

REPORT ON THE RADIO TESTING

FOR

PROMETHEAN LTD

ON

ACTIVBOARD PEN

DOCUMENT NO. TRA-025574-06-47-00A



Report Number: TRA-025574-06-47-00A
Issue: A

REPORT ON THE RADIO TESTING OF A
PROMETHEAN LTD
ActivBoard Pen
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.249 & IC RSS-210 ANNEX 2.9

TEST DATE: 3rd July - 20th July 2015



Tested by: A Tosif

A Tosif
Radio Test Engineer

Approved by:

John Charters

Digitally signed by John Charters
DN: cn=John Charters, o=TRAC Global Ltd,
ou=Radio Product Manager,
email=john.charters@tracglobal.com, c=GB
Date: 2015.07.30 10:39:46 +01'00'

John Charters
Radio Product Manager

Date:

30th July 2015

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

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	30 th July 2015	Original

2 Summary

TEST REPORT NUMBER:	TRA-025574-06-47-00A
WORKS ORDER NUMBER	TRA-025574-06
PURPOSE OF TEST:	Class II change
TEST SPECIFICATION(S):	47CFR15.249 & RSS-210 Annex 2.9
EQUIPMENT UNDER TEST (EUT):	ActivBoard Pen
FCC IDENTIFIER:	QAM017
IC IDENTIFIER:	5459A-017
EUT SERIAL NUMBER:	not applicable
MANUFACTURER/AGENT:	Promethean Ltd
ADDRESS:	Promethean House Lower Philips Road Whitebirk Industrial Estate Blackburn Lancashire BB1 5TH
CLIENT CONTACT:	John Harrison ☎ 01254 290 630 ✉ john.harrison@prometheanworld.com
ORDER NUMBER:	PG0021546
TEST DATE:	3rd July - 20th July 2015
TESTED BY:	A Tosif Radio Test Engineer TRaC Global Ltd.

2.1 Test Summary

Test Method and Description	Requirement Clause		Applicable to this equipment	Result / Note
	RSS	47CFR15		
Radiated spurious emissions	210, A2.9(b)	15.249(d)	☒	Pass
AC power line conducted emissions	Gen, 8.8	15.207	☐	N/A ¹
Occupied bandwidth	Gen, 6.6	15.215(c)	☒	Pass
Field strength of fundamental	210, A2.9(a)	15.249(a)	☒	Pass
Calculation of duty correction	-	15.35(c)	☐	N/A ²

¹ EUT is a battery powered device.

² No duty cycle correction required by the device.

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

3 Contents

1	Revision Record.....	3
2	Summary.....	4
2.1	Test Summary.....	5
3	Contents.....	6
4	Introduction	7
5	Test Specifications.....	8
5.1	Normative References	8
5.2	Deviations from Test Standards	8
6	Glossary of Terms.....	9
7	Equipment Under Test	10
7.1	EUT Identification.....	10
7.2	System Equipment.....	10
7.3	EUT Mode of Operation	10
7.3.1	Transmission.....	10
7.3.2	Reception.....	10
7.4	EUT Radio Parameters	10
7.5	EUT Description	10
8	Modifications.....	11
9	EUT Test Setup	12
9.1	Block Diagram.....	12
9.2	General Set-up Photograph	12
10	General Technical Parameters.....	13
10.1	Normal Conditions.....	13
10.2	Varying Test Conditions	13
11	Radiated emissions.....	14
11.1	Definitions	14
11.2	Test Parameters.....	14
11.3	Test Method	15
11.4	Test Equipment.....	17
11.5	Test Results	18
12	Occupied Bandwidth	22
12.1	Definitions	22
12.2	Test Parameters.....	22
12.3	Test Method	23
12.4	Test Equipment.....	23
12.5	Test Results	24
13	Transmitter output power (fundamental radiated emission)	26
13.1	Definition	26
13.2	Test Parameters.....	26
13.3	Test Method	26
13.4	Test Equipment.....	27
13.5	Test Results	27
14	Measurement Uncertainty	28
15	General SAR test reduction & exclusion guidance / RF Exposure.....	29

4 Introduction

This report TRA-025574-06-47-00A presents the results of the Radio testing on a Promethean Ltd, ActivBoard Pen to specification 47CFR15 Radio Frequency Devices and RSS-210 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Promethean Ltd by TRaC Global Ltd, at the address(es) detailed below.

☐	TRaC Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	☒	TRaC North West Unit 1 Pendle Place Skemersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

FCC Site Listing:

TRaC Global is accredited for the above sites under the US-EU MRA, Designation number UK0009.

IC Registration Number(s):

TRaC North West 3930B

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.
- Industry Canada RSS-210, Issue 8, December 2010 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus

5.2 Deviations from Test Standards

- There were no deviations from the test standard.

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: ActivBoard Pen
- Serial Number: not applicable
- Model Number: PRM-AS1-01
- Software Revision: V1.2
- Build Level / Revision Number: PCLF-612800207 Rev01

7.2 System Equipment

Not Applicable – No support/monitoring equipment required.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows.

EUT transmitting permanent modulated carrier

7.3.2 Reception

The mode of operation for Rx tests was as follows.

EUT in standby mode.

7.4 EUT Radio Parameters

Frequency of operation:	2400 – 2483.5 MHz
Modulation type(s):	BLE
Occupied channel bandwidth(s):	1216 kHz
ITU emission designator(s):	1M22F1D
Nominal Supply Voltage:	1.5 Vdc

7.5 EUT Description

The EUT is a 2.4GHz Bluetooth Low Energy transmitter

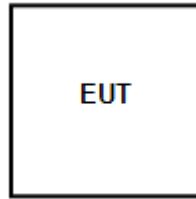
8 Modifications

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 photographs shows basic EUT set-up:



10 General Technical Parameters

10.1 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 1.5 Vdc from alkaline batteries.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

Variation of supply voltage is required to ensure stability of the declared output power. During carrier power testing the following variations were made:

	<i>Category</i>	<i>Nominal</i>	<i>Variation</i>
☐	Mains	110V ac +/-2%	85% and 115%
☒	Battery	New battery	N/A

11 Radiated emissions

11.1 Definitions

Out-of-band emissions

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

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:	TRaC North West
Test Chamber:	Radio
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	2402 MHz / 2426 MHz / 2480 MHz
EUT Channel Bandwidths:	2 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: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 43%RH	20%RH to 75%RH (as declared)
Supply: 1.5 Vdc	230Vac +/-10% / New battery (as declared)

Test Limits

Except for harmonics, out-of-band emissions shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in FCC 47CFR15.209 / RSS-Gen {see table below}, whichever is less stringent.

Harmonics shall be limited to a maximum level of 0.5 mV/m measured at 3 metres.

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

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

n.b. per FCC 47CFR15.35(b) / RSS-Gen 8.1, peak limit is 20dB above average.

11.3 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 100kHz 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;

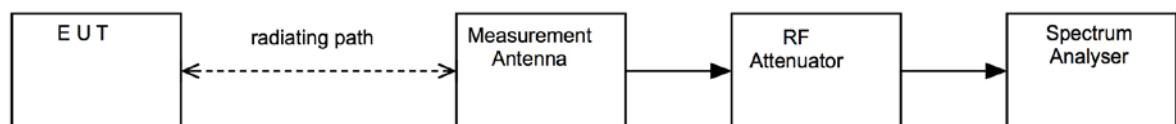
PA is the pre-amplifier gain in dB (where used);

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



Test Setup Photograph(s)

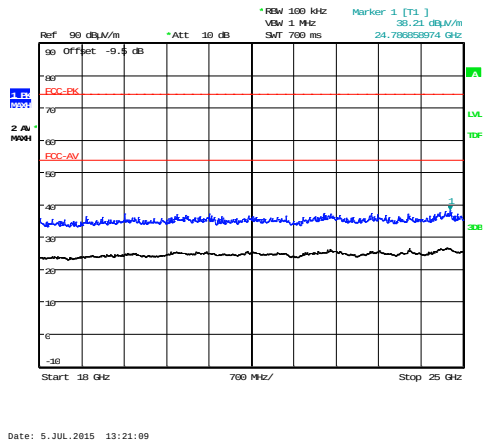
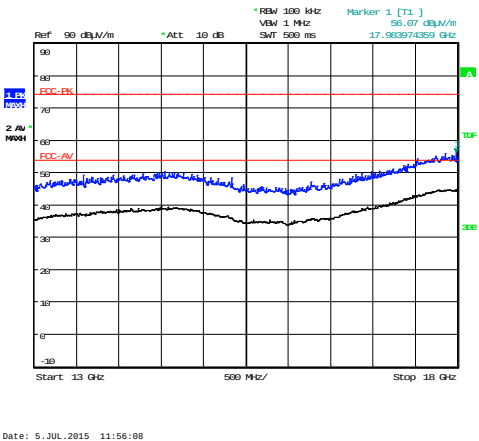
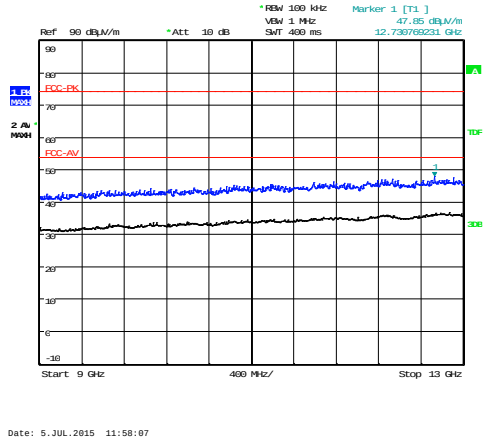
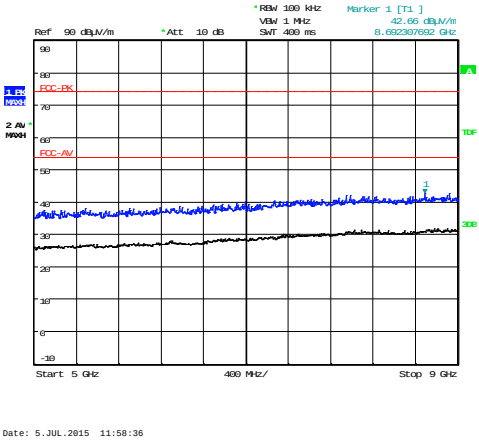
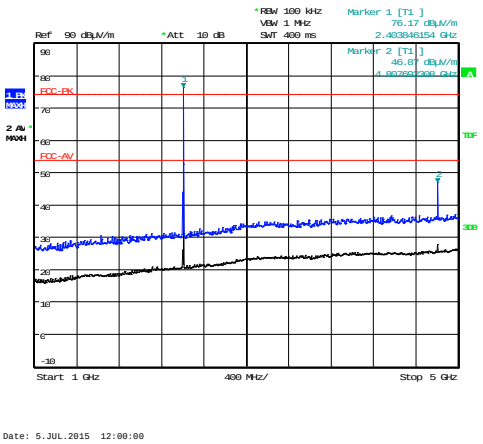
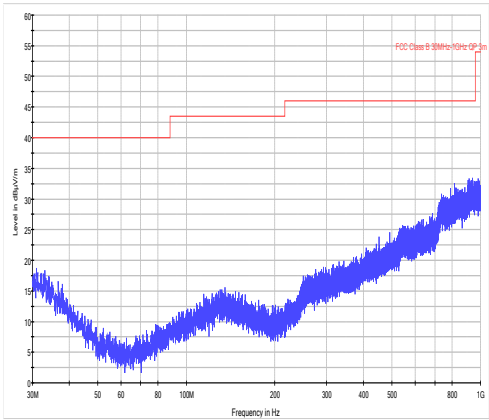


11.4 Test Equipment

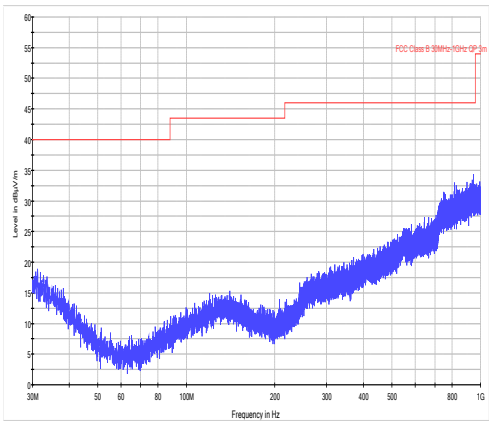
Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Bilog	Chase	CBL611/A	UH191	26/02/2015	24	26/02/2017
1-18GHz Horn	EMCO	3115	L138	17/10/2013	24	17/10/2015
Horn 18-26GHz (&UH330)	Flann	20240-20	L300	10/02/2014	24	10/02/2016
Receiver	R&S	ESVS10	L317	26/02/2015	12	26/02/2016
Pre Amp	Agilent	8449B	L572	10/02/2015	12	10/02/2016
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2014	24	08/09/2016
IC Reg Radio Chamber - PP	Rainford EMC	ATS	REF940	19/11/2014	36	19/11/2017

11.5 Test Results

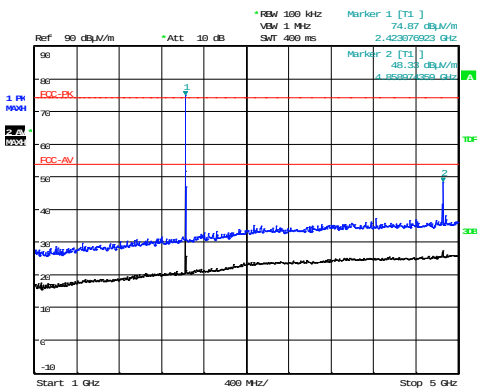
Radiated Transmitter Emissions – 2402 MHz



Radiated Transmitter Emissions – 2426 MHz

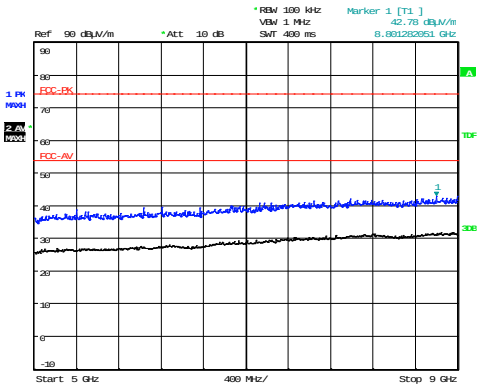


30MHz – 1GHz



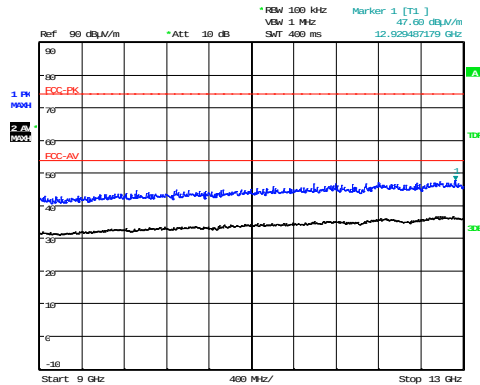
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1GHz – 5GHz



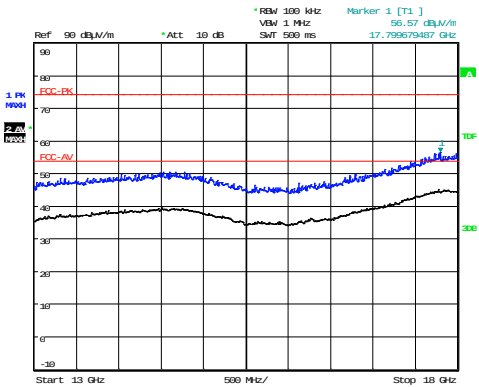
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5GHz – 9GHz



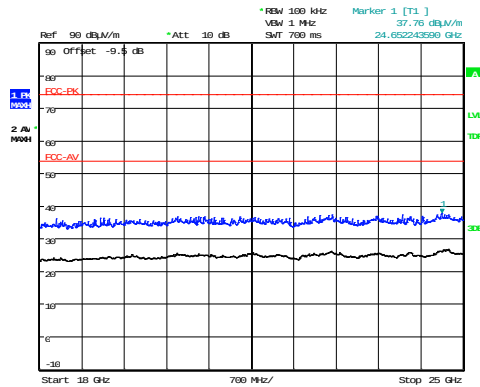
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9GHz – 13GHz



Date: 5 JUL 2015 11:38:56

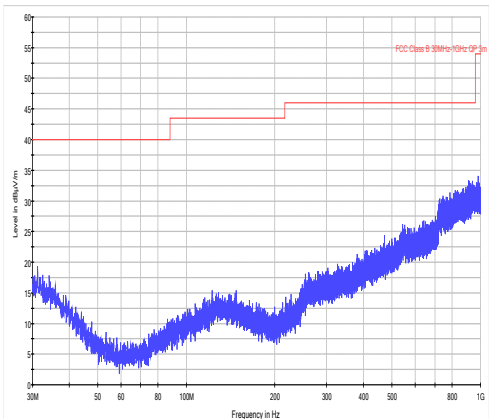
13GHz – 18GHz



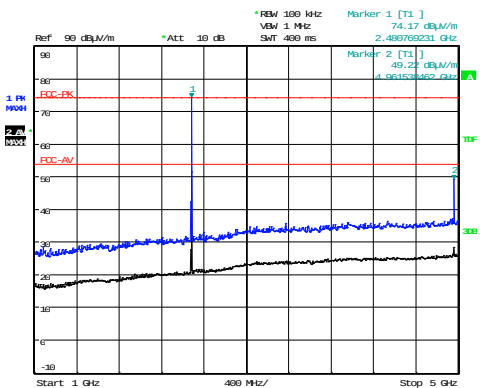
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18GHz – 25GHz

Radiated Transmitter Emissions – 2480 MHz

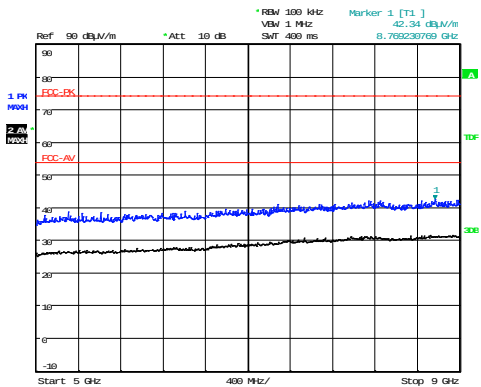


30MHz – 1GHz



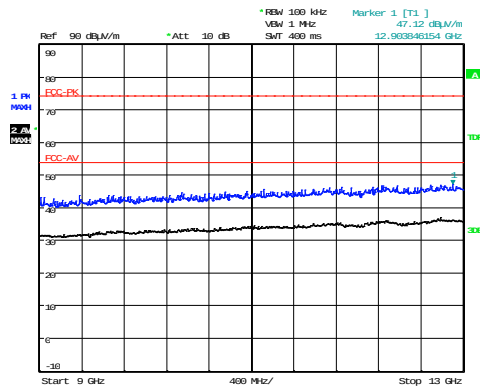
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1GHz – 5GHz



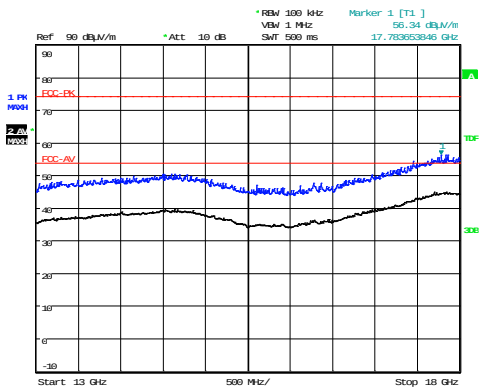
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5GHz – 9GHz



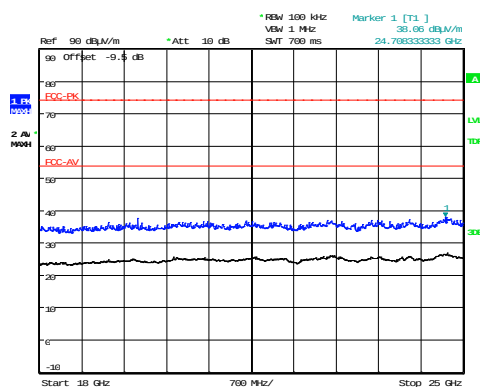
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9GHz – 13GHz



Date: 5 JUL 2015 11:46:41

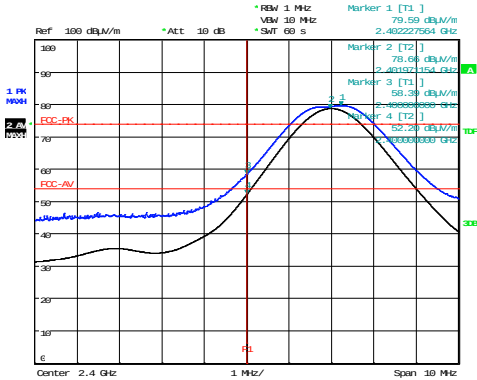
13GHz – 18GHz



Date: 5 JUL 2015 13:28:17

18GHz – 25GHz

High Power; Channel: 2402 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
Peak	4805.9	51.5	3.8	32.7	35.9	N/A	0.0	52.0	399.9	5000.0
Average	4805.9	45.5	3.8	32.7	35.9	N/A	0.0	46.1	202.1	500.0

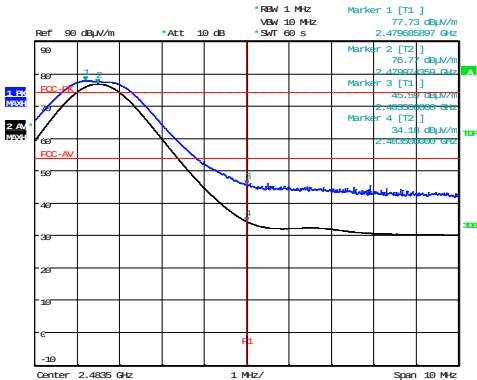


Date: 7.JUL.2015 13:23:21

Lower Bandedge Compliance

High Power; Channel: 2426 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
Peak	4853.9	52.1	3.7	32.9	35.9	N/A	0.0	52.8	438.0	5000.0
Average	4853.9	46.9	3.7	32.9	35.9	N/A	0.0	47.6	238.8	500.0

High Power; Channel: 2480 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
Peak	4958.0	52.9	3.6	33.2	35.9	N/A	0.0	53.8	488.1	5000.0
Average	4958.0	47.5	3.6	33.2	35.9	N/A	0.0	48.4	263.6	500.0



Date: 7.JUL.2015 13:12:50

12 Occupied Bandwidth

12.1 Definitions

Occupied bandwidth

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power. This is also known as the *99% emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

20dB bandwidth

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.

12.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	Radio
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channels / Frequencies Measured:	2402 MHz / 2426 MHz / 2480 MHz
EUT Channel Bandwidths:	2 MHz
EUT Test Modulations:	BLE
Deviations From Standard:	None
Measurement BW: (requirement: 1% to 5% OBW)	30 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	100 kHz
Measurement Span: (requirement 2 to 5 times OBW)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: +23 °C	+15 °C to +35 °C (as declared)
Humidity: 42%RH	20%RH to 75%RH (as declared)
Supply: 1.5 Vdc	230Vac +/-10% / New battery (as declared)

Test Limits

Industry Canada:

If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz

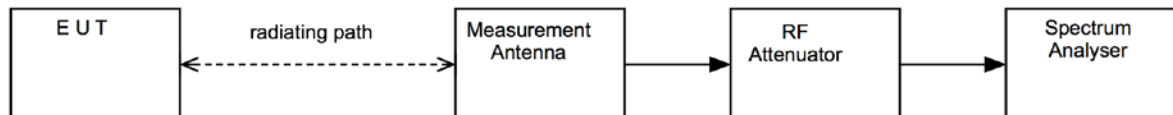
Federal Communications Commission:

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

12.3 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

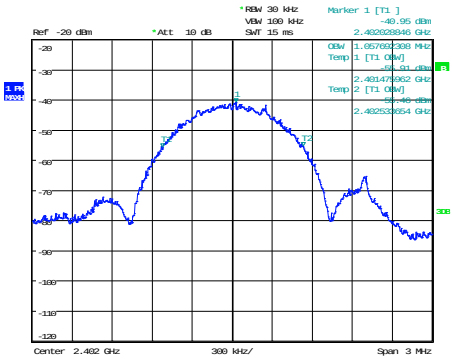


12.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
1-18GHz Horn	EMCO	3115	L138	17/10/2013	24	17/10/2015
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016

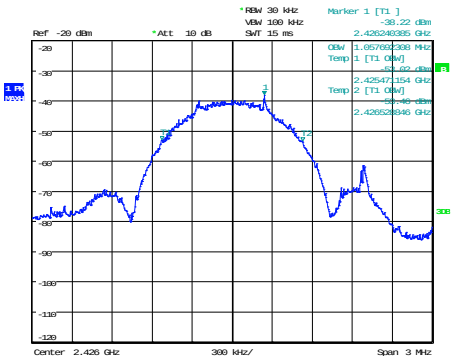
12.5 Test Results

RSS-210. Modulation: BLE; Data rate: 1 Mbps; Power setting: Max.				
Channel Frequency (MHz)	F _L (MHz)	F _H (MHz)	99% Bandwidth (kHz)	Result
2402	2401.476	2402.534	1057.692	PASS
2426	2425.471	2426.529	1057.692	PASS
2480	2479.457	2480.514	1057.692	PASS



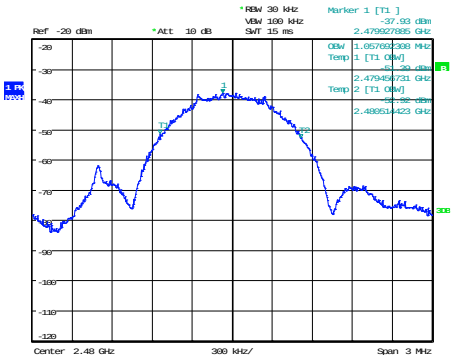
Date: 28.JUL.2015 14:03:46

99% Bandwidth - 2402 MHz



Date: 28.JUL.2015 14:02:29

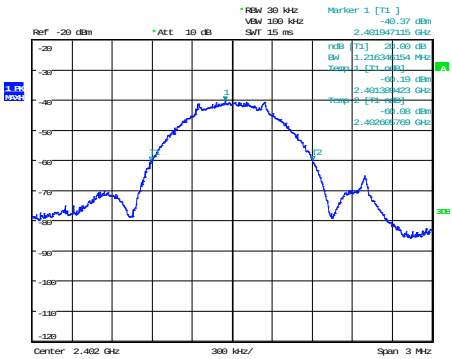
99% Bandwidth - 2426 MHz



Date: 28.JUL.2015 13:49:11

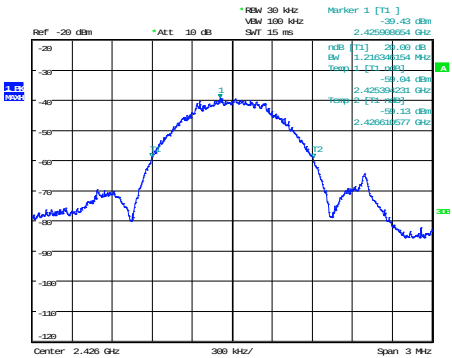
99% Bandwidth - 2480 MHz

FCC 15.249. Modulation: BLE; Data rate: 1 Mbps; Power setting: Max.				
Channel Frequency (MHz)	F _L (MHz)	F _H (MHz)	20dB Bandwidth (kHz)	Result
2402	2401.389	2402.606	1216.346	PASS
2426	2425.394	2426.611	1216.346	PASS
2480	2479.375	2480.591	1216.346	PASS



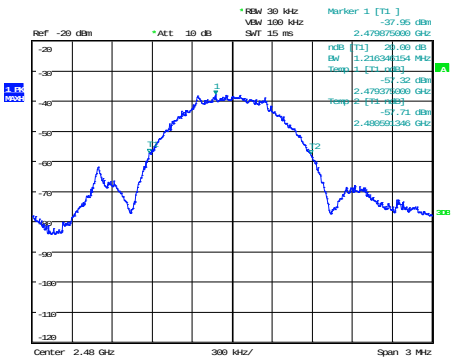
Date: 20.JUL.2015 13:40:19

20 dB Bandwidth - 2402 MHz



Date: 20.JUL.2015 13:47:02

20 dB Bandwidth - 2426 MHz



Date: 20.JUL.2015 13:48:00

20 dB Bandwidth - 2480 MHz

13 Transmitter output power (fundamental radiated emission)

13.1 Definition

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

13.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	Radio
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Channels / Frequencies Measured:	2402 MHz / 2426 MHz / 2480 MHz
EUT Channel Bandwidths:	2 MHz
Deviations From Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3 MHz
Measurement Detector:	Up to 1GHz: Quasi-peak Above 1GHz: Average RMS and Peak Mains Power = 85% and 115% of Nominal (FCC only requirement); Battery Power = new battery.
Voltage Extreme Environment Test Range:	

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 43%RH	20%RH to 75%RH (as declared)

Test Limits

The field strength measured at 3 metres shall not exceed the limits in the following table:

Field Strength Limits for License-Exempt Transmitters for Any Application

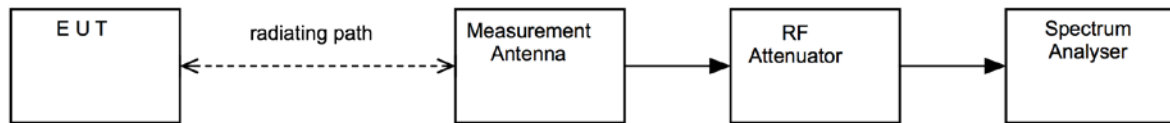
Fundamental frequency (MHz)	Field strength (mV/m at 3m)	Detector
902 – 928	50	Quasi-Peak
2400 – 2483.5	50	Average RMS
5725 – 5875	50	Average RMS

n.b. per FCC 47CFR15.249(e) / RSS-Gen 8.1, peak limit is 20dB above average.

13.3 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**13.4 Test Equipment**

Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
1-18GHz Horn	EMCO	3115	L138	17/10/2013	24	17/10/2015
Spectrum Analyser	R&S	FSU26	REF909	13/02/2015	12	13/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2014	24	08/09/2016
IC Reg Radio Chamber - PP	Rainford EMC	ATS	REF940	19/11/2014	36	19/11/2017

13.5 Test Results

Modulation: BLE; Data rate: 1 Mbps; Power setting: Max.			
Channel Frequency (MHz)	Peak Field Strength (mV/m)	Distance (m)	Result
2402	9.5	3	PASS
2426	8.2	3	PASS
2480	7.7	3	PASS

14 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

[1] Carrier power

Uncertainty in test result (Power Meter) = **1.08dB**

Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[2] Spurious emissions

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[3] AC power line conducted emissions

Uncertainty in test result = **3.4dB**

[4] Occupied bandwidth

Uncertainty in test result = **15.5%**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**

Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Duty cycle

Uncertainty in test result = **7.98%**

15 General SAR test reduction & exclusion guidance / RF Exposure

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

The SAR Test Exclusion Threshold for 100 MHz to 6 GHz will be determined as follows.

$$\text{SAR Exclusion Threshold (SARET)} = \text{Step 1} + \text{Step 2}$$

Step 1

$$NT = [(MP/TSD^A) * \sqrt{f_{\text{GHz}}}]$$

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (including tune-up tolerance)
TSD ^A	=	Min Test separation Distance or 50mm (whichever is lower)
	=	5mm (in this case)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$= [(NT \times TSD^A) / \sqrt{f_{\text{GHz}}}]$$

For Distances Greater than 50 mm Step 2 applies

Step 2

$$(TSD^B - 50\text{mm}) * 1$$

Where:

$$TSD^B = \text{Min Test separation Distance (mm)} = 50$$

Note: Step 2 doesn't apply here as the TSD^A is less than 50 mm

Operating Frequency 2.402 GHz

$$\text{SARET} = [(3.0 \times 5) / \sqrt{2.402}]$$

$$\text{SARET} = 9.68\text{mW}$$

Operating Frequency 2.426 GHz

$$\text{SARET} = [(3.0 \times 5) / \sqrt{2.426}]$$

$$\text{SARET} = 9.63\text{mW}$$

Operating Frequency 2.480 GHz

$$\text{SARET} = [(3.0 \times 5) / \sqrt{2.480}]$$

$$\text{SARET} = 9.53\text{mW}$$

Channel Frequency (MHz)	EIRP (mW)	SAR Exclusion Threshold (mW)	SAR Evaluation
2402	0.027	9.68	Not Required
2426	0.020	9.63	Not Required
2480	0.018	9.53	Not Required

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

Prediction of MPE limit at a given distance

Equation from IEEE C95.1

$$S = \frac{EIRP}{4\pi R^2} \text{ re - arranged } R = \sqrt{\frac{EIRP}{S 4\pi}}$$

Where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

FCC Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm ²)	Distance required to be less than the power density limit (R) (cm)
2402	0.027	1	0.047

IC Result

Prediction Frequency (MHz)	Maximum EIRP (W)	Exemption limit (W)	RF Exposure
2402	0.000027	5	Not Required