

Report on the Radio Testing
For
Extronics LTD
on
iTAG X30
Report no. TRA-048957-47-06B
23 July 2020

RF915 7.0



Report Number: TRA-048957-47-06B
Issue: B

REPORT ON THE RADIO TESTING OF A
Extronics LTD
iTAG X30
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 2020-02-24 to 2020-03-10

Written by:

Steven Garwell
Radio Test Engineer

Approved by:

John Charters
Department Manager - Radio

Date: 23 July 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	2020-04-16	Original
B	23 July 2020	RF Exposure Updated

2 Summary

TEST REPORT NUMBER:	TRA-048957-47-06A
WORKS ORDER NUMBER:	TRA-048957-02
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J.
TEST SPECIFICATION:	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	iTAG X30
FCC IDENTIFIER:	2AIZEEXTRFID00003
EUT SERIAL NUMBER:	102
MANUFACTURER/AGENT:	Extronics LTD
ADDRESS:	1 Dalton Way Midpoint 18 Middlewich Cheshire CW10 0HU United Kingdom
CLIENT CONTACT:	Julian Poyner ☎ +441606 539 636 ✉ Julian.Poyner@extronics.com
ORDER NUMBER:	PO-0020207-Luke
TEST DATE:	2020-02-24 to 2020-03-10
TESTED BY:	Daniel Moncayola, Steven Garwell, Michael Else Element

2.1 Test Summary

Test Method and Description		Requirement Clause 47CFR15		Result / Note
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.205	☒	PASS
AC power line conducted emissions		15.207	☒	PASS
Occupied bandwidth		15.247(a)(2)	☒	PASS
Conducted carrier power	Peak	15.247(b)(3)	☒	PASS
	Max.		☐	
Conducted / radiated RF power out-of-band		15.247(d)	☒	PASS
Power spectral density, conducted		15.247(e)	☒	PASS
Calculation of duty correction		-	☐	Customer Declaration

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)

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4 Introduction

This report TRA-048957-47-06B presents the results of the Radio testing on an Extronics LTD, iTAG X30 to specification 47CFR15 Radio Frequency Devices: Category I Equipment.

The testing was carried out for Extronics 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
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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.

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: iTAG X30
- Serial Number: 102
- Model Number: iTAGx30
- Software Revision: 1..22.4..7402.00
- Build Level / Revision Number: REV 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.

Laptop

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for transmit tests was as follows:-

The EUT was set to transmit permanently on top, middle or bottom channels as indicated.

7.4 EUT Radio Parameters

7.4.1 General

Frequencies of operation:	2412 MHz – 2462 MHz
Modulation types:	DSSS / OFDM
Occupied channel bandwidth:	20 MHz
Channel spacing:	5 MHz
Declared output power:	-18 dBm
Nominal Supply Voltage:	3.7 Vdc
Duty Cycle:	1 beacon/second, width=125uS = .0125%

7.4.2 Antennas

Type:	PCB Trace
Frequency range:	2412 MHz – 2462 MHz
Gain:	0 dBi

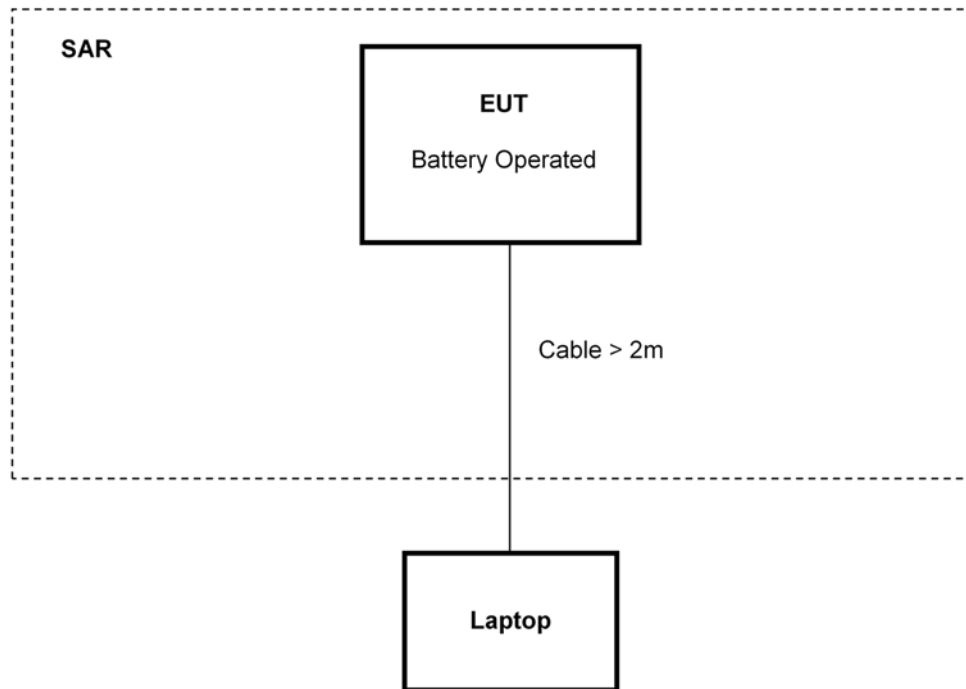
7.5 EUT Description

The Plymouth system is the next generation in Extronics worker safety solutions and is designed to accurately locate workers using Wi-Fi and GNSS technologies.

8 EUT Test Setup

8.1 Block Diagram

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



8.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



8.3 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.

9 General Technical Parameters

9.1 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 was 3.7 Vdc from internal Lithium batteries.

9.2 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	New battery	N/A

10 Radiated emissions

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:	Radio Chamber SK03
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 Bandwidth:	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: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 38 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	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 ($\mu\text{V/m}$ at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

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:

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

$$\text{Factor} = CL + AF - PA$$

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;

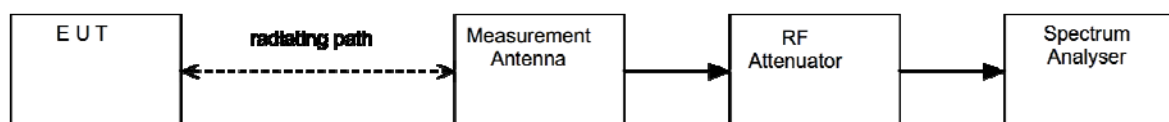
PA is the pre-amplifier gain in dB (where used);

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 Set-up Photograph



10.6 Test Equipment

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
CBL611/A	Chase	Bilog	U573	2021-09-19
3115	EMCO	1-18GHz Horn	L139	2021-07-16
20240-20	Flann	Horn 18-26GHz (&U330)	L300	2020-04-24
8449B	Agilent	Pre Amp	L572	2020-10-15
PreAmp	Watkins Johnson	6201-69	U372	2021-02-26
AFH-07000	Atlantic Microwave	High Pass Filter	U558	2020-03-20
Spectrum Analyser	Keysight	N9030B	*MY571417	2020-04-15

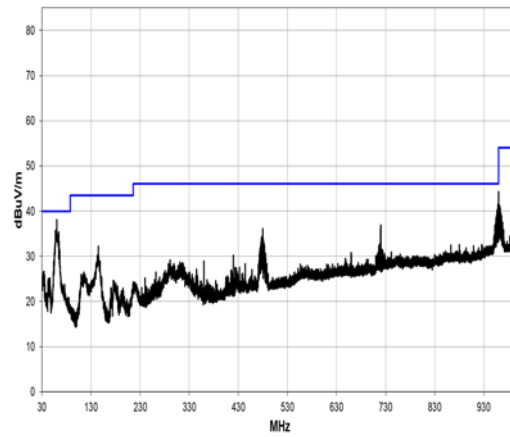
*Loan Spectrum Analyser

10.7 Test Results

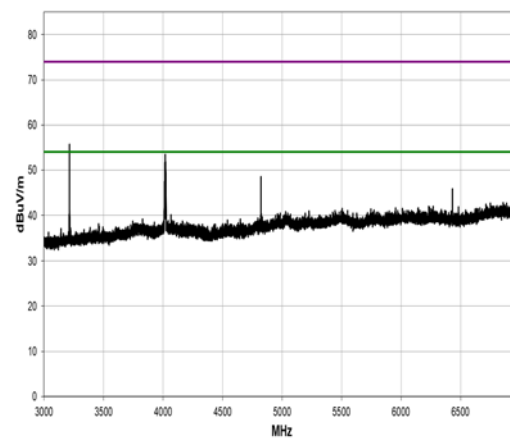
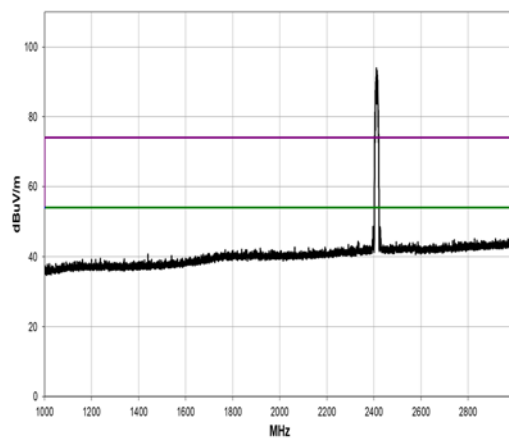
Measurement results common to all modes of operation 30 MHz to 1 GHz

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)
60.020	47.4	-16.7	1.0	349.0	3.0	0.0	Vert	QP	0.0	30.7	40.0	-9.3
720.030	31.8	2.1	1.0	321.9	3.0	0.0	Vert	QP	0.0	33.9	46.0	-12.1
959.344	27.0	6.7	1.22	326.0	3.0	0.0	Vert	QP	0.0	33.7	46.0	-12.3
720.028	28.4	2.1	1.0	6.9	3.0	0.0	Horz	QP	0.0	30.5	46.0	-15.5
959.344	23.3	6.7	2.8	208.0	3.0	0.0	Horz	QP	0.0	30.0	46.0	-16.0
55.074	39.5	-16.4	1.03	0.0	3.0	0.0	Vert	QP	0.0	23.1	40.0	-16.9
479.344	27.2	-2.2	1.0	84.1	3.0	0.0	Vert	QP	0.0	25.0	46.0	-21.0
948.461	18.2	6.1	2.66	233.1	3.0	0.0	Horz	QP	0.0	24.3	46.0	-21.7
910.254	18.4	4.4	2.79	72.0	3.0	0.0	Horz	QP	0.0	22.8	46.0	-23.2
872.381	18.5	4.2	1.7	188.0	3.0	0.0	Vert	QP	0.0	22.7	46.0	-23.3
849.861	18.6	4.0	1.59	22.0	3.0	0.0	Vert	QP	0.0	22.6	46.0	-23.4
474.599	24.7	-2.2	1.02	95.0	3.0	0.0	Vert	QP	0.0	22.5	46.0	-23.5
855.283	18.4	4.1	3.8	276.9	3.0	0.0	Horz	QP	0.0	22.5	46.0	-23.5
479.344	24.1	-2.2	1.0	53.0	3.0	0.0	Horz	QP	0.0	21.9	46.0	-24.1
32.247	20.8	-5.1	1.5	278.9	3.0	0.0	Vert	QP	0.0	15.7	40.0	-24.3
34.214	20.8	-6.1	2.81	74.0	3.0	0.0	Vert	QP	0.0	14.7	40.0	-25.3
483.434	21.7	-2.0	1.0	41.0	3.0	0.0	Horz	QP	0.0	19.7	46.0	-26.3
474.584	21.0	-2.2	1.0	229.9	3.0	0.0	Horz	QP	0.0	18.8	46.0	-27.2
144.001	24.8	-10.0	1.0	59.0	3.0	0.0	Vert	QP	0.0	14.8	43.5	-28.7
42.021	21.0	-10.1	1.0	352.1	3.0	0.0	Vert	QP	0.0	10.9	40.0	-29.1

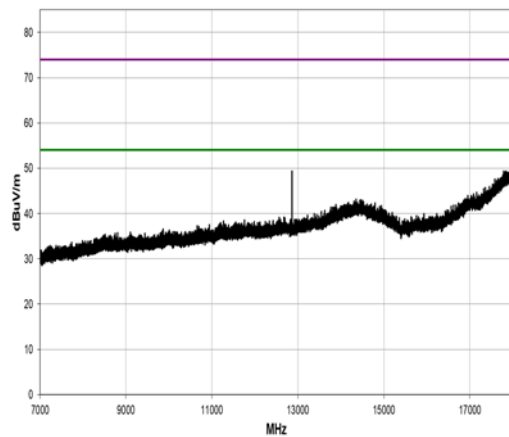
Bottom channel, 2412 MHz, 802.11 b



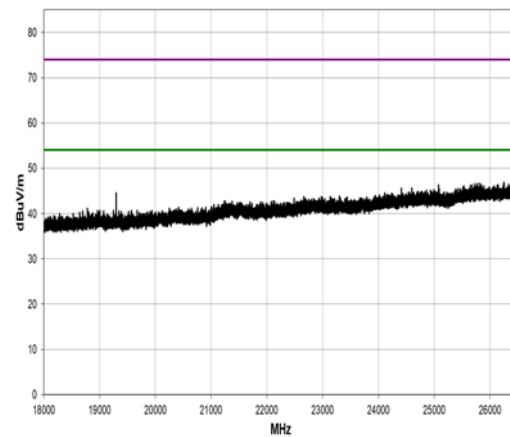
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

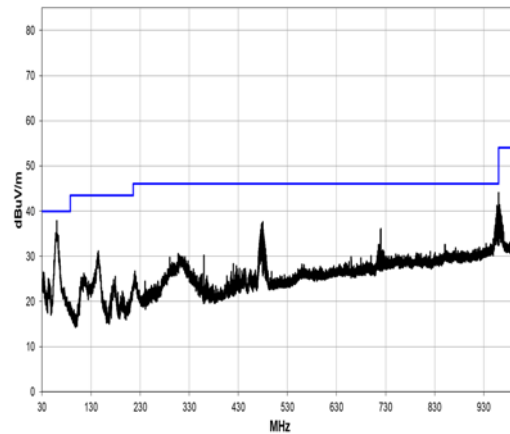


7 GHz to 18 GHz

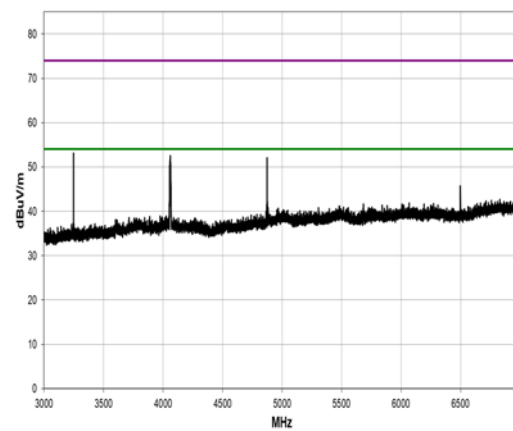
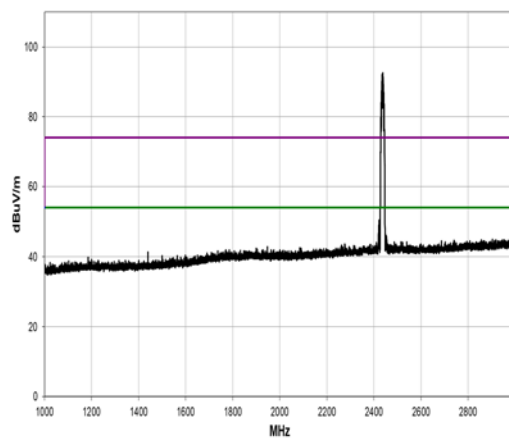
18 GHz to 26.5 GHz

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)
4021.233	49.7	2.7	1.5	270.1	3.0	0.0	Vert	AV	0.0	52.4	54.0	-1.6
4019.100	45.9	2.7	1.5	341.0	3.0	0.0	Horz	AV	0.0	48.6	54.0	-5.4
4824.012	41.7	3.5	1.5	78.0	3.0	0.0	Vert	AV	0.0	45.2	54.0	-8.8
4824.037	41.5	3.5	1.5	281.1	3.0	0.0	Horz	AV	0.0	45.0	54.0	-9.0
4021.100	57.4	2.7	1.5	270.1	3.0	0.0	Vert	PK	0.0	60.1	74.0	-13.9
4018.433	53.9	2.7	1.5	341.0	3.0	0.0	Horz	PK	0.0	56.6	74.0	-17.4
4824.178	49.2	3.5	1.5	281.1	3.0	0.0	Horz	PK	0.0	52.7	74.0	-21.3
4824.137	49.1	3.5	1.5	78.0	3.0	0.0	Vert	PK	0.0	52.6	74.0	-21.4

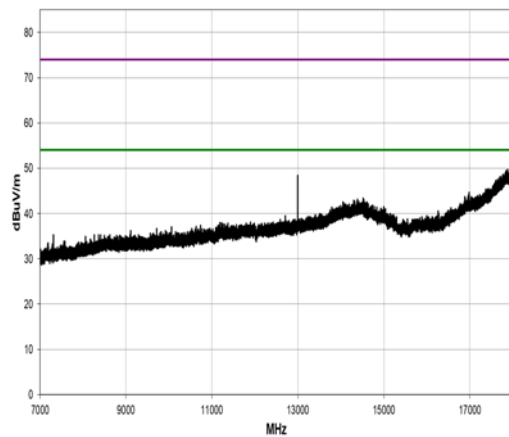
Middle channel, 2437 MHz, 802.11 b



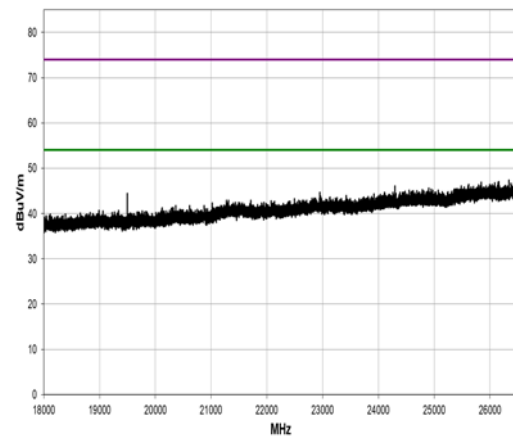
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

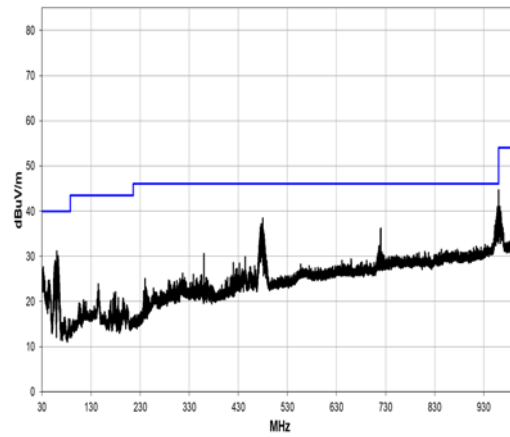


7 GHz to 18 GHz

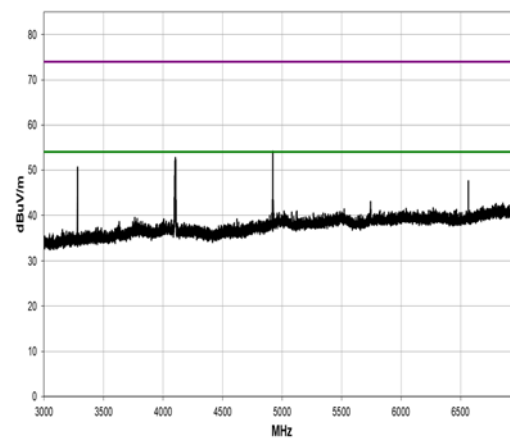
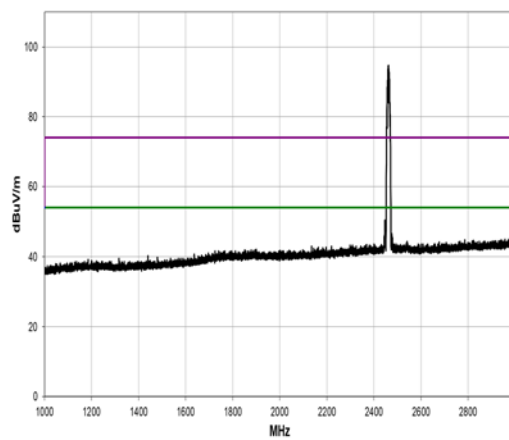
18 GHz to 26.5 GHz

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)
4060.690	49.3	2.7	1.5	258.1	3.0	0.0	Vert	AV	0.0	52.0	54.0	-2.0
4874.018	45.8	3.8	1.48	165.0	3.0	0.0	Vert	AV	0.0	49.6	54.0	-4.4
4060.823	46.3	2.7	1.78	340.0	3.0	0.0	Horz	AV	0.0	49.0	54.0	-5.0
4874.002	44.5	3.8	1.53	192.0	3.0	0.0	Horz	AV	0.0	48.3	54.0	-5.7
4062.957	56.4	2.7	1.5	258.1	3.0	0.0	Vert	PK	0.0	59.1	74.0	-14.9
4062.823	54.5	2.7	1.78	340.0	3.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8
4874.002	52.5	3.8	1.48	165.0	3.0	0.0	Vert	PK	0.0	56.3	74.0	-17.7
4874.102	51.2	3.8	1.53	192.0	3.0	0.0	Horz	PK	0.0	55.0	74.0	-19.0

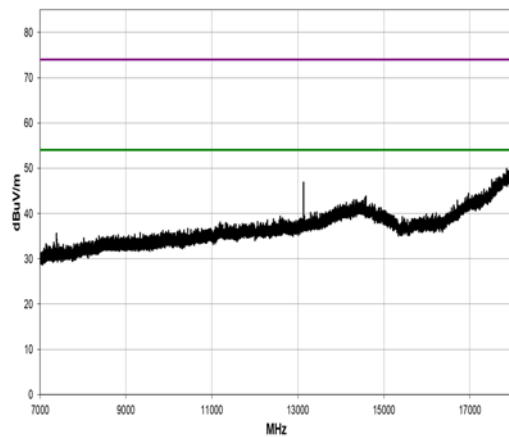
Top channel, 2462 MHz, 802.11 b



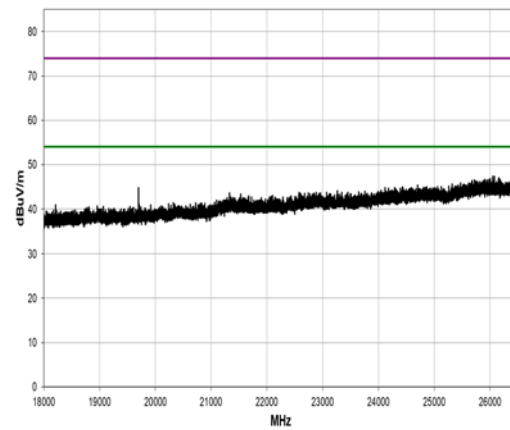
30 MHz to 1 GHz



1 GHz to 3 GHz



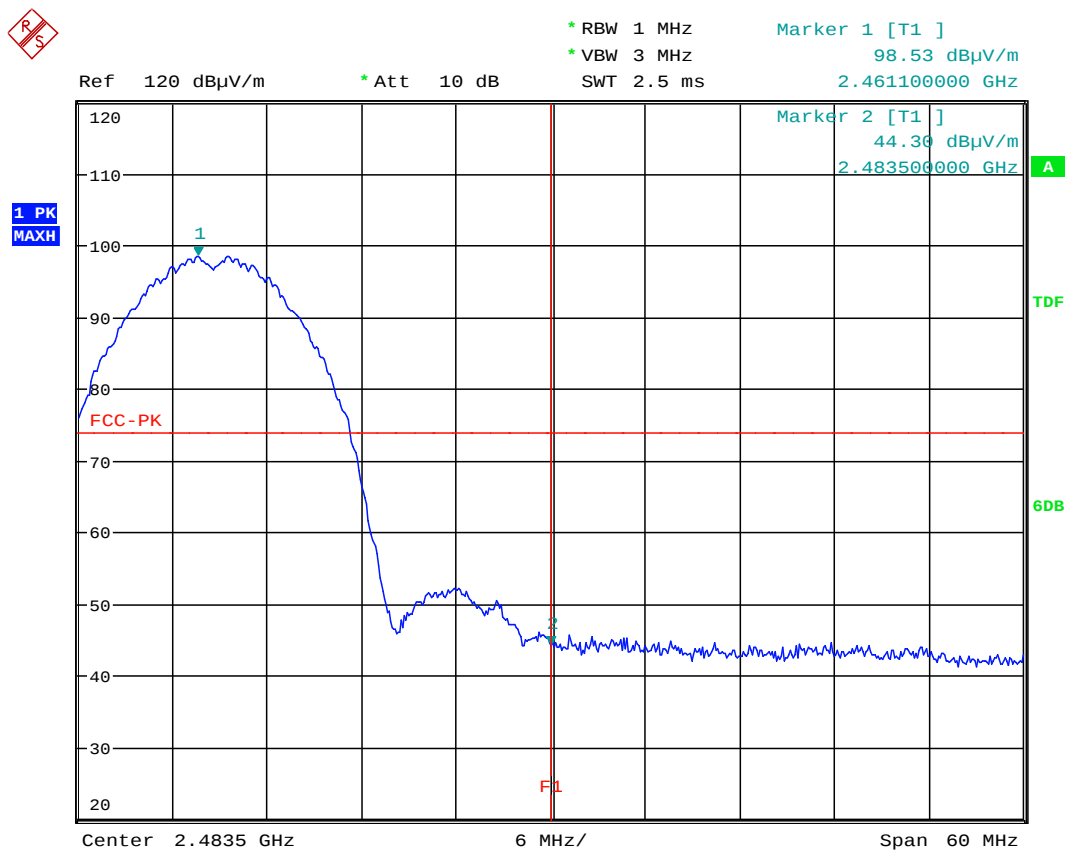
3 GHz to 7 GHz



7 GHz to 18 GHz

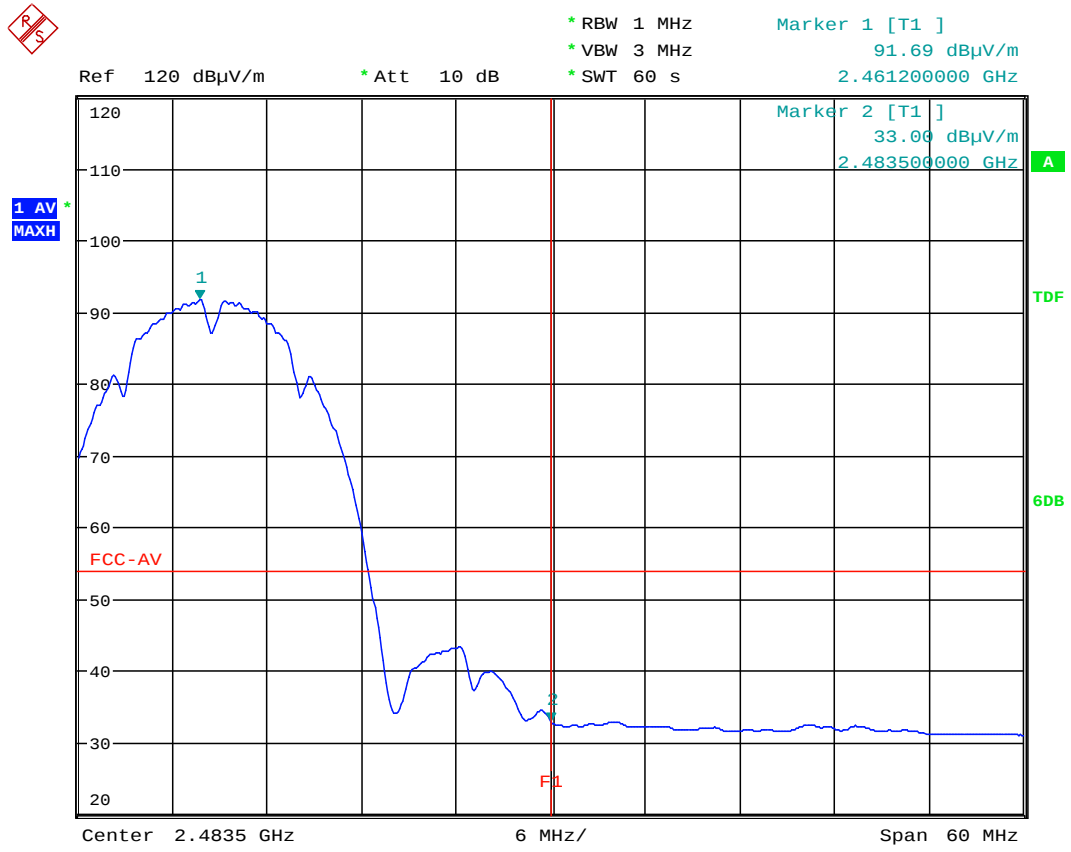
18 GHz to 26.5 GHz

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)
4102.423	49.3	2.8	1.61	269.0	3.0	0.0	Vert	AV	0.0	52.1	54.0	-1.9
4923.960	47.3	3.9	1.41	191.0	3.0	0.0	Horz	AV	0.0	51.2	54.0	-2.8
4923.943	47.3	3.9	1.5	161.1	3.0	0.0	Vert	AV	0.0	51.2	54.0	-2.8
4104.423	44.5	2.8	1.5	346.0	3.0	0.0	Horz	AV	0.0	47.3	54.0	-6.7
4102.023	56.0	2.8	1.61	269.0	3.0	0.0	Vert	PK	0.0	58.8	74.0	-15.2
4923.952	53.6	3.9	1.41	191.0	3.0	0.0	Horz	PK	0.0	57.5	74.0	-16.5
4924.043	53.3	3.9	1.5	161.1	3.0	0.0	Vert	PK	0.0	57.2	74.0	-16.8
4104.557	52.3	2.8	1.5	346.0	3.0	0.0	Horz	PK	0.0	55.1	74.0	-18.9



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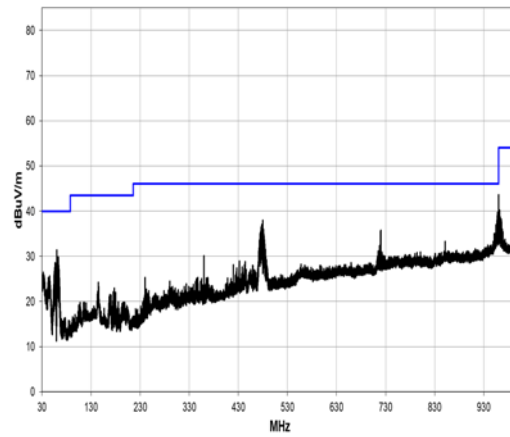
Upper Radiated Band Edge 1 Mbps - Peak



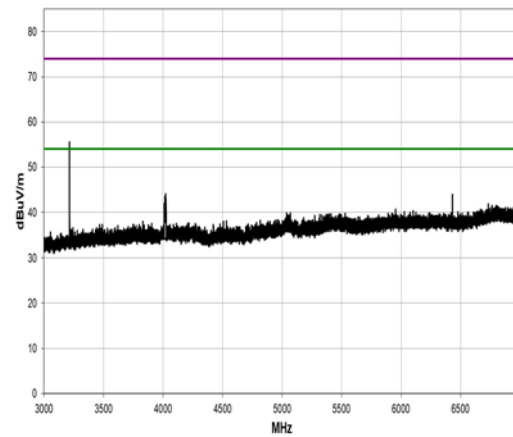
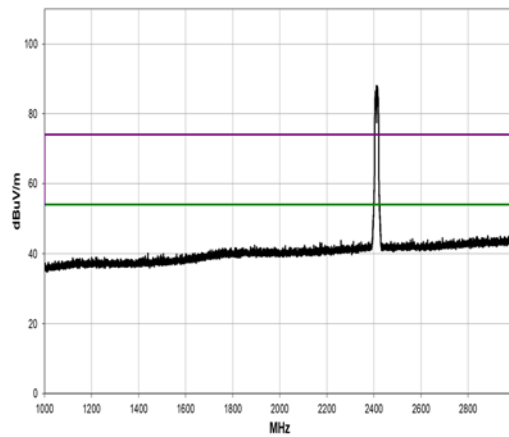
Date: 19.FEB.2020 11:22:34

Upper Radiated Band Edge 1 Mbps - Average

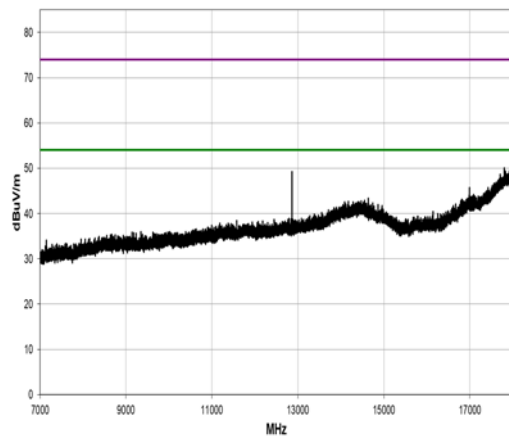
Bottom channel, 2412 MHz, 802.11 g



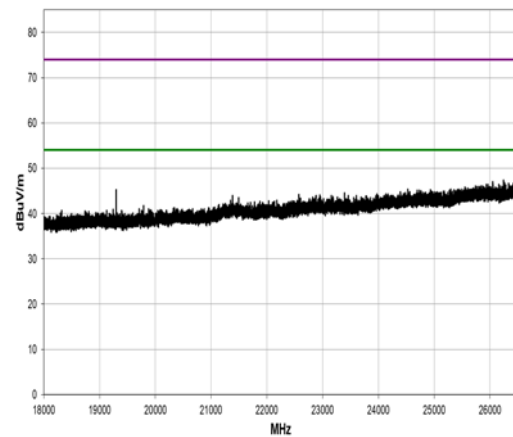
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

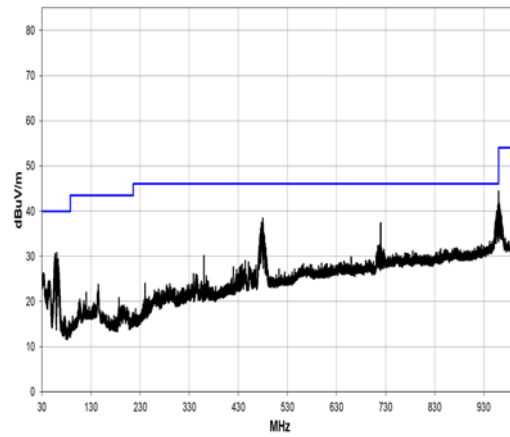


7 GHz to 18 GHz

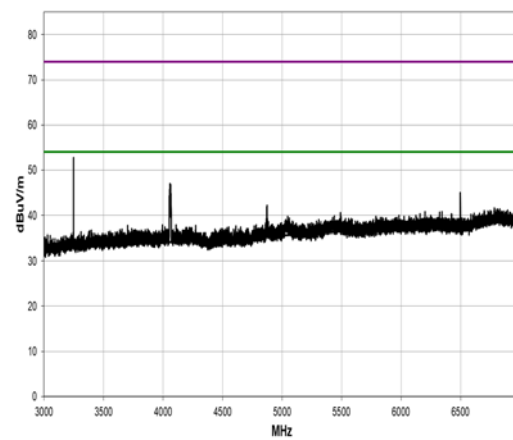
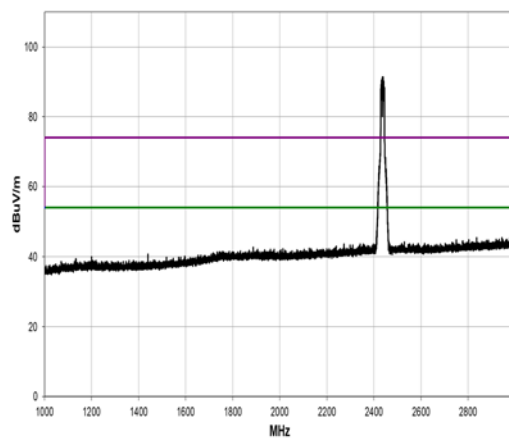
18 GHz to 26.5 GHz

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)
4018.750	35.8	2.7	1.65	276.0	3.0	0.0	Vert	AV	0.0	38.5	54.0	-15.5
4018.750	34.4	2.7	1.37	279.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9

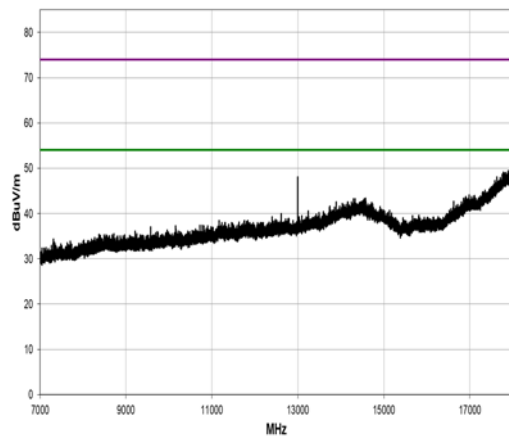
Middle channel, 2437 MHz, 802.11 g



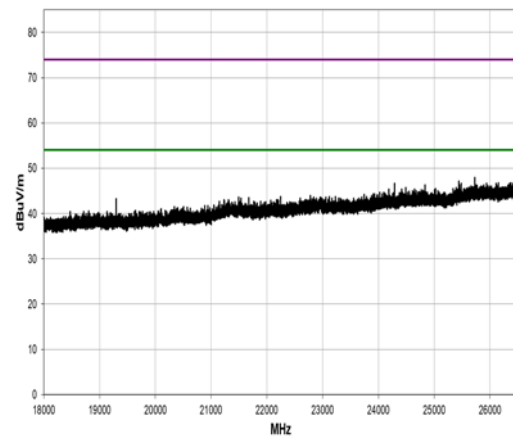
30 MHz to 1 GHz



1 GHz to 3 GHz



3 GHz to 7 GHz

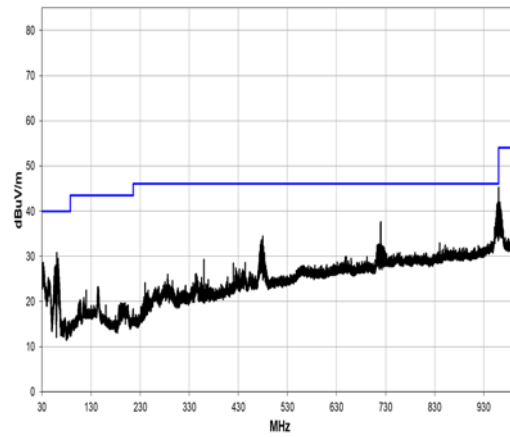


7 GHz to 18 GHz

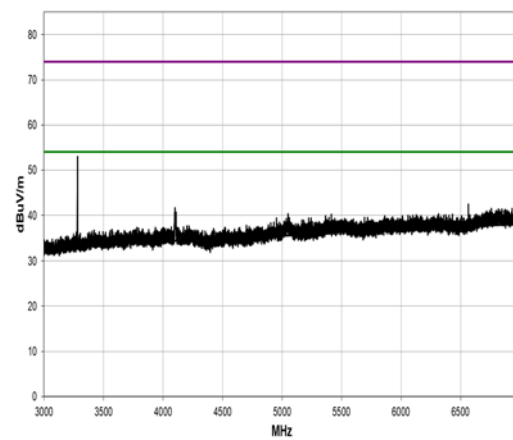
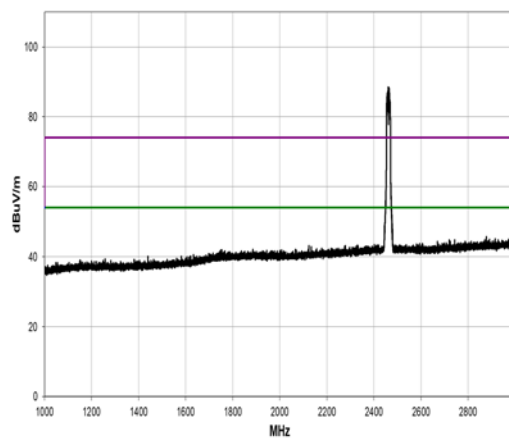
18 GHz to 26.5 GHz

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)
4060.467	37.2	2.7	1.92	287.0	3.0	0.0	Vert	AV	0.0	39.9	54.0	-14.1
4060.467	36.2	2.7	2.12	277.0	3.0	0.0	Horz	AV	0.0	38.9	54.0	-15.1
4875.133	31.3	3.8	1.12	253.0	3.0	0.0	Vert	AV	0.0	35.1	54.0	-18.9
4896.200	30.5	3.8	1.0	245.1	3.0	0.0	Horz	AV	0.0	34.3	54.0	-19.7

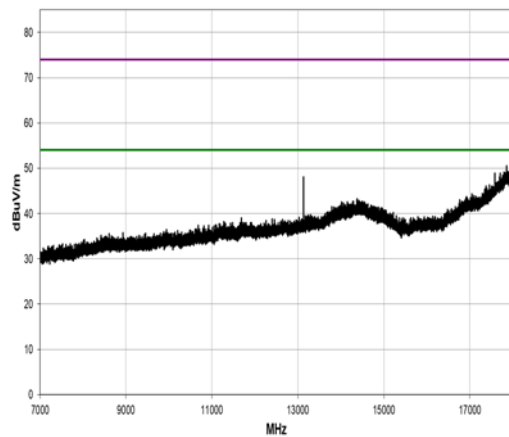
Top channel, 2462 MHz, 802.11 g



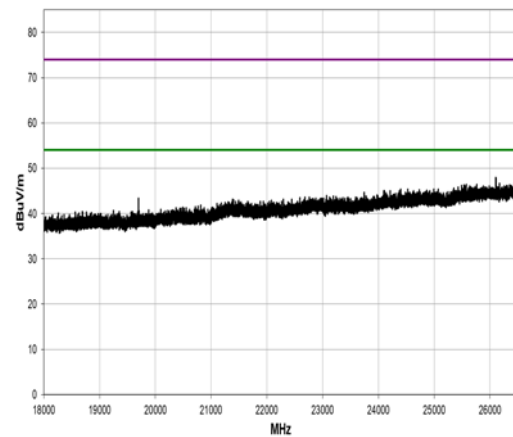
30 MHz to 1 GHz



1 GHz to 3 GHz



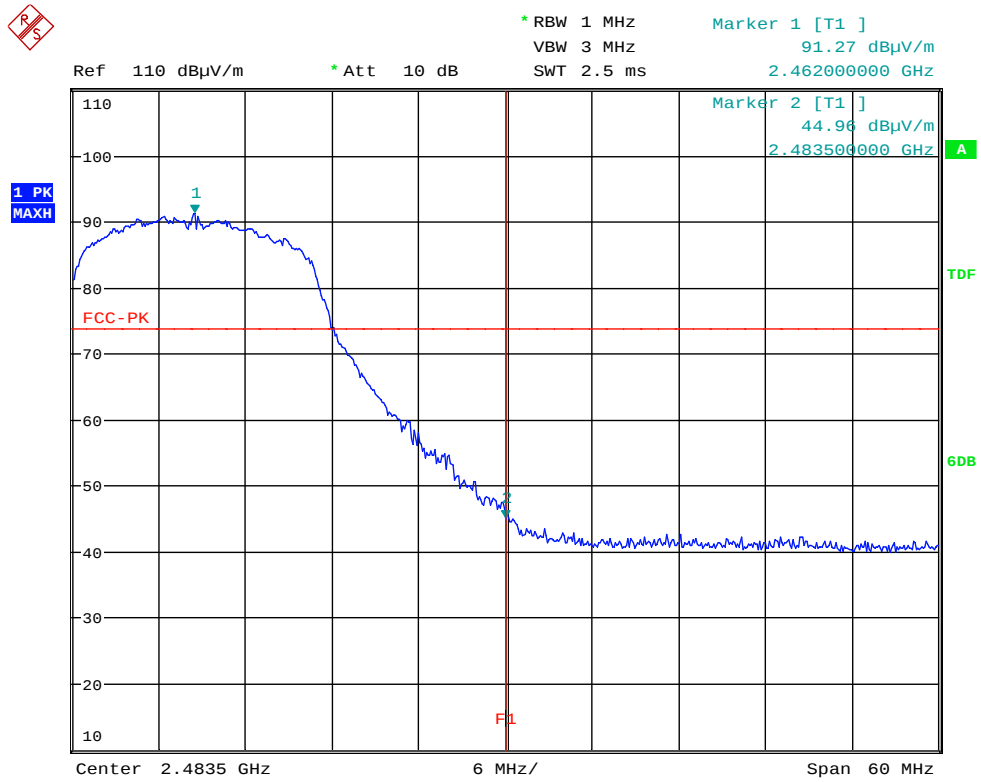
3 GHz to 7 GHz



7 GHz to 18 GHz

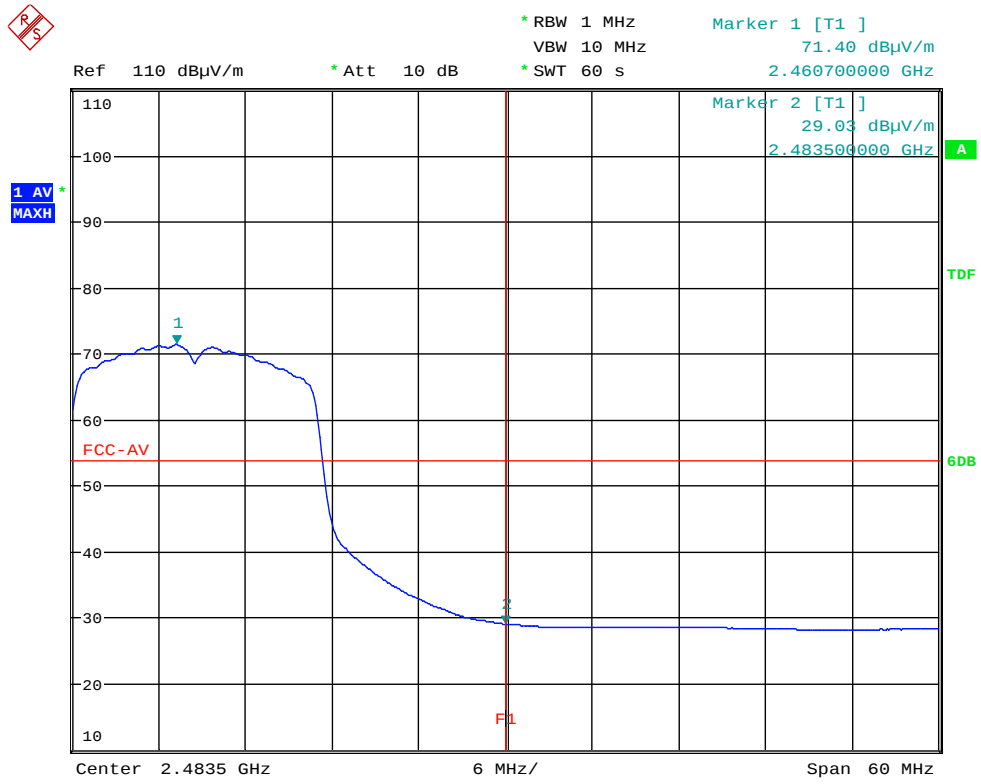
18 GHz to 26.5 GHz

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)
4102.083	34.4	2.8	1.63	269.1	3.0	0.0	Vert	AV	0.0	37.2	54.0	-16.8
4104.667	34.3	2.8	1.5	190.0	3.0	0.0	Horz	AV	0.0	37.1	54.0	-16.9



Date: 24.FEB.2020 20:25:27

Upper Radiated Band Edge 6 Mbps – Peak



Date: 24.FEB.2020 20:26:53

Upper Radiated Band Edge 6 Mbps - Average

11 AC power-line conducted emissions

11.1 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.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Transient Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Channels / Frequencies Measured:	Mid
EUT Channel Bandwidths:	1 MHz
EUT Modulation:	GFSK
Deviations From Standard:	None
Measurement Detectors:	Quasi-Peak and Average, RMS

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 30 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 V dc	3.7 V dc (as declared)

11.3 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

<i>Frequency (MHz)</i>	<i>Conducted limit (dBμV)</i>	
	<i>Quasi-Peak</i>	<i>Average**</i>
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.

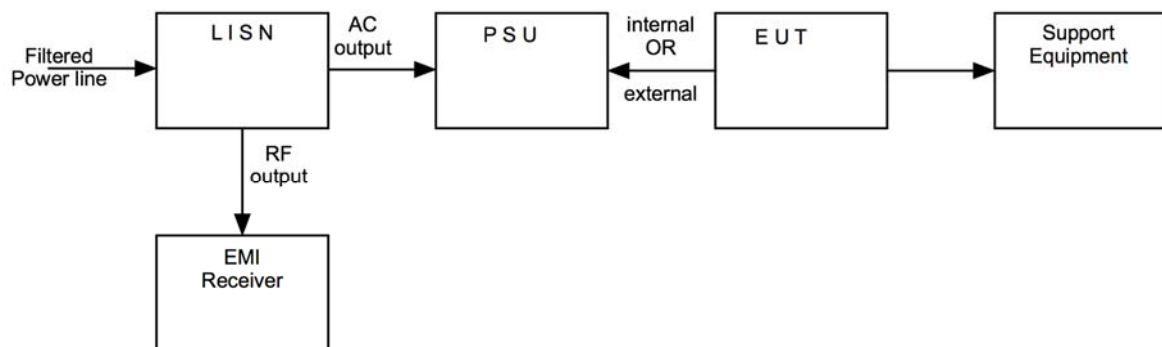
11.4 Test Method

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



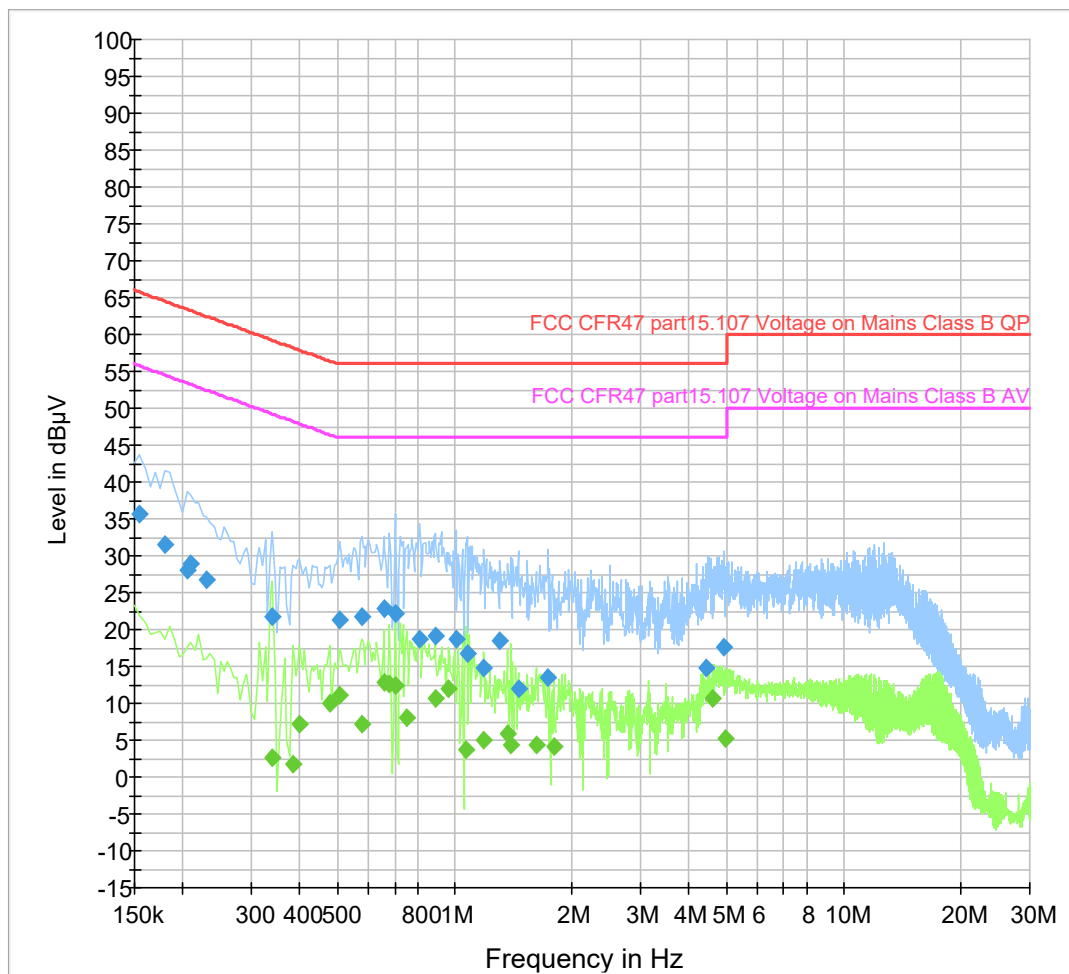
11.5 Test Set-up Photograph



11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESHS10	R&S	Receiver	U003	2020-10-23
ESH3-Z5.831.5	R&S	Lisn	U195	2020-10-04
ESH3-Z2	R&S	Pulse Limiter	U559	2020-10-17

11.7 Test Results



AC power-line conducted emissions, Transmit mode									
Results measured using the average detector									
Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.340000	2.7	2000.0	10.000	GND	L1	10.0	46.5	49.2	PASS
0.385000	1.8	2000.0	10.000	GND	L1	10.0	46.4	48.2	PASS
0.400000	7.3	2000.0	10.000	GND	L1	10.0	40.6	47.9	PASS
0.475000	9.9	2000.0	10.000	GND	L1	10.0	36.5	46.4	PASS
0.505000	11.2	2000.0	10.000	GND	L1	10.0	34.8	46.0	PASS
0.575000	7.2	2000.0	10.000	GND	L1	10.0	38.8	46.0	PASS
0.655000	12.9	2000.0	10.000	GND	L1	10.0	33.1	46.0	PASS
0.680000	12.5	2000.0	10.000	GND	L1	10.0	33.5	46.0	PASS
0.700000	12.5	2000.0	10.000	GND	L1	10.0	33.5	46.0	PASS
0.750000	8.1	2000.0	10.000	GND	L1	10.0	37.9	46.0	PASS
0.890000	10.7	2000.0	10.000	GND	L1	10.0	35.3	46.0	PASS
0.965000	11.9	2000.0	10.000	GND	L1	10.0	34.1	46.0	PASS
1.065000	3.7	2000.0	10.000	GND	L1	10.0	42.3	46.0	PASS
1.185000	4.9	2000.0	10.000	GND	L1	10.0	41.1	46.0	PASS
1.365000	5.9	2000.0	10.000	GND	L1	10.1	40.1	46.0	PASS
1.390000	4.3	2000.0	10.000	GND	L1	10.1	41.7	46.0	PASS
1.615000	4.4	2000.0	10.000	GND	L1	10.1	41.6	46.0	PASS
1.800000	4.2	2000.0	10.000	GND	L1	10.1	41.8	46.0	PASS
4.590000	10.6	2000.0	10.000	GND	L1	10.3	35.4	46.0	PASS
4.975000	5.3	2000.0	10.000	GND	L1	10.3	40.7	46.0	PASS

<i>Results measured using the quasi-peak detector</i>									
Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.155000	35.6	2000.0	10.000	GND	L1	10.0	30.1	65.7	PASS
0.180000	31.5	2000.0	10.000	GND	L1	10.0	33.0	64.5	PASS
0.205000	28.1	2000.0	10.000	GND	L1	10.0	35.3	63.4	PASS
0.210000	28.8	2000.0	10.000	GND	L1	10.0	34.4	63.2	PASS
0.230000	26.8	2000.0	10.000	GND	L1	10.0	35.6	62.4	PASS
0.340000	21.8	2000.0	10.000	GND	L1	10.0	37.4	59.2	PASS
0.505000	21.2	2000.0	10.000	GND	L1	10.0	34.8	56.0	PASS
0.575000	21.6	2000.0	10.000	GND	L1	10.0	34.4	56.0	PASS
0.655000	22.9	2000.0	10.000	GND	L1	10.0	33.1	56.0	PASS
0.700000	22.3	2000.0	10.000	GND	L1	10.0	33.7	56.0	PASS
0.810000	18.7	2000.0	10.000	GND	L1	10.0	37.3	56.0	PASS
0.890000	19.1	2000.0	10.000	GND	L1	10.0	36.9	56.0	PASS
1.005000	18.7	2000.0	10.000	GND	L1	10.0	37.3	56.0	PASS
1.075000	16.7	2000.0	10.000	GND	L1	10.0	39.3	56.0	PASS
1.185000	14.8	2000.0	10.000	GND	L1	10.0	41.2	56.0	PASS
1.305000	18.4	2000.0	10.000	GND	L1	10.1	37.6	56.0	PASS
1.455000	11.9	2000.0	10.000	GND	L1	10.1	44.1	56.0	PASS
1.735000	13.5	2000.0	10.000	GND	L1	10.1	42.5	56.0	PASS
4.425000	14.8	2000.0	10.000	GND	L1	10.2	41.2	56.0	PASS
4.930000	17.6	2000.0	10.000	GND	L1	10.3	38.4	56.0	PASS

12 Occupied Bandwidth

12.1 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.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	FCC: ANSI C63.10-2013, Clause 11.8
EUT Frequencies Measured:	2412 MHz, 2437 MHz, 2462 MHz
EUT Channel Bandwidth:	20 MHz
EUT Test Modulations:	DBPSK, BPSK and 64 QAM
Deviations From Standard:	None
Measurement BW:	100 kHz
(IC requirement: 1% to 5% OBW; FCC requirement: 100 kHz)	
Spectrum Analyzer Video BW:	300 kHz
(requirement at least 3x RBW)	
Measurement Span:	40 MHz
(requirement 2 to 5 times OBW)	
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (as declared)

12.3 Test Limit

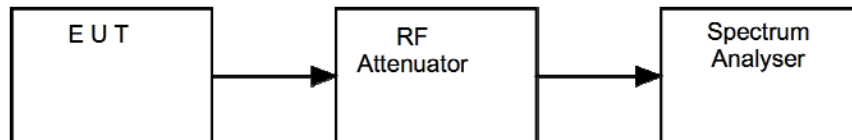
The minimum -6 dB bandwidth shall be at least 500 kHz.

12.4 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

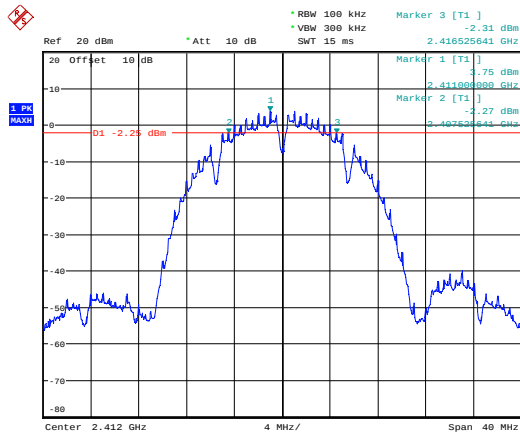


12.5 Test Equipment

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
FSU46	R&S	Spectrum Analyser	REF910	2020-10-17

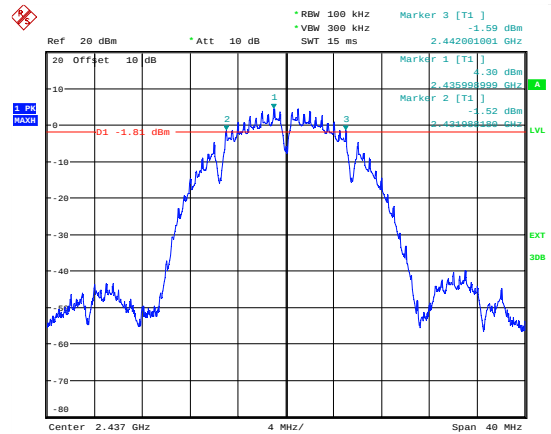
12.6 Test Results

FCC 15.247. Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2407.525641	2416.525641	9.000000	PASS
2437	2431.98818	2442.001001	10.012821	PASS
2462	2457.456918	2467.021021	9.564103	PASS



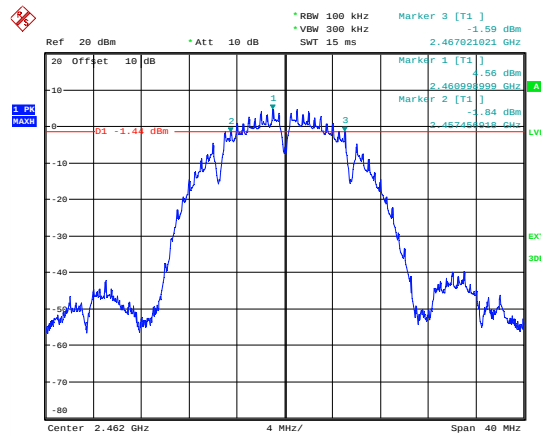
Date: 10.MAR.2020 08:22:07

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:54:50

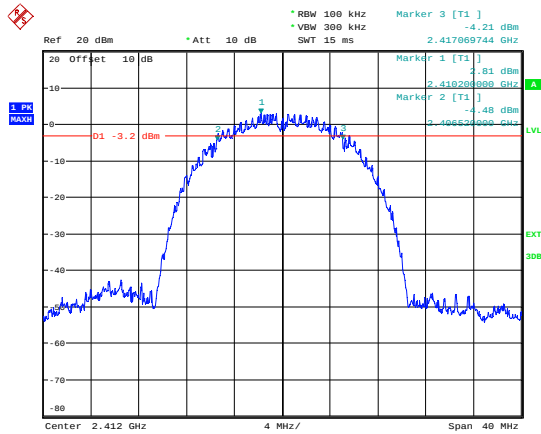
6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 08:56:47

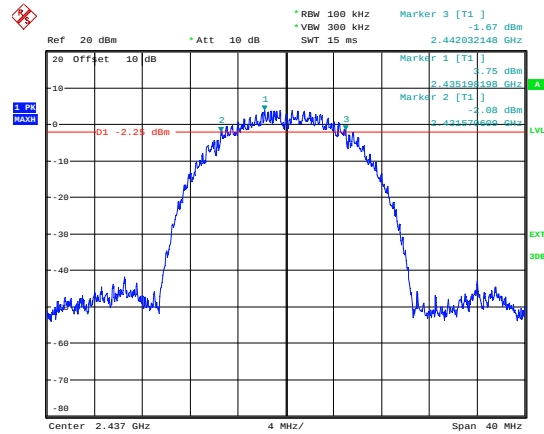
6 dB Bandwidth; 2462 MHz

FCC 15.247. Modulation: DBPSK; Data rate: 11 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2406.52000	2417.069744	10.549744	PASS
2437	2431.50609	2442.032148	10.526058	PASS
2462	2456.575229	2467.036768	10.461539	PASS



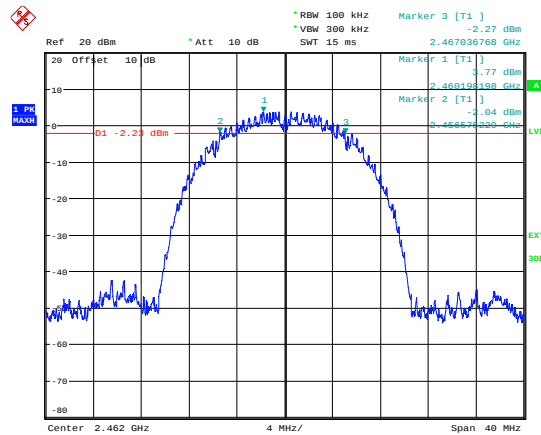
Date: 10.MAR.2020 08:25:12

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:53:06

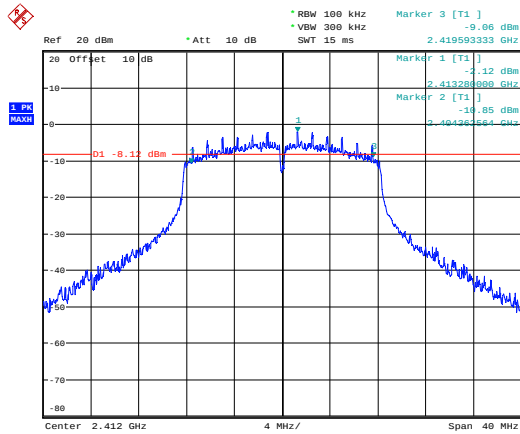
6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 09:03:42

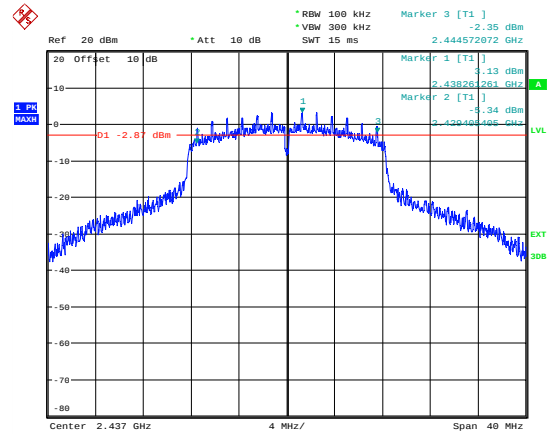
6 dB Bandwidth; 2462 MHz

FCC 15.247. Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2404.362564	2419.593333	15.230769	PASS
2437	2429.405405	2444.572072	15.166667	PASS
2462	2454.427928	2469.594595	15.166667	PASS



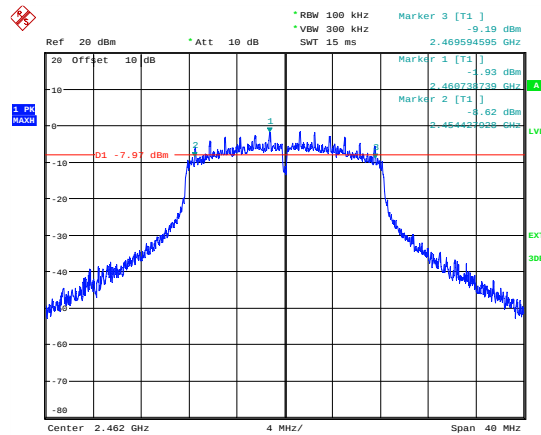
Date: 10.MAR.2020 08:30:46

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:50:59

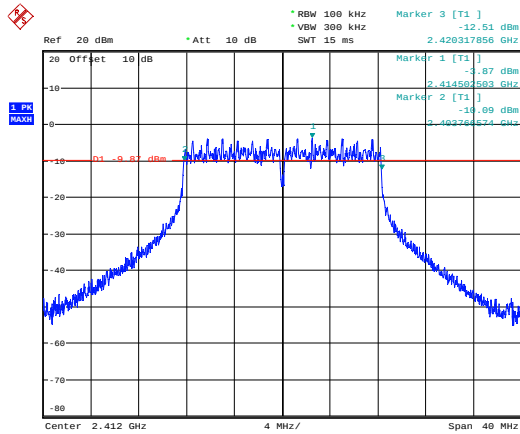
6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 09:05:19

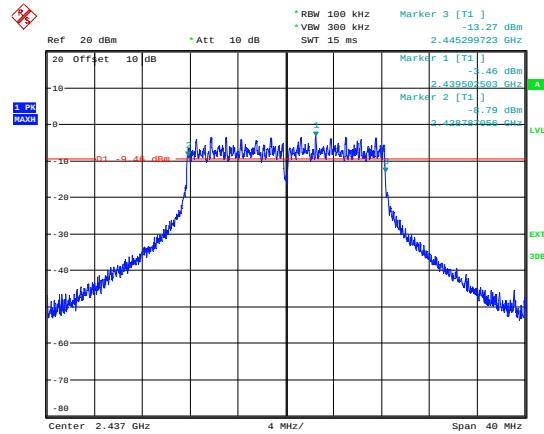
6 dB Bandwidth; 2462 MHz

FCC 15.247. Modulation: 16 QAM; Data rate: 54 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2403.766574	2420.317856	16.551282	PASS
2437	2428.787056	2445.299723	16.512667	PASS
2462	2453.789867	2470.277046	16.487179	PASS



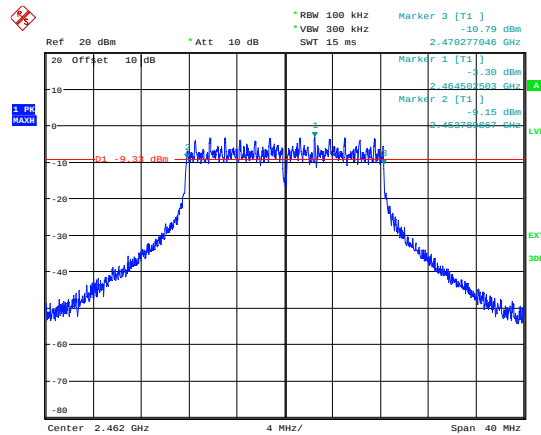
Date: 10.MAR.2020 08:35:44

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:48:37

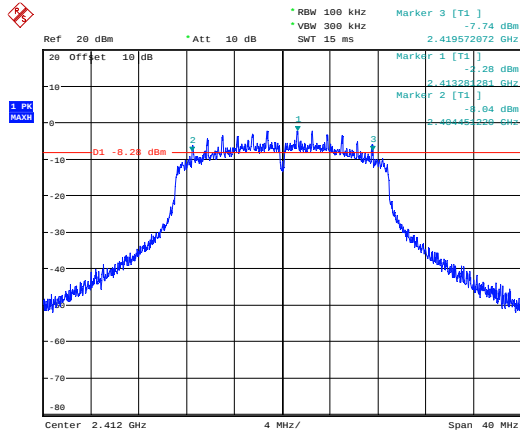
6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 09:07:26

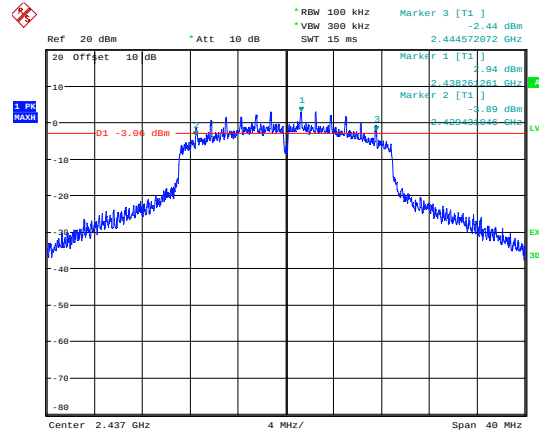
6 dB Bandwidth; 2462 MHz

FCC 15.247. Modulation: BPSK; Data rate: 7.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2404.451220	2419.572072	15.120852	PASS
2437	2429.431046	2444.572072	15.141026	PASS
2462	2454.451220	2469.592246	15.141026	PASS



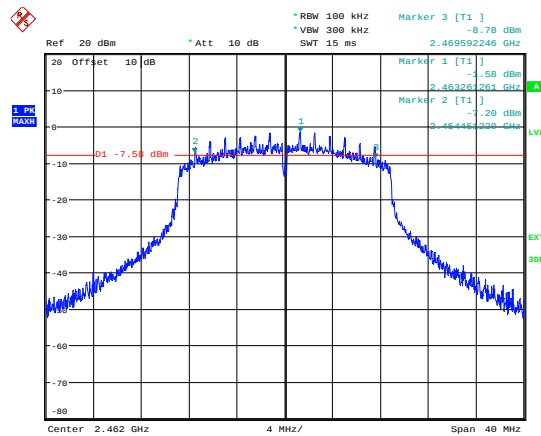
Date: 10.MAR.2020 08:37:40

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:45:58

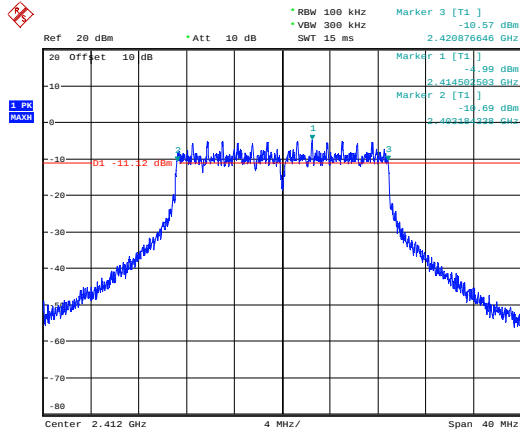
6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 09:09:05

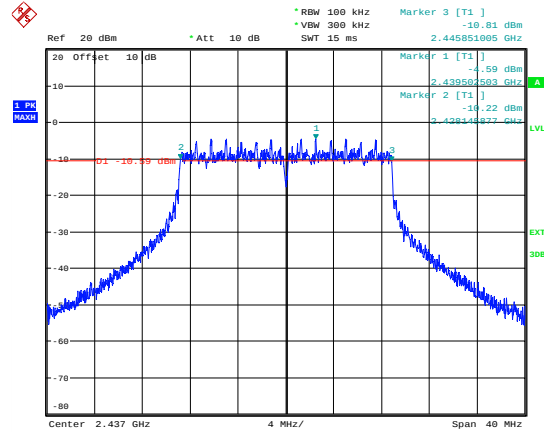
6 dB Bandwidth; 2462 MHz

FCC 15.247. Modulation: 64 QAM; Data rate: 72.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6dB Bandwidth (MHz)	Result
2412	2403.184338	2420.876646	17.692308	PASS
2437	2428.145877	2445.851005	17.705128	PASS
2462	2453.184338	2470.812543	17.628205	PASS



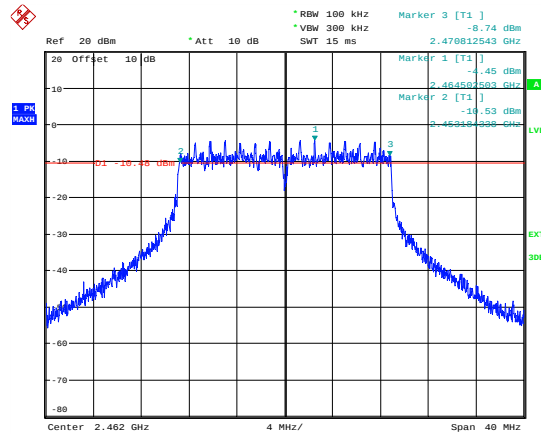
Date: 10.MAR.2020 08:39:58

6 dB Bandwidth; 2412 MHz



Date: 10.MAR.2020 08:42:30

6 dB Bandwidth; 2437 MHz



Date: 10.MAR.2020 09:11:03

6 dB Bandwidth; 2462 MHz

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 Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Frequencies Measured:	2412 MHz, 2437 MHz, 2462 MHz
EUT Channel Bandwidth:	20 MHz
Deviations From Standard:	None
Measurement BW:	20 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	30 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 30 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

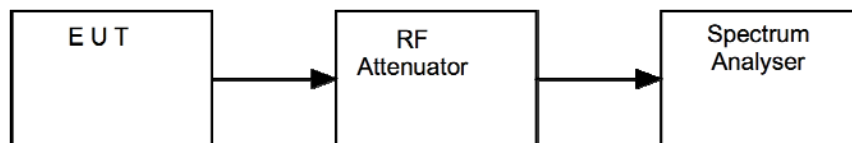
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

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

<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
FSU46	R&S	Spectrum Analyser	REF910	2020-10-17

13.6 Test Results

Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2412	15.94	0	39.26	PASS
2437	17.06	0	50.82	PASS
2462	16.98	0	49.89	PASS

Modulation: DBPSK; Data rate: 11 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2437	16.82	0	48.08	PASS

Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2412	16.91	0	49.09	PASS
2437	19.08	0	80.91	PASS
2462	17.98	0	62.81	PASS

Modulation: 64QAM; Data rate: 54 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2437	17.54	0	56.75	PASS

Modulation: BPSK; Data rate: 7.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2437	18.83	0	76.38	PASS

Modulation: 64QAM; Data rate: 72.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
2437	15.85	0	38.46	PASS

14 Out-of-band and conducted spurious emissions

14.1 Definition

Out-of-band emission.

Emission on a frequency or frequencies immediately outside the necessary bandwidth that results from the modulation process but excluding spurious emissions.

Spurious emission.

Emission on a frequency or frequencies that 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.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Frequencies Measured:	2412 MHz, 2437 MHz, 2462 MHz
EUT Channel Bandwidth:	20 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Detector:	Peak
Measurement Range:	30 MHz to 26.5 GHz

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 30 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (as declared)

14.3 Test Limit

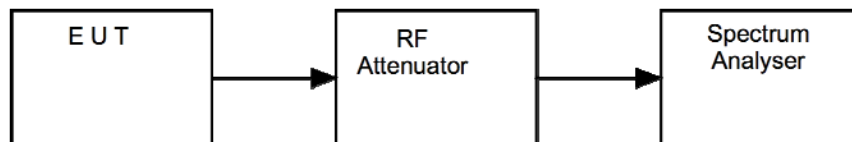
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in FCC 47CFR15.209(a) / RSS-Gen is not required.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions from the EUT were 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 v Test Setup

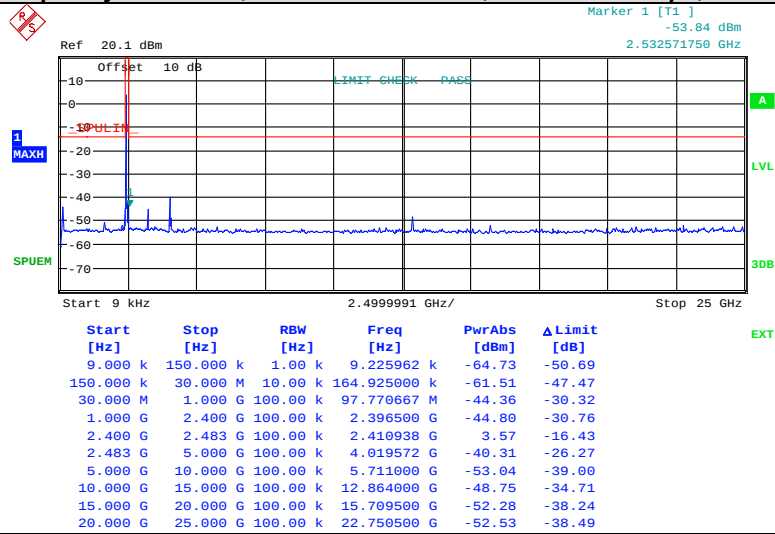


14.5 Test Equipment

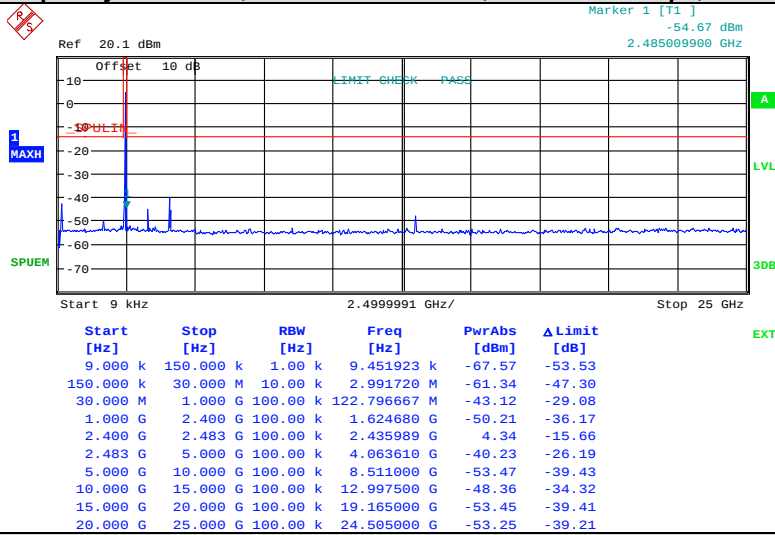
<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
FSU46	R&S	Spectrum Analyser	REF910	2020-10-17

14.6 Test Results

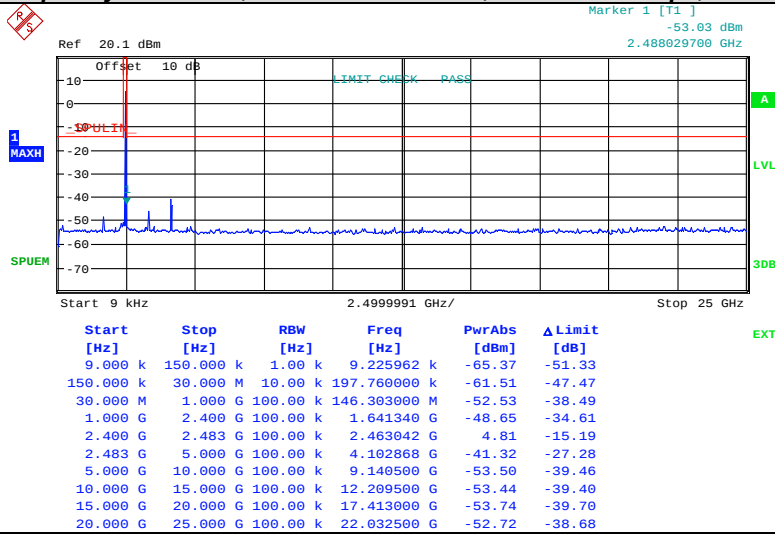
Frequency: 2412 MHz; Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0

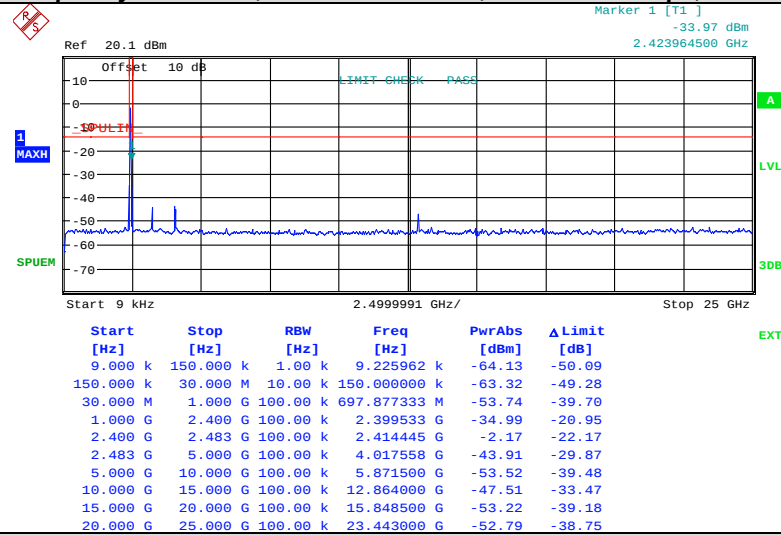
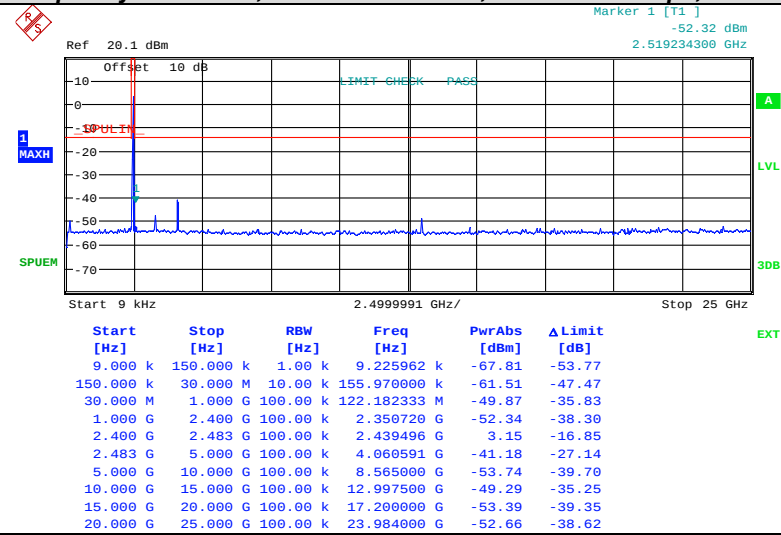
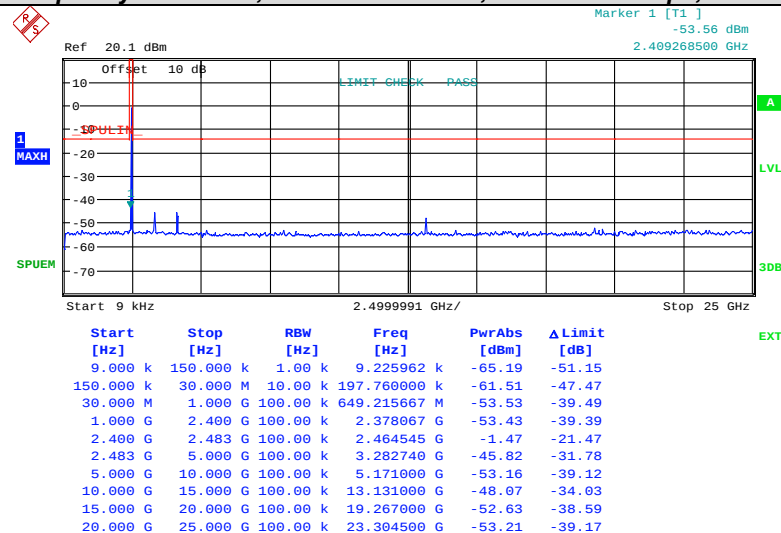


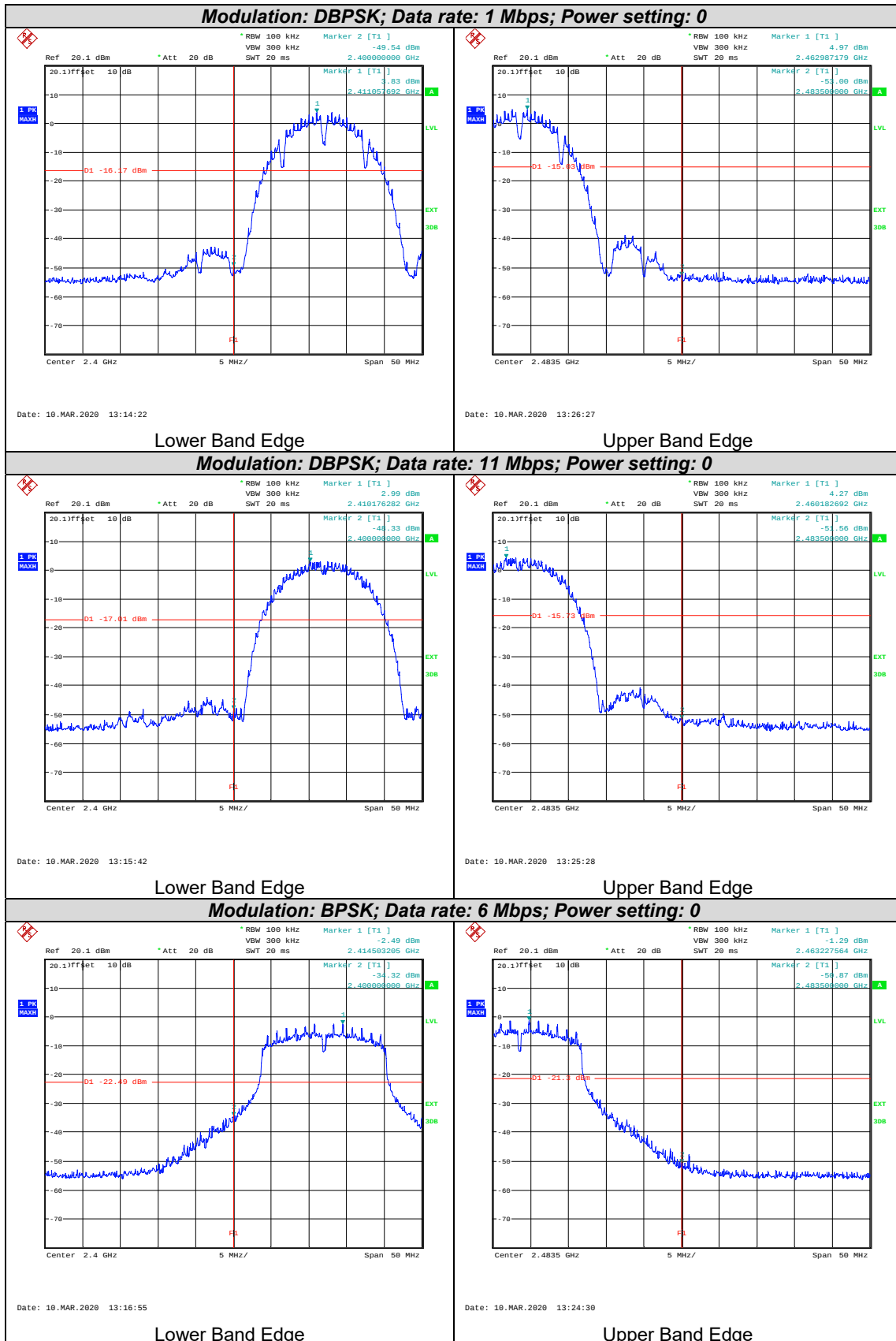
Frequency: 2437 MHz; Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0

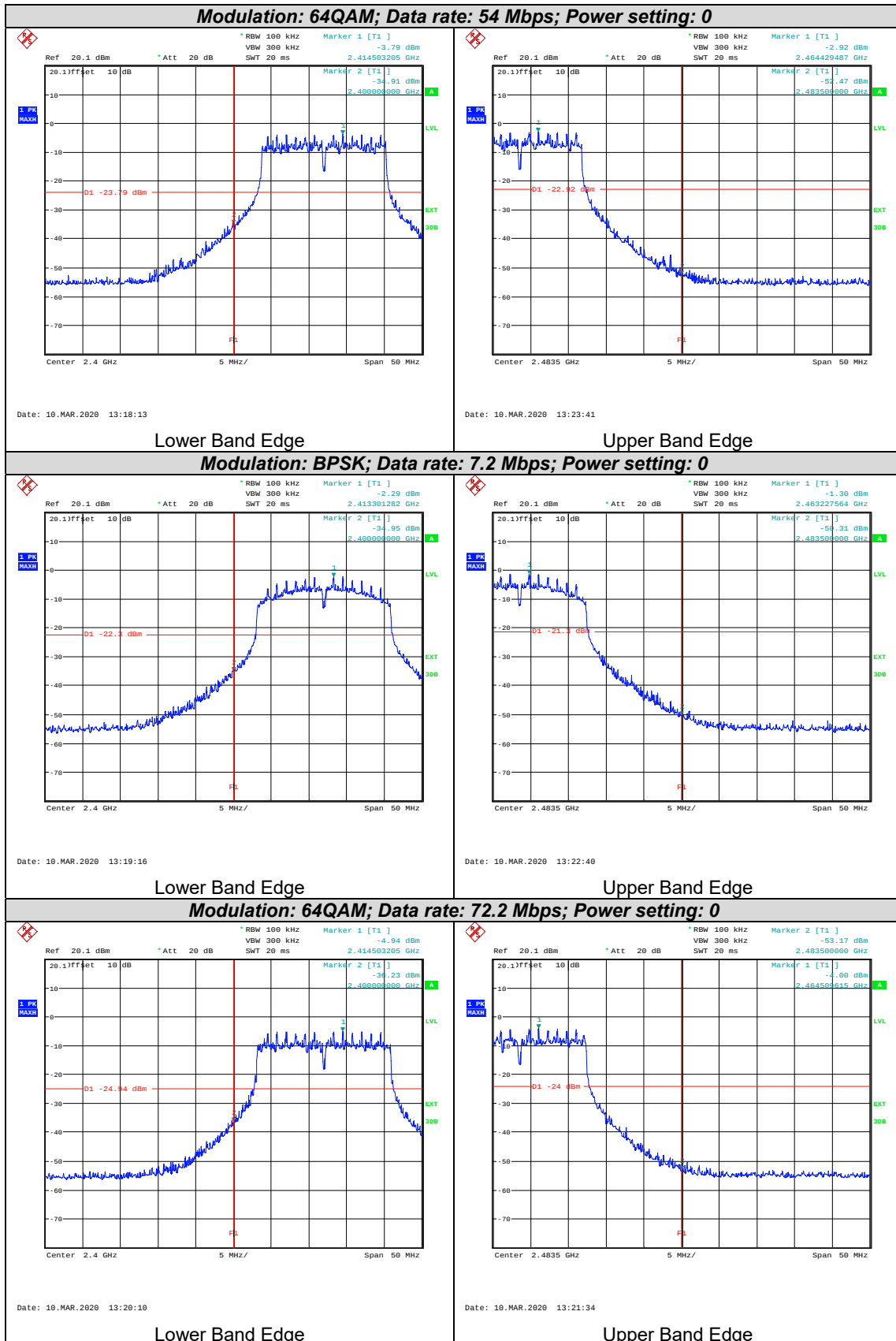


Frequency: 2462 MHz; Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0



Frequency: 2412 MHz; Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0**Frequency: 2437 MHz; Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0****Frequency: 2462 MHz; Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0**





15 Power spectral density

15.1 Definition

The power per unit bandwidth.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Frequencies Measured:	2412 MHz, 2437 MHz, 2462 MHz
EUT Channel Bandwidth:	20 MHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Span: (requirement 1.5 times Channel BW)	30 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 36 % RH	20 % RH to 75 % RH (as declared)
Supply: 3.7 Vdc	3.7 Vdc (as declared)

15.3 Test Limit

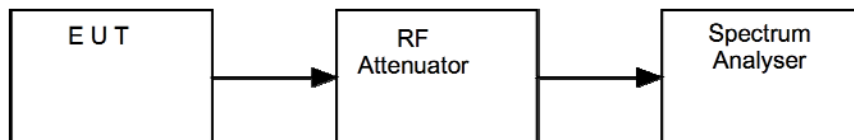
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, the peak emission of the EUT was measured on a spectrum analyser, with path losses taken into account.

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 vi Test Setup

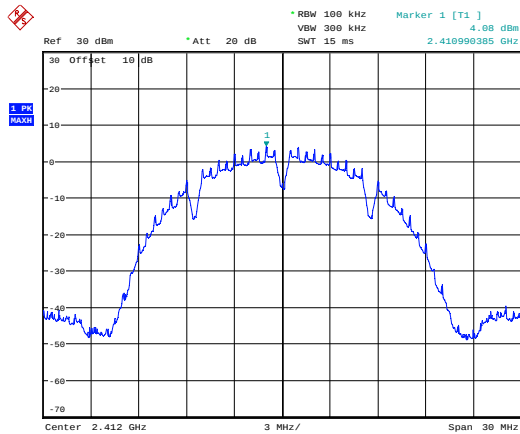


15.5 Test Equipment

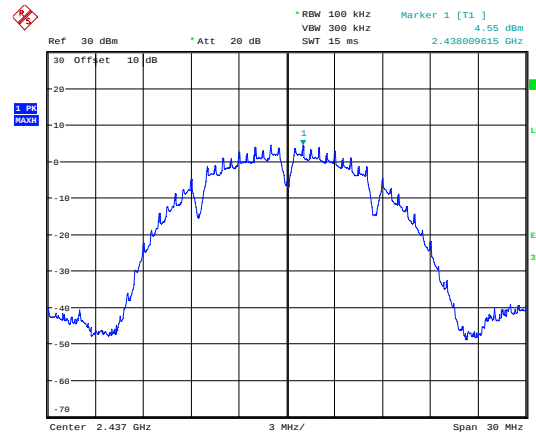
<i>Equipment Type</i>	<i>Manufacturer</i>	<i>Equipment Description</i>	<i>Element No</i>	<i>Due For Calibration</i>
FSU46	R&S	Spectrum Analyser	REF910	2020-10-17

15.6 Test Results

Modulation: DBPSK; Data rate: 1 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2412	4.08	0	4.08	PASS
2437	4.55	0	4.55	PASS
2462	4.33	0	4.33	PASS



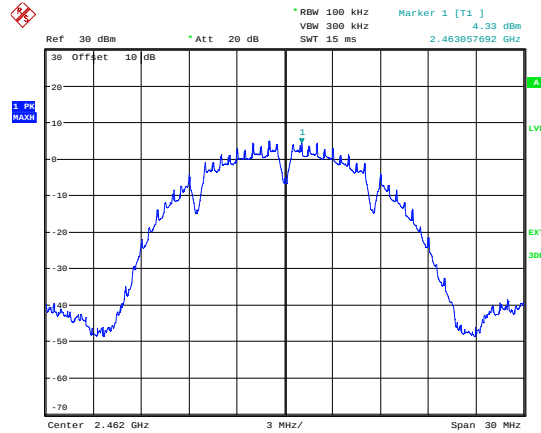
Date: 10.MAR.2020 12:23:30



Date: 10.MAR.2020 12:16:18

2412 MHz

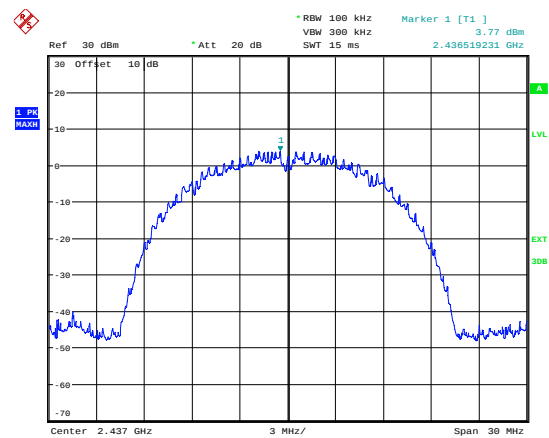
2437 MHz



Date: 10.MAR.2020 12:24:10

2462 MHz

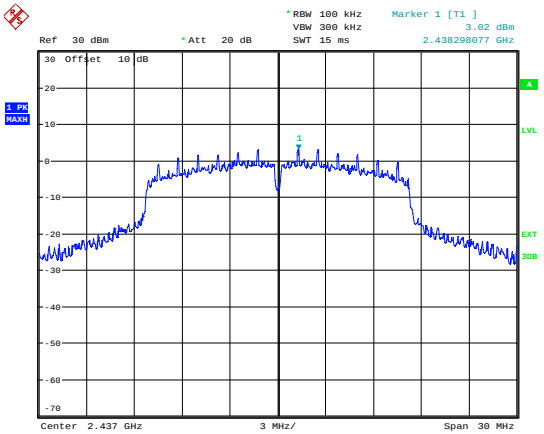
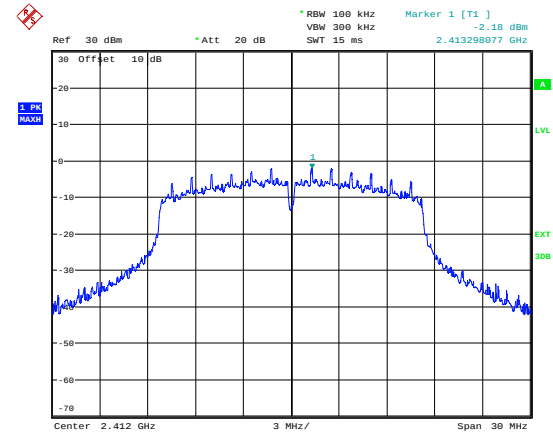
Modulation: DBPSK; Data rate: 11 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2437	3.77	0	3.77	PASS



Date: 10.MAR.2020 12:16:54

2437 MHz

Modulation: BPSK; Data rate: 6 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2412	-2.18	0	-2.18	PASS
2437	3.02	0	3.02	PASS
2462	-1.52	0	-1.52	PASS

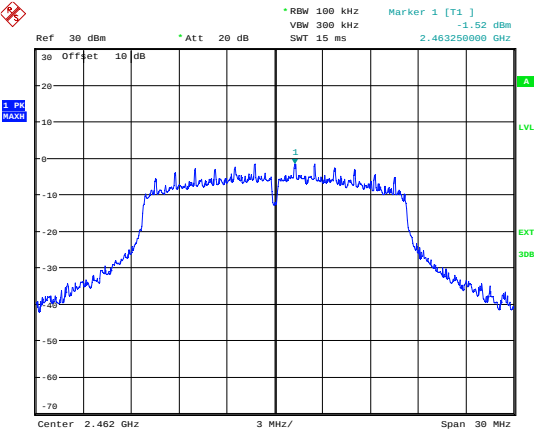


Date: 10.MAR.2020 12:22:39

Date: 10.MAR.2020 12:18:03

2412 MHz

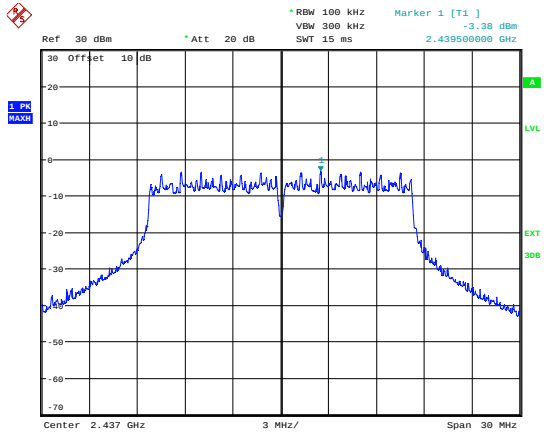
2437 MHz



Date: 10.MAR.2020 12:24:48

2462 MHz

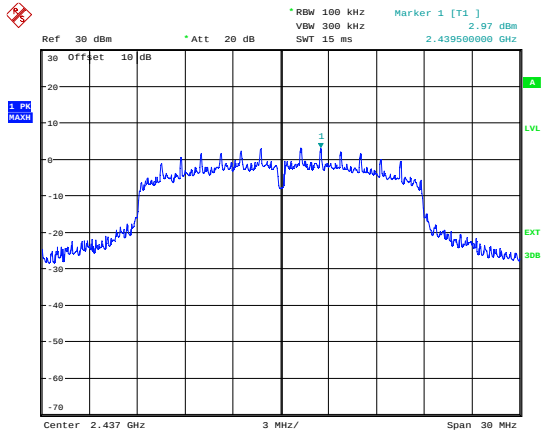
Modulation: 64QAM; Data rate: 54 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2437	-3.38	0	-3.38	PASS



Date: 10.MAR.2020 12:19:36

2437 MHz

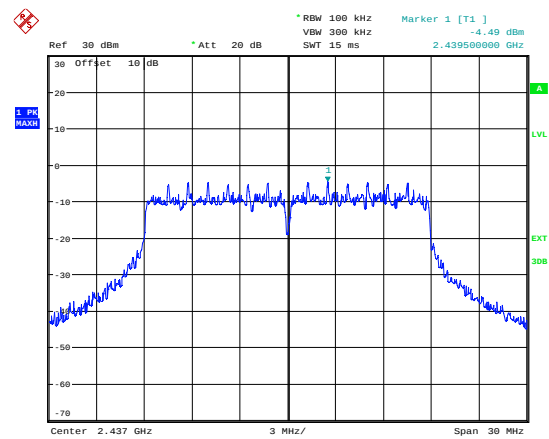
Modulation: BPSK; Data rate: 7.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2437	2.97	0	2.97	PASS



Date: 10.MAR.2020 12:20:20

2437 MHz

Modulation: 64QAM; Data rate: 72.2 Mbps; Power setting: 0				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (dBm)	Result
2437	-4.49	0	-4.49	PASS



Date: 10.MAR.2020 12:29:54

2437 MHz

16 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**

17 General SAR test reduction and exclusion guidance

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.

In the frequency range below 100 MHz to 6 GHz and test separation distance of <5mm, the SAR Test Exclusion Threshold for operation in the 2400 – 2483.5 MHz band will be determined as follows

SAR Exclusion Threshold (SARET)

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

NT = Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
 MP = Max Power of channel (mW) (inc tune up)
 TSD = When the minimum *test separation distance* is < 5 mm, a distance of 5 mm

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.

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

Operating Frequency 2.412 GHz

SARET = $[(3.0 \times 5) / \sqrt{2.412}]$
 SARET = $[15 / 1.55]$
 SARET = 9.677mW

Operating Frequency 2.437 GHz

SARET = $[(3.0 \times 5) / \sqrt{2.437}]$
 SARET = $[15 / 1.56]$
 SARET = 9.615mW

Operating Frequency 2.462 GHz

SARET = $[(3.0 \times 50) / \sqrt{2.462}]$
 SARET = $[15 / 1.57]$
 SARET = 9.554mW

KDB 447498				
Evaluation Frequency	2412	2437	2462	MHz
SAR Exclusion Threshold	9.677	9.615	9.554	mW
Conducted Power	16.91	19.08	17.98	dBm
Antenna Gain	0	0	0	dBi
Duty Cycle	1	1	1	%
Time Averaged EIRP	0.49	0.81	0.63	mW
SAR Evaluation	<i>Evaluation Required</i>			

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