

RF Report

Reelables, Inc.
Model: RA0002



Antenna Gain Measurements

Prepared for: Reelables, Inc.
600 1st Ave Ste 330-76660
Seattle, WA
98104-2246, US

COMMERCIAL-IN-CONFIDENCE

Document 75967623-10 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	09 June 2026

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

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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	09 June 2026

Table 1

1.2 Introduction

Applicant	Reelables, Inc. 600 1st Ave Ste 330-76660 Seattle, WA 98104-2246, US
Manufacturer	Reelables Europe, Ltd. 14 Windsor St. London N1 8QG UK.
Model Number(s)	RA0002
Serial Number(s)	Not Serialized (FAR-1023223-6) Not Serialized (FAR-1023223-8)
Hardware Version(s)	1.10
Software Version(s)	4.00
Number of Samples Tested	2
Order Number	PO0024
Date	20-April-2026
Date of Receipt of EUT	17-April-2026
Start of Test	20-April-2026
Finish of Test	23-April-2026
Name of Engineer(s)	Joshua Peploe-Williams



1.3 Brief Summary of Results

A brief summary of the tests carried out are shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: BLE				
2.1	-	Antenna Gain Measurements	-	For information only.

Table 2



1.4 Application Form

Equipment Description

Technical Description: <i>(Please provide a brief description of the intended use of the equipment)</i>	RA0002 is a Bluetooth Low Energy transmitter in the form factor of a thin shipping label/tag for asset and parcel identification. The device transmits Bluetooth LE advertisements only. The Bluetooth radio is TX-only, implemented at chipset level (no radio module), and configured for LE 1M PHY only
Manufacturer:	Reelables Europe, Ltd.
Model:	RA0002
Part Number:	RA0002
Hardware Version:	1.10
Software Version:	4.00

The type of Wideband Data Transmission Equipment

FHSS ☐ non-FHSS ☒

In case of FHSS

In case of non-Adaptive FHSS equipment:	
The number of Hopping Frequencies:	
In case of Adaptive FHSS equipment:	
The maximum number of Hopping Frequencies:	
The minimum number of Hopping Frequencies:	
The (average) dwell Time:	

Adaptive/non-adaptive Equipment

Non-adaptive Equipment	☒
Adaptive Equipment without the possibility to switch to a non-adaptive mode	☐
Adaptive Equipment which can also operate in a non-adaptive mode	☐



In case of Adaptive Equipment

The maximum Channel Occupancy Time implemented by the equipment:	40	ms
The equipment has implemented an LBT mechanism		☐
In case of non-FHSS equipment:		
The equipment is Frame Based equipment		☐
The equipment is Load Based equipment		☐
The equipment can switch dynamically between Frame Based and Load Based equipment		☐
The CCA time implemented by the equipment:		μs
The equipment has implemented a DAA mechanism		☐
The equipment can operate in more than one adaptive mode		☐

In case of Non-adaptive Equipment

Max Peak Output Power (dBm)	2.5	dBm
Antenna Gain	3.41	dBi
The maximum (corresponding) Duty Cycle	0.01	%
Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared)		
Bluetooth LE advertisements only, TX-only, LE 1M PHY only. Reference advertising period: 10 s. Total radio on-time is below 1 ms per period, giving a duty cycle below 0.01%.		

The worst case operational mode for each of the following tests

RF Output Power	LE1M
Power Spectral Density	LE1M
Duty cycle, Tx-Sequence, Tx-gap	N/A
Accumulated Transmit Time, Frequency Occupation & Hopping Sequence (only for FHSS equipment)	N/A
Hopping Frequency Separation (only for FHSS equipment)	N/A
Medium Utilisation:	N/A
Adaptivity & Receiver Blocking:	LE1M
Nominal Channel Bandwidth	LE1M
Transmitter unwanted emissions in the OOB domain	LE1M
Transmitter unwanted emissions in the spurious domain	LE1M
Receiver spurious emissions	LE1M



The different transmit operating modes (tick all that apply)

Operating mode 1: Single Antenna Equipment	☒
Equipment with only one antenna	☒
Equipment with two diversity antennas but only one antenna active at any moment in time	☐
Smart Antenna Systems with two or more antennas but operating in a (legacy) mode where only one antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)	☐
Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming	☐
Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)	☐
High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	☐
High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	☐
Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	☐
Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)	☐
High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1	☐
High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2	☐
NOTE: Add more lines if more channel bandwidths are supported.	

In case of Smart Antenna Systems

The number of Receive chains:	
The number of Transmit chains:	
symmetrical power distribution	☐
asymmetrical power distribution	☐
In case of beam forming, the maximum (additional) beam forming gain:	
	dB
NOTE: The additional beam forming gain does not include the basic gain of a single antenna.	

Operating Frequency Range(s) of the Equipment

Operating Frequency Range 1:	2400	MHz to	2483.5	MHz
Operating Frequency Range 2:		MHz to		MHz
NOTE: Add more lines if more Frequency Ranges are supported.				

Nominal Channel Bandwidth

Nominal Channel Bandwidth 1:	1	MHz
Nominal Channel Bandwidth 2:		MHz
NOTE: Add more lines if more channel bandwidths are supported.		



Type of Equipment (stand-alone, combined, plug-in radio device, etc.)

Stand-alone:	☒
Combined Equipment:	☐
Plug-in radio device:	☐
Other:	Please specify:

The normal and extreme operating conditions that apply to the equipment

Normal operating conditions (if applicable):					
Operating temperature:		-20 to 60	°C		
Other (please specify if applicable):		Battery powered label/tag	°C		
Extreme operating conditions:					
Operating temperature:	Minimum	-20	°C to Maximum	60	°C
Other (please specify if applicable):	Minimum		°C to Maximum		°C
Details provided are for the:					
stand-alone equipment					☐
combined equipment					☐
test jig					☐

The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels

Antenna Type:		
Integral Antenna (information to be provided in case of conducted measurements)		☒
Antenna Gain:	3.41	dBi
If applicable, additional beamforming gain (excluding basic antenna gain):		dB
Temporary RF connector provided		☐
No temporary RF connector provided		☒
Integral Antenna (information to be provided in case of conducted measurements)		☐
Dedicated Antennas (equipment with antenna connector)		☐
Single power level with corresponding antenna(s)		☐
Multiple power settings and corresponding antenna(s)		☐
Number of different Power Levels:		
Power Level 1	2.5	dBm



Power Level 2					dBm
Power Level 3					dBm
NOTES: Add more lines in case the equipment has more power levels. These power levels are conducted power levels (at antenna connector).					
For each of the power levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable					
Power Level 1				2.5	dBm
Number of antenna assemblies provided for this power level:					
Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number		
1	3.41	5.91 dBm	RA0002		
2					
3					
Power Level 2					dBm
Number of antenna assemblies provided for this power level:					
Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number		
1					
2					
3					
Power Level 3					dBm
Number of antenna assemblies provided for this power level:					
Assembly #	Gain (dBi)	e.i.r.p (dBm)	Part number or model number		
1					
2					
3					
NOTE 3: Add more rows in case more antenna assemblies are supported for this power level.					

The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined equipment or test jig in case of plug-in devices

Details provided are for the:				
stand-alone equipment				☒
combined equipment				☐
test jig				☐
Supply Voltage				
AC mains	☐	AC voltage:		V
DC	☒	DC voltage:	3.0	V
In case of DC, indicate the type of power source				



Internal Power Supply	☐
External Power Supply or AC/DC adapter	☐
Battery	☒
Other:	☐ Please specify:

Describe the test modes available which can facilitate testing

--

The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3] IEEE 802.15.4™, proprietary, etc.)

Bluetooth Low Energy

If applicable, the statistical analysis referred in clause 5.4.1 q)

N/A



If applicable, the statistical analysis referred in clause 5.4.1 r)

N/A

Geo-location capability supported by the equipment

Yes	☐
The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.	☐
No	☒

Configuration for testing (see clause 5.3.2.3 of ETSI EN 300 328 V2.2.2)

From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 5.4.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment.

Unless otherwise specified in ETSI EN 300 328, this power setting is to be used for testing against the requirements of ETSI EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also ETSI EN 300 328, clause 5.3.2.3.

Highest overall e.i.r.p. value:	5.91	dBm	
Corresponding Antenna assembly gain:	3.41	dBi	Antenna Assembly #:
Corresponding conducted power setting: (also the power level to be used for testing)	2.5	dBm	Listed as Power Setting #:

Modulation

ITU Class(es) of emission:	1M00GXW			
Can the transmitter operate unmodulated?	Yes	☐	No	☒

Duty Cycle

The transmitter is intended for:	
Continuous duty	☒
Intermittent duty	☐
Continuous operation possible for testing purposes	☐

About the UUT

The equipment submitted are representative production models	☒
If not, the equipment submitted are pre-production models?	☐



If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested	☐
If not, supply full details:	



Additional items and/or supporting equipment provided

Spare batteries (e.g. for portable equipment)	☐
Battery charging device	☐
External Power Supply or AC/DC adapter	☐
Test Jig or interface box	☐
RF test fixture (for equipment with integrated antennas)	☐
Combined equipment	☐
Manufacturer:	☐
Model:	☐
Model Name:	☐
User Manual	☐
Technical documentation (Handbook and circuit diagrams)	☐

Cable Loss

Adapter Cable Loss (Conducted sample)	0.54	dB
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I hereby declare that the information supplied is correct and complete.

Name: Brian Krejcarek

Position held: CTO

Date: April 24, 2026



1.5 Product Information

1.5.1 Technical Description

RA0002 is a Bluetooth Low Energy transmitter in the form factor of a thin shipping label/tag for asset and parcel identification. The device transmits Bluetooth LE advertisements only. The Bluetooth radio is TX-only, implemented at chipset level (no radio module), and configured for LE 1M PHY only

1.6 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: RA0002, Serial Number: Not Serialised (FAR-1023223-6)			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: RA0002, Serial Number: Not Serialised (FAR-1023223-8)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3



1.7 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: BLE		
Antenna Gain Measurements	Joshua Peploe-Williams	None

Table 4

Office Address:

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



2 Test Details

2.1 Antenna Gain Measurements

2.1.1 Equipment Under Test and Modification State

RA0002, S/N Not Serialized (FAR-1023223-6): - Modification State 0 (Radiated)
RA0002, S/N Not Serialized (FAR-1023223-8): - Modification State 0 (Conducted)

2.1.2 Date of Test

20-April-2026 to 23-April-2026

2.1.3 Test Method

The manufacturer provided a modified sample with a temporary 50 ohm SMA connector in place of the antenna which was used to perform a conducted power measurement in accordance with ANSI C63.10 clause 11.9.1.1.

A non-modified sample was then placed in a fully anechoic chamber on a turntable at 1.5m height at a measurement distance of 1m. The equipment under test (EUT) was placed in 3 orientations (X, Y, Z) to establish which plane provided the maximum EIRP.

The chamber is calibrated to make EIRP measurements thus for each frequency point the total loss from the centre of the turntable is determined using the substitution method and set as a correction factor on the measuring equipment. The EUT was oriented for maximum EIRP and rotated in azimuth in 15 degree steps and the EIRP recorded as shown on the polar plots in the test result section below.

2.1.4 Environmental Conditions

Ambient Temperature	21.7 – 22.1°C
Relative Humidity	32.5 – 38.4 %

2.1.5 Test Equipment Diagram

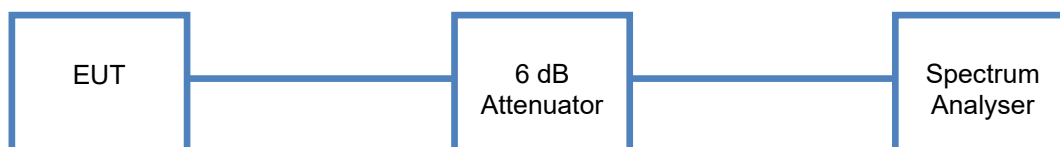


Figure 1 – Conducted Test Setup

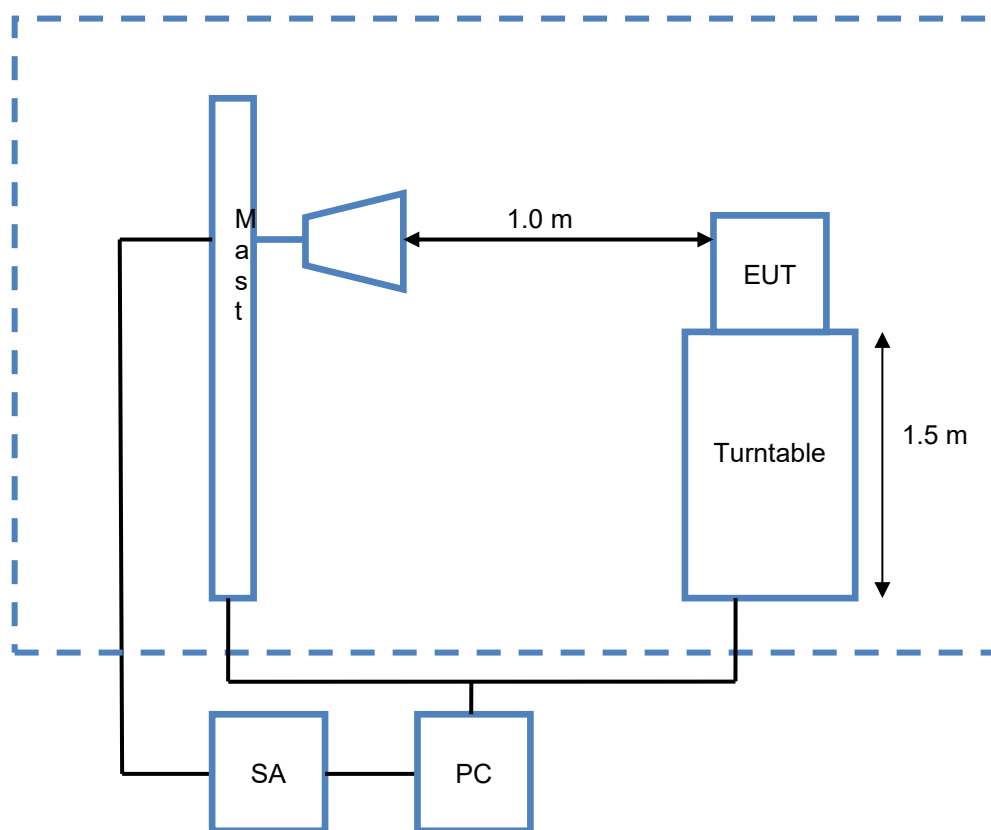


Figure 2 – Radiated Test Setup BLE



2.1.6 Test Results

BLE

Summary of Results

Frequency (MHz)	Antenna Gain (dBi)
2402	1.28
2440	2.74
2480	3.41

Table 5 – Antenna Gain Results

Conducted Results

Frequency (MHz)	Result (dBm)
2402	1.06
2440	1.06
2480	0.88

Table 6 – Maximum Conducted Output Power Results

Radiated Results

Frequency (MHz)	Result (dBm EIRP)
2402	2.34
2440	3.80
2480	4.29

Table 7 – Maximum Radiated Output Power Results

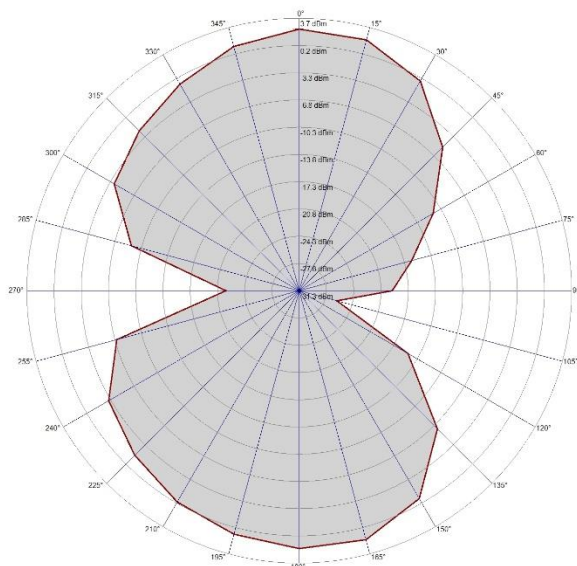


Figure 3 – 2402 MHz, Horizontal

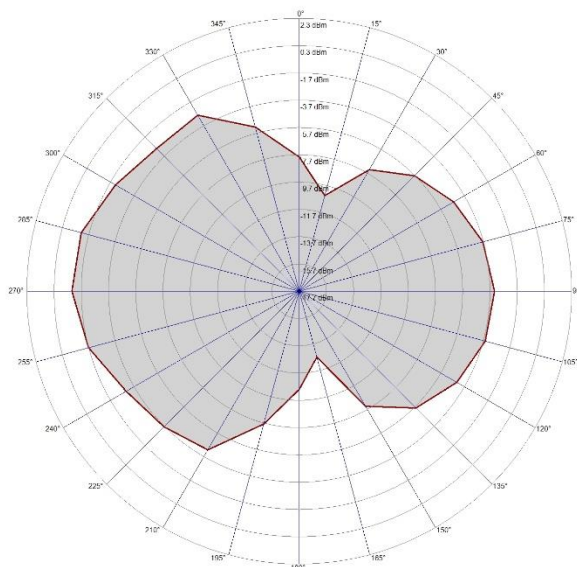


Figure 4 – 2402 MHz, Vertical

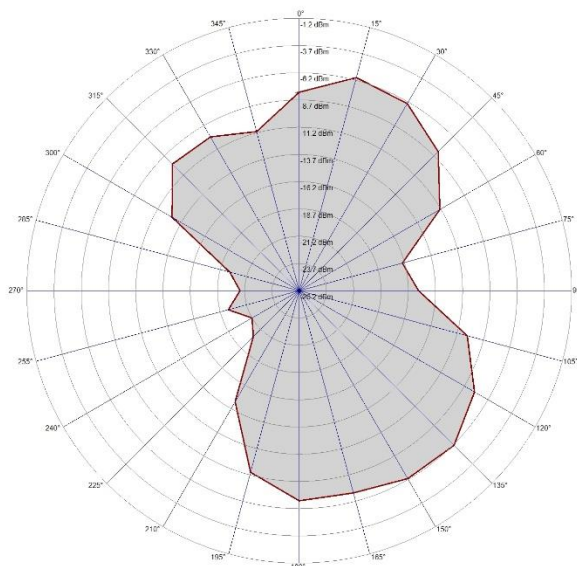


Figure 5 – 2440 MHz, Horizontal

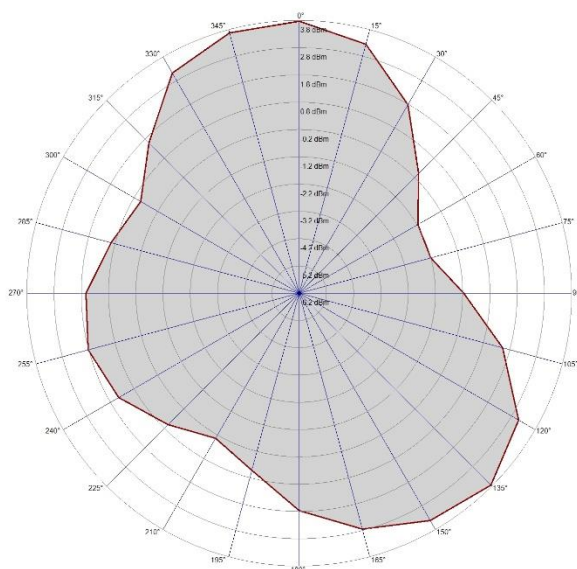


Figure 6 – 2440 MHz, Vertical

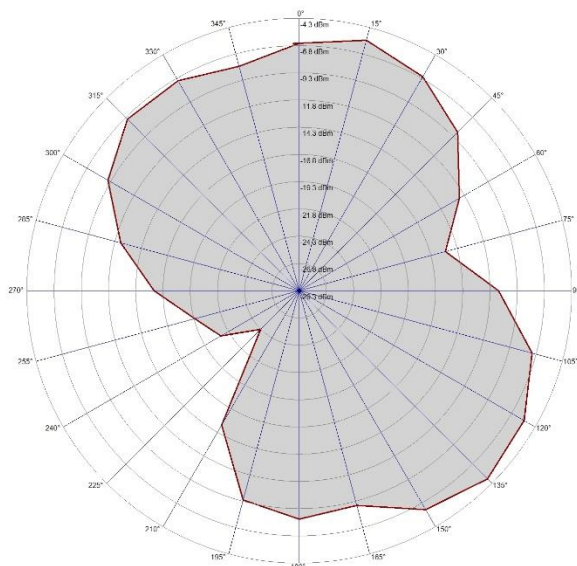


Figure 7 – 2480 MHz, Horizontal

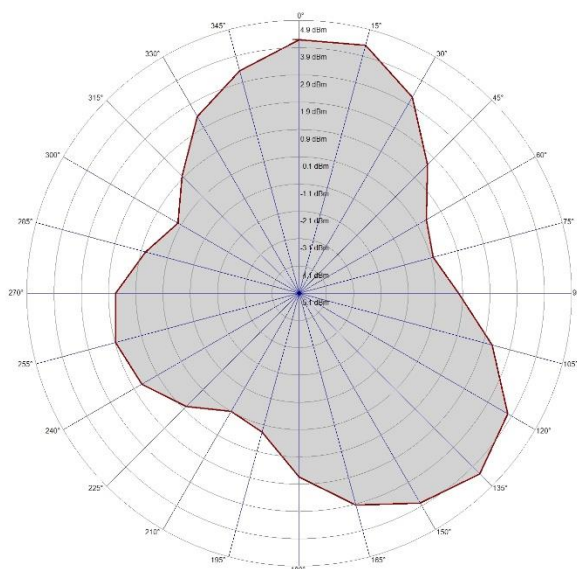


Figure 8 – 2480 MHz, Vertical



This test was carried out in RF Chamber 8 & RF Laboratory 1.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Antenna (Double Ridge Guide)	EMCO	3115	34	12	29-Nov-2026
3m Fully-Anechoic Chamber	Rainford	RF Chamber 8	1548	12	16-May-2026
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	12-May-2026
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Jul-2026
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	02-Jul-2026
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	23-Feb-2027
EXA Signal Analyser	Keysight Technologies	N9010B	4968	24	05-Feb-2028
Emissions Software	TUV SUD	EmX V3.6.1	5125	-	N/A - Software
1m Coaxial Cable Assy	Junkosha	MWX221-01000AMSAMS/A	6381	12	30-Jul-2026
1m Coaxial Cable Assy	Junkosha	MWX221-01000DMSDMS/A	6409	-	O/P Mon
4m Coaxial Cable Assy	Junkosha	MWX221-04000NMSNMS/A	6411	-	O/P Mon
2m Coaxial Cable Assy	Junkosha	MWX221-02000NMSNMS/A	6414	-	O/P Mon
6dB 10W/18GHz F/M SMA bidirectional Attenuator	Weinschel	WA41-6-0102	7030	12	06-Jun-2026

Table 8 – Test Equipment

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs

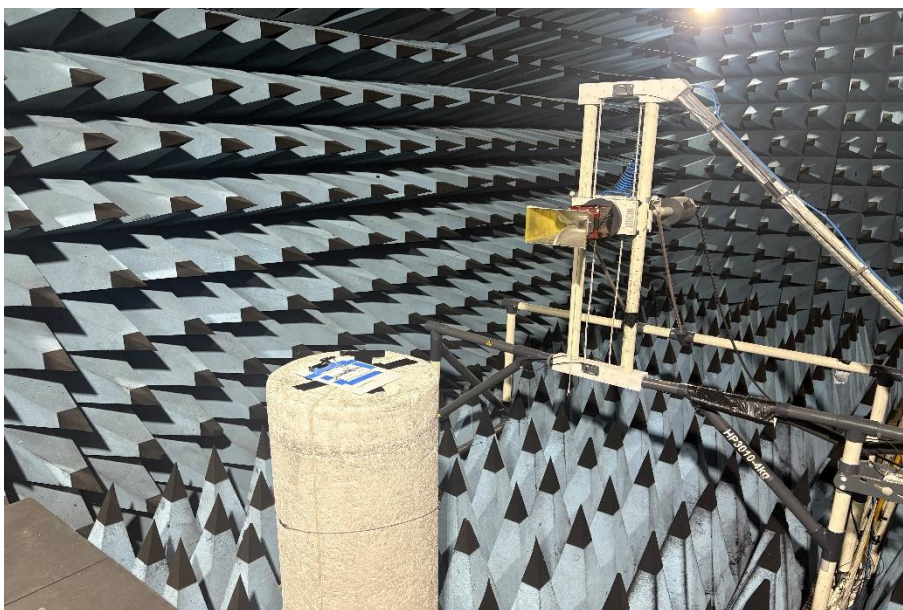


Figure 9 – Test Setup Photo (Radiated)

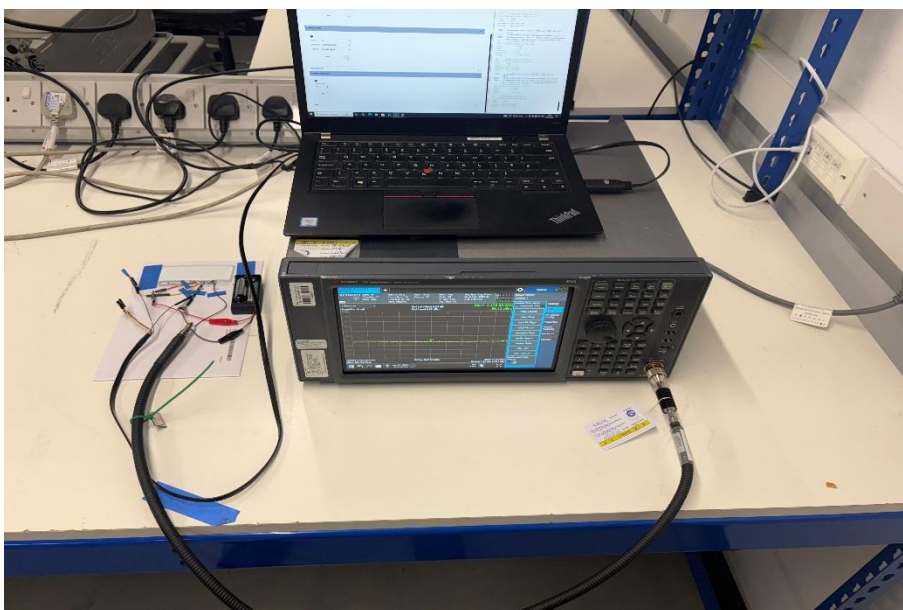


Figure 10 – Test Setup Photo (Conducted)

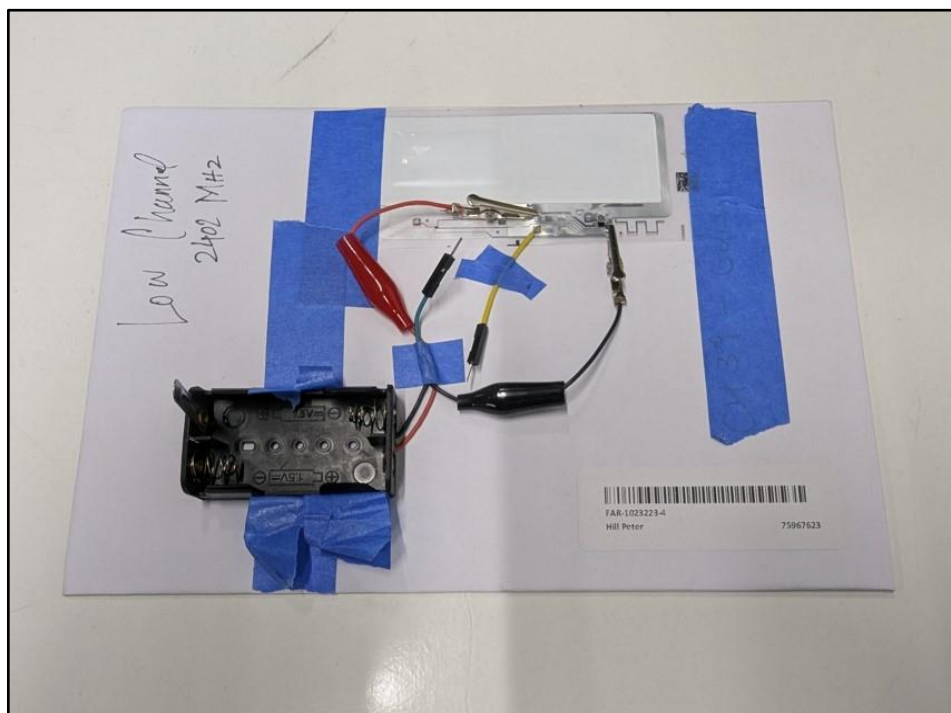


Figure 11 – EUT – General View



4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Antenna Gain Measurements	Conducted: ± 0.96 dB Radiated: ± 3.08 dB

Table 9

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.