Report on the Radio Testing

For

Inova Design Solutions Ltd (Bodytrak)

on

Bodytrak I

Report no. TRA-054222-47-13A

17th August 2022

0026

Report Number: TRA-054222-47-13A
Issue: A

REPORT ON THE RADIO TESTING OF A
Inova Design Solutions Ltd (Bodytrak)
Bodytrak I
WITH RESPECT TO SELECTED CLAUSES OF SPECIFICATION
FCC 47CFR 15.247 & KDB 996369 D04 v02

TEST DATE: 09-08-2022 to 12-08-2022

Tested by: Michael Else

Written by: Digitally signed by Michael Else Date: 2022.08.17 12:08:14 +01'00' — Michael Else, Radio Test Engineer

Approved by: Digitally signed by Daniel Winstanley DN: cn=Daniel Winstanley, o=Element, ou, email=daniel.winstanley@element.com, c=GB Date: 2022.08.17 15:40:01 +01'00' Adobe Acrobat version: 2022.002.20191 — Dan Winstanley, Senior Radio Test Engineer

Date: 17th August 2022

Disclaimers:

[1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	17th August 2022	Original

2 Summary

TEST REPORT NUMBER:	TRA-054222-47-13A
WORKS ORDER NUMBER:	TRA-054222-08
PURPOSE OF TEST:	Permissive change class investigation
TEST SPECIFICATION:	47CFR15.247 / KDB 996369 D04 v02
EQUIPMENT UNDER TEST (EUT):	Bodytrack I
FCC IDENTIFIER: Contains FCCID (BLE): Contains FCCID (LTE):	2A3CVA T7V1326C2 XPY1ElQ24NN
EUT SERIAL NUMBER:	Conducted: BCP1N-A0146 Radiated: BCP1N-A0140
MANUFACTURER/AGENT:	Inova Design Solutions Ltd (Bodytrak)
ADDRESS:	86-90 Paul Street. London EC2A 4NE United Kingdom
CLIENT CONTACT:	Leon Marsh ☎ +44 (0) 203 432 5439 ✉ regulatory@bodytrak.co
ORDER NUMBER:	PO-0290
TEST DATE:	09-08-2022 to 12-08-2022
TESTED BY:	Michael Else Element

2.1 Test Summary

Test Method and Description		*Requirement Clause 47CFR15*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.247 (d)	☒	*Pass*
AC power line conducted emissions		15.207	☐	*Note 1*
Occupied bandwidth		15.247 (a) (2)	☒	*Pass*
Conducted carrier power	Peak	15.247 (b) (3)	☒	*Pass*
	Max.		☐	
Out of band emissions		15.247 (d)	☐	*Note 1*
Power spectral density		15.247 (e)	☐	*Note 1*
Calculation of duty correction		-	☐	-
TX Radiated spurious emissions (Full Operation)		KDB 996369 D04 v02	☒	*Pass*

Specific Note:

1. Limited testing performed to selected clauses of FCC 47CFR 15.247 & KDB 996369 D04 v02 to facilitate permissive class change investigation.

General Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except were identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-054222-47-13A presents the results of the Radio testing on a Inova Design Solutions Ltd (Bodytrak), Bodytrak Ito specification 47CFR15 Radio Frequency Devices & KDB 996369 D04 v02.

The testing was carried out for Inova Design Solutions Ltd (Bodytrak) by Element, at the address detailed below.

☐ Element Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ Element Skelmersdale
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:

The test laboratory is accredited for the above sites under the US-UK MRA,

Designation number(s):
Element Hull UK2007
Element Skelmersdale UK2020

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- KDB 996369 D04 Module Integration Guide v02 - Modular transmitter integration guide - Guidance for host product manufacturers.

5.2 Deviations from Test Standards

Limited testing performed to selected clauses of FCC 47CFR 15.247 & KDB 996369 D04 v02 to facilitate permissive class change investigation.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
IC	Industry Canada
ITU	International Telecommunication Union
LBT	Listen before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: Bodytrak I
- Serial Number: BCP1N
- Model Number: Bodytral I
- Software Revision: 4120
- Build Level / Revision Number: B3 (Build 3)

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

Texas Instruments CC31XXEMUBOOST
HP Probook 4540s Laptop

7.3 EUT Mode of Operation

Radiated
The EUT was programmed with test modes that when enabled caused the unit to transmit on the required channel with the detailed operating mode.

Conducted
The EUT was programmed to transmit on the required frequencies using a Texas instruments CC31XXEMUBOOST dev board and CC31XX/CC32XX Radio tool software (Version1.03.18) Via a test laptop.

7.4 EUT Radio Parameters

7.4.1 General

WiFi

Frequency of operation:	2412 MHz -2462 MHz
Modulation type(s):	DSSS, OFDM
Occupied channel bandwidth(s):	20 MHz
Channel spacing:	5 MHz
ITU emission designator(s):	GXW
Declared output power(s):	<20 dBm
Warning against use of alternative antennas in user manual (yes/no):	N/A integral antenna
Nominal Supply Voltage:	3.7 Vdc
Location of notice for license exempt use:	Label / user manual / both.

BLE

Frequency of operation:	2402 to 2480 MHz
Modulation type(s):	GFSK
Occupied channel bandwidth(s):	2 MHz
Channel spacing:	2 MHz
ITU emission designator(s):	F1D
Declared output power setting:	-3 dBm
Nominal Supply Voltage:	3.7 Vdc From Li-Po rechargeable battery
Duty cycle:	100% for test

LTE

Radio:	**LTE**
Band(s) of operation:	12
Frequencies of operation:	707.5 MHz
Modulation type(s):	OFDM
Channel bandwidth(s):	10 MHz
Nominal Supply Voltage:	3.7 Vdc

7.4.2 Antennas

WiFi

Type:	Antennova SR4W035
Frequency range:	2.4 – 2.5 (GHz)
Impedance:	50 Ω
VSWR:	1.85:1
Gain:	3.5 dBi Peak
Polarisation:	Linear
Beam width:	Wideband
Connector type:	SMD
Length:	6.0mm
Weight:	4.0mm
Environmental limits:	-40°C to140°C
Mounting:	Soldered

BLE

Type:	Component Multilayer Antenna
Make/Model	TDK ANT016008LCS2442MA1
Frequency range:	2400 MHz to 2484 MHz
Gain:	1.6 dBi
Connector type:	Integral

LTE

Manufacturer:	Bodytrak (Low Band)
Bands covered:	5 (LTE 850/UMTS) & 12 (LTE 700)
Type:	PCB trace and Flex PCB patch
Gain:	-0.9 dBi
Model number:	N/A

7.5 EUT Description

The EUT is a personal wearable device and is comprised of a miniature earpiece with integrated sensors connected to a torso-worn communication pack. The normal power source applied was 3.7 Vdc from internal Li-Po Rechargeable battery.

8 Modifications

No modifications were performed during this assessment.

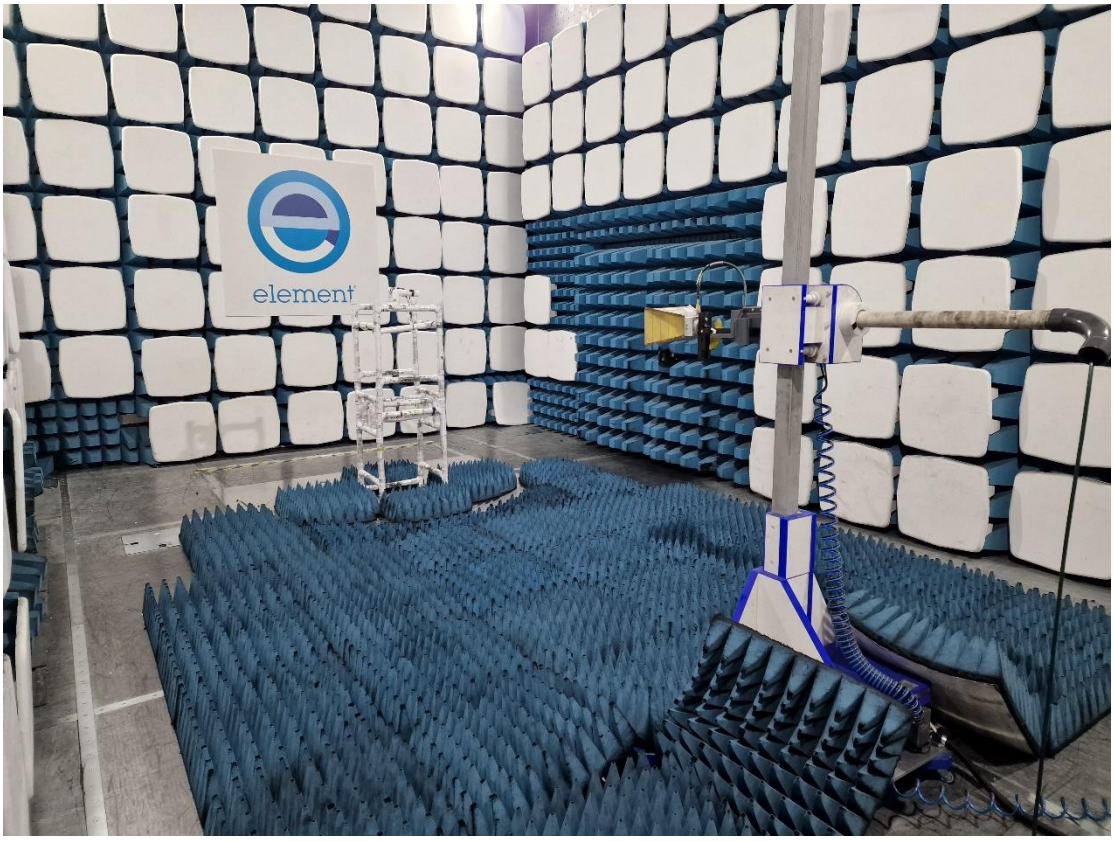
9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:

9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



9.3 Measurement software

Where applicable, the following software was used to perform measurements contained within this report.

Element Emissions R5 2022.07.06.0
Element Transmitter Bench Test
ETS Lindgren EMPower V1.0.4.2

10 Radiated emissions, WiFi

10.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

10.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 03
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2412 MHz & 2462 MHz
Deviations from Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak; Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	As declared

10.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

Frequency (MHz)	*Field Strength (µV/m at 3 m)*	*Field Strength (dBµV/m at 3 m)*
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

On frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function. On frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit.

10.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

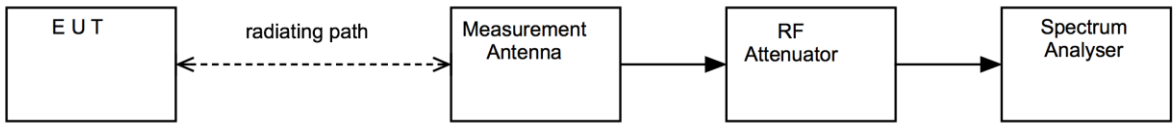
$$FS = PR + CL + AF - PA + DC - CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance different to limit distance);

This field strength value is then compared with the regulatory limit.

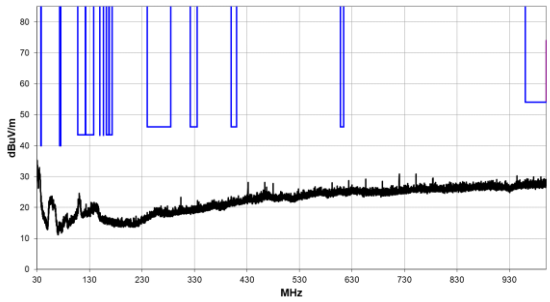
Figure i Test Setup



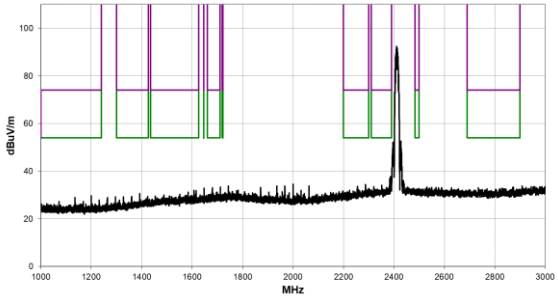
10.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Emissions R5 – 2022.07.06.0	Element	Radiated Test Software	REF9000	Cal not required
ATS	Rainford EMC	Chamber 1	U387	2023-10-24
FSU46	R&S	Spectrum Analyser	REF910	2022-12-22
LNA6901	AMETEK	Pre Amp	U711	2023-03-14
CBL6112	Chase	Bilog	U420	2023-01-28
8449B	Agilent	Pre Amp	L572	2022-10-29
3115	EMCO	1-18GHz Horn	U223	2023-12-13
3115	EMCO	1-18GHz Horn	L139	2024-07-01
SN 4478	BSC	2.4G Band Stop Filter	U543	2023-02-03
20240-20	Flann	Horn 18-26GHz (&U330)	L263A	2024-06-23

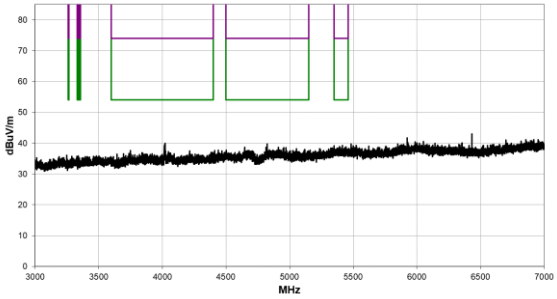
10.6 Test Results



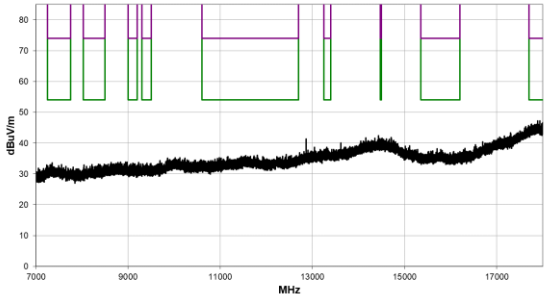
30 MHz to 1 GHz



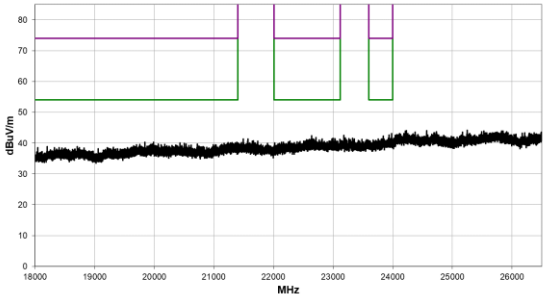
1 GHz to 3 GHz



3 GHz to 7 GHz



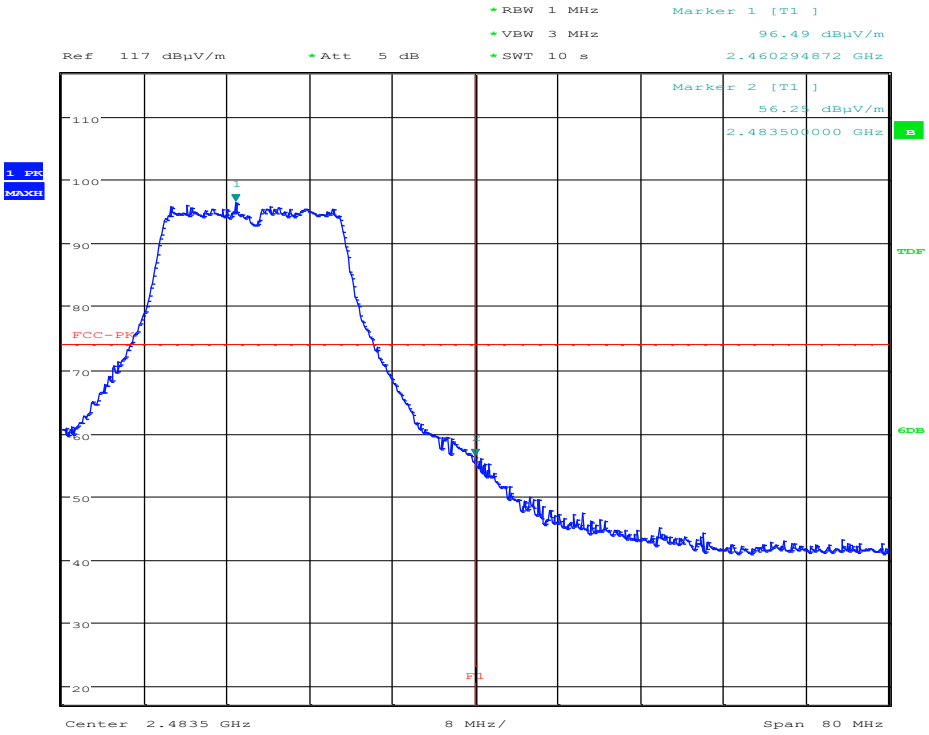
7 GHz to 18 GHz



18 GHz to 26.5 GHz

Frequency: 2412 MHz; Channel: 1; DSSS1;								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Factor (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Limit (dBµV/m)***	***Margin (dB)***
No significant emissions within 20 dB of the limit.								

Upper Radiated Band Edge Peak



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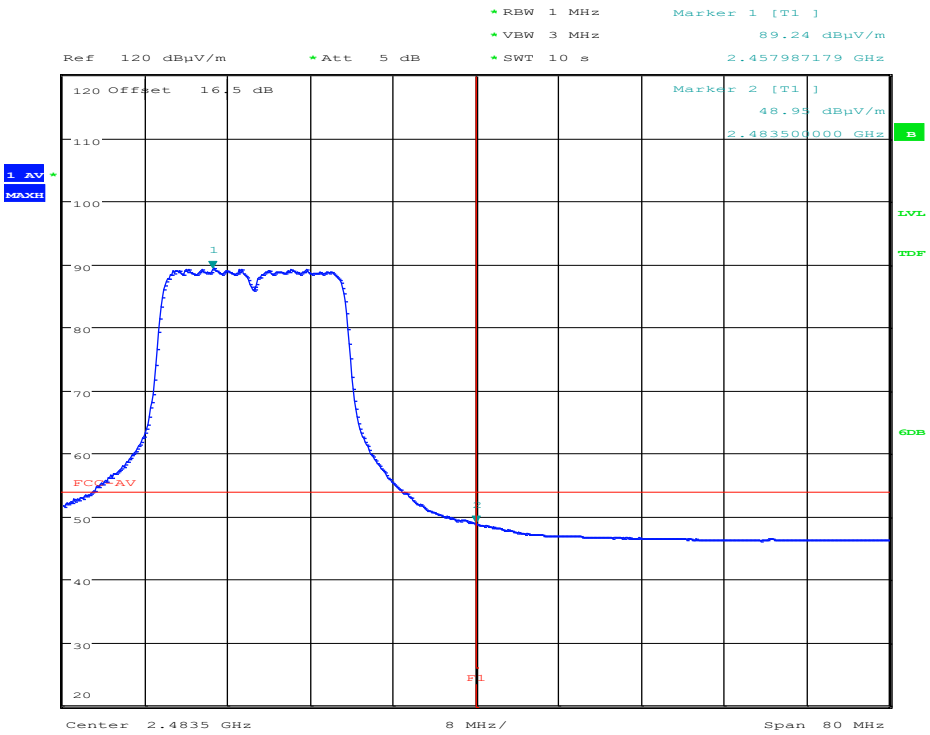
Upper Radiated Band Edge Average



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11 Radiated emissions, Full Operation (FCC)

11.1 Definitions

Spurious emissions
Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Restricted bands
A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 03
Test Standard and Clause:	TIA 603-D, clause 2.2.12
Channels / Frequencies Measured:	BLE: 2402 MHz; WiFi: 2462 MHz; LTE: 707.5 MHz;
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Below 1 GHz: Peak Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Radiated

Temperature: 21 °C

Humidity: 56 %RH

Supply: 3.7 Vdc

11.3 Test Limits

Part 15
Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

Frequency (MHz)	*Field Strength (µV/m at 3 m)*
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

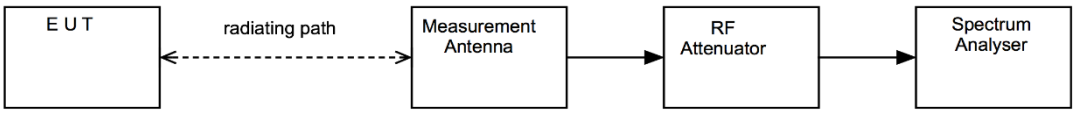
Part 22, Part 24 & Part 27

At least 43 + 10 log P dB
$(10\log P_{watts}) - (43+10\log (P_{watts} * 1000)) = LIMIT = -13$ dBm

11.3.1 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure viii the emissions from the EUT were measured on a spectrum analyzer / EMI receiver. The EUT was rotated in three orthogonal planes and the measurement antenna height scanned (below 1GHz, from 1 to 4 m; above 1GHz as necessary) in order to maximise emissions.
The measurements were performed with EUT set at its maximum gain. All modulation schemes, data rates and power settings were used to observe the worst-case configuration at each frequency.
The EUT was substituted with a known generator and antenna and for the same level achieved at the analyser, the effective radiated power was recorded.
Pre-scan plots are shown with a peak detector and 100kHz RBW.

Figure i-b Test Setup

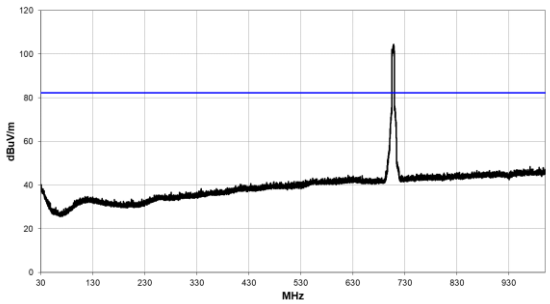


11.3.2 Test Equipment

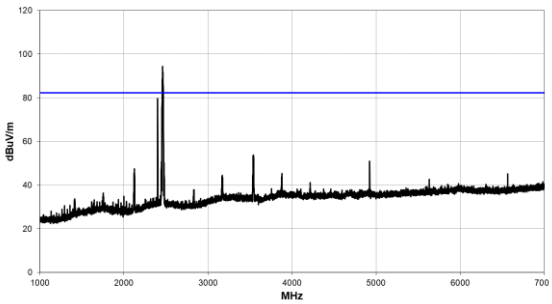
Equipment Description	***Manufacturer***	***Equipment Type***	***Element No***	***Due For Calibration***
Radiated Test Software	Element	Emissions R5 2022.07.06.0	REF9000	Cal not required
Chamber 1	Rainford EMC	ATS	U387	2023-10-24
Spectrum Analyser	R&S	FSU46	REF910	2022-12-22
Pre Amp	AMETEK	LNA6901	U711	2023-03-14
Bilog	Chase	CBL6112	U420	2023-01-28
Pre Amp	Agilent	8449B	L572	2022-10-29
1-18GHz Horn	EMCO	3115	U223	2023-12-13
1-18GHz Horn	EMCO	3115	L139	2024-07-01
2.4G Band Stop Filter	BSC	SN 4478	U543	2023-02-03
Horn 18-26GHz (&U330)	Flann	20240-20	L263A	2024-06-23

11.3.3 Test Results

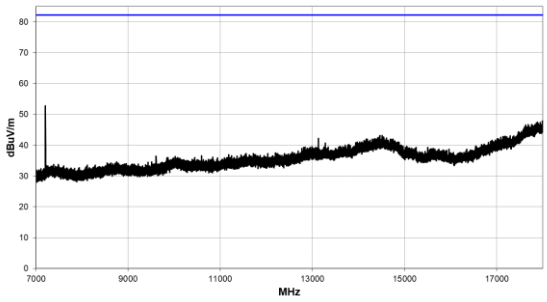
Radio 1: Bluetooth LE; Frequency: 2402 MHz; Power Setting: 0 dBm; Data Rate: 1 Mbps Radio 2: 2.4 GHz WiFi; Frequency: 2462 MHz; Power Setting: Fixed; Data Rate:11b 1M; Radio 3:Band 12; ARFCN: 123095; Frequency: 707.5 MHz; Power Setting: High;					
Emission	***Frequency (MHz)***	***Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Intermodulation emissions were detected within 10 dB of the limit.					



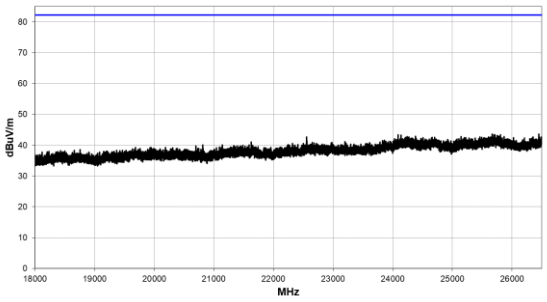
30 MHz to 1 GHz



1 GHz to 7 GHz



7 GHz to 18 GHz



18 GHz to 26.5 GHz

12 Maximum peak conducted output power

12.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 03
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	2412 MHz
EUT Channel Bandwidths:	20 MHz
Deviations From Standard:	None
Measurement BW:	N/A, Wideband Peak Power Meter
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	30 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new / fully charged battery.

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 ºC to +35 ºC (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

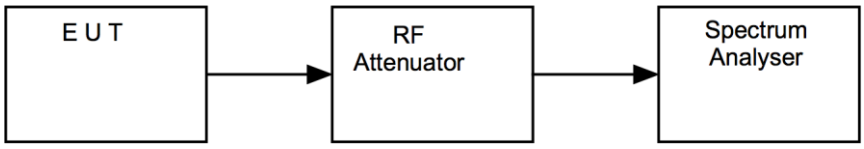
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iv Test Setup



12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	U405	2023-04-21
SMB100A	R&S	Signal Generator	U677	2023-01-26
7002-006	ETS Lindgren	Power Meter	REF2286	2022-11-02
ATT20KXP-483001-S4S5	Atlantec Microwave	20 dB attenuator	N/A	In Use

12.6 Test Results

Modulation: 802.11b; Data rate: 1mbps			
Frequency (MHz)	***Maximum peak conducted output power***		***Result***
	(dBm)	***(mW)***	
2412	11.93	15.60	Pass

13 Occupied Bandwidth

13.1 Definition

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

The 99% emission bandwidth is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	6 dB Bandwidth: ANSI C63.10-2013, Clause 11.8
EUT Channels / Frequencies Measured:	2412 MHz
EUT Channel Bandwidths:	20 MHz
EUT Test Modulations:	DSSS
Deviations From Standard:	None
Measurement BW:	100 kHz
Measurement Span: (requirement 2 to 5 times OBW)	50 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 25 °C	+15 ºC to +35 ºC (as declared)
Humidity: 52 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc ±10 % (as declared)

13.3 Test Limit

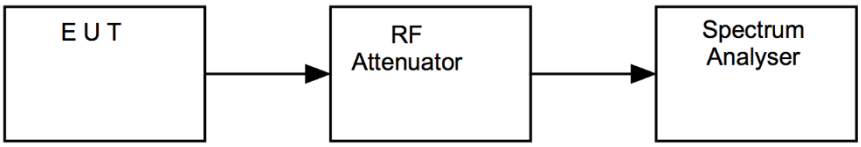
The minimum -6 dB bandwidth shall be at least 500 kHz.

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iii Test Setup



13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSW 43	R&S	Spectrum Analyser	U728	2023-04-26
ATT20KXP-483001-S4S5	Atlantec Microwave	20 dB attenuator	N/A	In Use

13.6 Test Results

Bandwidth Type: 6 dB; Modulation: 802.11b; Data rate: 1mbps				
Frequency (MHz)	***F_L (MHz)***	***F_H (MHz)***	***Bandwidth (MHz)***	***Result***
2412	2406.955000	2416.545000	9.590	PASS

08:09:26 12.08.2022

14 Duty Cycle

14.1 Definition

The ratio of the sum of all pulse durations to the total period, during a specified period of operation.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 03
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.6
Deviations From Standard:	None
Temperature Extreme Environment Test Range:	N/A
Voltage Extreme Environment Test Range:	N/A

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 53 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (as declared)

14.3 Test Limit

N/A.
Note, the maximum duty cycle correction factor which may be used is 20 dB.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vii, the duty of the EUT was calculated from the sum of total on and off times over the observation period.

The measurements were performed with EUT set at its maximum duty. WiFi 802.11.b 1Mb/s; DSSS1 was Measured.

[1] Single antenna output devices

Duty was measured at the antenna port / at a distance of 3 m.

[2] Multiple antenna output devices

Duty was measured as the combination of all ports simultaneously / at a distance of 3 m.

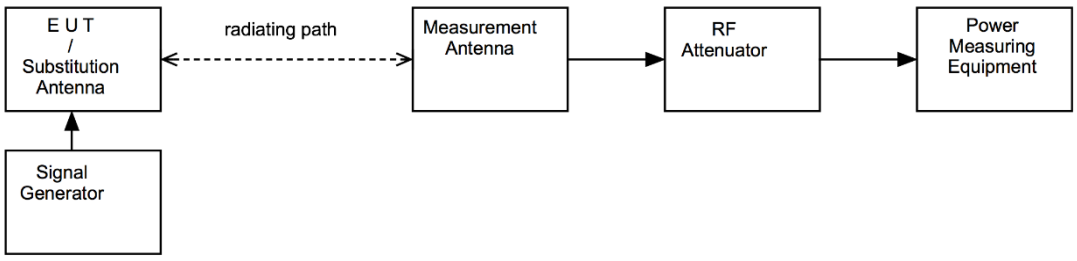
The duty cycle correction factor, DC, shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as:

1) If power averaging (rms) mode was used in step f), then the applicable correction factor is [10 log (1 / D)], where D is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.

3) If a specific emission is demonstrated to be continuous (D ≥ 98%) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Figure vii Test Setup



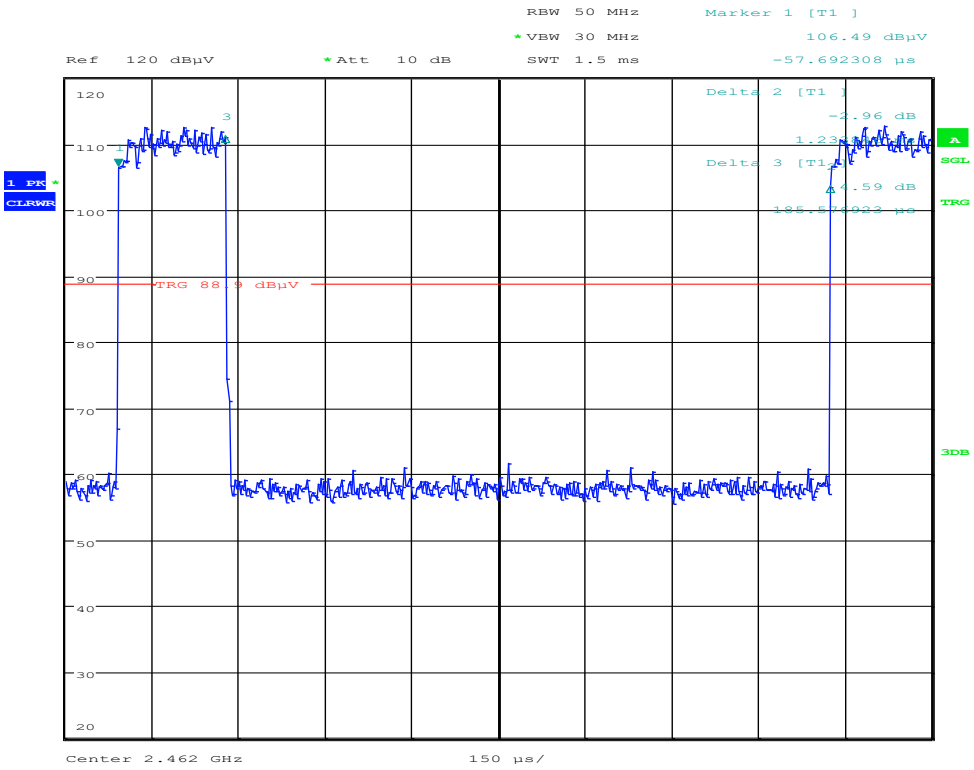
14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Emissions R5	Element	Radiated Test Software	REF9000	Cal not required
FSU46	R&S	Spectrum Analyser	REF910	2022-12-22
8449B	Agilent	Pre Amp	L572	2022-10-29
3115	EMCO	1-18GHz Horn	L139	2024-07-01

14.6 Test Results

WiFi 802.11.b 1Mb/s

WiFi; 802.11.b 1Mb/s; DSSS1;				
Test Environment		*TxOn time (ms)*	*Frame Period (ms)*	*Calculated Factor (dB)*
$V_{nominal}$	$T_{nominal}$	0.185576	1.233846	16.5



15 Measurement Uncertainty

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence where no required test level exists.

Test/Measurement	Budget Number	MU
Conducted RF Power, Power Spectral Density, Adjacent Channel Power and Spurious emissions		
Absolute RF power (via antenna connecter) Dare RPR3006W Power Head	MU4001	**0.9 dB**
Carrier Power and PSD - Spectrum Analysers	MU4004	**0.9 dB**
Adjacent Channel Power	MU4002	**1.9 dB**
Transmitter conducted spurious emissions	MU4041	**0.9 dB**
Conducted power and spurious emissions 40 GHz to 50 GHz	MU4042	**2.4 dB**
Conducted power and spurious emissions 50 GHz to 75 GHz	MU4043	**2.5 dB**
Conducted power and spurious emissions 75 GHz to 110 GHz	MU4044	**2.4 dB**
Radiated RF Power and Spurious emissions ERP and EIRP		
Effective Radiated Power Reverb Chamber	MU4020	**3.7 dB**
Effective Radiated Power	MU4021	**4.7 dB**
TRP Emissions 30 MHz to 1 GHz using CBL6111 or CBL6112 Bilog Antenna	MU4046	**5.3 dB**
TRP Emissions 1 GHz to 18 GHz using HL050 Log Periodic Antenna	MU4047	**5.1 dB**
TRP Emissions 18 GHz to 26.5 GHz using Standard Gain Horn	MU4048	**2.7 dB**
TRP Emissions 26.5 GHz to 40 GHz using Standard Gain Horn	MU4049	**2.7 dB**
Spurious Emissions Electric and Magnetic Field		
Radiated Spurious Emissions 30 MHz to 1 GHz	MU4037	**4.7 dB**
Radiated Spurious Emissions 1-18 GHz	MU4032	**4.5 dB**
E Field Emissions 18GHz to 26 GHz	MU4024	**3.2 dB**
E Field Emissions 26GHz to 40 GHz	MU4025	**3.3 dB**
E Field Emissions 40GHz to 50 GHz	MU4026	**3.5 dB**
E Field Emissions 50GHz to 75 GHz	MU4027	**3.6 dB**
E Field Emissions 75GHz to 110 GHz	MU4028	**3.6 dB**
Radiated Magnetic Field Emissions	MU4031	**2.3 dB**
Frequency Measurements		
Frequency Deviation	MU4022	**0.316 kHz**
Frequency error using CMTA test set	MU4023	**113.441 Hz**
Frequency error using GPS locked frequency source	MU4045	**0.0413 ppm**
Bandwidth/Spectral Mask Measurements		
Channel Bandwidth	MU4005	**3.87 %**
Transmitter Mask Amplitude	MU4039	**1.3 dB**
Transmitter Mask Frequency	MU4040	**2.59 %**
Time Domain Measurements		
Transmission Time	MU4038	**4.40 %**
Dynamic Frequency Selection (DFS) Parameters)		
DFS Analyser - Measurement Time	MU4006	**679 µs**
DFS Generator - Frequency Error	MU4007	**92 Hz**
DFS Threshold Conducted	MU4008	**1.3 dB**
DFS Threshold Radiated	MU4009	**3.2 dB**

Test/Measurement	Budget Number	MU
Receiver Parameters		
EN300328 Receiver Blocking	MU4010	**1.1 dB**
EN301893 Receiver Blocking	MU4011	**1.1 dB**
EN303340 Adjacent Channel Selectivity	MU4012	**1.1 dB**
EN303340 Overloading	MU4013	**1.1 dB**
EN303340 Receiver Blocking	MU4014	**1.1 dB**
EN303340 Receiver Sensitivity	MU4015	**0.9 dB**
EN303372-1 Image Rejection	MU4016	**1.4 dB**
EN303372-1 Receiver Blocking	MU4017	**1.1 dB**
EN303372-2 Adjacent Channel Selectivity	MU4018	**1.1 dB**
EN303372-2 Dynamic Range	MU4019	**0.9 dB**
Receiver Blocking Talk Mode Conducted	MU4033	**1.2 dB**
Receiver Blocking Talk Mode- radiated	MU4034	**3.4 dB**
Rx Blocking, listen mode, blocking level	MU4035	**3.2 dB**
Rx Blocking, listen mode, radiated Threshold Measurement	MU4036	**3.4 dB**
Adjacent Sub Band Selectivity	MU4003	**4.2 dB**