Report on the Radio Testing

For

Inova Design Solutions Ltd (Bodytrak)

On a

Bodytrack I

Report no. TRA-054222-47-10B

01 February 2022

RF908 2.0

Report Number: TRA-054222-47-10B
Issue: B

REPORT ON THE RADIO TESTING OF A
Inova Design Solutions Ltd (Bodytrak)
Bodytrack I
WITH RESPECT TO SELECTED CLAUSES OF SPECIFICATIONS
KDB 996369 D04 v02
(Intermodulation Investigation)

TEST DATE: 2022-01-10 to 2022-01-12

Tested by: M Else

Written by: Michael Else
Radio Test Engineer

Approved by: J Charters
Lab Manager

Date: 01 February 2022

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	01 February 2022	Original
B	07/06/2022	Model number updated, Serial number, revision number updated, Band 2 and 5 corrected to UMTS bands, Band 4 Plot 1.7-3 GHz Scan corrected, Test set-up photo removed due to confidentiality requirement.

Summary

TEST REPORT NUMBER:	TRA-054222-47-10B
WORKS ORDER NUMBER:	TRA-054222-01
TEST SPECIFICATION:	KDB 996369 D04 v02
EQUIPMENT UNDER TEST (EUT):	BodyTRAK I
FCC IDENTIFIER:	2A3CVA
CONTAINS FCC IDENTIFIER:	T7V1326C2
CONTAINS FCC IDENTIFIER:	XPY1ELQ24NN
MANUFACTURER/AGENT:	Inova Design Solutions Ltd (Bodytrak)
ADDRESS:	Innovation Warehouse 1st Floor 1 East Poultry Avenue London EC2A 4NE United Kingdom
CLIENT CONTACT:	Dmitry Iakovlev ☎ +44 (0)203 432 5439 ✉ dmitry.iakovlev@bodytrak.co
ORDER NUMBER:	PO-2020AA0085
TEST DATE:	2022-01-10 to 2022-01-12
TESTED BY:	M.Else Element

1.1 Test Summary

Test Method and Description	*Applicable to this equipment*	*Result / Note*
Radiated Spurious Emissions (Intermodulation Investigation)	☒	*Pass*

Notes:

Only limited testing was performed to check the intermodulation emissions.

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 where identified in Section 5.2 of this test report (Deviations from Test Standards).

2 Contents

3 Introduction

This report TRA-054222-47-10B presents the results of the Radio testing on a Inova Design Solutions Ltd (Bodytrak), Bodytrak I to selected clauses of specifications KDB 996369 D04 Module Integration Guide v02 - Modular transmitter integration guide -Guidance for host product manufacturers.

The testing was carried out for System Loco Ltd, 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
Skelmersdale
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.

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.

4 Test Specifications

4.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- FCC 47 CFR Ch. I – Part 22 – Public Mobile Services.
- FCC 47 CFR Ch. I – Part 24 – Personal Communications Services.
- FCC 47 CFR Ch. I – Part 27 – Miscellaneous Wireless Communications Services.
- 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.
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4.2 Deviations from Test Standards

Only limited testing was performed to check the intermodulation emissions.

5 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ACK	Acknowledgement signal
AFH	Adaptive Frequency Hopping
BTC	Bluetooth Classic
BTLE	Bluetooth Low Energy
BW	bandwidth
C	Celsius
CCA	Clear Channel Assessment
COT	Channel Occupancy Time
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DAA	Detect And Avoid
DC	Direct Current
EIRP	Equivalent Isotropically Radiated Power
EN	European Normative document
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
min	minimum
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
R&TTE	Radio and Telecommunications Terminal Equipment
RE	Radio Equipment
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

6 Equipment under Test

6.1 EUT Identification

- Name: : Bodytrack I
- Model Number: BCP1N
- Serial Number: BTCP1-B0045
- Software Revision: 4118
- Build Level / Revision Number: Not Applicable

6.2 Pre-approved module identification

Bluetooth Module Information

- Manufacturer: Panasonic Industrial Devices Europe GmbH
- Model: 1326C2
- CONTAINS FCC ID: T7V1326C2
- CONTAINS ISED ID: 216Q-1326C2

Cellular Module information

- Manufacturer: uBLOX
- Model: LARA-R202
- CONTAINS FCC ID: XPY1ELQ24NN
- CONTAINS ISED ID: 8595A-1ELQ24NN

6.3 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.

Not Applicable – No support/monitoring equipment required.

6.4 EUT Mode of Operation

The mode of operation for transmitter tests was as follows:

Radios were set to transmit permanently in various combinations, the spectrum was checked to determine if any intermodulation products were generated due to multiple radios operating simultaneously. The worst case emission plots are shown in this document.

EUT was operated with worst case modes of operation for each radio device.

6.5 EUT Radio Parameters

Modes of operation:	**Bluetooth Classic**	**Wi-Fi**
Frequencies of operation:	2402 MHz to 2480 MHz	2412 MHz to 2462 MHz
Modulation type(s)	GFSK	DSSS / OFDM
Nominal Supply Voltage:	3.7 V DC Rechargeable Battery	3.7 V DC Rechargeable Battery

Mode of operation:	**Cellular**
Bands / Frequencies of operation:	UMTS Band 2: 1880 MHz UMTS Band 5: 836.4 MHz LTE Band 4: 1732.4 MHz LTE Band 12: 707.5 MHz

6.6 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.

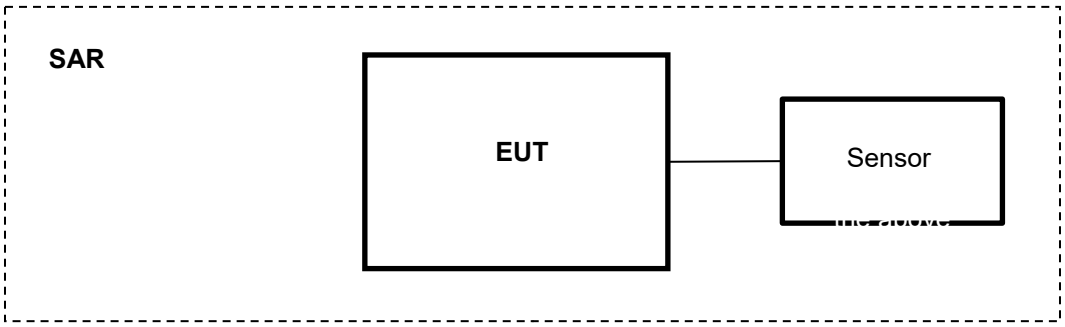
7 Modifications

No modifications were performed during this assessment.

8 EUT Test Setup

8.1 Block Diagram

The following diagram shows basic EUT Test set up.



8.2 General Set-up Photograph

The following photographs shows basic EUT radiated set-up for FCC testing:

No Photograph requested due to confidentiality requirement.

9 General Technical Parameters

9.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 3.7 Vdc from internal Li-Po Rechargeable battery.

10 Radiated emissions, Intermodulation products (FCC)

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:	SK01 Radio Chamber
Test Standard and Clause:	TIA 603-D, clause 2.2.12
Deviations from Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: Peak Above 1 GHz: Peak

Environmental Conditions (Normal Environment)

Temperature: 15.9 °C	Standard Requirement: +15 ºC to +35 ºC
Humidity: 45 % RH	Standard Requirement: 20 % RH to 75 % RH

10.3 Test Limit

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

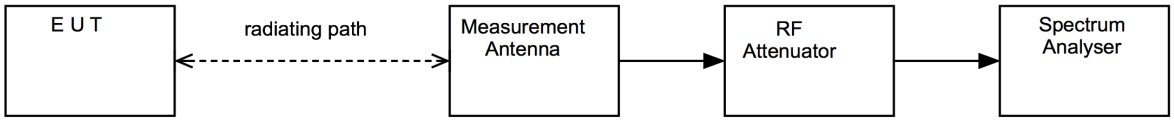
Part 22, Part 24 & Part 27

At least 43 + 10 log P dB

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

10.4 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 Test Setup

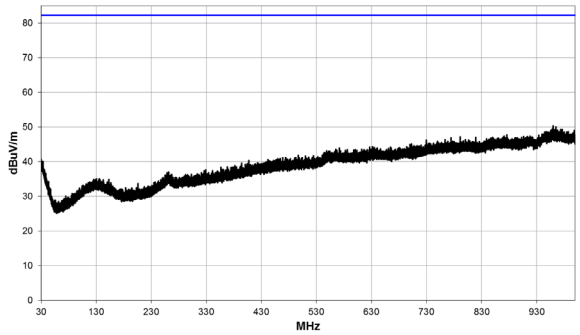


10.5 Test Equipment

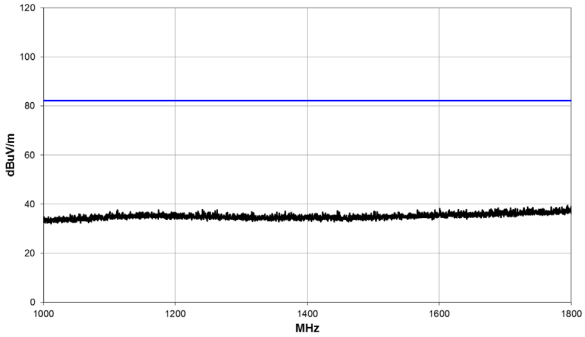
Equipment Description	Manufacturer	Equipment Type	Element No	Due For Calibration
Chamber 1	Rainford EMC	ATS	U387	2023-10-24
Radiated Test Software	Element	Emissions R5	REF9000	Cal not required
Spectrum Analyser	R&S	FSU46	REF910	2022-12-22
Pre Amp	AMETEK	LNA6901	U711	2022-02-03
High Pass Filter	Atlantic Microwave	AFH-07000	U558	2022-01-30
1-18GHz Horn	EMCO	3115	L139	2023-07-27
PreAmp	Watkins Johnson	6201-69	U372	2022-03-01
Pre Amp	Agilent	8449B	L572	2022-10-29
Bilog	Chase	CBL611/B	U573	2023-01-28
High Pass Filter	MiniCircuits	VHF-1500+	U519	2022-01-30
High Pass Filter	BSC	SH4141	REF977	2022-01-30
Horn 18-26GHz (&U330)	Flann	20240-20	L300	2022-04-23

10.6 Test Results

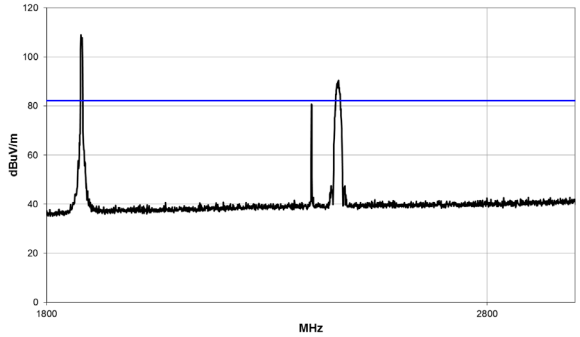
Radio 1: Bluetooth ; Frequency: 2402 MHz; Power Setting: -3 dBm; Data Rate: 1 Mbps Radio 2: 2.4 GHz WiFi; Frequency: 2462 MHz; Power Setting: Fixed; Data Rate:11b 1M; Radio 3: UMTS Band 2; ARFCN: 9400; Frequency: 1880 MHz; Power Setting: High;					
Emission	***Frequency (MHz)***	***Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Intermodulation emissions were detected within 10 dB of the limit.					



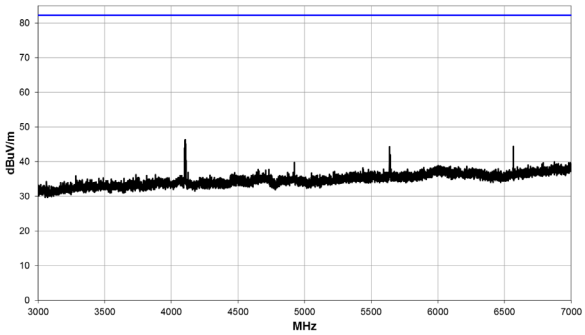
30 MHz to 1 GHz



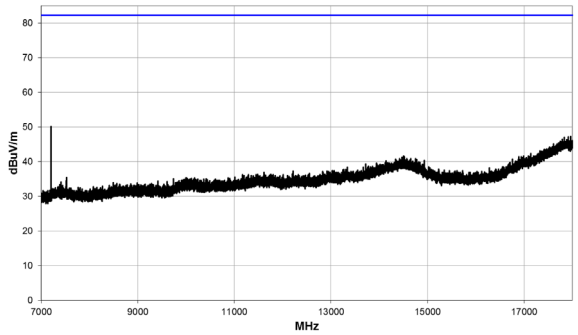
1 GHz to 1.8 GHz



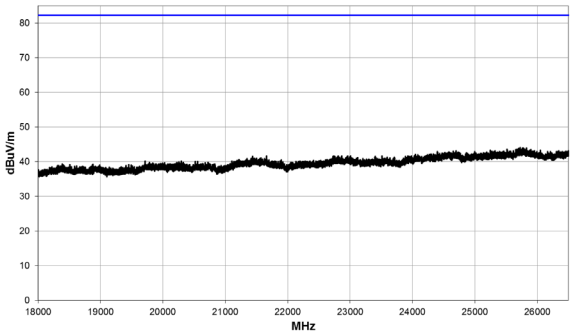
1.8 GHz to 3 GHz



3 GHz to 7 GHz

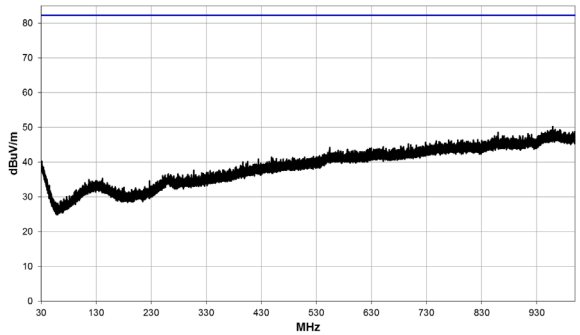


7 GHz to 18 GHz

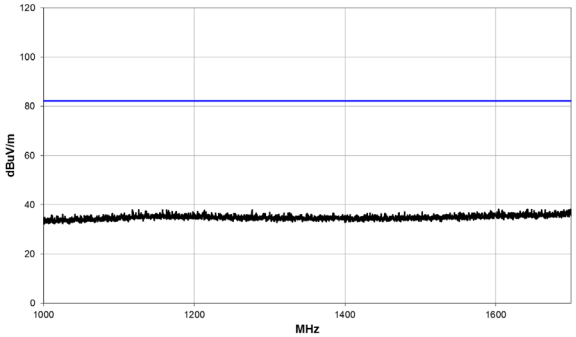


18 GHz to 26.5 GHz

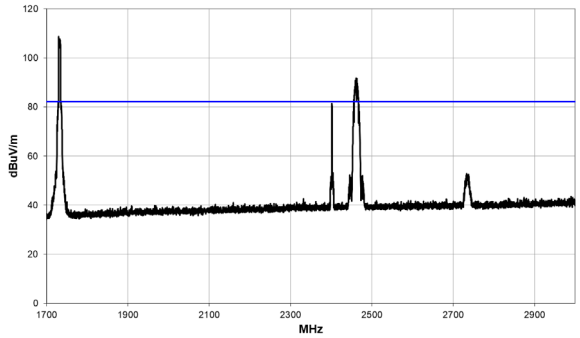
Radio 1: Bluetooth ; Frequency: 2402 MHz; Power Setting: -3 dBm; Data Rate: 1 Mbps Radio 2: 2.4 GHz WiFi; Frequency: 2462 MHz; Power Setting: Fixed; Data Rate:11b 1M; Radio 3: LTE Band 4; ARFCN: 120174; Frequency: 1732.4 MHz; Power Setting: High;					
Emission	***Frequency (MHz)***	***Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Intermodulation emissions were detected within 10 dB of the limit.					



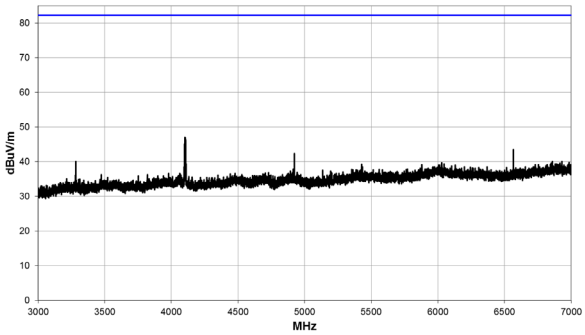
30 MHz to 1 GHz



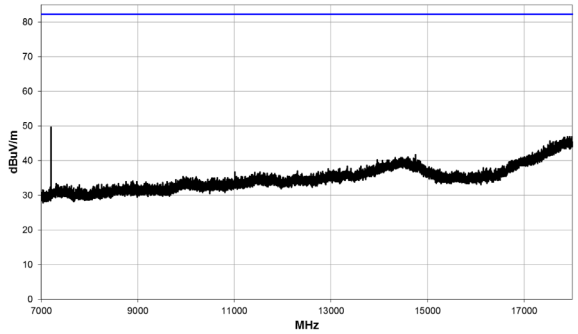
1 GHz to 1.7 GHz



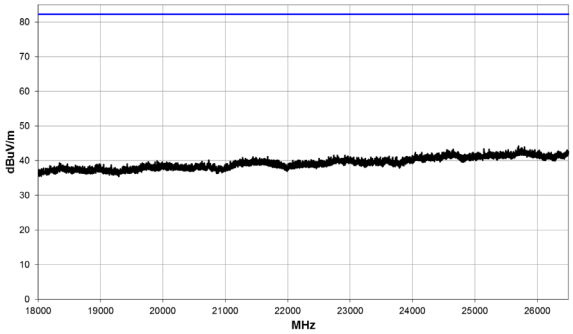
1.7 GHz to 3 GHz



3 GHz to 7 GHz

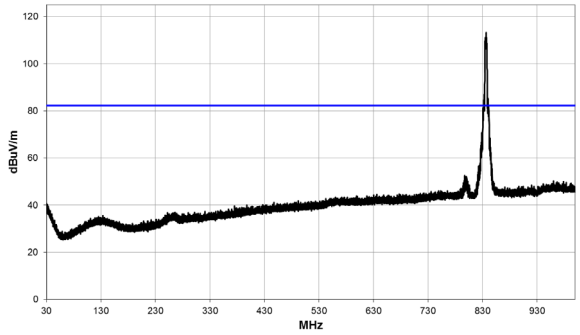


7 GHz to 18 GHz

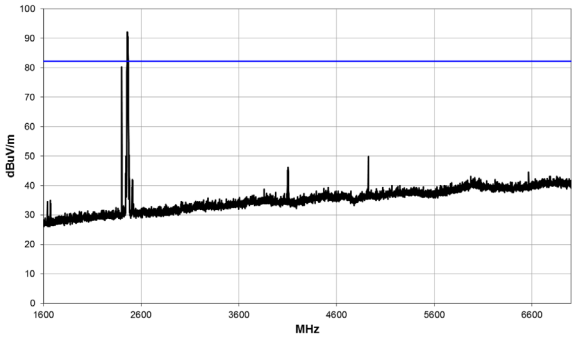


18 GHz to 26.5 GHz

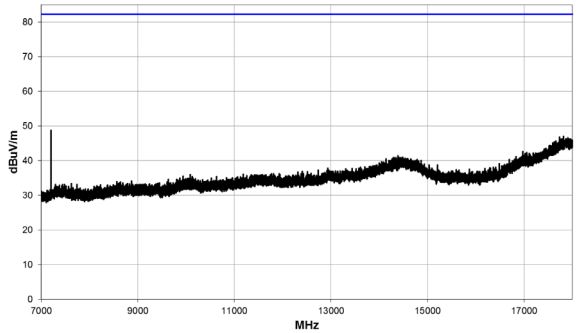
Radio 1: Bluetooth ; Frequency: 2402 MHz; Power Setting: -3 dBm; Data Rate: 1 Mbps Radio 2: 2.4 GHz WiFi; Frequency: 2462 MHz; Power Setting: Fixed; Data Rate:11b 1M; Radio 3: UMTS Band 5; ARFCN: 4182; Frequency: 836.4 MHz; Power Setting: High;					
Emission	***Frequency (MHz)***	***Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Intermodulation emissions were detected within 10 dB of the limit.					



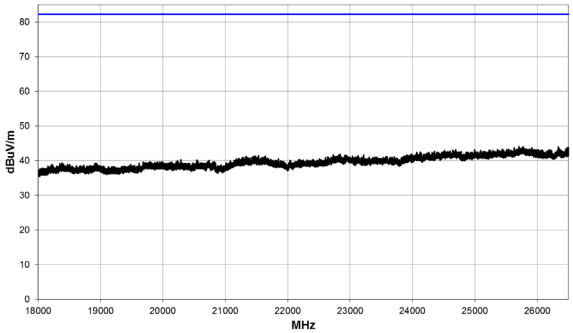
30 MHz to 1 GHz



1 GHz to 7 GHz

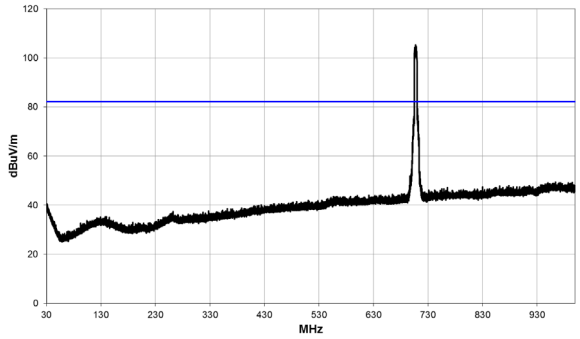


7 GHz to 18 GHz

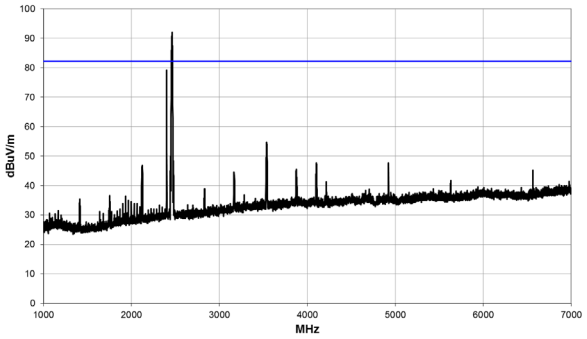


18 GHz to 26.5 GHz

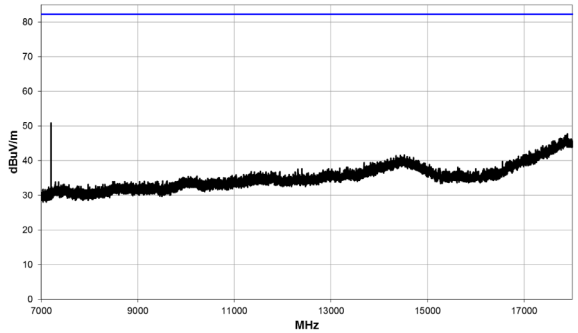
Radio 1: Bluetooth LE; Frequency: 2480 MHz; Power Setting: 0 dBm; Data Rate: 1 Mbps Radio 2: 2.4 GHz WiFi; Frequency: 2412 MHz; Power Setting: Fixed; Data Rate:11b 1M; Radio 3:Band 12; ARFCN: 123095; Frequency: 707.5 MHz; Power Setting: High;					
Emission	***Frequency (MHz)***	***Level (dBm)***	***Limit (dBm)***	***Margin (dB)***	***Result***
No Intermodulation emissions were detected within 10 dB of the limit.					



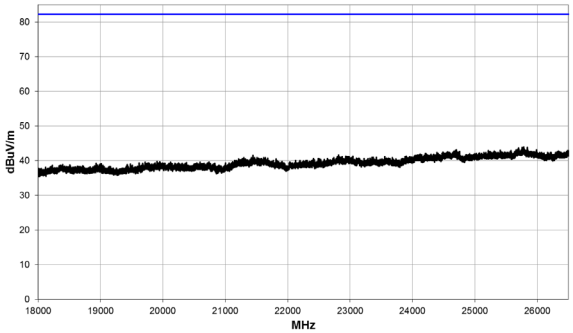
30 MHz to 1 GHz



1GHz to 7 GHz



7 GHz to 18 GHz



18 GHz to 26.5 GHz

11 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**