

FCC and ISED Test Report

XYZ Reality Ltd

Model: Atom Tracking Beacon

In accordance with FCC 47 CFR Part 15C, ISED
RSS-247 and ISED RSS-GEN
(2.4 GHz Bluetooth Low Energy)

Prepared for: XYZ Reality Ltd
Unit G0, G02, 338-346
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Add value.
Inspire trust.

FCC ID: 2A3C5-XYZ5201 (Contains FCC ID: SQGBL652)
IC: 28181XYZ5201 (Contains IC: 3147A-BL652)

COMMERCIAL-IN-CONFIDENCE

Document 75952587-20 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	11 February 2022

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 15C, ISED RSS-247 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	Graeme Lawler	11 February 2022	

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 15C: 2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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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	11-February-2022

Table 1

1.2 Introduction

Applicant	XYZ Reality Ltd
Manufacturer	XYZ Reality Ltd
Model Number(s)	Atom Tracking Beacon
Serial Number(s)	Not serialised (Storix-ID 599374-104)
Hardware Version(s)	Not Applicable
Software Version(s)	Not Applicable
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020, ISED RSS-247, Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	XYZ0179
Date	21-June-2021
Date of Receipt of EUT	06-September-2021
Start of Test	18-October-2021
Finish of Test	17-November-2021
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10 (2013) KDB 996369 D04 Module Integration Guide v02



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISSED RSS-247 and ISSED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth Low Energy						
2.1	15.207	-	8.8	AC Power Line Conducted Emissions	Pass	
2.2	15.247 (b)	5.4	6.12	ERP/EIRP Verification	Pass	
2.3	15.247 (d) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	

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)	Devices to enable 3D tracking within designate-able zones	
Manufacturer:	XYZ Reality Ltd	
Model:	Atom Tracking Beacon	
Part Number:	XYZ-52-01	
Hardware Version:	N/A	
Software Version:	N/A	
FCC ID of the product under test – see guidance here	2A3C5-XYZ5201 (Contains FCC ID: SQGBL652)	
IC ID of the product under test – see guidance here	28181XYZ5201 (Contains IC: 3147A-BL652)	

Table 3

Intentional Radiators

Technology	Bluetooth					
Frequency Range (MHz to MHz)	2402-2480					
Conducted Declared Output Power (dBm)	0					
Antenna Gain (dBi)	0					
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	1					
Modulation Scheme(s) (e.g GFSK, QPSK etc)	GFSK / DQPSK					
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	1M00F1D					
Bottom Frequency (MHz)	2402					
Middle Frequency (MHz)	2440					
Top Frequency (MHz)	2480					

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	
Lowest frequency generated or used in the device or on which the device operates or tunes	
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:		Hz
Voltage		V
Max current:		A
Single Phase ☐ Three Phase ☐		

Table 6

DC Power Source

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

Table 7

Battery Power Source

Voltage:	7.4	V
End-point voltage:		V (Point at which the battery will terminate)
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ *(Vehicle regulated)		
Other ☒	Please detail:	Li Ion

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☒
---	---

Table 9

Temperature

Minimum temperature:	0	°C
Maximum temperature:	40	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)	1.3	dB
---------------------------------------	-----	----

Table 11



Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	Integrated BL652-SA-01	Gain	0	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 ☐					

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: Dave Williams
Position held: Director of Engineering, DitroniX Ltd
Date: 04 November 2021



1.5 Product Information

1.5.1 Technical Description

The EUT is a device for interacting with Atom Hard Hat and Atom Controller. It is to enable 3D tracking within designate-able zones.

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: Atom Tracking Beacon, Serial Number: Not serialised (Storix-ID 599374-104)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14

1.8 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth Low Energy		
AC Power Line Conducted Emissions	Graeme Lawler	UKAS
ERP/EIRP Verification	Graeme Lawler	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS

Table 15

Office Address:

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



2 Test Details

2.1 AC Power Line Conducted Emissions

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.207
ISED RSS-GEN, Clause 8.8

2.1.2 Equipment Under Test and Modification State

Atom Tracking Beacon, S/N: Not serialised (Storix-ID 599374-104) - Modification State 0

2.1.3 Date of Test

17-November-2021

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.2.
The EUT was placed on a non-conductive table 0.8m above a reference ground plane and 0.4m away from a vertical coupling plane.

All power was connected to the EUT through an Artificial Mains Network (AMN).

Conducted disturbance voltage measurements on mains lines were made at the output of the AMN.

2.1.5 Environmental Conditions

Ambient Temperature	20.8 °C
Relative Humidity	39.8 %



2.1.6 Test Results

2.4 GHz Bluetooth Low Energy

Applied supply voltage: 117.7 V AC
Applied supply frequency: 60 Hz

Frequency (MHz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
0.497	36.1	56.0	-19.9	Q-Peak	0	100	Horizontal
0.497	28.2	46.0	-17.8	CISPR Avg	0	100	Horizontal
0.511	40.6	56.0	-15.4	Q-Peak	0	100	Horizontal
0.511	34.0	46.0	-12.0	CISPR Avg	0	100	Horizontal

Table 16 - Neutral Line Emissions Results

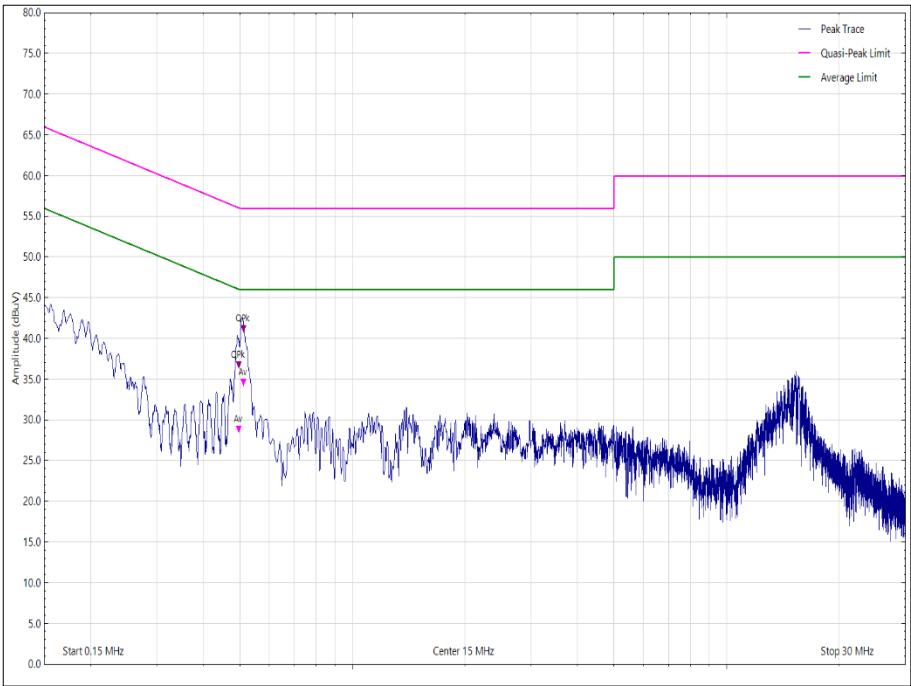


Figure 1 - Neutral Line - 150 kHz to 30 MHz

Frequency (MHz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
0.494	37.0	56.1	-19.2	Q-Peak	0	100	Horizontal
0.494	29.5	46.1	-16.6	CISPR Avg	0	100	Horizontal
0.510	40.1	56.0	-15.9	Q-Peak	0	100	Horizontal
0.510	33.6	46.0	-12.4	CISPR Avg	0	100	Horizontal

Table 17 - Live Line Emissions Results

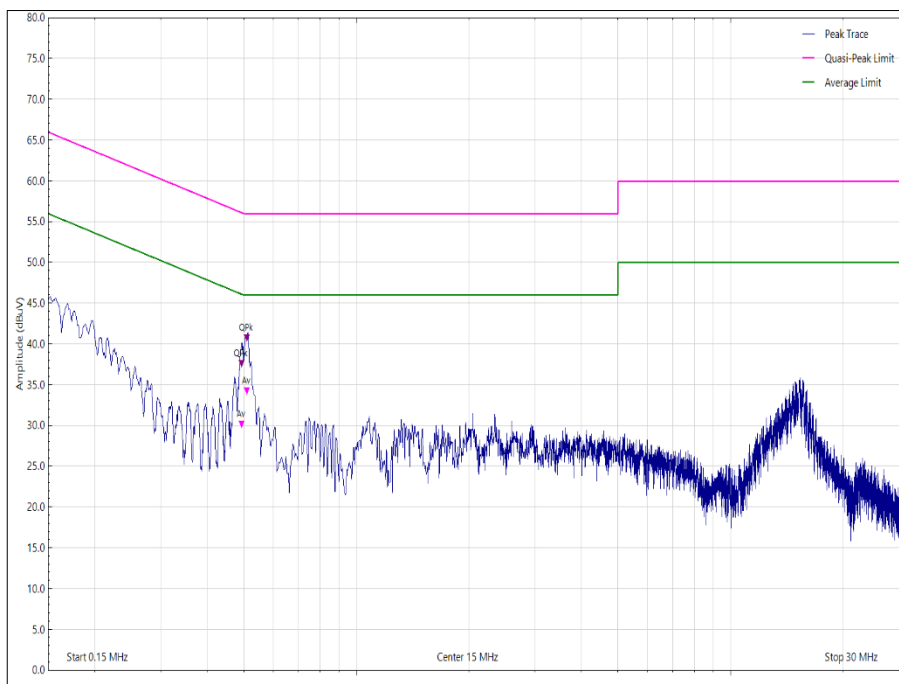


Figure 2 - Live Line - 150 kHz to 30 MHz

FCC 47 CFR Part 15, Limit Clause 15.207 and ISSED RSS-GEN, Limit Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	CISPR Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Table 18

*Decreases with the logarithm of the frequency.



2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Transient Limiter	Hewlett Packard	11947A	15	12	13-Oct-2022
LISN	Rohde & Schwarz	ESH3-Z5	1390	12	28-Jan-2022
Multimeter	Iso-tech	IDM101	2421	12	28-Oct-2022
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable (K-Type to K-Type, 2 m)	Scott Cables	KPS-1501-2000-KPS	4526	6	06-Mar-2022
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023

Table 19



2.2 ERP/EIRP Verification

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause 6.12

2.2.2 Equipment Under Test and Modification State

Atom Tracking Beacon, S/N: Not serialised (Storix-ID 599374-104) - Modification State 0

2.2.3 Date of Test

17-November-2021

2.2.4 Test Method

The following test was performed to check the fundamental of the integrated module was not adversely affected when integrated into the host device as required by KDB 996369 D04, clause 3.4.
This test was performed in accordance with ANSI C63.10 clause 6.3 and clause 11.9.1.1.

2.2.5 Environmental Conditions

Ambient Temperature	20.9 °C
Relative Humidity	46.0 %



2.2.6 Test Results

2.4 GHz Bluetooth Low Energy

The worst-case mode was identified as:

Measurements were performed with the EUT in the worst case orientation.

Frequency (MHz)	Result	Limit	Unit
2402	2.84	21	dBm
2426	1.79	21	dBm
2480	0.49	21	dBm

Table 20 - EIRP Verification Results

2.2.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable (K-Type to K-Type, 2 m)	Scott Cables	KPS-1501-2000-KPS	4526	6	06-Mar-2022
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Antenna (DRG, 1 GHz to 10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	15-Oct-2022
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023

Table 21

TU - Traceability Unscheduled



2.3 Spurious Radiated Emissions

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.209
ISED RSS-247, Clause 3.3 and 5.5
ISED RSS-GEN, Clause, 6.13 and 8.9

2.3.2 Equipment Under Test and Modification State

Atom Tracking Beacon, S/N: Not serialised (Storix-ID 599374-104) - Modification State 0

2.3.3 Date of Test

18-October-2021 to 19-October-2021

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

Measurements were only performed over the frequency range specified in FCC Part 15.35(b) as required by KDB 996369 D04, clause 3.4

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. For an EUT which could reasonably be used in multiple planes, pre-scans were performed with the EUT orientated in X and Y planes with reference to the ground plane.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBμV/m to μV/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$

Where formal measurements have been necessary, the results have been presented in the emissions table.

2.3.5 Example Test Setup Diagram

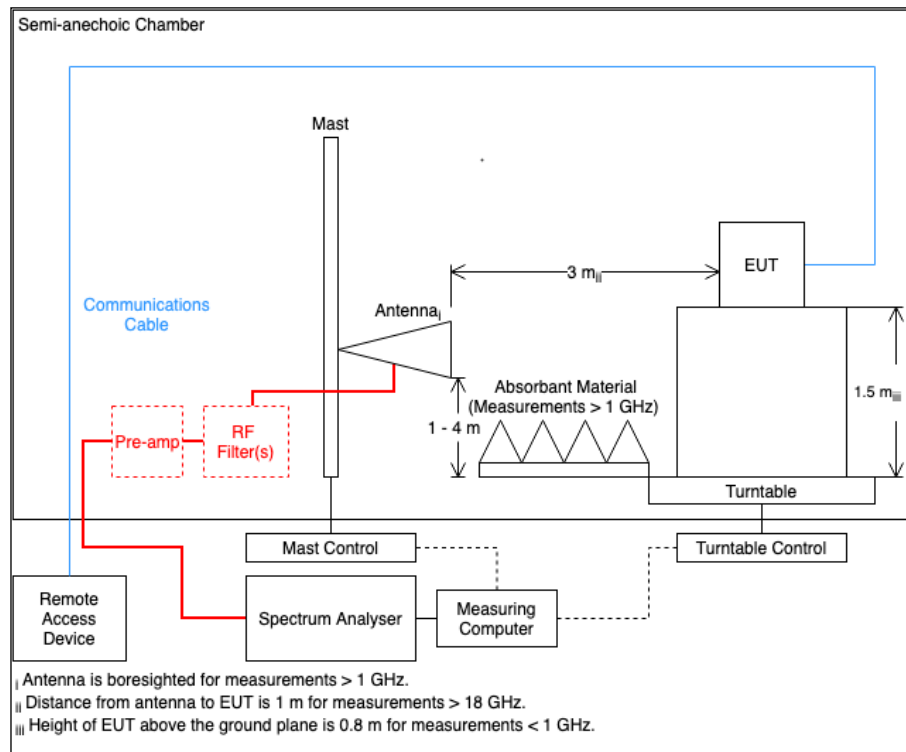


Figure 3

2.3.6 Environmental Conditions

Ambient Temperature	20.8 - 20.9 °C
Relative Humidity	61.1 - 64.7 %



2.3.7 Test Results

2.4 GHz Bluetooth Low Energy

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 22 - BLE - X, 2402-2426-2480 MHz, 30 MHz to 13 GHz

*No emissions found within 10 dB of the limit.

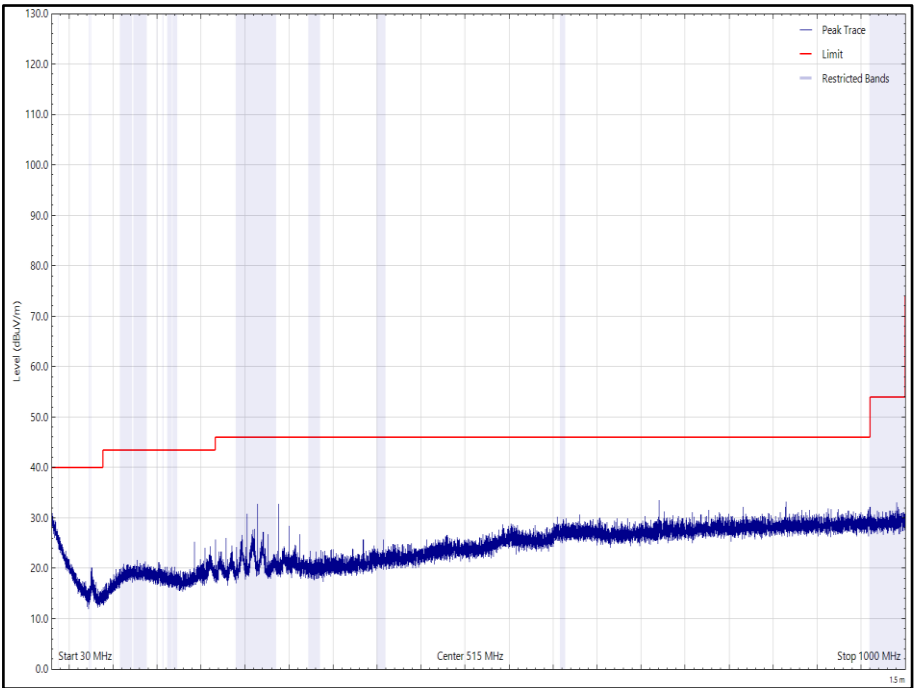


Figure 4 - BLE - X, 2402-2426-2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

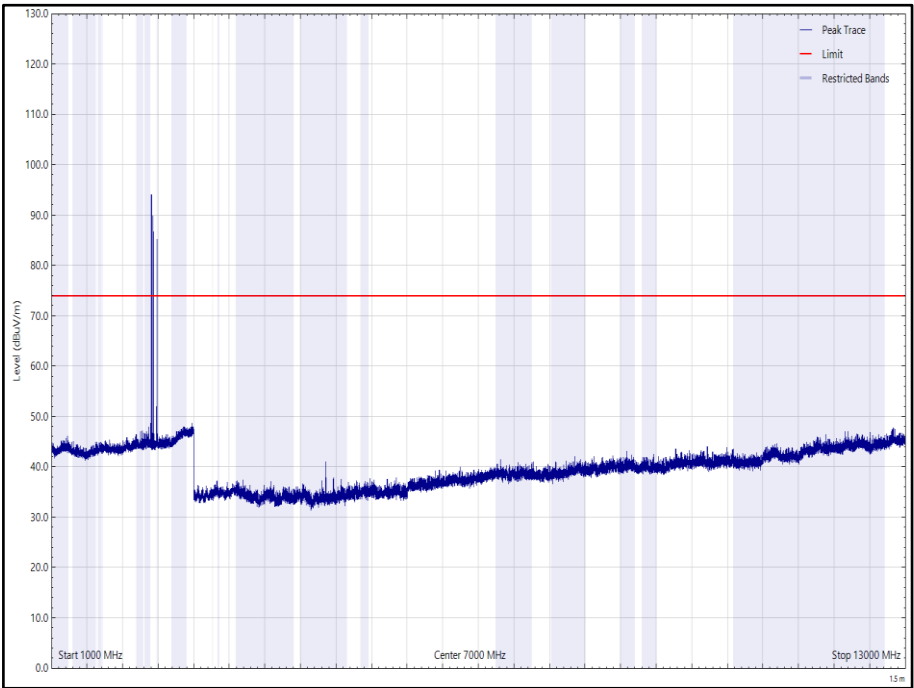


Figure 5 - BLE - X, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Horizontal (Peak)

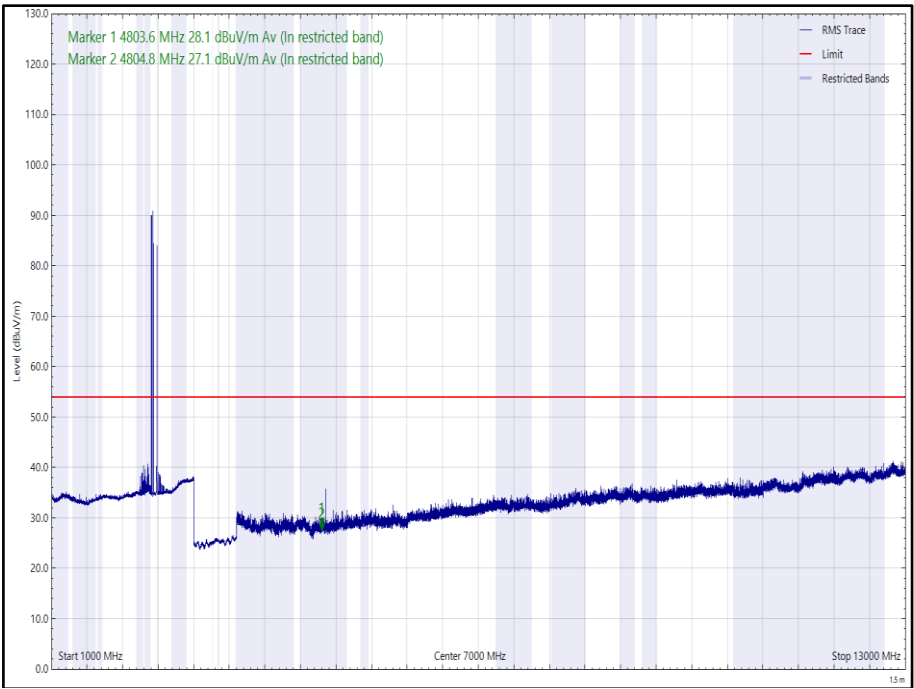


Figure 6 - BLE - X, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Horizontal (rms)

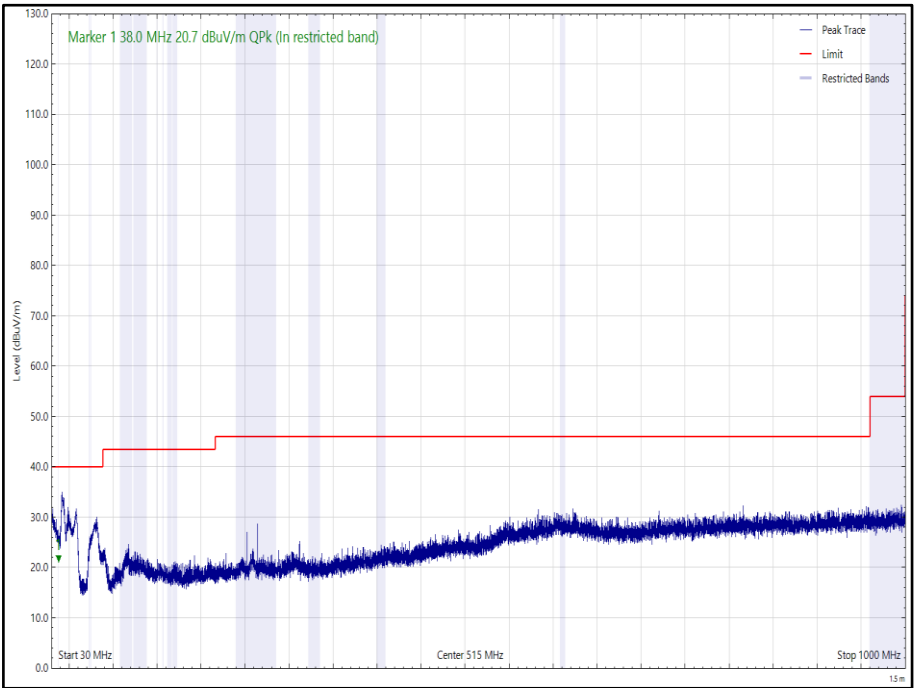


Figure 7 - BLE - X, 2402-2426-2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

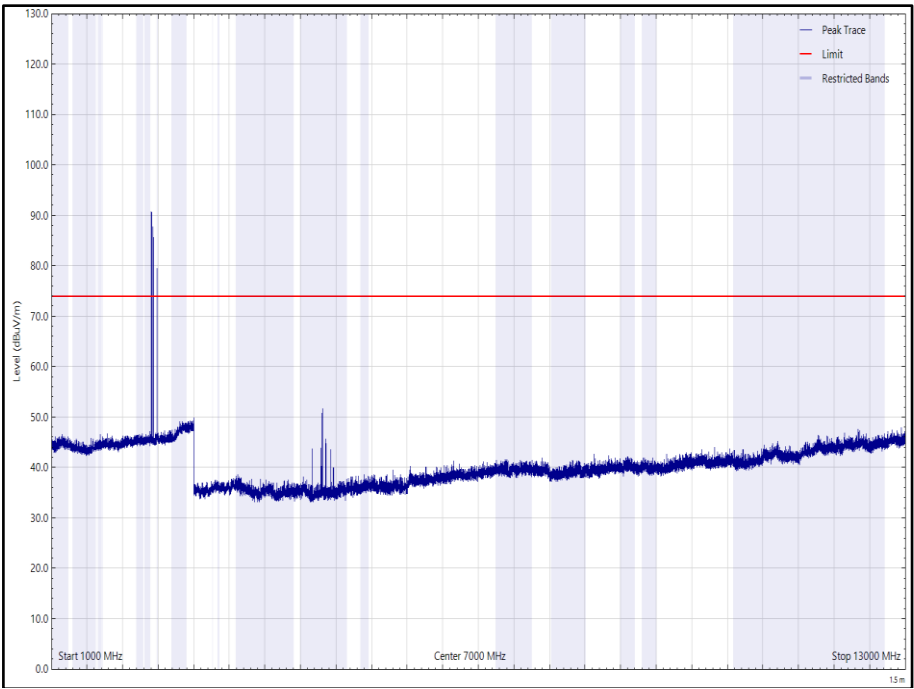


Figure 8 - BLE - X, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Vertical (Peak)

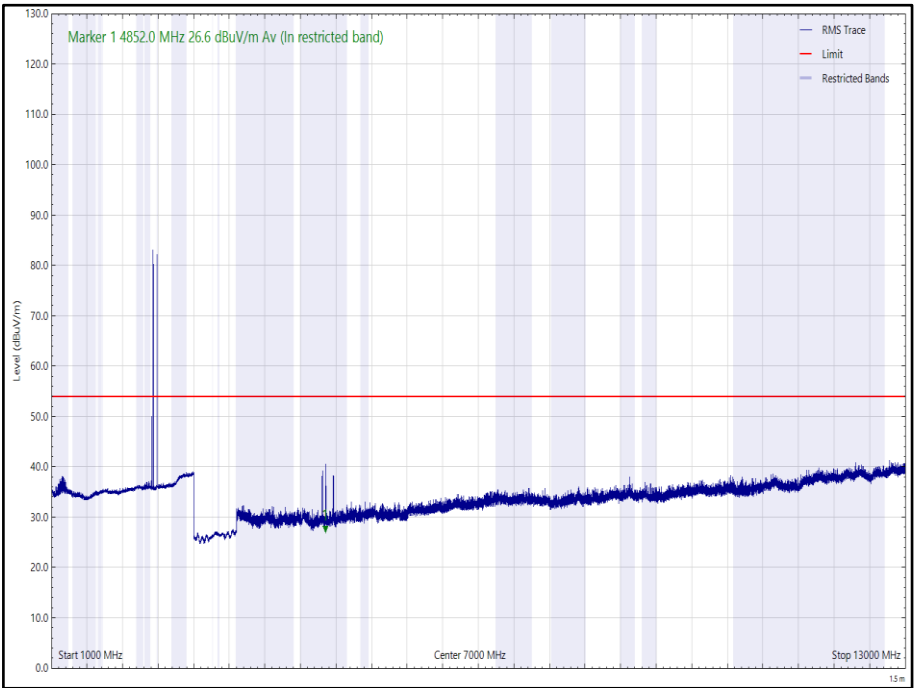


Figure 9 - BLE - X, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 23 - BLE - Y, 2402-2426-2480 MHz, 30 MHz to 13 GHz

*No emissions found within 10 dB of the limit.

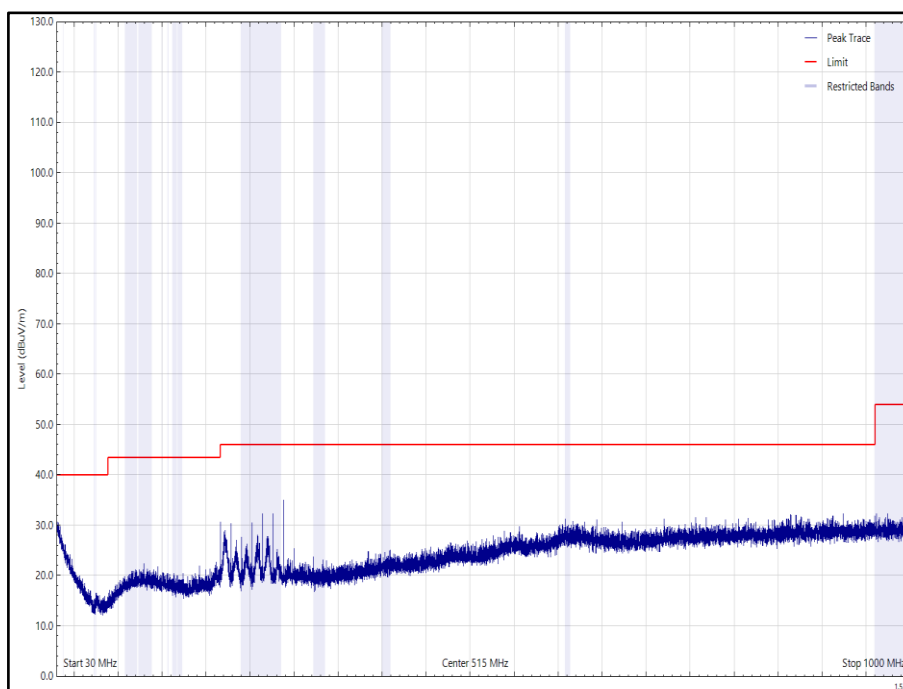


Figure 10 - BLE - Y, 2402-2426-2480 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

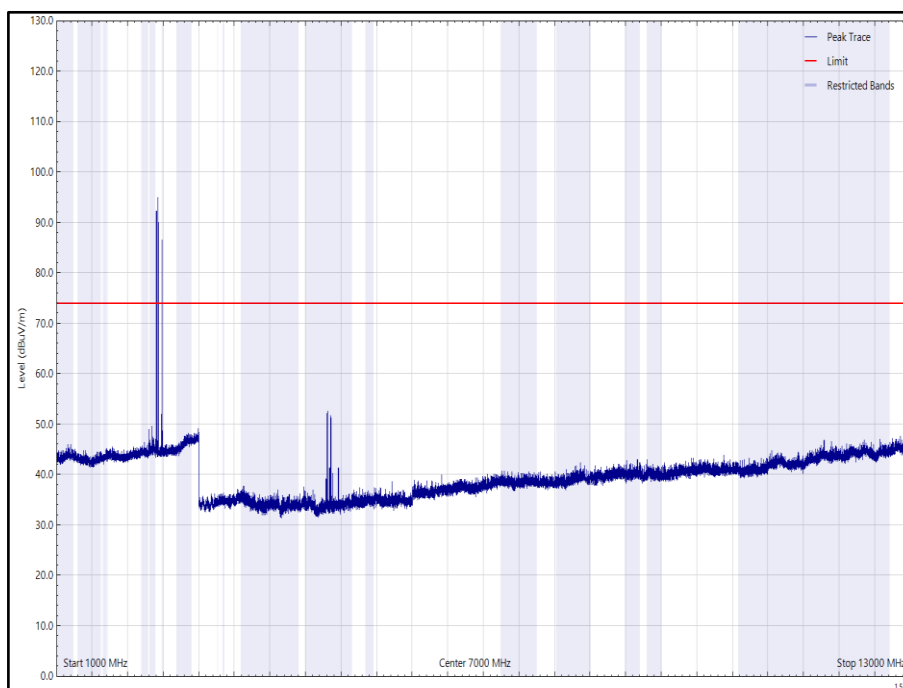


Figure 11 - BLE - Y, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Horizontal (Peak)

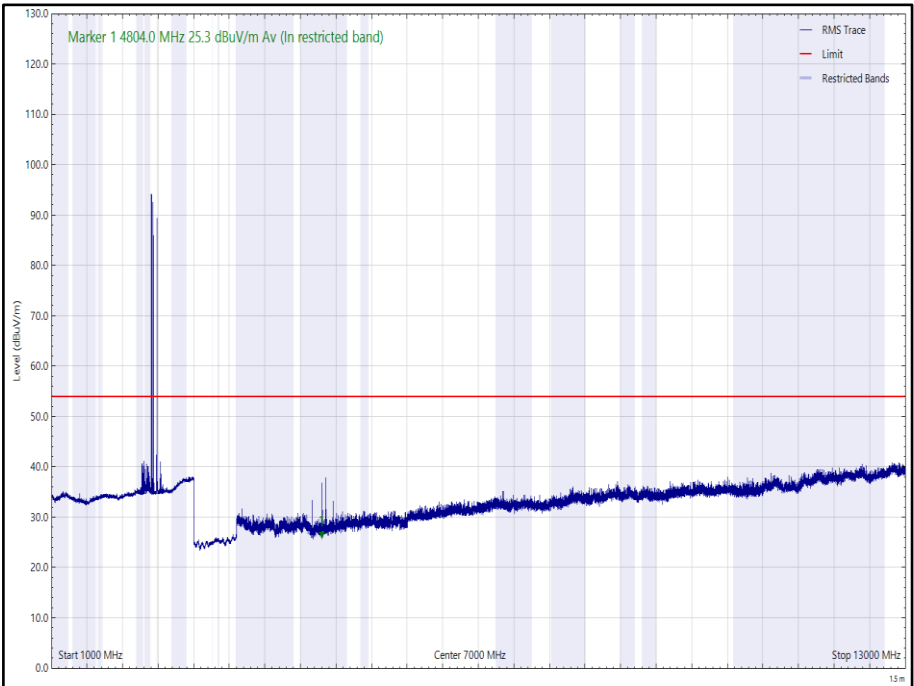


Figure 12 - BLE - Y, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Horizontal (rms)

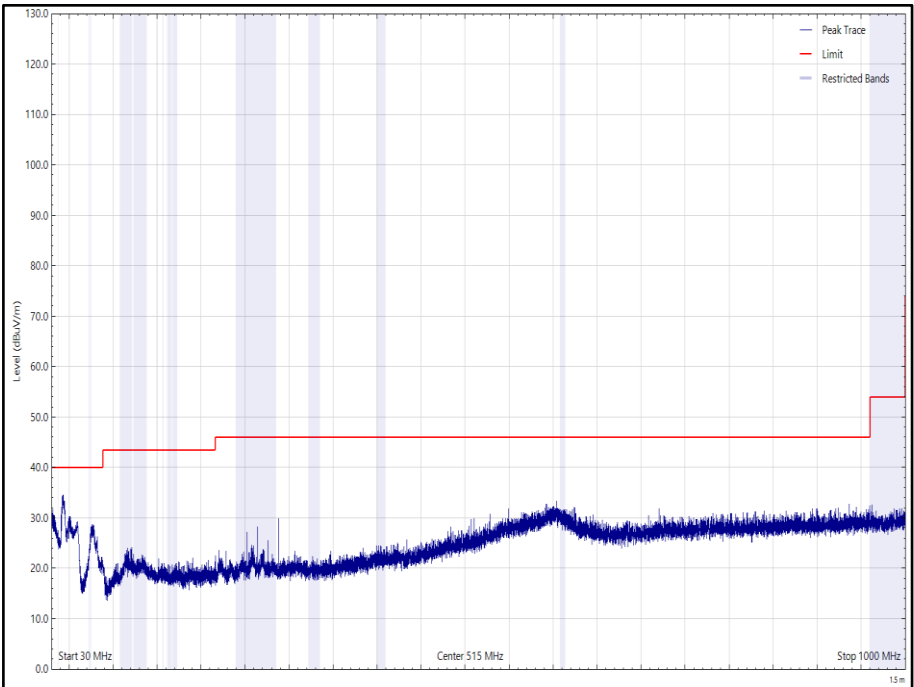


Figure 13 - BLE - Y, 2402-2426-2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

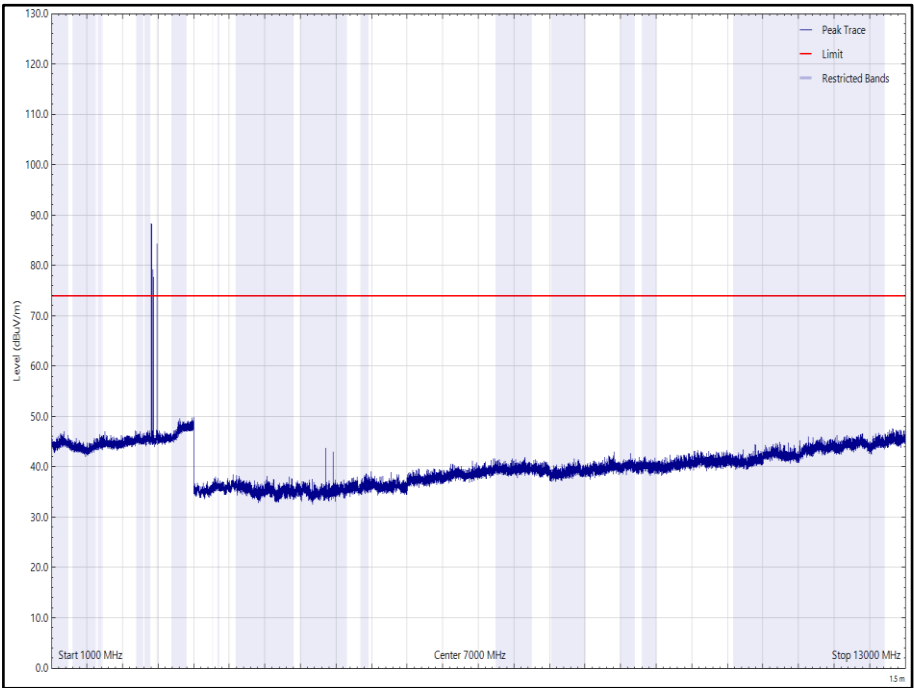


Figure 14 - BLE - Y, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Vertical (Peak)

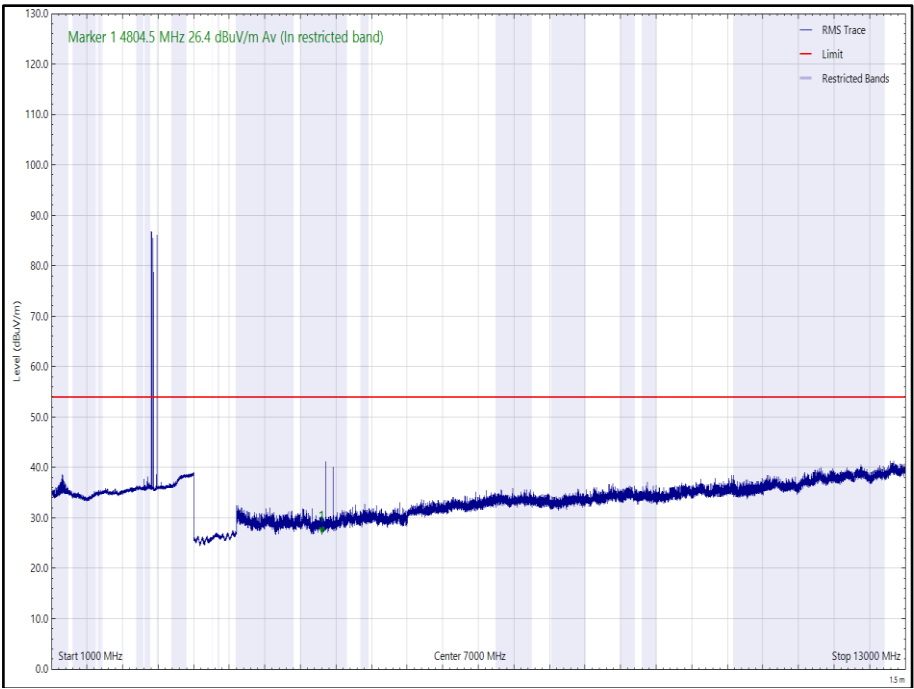


Figure 15 - BLE - Y, 2402-2426-2480 MHz, 1 GHz to 13 GHz, Vertical (rms)



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in RSS-GEN, clause 8.10, must also comply with the radiated emission limits specified in RSS-GEN clause 8.9.



2.3.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Antenna with attenuator (Bilog, 30 MHz to 3 GHz)	Schaffner	CBL6143	287	24	14-Oct-2022
Pre-Amplifier (8 GHz to 18 GHz)	Phase One	PS04-0086	1533	12	05-Feb-2022
Comb Generator	Schaffner	RSG1000	3034	-	TU
Multimeter	Fluke	79 Series II	3057	12	23-Aug-2022
Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
Cable 1503 2M 2.92(P)m 2.92(P)m	Rhophase	KPS-1503A-2000-KPS	4293	12	16-Nov-2021
Cable (K-Type to K-Type, 2 m)	Scott Cables	KPS-1501-2000-KPS	4526	6	06-Mar-2022
Cable (N-Type to N-Type, 1 m)	Rosenberger	LU7-036-1000	5031	12	23-Jul-2022
EmX Emissions Software	TUV SUD	V2.1.11	5125	-	Software
Pre-Amplifier (1 GHz to 18 GHz)	Schwarzbeck	BBV 9718 C	5350	12	22-Sep-2022
Cable (sma-sma, 2 m)	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Cable (N-Type to N-Type, 8 m)	Teledyne	PR90-088-8MTR	5450	6	08-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	09-Apr-2022
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5512	12	09-Apr-2022
2m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5524	12	24-Mar-2022
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	07-May-2022
Antenna (DRG, 7.5 GHz to 18 GHz)	Schwarzbeck	HWRD750	5610	12	15-Oct-2022
Antenna (DRG, 1 GHz to 10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	15-Oct-2022
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
CBL 6111D 30-1000MHz Bi-Log Antenna	Teseq	CBL6111D	5615	24	16-Oct-2022
Screened Room (12)	MVG	EMC-3	5621	36	11-Aug-2023

Table 24

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs



Figure 16 - Test Setup - AC Line Conducted Emissions



Figure 17 - Test Setup - AC Line Conducted Emissions



Figure 18 - Test Setup - 30 MHz to 1 GHz - X Orientation



Figure 19 - Test Setup - 30 MHz to 1 GHz - Y Orientation



Figure 20 - Test Setup - 1 GHz to 13 GHz - X Orientation



Figure 21 - Test Setup - 1 GHz to 13 GHz - Y Orientation



4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
AC Power Line Conducted Emissions	150 kHz to 30 MHz, LISN, ± 3.7 dB
ERP/EIRP Verification	± 3.2 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 25

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2007, Clause 4.4.3 and 4.5.1. (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.