Radio Test Report

Manufacturer: LEGO System A/S
Model: SENSOR COLOUR NO. 3

In accordance with ARIB STD-T66 and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19) (2.4 GHz Bluetooth Low Energy)

Prepared for: LEGO System A/S
Aastvej 1
7190 Billund
DENMARK

COMMERCIAL-IN-CONFIDENCE

Document 75962745-08 Issue 01

SIGNATURE			
S. MM			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	19 March 2025

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

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with ARIB STD-T66 3.7 (2014-10) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19) for the tests detailed in section 1.3.

DISCLAIMER AND COPYRIGHT
This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2025 TÜV SÜD. This report relates only to the actual item/items tested.

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). Results of tests covered by our Flexible UKAS Accreditation Schedule are marked FS (Flexible Scope).

TÜV SÜD
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

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

Contents

1.1 Report Modification Record 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Application Form 4
1.5 Product Information 9
1.6 Deviations from the Standard 9
1.7 EUT Modification Record 9
1.8 Test Location 10

2 Test Details 11

2.1 Antenna Power 11
2.2 Frequency Deviation 16
2.3 Allowable Value for Occupied Bandwidth 22
2.4 Voltage Variations 28
2.5 Antenna Gain 31
2.6 Interference Protection Function 32
2.7 Permissible Value of Spurious or Unnecessary Radiation Intensity 34
2.8 Limit on Secondary Radiation 47

3 Photographs 52

3.1 Equipment Under Test (EUT) 52

4 Measurement Uncertainty 57

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	19 March 2025

Table 1

1.2 Introduction

Applicant	LEGO System A/S
Manufacturer	LEGO System A/S
Model Number(s)	SENSOR COLOUR NO. 3
Serial Number(s)	CS_EP2-0016, CS_EP2-0014, CS_EP2-0085 and CS_EP2-0068
Hardware Version(s)	EP2
Software Version(s)	0.3.1
Number of Samples Tested	4
Test Specification/Issue/Date	ARIB STD-T66 3.7 (2014-10) MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)
Order Number	7000395236
Date	15-October-2024
Date of Receipt of EUT	17-January-2025 and 20-January-2025
Start of Test	21-January-2025
Finish of Test	25-February-2025
Name of Engineer(s)	Thomas Biddlecombe, George Williams and Joshua Peploe-Williams
Related Document(s)	Radio Equipment Regulations, Article 24 Radio Equipment Regulations, Article 14 Radio Equipment Regulations, Article 5 Table 1 Radio Equipment Regulations, Article 7, Table 3 Radio Equipment Regulations, Article 6, Table 2 Radio Equipment Regulations, Article 49-20 Radio Equipment Regulations, Article 9-4

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with ARIB STD-T66 and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19) is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: 2.4 GHz Bluetooth Low Energy				
2.1	3.2 (2)	Antenna Power	Pass	Radio Equipment Regulations, Article 14
2.2	3.2 (4)	Frequency Deviation	Pass	Radio Equipment Regulations, Article 5 Table 1
2.3	3.2 (7)	Allowable Value for Occupied Bandwidth	Pass	Radio Equipment Regulations, Article 6, Table 2
2.4	-	Voltage Variations	Satisfactory	Article 2, Item (19) Notice 88, Appendix 43
2.5	3.6 (2)	Antenna Gain	Pass	Radio Equipment Regulations, Article 49-20
2.6	3.4 (1)	Interference Protection Function	Pass	Radio Equipment Regulations, Article 9-4
2.7	3.2 (6)	Permissible Value of Spurious or Unnecessary Radiation Intensity	Pass	Radio Equipment Regulations, Article 7, Table 3
2.8	3.3 (1)	Limit on Secondary Radiation	Pass	Radio Equipment Regulations, Article 24

Table 2

1.4 Application Form

The type of Wideband Data Transmission Equipment

FHSS ☐	non-FHSS ☒

Table 3

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.	

Table 4

~~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.~~		

Table 5

Operating Frequency Range(s) of the Equipment

Operating Frequency Range 1:	2402	MHz to	2480	MHz
Operating Frequency Range 2:		MHz to		MHz
NOTE: Add more lines if more Frequency Ranges are supported.				

Table 6

Nominal Channel Bandwidth

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

Table 7

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

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

Table 8

The normal and extreme operating conditions that apply to the equipment

Normal operating conditions (if applicable):					
Operating temperature:				25	°C
Other (please specify if applicable):				25	°C
Extreme operating conditions:					
Operating temperature:	Minimum	0	°C to Maximum	35	°C
Other Storage:	Minimum	0	°C to Maximum	55	°C
Details provided are for the:					
stand-alone equipment					☐
combined equipment					☒
test jig					☐

Table 9

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 – PCB Antenna			☒
Antenna Gain:		-6.88	dBi
If applicable, additional beamforming gain (excluding basic antenna gain):		N/A	dB
Temporary RF connector provided			☒
No temporary RF connector provided			☐
Integral Antenna – PCB Antenna			☒
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		0	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~~			~~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 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.~~			

Table 10

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:	3.85	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:		

Table 11

Describe the test modes available which can facilitate testing

Approve Test Mode – ATM Safety Test Mode – STM Direct Test Mode – DTM/PTM

Table 12

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

Bluetooth Low Energy

Table 13

Modulation

ITU Class(es) of emission:	1M00F1D			
Can the transmitter operate unmodulated?	Yes	☒	No	☐

Table 14

Duty Cycle

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

Table 15

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:	

Table 16

Additional items and/or supporting equipment provided

Spare batteries (e.g. for portable equipment)	☒
Battery charging device - Multi-Charger system	☒
External Power Supply or AC/DC adapter - Interface cables USB-A (test system side) to UART (on USB-C socket at DUT side, in test mode for HCI)	☒
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)	☒

Table 17

Cable Loss

Adapter Cable Loss (Conducted sample)	Cable + Connector 0.5dB + 0.5dB = 1dB	1 dB

Table 18

The above information was provided by the applicant.

1.5 Product Information

1.5.1 Technical Description

The Equipment under test (EUT) was a LEGO System A/S, Model: SENSOR COLOUR NO. 3 incorporating Bluetooth Low Energy and NFC transmitters.

The primary function of the EUT is a Toy for use in a classroom.

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: SENSOR COLOUR NO. 3, Serial Number: CS_EP2-0068			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: SENSOR COLOUR NO. 3, Serial Number: CS_EP2-0085			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: SENSOR COLOUR NO. 3, Serial Number: CS_EP2-0014			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: SENSOR COLOUR NO. 3, Serial Number: CS_EP2-0016			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 19

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: 2.4 GHz Bluetooth Low Energy		
Antenna Power	Thomas Biddlecombe	UKAS
Frequency Deviation	Thomas Biddlecombe	UKAS
Allowable Value for Occupied Bandwidth	Thomas Biddlecombe	UKAS
Voltage Variations	George Williams	UKAS
Antenna Gain	Thomas Biddlecombe	UKAS
Interference Protection Function	George Williams	UKAS
Permissible Value of Spurious or Unnecessary Radiation Intensity	Joshua Peploe-Williams	UKAS
Limit on Secondary Radiation	Joshua Peploe-Williams	UKAS

Table 20

Office Address:

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

2 Test Details

2.1 Antenna Power

2.1.1 Specification Reference

ARIB STD-T66 Clause 3.2 (2) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.1.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0014 - Modification State 0

2.1.3 Date of Test

23-January-2025

2.1.4 Test Method

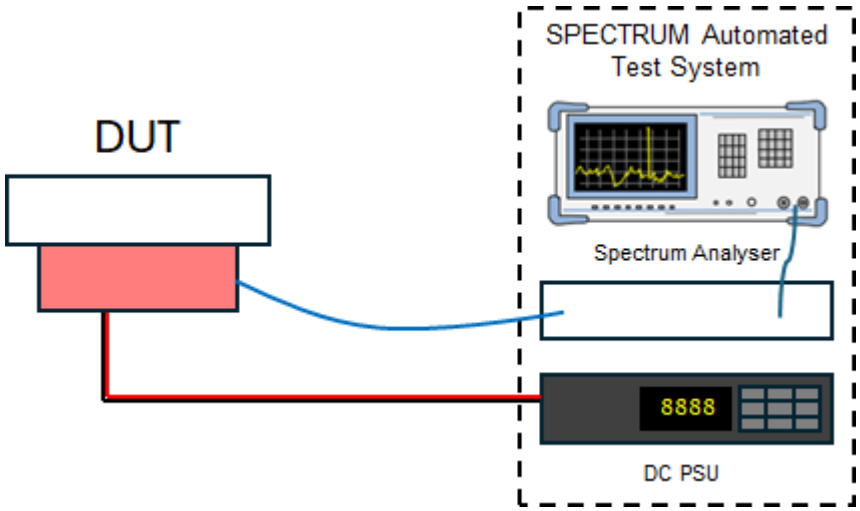
The Power Spectral Density was measured using a spectrum analyser which was tuned to the test frequency with the relevant RBW to match the limit. The max hold function on the analyser was used to obtain output power.

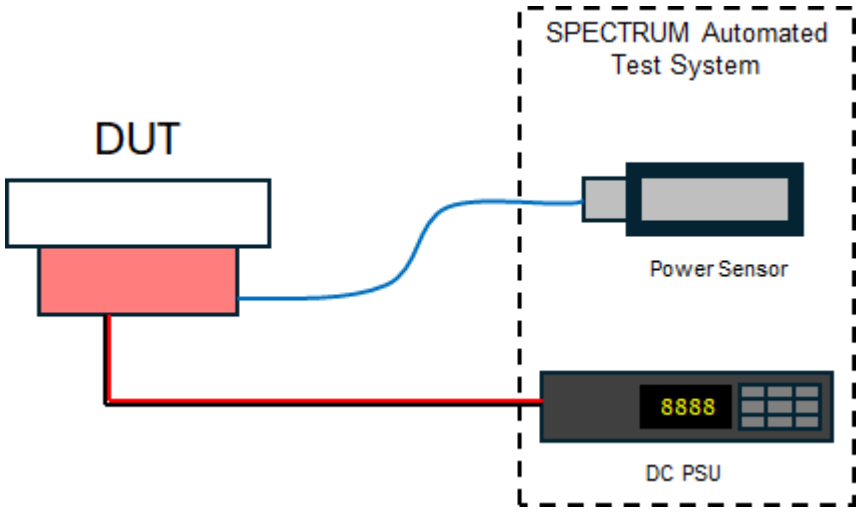
The Conducted Output Power was measured using a wideband power meter set to measure peak power. A percentage deviation from the measured power to the declared power was calculated and assessed against the tolerance limits.

The DUT was modified by the customer to bypass the integral battery and have trailing DC leads instead. These have been used to power the DUT to keep input voltage consistent at 3.85 VDC across all tests.

The DUT was configured to transmit a modulated package with a 37 byte PRBS payload at max power.

2.1.5 Test Setup Diagram





2.1.6 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	32.3 %

2.1.7 Test Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (2)(b) 3.2 (3)	Test Method(s):	Refer to Test Method
Additional Reference(s):	3.6		

DUT Configuration			
Mode:	BLE GFSK (LE 1M)	Duty Cycle (%):	63.7
Antenna Configuration:	SISO	DCCF (dB):	1.96
Active Port(s):	A	Peak Antenna Gain (dBi):	-6.88

Test Frequency (MHz)	Conducted Output Power Density (mW/MHz)					Limit (mW/MHz)
	A	B	C	D	∑	
2402	0.92	-	-	-	-	10.00
2442	0.79	-	-	-	-	10.00
2480	0.69	-	-	-	-	10.00

Table 21 - Output Power Results

Test Frequency (MHz)	Conducted Output Power (mW)					Declared (mW)	Tolerance (%)	Limit (%)
	A	B	C	D	∑			
2402	0.94	-	-	-	-	1.00	-6.49	-80 ≤ n ≤ +20
2442	0.81	-	-	-	-	1.00	-19.18	-80 ≤ n ≤ +20
2480	0.70	-	-	-	-	1.00	-29.49	-80 ≤ n ≤ +20

Table 22 - Output Power Tolerance Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (2)(b) 3.2 (3)	Test Method(s):	Refer to Test Method
Additional Reference(s):	3.6		

DUT Configuration			
Mode:	BLE GFSK (LE 2M)	Duty Cycle (%):	34.1
Antenna Configuration:	SISO	DCCF (dB):	4.67
Active Port(s):	A	Peak Antenna Gain (dBi):	-6.88

Test Frequency (MHz)	Conducted Output Power Density (mW/MHz)					Limit (mW/MHz)
	A	B	C	D	∑	
2402	0.73	-	-	-	-	10.00
2442	0.64	-	-	-	-	10.00
2480	0.55	-	-	-	-	10.00

Table 23 - Output Power Results

Test Frequency (MHz)	Conducted Output Power (mW)					Declared (mW)	Tolerance (%)	Limit (%)
	A	B	C	D	∑			
2402	0.93	-	-	-	-	1.00	-6.74	-80 ≤ n ≤ +20
2442	0.81	-	-	-	-	1.00	-19.17	-80 ≤ n ≤ +20
2480	0.70	-	-	-	-	1.00	-29.56	-80 ≤ n ≤ +20

Table 24 - Output Power Tolerance Results

ARIB STD T-66, Limit Clause 3.2

Clause	Requirement
3.2(2)(b)	10 mW/MHz

Table 25 - Antenna Power Limit

2.1.8 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
Multimeter	White Gold	WG022	190	12	18-Nov-2025
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	18-Sep-2025
USB Power Sensor	Boonton	RTP5008	5833	12	26-Jul-2025
Modular Power System Mainframe	Keysight Technologies	N6701C	5835	-	TU
DC Power Module 60V 20A 300W	Keysight Technologies	N6754A	5836	-	O/P Mon
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	6350	12	02-Aug-2025
SCU Cable Assembly	TUV SUD	SPECTRUM_SCU_CA	6638	12	02-Aug-2025

Table 26

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

2.2 Frequency Deviation

2.2.1 Specification Reference

ARIB STD-T66 Clause 3.2 (4) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.2.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0014 - Modification State 0

2.2.3 Date of Test

23-January-2025

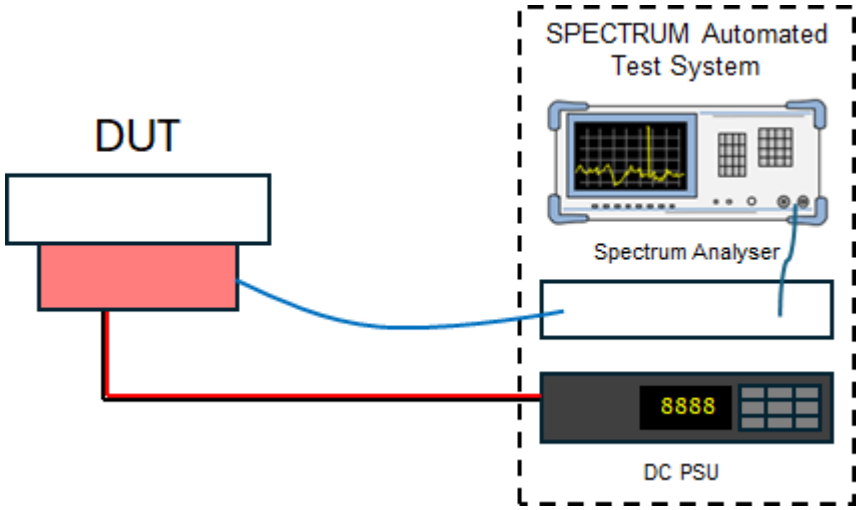
2.2.4 Test Method

The frequency of the spectrum was measured using a spectrum analyser by finding the centre point of the 10 dB bandwidth. The deviation of the measured value from the assigned frequency was calculated in ppm.

The DUT provided by the customer had trailing DC leads to bypass the internal battery. These have been used to power the DUT to keep input voltage consistent at 3.85 VDC across all tests.

The DUT was configured to transmit a modulated package with a 37 byte PRBS payload at max power.

2.2.5 Test Setup Diagram



2.2.6 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	32.3 %

2.2.7 Test Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (4)	Test Method(s):	Refer to Test Method
Additional Reference(s):	-		

DUT Configuration			
Mode:	BLE GFSK (LE 1M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	Frequency Error (ppm)				Limit (ppm)
	A	B	C	D	
2402	-23.722	-	-	-	±50.0
2442	-22.342	-	-	-	±50.0
2480	-24.706	-	-	-	±50.0

Table 27 - Frequency Tolerance Results

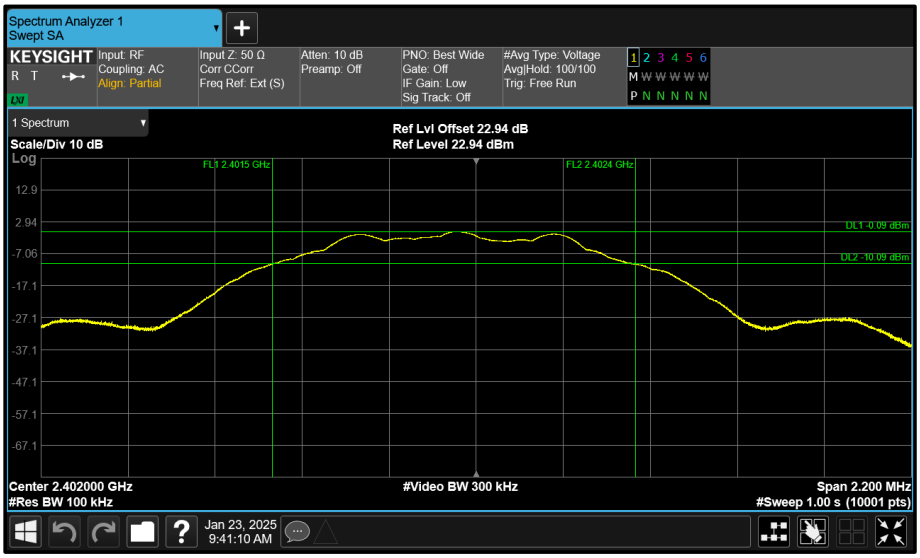


Figure 1 - BLE 1M 2402 MHz (CH37)

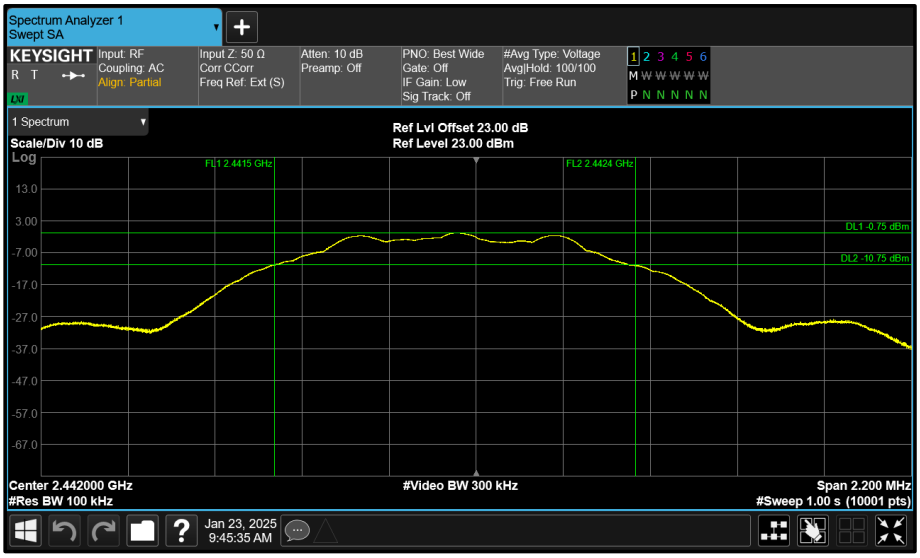


Figure 2 - BLE 1M 2442 MHz (CH18)

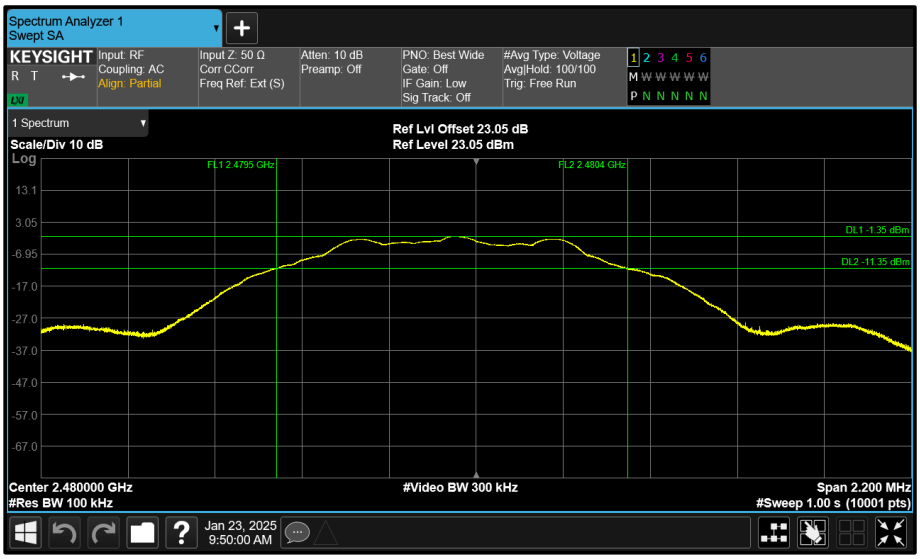


Figure 3 - BLE 1M 2480 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (4)	Test Method(s):	Refer to Test Method
Additional Reference(s):	-		

DUT Configuration			
Mode:	BLE GFSK (LE 2M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	Frequency Error (ppm)				Limit (ppm)
	A	B	C	D	
2402	-29.376	-	-	-	±50.0
2442	-28.550	-	-	-	±50.0
2480	-28.282	-	-	-	±50.0

Table 28 - Frequency Tolerance Results

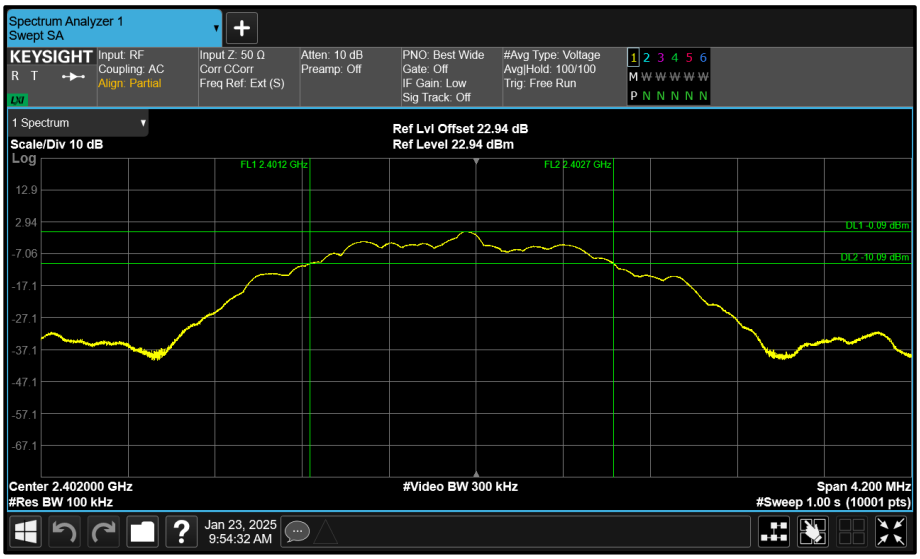


Figure 4 - BLE 2M 2402 MHz (CH37)

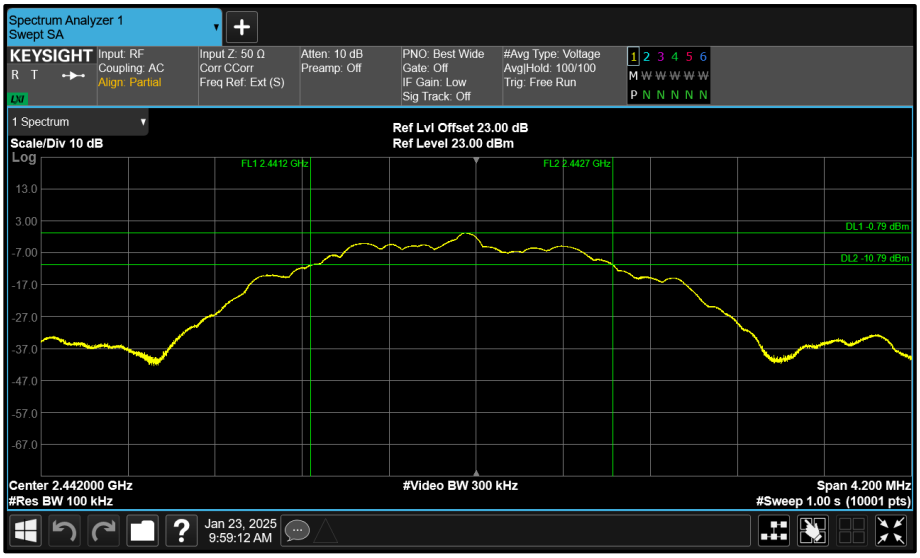


Figure 5 - BLE 2M 2442 MHz (CH18)

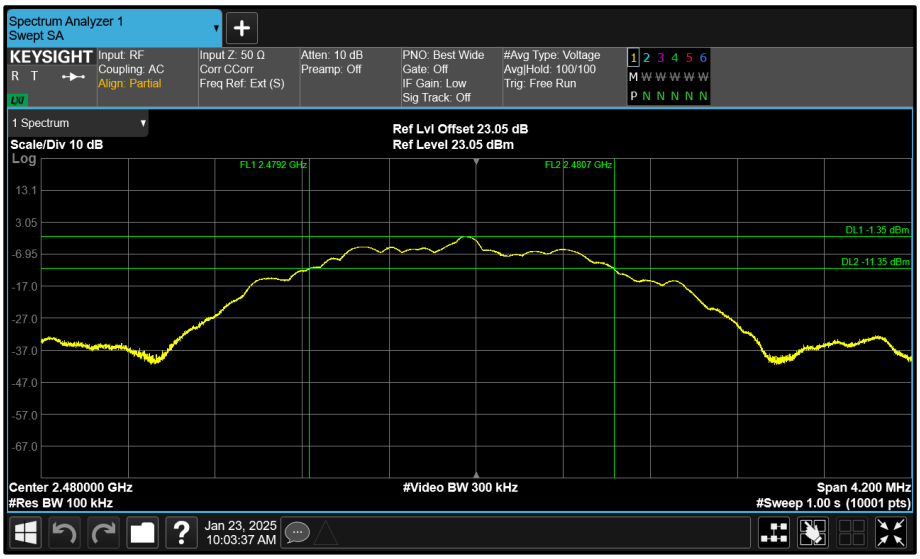


Figure 6 - BLE 2M 2480 MHz (CH39)

ARIB STD T-66, Limit Clause 3.2 (4)

± 50 x 10^{-6}.

2.2.8 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
Multimeter	White Gold	WG022	190	12	18-Nov-2025
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	18-Sep-2025
Modular Power System Mainframe	Keysight Technologies	N6701C	5835	-	TU
DC Power Module 60V 20A 300W	Keysight Technologies	N6754A	5836	-	O/P Mon
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	6350	12	02-Aug-2025
SCU Cable Assembly	TUV SUD	SPECTRUM_SCU_CA	6638	12	02-Aug-2025

Table 29

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

2.3 Allowable Value for Occupied Bandwidth

2.3.1 Specification Reference

ARIB STD-T66 Clause 3.2 (7) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.3.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0014 - Modification State 0

2.3.3 Date of Test

23-January-2025

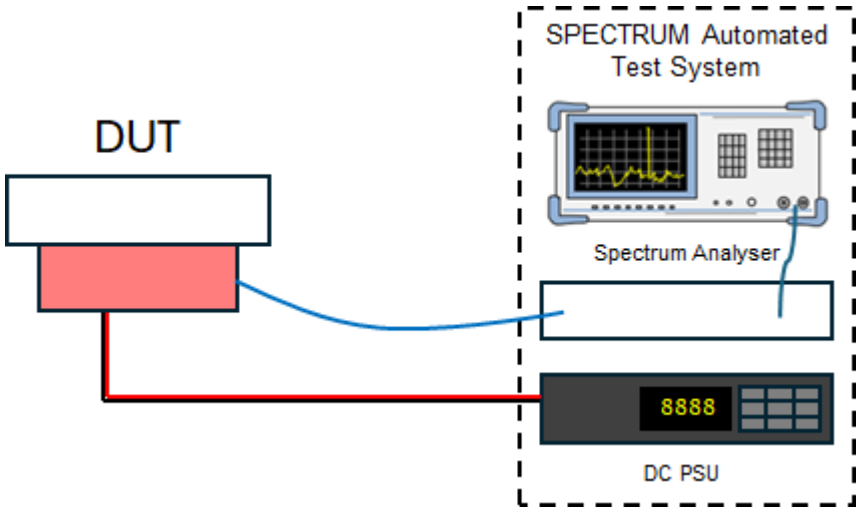
2.3.4 Test Method

OBW was measured using the test method in Article 2, Item 19, Appendix 43.4 to find 99% Bandwidth and compared against the clause in ARIB T-66 3.2 (7) for "any other system".

The DUT provided by the customer had trailing DC leads to bypass the internal battery. These have been used to power the DUT to keep input voltage consistent at 3.85 VDC across all tests.

The DUT was configured to transmit a modulated package with a 37 byte PRBS payload at max power.

2.3.5 Test Setup Diagram



2.3.6 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	32.3 %

2.3.7 Test Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (7)	Test Method(s):	Article 2, Item 19, Appendix 43.4
Additional Reference(s):	-		

DUT Configuration			
Mode:	BLE GFSK (LE 1M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (MHz)
	A	B	C	D	Maximum	
2402	1.331	-	-	-	1.331	≤26.0
2442	1.320	-	-	-	1.320	≤26.0
2480	1.327	-	-	-	1.327	≤26.0

Table 30 - 99% Bandwidth Results

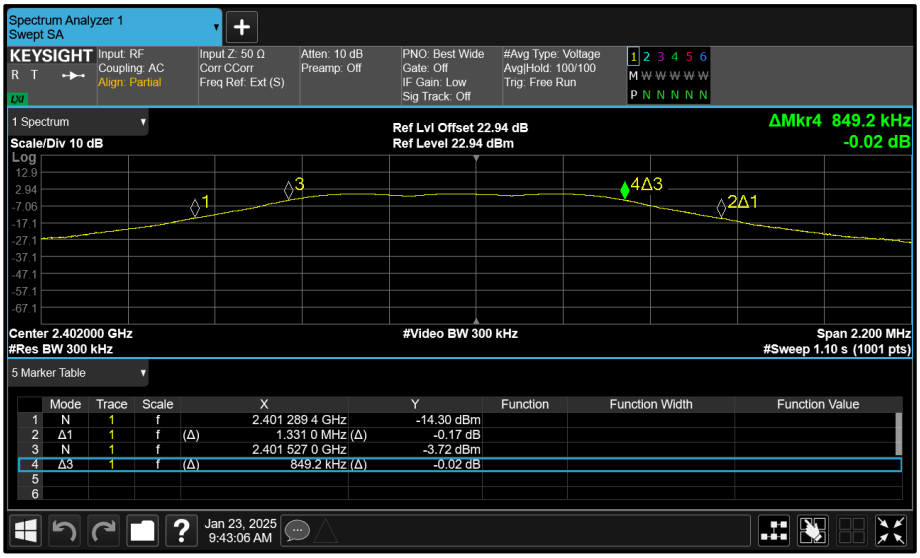


Figure 7 - BLE 1M 2402 MHz (CH37)

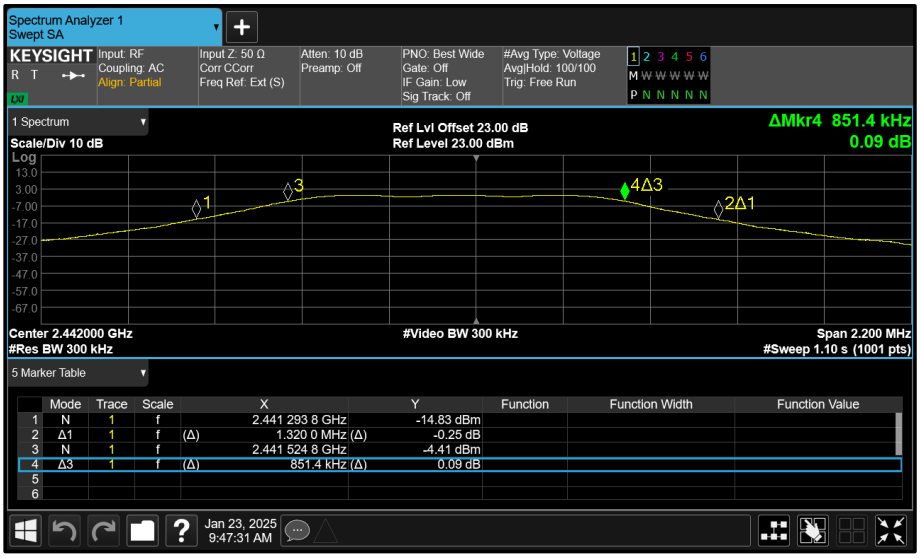


Figure 8 - BLE 1M 2442 MHz (CH18)

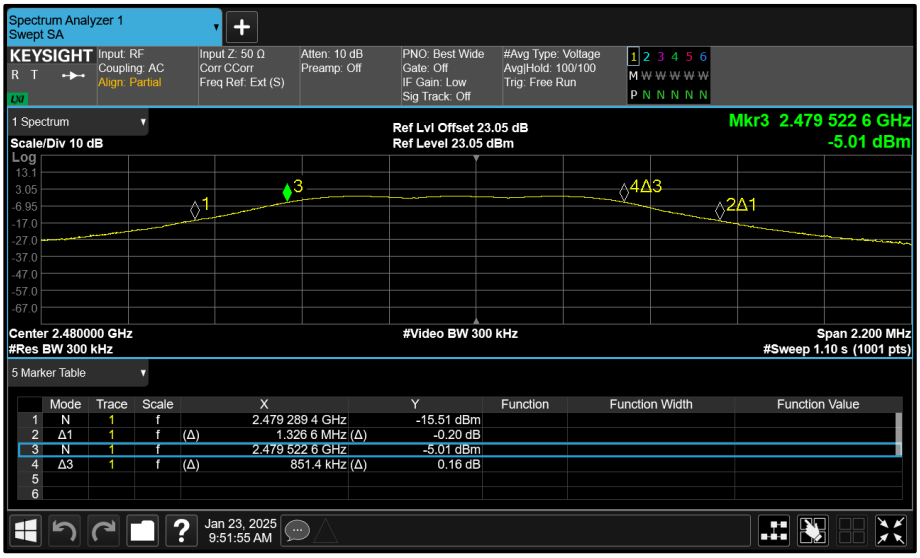


Figure 9 - BLE 1M 2480 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	3.2 (7)	Test Method(s):	Article 2, Item 19, Appendix 43.4
Additional Reference(s):	-		

DUT Configuration			
Mode:	BLE GFSK (LE 2M)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (MHz)
	A	B	C	D	Maximum	
2402	2.171	-	-	-	2.171	≤26.0
2442	2.155	-	-	-	2.155	≤26.0
2480	2.184	-	-	-	2.184	≤26.0

Table 31 - 99% Bandwidth Results

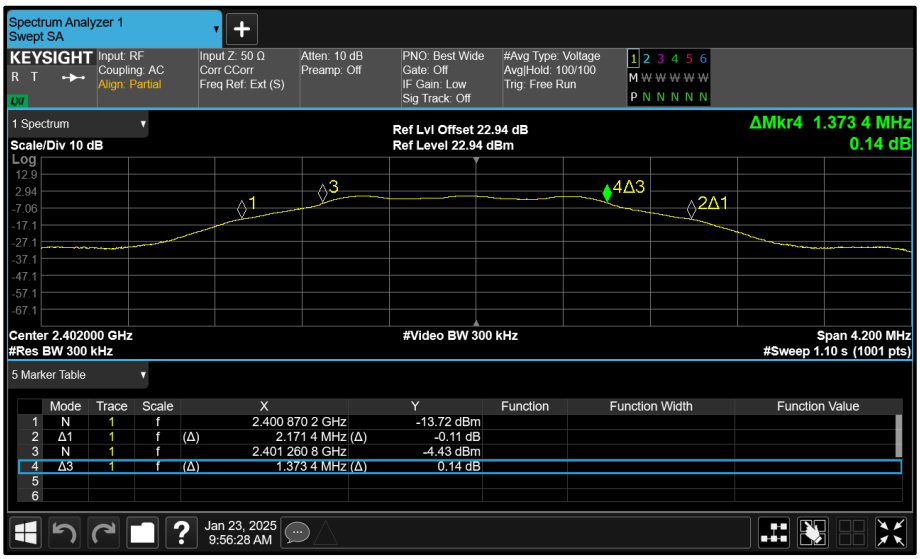


Figure 10 - BLE 2M 2402 MHz (CH37)

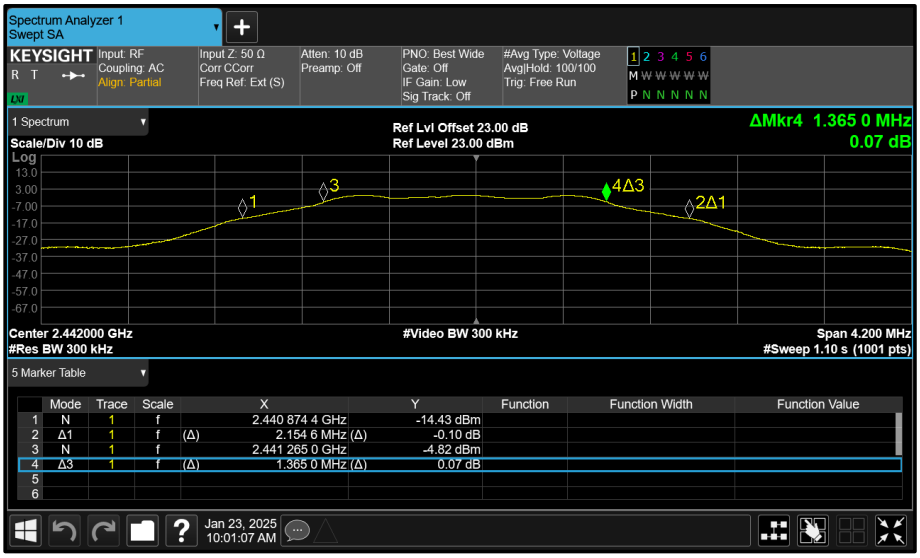


Figure 11 - BLE 2M 2442 MHz (CH18)

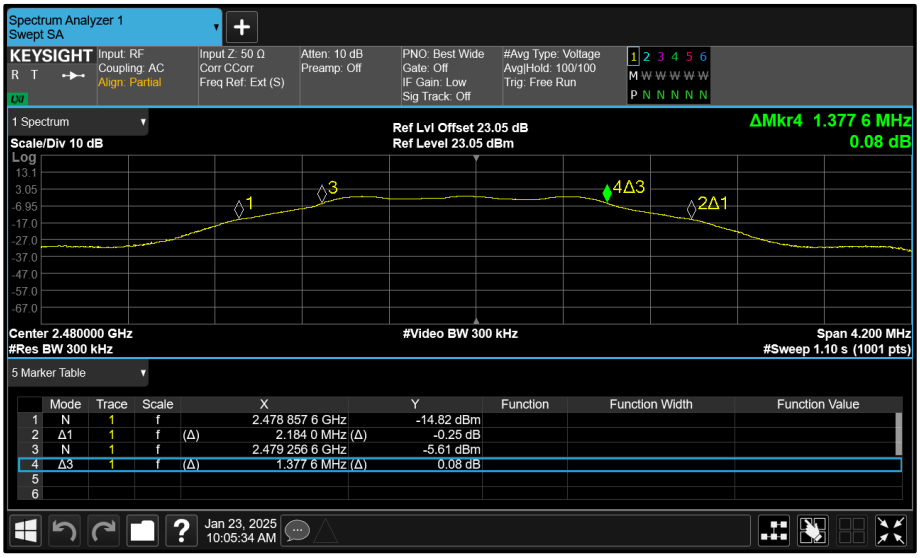


Figure 12 - BLE 2M 2480 MHz (CH39)

ARIB STD T-66, Limit Clause 3.2 (7)

Permissible value of occupied frequency bandwidth for transmission devices using a FH system, a DS-FH hybrid system, or a FH-OFDM hybrid system is at most 83.5MHz; for transmission devices using an OFDM system is at most 38MHz; and for transmission devices using any other system the necessary frequency bandwidth is at most 26MHz.

2.3.8 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
Multimeter	White Gold	WG022	190	12	18-Nov-2025
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
GPSDR Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	09-Mar-2025
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	18-Sep-2025
Modular Power System Mainframe	Keysight Technologies	N6701C	5835	-	TU
DC Power Module 60V 20A 300W	Keysight Technologies	N6754A	5836	-	O/P Mon
Signal Conditioning Unit	TUV SUD	SPECTRUM_SCU001	6350	12	02-Aug-2025
SCU Cable Assembly	TUV SUD	SPECTRUM_SCU_CA	6638	12	02-Aug-2025

Table 32

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

2.4 Voltage Variations

2.4.1 Specification Reference

MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.4.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0016 - Modification State 0

2.4.3 Date of Test

21-January-2025

2.4.4 Test Method

The input voltage was set to ±10% of the nominal voltage specified by the manufacturer. Using a DVM the input voltage to the RF circuit was measured.

2.4.5 Test Setup Diagram

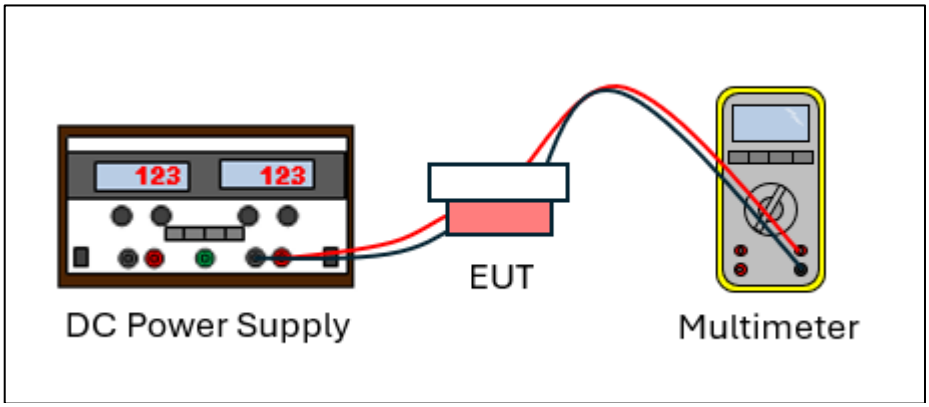


Figure 13 – Voltage Variation Setup Diagram

2.4.6 Environmental Conditions

Ambient Temperature	21.2 °C
Relative Humidity	28.9 %

2.4.7 Test Results

Input Supply Voltage	Measured Voltage at RF Circuitry
3.465 VDC	3.311 VDC
3.85 VDC	3.311 VDC
4.235 VDC	3.311 VDC

Table 33 - Voltage Variation Results

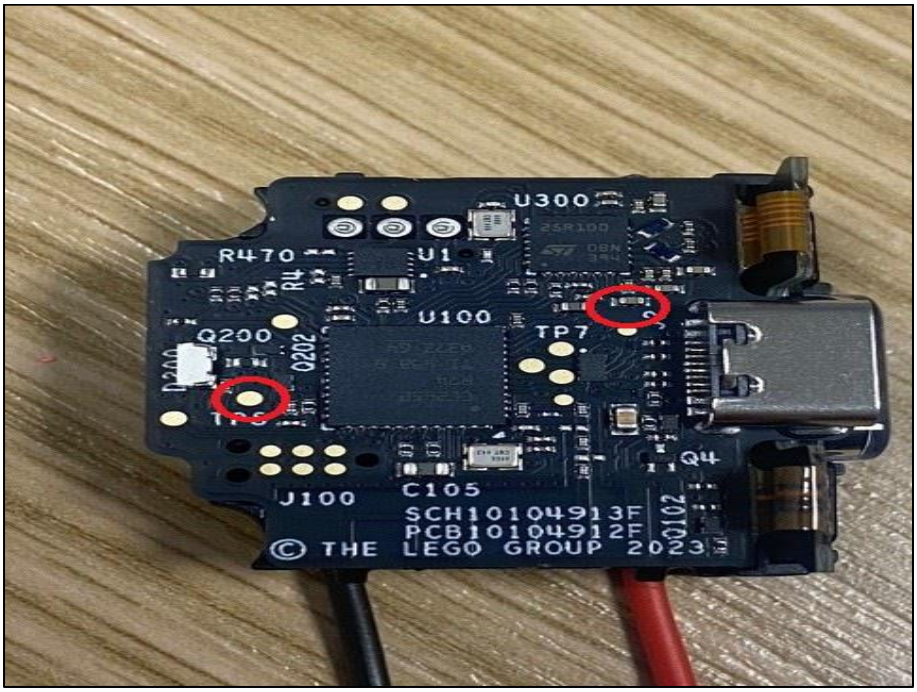


Figure 14 - Photograph showing the test point at which the voltage was measured to the RF Circuitry

The input voltage to the receiver RF circuit varied less than ±1% as the input voltage from the external power supply to the receiver was varied ±10% therefore tests are performed only at the manufacturer's nominal voltage.

2.4.8 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
Multimeter	White Gold	WG022	190	12	18-Nov-2025
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
Programmable Power Supply 188 W	Rohde & Schwarz	HMP2020x0	6598	-	O/P Mon

Table 34

O/P Mon – Output Monitored using calibrated equipment

2.5 Antenna Gain

2.5.1 Specification Reference

ARIB STD-T66 Clause 3.6 (2) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.5.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0014 - Modification State 0

2.5.3 Date of Test

23-January-2025

2.5.4 Test Method

The maximum half power beamwidth was calculated by determining the EIRP relative to an antenna with a transmitting power of 12.14 dBm/MHz (16.37 mW/MHz).

A = EIRP (mW/MHz) / 16.37

Maximum Half-Power Beamwidth = 360 degrees / A.

2.5.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	32.3 %

2.5.6 Test Results

Parameter	Results
Frequency Range (MHz)	2400-2483.5
Antenna Gain (dBi)	-6.88
Half-Power Beamwidth	150 Degrees
EIRP (mW/MHz)	0.19
A	0.0115
Calculated Maximum Half-Power Beamwidth	360 Degrees

Table 35

ARIB STD-T66, Limit Clause 3.6 (2)

The absolute gain of transmitting antennas must be at most 12.14 dB.

2.6 Interference Protection Function

2.6.1 Specification Reference

ARIB STD-T66 Clause 3.4 (1) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.6.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0085- Modification State 0

2.6.3 Date of Test

27-January-2025

2.6.4 Test Method

This test was performed in accordance with Notification 88, Annex 45, clause 9.

Evidence of the device transmitting a MAC address was captured using a Bluetooth scanner application on an android mobile phone.

The Device was powered by its internal battery for the duration of the test.

2.6.5 Test Setup Diagram

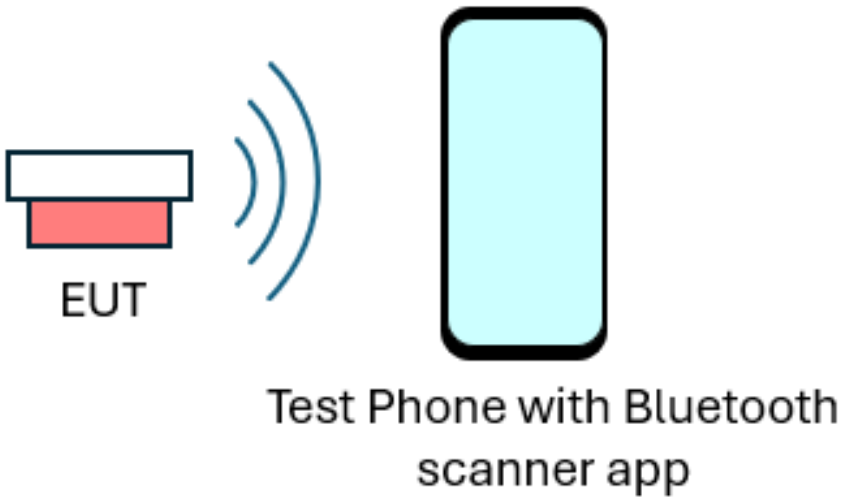


Figure 15 – Interference Protection Function Setup Diagram

2.6.6 Environmental Conditions

Ambient Temperature	20.7 °C
Relative Humidity	37.8 %

2.6.7 Test Results

Result: The client device under test transmitted an identification code to the master device to identify itself as a valid/authorised client.

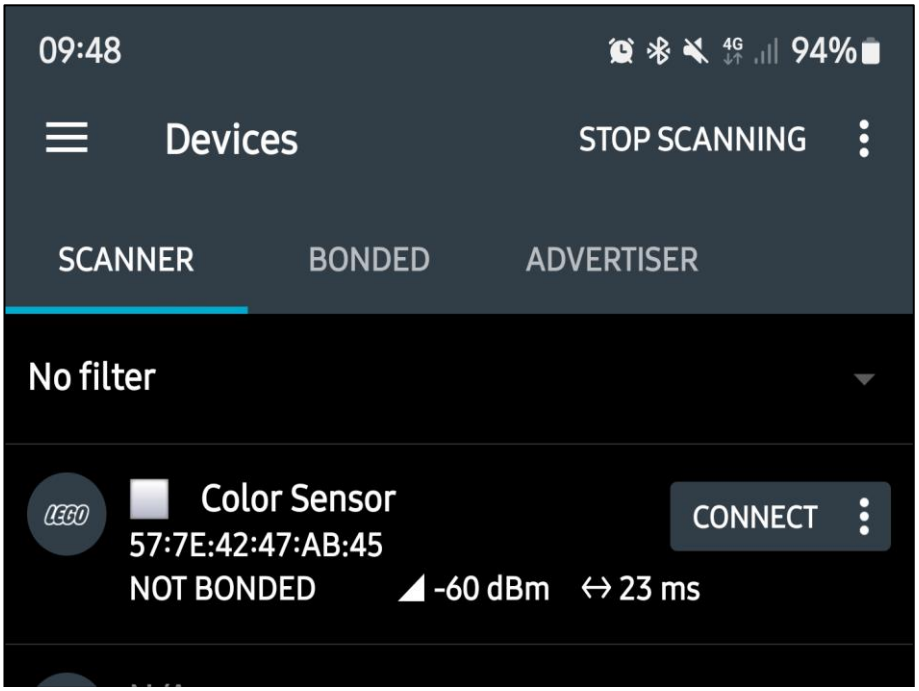


Figure 16 - Evidence

Radio Equipment Regulations Article 9-4, paragraph 1, item 8

Client devices should send an identification code to the master device in order to identify itself as a valid/authorized client.

2.6.8 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Hygrometer	Rotronic	A1	2138	12	28-Nov-2025

Table 36

2.7 Permissible Value of Spurious or Unnecessary Radiation Intensity

2.7.1 Specification Reference

ARIB STD-T66 Clause 3.2 (6) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.7.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0068 - Modification State 0

2.7.3 Date of Test

27-January-2025 to 25 February 2025

2.7.4 Test Method

This test was performed in accordance with ARIB STD-T66 Clause 3.2 (6).
The EUT was connected via a 1m cable and 10 dB of attenuation.
A preliminary sweep was performed using EmX and for results within 10 dB a final measurement was performed.
A measurement bandwidth of 100 kHz was used for below 1 GHz and 1 MHz was used for above 1 GHz.
The EUT was battery powered and fully charged prior to testing.

2.7.5 Test Setup Diagram

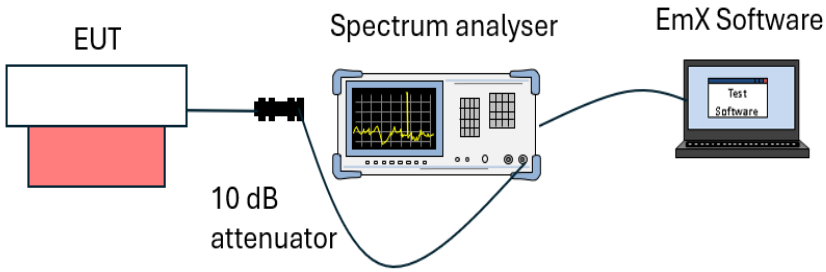


Figure 17 – Conducted Emissions Setup Diagram

2.7.6 Environmental Conditions

Ambient Temperature	20.5 - 21.6 °C
Relative Humidity	34.5 – 35.4 %

2.7.7 Test Results

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 37 - CH37_LE1M, 2402 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

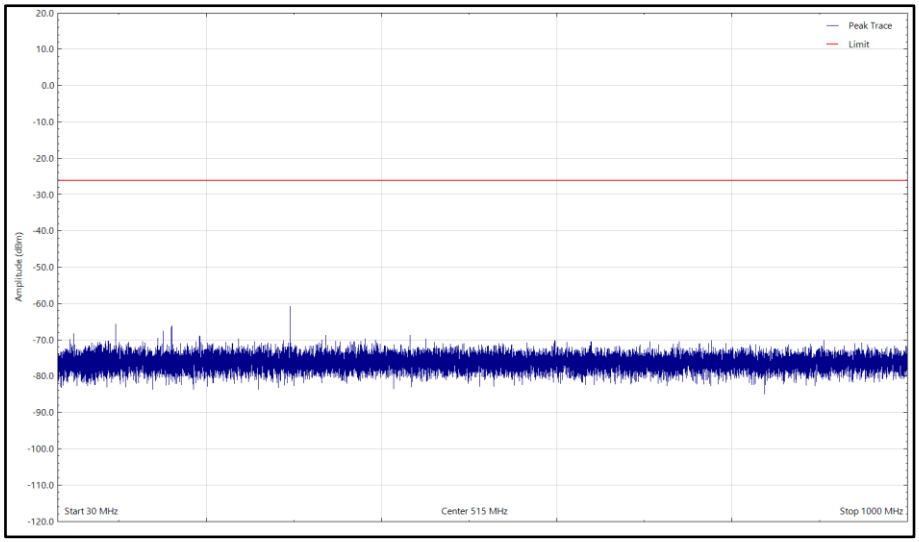


Figure 18 - CH37_LE1M, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

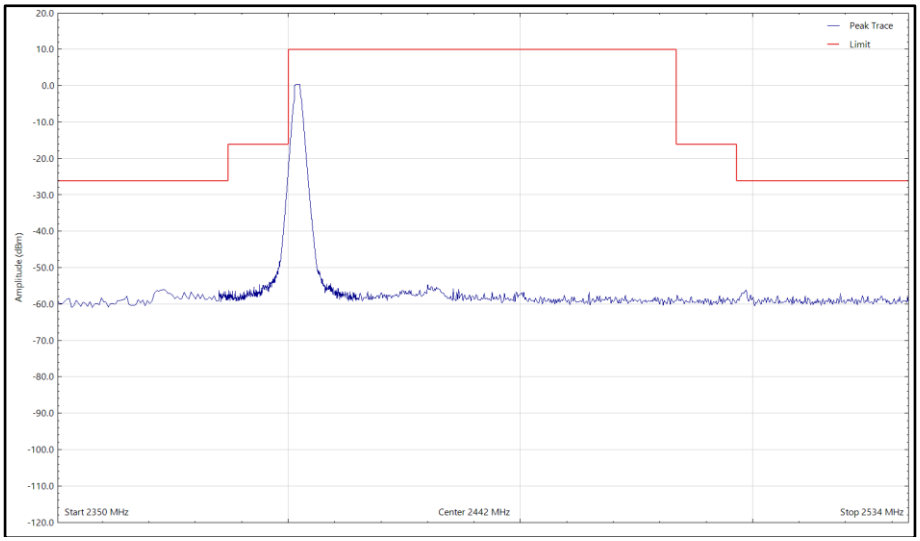


Figure 19 - CH37_LE1M, 2402 MHz, 2 GHz to 3 GHz, Vertical (Peak)

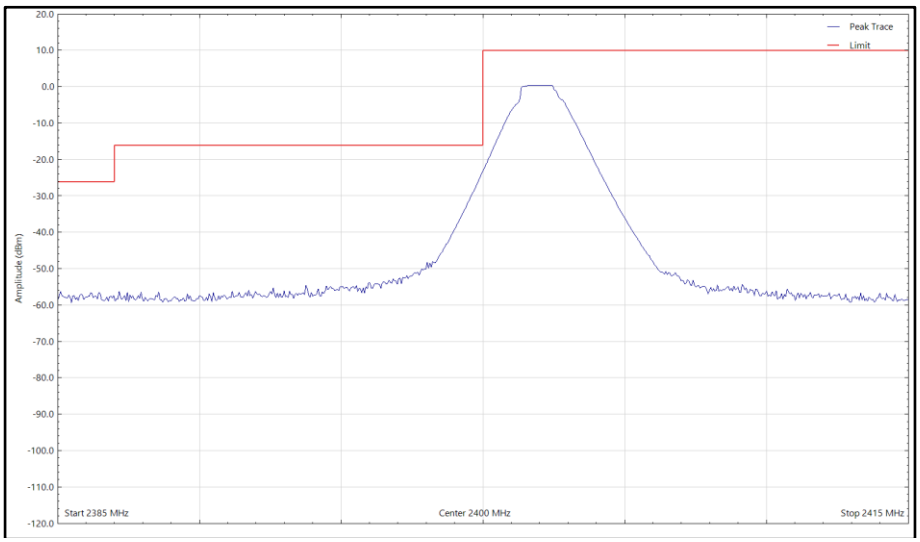


Figure 20 - CH37_LE1M, 2402 MHz, 2.385 GHz to 2.415 GHz, Vertical (Peak)

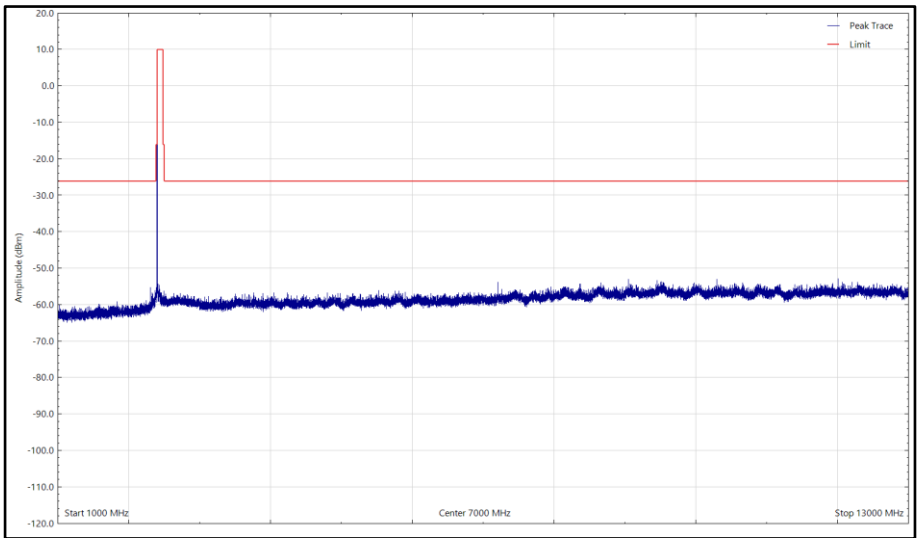


Figure 21 - CH37_LE1M, 2402 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 38 - CH18_LE1M, 2442 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

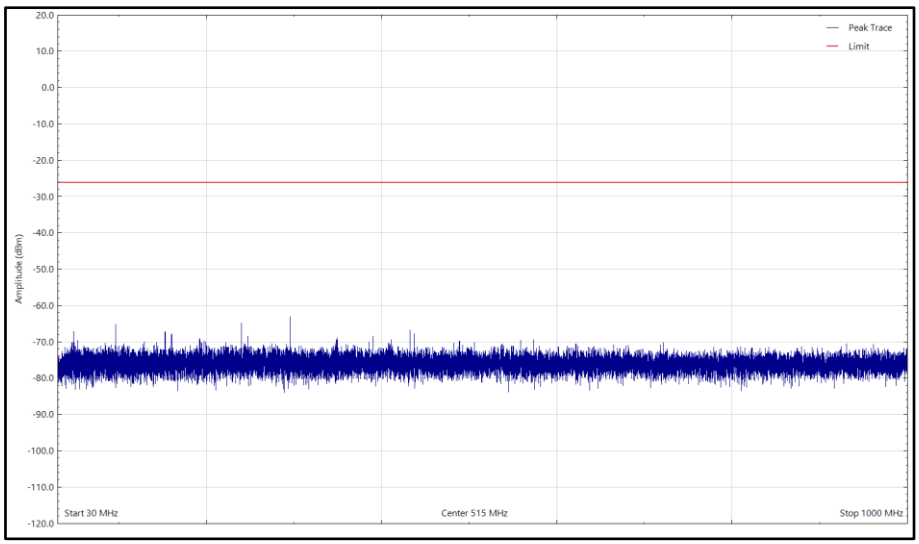


Figure 22 - CH18_LE1M, 2442 MHz, 30 MHz to 1 GHz, Vertical (Peak)

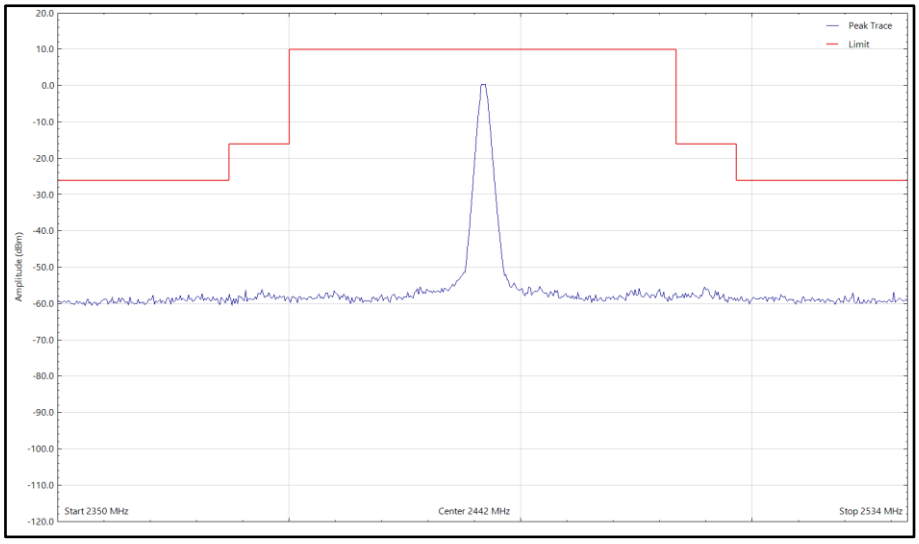


Figure 23 - CH18_LE1M, 2442 MHz, 2 GHz to 3 GHz, Vertical (Peak)

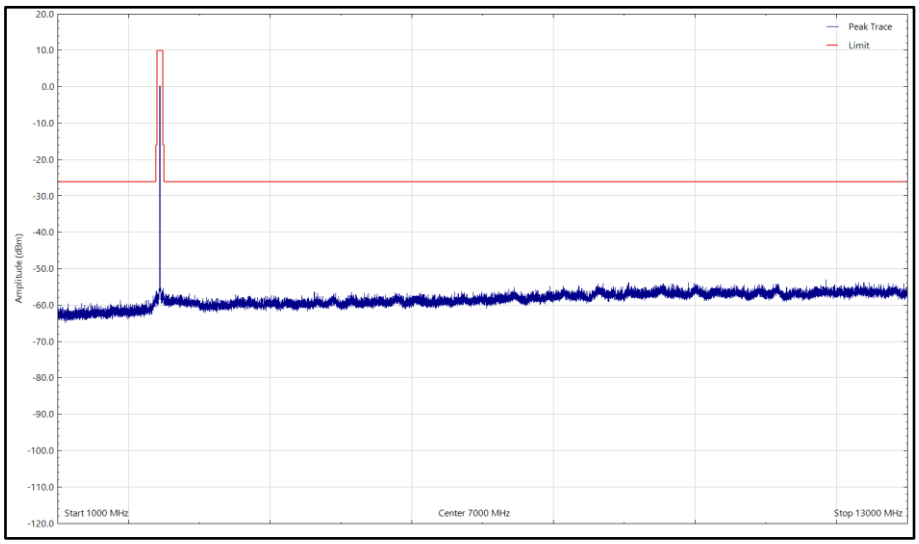


Figure 24 - CH18_LE1M, 2442 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 39 - CH39_LE1M, 2480 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

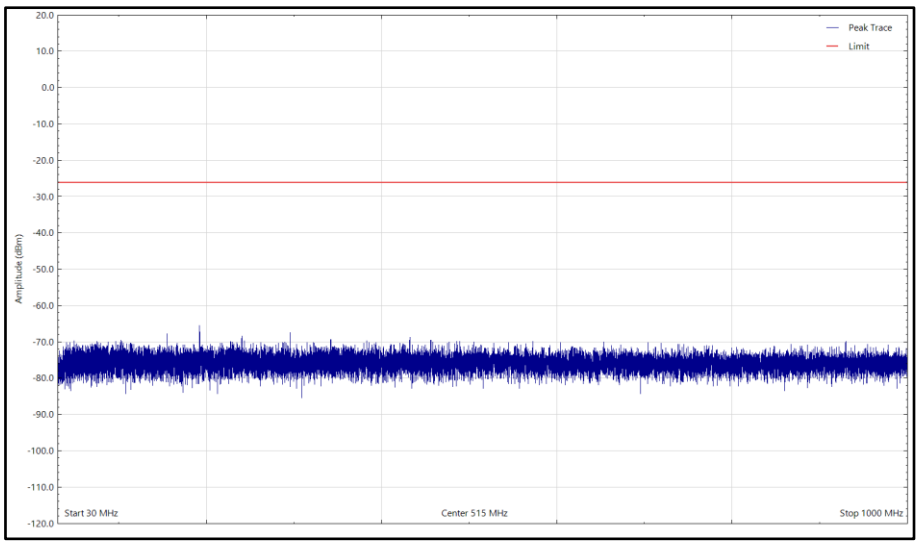


Figure 25 - CH39_LE1M, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

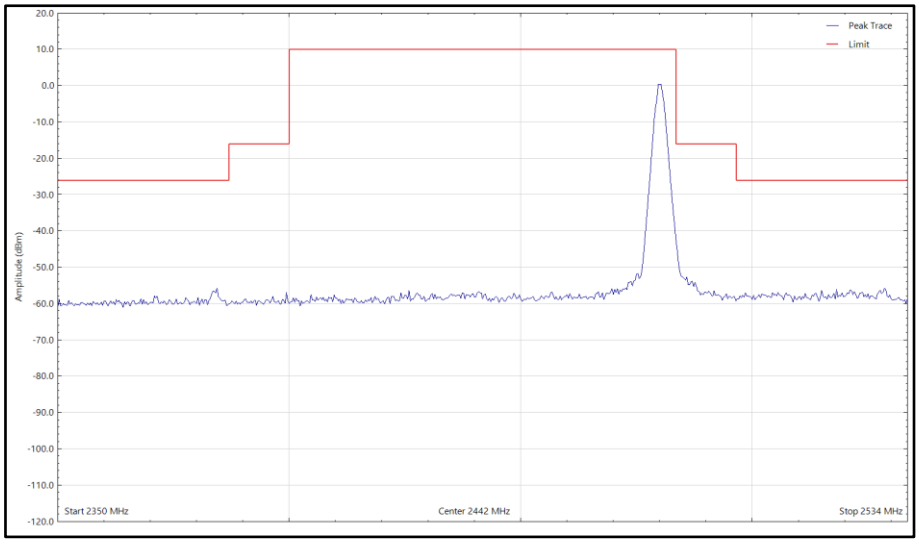


Figure 26 - CH39_LE1M, 2480 MHz, 2 GHz to 3 GHz, Vertical (Peak)

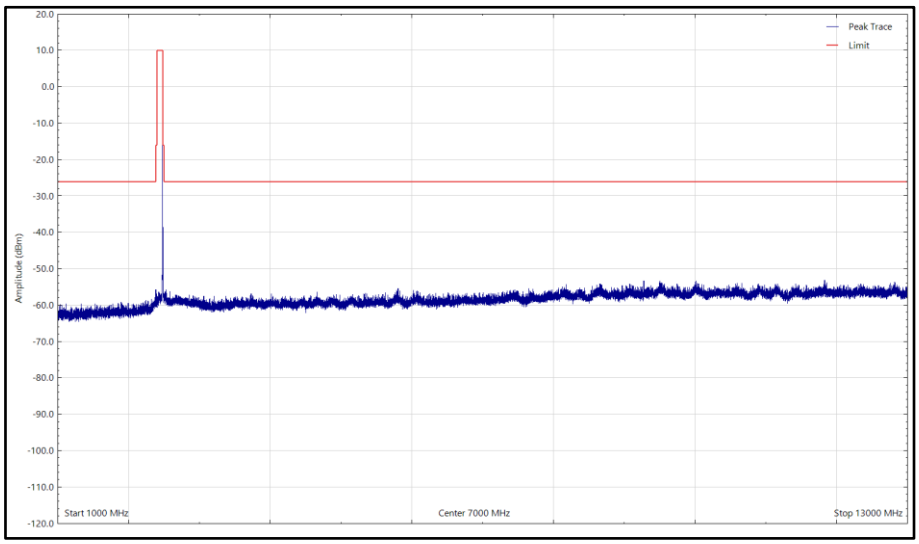


Figure 27 - CH39_LE1M, 2480 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2399.948	-19.14	-16	-3.14	Peak	-	-	-

Table 40 - CH37_LE2M, 2402 MHz, 30 MHz to 13 GHz

No other emissions were found within 6 dB of the limit.

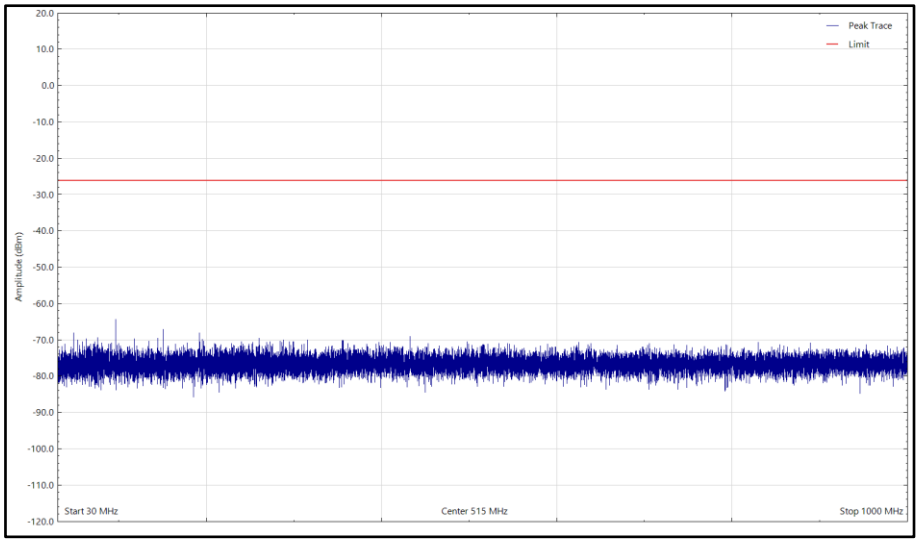


Figure 28 - CH37_LE2M, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

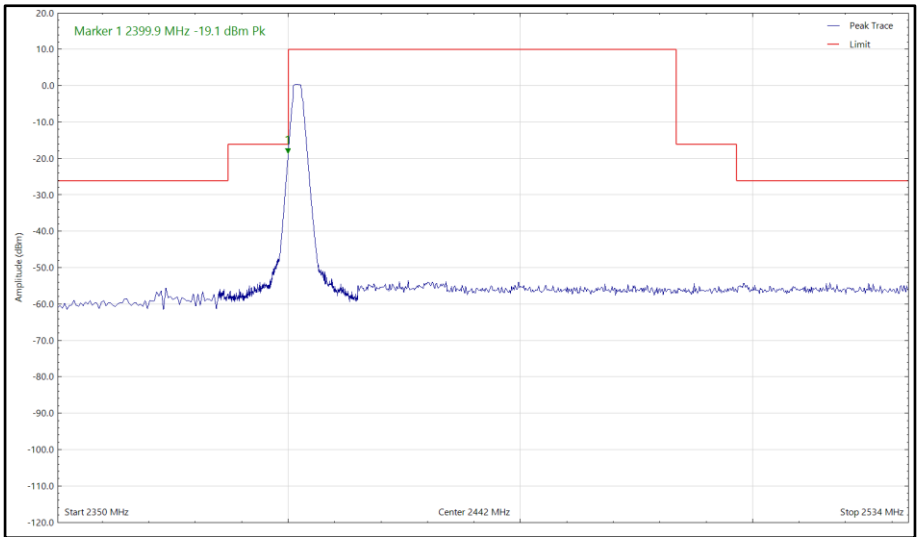


Figure 29 - CH37_LE2M, 2402 MHz, 2 GHz to 3 GHz, Vertical (Peak)

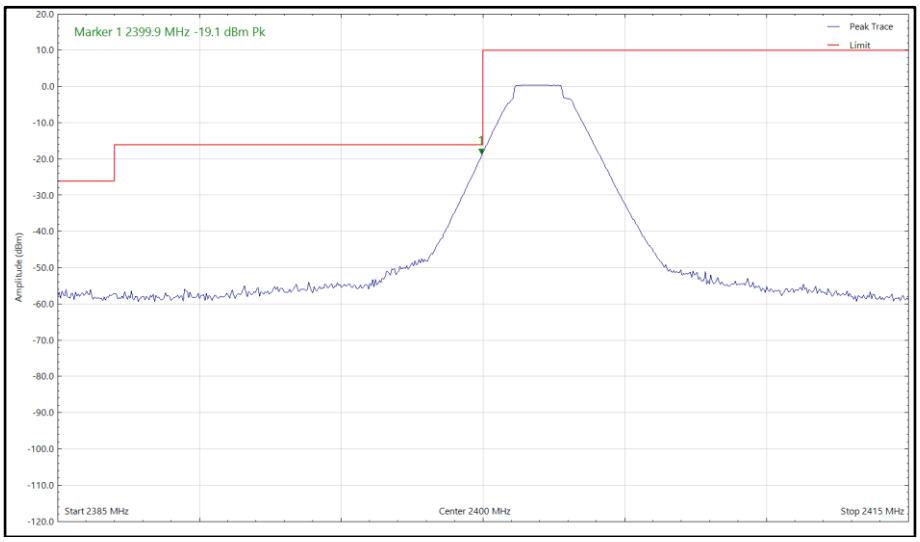


Figure 30 - CH37_LE2M, 2402 MHz, 2.385 GHz to 2.415 GHz, Vertical (Peak)

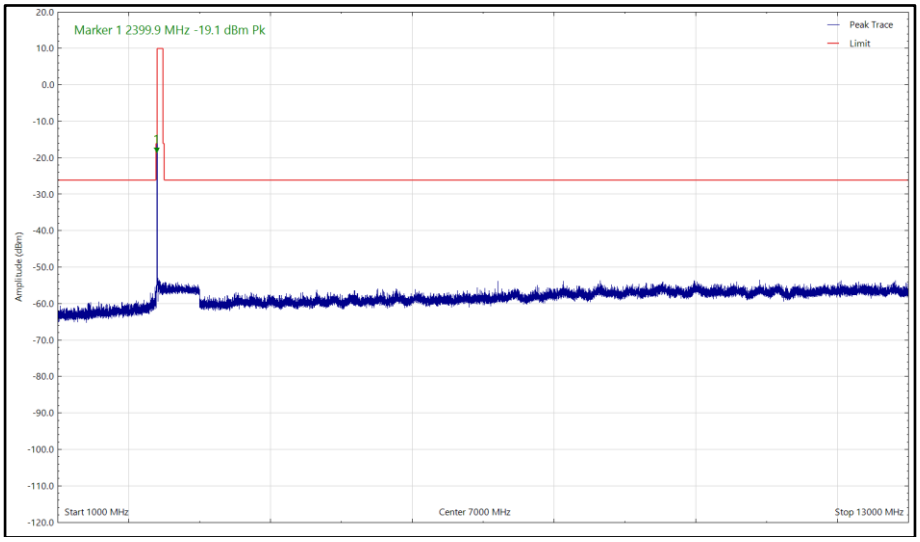


Figure 31 - CH37_LE2M, 2402 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 41 - CH18_LE2M, 2442 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

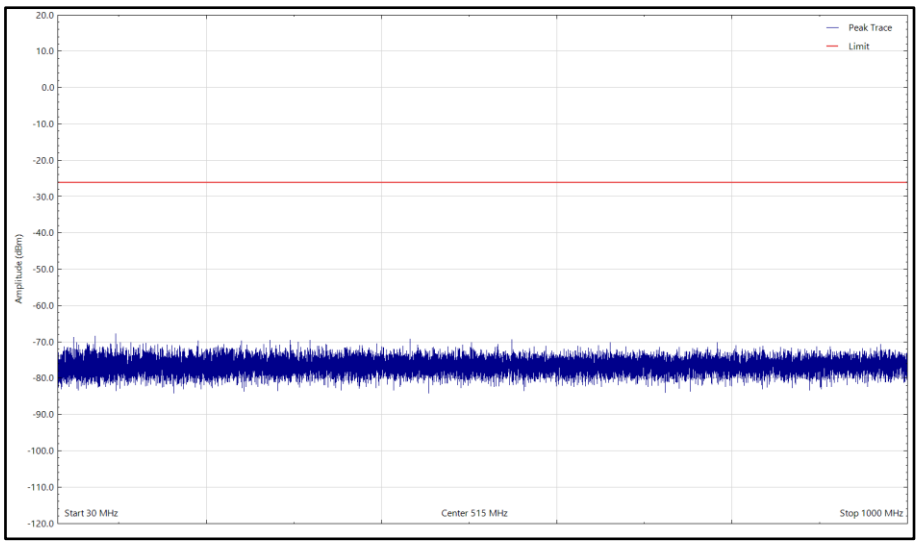


Figure 32 - CH18_LE2M, 2442 MHz, 30 MHz to 1 GHz, Vertical (Peak)

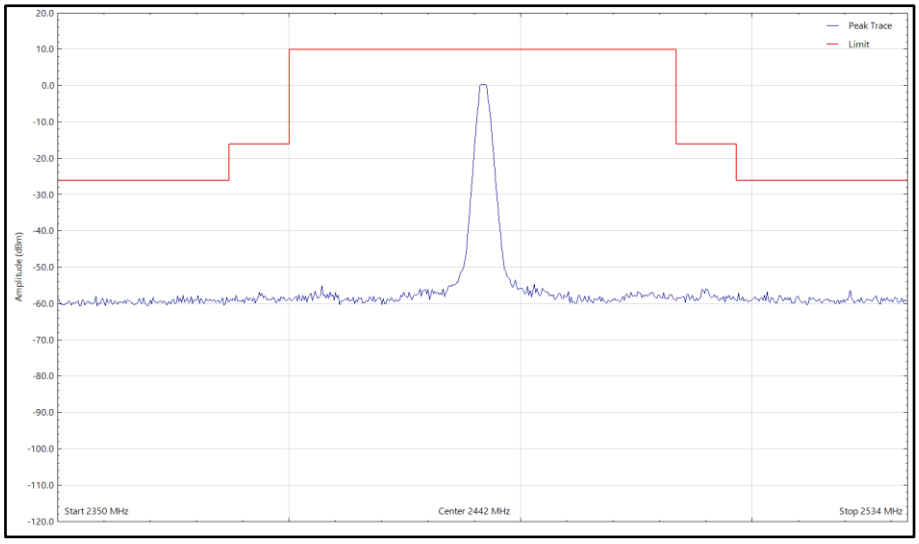


Figure 33 - CH18_LE2M, 2442 MHz, 2 GHz to 3 GHz, Vertical (Peak)

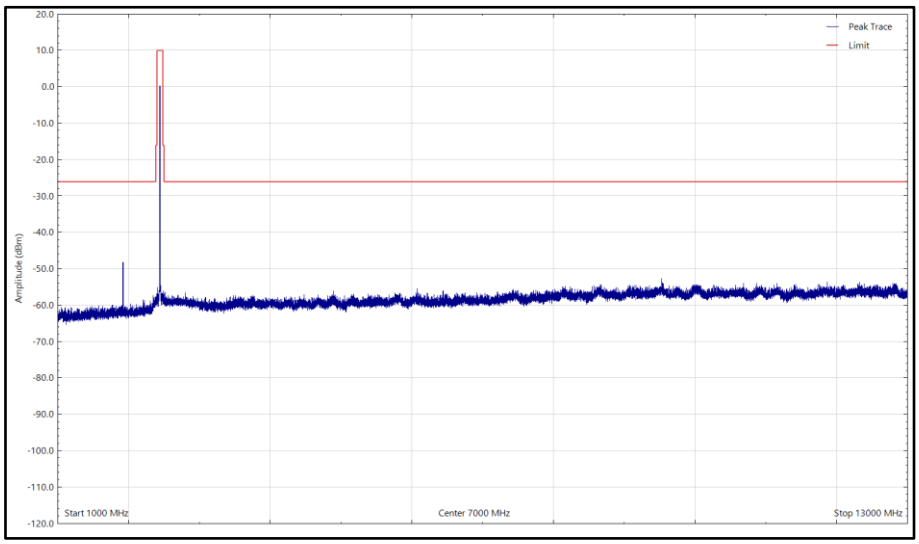


Figure 34 - CH18_LE2M, 2442 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 42 - CH39_LE2M, 2480 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

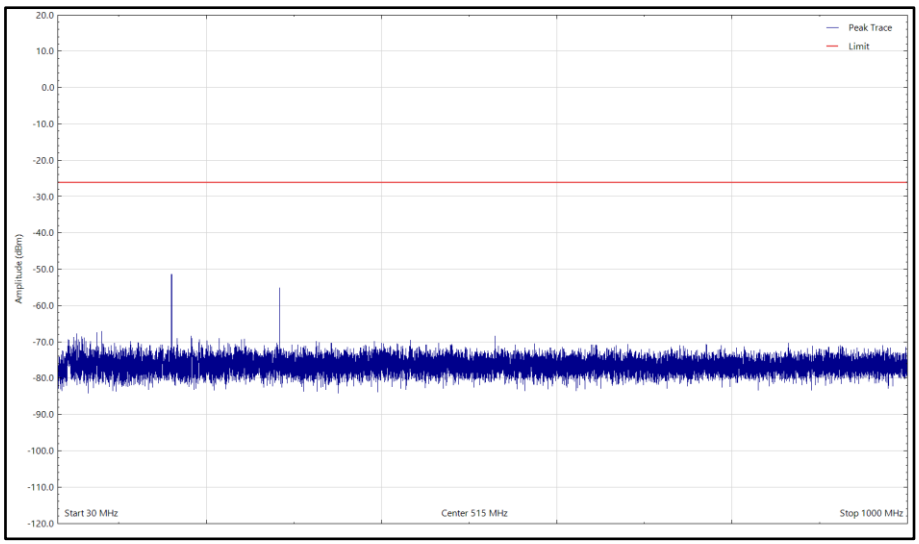


Figure 35 - CH39_LE2M, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

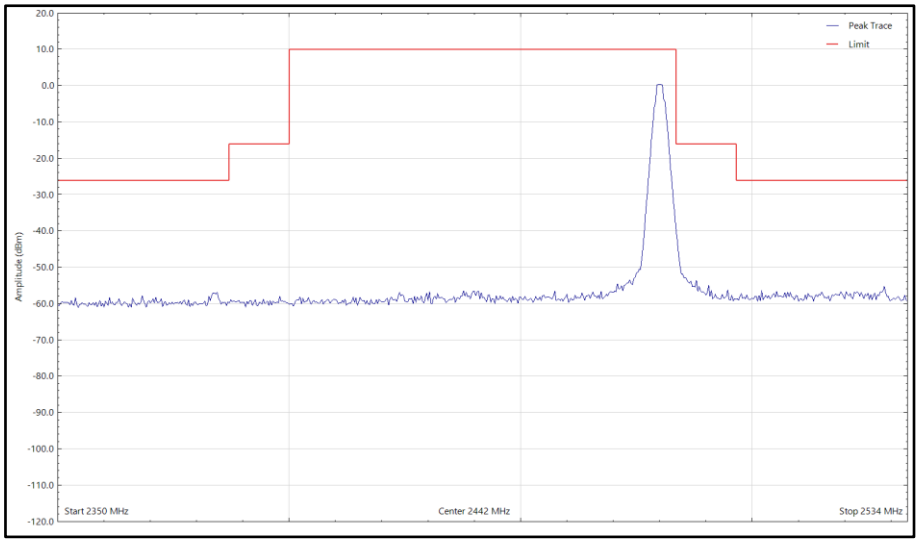


Figure 36 - CH39_LE2M, 2480 MHz, 2 GHz to 3 GHz, Vertical (Peak)

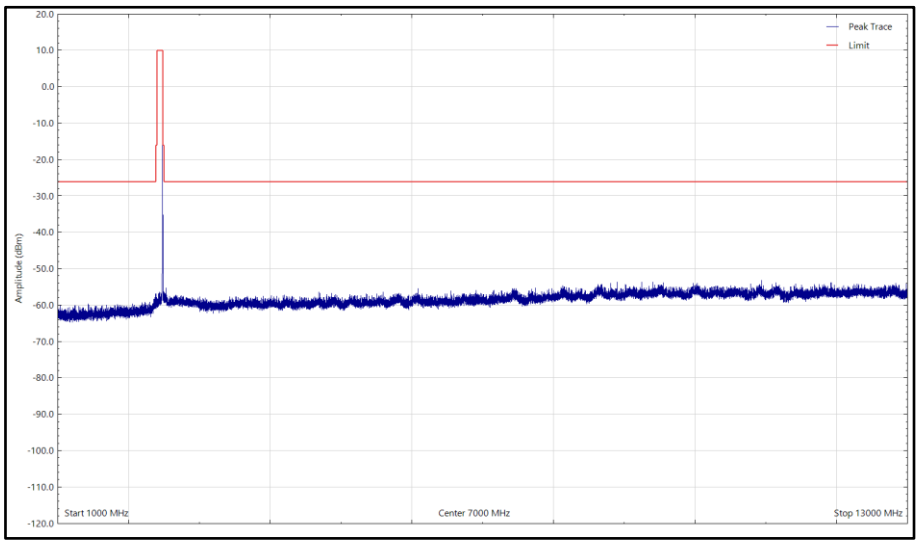


Figure 37 - CH39_LE2M, 2480 MHz, 1 GHz to 13 GHz, Vertical (Peak)

ARIB STD-T66, Limit Clause 3.2 (6)

Frequency Range	Limit
2387 MHz to 2400 MHz and 2483.5 MHz to 2496.5 MHz	25 µW or -16 dBm
9 kHz to <2387 MHz and >2496.5 MHz to 25 GHz	2.5 µW or -26 dBm

2.7.8 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
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	31-May-2025
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5516	12	23-Oct-2025
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	6551	12	18-Jun-2025

Table 43

2.8 Limit on Secondary Radiation

2.8.1 Specification Reference

ARIB STD-T66 Clause 3.3 (1) and MIC No. 88 Annex 43 (Article 2 Paragraph 1 Item 19)

2.8.2 Equipment Under Test and Modification State

SENSOR COLOUR NO. 3, S/N: CS_EP2-0068 - Modification State 0

2.8.3 Date of Test

23-January-2025

2.8.4 Test Method

This test was performed in accordance with ARIB STD-T66 Clause 3.3 (1).
The EUT was connected via a 1m cable and 10 dB of attenuation.
A preliminary sweep was performed using EmX and for results within 10 dB a final measurement was performed.
A measurement bandwidth of 100 kHz was used for below 1 GHz and 1 MHz was used for above 1 GHz.
The EUT was battery powered and fully charged prior to testing.

2.8.5 Test Setup Diagram

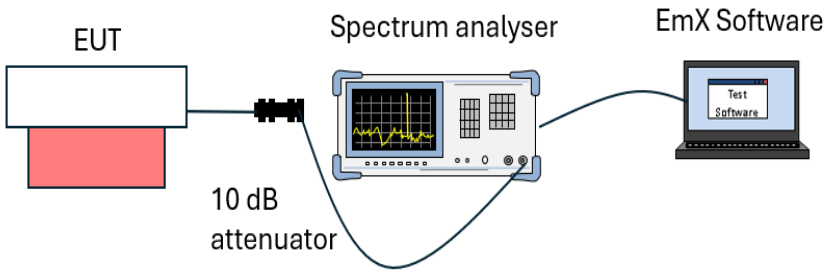


Figure 38 – Conducted Emissions Setup Diagram

2.8.6 Environmental Conditions

Ambient Temperature	21.6 °C
Relative Humidity	34.5 %

2.8.7 Test Results

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 56 - CH37_Rx, 2402 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

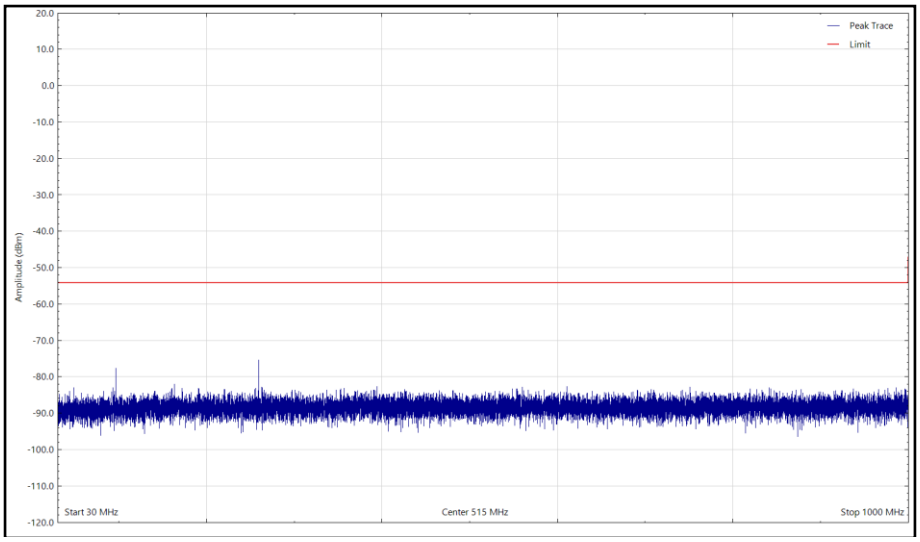


Figure 33 - CH37_Rx, 2402 MHz, 30 MHz to 1 GHz, Vertical (Peak)

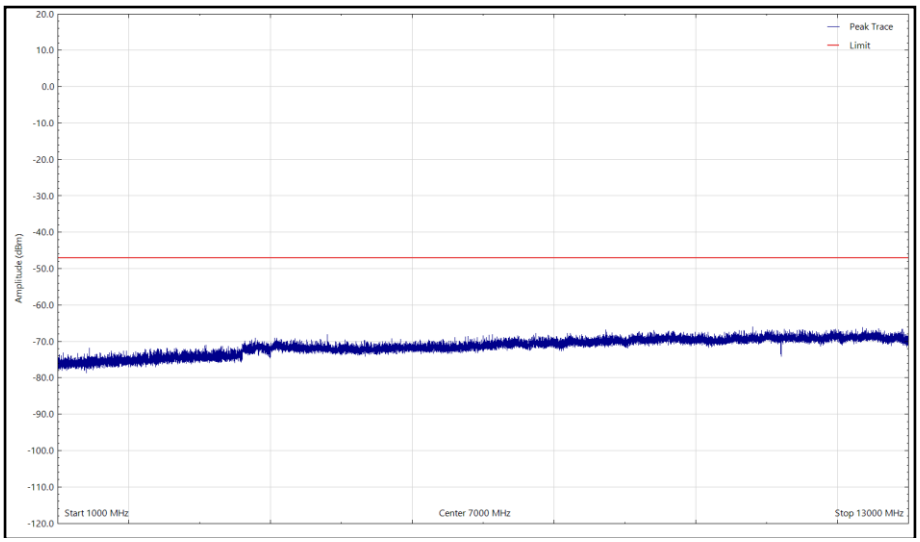


Figure 34 - CH37_Rx, 2402 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 57 - CH18_Rx, 2442 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

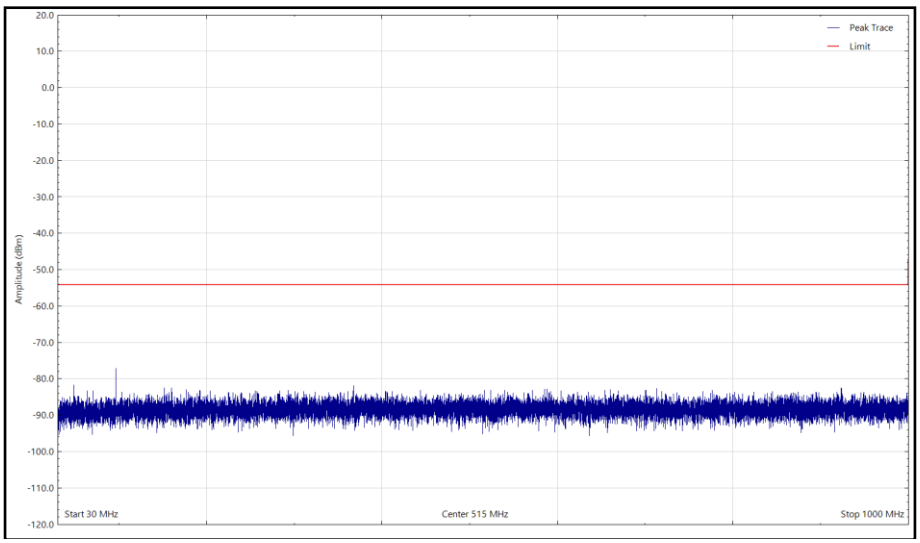


Figure 35 - CH18_Rx, 2442 MHz, 30 MHz to 1 GHz, Vertical (Peak)

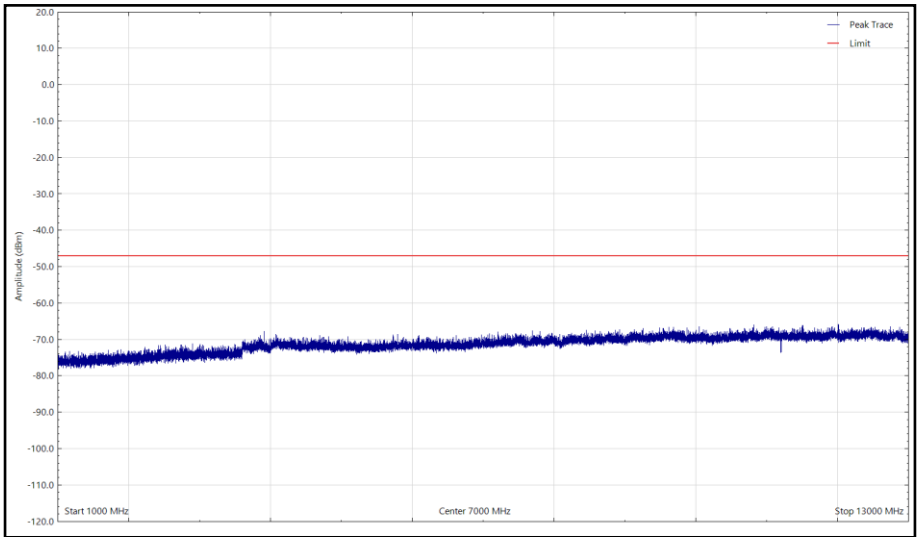


Figure 36 - CH18_Rx, 2442 MHz, 1 GHz to 13 GHz, Vertical (Peak)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 58 - CH39_Rx, 2480 MHz, 30 MHz to 13 GHz

*No emissions found within 6 dB of the limit.

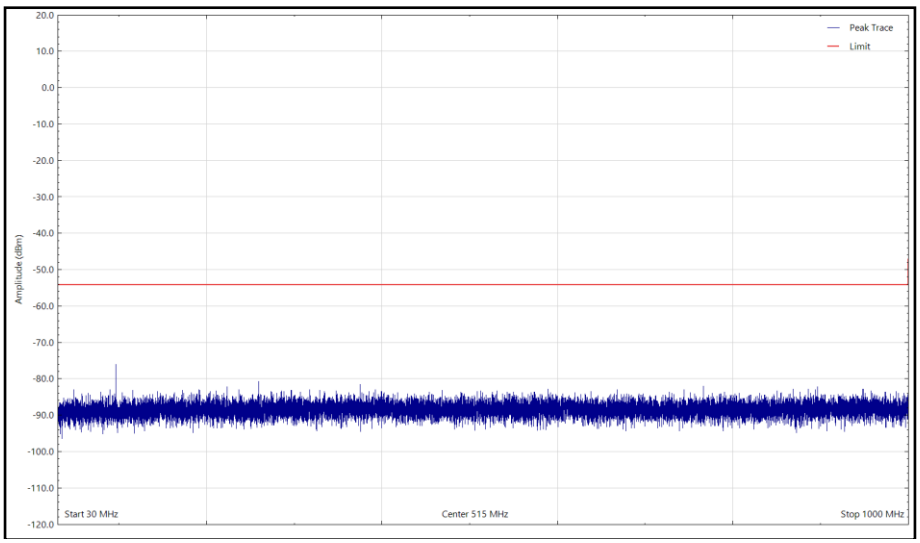


Figure 37 - CH39_Rx, 2480 MHz, 30 MHz to 1 GHz, Vertical (Peak)

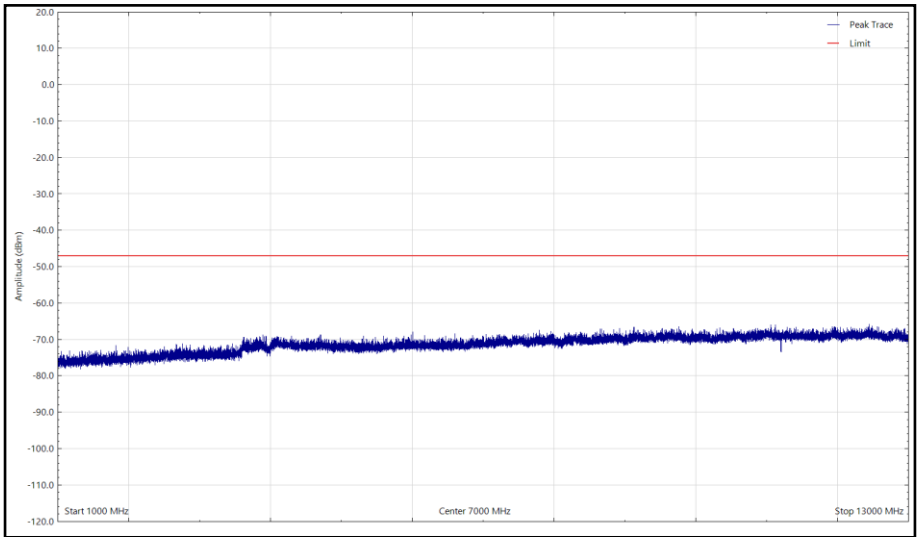


Figure 38 - CH39_Rx, 2480 MHz, 1 GHz to 13 GHz, Vertical (Peak)

ARIB STD-T66, Limit Clause 3.3 (1)

The limit at which secondary radiation will not hinder the function of other radio equipment is, if a fictional antenna circuit with the same electrical constant as the receiving antenna were to be used in calculations, at most 4nW if using a frequency below 1GHz and at most 20nW if using a frequency above or equal to 1GHz.

2.8.8 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
Hygrometer	Rotronic	I-1000	2891	12	02-Dec-2025
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	31-May-2025
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5516	12	23-Oct-2025
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	6551	12	18-Jun-2025

Table 59

3 Photographs

3.1 Equipment Under Test (EUT)

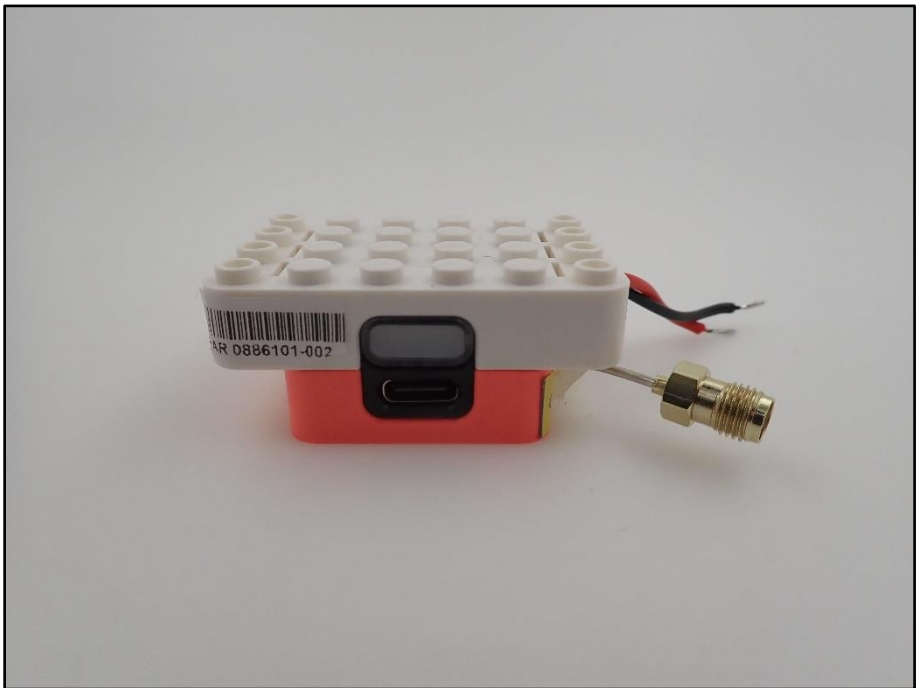


Figure 39 – SENSOR COLOUR NO. 3_Conducted Sample_Front View

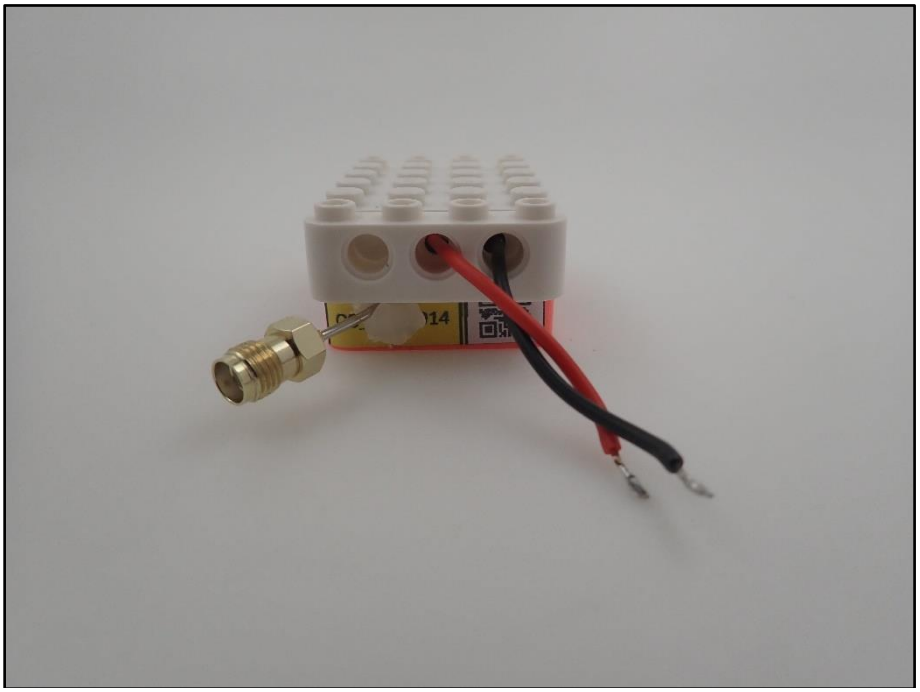


Figure 40 – SENSOR COLOUR NO. 3_Conducted Sample_Side View

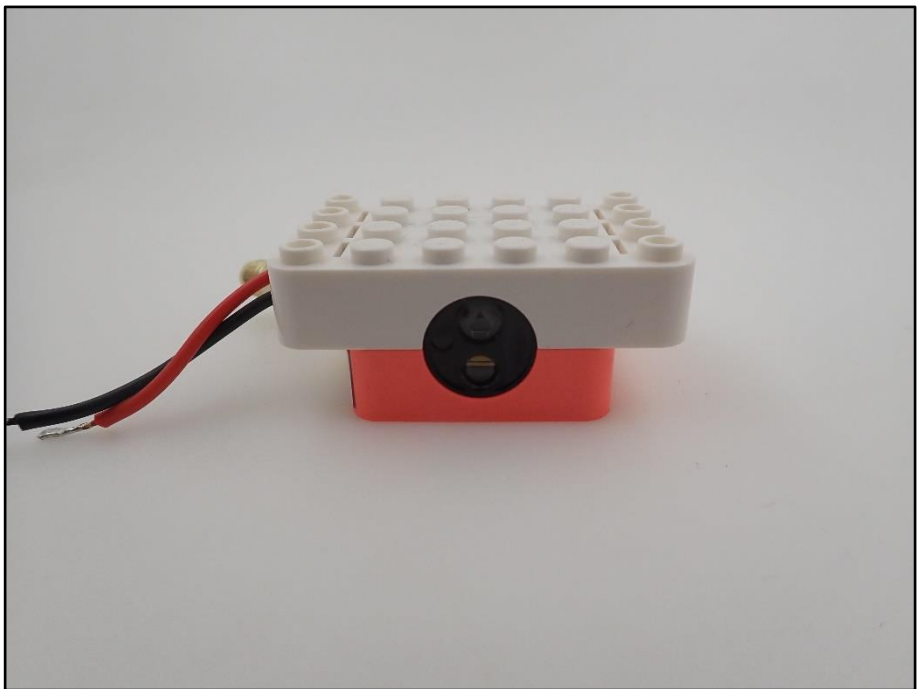


Figure 41 – SENSOR COLOUR NO. 3_Conducted Sample_Rear View

Figure 42 – SENSOR COLOUR NO. 3_ MAC Address Sample_Front View

Figure 43 – SENSOR COLOUR NO. 3_MAC Address Sample_Side View

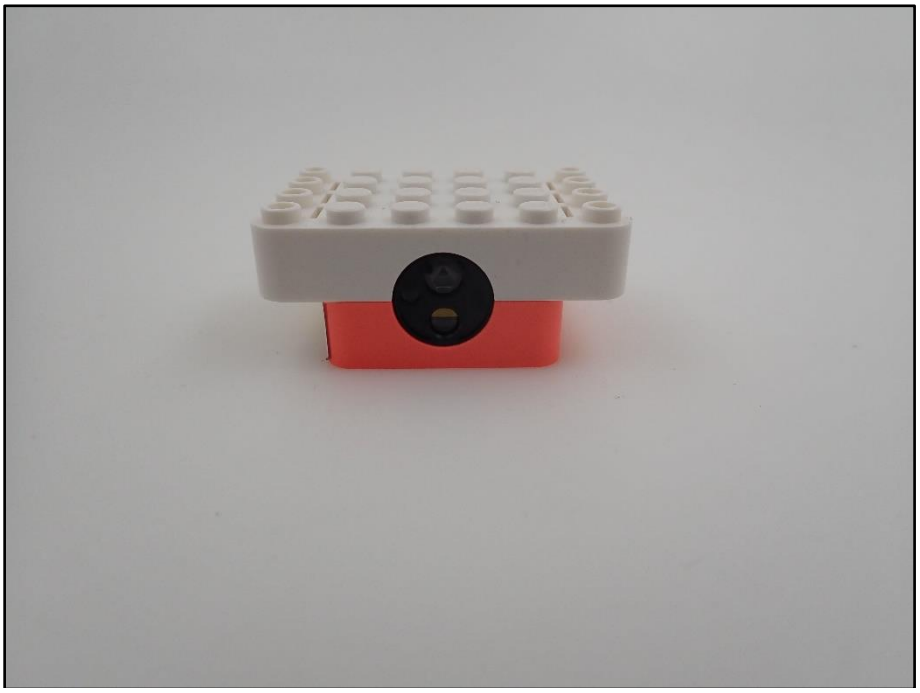


Figure 44 – SENSOR COLOUR NO. 3_MAC Address Sample_Rear View

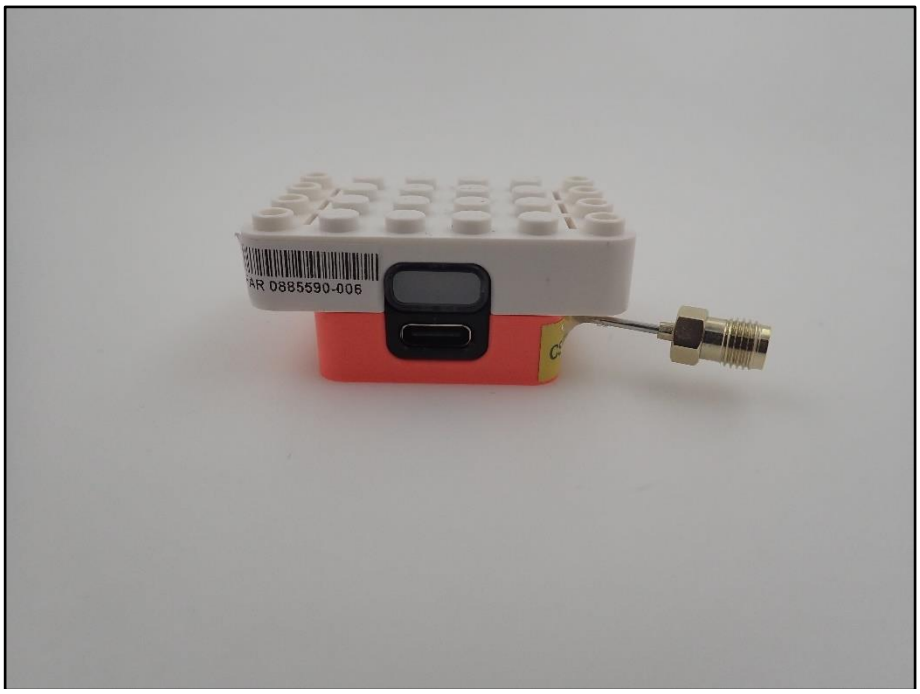


Figure 45 – SENSOR COLOUR NO. 3_Conducted Sample_Front View

Figure 46 – SENSOR COLOUR NO. 3_Conducted Sample_Side View

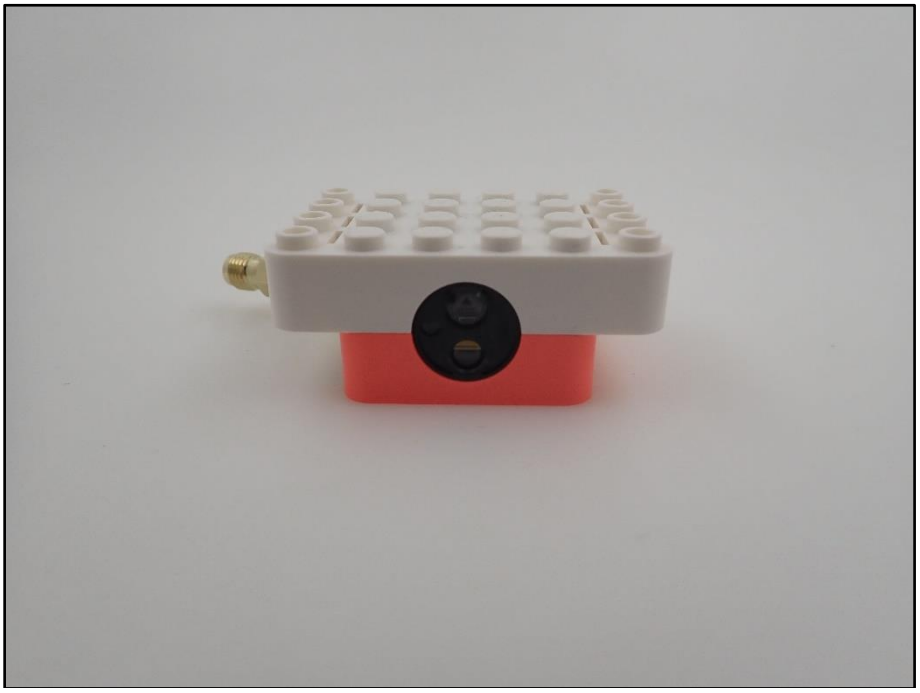


Figure 47 – SENSOR COLOUR NO. 3_Conducted Sample_Rear View

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Antenna Power	± 0.64 dB
Frequency Deviation	± 25.32 kHz
Allowable Value for Occupied Bandwidth	± 42.21 kHz
Voltage Variations	-
Antenna Gain	-
Interference Protection Function	-
Permissible Value of Spurious or Unnecessary Radiation Intensity	± 3.454 dB
Limit on Secondary Radiation	±3.45 dB

Table 60

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.