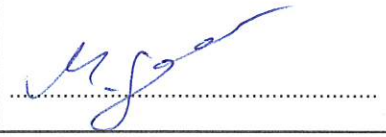
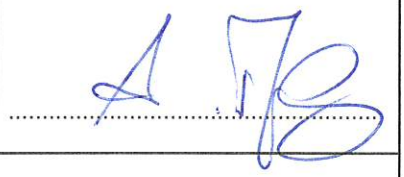
CUSTOMER SPECIFIC EMC TEST REPORT

FCC CFR Title 47 / Chapter I / Subchapter A / Part 15 / Subpart B

ISED ICES-003 Issue 7

Report Reference No	G0M-2210-1706-EF0115B-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	A2LA - Registration number: 1983.01 (ISED) ISED wireless device testing laboratory: CN 3470A DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	Haltian Oy
Address	Yrttipellontie 1 D 90230 Oulu Finland
Test Specification Standard(s)	FCC CFR Title 47 / Chapter I / Subchapter A / Part 15 / Subpart B ISED ICES-Gen Issue 1 ; Amendment 1 (February 2021) ISED ICES-003 Issue 7 ANSI C63.4:2014+A1:2017
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Asset tracking tag
Model(s)	TTG
Additional Model(s)	None
Brand Name(s)	Thingsee Nano Tag
Hardware Version(s)	TTG_04S
Software Version(s)	thingsee_tag_silabs_01b_wp51_2022.02.01.1
FCC-ID	2AEU3TSNANO
IC	20236-TSNANO
Test Result	**PASSED**

Possible test case verdicts:		
required by standard but not tested	N/T	
not required by standard	N/R	
required by standard but not appl. to test object	N/A	
test object does meet the requirement	P(PASS)	
test object does not meet the requirement	F(FAIL)	
Testing:		
Date of receipt of test item	2022-10-07	
Report:		
Compiled by	Jens Degenhardt	
Tested by (+ signature)	Jens Degenhardt	
Responsible for Test (+ signature)	Manuel Engel	
Approved by (+ signature) (Test Lab Engineer)	Andreas Pflug	
Date of Issue	2022-11-30	
Total number of pages	23	
General Remarks:		
The test results presented in this report relate only to the object tested. **The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.** This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.		
Additional Comments:		
Re-testing (see report G0M-2201-1258-EF0115B-V02) is necessary because of hardware changes. According to customer request radiated emission test was performer from 1 – 13 GHz. The performed test range (1 – 13 GHz) does not have to be the worst case. EUT configuration according to customer request with an external battery holder attached via short cable (see photographs below).		

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
T_{NOM}	Nominal operating temperature
V_{NOM}	Nominal supply voltage

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2022-11-30	Initial Release	-

REPORT INDEX

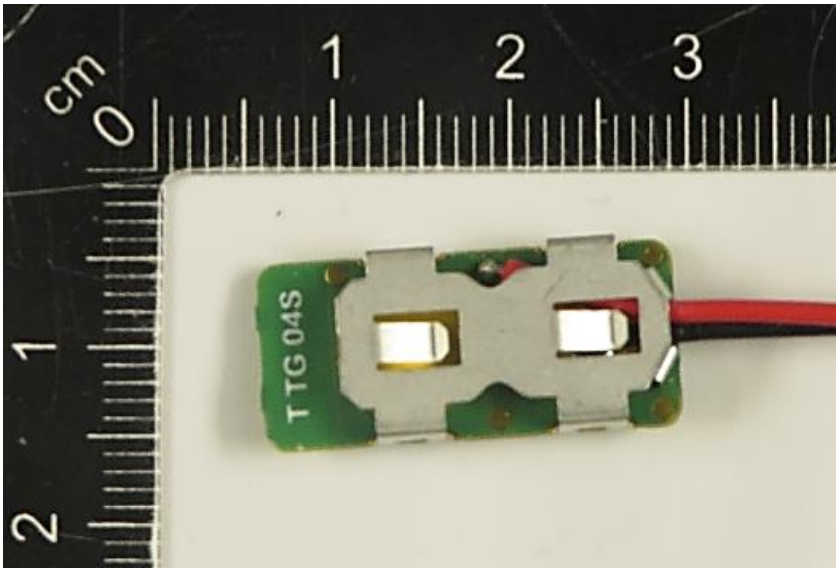
1 Equipment (Test Item) Under Test

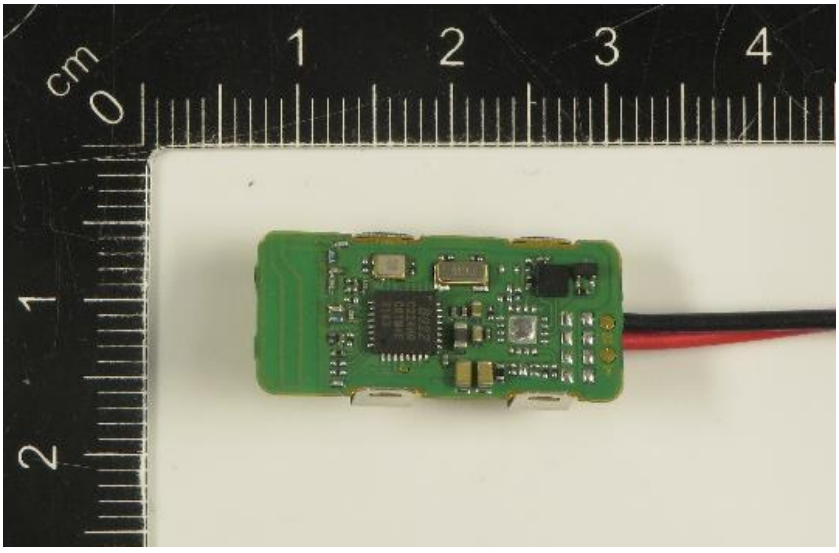
Description	Asset tracking tag	
Intended use	EUT is a part of a system for modular, reliable, and flexible solution for smart buildings. The Thingsee solution includes connectivity from device to device over BLE.	
Model	TTG	
Additional Model(s)	None	
Brand Name(s)	Thingsee Nano Tag	
Hardware Version(s)	TTG_04S	
Software Version(s)	thingsee_tag_silabs_01b_wp51_2022.02.01.1	
Number of tested samples	1	
Sample Identification	Sample-ID	Serial Number
	41732	MAC: 040D84BEAE7F
EUT Dimensions [cm]	2.54 x 1.27 x 0.72	
FCC-ID	2AEU3TSNANO	
IC	20236-TSNANO	
Class	Class B	
Equipment type	Table top	
Highest internal frequency [MHz]	2483.5	
Protective Earth	N/A	
Radio Module	Type	BLE
	Model	EFR32BG22C224F512GM32-C SoC
	Manufacturer	Silicon Labs
	FCC-ID	N/A
	IC	N/A
Supply Voltage	V_{NOM}	3 V DC by internal lithium battery (LiMnO2)
AC/DC-Adaptor	N/A	
Manufacturer	Haltian Oy Yrttipellontie 1 D 90230 Oulu Finland	

1.1 Equipment Ports

Name	Type	Attributes	Comment
None			
Description:			
AC	AC mains power input/output port		
DC	DC power input/output port		
BAT	DC power input port connected to external battery		
IO	Input/Output port		
TP	Telecommunication port		
NE	Non-electrical port		

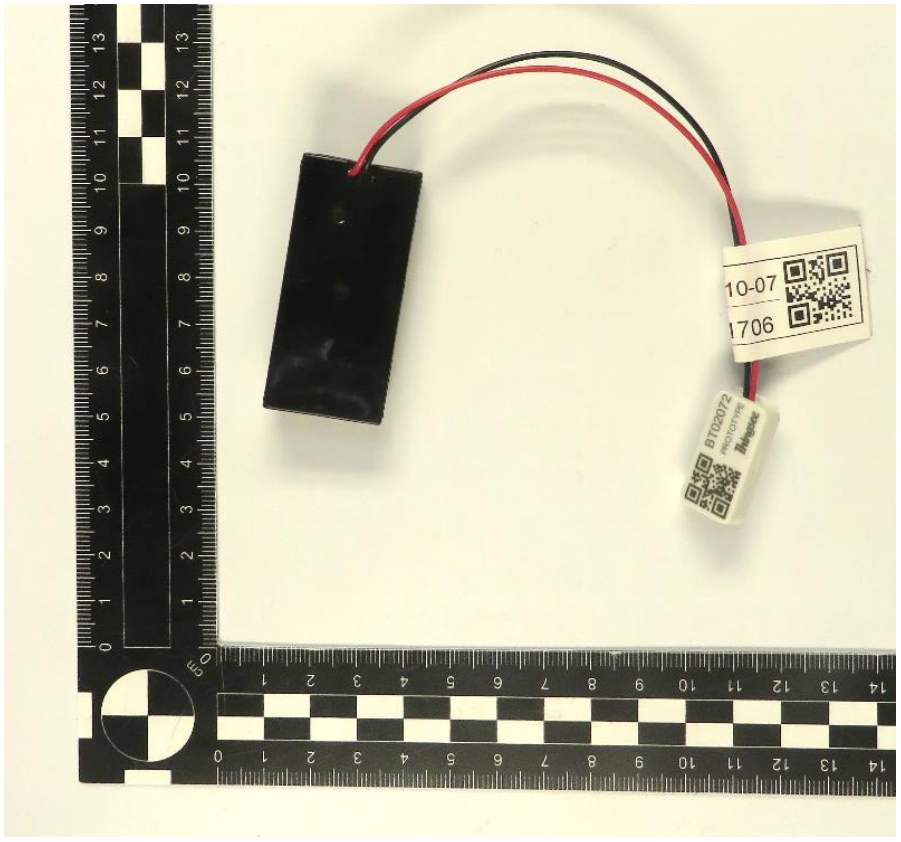
1.2 Equipment Photos – Internal

EUT 41732 internal top


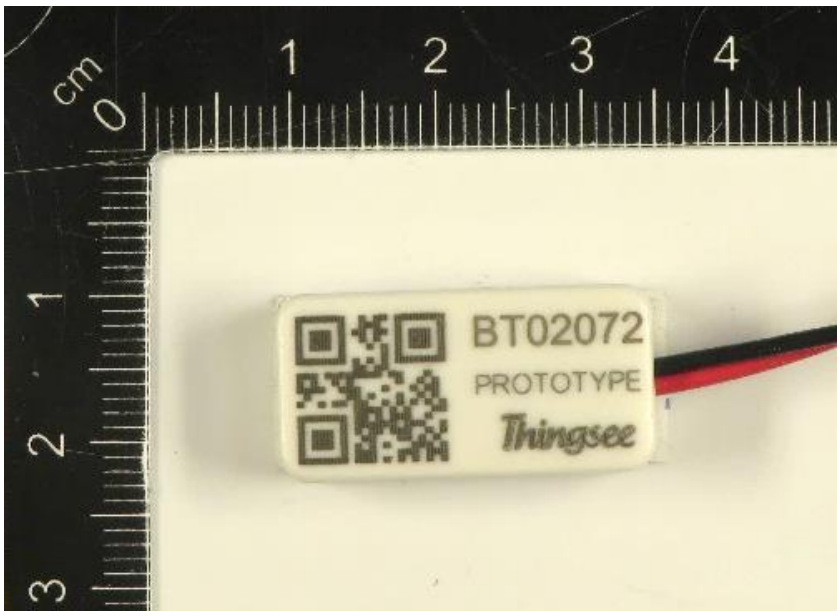
EUT #41732 internal bottom


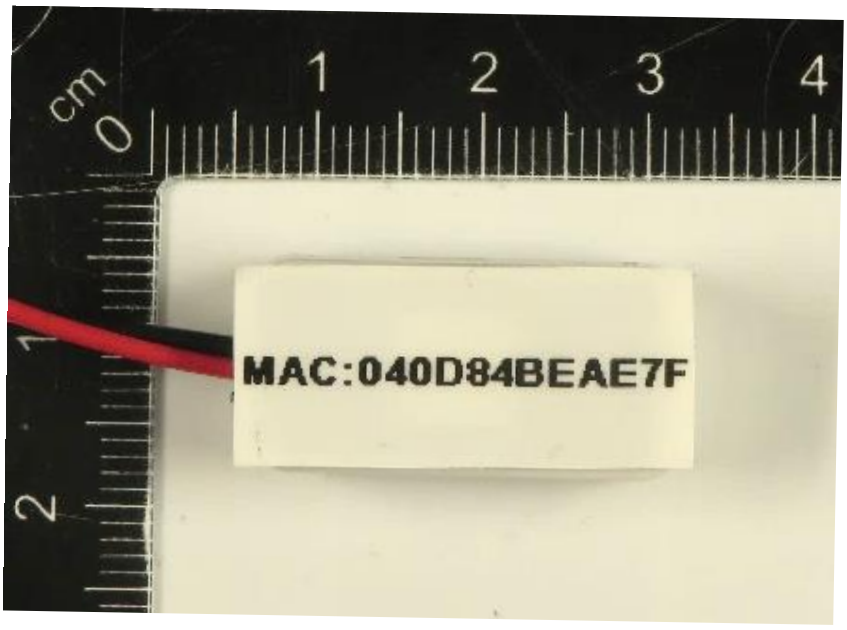
1.3 Equipment Photos - External

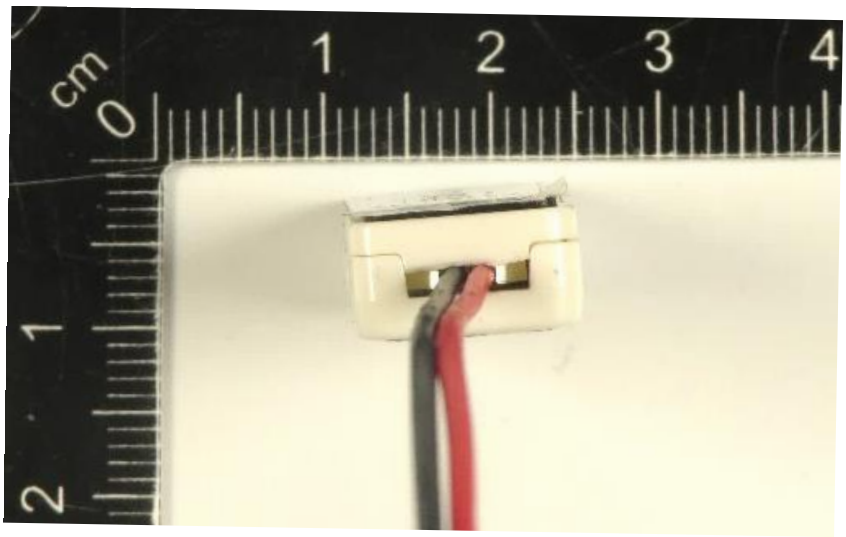
EUT #41732 with cable and battery holder

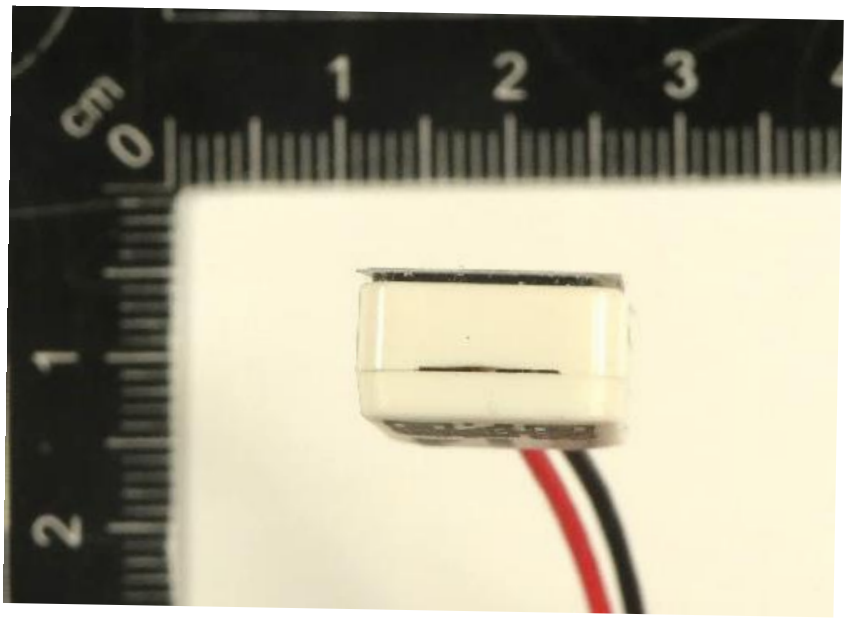


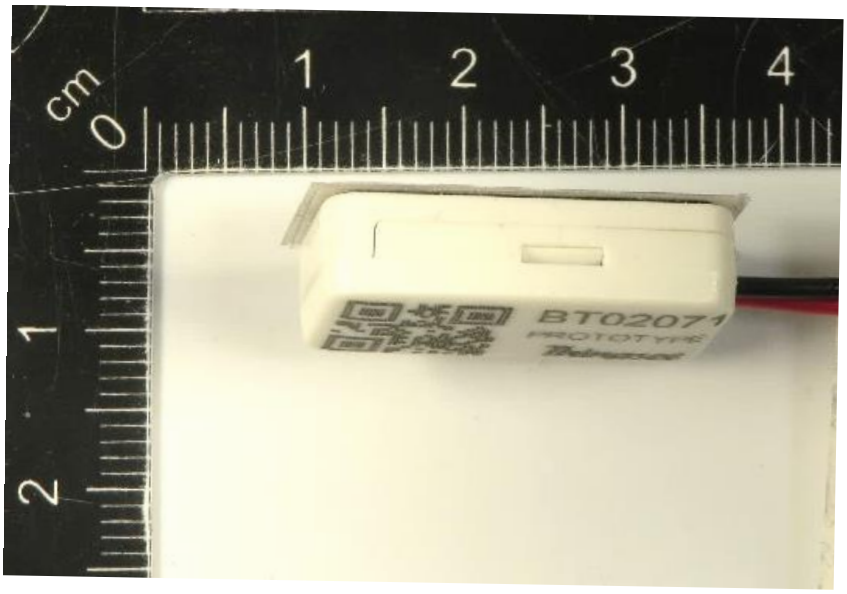
EUT #41732 external top

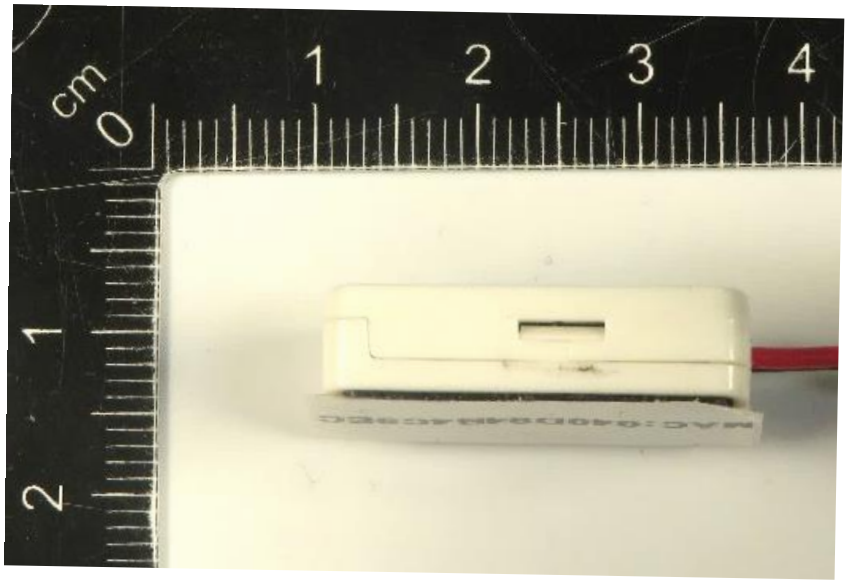


EUT #41732 external bottom


EUT #41732 external front


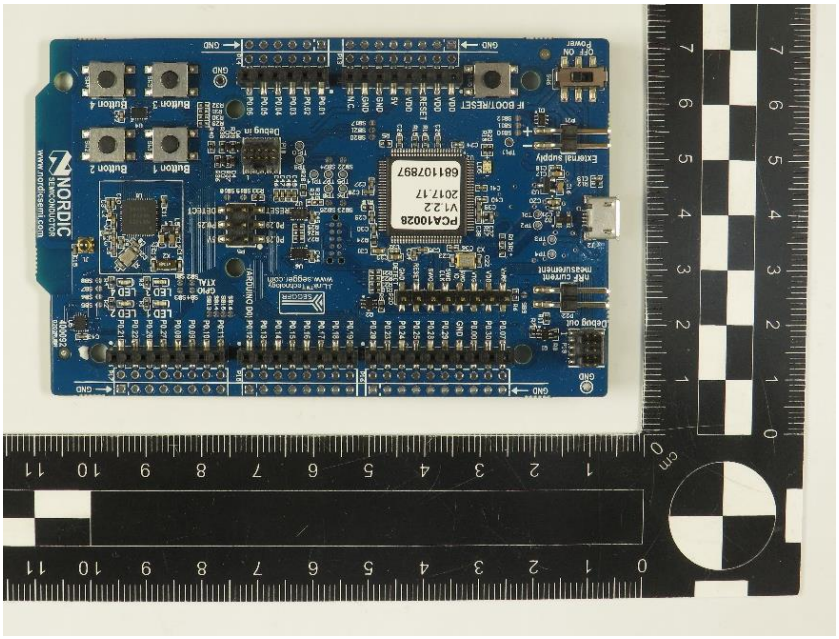
EUT #41732 external rear


EUT #41732 external left


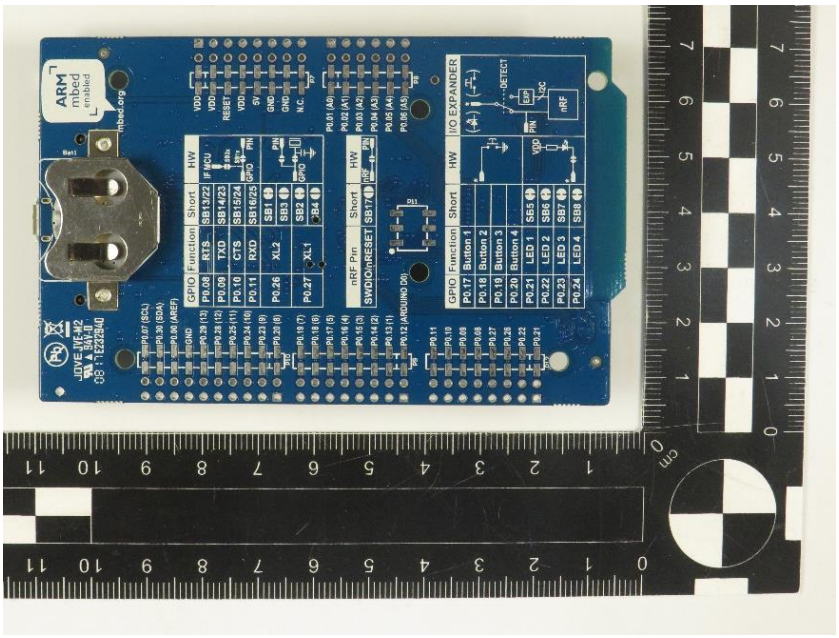
EUT #41732 external right


EUT #41732 Label


SUPPORT EQUIPMENT: Nordic rf51DK - top side



SUPPORT EQUIPMENT: Nordic rf51DK - bottom side



1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Lithum batteries	RENTATA	CR1025	--
AE	Laptop	Lenovo	X250	PC05N7T7
AE	Remote station for Wirepas communication	Nordic	rf51DK	Customer Support Equipment
SW	Terminal Program	Tobias Hammer	HTerm 0.8.8	--
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
MON	Monitoring Equipment			
CBL	Connecting Cable			
SW	Software			
Comment: --				

1.5 Operational Modes

Mode #	Description
1	EUT operates in 2.4GHz ISM band with BLE (2.4 GHz; transmitting power: 1 dBm) in TX mode (second-by-second) with Remote station for Wirepas communication setup as receiver (receives data about every second)
Comment: --	

1.6 EUT Configuration

Configuration #	Description
1	EUT powered via 2 pieces of AAA cells inserted to attached battery holder. The Remote station for Wirepas communication (rf51DK board) is connected to Laptop. Monitoring of radio connection via Terminal Program.
Comment: --	

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyser in dBµV. Any external preamplifiers used are taken into account through internal analyser settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyser. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyser (dBµV) + A.F. (dB/m) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading	:	Net reading - FCC limit	= Margin
+21.5 dBµV + 26 dB/m	= 47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

2 Result Summary

Title 47 CFR Part 15B, ISED ICES-003 Issue 7				
Reference	**Requirement**	**Reference Method**	**Result**	**Remarks**
Emission				
FCC 15.109 ICES-003, 3.2.2	Radiated emissions	ANSI C63.4:2014 +A1:2017	PASS	--
FCC 15.107 ICES-003, 3.2.1	AC power line conducted emissions	ANSI C63.4:2014 +A1:2017	N/R	No relevant port
Comment: --				

Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

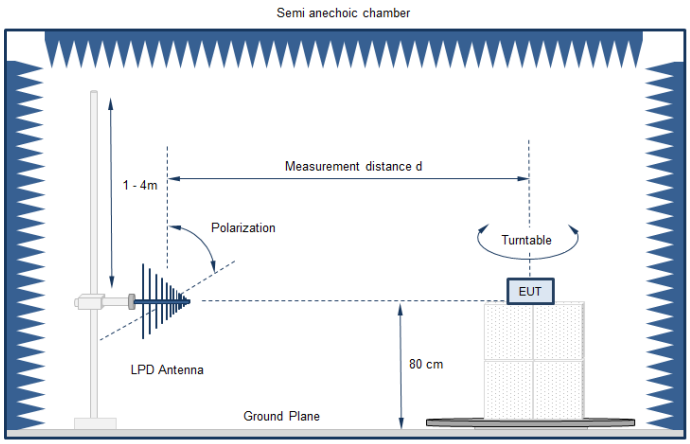
2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

2.1.1 Information

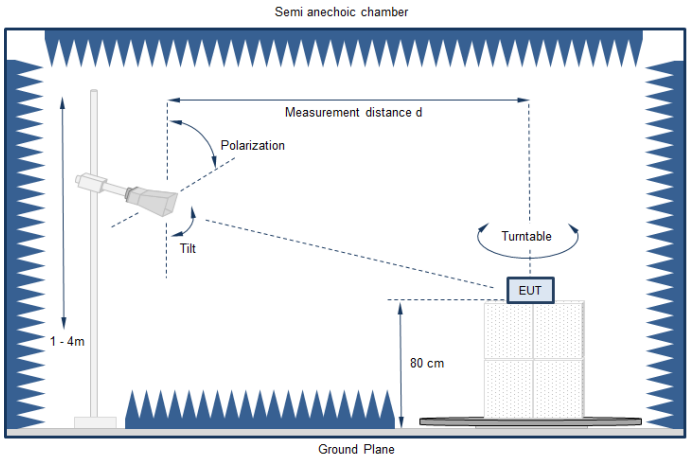
Test Information	
Reference	FCC 15.109, ICES-003, 3.2.2
Reference method	ANSI C63.4:2014+A1:2017 Section 8
Equipment class	Class B
Equipment type	Table top
Highest internal frequency [MHz]	2483.5
Measurement range	30 MHz to 13000 MHz
Temperature [°C]	21
Humidity [%]	47
Operator	Jens Degenhardt
Date	2022-11-04

2.1.2 Setup

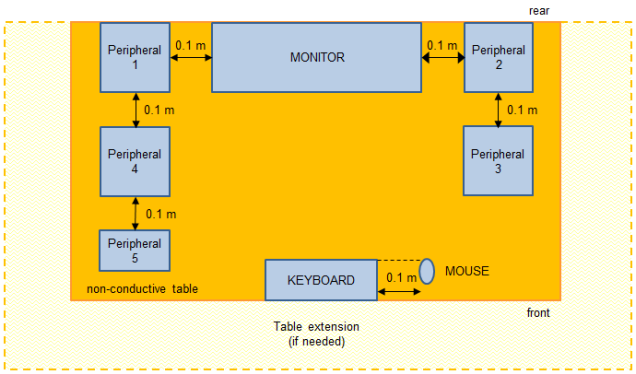
Measurement up to 1 GHz



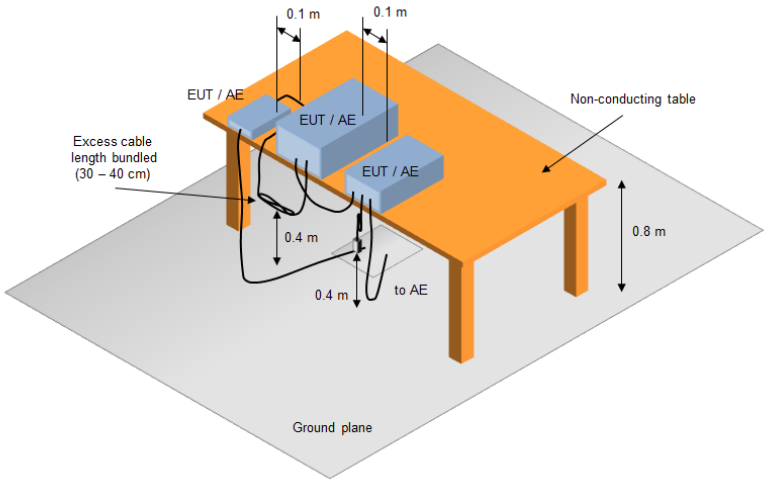
Measurement above 1 GHz



Equipment placement - Table top



Test Setup



2.1.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2020.1.8

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber (NSA)	Frankonia	AC6	EF00910	2021-07	2024-07
Anechoic chamber (SVSWR)	Frankonia	AC6	EF00899	2021-07	2024-07
EMI Test Receiver	R&S	ESU26	EF00887	2022-09	2023-09
Horn Antenna	Horn antenna	BBHA	EF01561	2021-11	2022-11
Climatic Sensor	Embedded Data Systems, LLC.	9A00100000254 77E	EF01124	2022-07	2023-07

2.1.4 Procedure

Exploratory measurement
1. The EUT was placed on a non-conductive table at a height of 0.8m. 2. The EUT and support equipment, if needed, were set up to simulate typical usage. 3. Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage. 4. The antenna was placed at a distance of 3 or 10 m. 5. The received signal was monitored at the measurement receiver. 6. This procedure has to be performed in both antenna polarizations, horizontal and vertical. 7. The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 2.1.2

Final measurement
1. The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver. 2. A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 1000 MHz. Above one 1 GHz a Double Ridged Broadband Horn antenna was used. The antenna was placed on an adjustable height antenna mast. 3. The EUT and cable arrangement were based on the exploratory measurement results. 4. Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded. 5. The test data of the worst-case conditions were recorded and shown on the next pages.

2.1.5 Limits

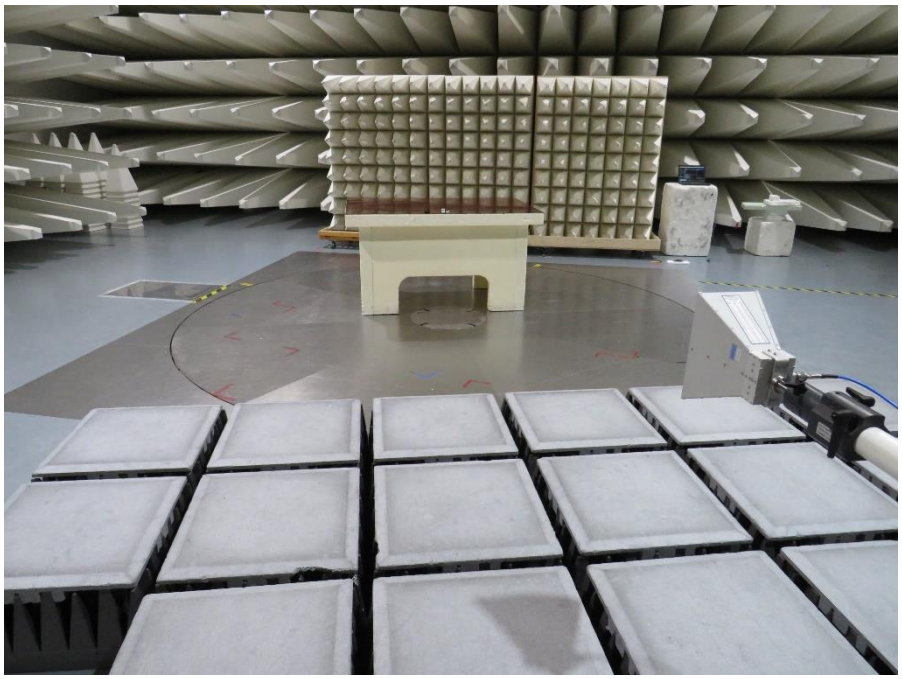
Class B @ 3 m		
Frequency [MHz]	Detector	Limit [dBµV/m]
30 - 88	Quasi-peak	40
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46
960 - 1000	Quasi-peak	54
> 1000	Peak Average	74 54

2.1.6 Results

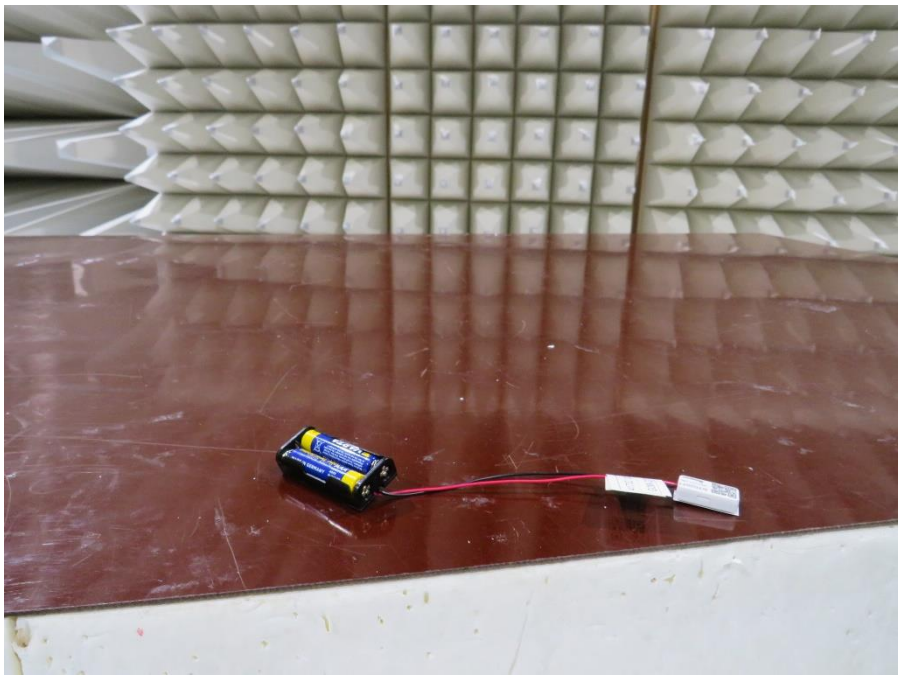
Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1	1	PASS	--

2.1.7 Setup Photos

TEST SETUP – Radiated emissions – 1-13GHz



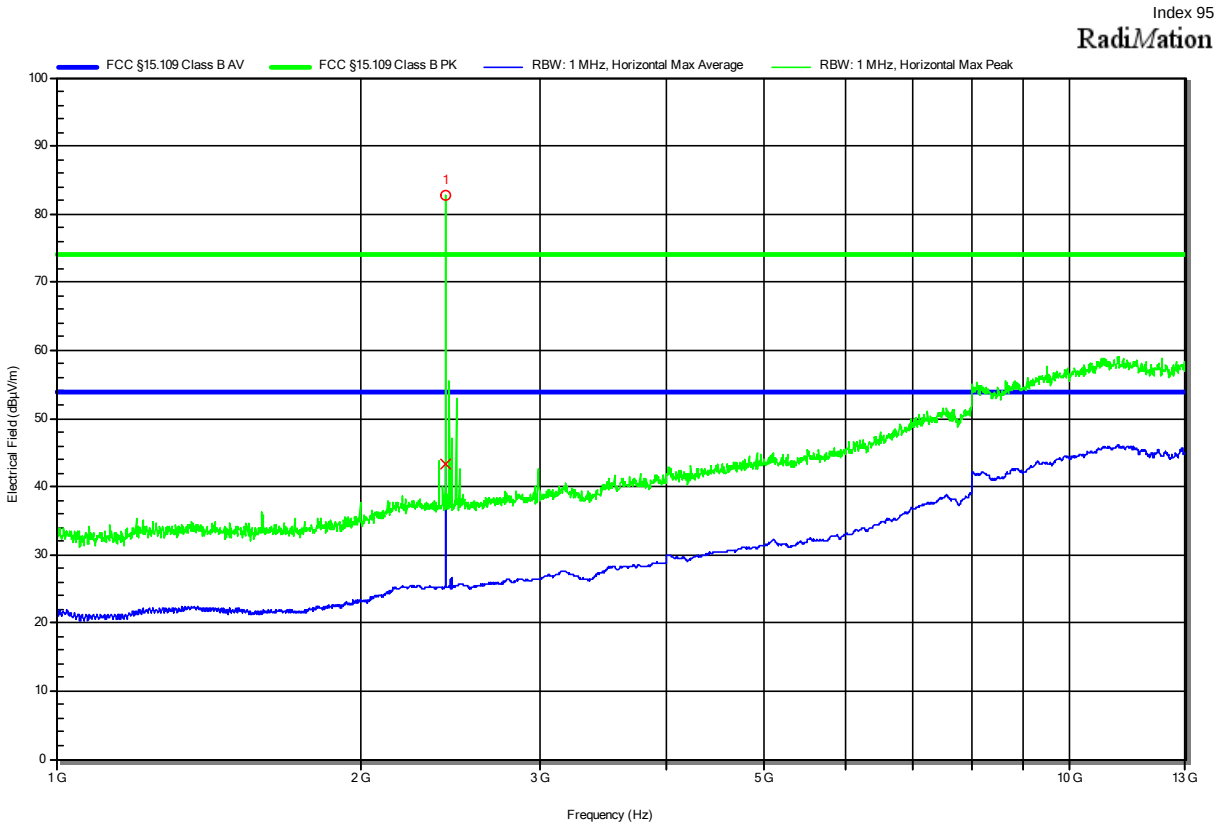
TEST SETUP – Radiated emissions – 1-13GHz – closeup EUT



2.1.8 Records

Radiated emissions according to FCC 15B

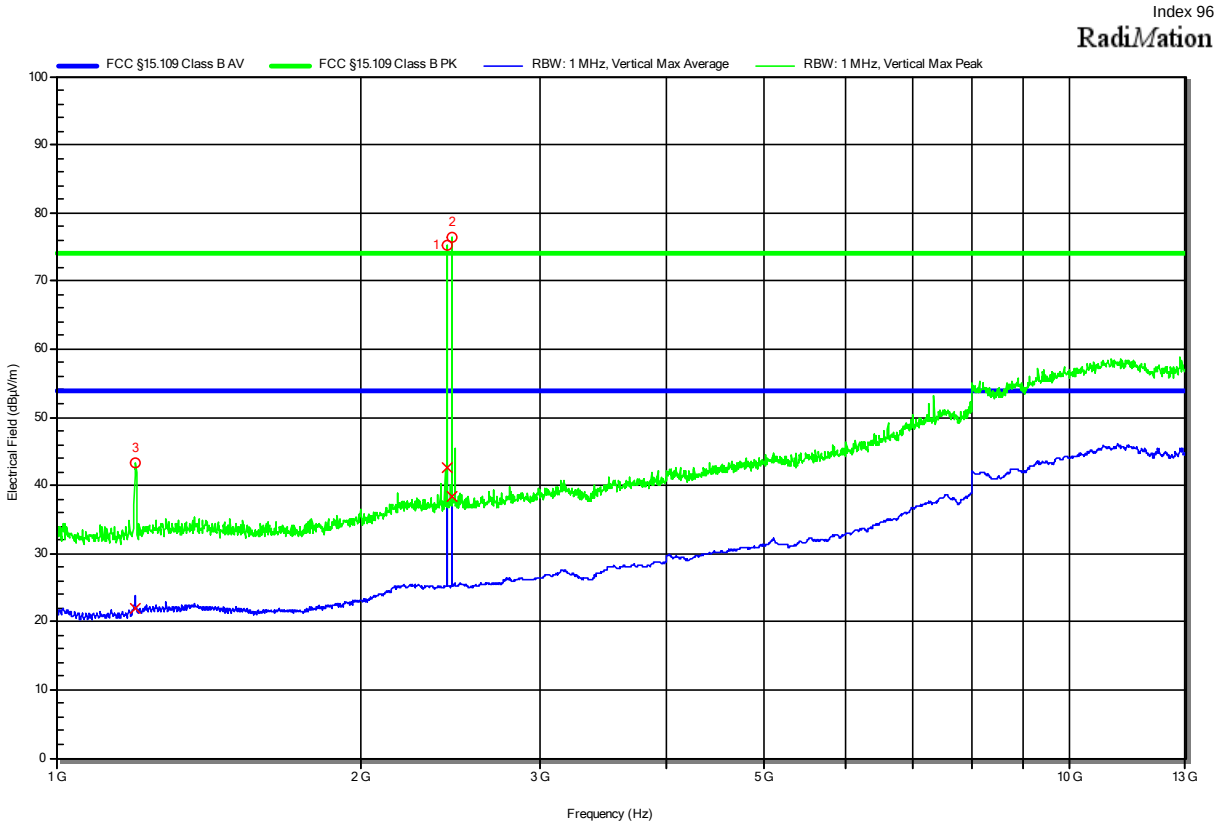
Project Number:	G0M-2210-1706
Applicant:	Haltian Oy
Model Description:	Asset tracking tag
Model:	TTG
Test Sample ID:	41732
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Degenhardt
Test Date:	2022-11-04
Operating Conditions:	ambient temperature: 21 °Celsius power input: 3.0 V DC
Antenna:	Schwarzbeck BBHA 9120D, Horizontal
Measurement Distance:	3m
Operational Mode:	Mode 1
EUT Configuration:	Configuration 1



Peak Number	Frequency	Note
1	2.423 GHz	BLE-Carrier

Radiated emissions
according to FCC 15B

Project Number:	G0M-2210-1706
Applicant:	Haltian Oy
Model Description:	Asset tracking tag
Model:	TTG
Test Sample ID:	41732
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Degenhardt
Test Date:	2022-11-04
Operating Conditions:	ambient temperature: 21 °Celsius power input: 3.0 V DC
Antenna:	Schwarzbeck BBHA 9120D, Vertical
Measurement Distance:	3m
Operational Mode:	Mode 1
EUT Configuration:	Configuration 1



Peak Number	Frequency	Note					
1	2.43 GHz	BLE-Carrier					
2	2.456 GHz	BLE-Carrier					
3	1.198 GHz	22 dBµV/m	54 dBµV/m	-31.9 dB	Pass	0 degrees	1 m

3 Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2.

Test Name	Measurement Uncertainty
Radiated Emission (AC6)	30 MHz to 1 GHz @ 10 m, 6.25 dB 1 GHz to 6 GHz @ 3 m, 4.86 dB 6 GHz to 18 GHz @ 3 m, max. 5.39 dB