

Report on the Radio Testing
For
Current Health Limited
on
Wearable Gen 1.1
Report no. TRA-052152-47-01B
18 December 2020

RF915 7.0



Report Number: TRA-052152-47-01B
Issue: A

REPORT ON THE RADIO TESTING OF A
Current Health Limited
Wearable Gen 1.1
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 2020-10-09 to 2020-10-20

Written by:

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Approved by:

John Charters
Lab Manager

Date: 18 December 2020

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	18 December 2020	Original

2 Summary

TEST REPORT NUMBER:	TRA-052152-47-01B
WORKS ORDER NUMBER	TRA-052152-00
PURPOSE OF TEST:	Class II permissive change
TEST SPECIFICATION(S):	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	Wearable Gen 1.1
FCC IDENTIFIER:	2AUFS-WD2
EUT SERIAL NUMBER:	50002
MANUFACTURER/AGENT:	Current Health Limited
ADDRESS:	Playfair House 6 Broughton Street Lane Edinburgh EH1 3LY United Kingdom
CLIENT CONTACT:	Pavel Boav ☎ 0131 285 8101 ✉ pavel.boev@currenthealth.com
ORDER NUMBER:	0753
TEST DATE:	2020-10-09 to 2020-10-20
TESTED BY:	Michael Else Element

2.1 Test Summary

Test Method and Description		Requirement Clause		Applicable to this equipment	Result / Note
		RSS	47CFR15		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		Gen, 8.10	15.205	☒	PASS
AC power line conducted emissions		Gen, 8.8	15.207	☒	Note 1
Occupied bandwidth		247, 5.2 (1)	15.247(a)(2)	☐	Note 1
Conducted carrier power	Peak	247, 5.4 (4)	15.247(b)(3)	☒	PASS
	Max.			☐	
Conducted / radiated RF power out-of-band		247, 5.5	15.247(d)	☐	Note 1
Power spectral density, conducted		247, 5.2 (2)	15.247(e)	☐	Note 1
Calculation of duty correction		-	15.35(c)	☐	Note 1

Notes:

- 1- This report contains limited testing to show compliance with a Class II permissive change.
- 2- This testing is performed with the highest output power radio operational. Please see Element test report TRA-052152-47-00A for results with Bluetooth low energy transmitter active.

Note1: Limited testing to confirm radiated carrier power and transmitter radiated spurious emissions only as requested by the client, this report covers the testing of Wi-Fi module only.

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).

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4 Introduction

This report TRA-052152-47-01B presents the results of the Radio testing on a Current Health Limited, Wearable Gen 1.1 to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Current Health Limited by Element, at the address(es) 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
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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:

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

IC Registration Number(s):

Element Hull	3483A
Element 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.

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: Wearable Gen 1.1
- Serial Number: No BLE-1
- Model Number: Gen 1.1 Wearable
- Software Revision: mfg_test_1.0.0
- Build Level / Revision Number: Main PCB rev 1.2, Sensor PCB rev 1.2

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.

Thinkpad laptop
Segger J-Link Plus.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows...

The EUT was set to transmit using customer provided Laptop and software, Wearable FCC test Version 2.0.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	2412 MHz to 2462 MHz
Modulation type(s):	802.11b, 802.11g and 802.11n
Occupied channel bandwidth(s):	20 MHz
Declared output power(s):	23 dBm
Nominal Supply Voltage:	3.7 V/dc

7.4.2 Antennas

Type:	Chip Monopole Antenna
Frequency range:	2400 MHz to 2500 MHz
Impedance:	50 Ohm
Gain:	+ 1.9 dBi
Polarisation:	Omnidirectional
Connector type:	Not Applicable, PCB mounted
Mounting:	PCB mounted

7.5 EUT Description

The EUT is a wearable device for health monitoring (Medical device) containing 2.4 GHz WiFi/BTLE module. This report covers WiFi operation only.

8 Modifications

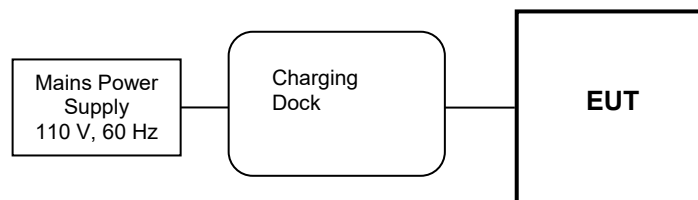
No modifications were performed during this assessment.

9 EUT Test Setup

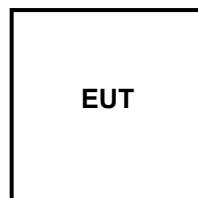
9.1 Block Diagram

The following diagram shows basic EUT interconnections:

EUT on charging dock



EUT



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 (See Note)
Element Transmitter Bench Test (See Note)
ETS Lindgren EMPower V1.0.4.2

Note:

The version of the Element software used is recorded in the results sheets contained within this report.

10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied 3.7 V dc from Lithium batteries. The charging dock was connected to 110 V ac, 60 Hz, from the mains.

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:

	Category	Nominal	Variation
☒	Mains	110 V ac +/-2 %	85 % and 115 %
☒	Battery	3.7 V/dc	N/A

11 Radiated emissions

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:	SK 01 Semi-Anechoic chamber 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2412 MHz / 2437 MHz / 2462 MHz
EUT Channel Bandwidths:	20 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: 16.8 °C	+15 °C to +35 °C (as declared)
Humidity: 52 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 V/dc	3.7 /dc ±10 % (as declared)

11.3 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

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

11.4 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;

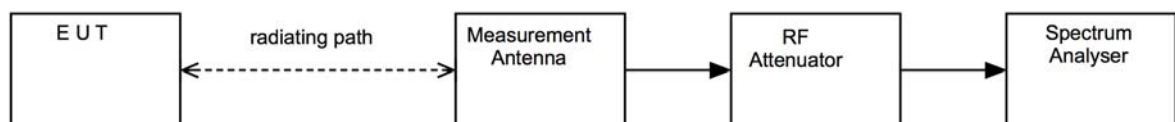
PA is the pre-amplifier gain in dB (where used);

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



11.5 Test Set-up Photograph

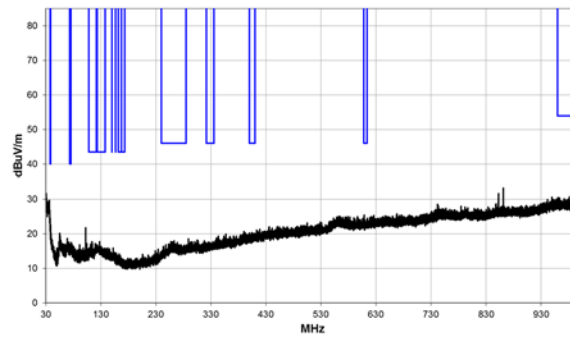


11.6 Test Equipment

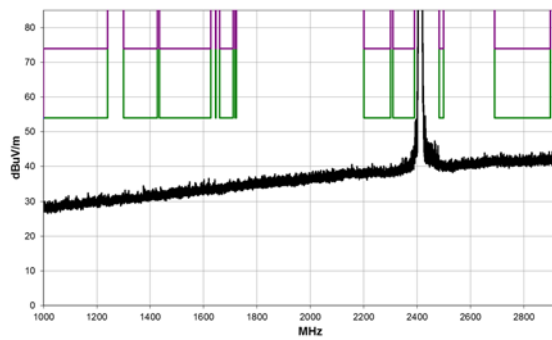
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
HL 050	R&S	Log Periodic Antenna	U385	2021-01-16
CBL611/A	Chase	Bilog	U573	2021-09-19
6201-69	Watkins Johnson	PreAmp	U372	2021-02-26
ATS	Rainford EMC	Chamber 1	U387	2021-09-09
ESR26	R&S	EMI Receiver	U489	2020-12-18
8449B	Agilent	Pre Amp	L572	2021-10-19
SN 4478	BSC	2.4G Band Stop Filter	U543	2021-01-22
AFH-07000	Atlantic Microwave	High Pass Filter	U558	2021-01-22
20240-20	Flann	Horn 18-26GHz (&U330)	L300	2022-04-23

11.7 Test Results

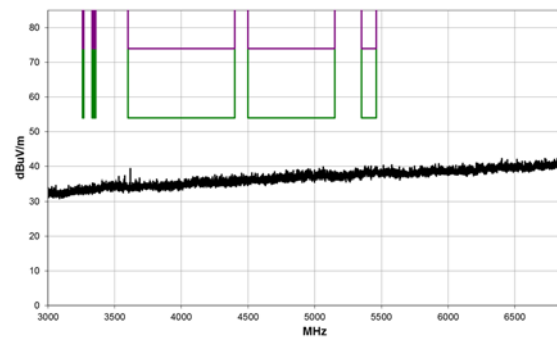
Bottom channel 2412 MHz



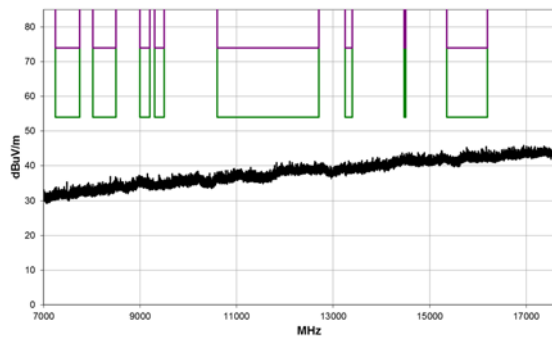
30 MHz to 1 GHz



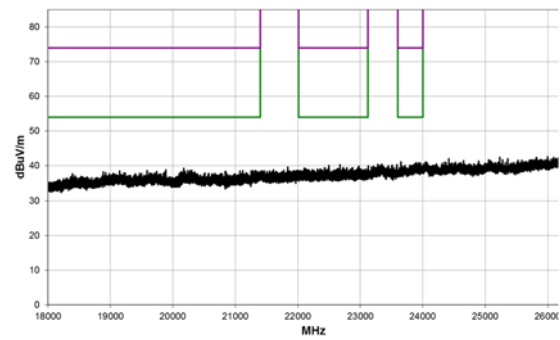
1 GHz to 3 GHz



3 GHz to 7 GHz



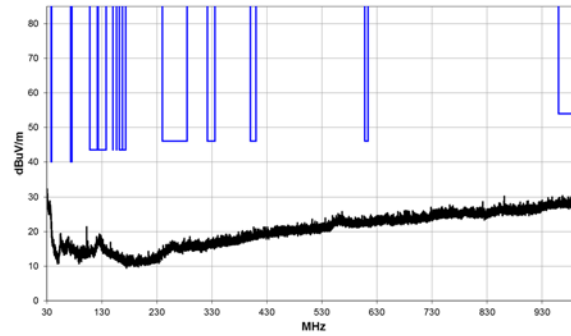
7 GHz to 18 GHz



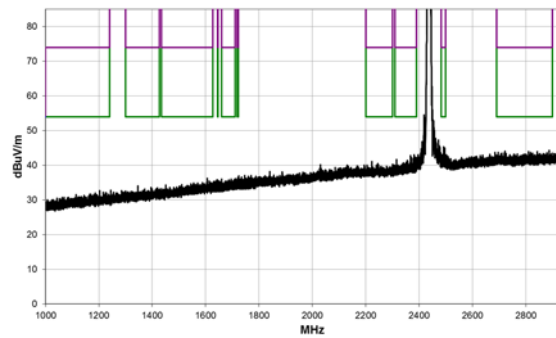
18 GHz to 26.5 GHz

Bottom Channel 2412 MHz, 802.11 b, 20 MHz Bandwidth, 1Mbps, Power setting 121;												
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
37.518	30.1	-8.0	1.0	132.9	3.0	0.0	Vert	QP	0.0	22.1	40.0	-17.9
37.518	25.7	-8.0	2.87	285.0	3.0	0.0	Horz	QP	0.0	17.7	40.0	-22.3
2385.952	44.9	-3.1	1.5	332.1	3.0	0.0	Horz	AV	0.0	41.8	54.0	-12.2
2382.977	44.5	-3.1	1.69	0.8	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6
2386.110	59.1	-3.1	1.75	26.2	3.0	0.0	Horz	PK	0.0	56.0	74.0	-18.0
2385.822	38.7	-3.1	2.2	76.0	3.0	0.0	Vert	AV	0.0	35.6	54.0	-18.4
2385.777	38.6	-3.1	2.12	309.0	3.0	0.0	Vert	AV	0.0	35.5	54.0	-18.5
2386.271	58.6	-3.1	1.69	0.8	3.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5
3617.775	32.6	2.9	1.56	343.9	3.0	0.0	Horz	AV	0.0	35.5	54.0	-18.5

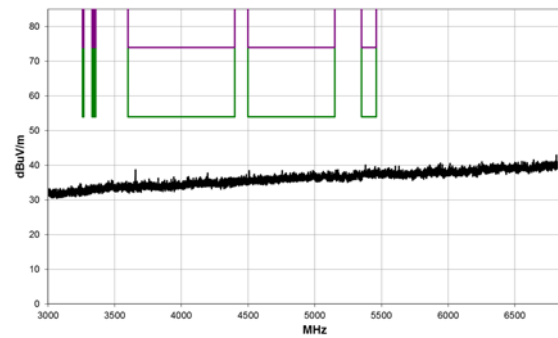
Middle channel 2437 MHz



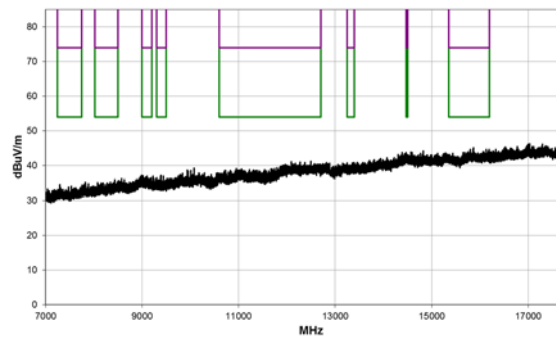
30 MHz to 1 GHz



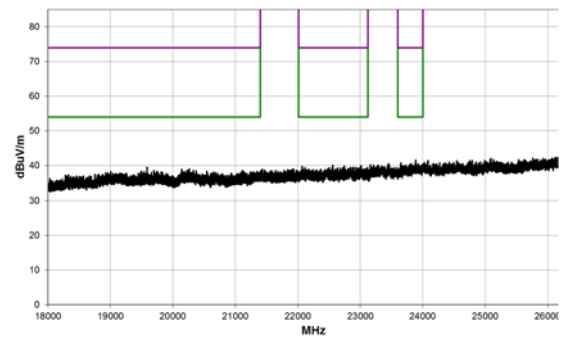
1 GHz to 3 GHz



3 GHz to 7GHz



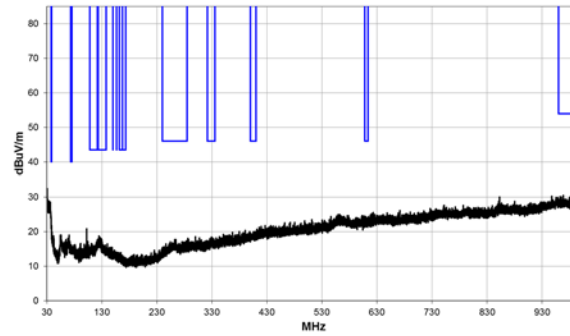
7 GHz to 18 GHz



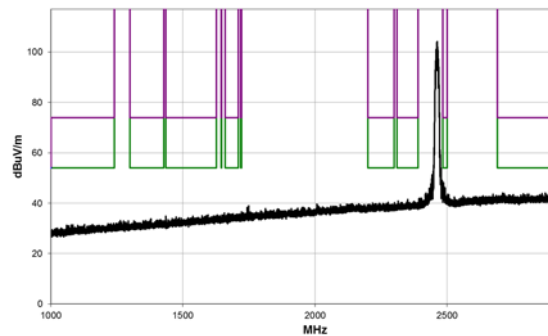
18 GHz to 26.5 GHz

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
37.518	29.3	-8.0	1.0	198.9	3.0	0.0	Vert	QP	0.0	21.3	40.0	-18.7
2496.300	38.7	-2.5	1.5	115.1	3.0	0.0	Horz	AV	0.0	36.2	54.0	-17.8
2497.273	38.7	-2.5	1.88	10.2	3.0	0.0	Vert	AV	0.0	36.2	54.0	-17.8
2384.894	38.4	-3.1	2.19	243.9	3.0	0.0	Horz	AV	0.0	35.3	54.0	-18.7
2385.243	38.4	-3.1	1.64	189.0	3.0	0.0	Vert	AV	0.0	35.3	54.0	-18.7
2317.105	38.2	-3.4	2.11	128.1	3.0	0.0	Horz	AV	0.0	34.8	54.0	-19.2
2317.238	38.2	-3.4	2.03	132.0	3.0	0.0	Vert	AV	0.0	34.8	54.0	-19.2
2226.388	38.4	-3.8	1.5	19.0	3.0	0.0	Horz	AV	0.0	34.6	54.0	-19.4
2226.379	38.4	-3.8	2.8	61.2	3.0	0.0	Vert	AV	0.0	34.6	54.0	-19.4
3655.300	32.5	2.9	1.21	356.0	3.0	0.0	Horz	AV	0.0	35.4	54.0	-18.6

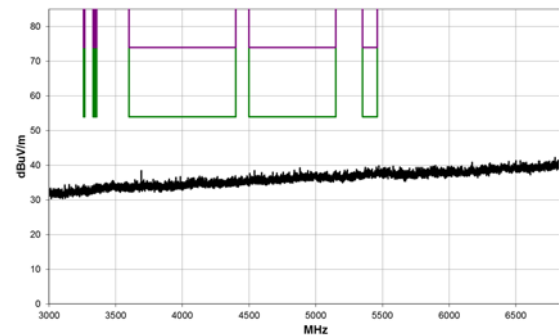
Top Channel 2462 MHz



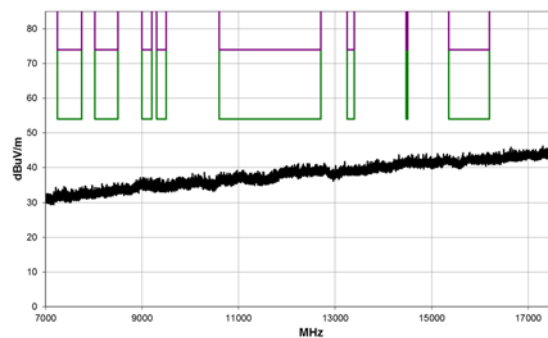
30 MHz to 1 GHz



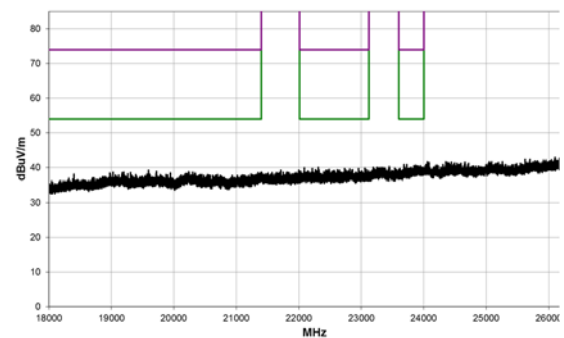
1 GHz to 3 GHz



3 GHz to 7 GHz



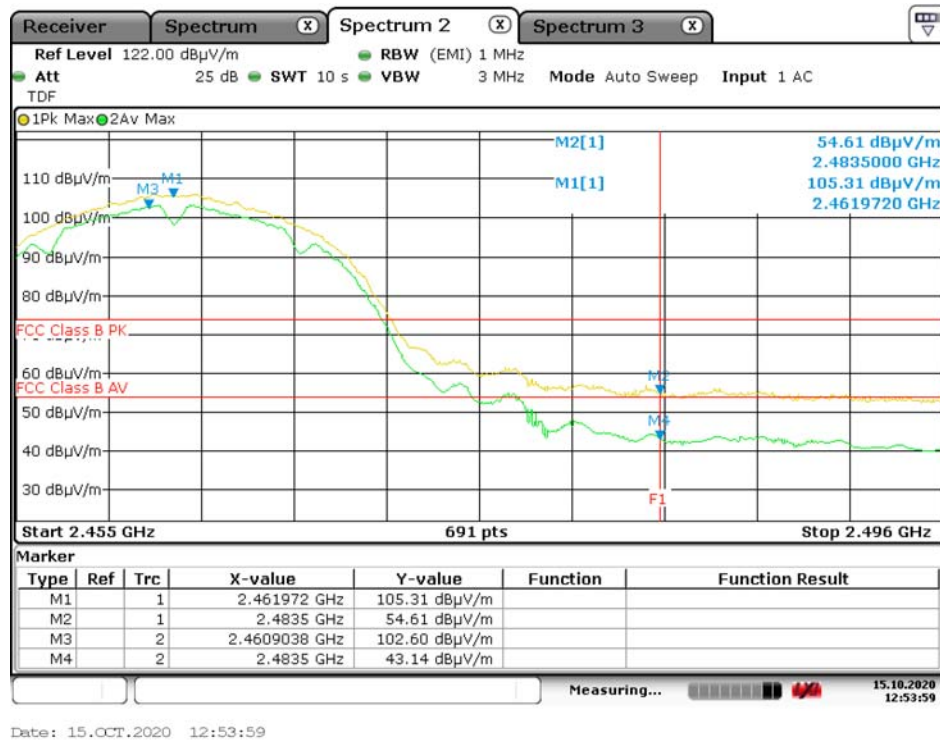
7 GHz to 18 GHz



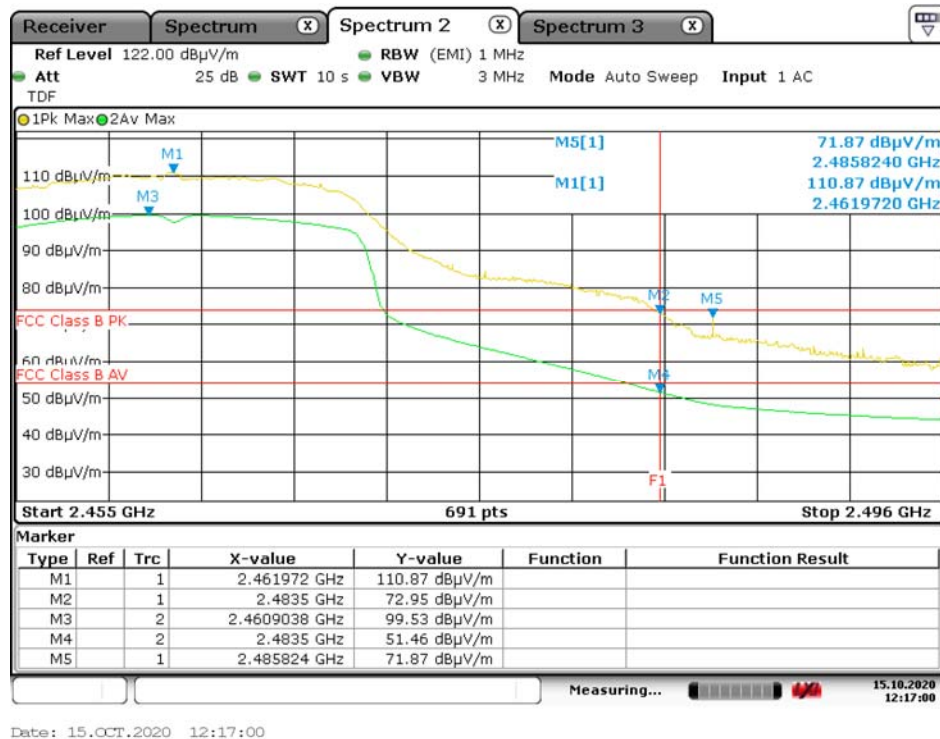
18 GHz to 26.5 GHz

Top Channel 2462 MHz, 802.11 b, 20 MHz Bandwidth, 1Mbps, Power setting 121;												
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
37.518	29.1	-8.0	1.0	229.9	3.0	0.0	Vert	QP	0.0	21.1	40.0	-18.9
2488.564	47.0	-2.5	1.5	330.0	3.0	0.0	Horz	AV	0.0	44.5	54.0	-9.5
2487.857	60.2	-2.6	1.5	330.0	3.0	0.0	Horz	PK	0.0	57.6	74.0	-16.4
2488.473	40.1	-2.5	2.16	248.0	3.0	0.0	Vert	AV	0.0	37.6	54.0	-16.4
3692.775	33.5	3.0	1.5	33.1	3.0	0.0	Horz	AV	0.0	36.5	54.0	-17.5

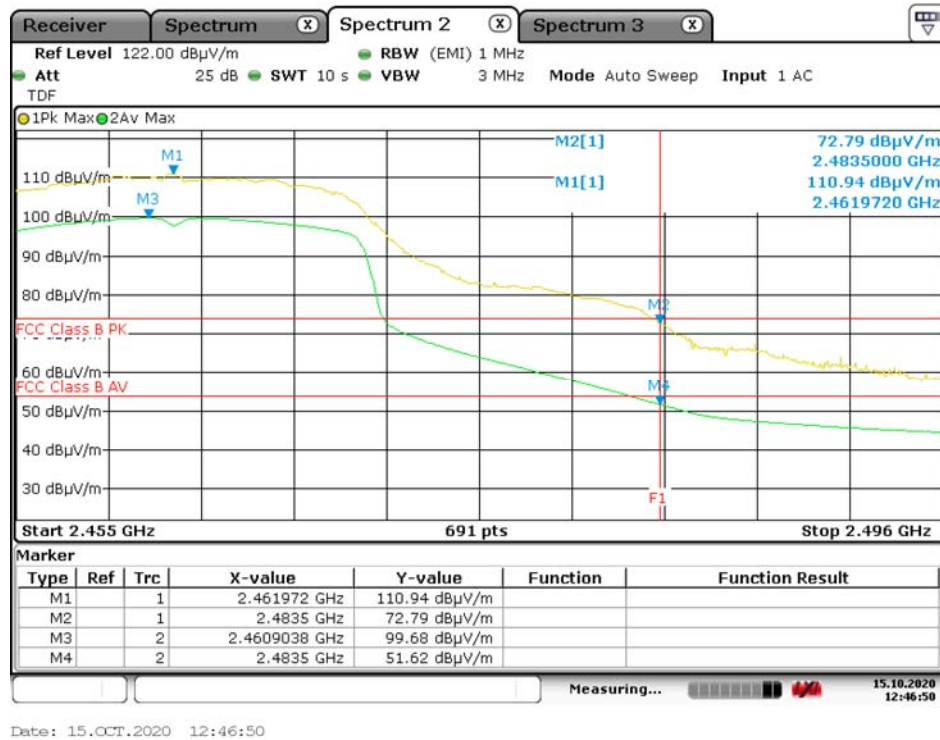
Upper Radiated Band Edge, Mode b – Peak & Average



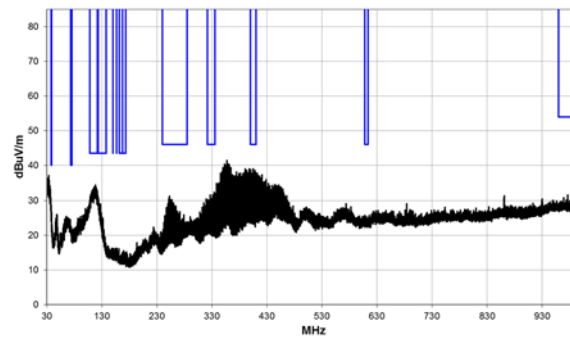
Upper Radiated Band Edge, Mode g – Peak & Average



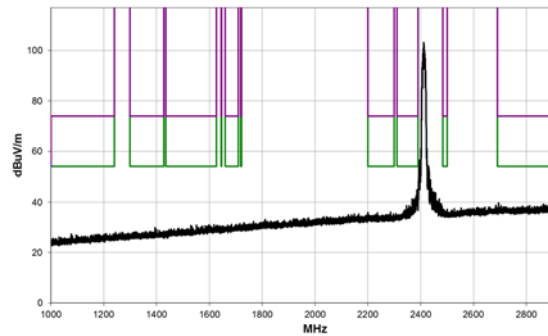
Upper Radiated Band Edge, Mode n – Peak & Average



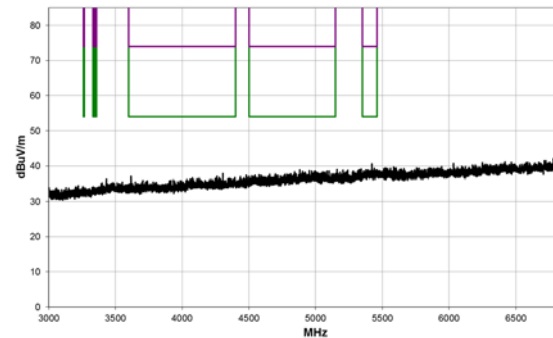
Bottom channel 2412 MHz, EUT placed on charger



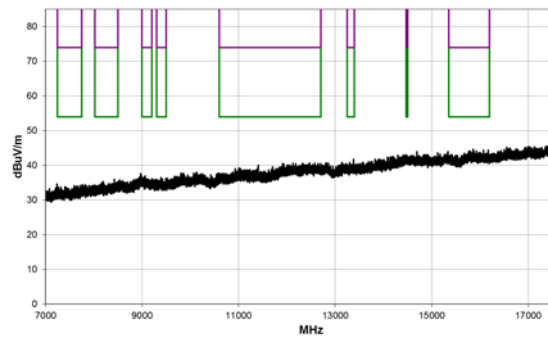
30 MHz to 1 GHz



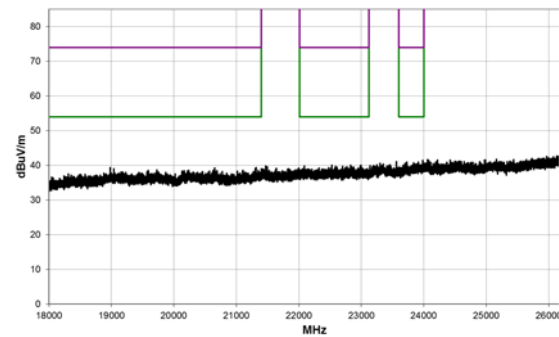
1 GHz to 3 GHz



3 GHz to 7 GHz



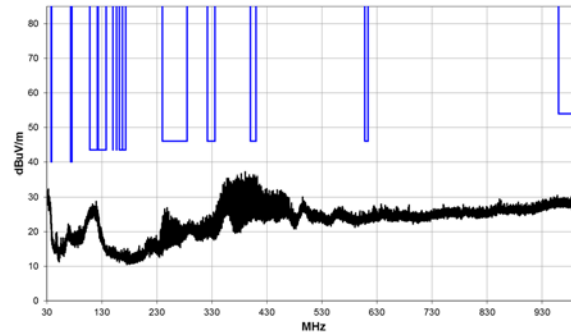
7 GHz to 18 GHz



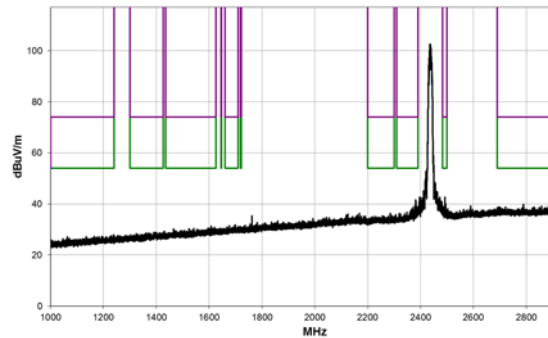
18GHz to 26.5 GHz

Bottom Channel 2412 MHz, 802.11 b, 20 MHz Bandwidth, 1Mbps, Power setting 121, EUT on charger;												
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
401.023	40.8	-5.2	1.0	186.1	3.0	0.0	Horz	QP	0.0	35.6	46.0	-10.4
118.884	43.2	-10.5	1.0	124.1	3.0	0.0	Vert	QP	0.0	32.7	43.5	-10.8
37.518	36.7	-8.0	1.0	306.9	3.0	0.0	Vert	QP	0.0	28.7	40.0	-11.3
401.011	34.6	-5.2	1.48	245.1	3.0	0.0	Vert	QP	0.0	29.4	46.0	-16.6
118.286	37.3	-10.5	2.46	157.2	3.0	0.0	Horz	QP	0.0	26.8	43.5	-16.7
252.855	37.1	-9.0	1.0	30.1	3.0	0.0	Vert	QP	0.0	28.1	46.0	-17.9
252.834	36.7	-9.0	1.19	116.1	3.0	0.0	Horz	QP	0.0	27.7	46.0	-18.3

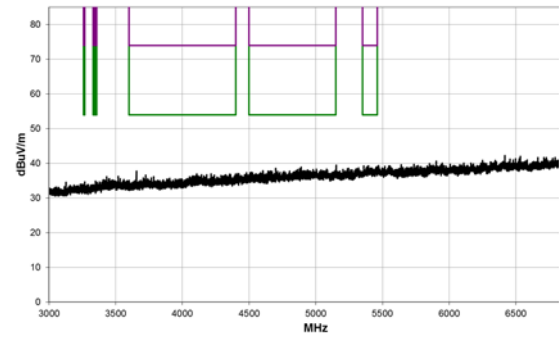
Middle channel 2437 MHz, EUT placed on charger



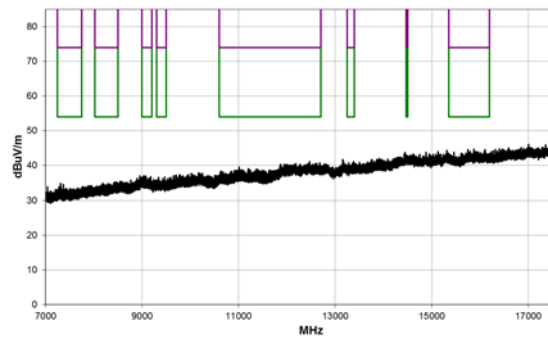
30 MHz to 1 GHz



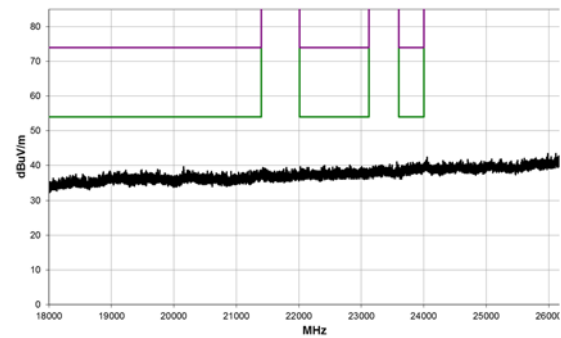
1 GHz to 3 GHz



3 GHz to 7 GHz



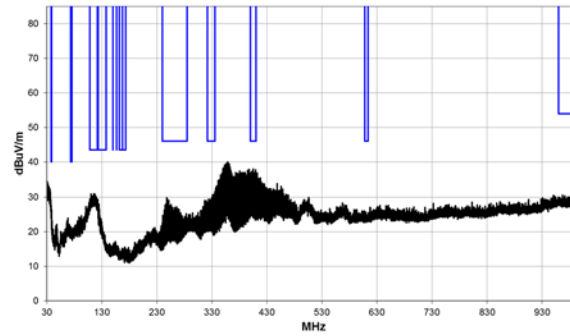
7 GHz to 18 GHz



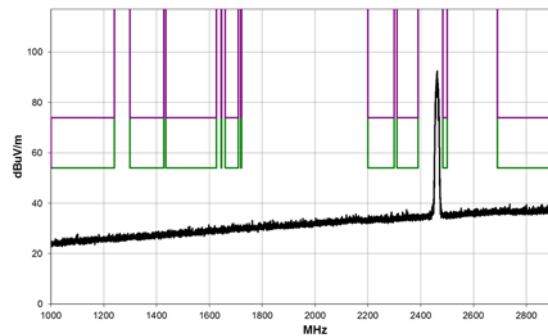
18 GHz to 26.5 GHz

Middle Channel 2437 MHz, 802.11 b, 20 MHz Bandwidth, 1Mbps, Power setting 121, EUT on Charger;												
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
120.937	38.1	-10.3	1.0	96.2	3.0	0.0	Vert	QP	0.0	27.8	43.5	-15.7
400.803	35.1	-5.2	1.0	196.2	3.0	0.0	Horz	QP	0.0	29.9	46.0	-16.1
37.511	30.5	-8.0	1.0	321.2	3.0	0.0	Vert	QP	0.0	22.5	40.0	-17.5
108.796	37.0	-11.6	1.0	83.0	3.0	0.0	Vert	QP	0.0	25.4	43.5	-18.1
400.770	32.1	-5.2	1.47	267.2	3.0	0.0	Vert	QP	0.0	26.9	46.0	-19.1
108.784	35.3	-11.6	2.95	159.2	3.0	0.0	Horz	QP	0.0	23.7	43.5	-19.8
248.424	39.3	-9.5	1.21	292.9	3.0	0.0	Horz	QP	0.0	29.8	46.0	-16.2
248.469	37.5	-9.5	1.0	48.9	3.0	0.0	Vert	QP	0.0	28.0	46.0	-18.0
322.566	34.0	-7.9	1.14	100.1	3.0	0.0	Horz	QP	0.0	26.1	46.0	-19.9
2494.800	39.2	-2.5	1.89	10.8	3.0	0.0	Horz	AV	0.0	36.7	54.0	-17.3
3655.291	32.3	2.9	1.33	43.9	3.0	0.0	Vert	AV	0.0	35.2	54.0	-18.8

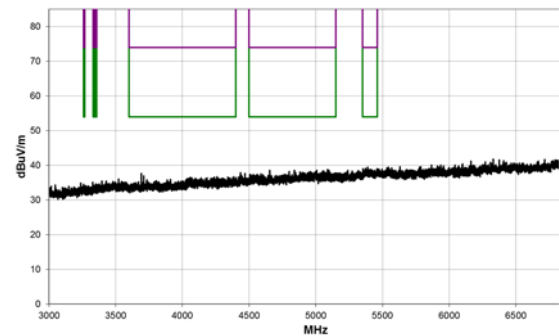
Top channel 2462 MHz, EUT placed on charger



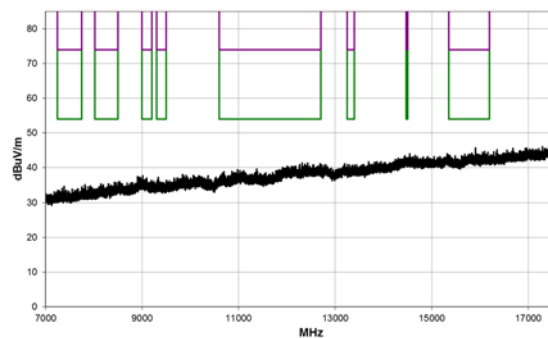
30 MHz to 1 GHz



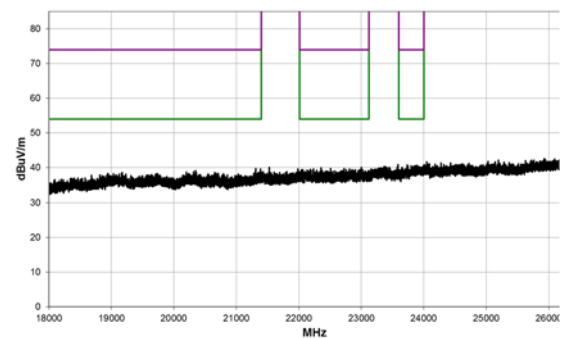
1 GHz to 3 GHz



3 GHz to 7 GHz



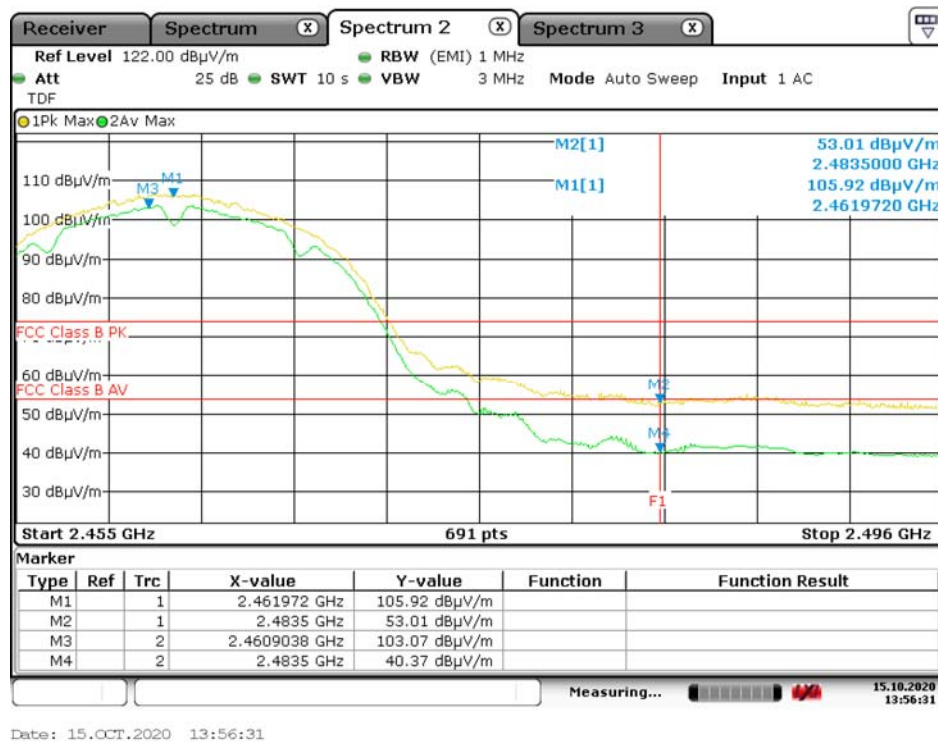
7 GHz to 18 GHz



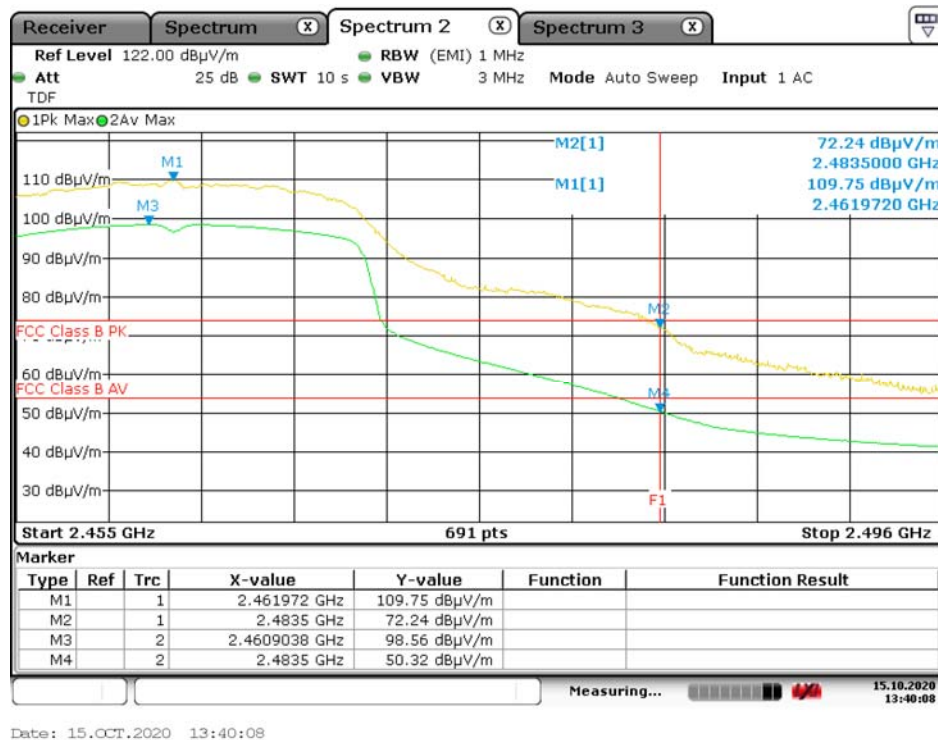
18GHz to 26.5 GHz

Top Channel 2462 MHz, 802.11 b, 20 MHz Bandwidth, 1Mbps, Power setting 121, EUT on charger;												
Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)
108.762	38.7	-11.6	1.04	103.2	3.0	0.0	Vert	QP	0.0	27.1	43.5	-16.4
403.706	36.7	-5.1	1.0	172.2	3.0	0.0	Horz	QP	0.0	31.6	46.0	-14.4
403.708	34.9	-5.1	1.7	211.8	3.0	0.0	Vert	QP	0.0	29.8	46.0	-16.2
37.809	35.7	-8.2	1.01	261.0	3.0	0.0	Vert	QP	0.0	27.5	40.0	-12.5
73.165	36.5	-16.1	1.71	73.0	3.0	0.0	Vert	QP	0.0	20.4	40.0	-19.6
3692.775	32.7	3.0	1.43	45.0	3.0	0.0	Vert	AV	0.0	35.7	54.0	-18.3
15910.24	28.7	19.3	2.57	82.1	1.0	0.0	Horz	AV	-9.5	38.5	54.0	-15.5
15909.05	28.7	19.3	1.65	20.2	1.0	0.0	Vert	AV	-9.5	38.5	54.0	-15.5
15909.89	45.1	19.3	2.57	82.1	1.0	0.0	Horz	PK	-9.5	54.9	74.0	-19.1
15909.84	45.1	19.3	1.65	20.2	1.0	0.0	Vert	PK	-9.5	54.9	74.0	-19.1

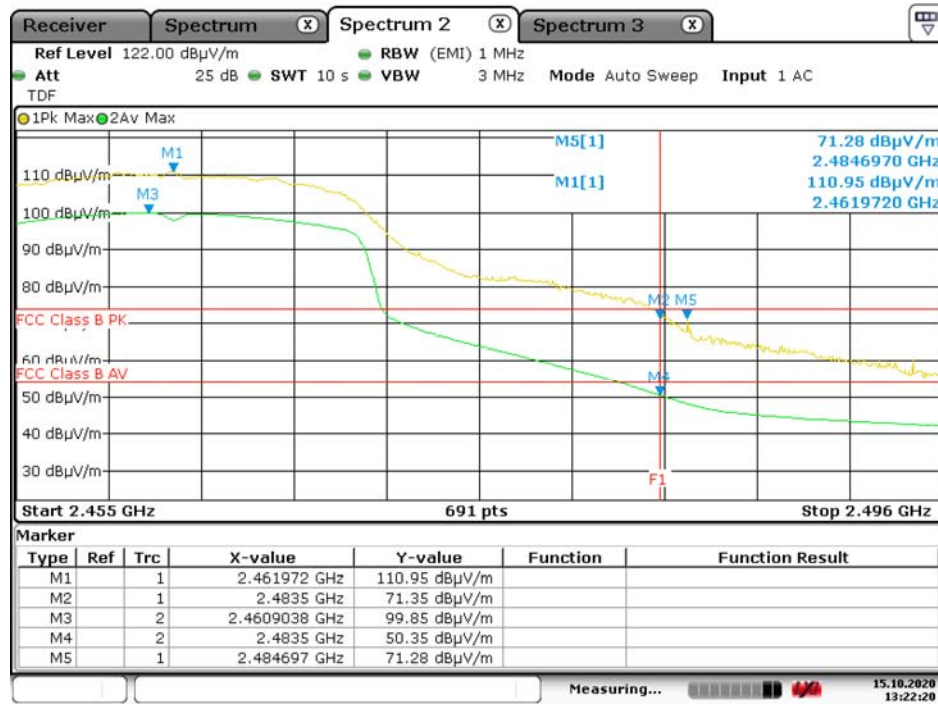
Upper Radiated Band Edge, Mode b, EUT on charger – Peak & Average



Upper Radiated Band Edge, Mode n, EUT on charger – Peak & Average



Upper Radiated Band Edge, Mode g, EUT on charger – Peak & Average



Date: 15.OCT.2020 13:22:20

12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	LF Lab.
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Frequencies Measured:	2437 MHz
EUT Channel Bandwidths:	20 MHz
EUT Modulation:	QPSK
Deviations From Standard:	None
Measurement BW:	10 kHz
Measurement Detectors:	Quasi-Peak and Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)
Supply: 120 V ac	120 V ac ± 10 % (as declared)

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average**
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.

**A linear average detector is required.

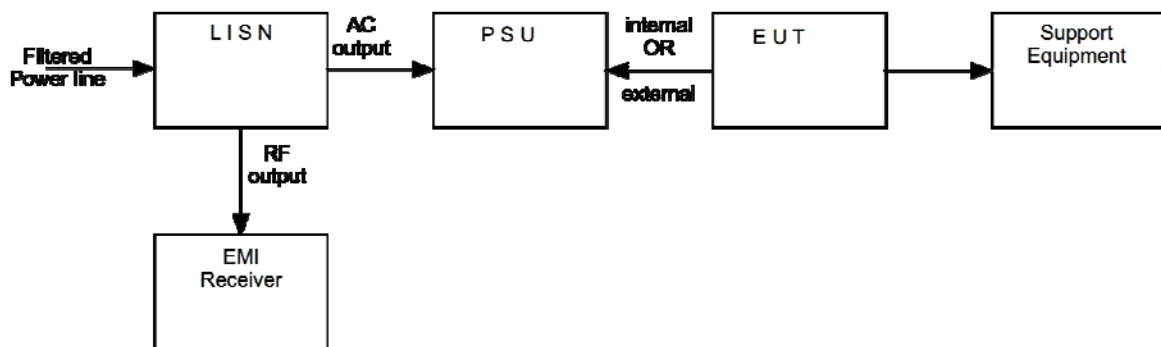
12.4 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



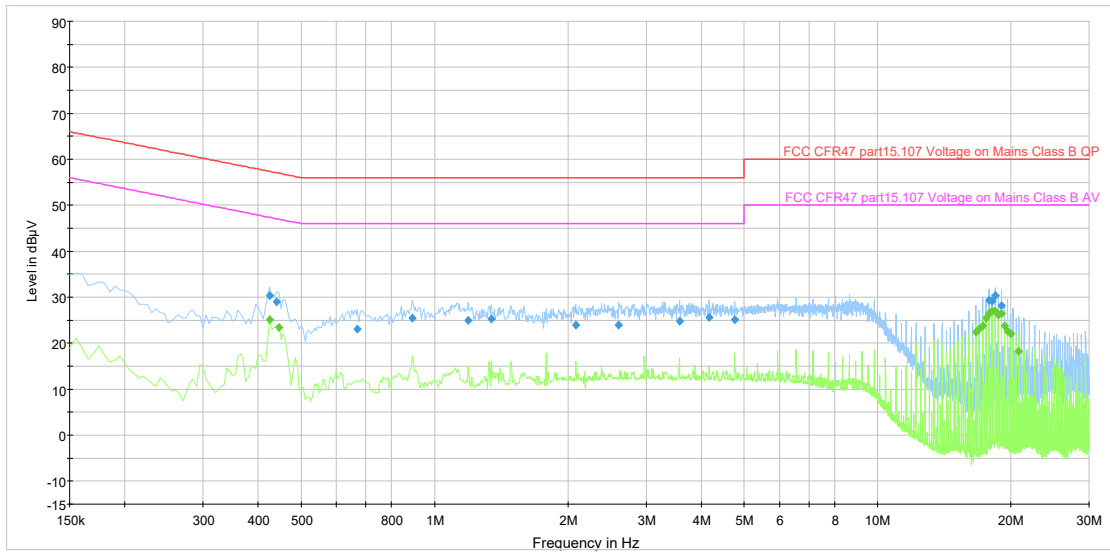
12.5 Test Set-up Photograph



12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ENV216	R&S	Lisn	U396	2021-09-07
ESHS10	R&S	Receiver	U003	2020-10-23

12.7 Test Results



AC power-line conducted emissions, Transmit mode									
Results measured using the quasi-peak detector									
Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.425000	30.3	2000.	10.000	On	N	9.6	27.0	57.3	Pass
0.440000	29.0	2000.	10.000	On	L1	9.6	28.1	57.1	Pass
0.670000	23.1	2000.	10.000	On	N	9.6	32.9	56.0	Pass
0.890000	25.4	2000.	10.000	On	N	9.6	30.6	56.0	Pass
1.190000	25.0	2000.	10.000	On	N	9.6	31.0	56.0	Pass
1.345000	25.3	2000.	10.000	On	N	9.6	30.7	56.0	Pass
2.080000	24.0	2000.	10.000	On	N	9.6	32.0	56.0	Pass
2.605000	23.9	2000.	10.000	On	N	9.6	32.1	56.0	Pass
3.570000	24.9	2000.	10.000	On	N	9.6	31.1	56.0	Pass
4.165000	25.6	2000.	10.000	On	N	9.6	30.4	56.0	Pass
4.760000	25.1	2000.	10.000	On	N	9.6	30.9	56.0	Pass
17.855000	29.4	2000.	10.000	On	L1	9.7	30.6	60.0	Pass
18.150000	29.2	2000.	10.000	On	N	9.7	30.8	60.0	Pass
18.450000	30.4	2000.	10.000	On	L1	9.7	29.6	60.0	Pass
19.040000	28.2	2000.	10.000	On	N	9.8	31.8	60.0	Pass

Results measured using the average detector									
Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.425000	25.1	2000.0	10.000	On	N	9.6	22.2	47.3	Pass
0.445000	23.5	2000.0	10.000	On	N	9.6	23.5	47.0	Pass
16.665000	22.4	2000.0	10.000	On	L1	9.7	27.6	50.0	Pass
16.960000	23.1	2000.0	10.000	On	L1	9.7	26.9	50.0	Pass
17.255000	23.8	2000.0	10.000	On	L1	9.7	26.2	50.0	Pass
17.555000	25.4	2000.0	10.000	On	L1	9.7	24.6	50.0	Pass
17.855000	26.4	2000.0	10.000	On	L1	9.7	23.6	50.0	Pass
18.150000	27.0	2000.0	10.000	On	L1	9.7	23.0	50.0	Pass
18.450000	26.9	2000.0	10.000	On	L1	9.7	23.1	50.0	Pass
18.745000	26.1	2000.0	10.000	On	N	9.8	23.9	50.0	Pass
19.045000	26.5	2000.0	10.000	On	N	9.8	23.5	50.0	Pass
19.340000	23.7	2000.0	10.000	On	L1	9.7	26.3	50.0	Pass
19.640000	22.5	2000.0	10.000	On	L1	9.7	27.5	50.0	Pass
19.935000	22.0	2000.0	10.000	On	N	9.8	28.0	50.0	Pass
20.830000	18.1	2000.0	10.000	On	L1	9.7	31.9	50.0	Pass

13 Maximum peak conducted output power

13.1 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.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Laboratory
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Frequencies Measured:	2412 MHz / 2437 MHz / 2480 MHz
EUT Channel Bandwidths:	20 MHz
Deviations From Standard:	None
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

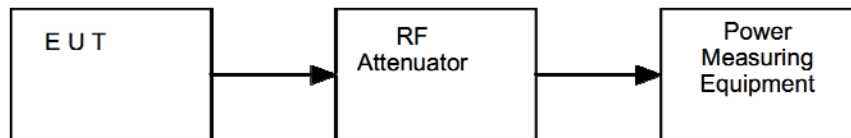
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

13.4 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



13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
RPR3006W	Dare	Power Meter	REF2223	2020-12-30

13.6 Test Results

802.11b; Data rate: 1 MBps; Power setting: 121					
Channel Frequency (MHz)	Power Meter Level (dBm)	Cable loss (dB)	Power (dBm)	Power (W)	Result
2412	-1.1	19.9	18.8	0.076	PASS
2437	-1.3	19.9	18.6	0.072	PASS
2462	-1.5	19.9	18.4	0.069	PASS

802.11g; Data rate: 6 MBps; Power setting: 121					
Channel Frequency (MHz)	Power Meter Level (dBm)	Cable loss (dB)	Power (dBm)	Power (W)	Result
2412	2.3	19.9	22.2	0.166	PASS
2437	1.8	19.9	21.7	0.148	PASS
2462	1.8	19.9	21.7	0.148	PASS

802.11n; Data rate: 6.5 MBps; Power setting: 121					
Channel Frequency (MHz)	Power Meter Level (dBm)	Cable loss (dB)	Power (dBm)	Power (W)	Result
2412	0.5	19.9	20.4	0.110	PASS
2437	2.3	19.9	22.2	0.166	PASS
2462	1.3	19.9	21.2	0.132	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] Radiated spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.75 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.46 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.2 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.58 %**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **0.93 dB**

[5] Conducted RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**

Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**

[6] Radiated RF power out-of-band

Uncertainty in test result (30 MHz to 1 GHz) = **4.75 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.46 dB**

[7] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **3.11 dB**

[8] ERP / EIRP

Uncertainty in test result (Laboratory) = **4.71 dB**

Uncertainty in test result (Pershore OATS) = **4.26 dB**