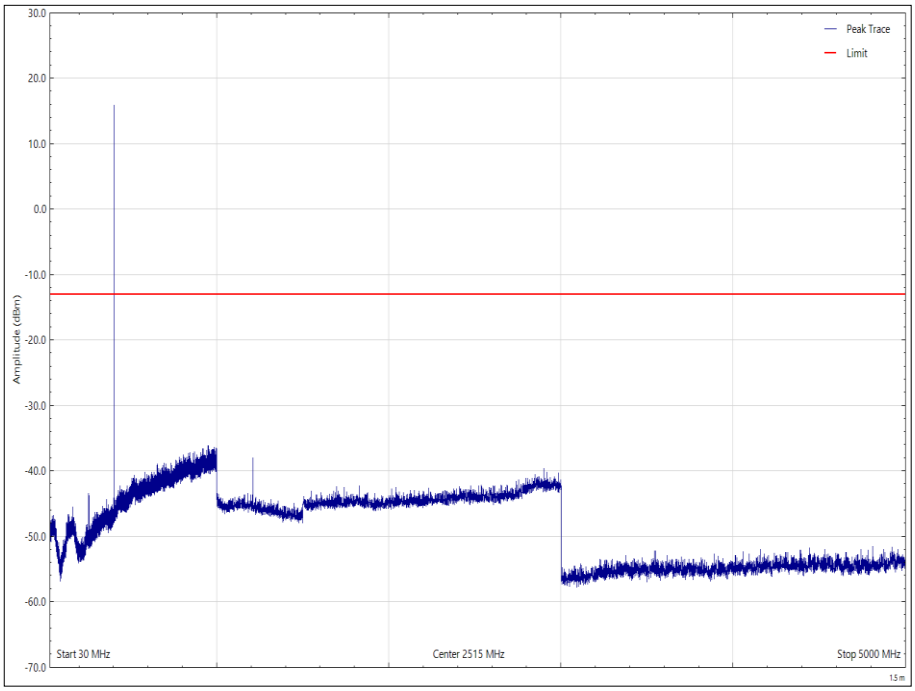


Figure 8 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, X Orientation

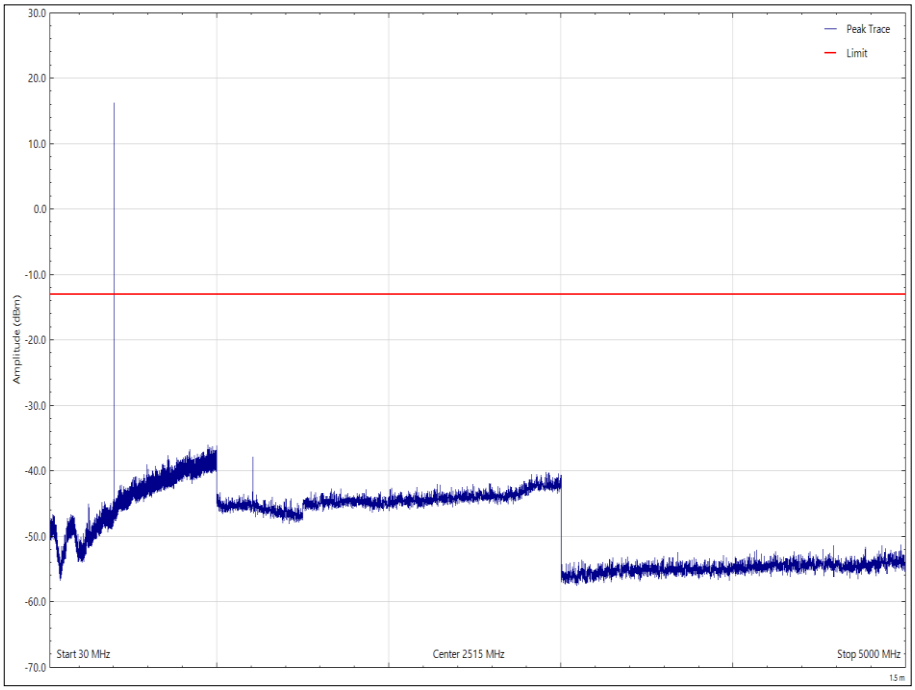


Figure 9 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, X Orientation

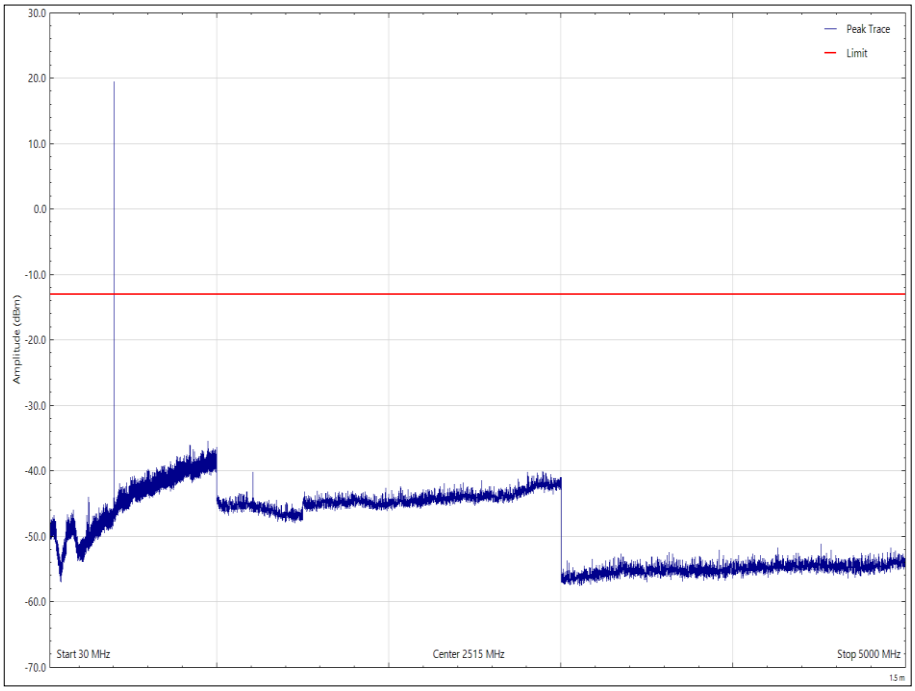


Figure 10 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, Y Orientation

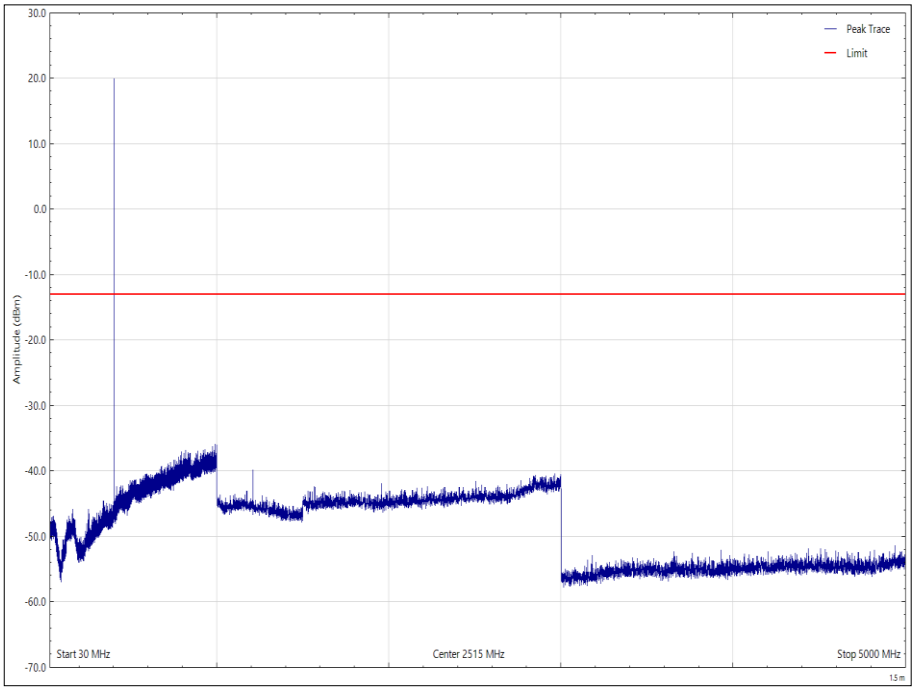


Figure 11 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, Y Orientation

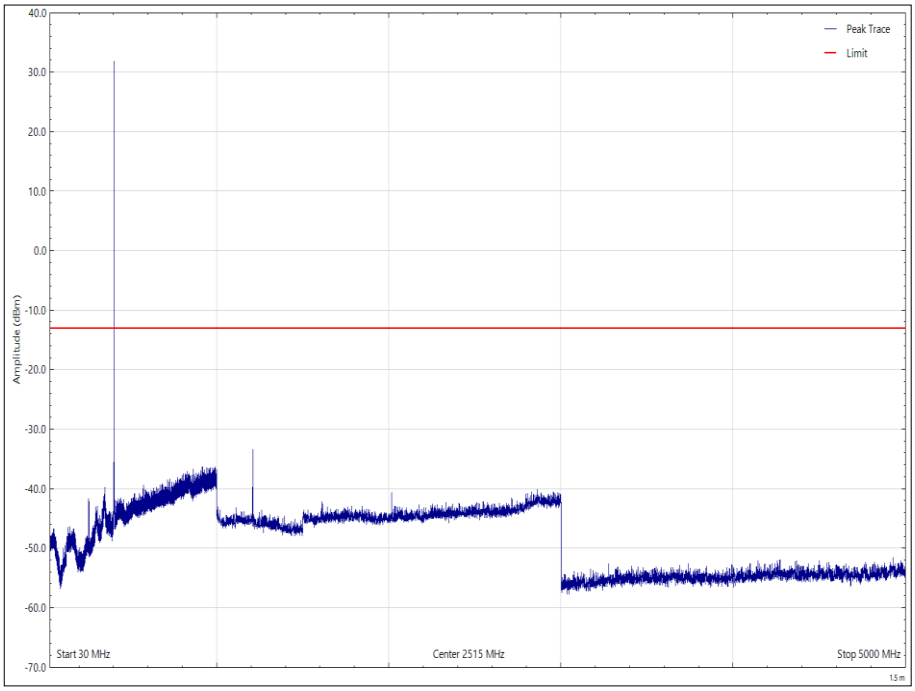


Figure 12 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, Z Orientation

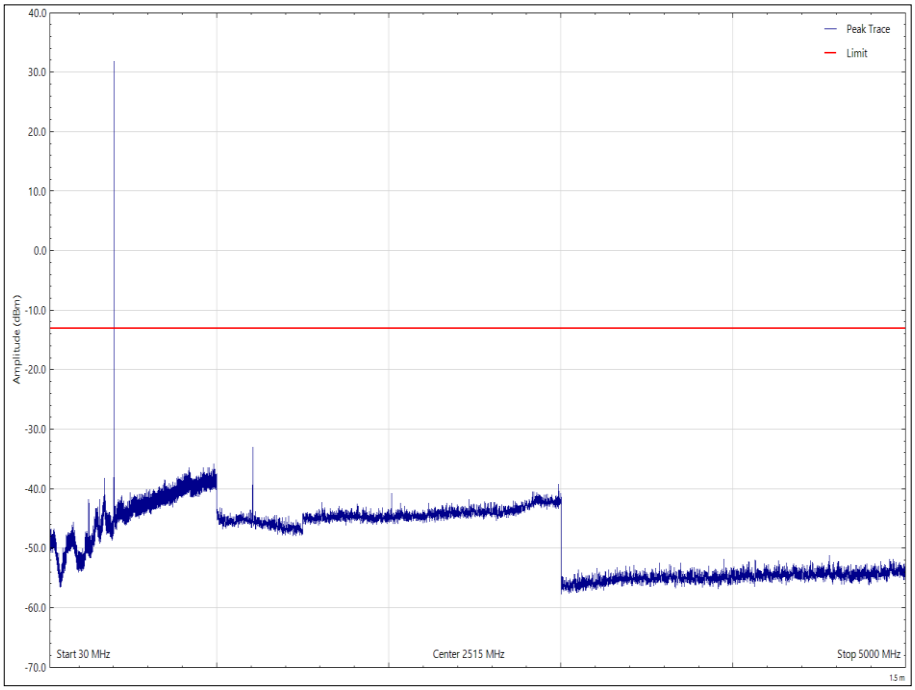


Figure 13 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, Z Orientation

400 MHz - PCB coil

Frequency (MHz)	Level (dBm)	Polarisation	Orientation
224.679	-32.05*	Vertical	X
448.962	-37.29*	Vertical	X
225.291	-19.20*	Horizontal	X
449.109	-30.34*	Horizontal	X
225.159	-37.44*	Vertical	Y
449.429	-49.56*	Vertical	Y
225.410	-18.07*	Horizontal	Y
451.197	-43.47*	Horizontal	Y
225.409	-25.39*	Vertical	Z
448.951	-30.76*	Vertical	Z
224.524	-13.99*	Horizontal	Z
449.576	-33.22*	Horizontal	Z
349.389	-62.28*	Vertical	X
174.908	-64.29*	Horizontal	X

Table 24 - 399.91 MHz, 30 MHz to 5GHz

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

*Refer to Note 1 in section 2.2.4.

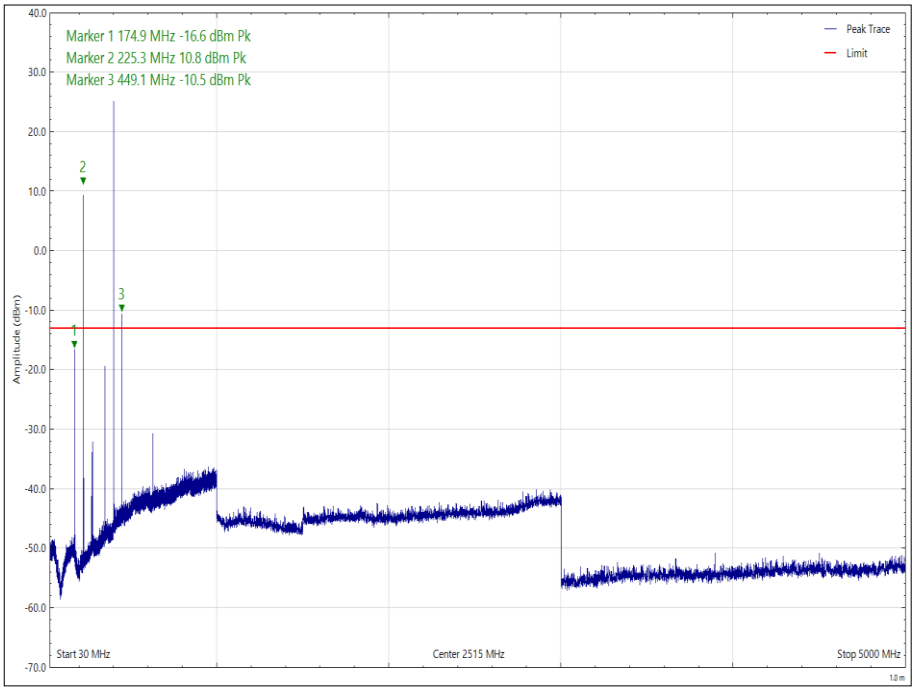


Figure 14 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, X Orientation

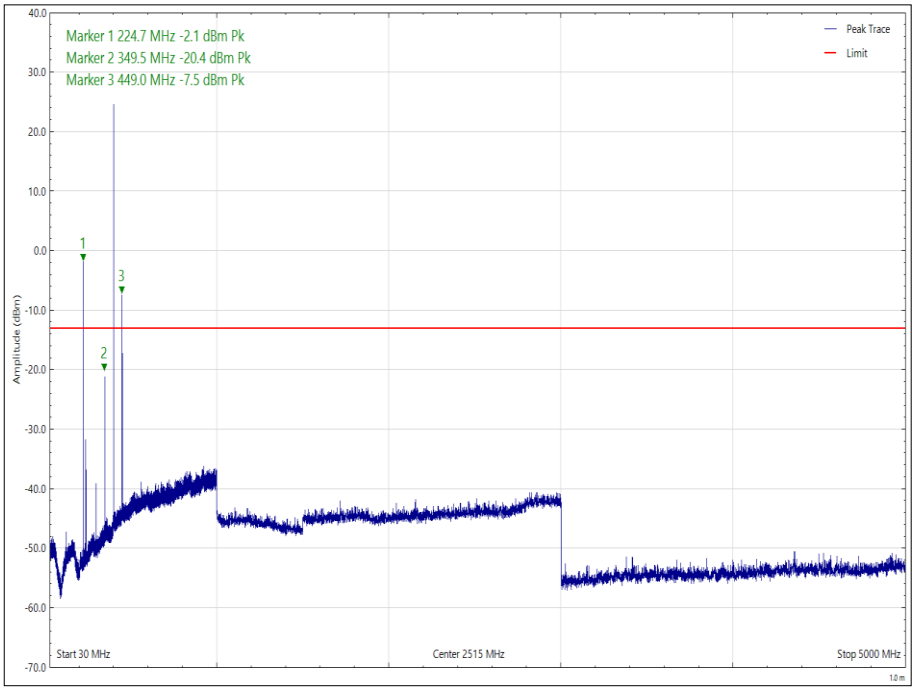


Figure 15 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, X Orientation

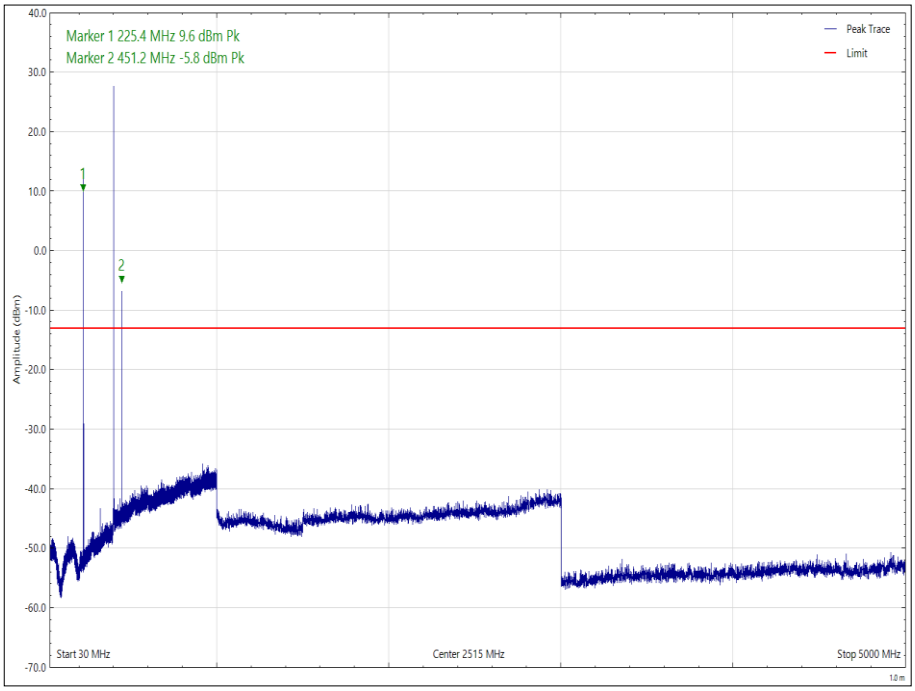


Figure 16 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, Y Orientation

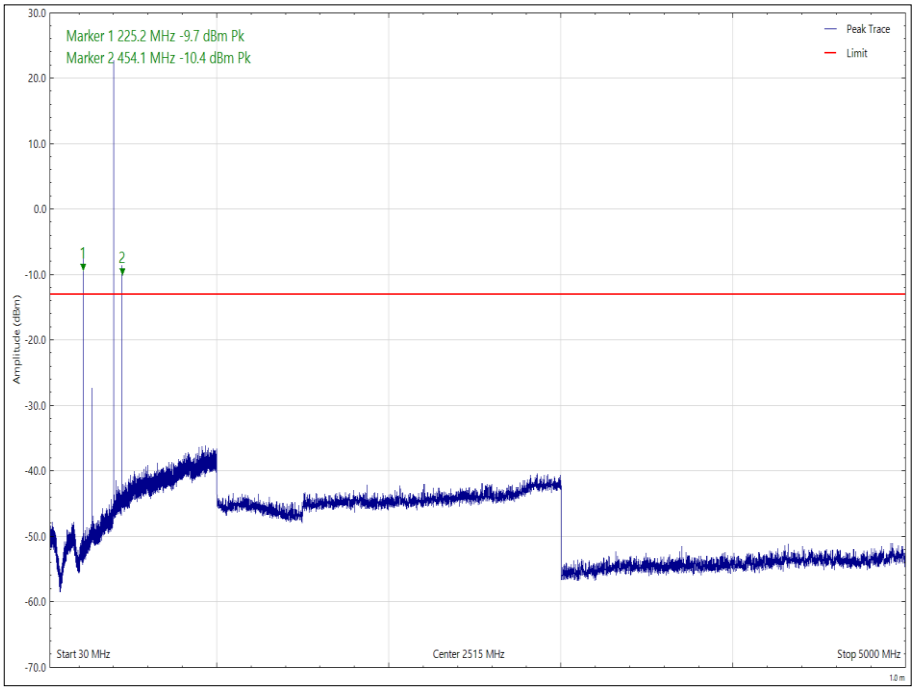


Figure 17 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, Y Orientation

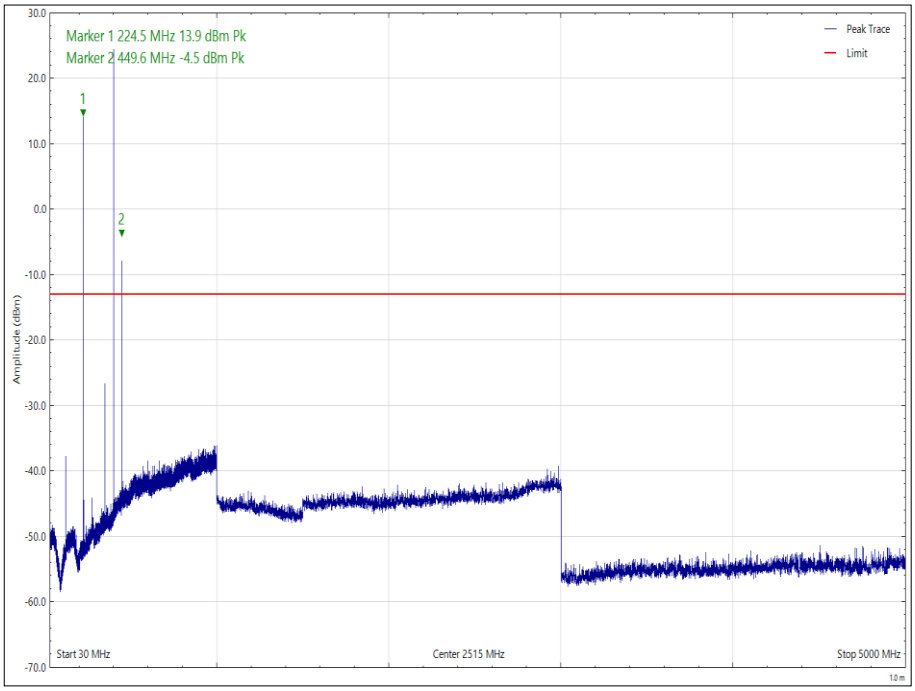


Figure 18 - 399.91 MHz - 30 MHz to 5 GHz, Horizontal, Z Orientation

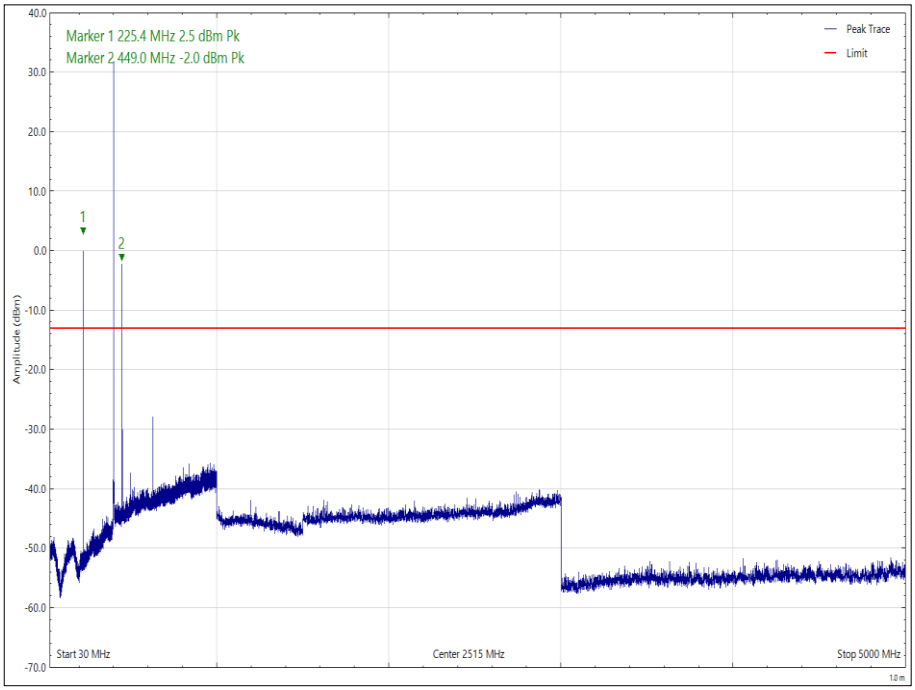


Figure 19 - 399.91 MHz - 30 MHz to 5 GHz, Vertical, Z Orientation

Frequency (MHz)	Level (dBm)	Polarisation	Orientation
224.234	-51.22*	Vertical	X
449.514	-37.27*	Vertical	X
224.222	-33.95*	Horizontal	X
450.464	-37.50*	Horizontal	X
448.797	-48.93*	Vertical	Y
226.253	-35.85*	Horizontal	Y
449.543	-35.47*	Horizontal	Y
224.696	-21.79*	Vertical	Z
450.162	-34.97*	Vertical	Z
225.126	-14.33*	Horizontal	Z
450.329	-37.27*	Horizontal	Z

Table 25 - 402.99 MHz, 30 MHz to 5GHz

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

*Refer to Note 1 in section 2.2.4.

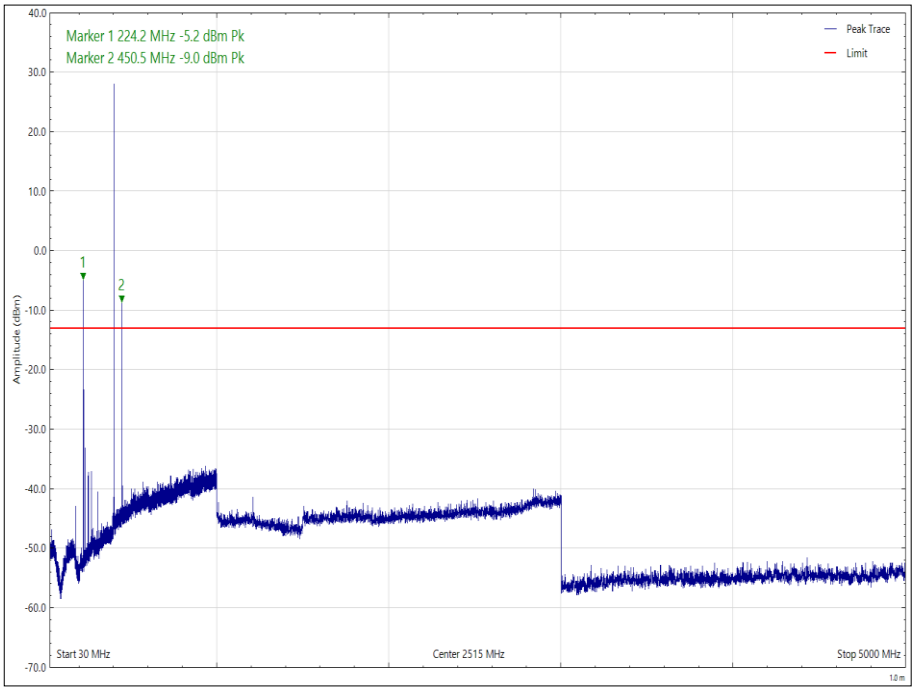


Figure 20 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, X Orientation

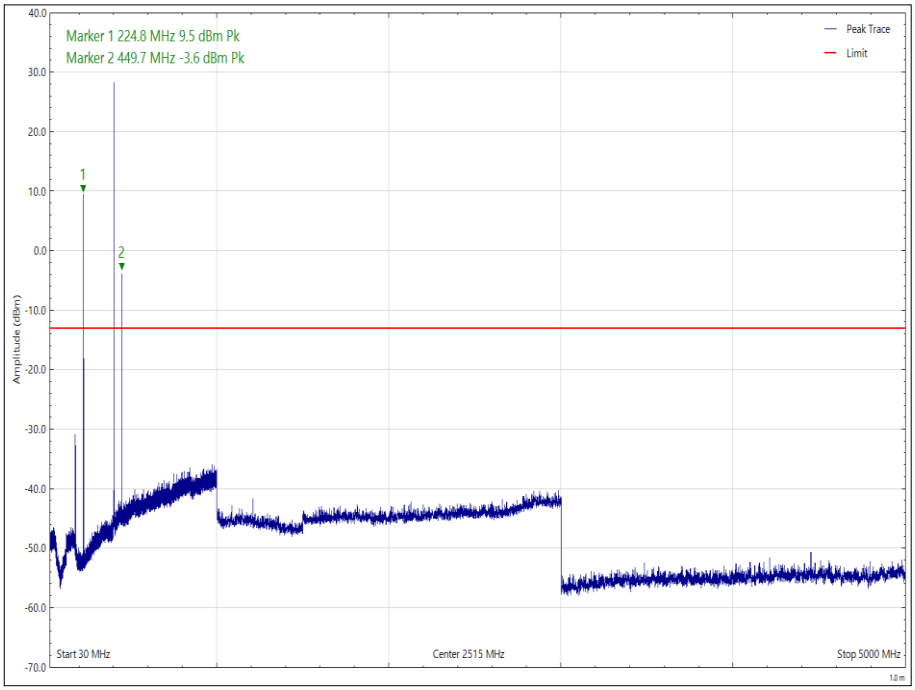


Figure 21 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, X Orientation

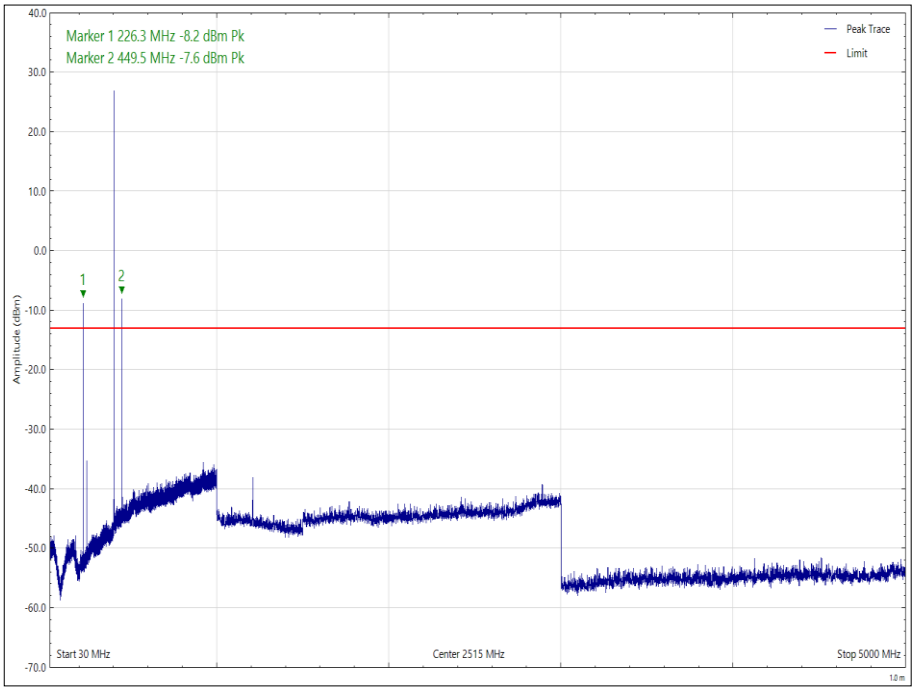


Figure 22 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, Y Orientation

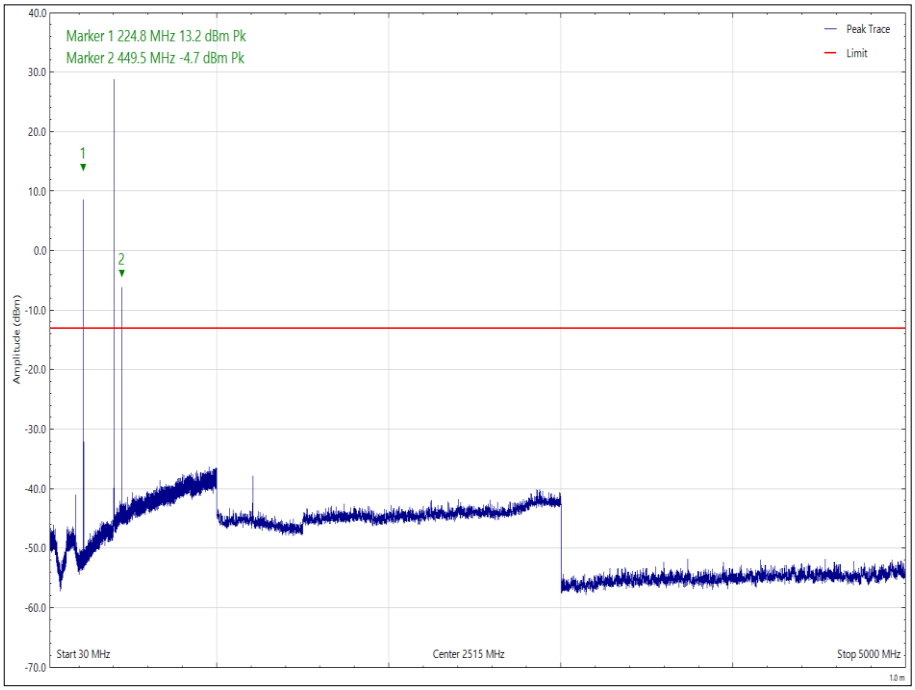


Figure 23 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, Y Orientation

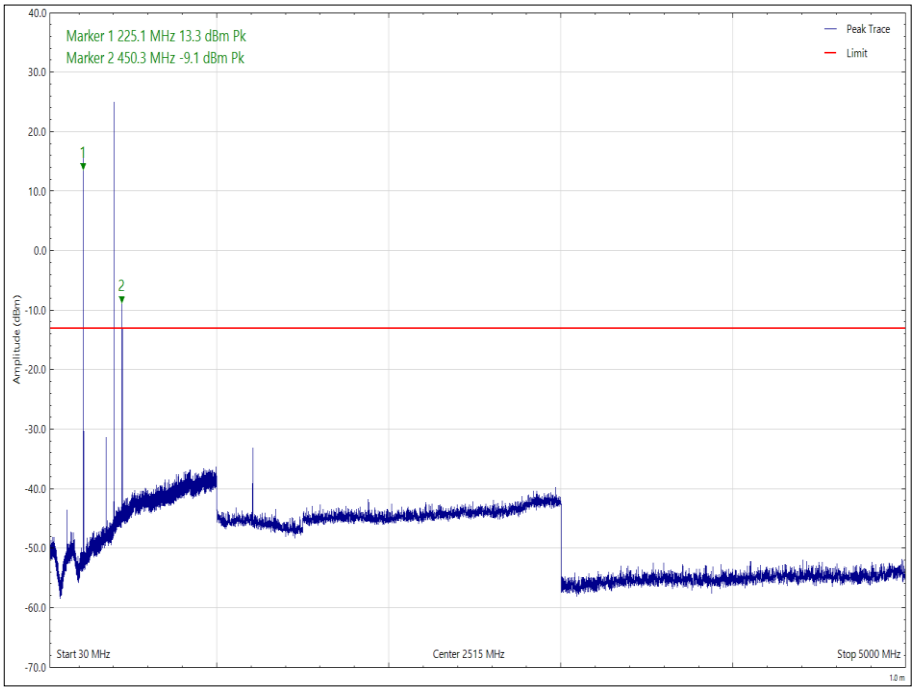


Figure 24 - 402.99 MHz - 30 MHz to 5 GHz, Horizontal, Z Orientation

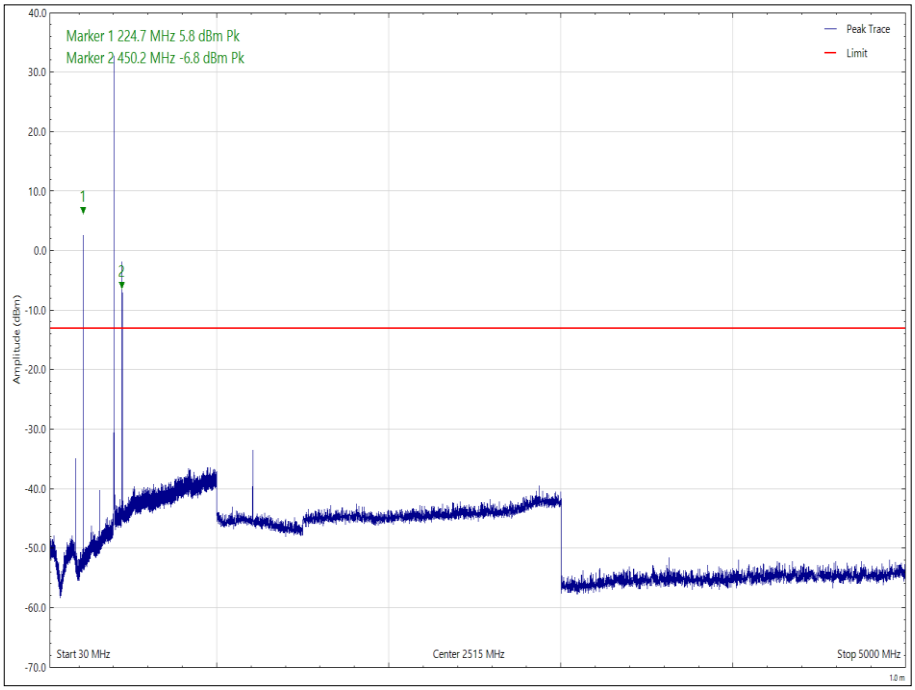


Figure 25 - 402.99 MHz - 30 MHz to 5 GHz, Vertical, Z Orientation

FCC 47 CFR Part 2, Limit Clause 25.202(f)

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the authorised bandwidth;
35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the authorised bandwidth;
43 + 10 Log p (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the authorised bandwidth.

ISED RSS-170, Limit Clause 5.8

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth or necessary bandwidth, whichever is greater;
35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth or necessary bandwidth, whichever is greater;
43 + 10 Log p (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth or necessary bandwidth, whichever is greater.

2.2.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5 and RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Dual Power Supply Unit	Hewlett Packard	6253A	292	-	O/P Mon
3m Semi-Anechoic Chamber	Rainford	RF Chamber 5	1545	36	15-Apri-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Filter (Hi Pass)	Mini-Circuits	NHP-600	2834	12	19-Jan-2024
True RMS Multimeter	Fluke	179	4007	12	18-Nov-2023
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	08-Aug-2024
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
4dB Attenuator	Pasternack	PE7047-4	4935	12	20-Jul-2024
High Pass filter	Wainwright	WHKX12-1290-1500-18000-80SS	4962	12	14-Jun-2024
Test Receiver	Rohde & Schwarz	ESW44	5084	12	31-Aug-2024
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
3m Semi-Anechoic Chamber	Rainford	RF Chamber 11	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBHA9120B	5215	12	09-Jul-2024
Pre-Amplifier (1 GHz to 26.5 GHz)	Agilent Technologies	8449B	5445	12	25-May-2024
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	20-Apr-2024
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5512	12	21-May-2024
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	21-May-2024
Cable (SMA to SMA, 2 m)	Junkosha	MWX221-02000AMSAMS/A	5518	12	14-Apr-2024
Cable (N-Type to N-Type, 8 m)	Junkosha	MWX221-08000NMSNMS/B	5521	12	05-Jun-2024
Cable (N-Type to N-Type,	Junkosha	MWX221-	5522	12	14-Apr-2024

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
8 m)		08000NMSNMS/B			
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	15-Jun-2024
Antenna (Tri-log, 30 MHz to 1 GHz)	Schwarzbeck	VULB 9168	5942	24	03-Feb-2024
Attenuator (4 dB)	Pasternack	PE7074-4	6202	24	16-Jul-2024
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	6635	24	13-Jun-2025

Table 26

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

2.3 Modulation Characteristics

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047 (d)

2.3.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203379 - Modification State 0

2.3.3 Date of Test

17-October-2023

2.3.4 Test Method

Declaration provided by the applicant.

2.3.5 Test Results

400 MHz Transmitter

The following description was provided by the manufacturer:

Three modulations are of type BPSK between +/-1.1 radians.
The bit rates are respectively, 400bps for LDA2, 300bps for LDK and 200bps for VLDA4.

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.

2.4 Occupied Bandwidth

2.4.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
ISED RSS-GEN, Clause 6.7

2.4.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203378 - Modification State 0

2.4.3 Date of Test

17-October-2023

2.4.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.4.4.

The modulation used for this measurement was LDA2 which was determined from pre-test to have the widest bandwidth.

2.4.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	38.1 %

2.4.6 Test Results

400 MHz Transmitter

Occupied Bandwidth (kHz)	
399.91 MHz	402.99 MHz
6.903	6.944

Table 27

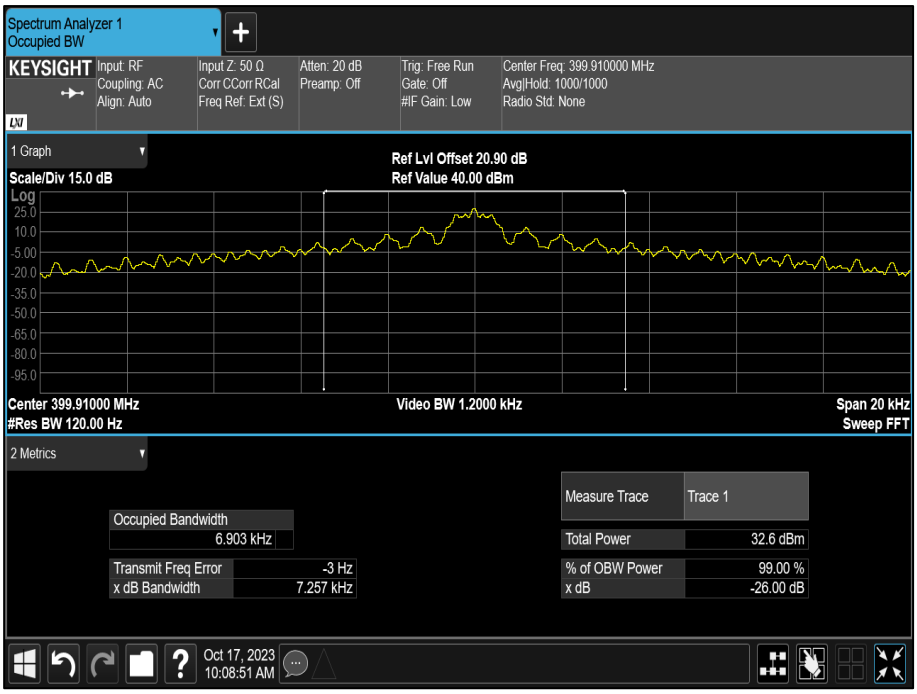


Figure 26 - 399.91 MHz

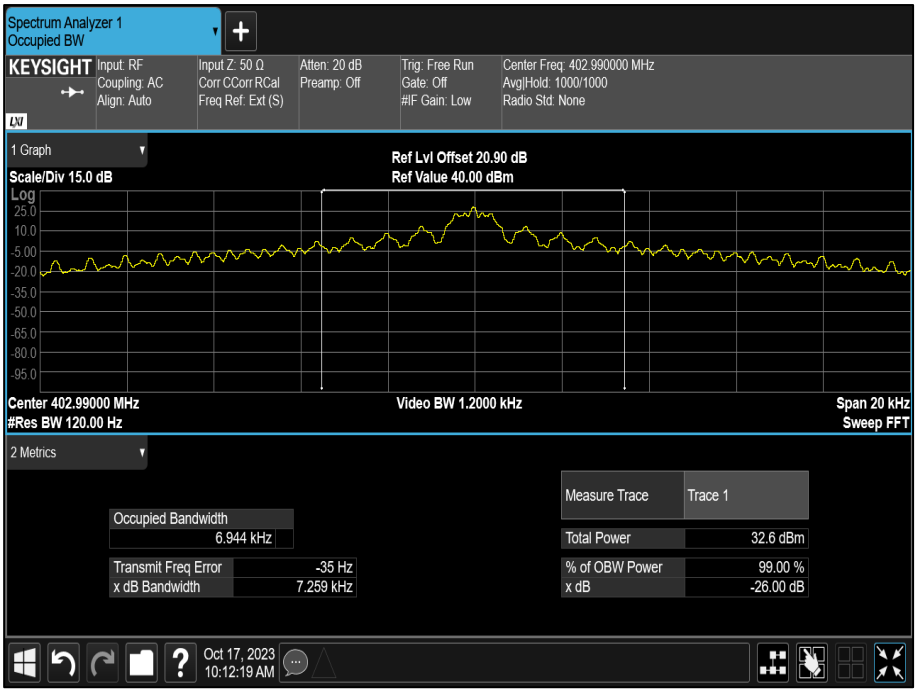


Figure 27- 402.99 MHz

FCC 47 CFR Part 2, Limit Clause 2.1049

None specified.

ISED RSS-GEN, Limit Clause

None specified.

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
Power Supply Unit	Farnell	TSV-70	2043	12	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	15-Nov-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Digital Multi-meter	Iso-tech	IDM93N	4435	12	04-Mar-2024
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	05-Jun-2024
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	5497	12	18-Apr-2024
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025

Table 28

O/P Mon – Output Monitored using calibrated equipment

2.5 Spurious Emissions at Antenna Terminals

2.5.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(f)
FCC 47 CFR Part 2, Clause 2.1051
ISED RSS-170, Clause 5.8
ISED RSS-GEN, Clause 6.13

2.5.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203315 - Modification State 0

2.5.3 Date of Test

22-November-2023

2.5.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7.

Where an RBW > 4 kHz was used, this was considered worst case.

2.5.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	44.1 %

2.5.6 Test Results

400 MHz Transmitter

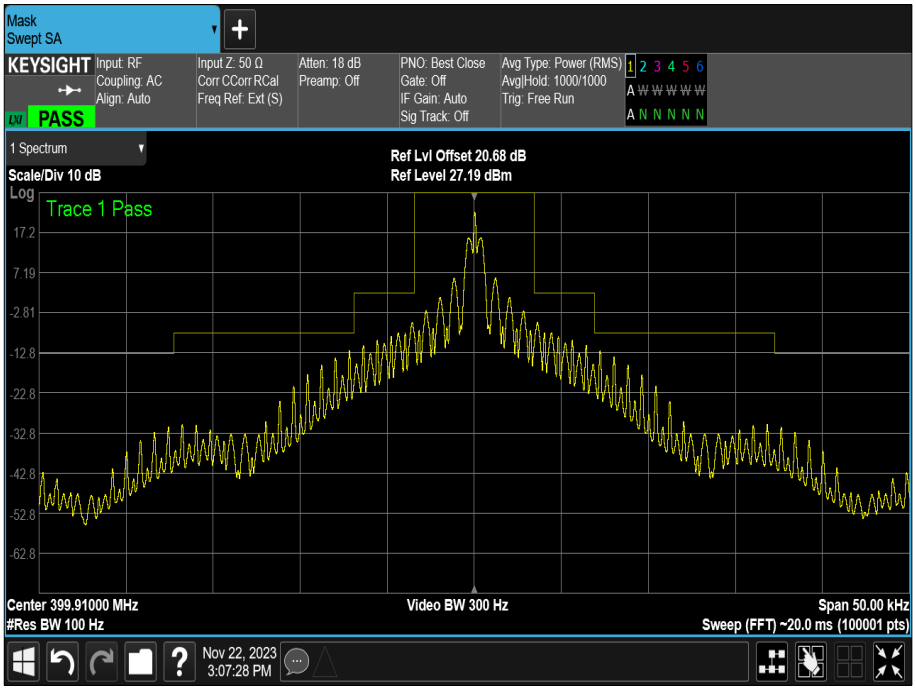


Figure 28 - 399.91 MHz - Emission Mask

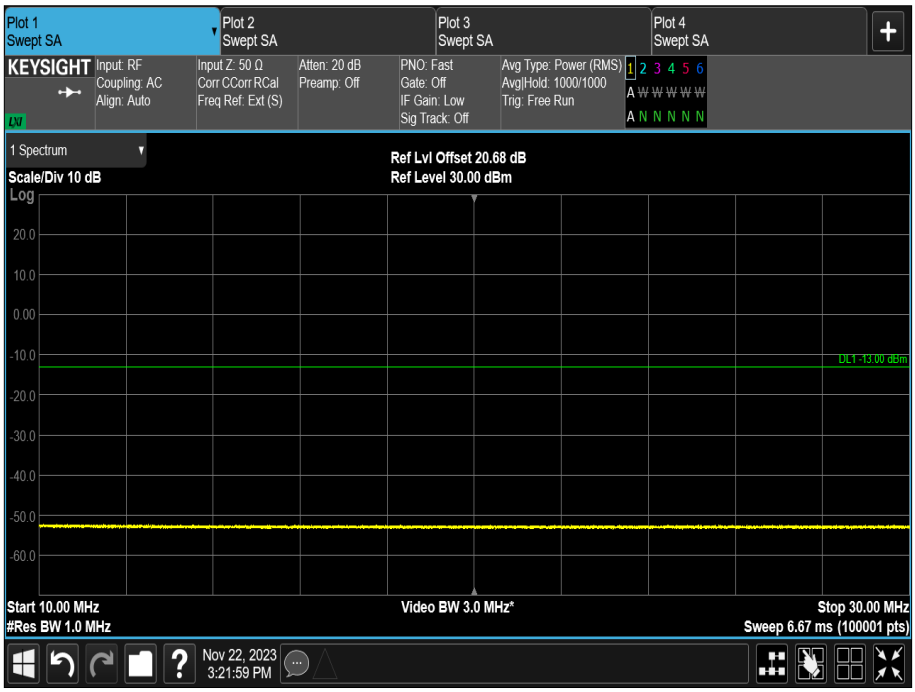


Figure 29 - 399.91 MHz - 10 MHz to 30 MHz

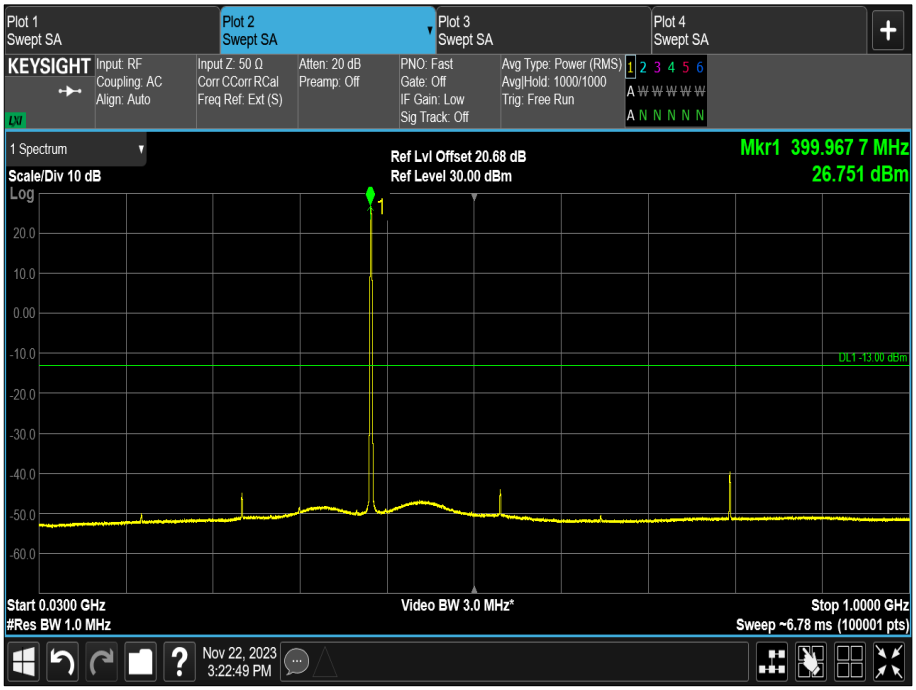


Figure 30 - 399.91 MHz - 30 MHz to 1 GHz

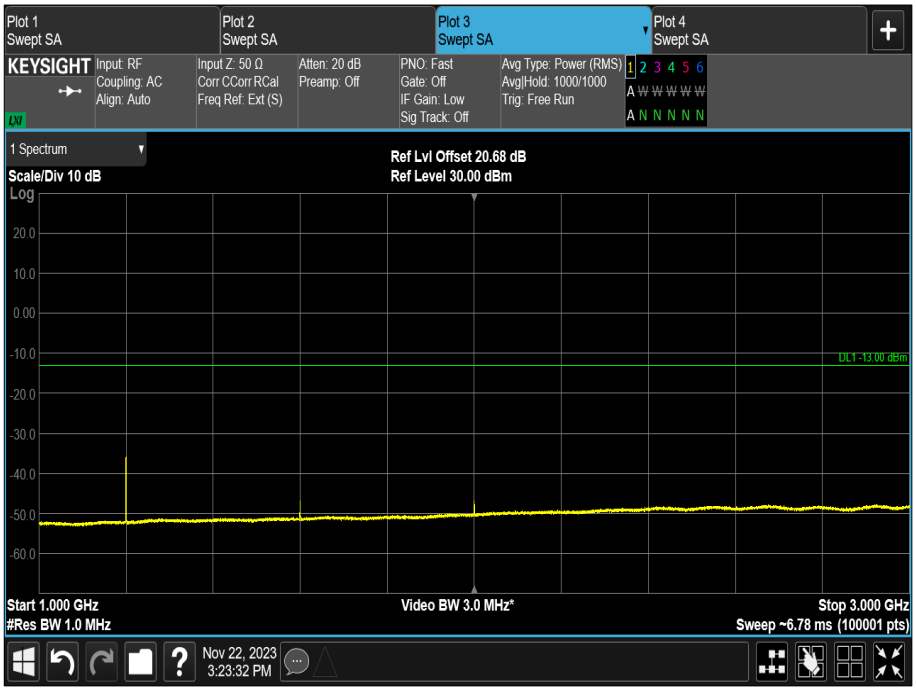


Figure 31 - 399.91 MHz - 1 GHz to 3 GHz

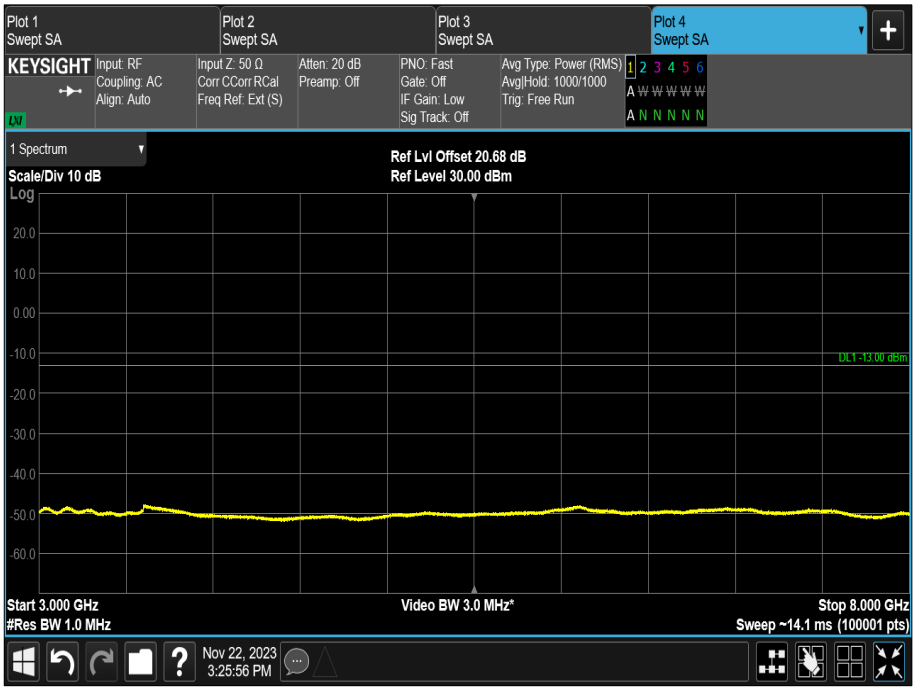


Figure 32 - 399.91 MHz - 3 GHz to 8 GHz

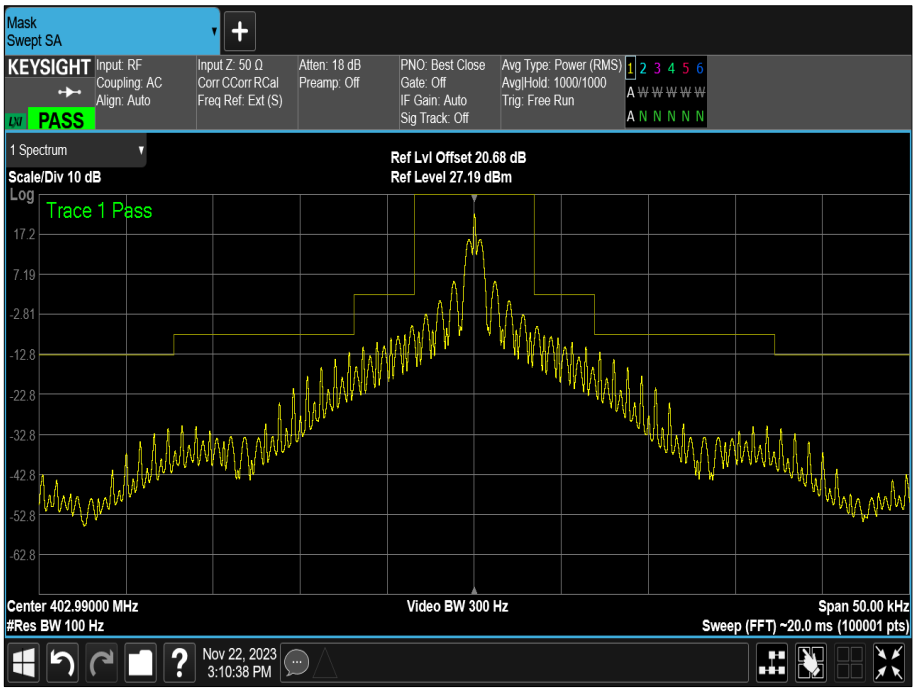


Figure 33 - 402.99 MHz - Emission Mask

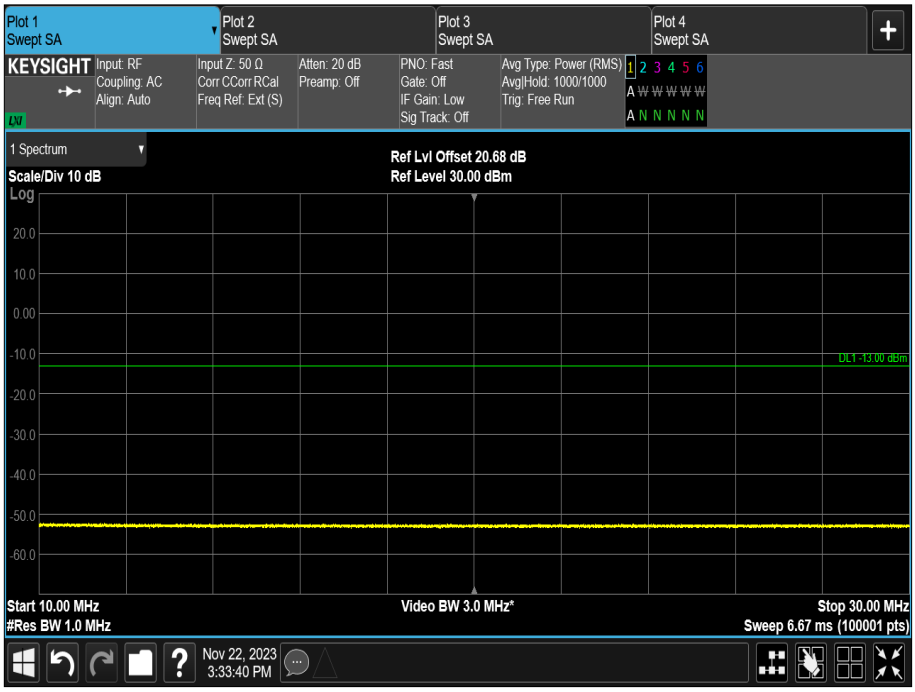


Figure 34 - 402.99 MHz - 10 MHz to 30 MHz

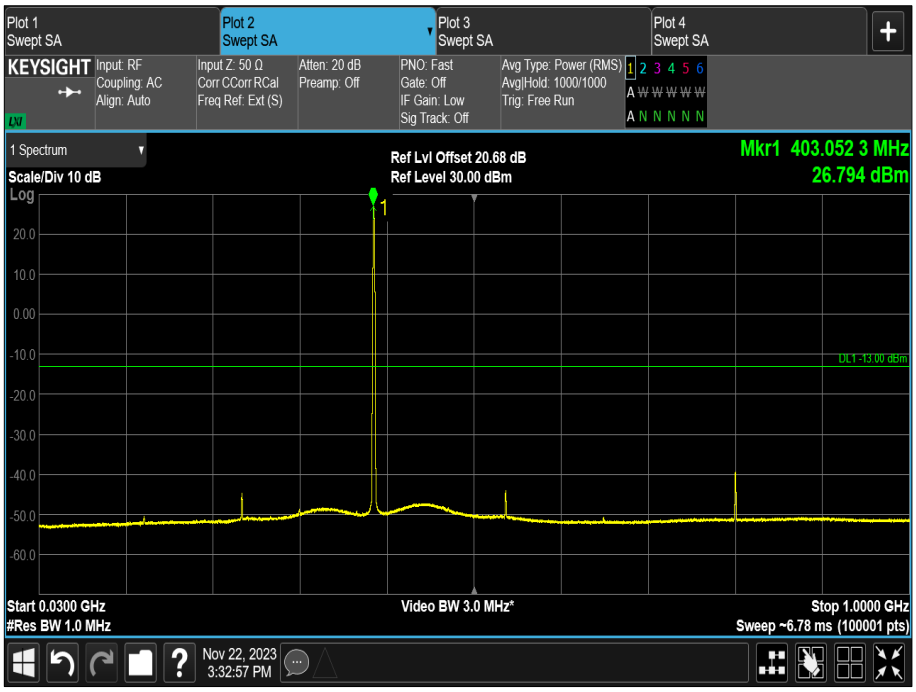


Figure 35 - 402.99 MHz - 30 MHz to 1 GHz

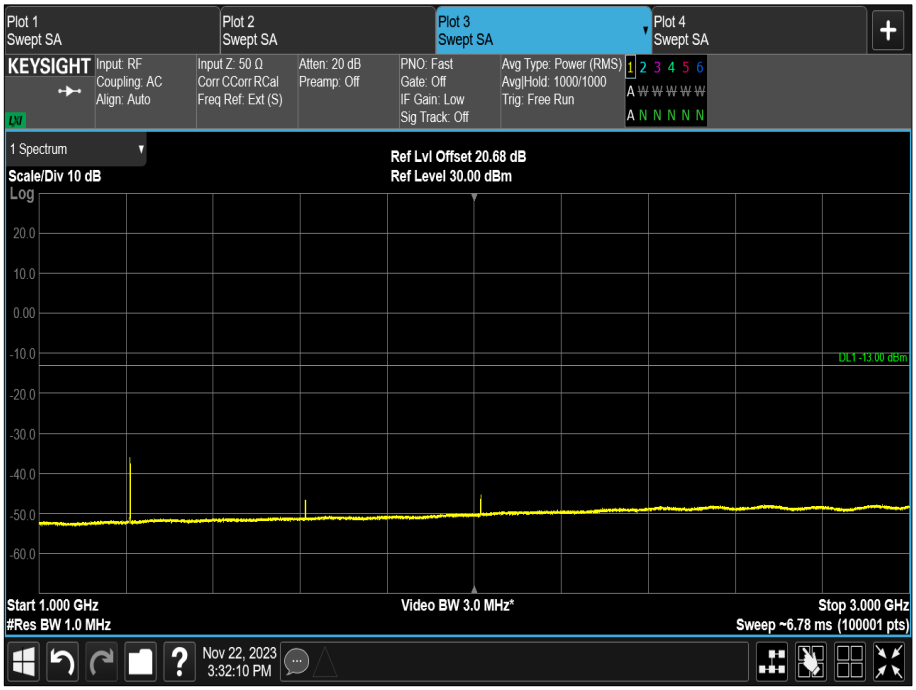


Figure 36 - 402.99 MHz - 1 GHz to 3 GHz

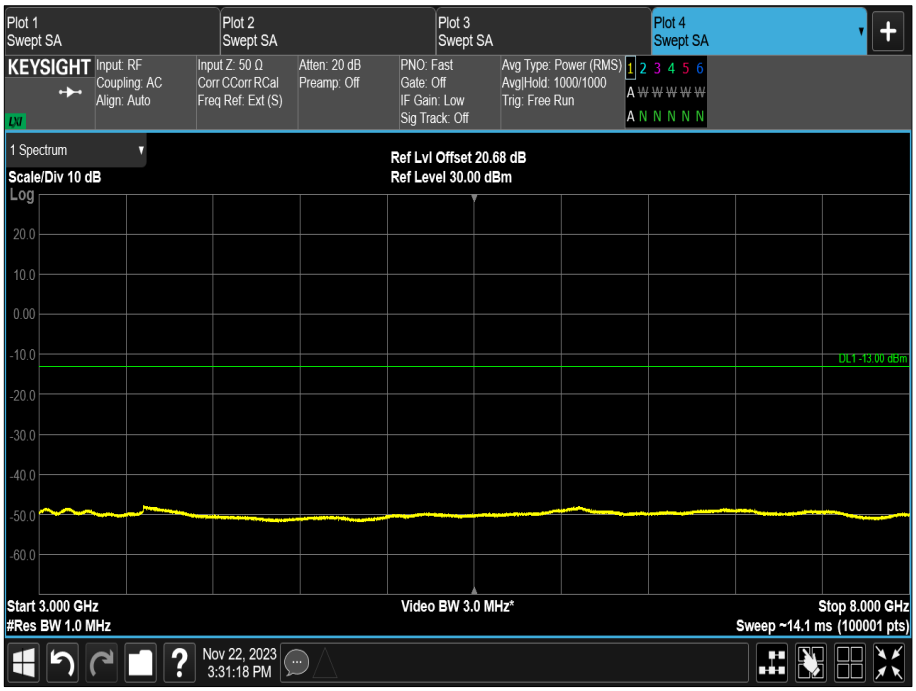


Figure 37 - 402.99 MHz - 3 GHz to 8 GHz

FCC 47 CFR Part 2, Limit Clause 25.202(f)

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50 %, up to and including 100 % of the authorised bandwidth;
- 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100 %, up to and including 250 % of the authorised bandwidth;
- 43 + 10 Log p (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250 % of the authorised bandwidth.

ISED RSS-170, Limit Clause 5.8

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50 %, up to and including 100 % of the occupied bandwidth or necessary bandwidth, whichever is greater
- 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100 %, up to and including 250 % of the occupied bandwidth or necessary bandwidth, whichever is greater
- 43 + 10 Log p (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250 % of the occupied bandwidth or necessary bandwidth, whichever is greater.

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
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Digital Multi-meter	Iso-tech	IDM93N	4435	12	04-Mar-2024
Hygrometer with pressure meter	Testo	622	5047	12	28-Sep-2024
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	5500	12	21-May-2024
Modular Power System Mainframe	Keysight Technologies	N6701C	5835	-	TU
DC Power Module 60V 20A 300W	Keysight Technologies	N6754A	5836	-	O/P Mon
1m K-Type Cable	Junkosha	MWX221/B	5908	12	21-May-2024
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025

Table 29

O/P Mon – Output Monitored using calibrated equipment

2.6 Frequency Tolerance

2.6.1 Specification Reference

FCC 47 CFR Part 25, Clause 25.202(d)
FCC 47 CFR Part, Clause 2, 2.1055
Industry Canada RSS-170, Clause 5.3
ISED RSS-GEN, Clause 6.11

2.6.2 Equipment Under Test and Modification State

1, Model: KIM2-HW1-FW1, S/N: KIM2102306203379 - Modification State 0

2.6.3 Date of Test

17-October-2023

2.6.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.6.

The measurement was made with the carrier unmodulated using a spectrum analyser set to a low span, low RBW with a peak detector and max hold trace to determine the centre frequency of the carrier in Hz to 2 decimal places.

2.6.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	38.1 %

2.6.6 Test Results

400 MHz Transmitter

Temperature (˚C)	Voltage	399.91 MHz		402.99 MHz	
		Frequency Error (%)	Frequency Error (ppm)	Frequency Error (%)	Frequency Error (ppm)
-30	3.6 V DC	0.000039134	0.391	0.000037247	0.372
-20	3.6 V DC	0.000034995	0.350	0.000042185	0.422
-10	3.6 V DC	0.000040109	0.401	0.000037544	0.375
0	3.6 V DC	0.000030169	0.302	0.000032718	0.327
10	3.6 V DC	0.000025593	0.256	0.000024666	0.247
20	3.3 V DC	0.000015003	0.150	0.000013648	0.136
20	3.6 V DC	0.000003751	0.038	0.000017370	0.174
20	5 V DC	0.000015003	0.150	0.000017370	0.174
30	3.6 V DC	0.000015328	0.153	0.000022172	0.222
40	3.6 V DC	0.000012503	0.125	0.000013648	0.136
50	3.6 V DC	0.000023755	0.238	0.000016129	0.161

Table 30

FCC 47 CFR Part 2, Limit Clause 25.202(d)

The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency.

ISED RSS-170, Limit Clause 5.3

For MES equipment, the carrier frequency shall not drift from the reference frequency by more than ±10 ppm.

2.6.7 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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Digital Temperature Indicator	Fluke	51	1385	12	06-Jun-2024
Power Supply Unit	Farnell	TSV-70	2043	12	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	15-Nov-2023
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Digital Multi-meter	Iso-tech	IDM93N	4435	12	04-Mar-2024
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	05-Jun-2024
Attenuator 5W 20dB DC-18GHz	Aaren	AT40A-4041-D18-20	5497	12	18-Apr-2024
MXA Signal Analyser	Keysight Technologies	N9020B	6418	24	27-Feb-2025

Table 31

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Test Setup Photographs

Figure 38 – Coil X Plane, 30MHz to 1GHz

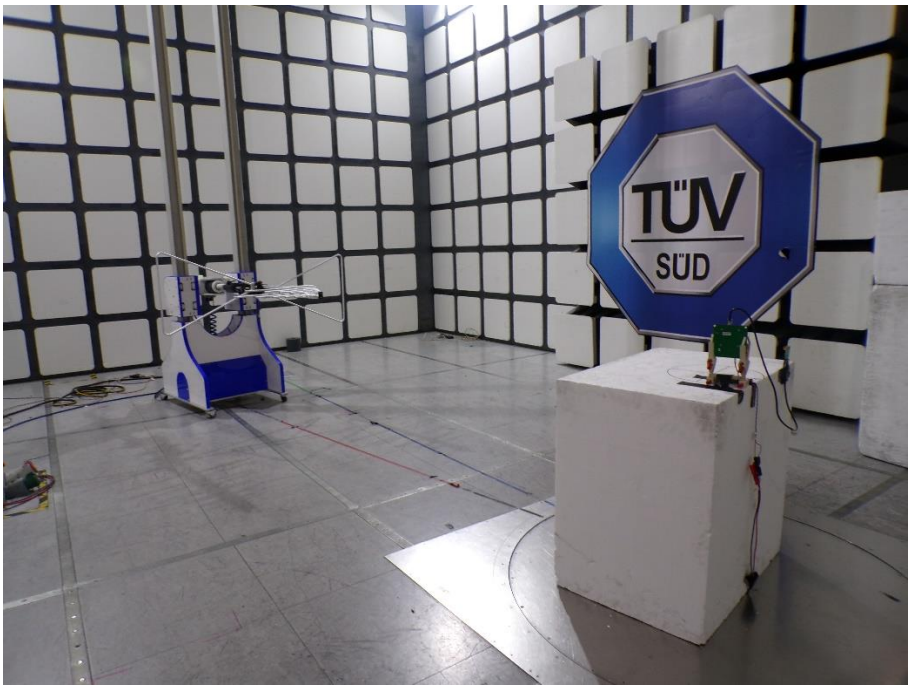


Figure 39 – Coil Y Plane, 30MHz to 1GHz

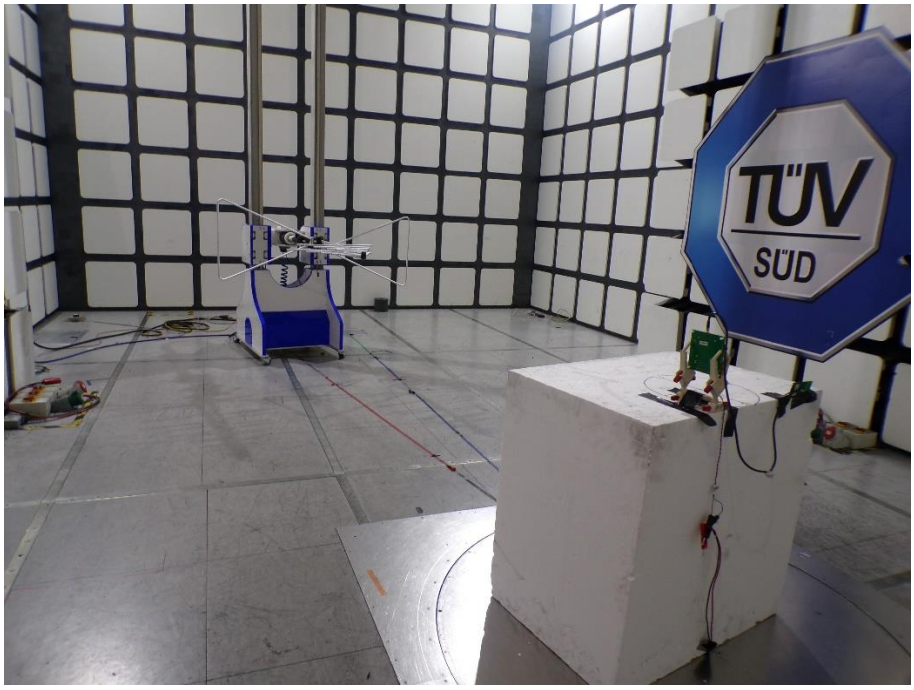


Figure 40 – Coil Z Plane, 30MHz to 1GHz

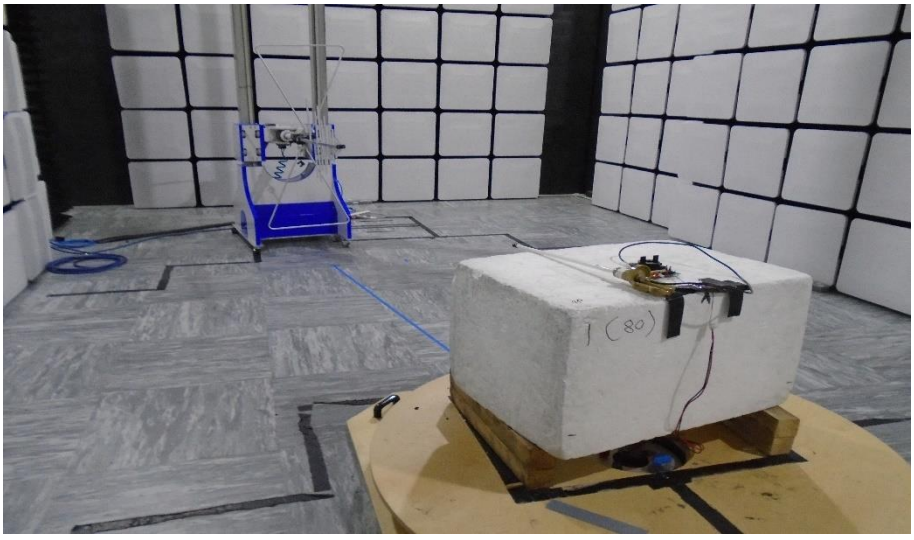


Figure 41 – Whip X Plane, 30MHz to 1GHz

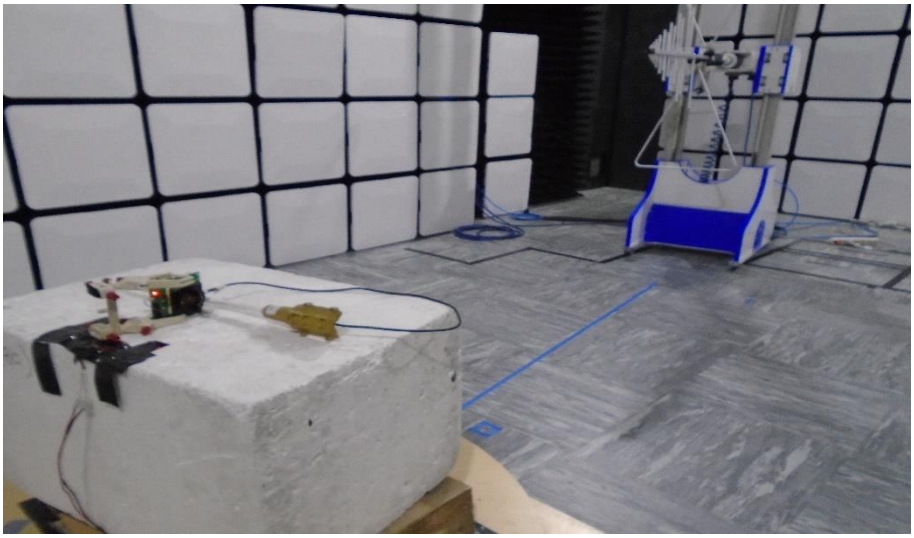


Figure 42 – Whip Y Plane, 30MHz to 1GHz

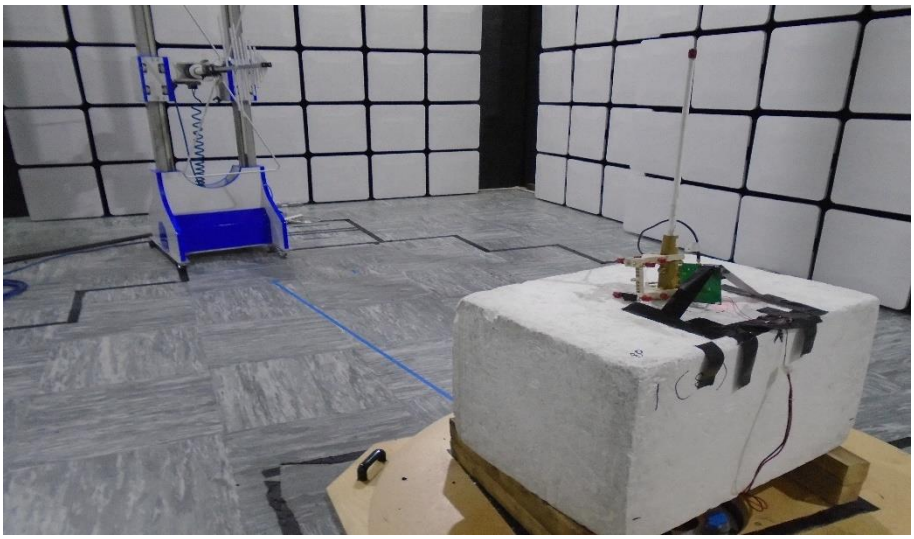


Figure 43 – Whip Z Plane, 30MHz to 1GHz

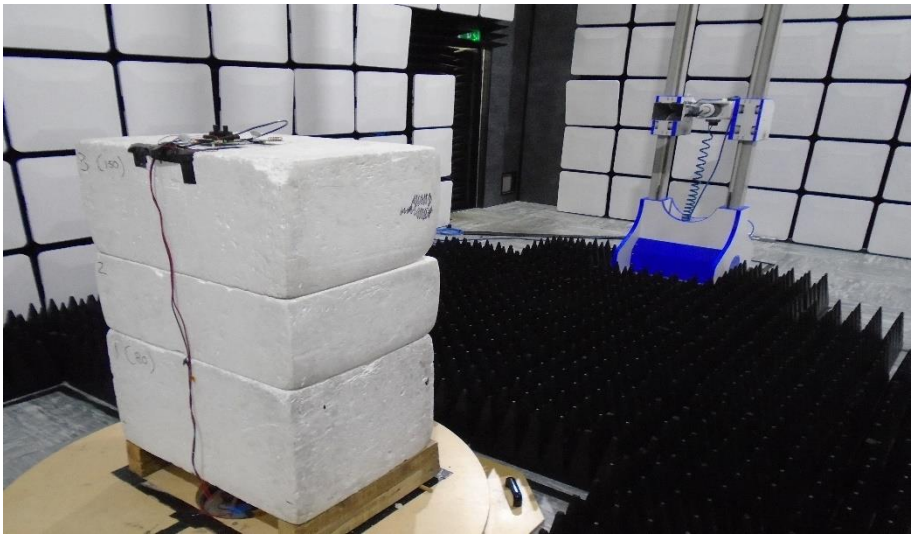


Figure 44 - Coil X Plane, 1GHz to 5GHz

Figure 45 - Coil Y Plane, 1GHz to 5GHz

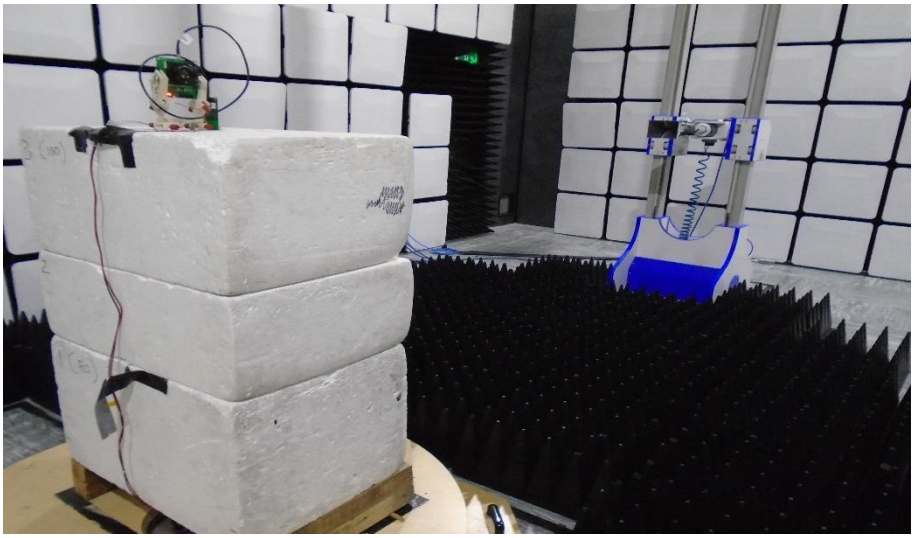


Figure 46 – Coil Z Plane, 1GHz to 5GHz

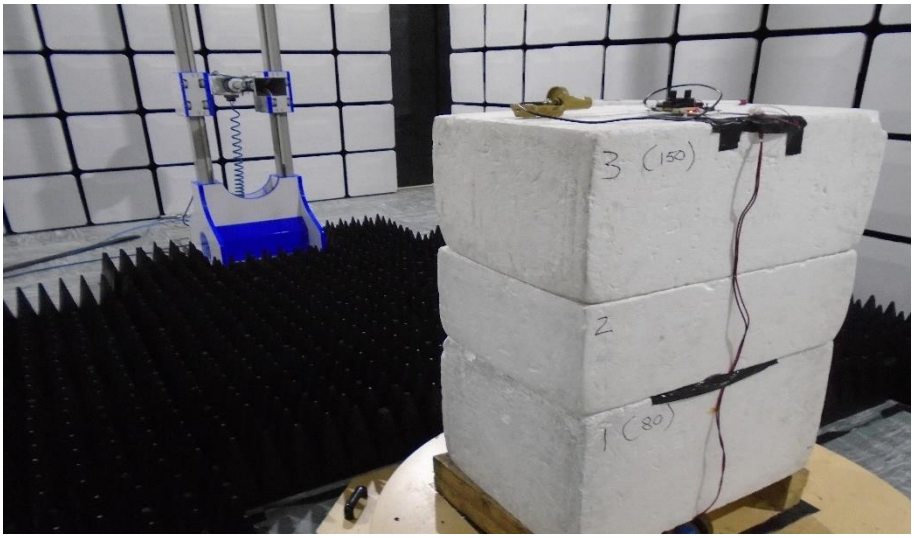


Figure 47 – Whip X Plane, 1GHz to 5GHz

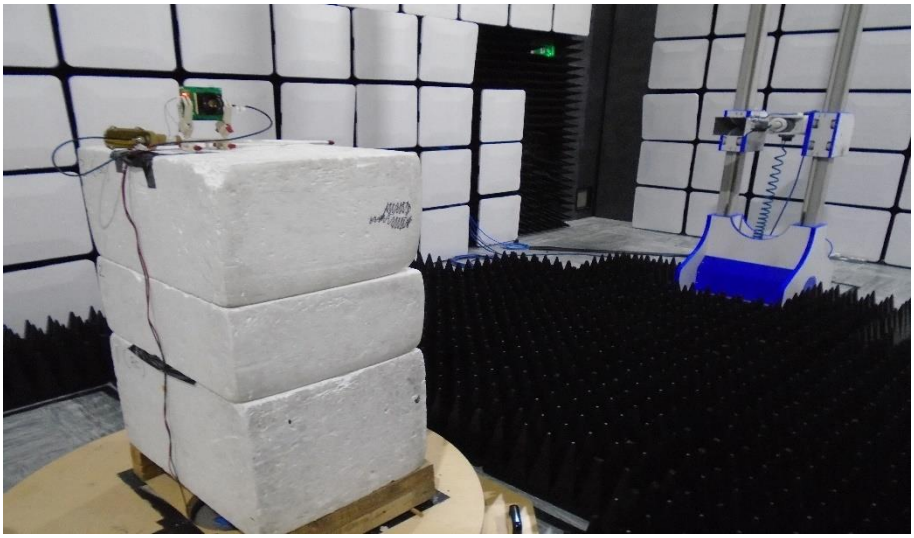


Figure 48 – Whip Y Plane, 1GHz to 5GHz

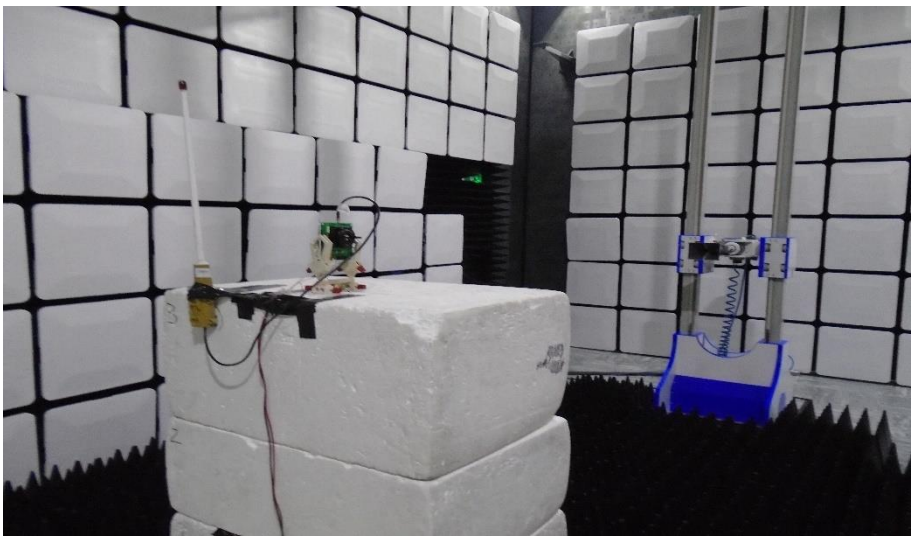


Figure 49 – Whip Z Plane, 1GHz to 5GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Occupied Bandwidth	± 100.22 Hz
Spurious Emissions at Antenna Terminals	± 3.08 dB
Frequency Tolerance	± 3.54 Hz
Equivalent Isotropic Radiated Power	Conducted: ± 3.2 dB Radiated: ± 6.3 dB (1 GHz to 18 GHz)
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB

Table 32

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.