Report on the Radio Testing

For

Signifier Medical Technologies Limited

on

Snoozeal Control Unit

Report no. TRA-046160-45-02B

12 March 2020

Report Number: TRA-046160-45-02B
Issue: B

REPORT ON THE RADIO TESTING OF A
Signifier Medical Technologies Limited
Snoozeal Control Unit
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 2019-12-06 to 2019-12-24

Tested by: A Tosif & A Wong

Written by: A Tosif
Radio Test Engineer

Approved by: Digitally signed by John Charters
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Reason: I am approving this document
Date: 2020.03.12 09:52:22 Z
J Charters
Lab Manager

Date: 12 March 2020

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	22 January 2020	Original
B	12 March 2020	Sections 9.1 & 16.2 updated

2 Summary

TEST REPORT NUMBER:	TRA-046160-45-02B
WORKS ORDER NUMBER:	TRA-046160-00
PURPOSE OF TEST:	Certification
TEST SPECIFICATION:	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	Snoozeal Control Unit
FCC IDENTIFIER:	2AVCE5060627480024
MANUFACTURER/AGENT:	Signifier Medical Technologies Limited
ADDRESS:	The Triangle, 6th Floor Hammersmith Grove Hammersmith London W6 0LG United Kingdom
CLIENT CONTACT:	Yasser Zayni ☎ +447814884916 ✉ Yasser.z@snoozeal.com
ORDER NUMBER:	SZL201907/001/EMT
TEST DATE:	2019-12-06 to 2019-12-24
TESTED BY:	A Tosif & A Wong Element

2.1 Test Summary

Test Method and Description		*Requirement Clause 47CFR15*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.205	☒	*Pass*
AC power line conducted emissions		15.207	☐	*Note 1*
Occupied bandwidth		15.247(a)(2)	☒	*Pass*
Conducted carrier power	Peak	15.247(b)(3)	☒	*Pass*
	Max.		☐	
Out of band emissions		15.247(d)	☒	*Pass*
Power spectral density		15.247(e)	☒	*Pass*

Specific Note:

1. The EUT has got a rechargeable battery, but as per client's declaration, it doesn't transmit while charging.

General Notes:

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

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

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

3 Contents

4 Introduction

This report TRA-046160-45-02B presents the results of the Radio testing on a Signifier Medical Technologies Limited, Snoozeal Control Unit to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Signifier Medical Technologies Limited by Element, at the address detailed below.

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

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

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

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

Throughout this report EUT denotes equipment under test.

FCC Site Listing:
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
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: Snoozeal Control Unit
- Model Number: 800300000
- Software Revision: 1.02.03
- Build Level / Revision Number: Rev B.6

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.

Mouthpiece unit
Laptop with Tera Term software

7.3 EUT Mode of Operation

The EUT was transmitting modulated carrier on required channels with power setting 8.

7.4 EUT Radio Parameters

Frequency of operation:	2402 MHz – 2480 MHz
Modulation type:	GFSK
Channel bandwidth:	2 MHz
Antenna type:	Integral
Nominal Supply Voltage:	3.7 Vdc

7.5 EUT Description

The EUT holds the lithium ion battery that powers the device to drive therapeutic pulses through the mouthpiece to the patients tongue.

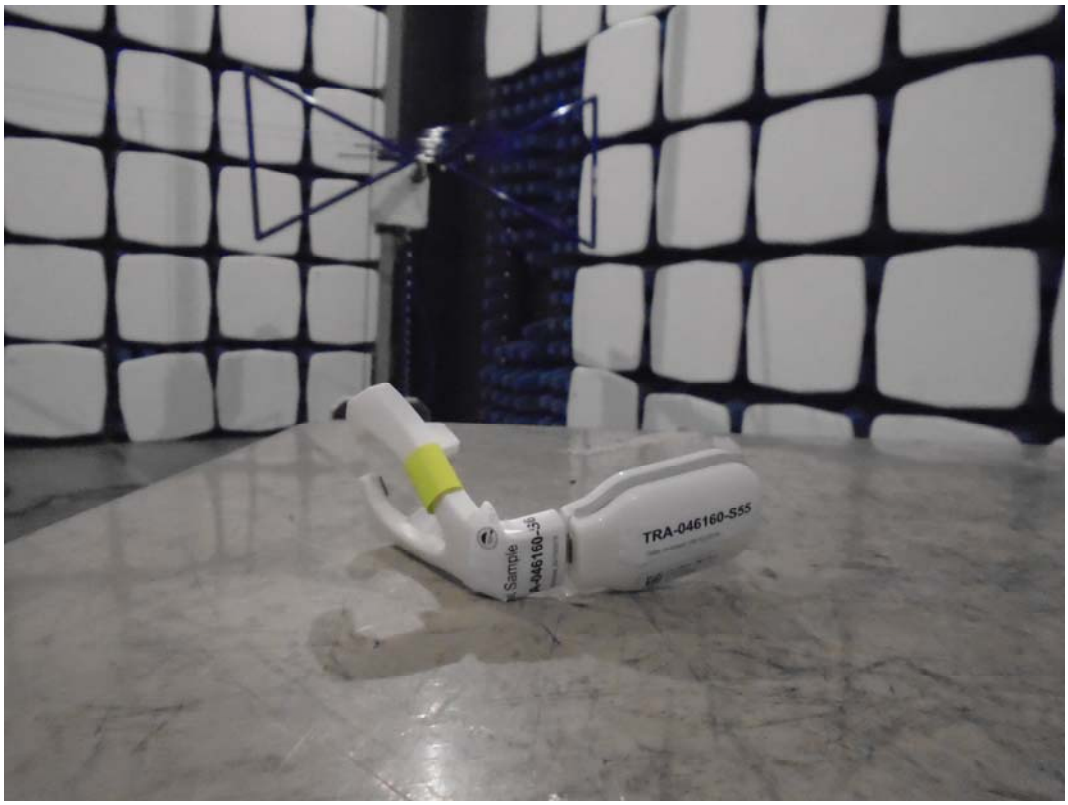
8 Modifications

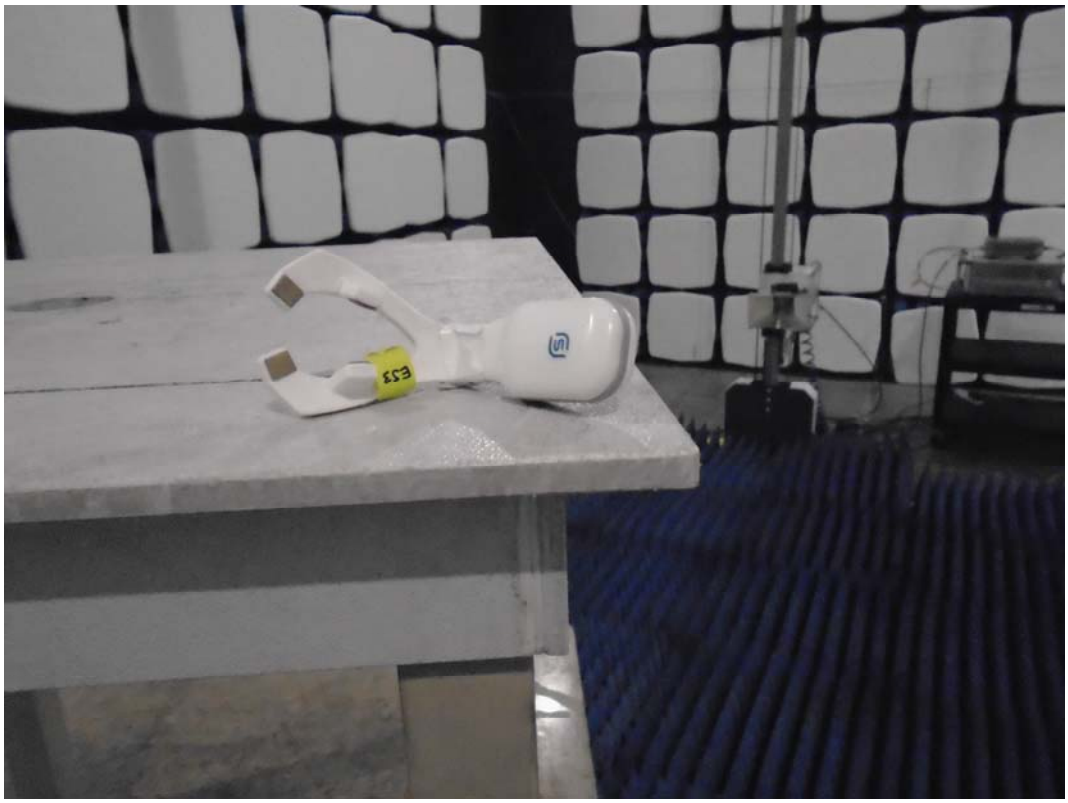
No modifications were performed during this assessment.

9 EUT Test Setup

9.1 General Set-up Photographs

The following photographs show basic EUT radiated set-up:





9.2 Measurement software

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

Element Emissions R5

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 3.7 V dc from internal battery.

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.

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

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 Hull
Test Chamber:	Wireless Lab 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
EUT Channel Bandwidth:	1 MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz; Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

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

Frequency (MHz)	*Field Strength (µV/m at 3 m)*
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:

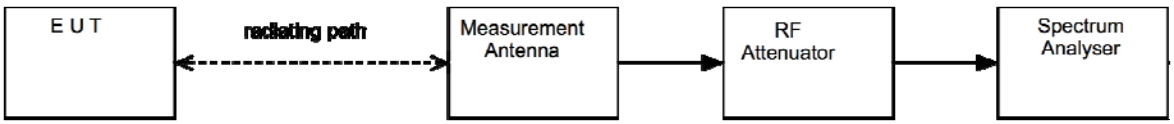
$$FS = PR + CL + AF – PA + DC + CF$$

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



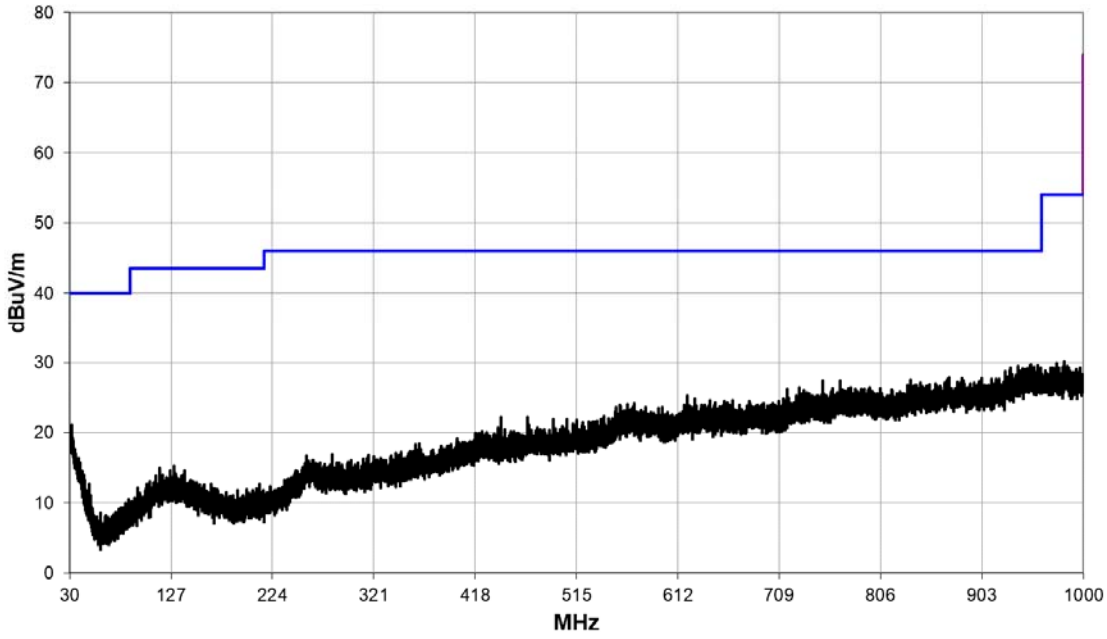
11.5 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Ferrite Lined Chamber	Rainford	ATS	REF886	2020-07-29
Spectrum Analyser	R&S	FSU26	REF909	2020-06-21
Pre-Amp (1 - 26.5 GHz)	Agilent	8449B	REF913	2020-02-06
Bilog Antenna	Chase	CBL6111B	REF2233	2020-08-17
Horn Antenna	EMCO	3115	RFG129	2020-02-12
Pre-Amp (9 kHz - 1 GHz)	Sonoma	310	REF927	2020-05-29
Radiated Test Software	Element	Emissions R5	REF9000	N/A

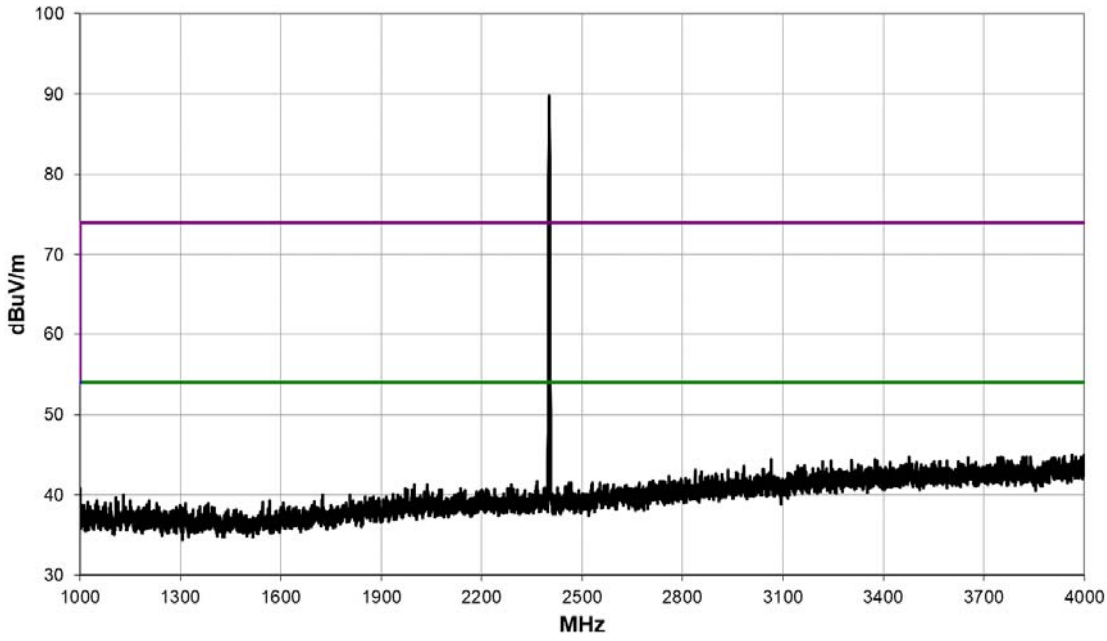
11.6 Test Results

Power Setting: 8; Frequency: 2402 MHz								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Peak	4803.4	47.5	4.4	32.9	35.4	49.4	295.1	5000.0
Average	4804.5	36.3	4.4	32.9	35.4	38.2	81.3	500.0

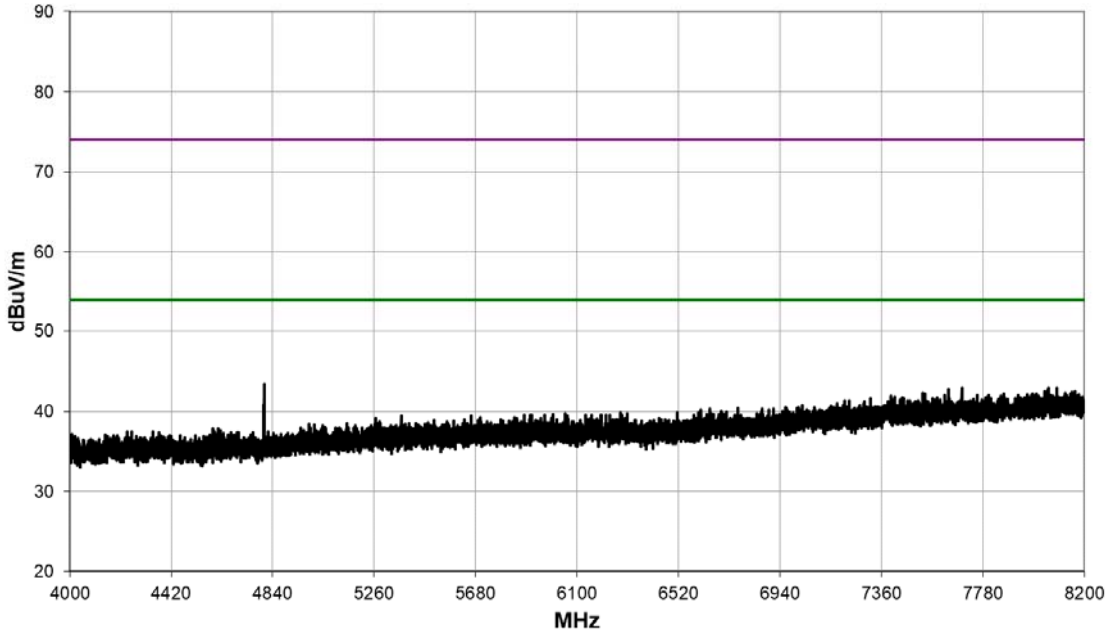
30 MHz – 1 GHz



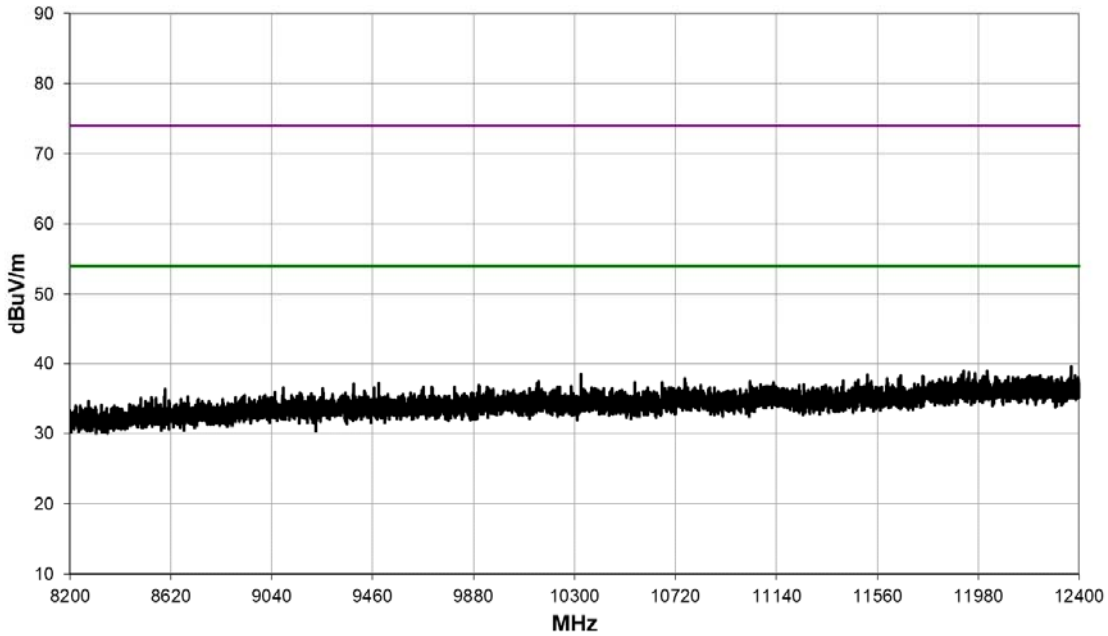
1 GHz – 4 GHz



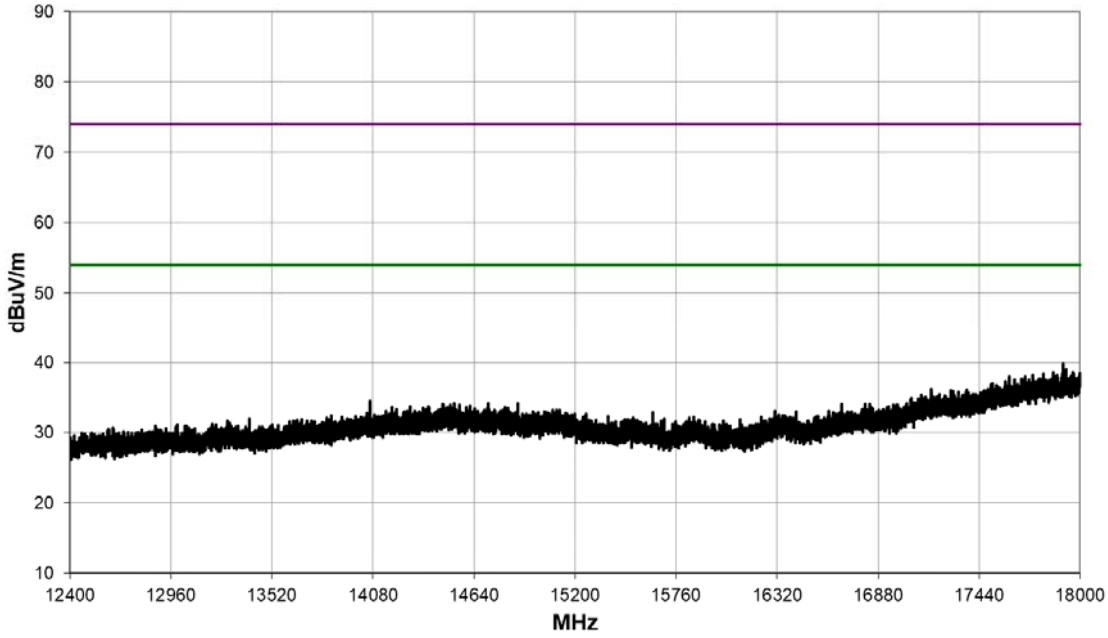
4 GHz – 8.2 GHz



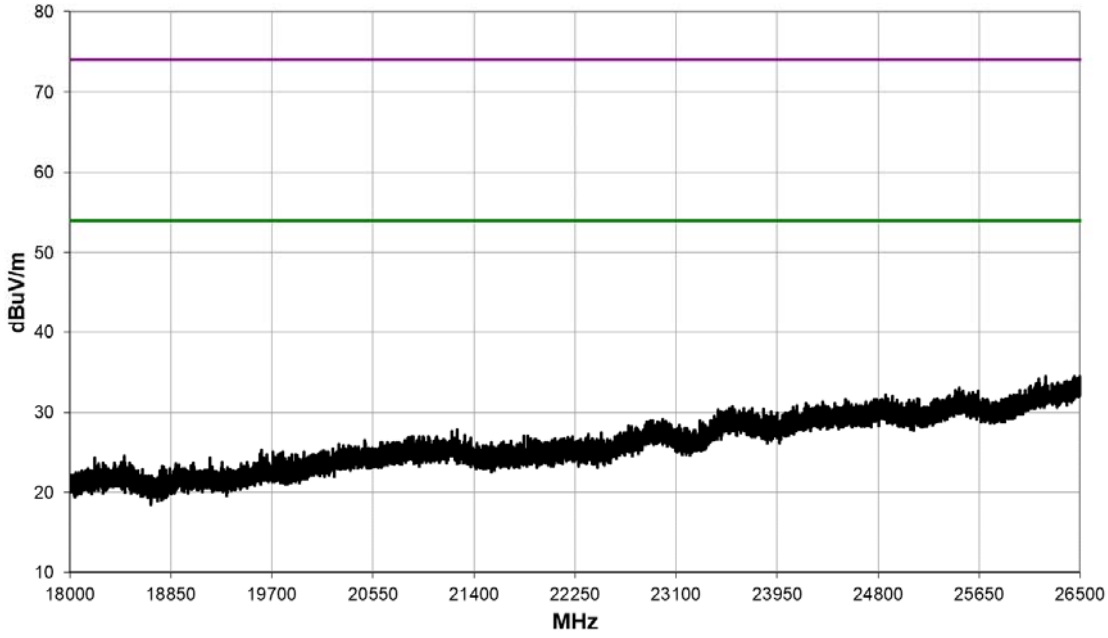
8.2 GHz – 12.4 GHz



12.4 GHz – 18 GHz

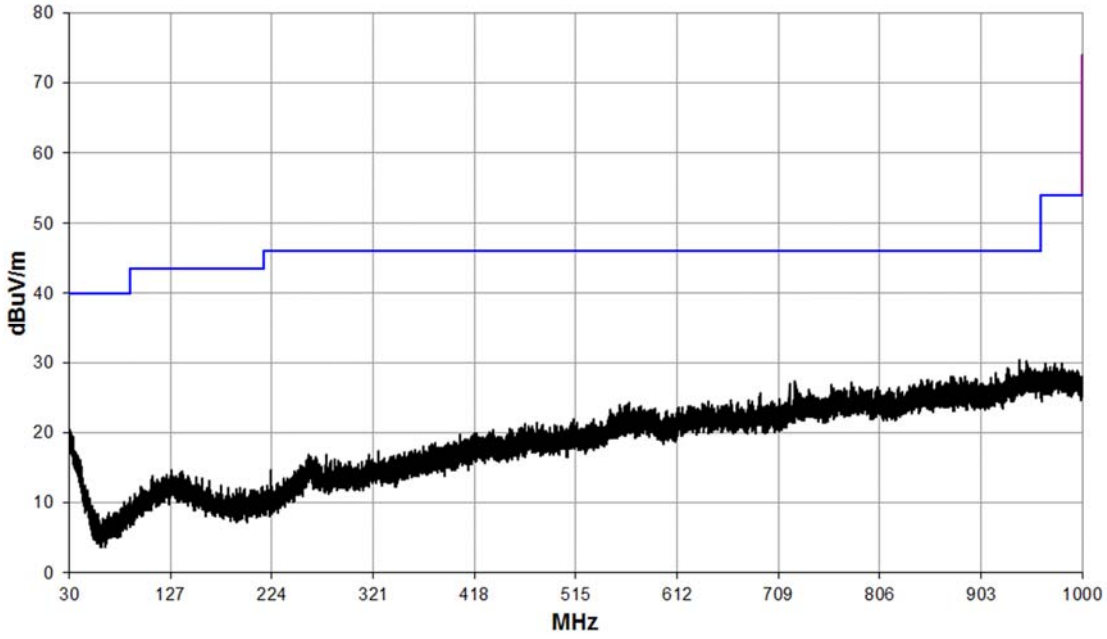


18 GHz – 26.5 GHz

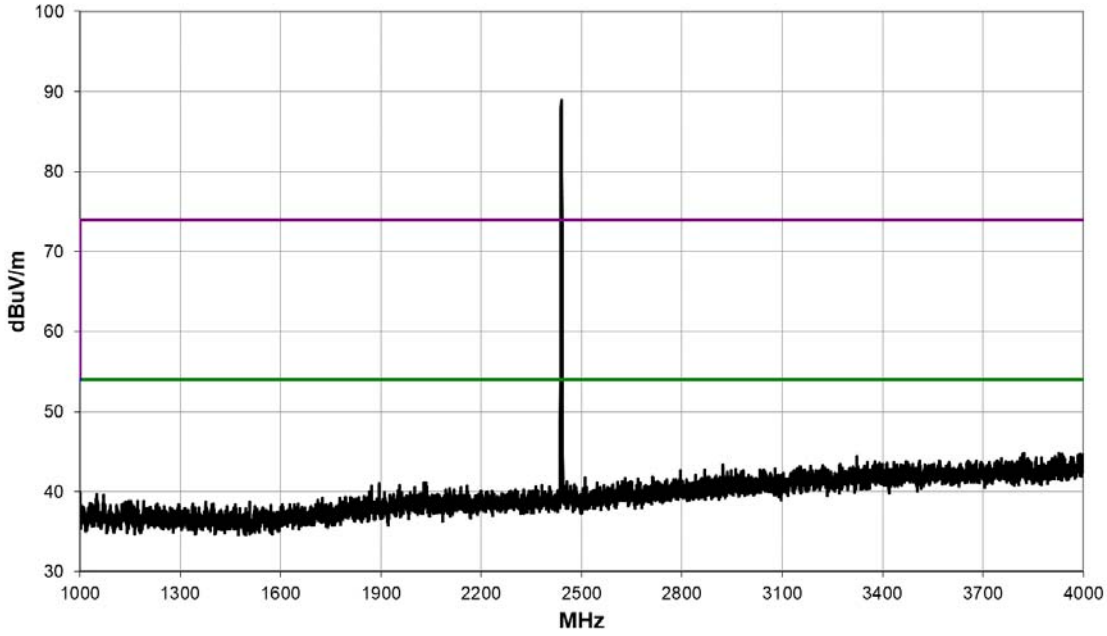


Power Setting: 8; Frequency: 2440 MHz								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Peak	4879.4	46.0	4.5	33.1	35.4	48.2	257.0	5000.0
Average	4879.5	33.1	4.5	33.1	35.4	35.3	58.2	500.0

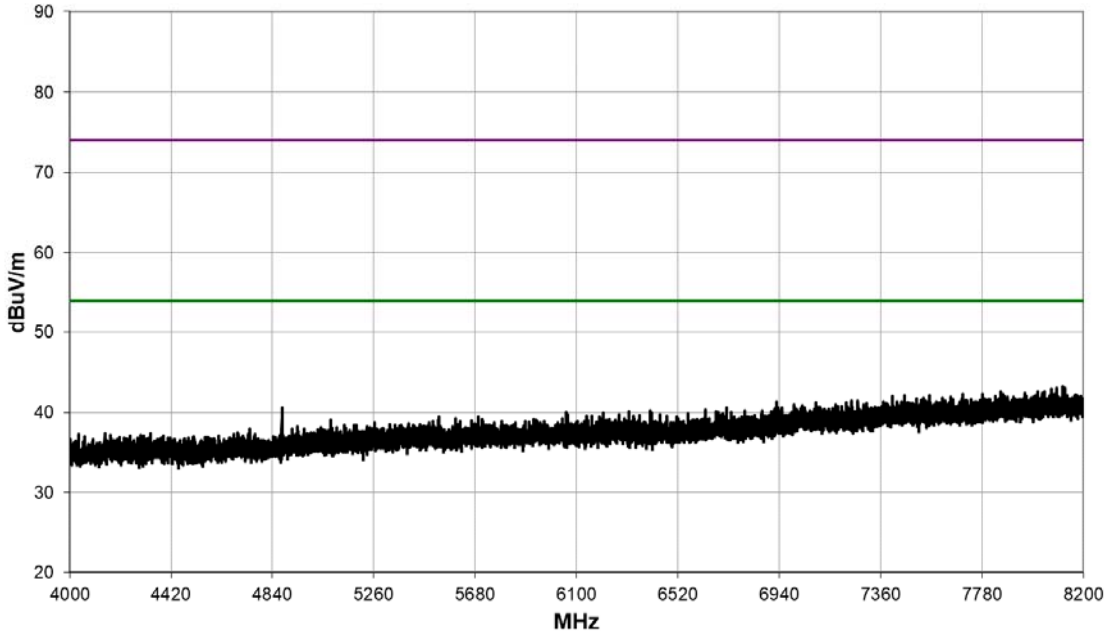
30 MHz – 1 GHz



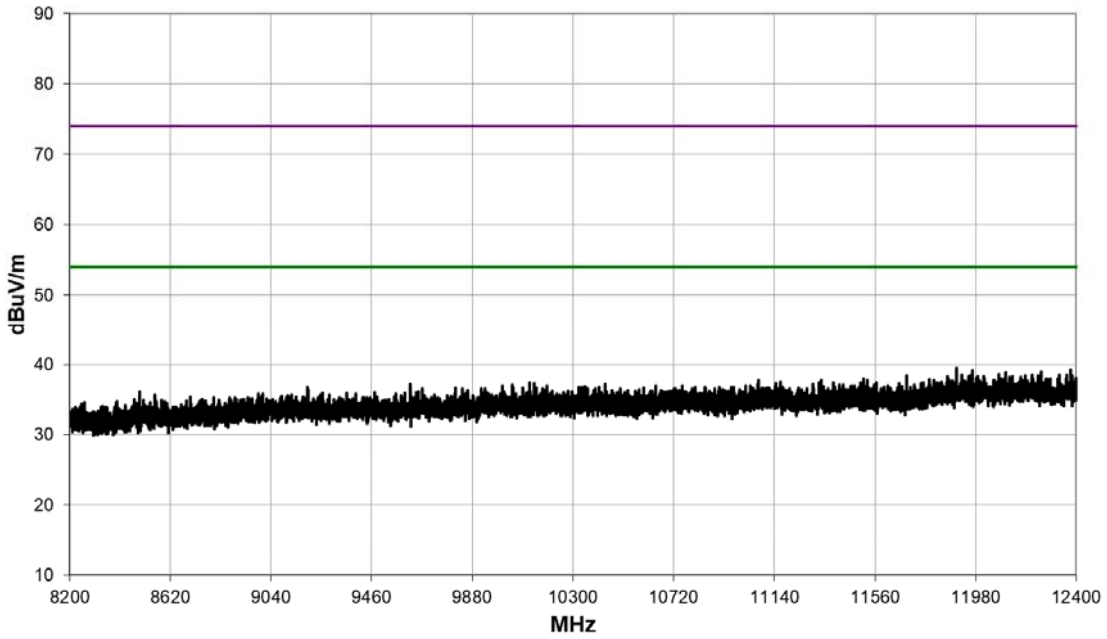
1 GHz – 4 GHz



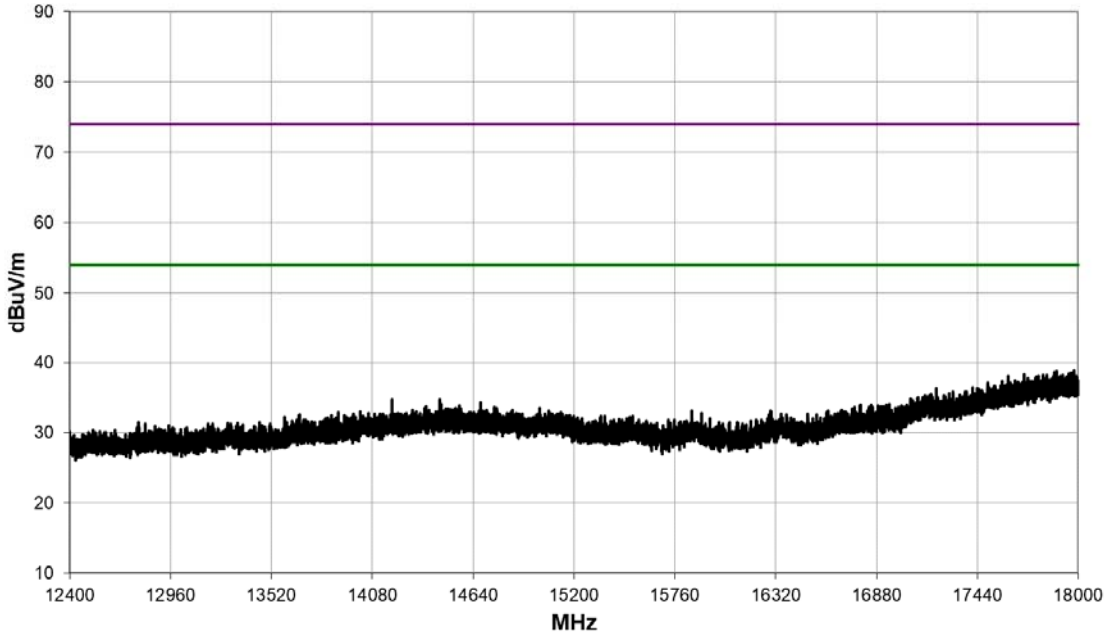
4 GHz – 8.2 GHz



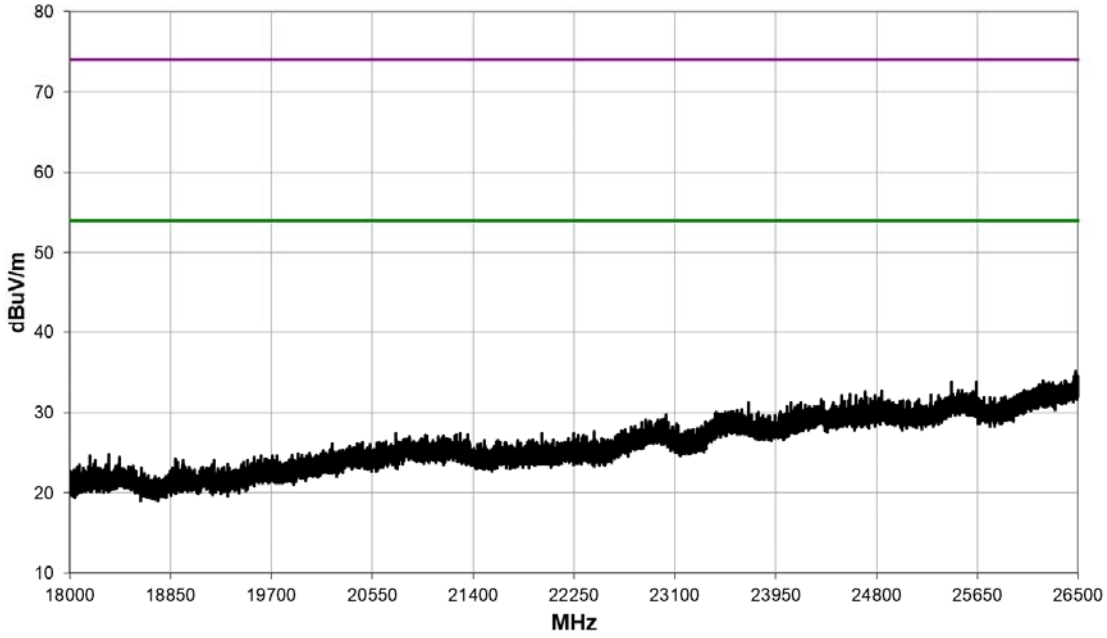
8.2 GHz – 12.4 GHz



12.4 GHz – 18 GHz

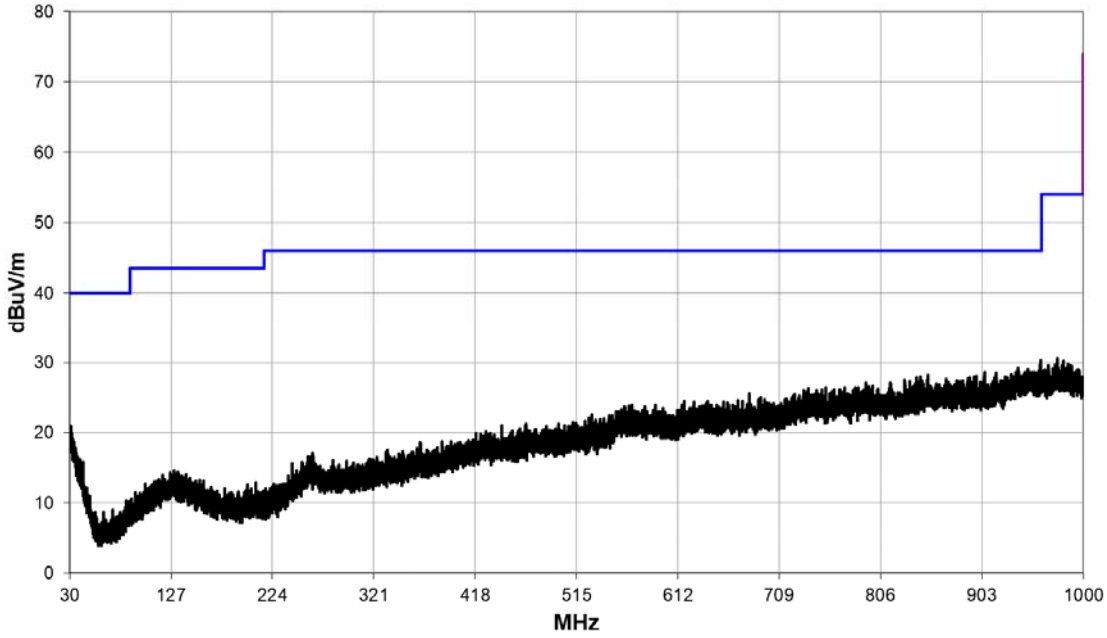


18 GHz – 26.5 GHz

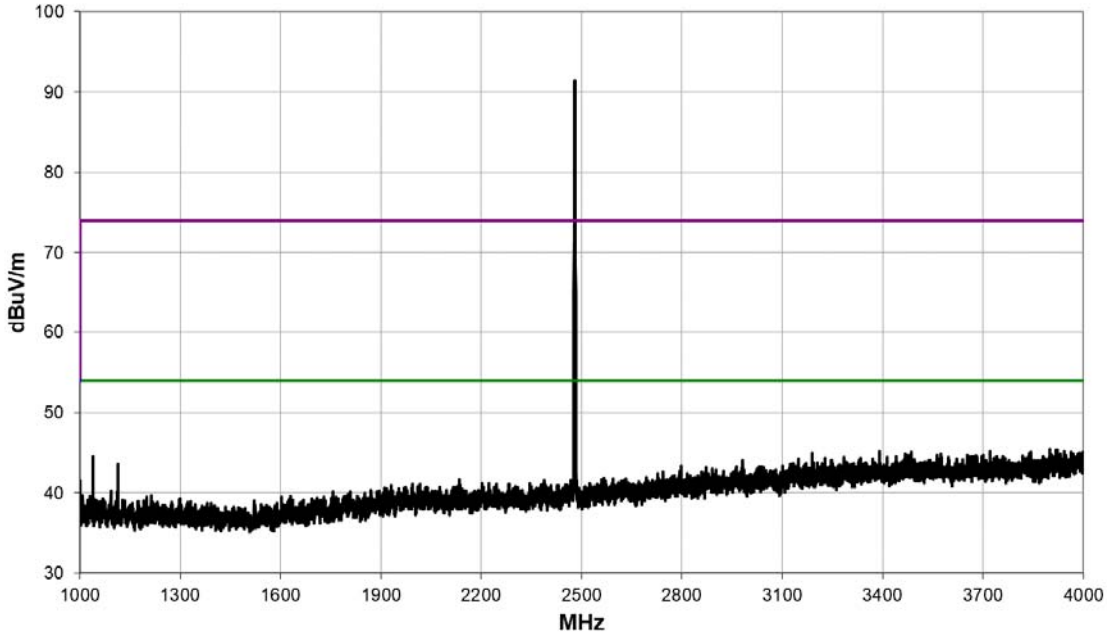


Power Setting: 8; Frequency: 2480 MHz								
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
Peak	4960.5	47.4	4.5	33.2	35.4	49.7	305.5	5000.0
Average	4959.6	35.5	4.5	33.2	35.4	37.8	77.6	500.0

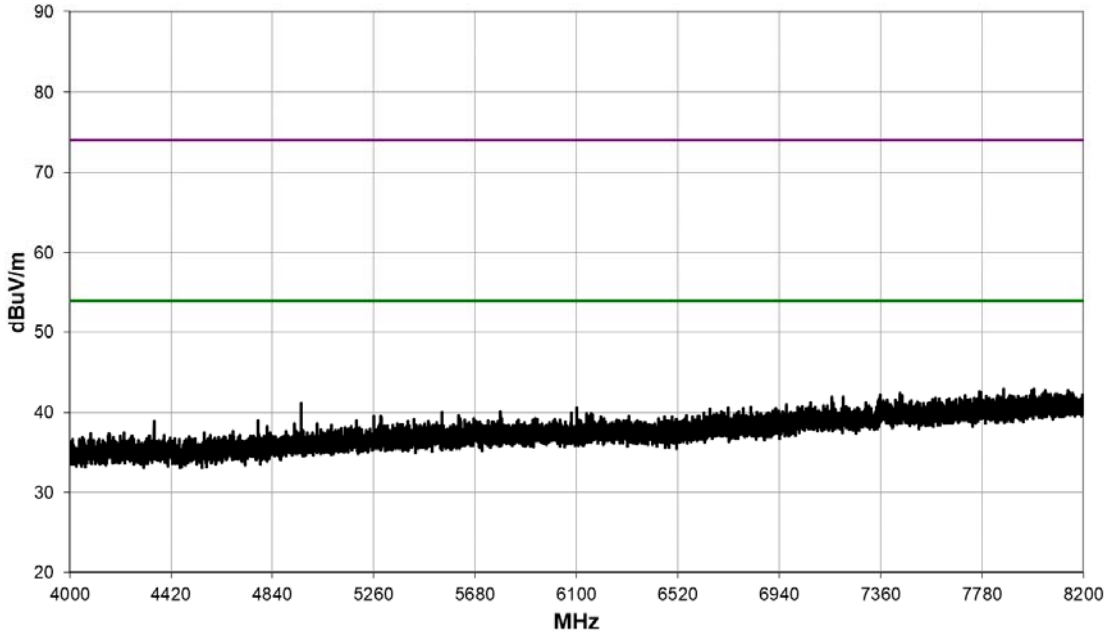
30 MHz – 1 GHz



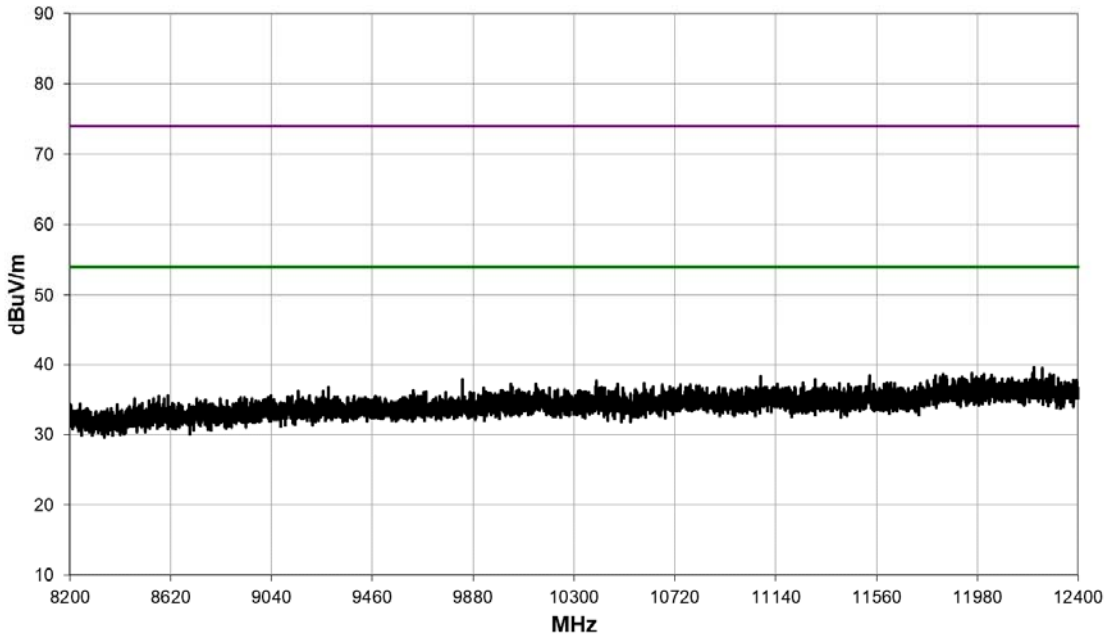
1 GHz – 4 GHz



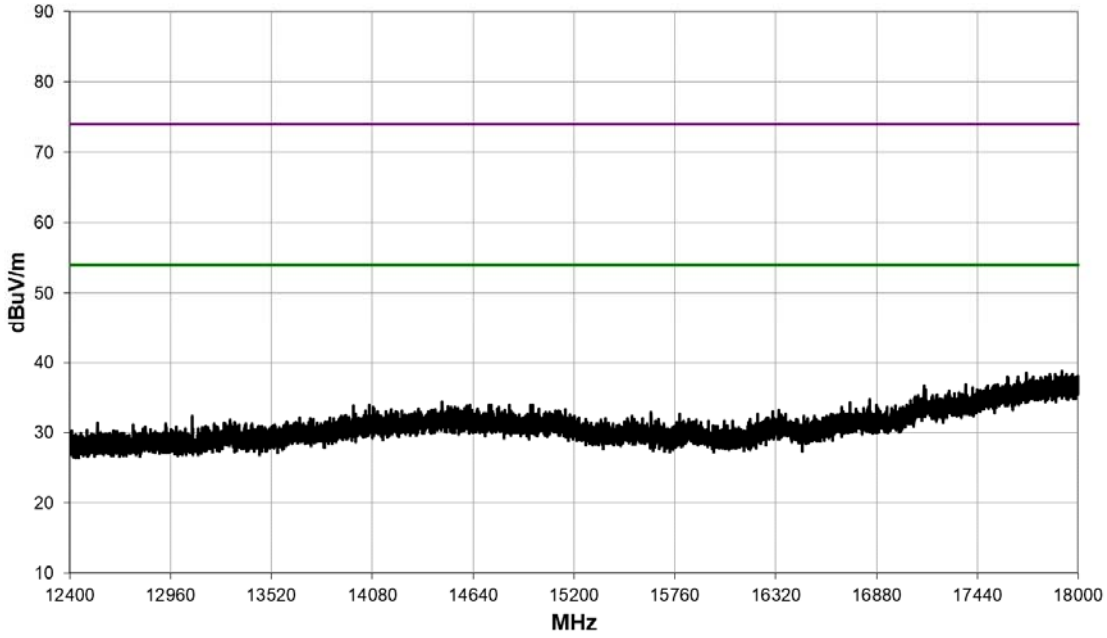
4 GHz – 8.2 GHz



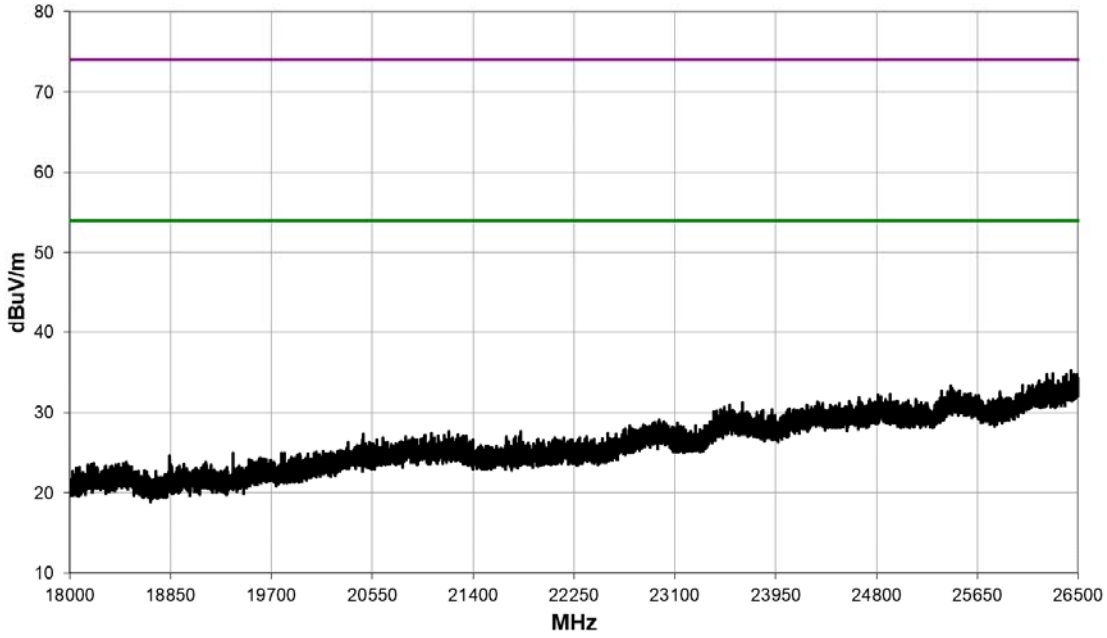
8.2 GHz – 12.4 GHz



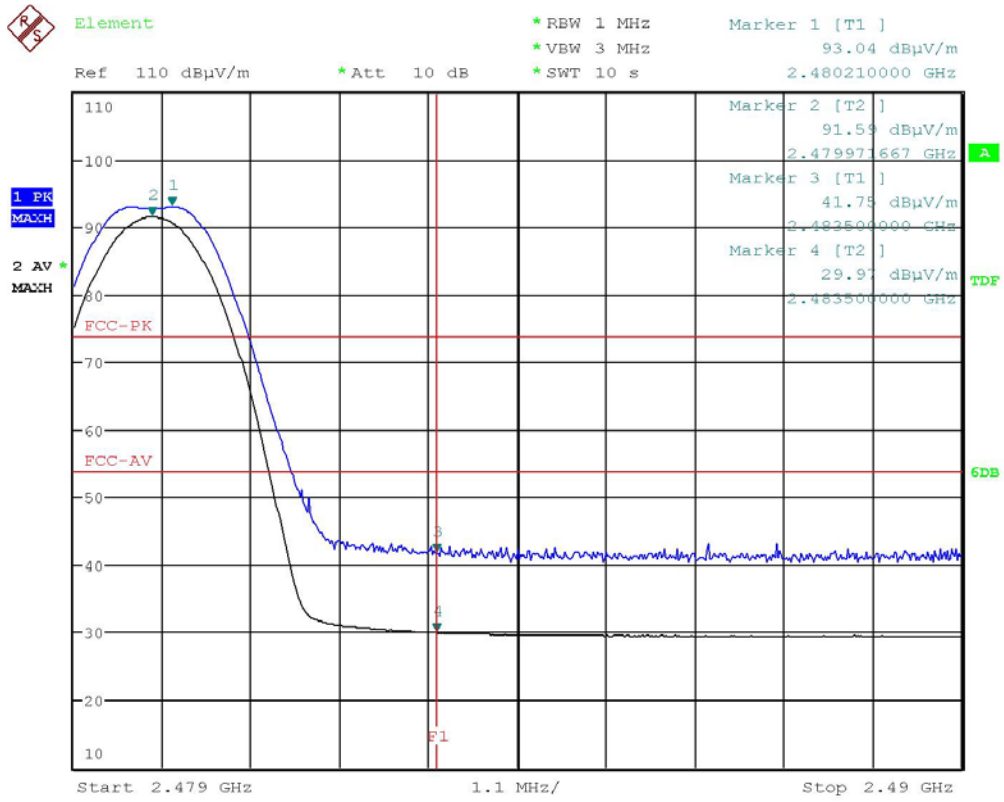
12.4 GHz – 18 GHz



18 GHz – 26.5 GHz



Upper Band Edge



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 Hull
Test Chamber:	Wireless Lab 1
Test Standard and Clauses:	ANSI C63.10-2013, Clause 11.8
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
Deviations From Standard:	None
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

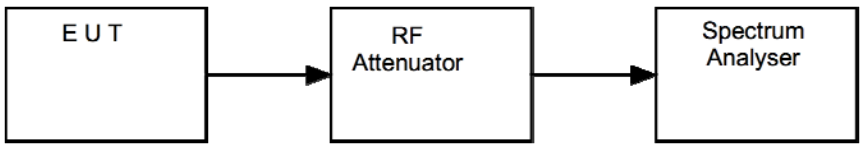
12.3 Test Limit

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

12.4 Test Method

With the EUT connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser.

Figure iii Test Setup

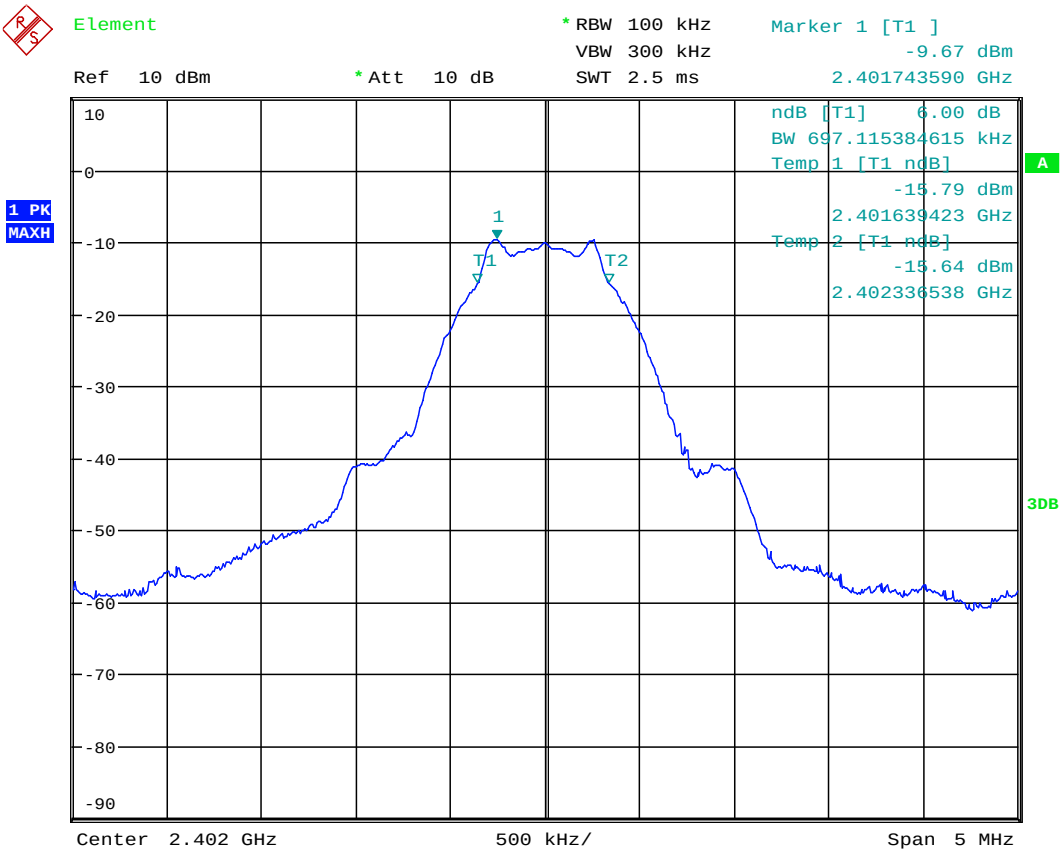


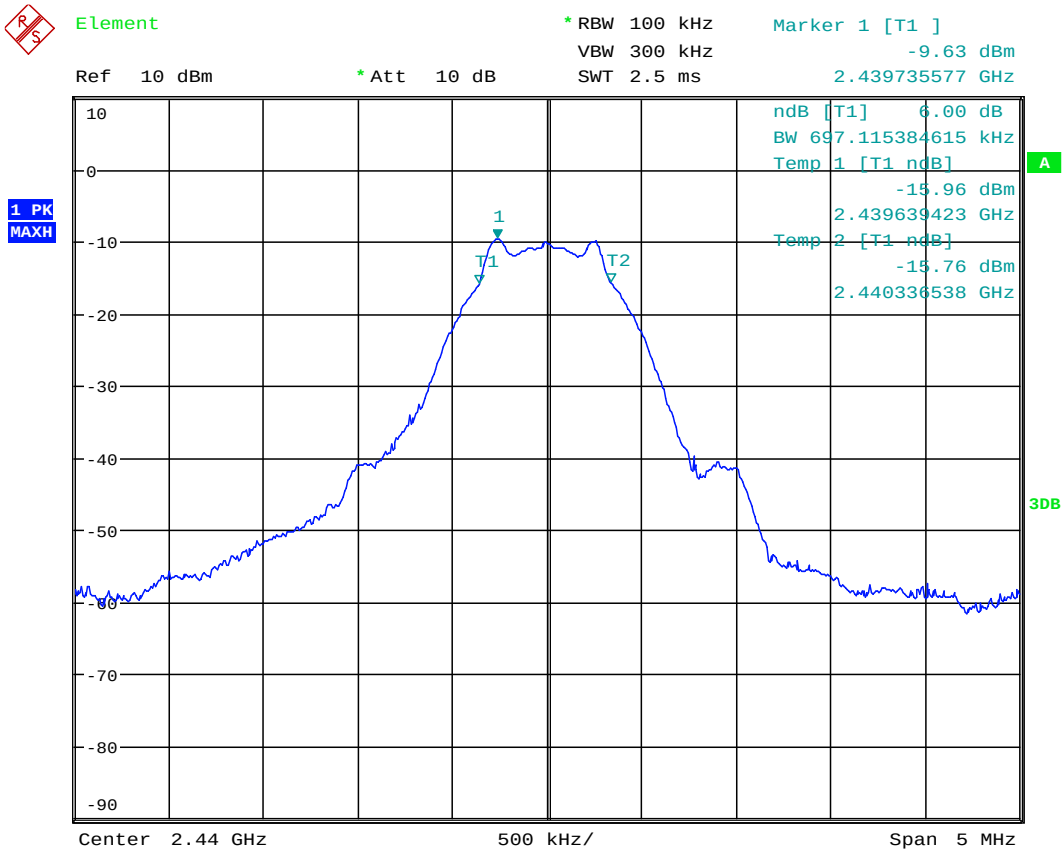
12.5 Test Equipment

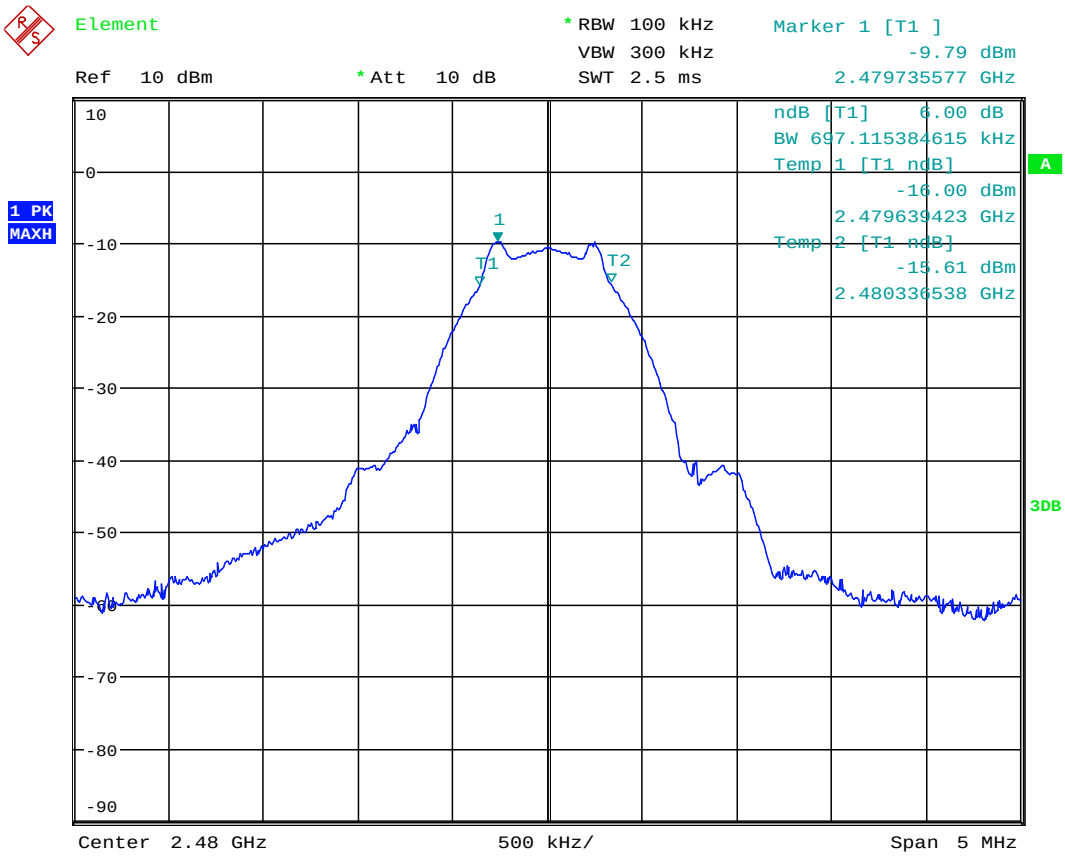
Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

12.6 Test Results

Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	6 dB Bandwidth (KHz)	Result
2402	2401.639423	2402.336538	697.115	PASS
2440	2439.639423	2440.336538	697.115	PASS
2480	2479.639423	2480.336538	697.115	PASS




Element
*RBW 100 kHz
VBW 300 kHz
Ref 10 dBm
*Att 10 dB
SWT 2.5 ms
Marker 1 [T1]
-9.63 dBm
2.439735577 GHz
ndB [T1] 6.00 dB
BW 697.115384615 kHz
Temp 1 [T1 ndB]
-15.96 dBm
2.439639423 GHz
Temp 2 [T1 ndB]
-15.76 dBm
2.440336538 GHz
1 PK
MAXH
A
3DB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.44 GHz
500 kHz/
Span 5 MHz


Element
*RBW 100 kHz
VBW 300 kHz
Ref 10 dBm
*Att 10 dB
SWT 2.5 ms
Marker 1 [T1]
-9.79 dBm
2.479735577 GHz
ndB [T1] 6.00 dB
BW 697.115384615 kHz
Temp 1 [T1 ndB]
-16.00 dBm
2.479639423 GHz
Temp 2 [T1 ndB]
-15.61 dBm
2.480336538 GHz
1 PK
MAXH
A
3DB
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
500 kHz/
Span 5 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 Hull
Test Chamber:	Wireless Lab 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
Deviations From Standard:	None

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

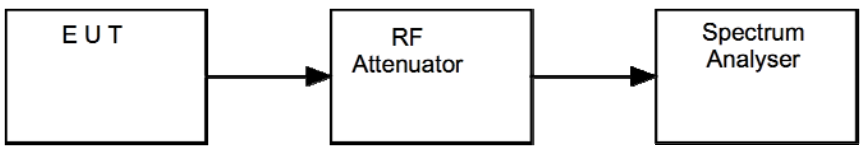
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

13.4 Test Method

With the EUT 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

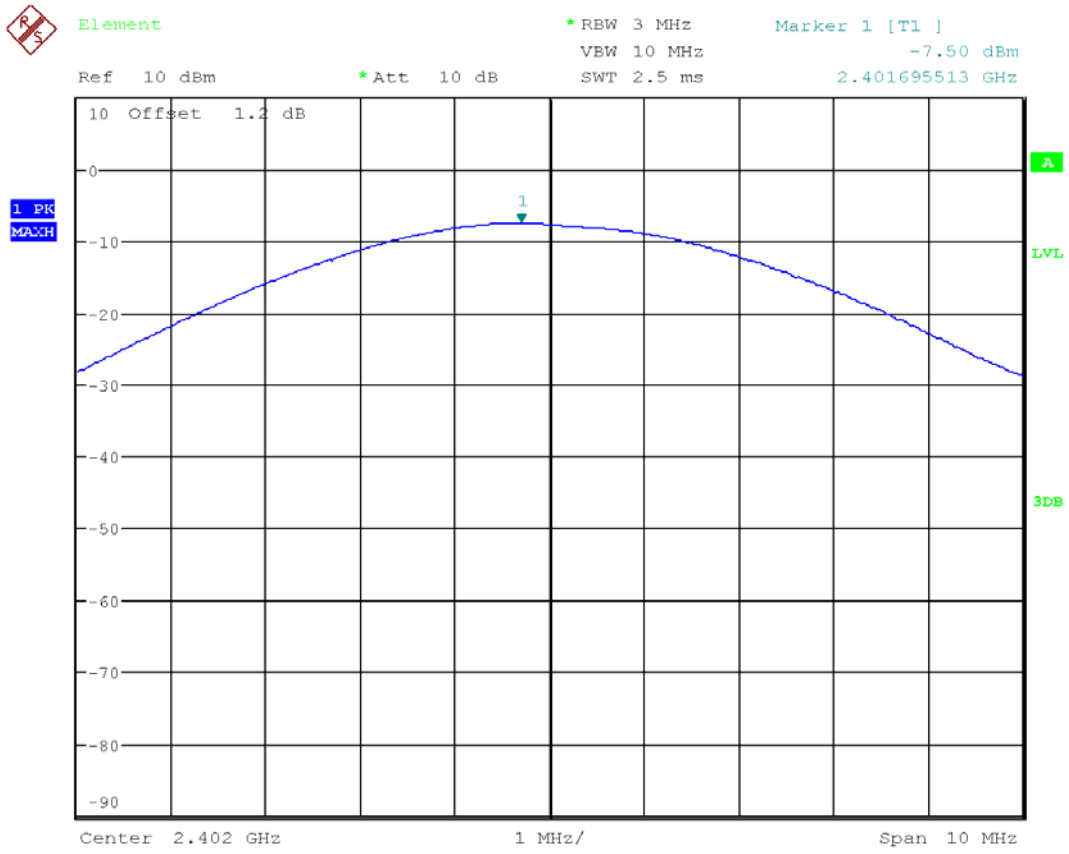


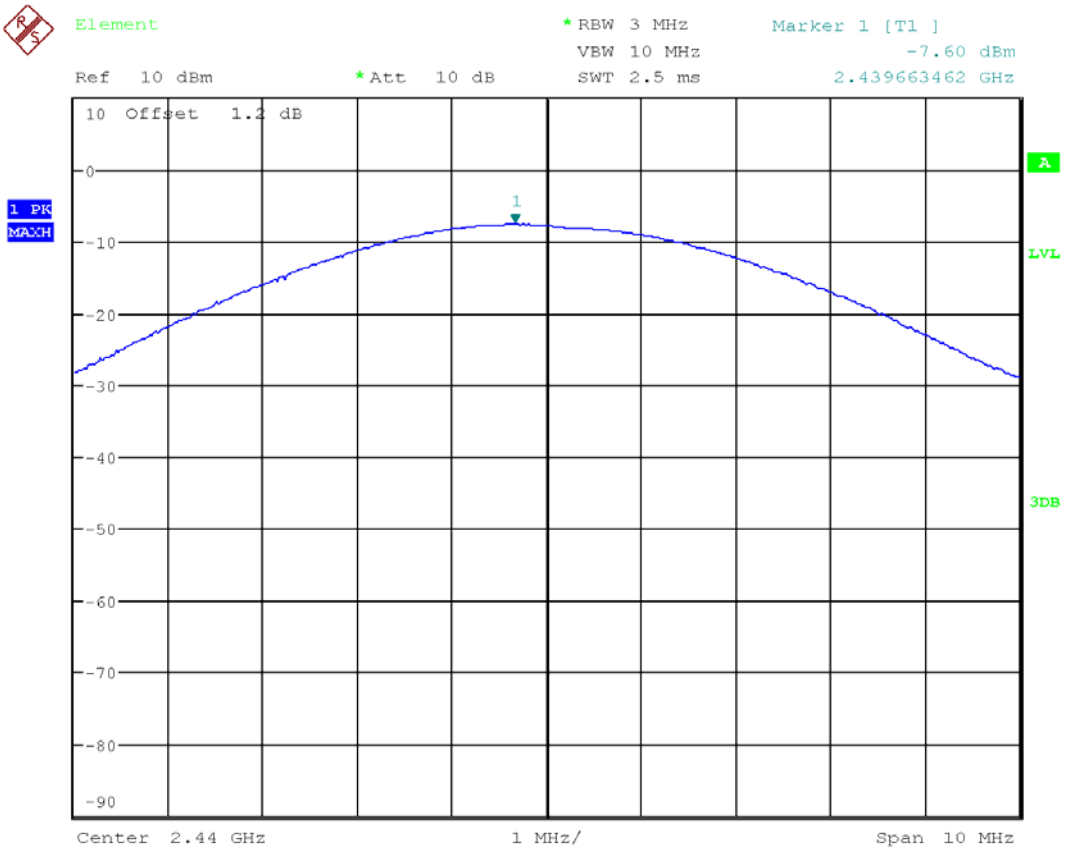
13.5 Test Equipment

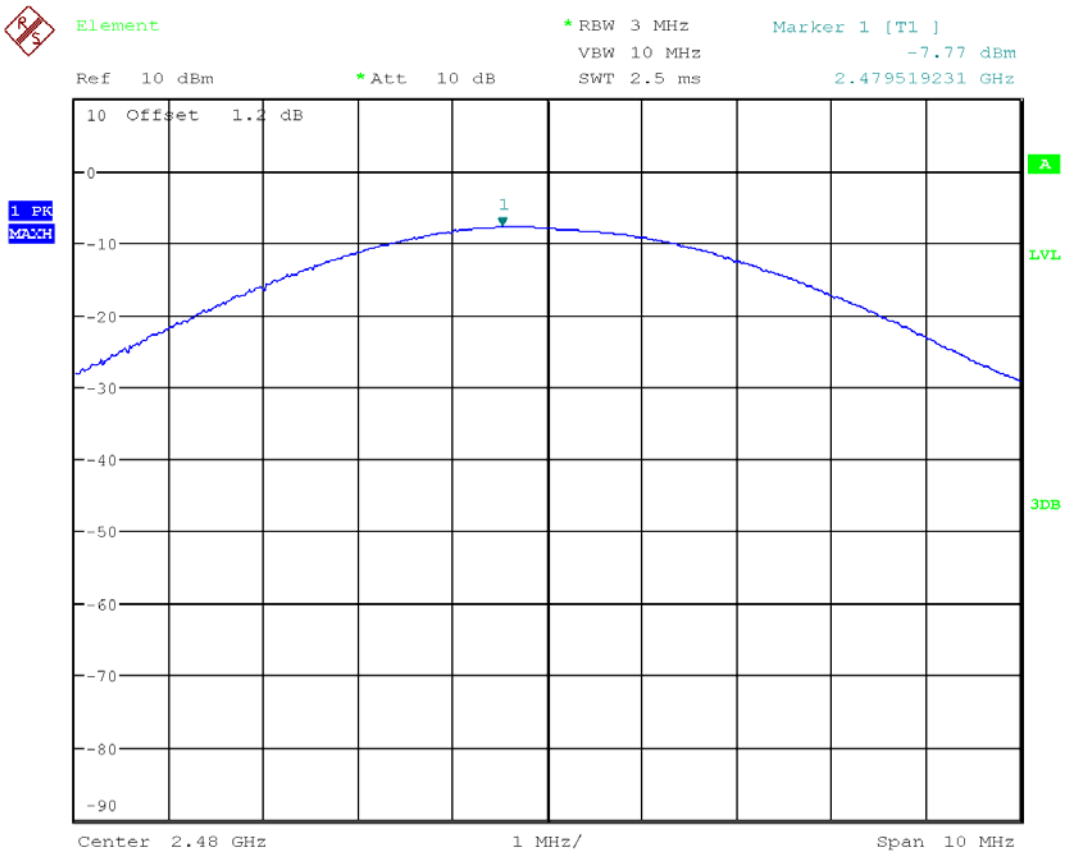
Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

13.6 Test Results

Channel Frequency (MHz)	*Maximum peak conducted output power (dBm)*	*Maximum peak conducted output power (W)*	*Result*
2402	-7.50	0.000178	PASS
2440	-7.60	0.000174	PASS
2480	-7.77	0.000167	PASS




Element
Ref 10 dBm
Att 10 dB
RBW 3 MHz
VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
-7.60 dBm
2.439663462 GHz
10 Offset 1.2 dB
1 PK
MAXH
A
LVL
3DB
Center 2.44 GHz
1 MHz/
Span 10 MHz


Element
Ref 10 dBm
Att 10 dB
RBW 3 MHz
VBW 10 MHz
SWT 2.5 ms
Marker 1 [T1]
-7.77 dBm
2.479519231 GHz
10 Offset 1.2 dB
1 PK
MAXH
A
LVL
3DB
Center 2.48 GHz
1 MHz/
Span 10 MHz

14 Effective isotropic radiated power

14.1 Definition

The effective isotropic radiated power (EIRP) is defined as the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

14.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
Deviations From Standard:	None
Measurement BW:	3 MHz
Spectrum Analyzer Video BW:	10 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

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

14.3 Test Limit

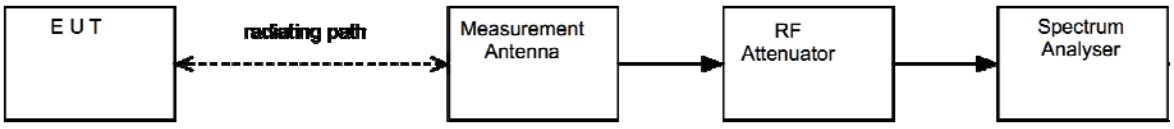
The EIRP shall not exceed 4 W.

14.4 Test Method

With the EUT connected as per Figure x, 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 x Test Setup



14.5 Test Equipment

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Ferrite Lined Chamber	Rainford	ATS	REF886	2020-07-29
Spectrum Analyser	R&S	FSU26	REF909	2020-06-21
Pre-Amp (1 - 26.5 GHz)	Agilent	8449B	REF913	2020-02-06
Horn Antenna	EMCO	3115	RFG129	2020-02-12
Radiated Test Software	Element	Emissions R5	REF9000	N/A

14.6 Test Results

Channel Frequency (MHz)	*Peak Field Strength (dBµV/m)*	*Peak Field Strength (V/m)*	*Distance (m)*	*EIRP (W)*	*Result*
2402	90.6	0.0339	3	0.000344	PASS
2440	89.6	0.0302	3	0.000274	PASS
2480	93.3	0.0462	3	0.000641	PASS

The following formula was used to convert field strength (*E*) in volts/metre to EIRP in watts:

$$\mathrm{EIRP} = (E \times d)^2 / 30$$

Where,
E is the electric field strength in V/m
d is the measurement distance in meters (m)

15 Out-of-band and conducted spurious emissions

15.1 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.

15.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
Deviations From Standard:	None
Measurement Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Measurement Detector:	Peak
Measurement Range:	9 kHz to 25 GHz

Environmental Conditions (Normal Environment)

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

15.3 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.

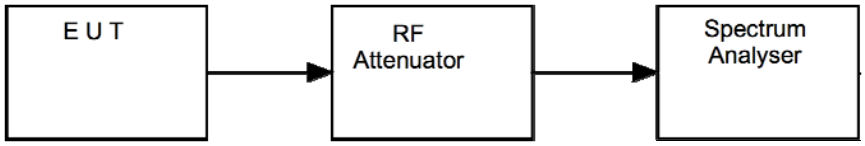
Attenuation below the general field strength limits specified in FCC 47CFR15.209 (a) is not required.

15.4 Test Method

With the EUT 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

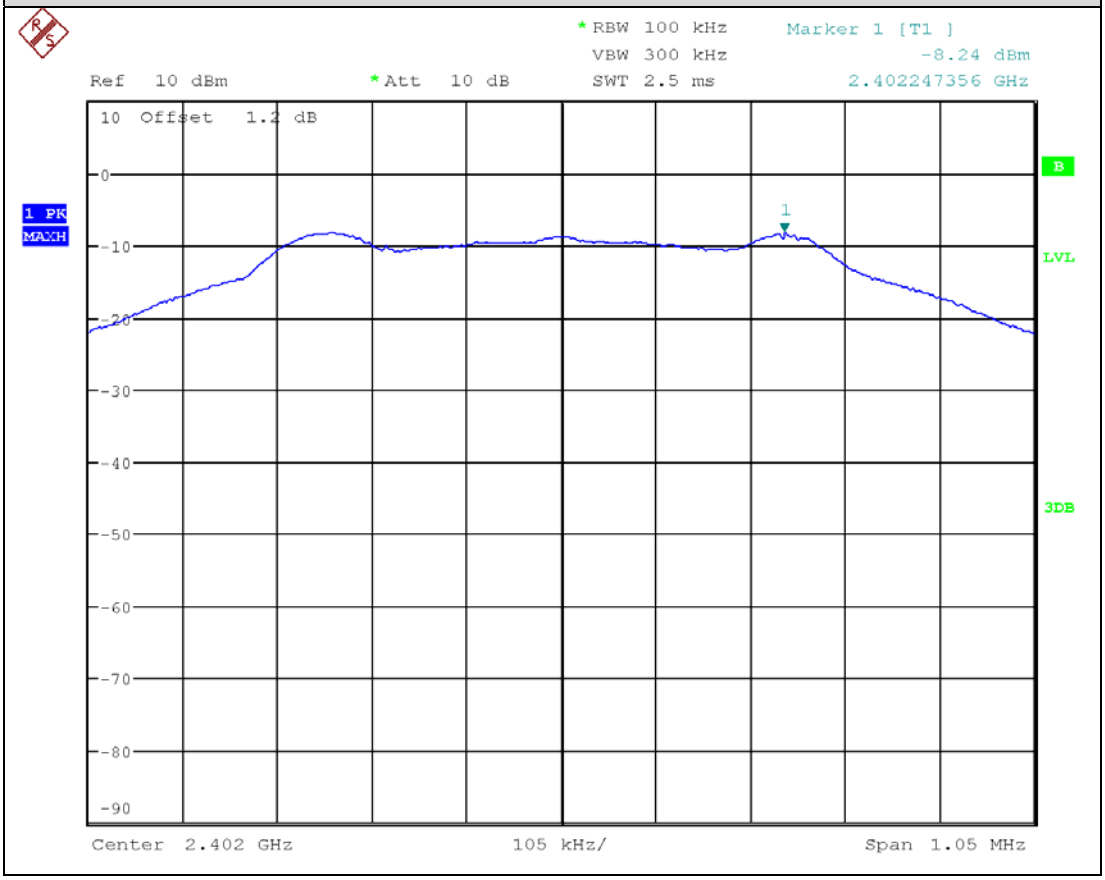


15.5 Test Equipment

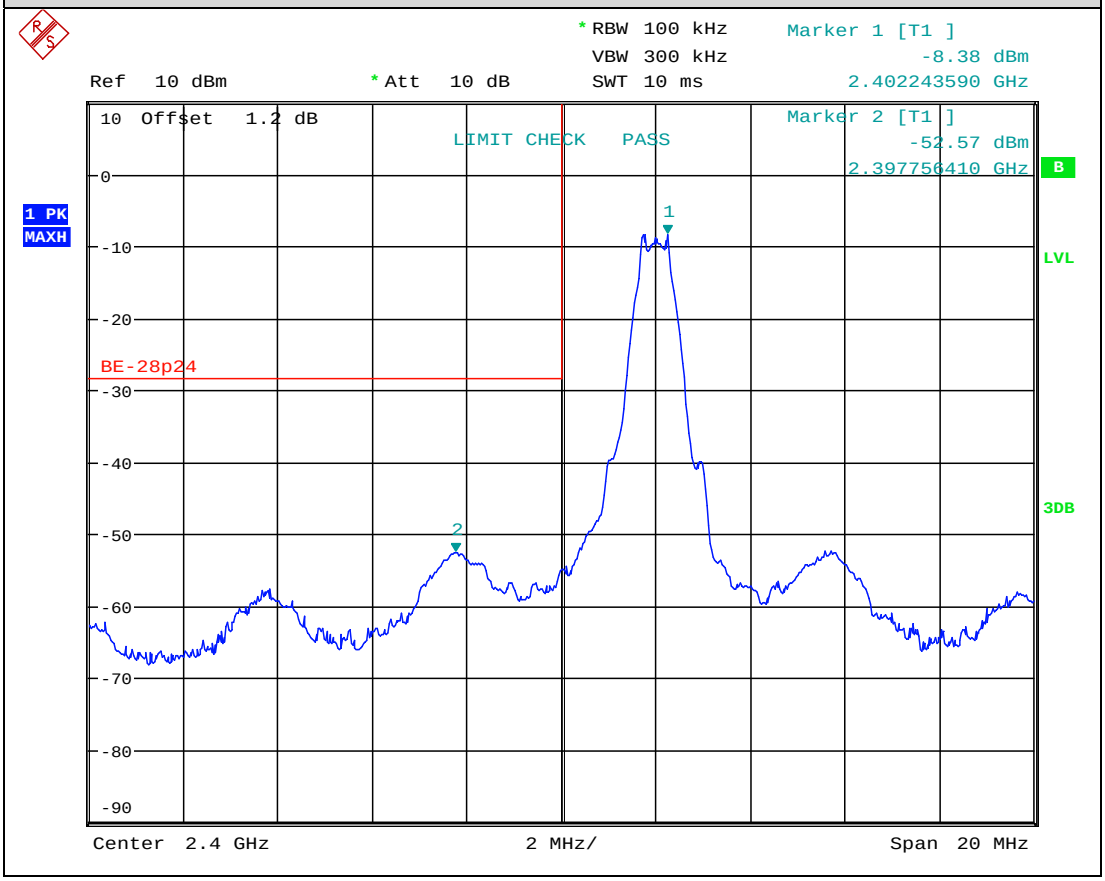
Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

15.6 Test Results

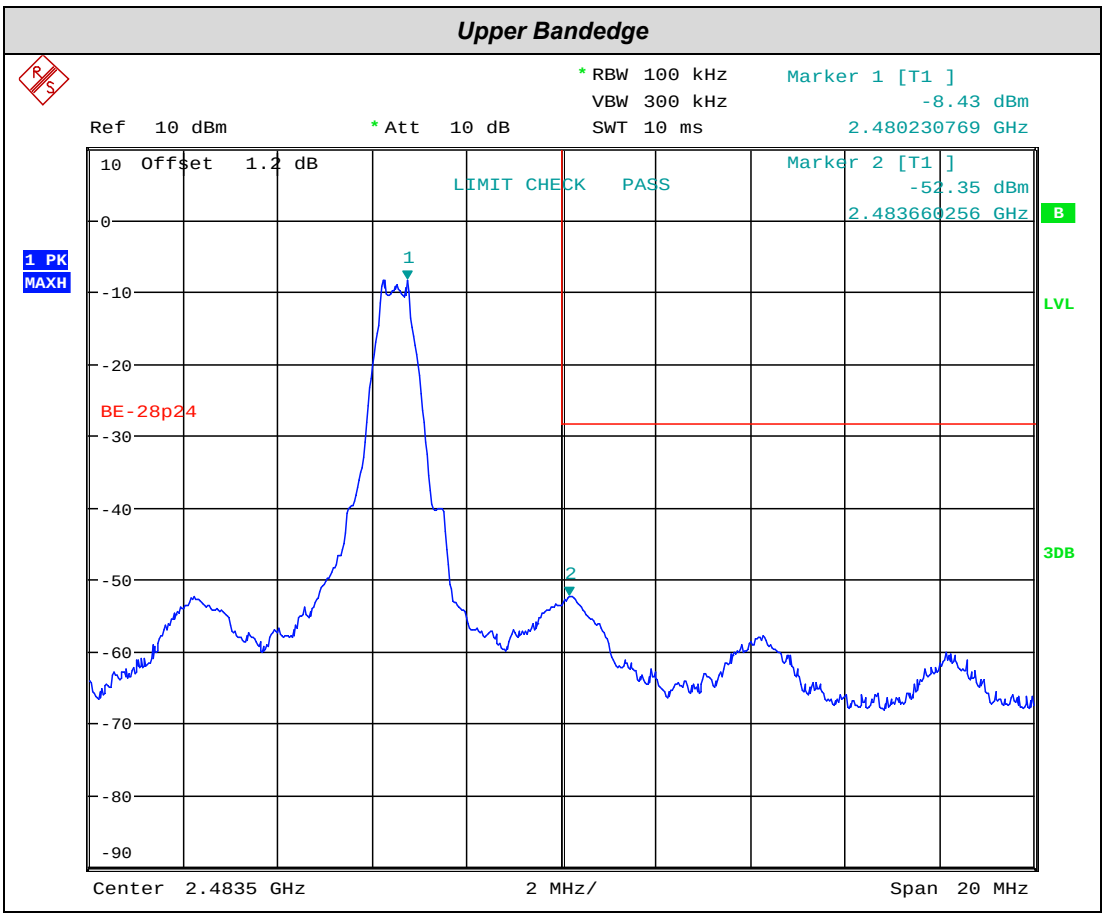
Reference Level



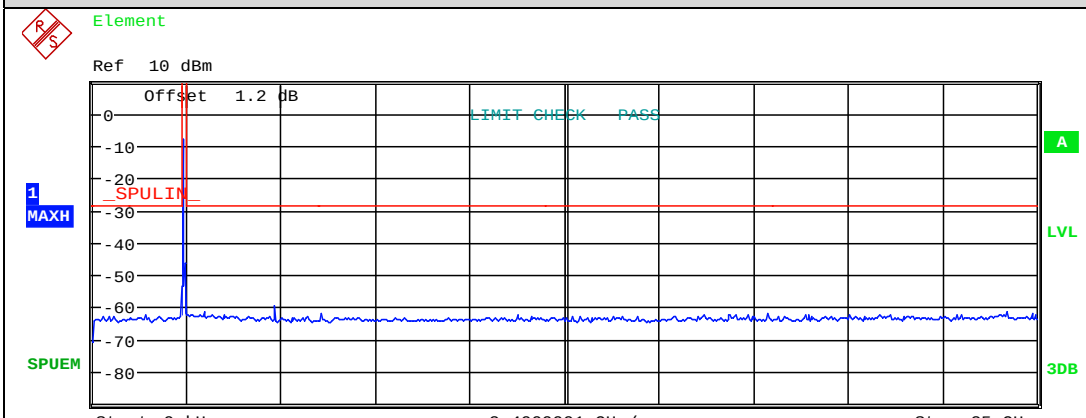
Lower Bandedge



Upper Bandedge

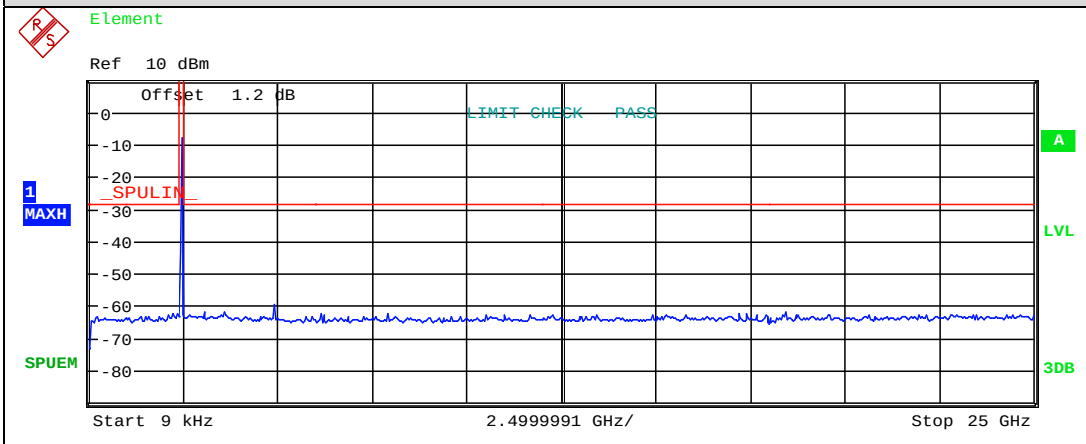


2402 MHz Out of Band Emissions



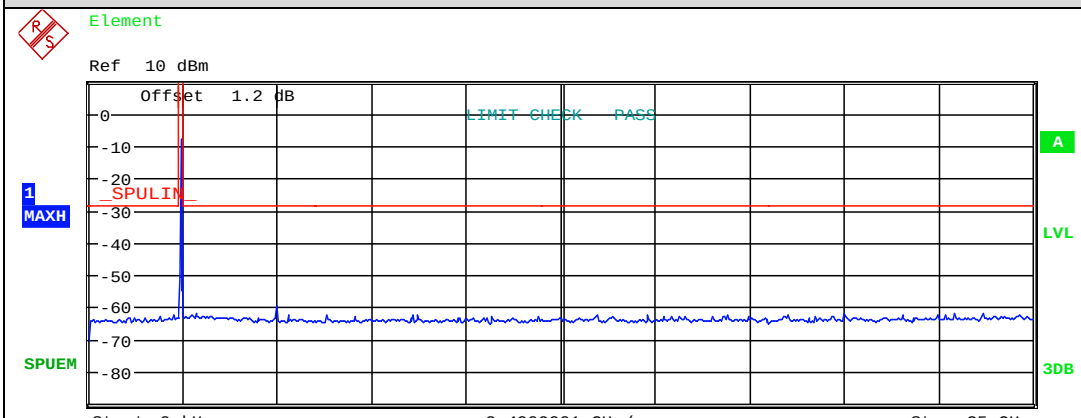
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	34.533654 k	-73.61	-45.37
150.000 k	30.000 M	10.00 k	185.820000 k	-70.93	-42.69
30.000 M	1.000 G	100.00 k	280.260000 M	-63.09	-34.85
1.000 G	2.400 G	100.00 k	2.397760 G	-53.56	-25.32
2.400 G	2.483 G	3.00 M	2.402007 G	-8.07	-38.07
2.483 G	6.000 G	100.00 k	4.804390 G	-59.62	-31.38
6.000 G	12.000 G	100.00 k	6.045000 G	-62.28	-34.04
12.000 G	18.000 G	100.00 k	17.868600 G	-62.08	-33.84
18.000 G	25.000 G	100.00 k	24.181000 G	-61.79	-33.55

2440 MHz Out of Band Emissions



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	34.533654 k	-74.90	-46.66
150.000 k	30.000 M	10.00 k	176.865000 k	-73.44	-45.20
30.000 M	1.000 G	100.00 k	212.554000 M	-63.57	-35.33
1.000 G	2.400 G	100.00 k	2.336300 G	-62.38	-34.14
2.400 G	2.483 G	3.00 M	2.440144 G	-8.13	-38.13
2.483 G	6.000 G	100.00 k	4.879643 G	-59.52	-31.28
6.000 G	12.000 G	100.00 k	7.891800 G	-62.42	-34.18
12.000 G	18.000 G	100.00 k	17.170800 G	-62.42	-34.18
18.000 G	25.000 G	100.00 k	18.448700 G	-62.08	-33.84

2480 MHz Out of Band Emissions



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
9.000 k	150.000 k	1.00 k	34.533654 k	-74.90	-46.66
150.000 k	30.000 M	10.00 k	158.955000 k	-70.72	-42.48
30.000 M	1.000 G	100.00 k	785.339000 M	-63.88	-35.64
1.000 G	2.400 G	100.00 k	2.227800 G	-62.64	-34.40
2.400 G	2.483 G	3.00 M	2.479753 G	-8.30	-38.30
2.483 G	6.000 G	100.00 k	2.483852 G	-55.48	-27.24
6.000 G	12.000 G	100.00 k	8.554200 G	-62.32	-34.08
12.000 G	18.000 G	100.00 k	13.456800 G	-62.32	-34.08
18.000 G	25.000 G	100.00 k	20.010400 G	-61.94	-33.70

16 Power spectral density

16.1 Definition

The power per unit bandwidth.

16.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Frequencies Measured:	2402 MHz, 2440 MHz & 2480 MHz
Deviations From Standard:	None
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 ºC to +35 ºC (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

16.3 Test Limit

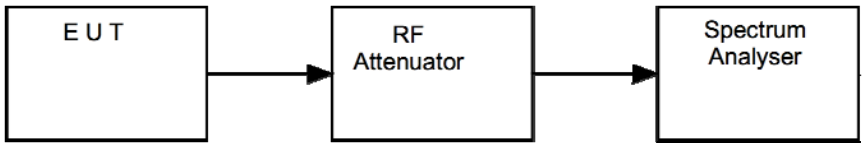
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

16.4 Test Method

With the EUT 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

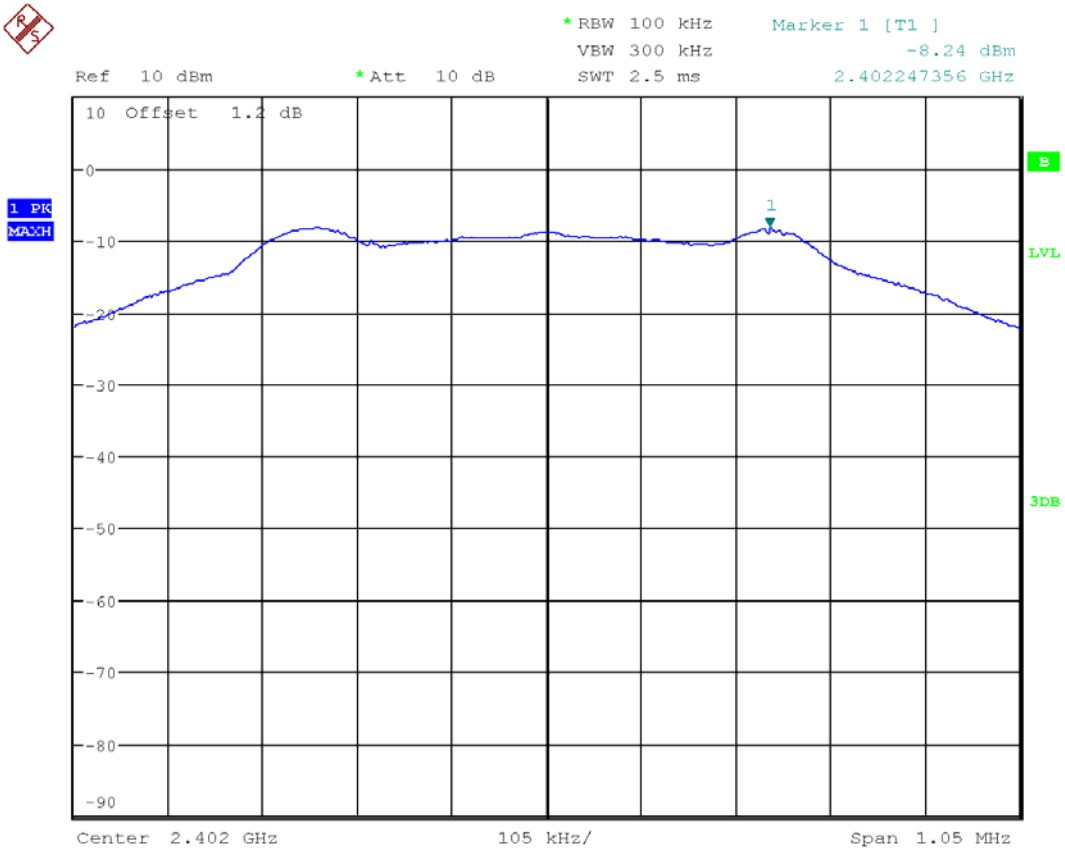


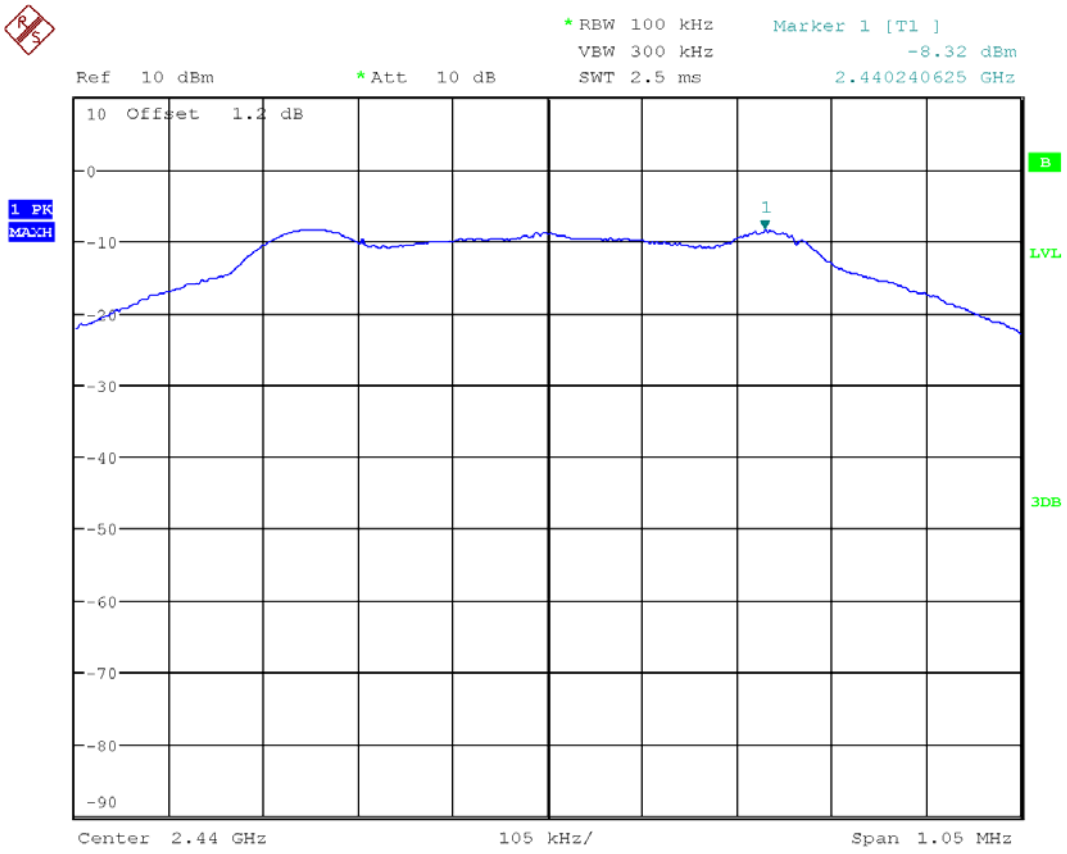
16.5 Test Equipment

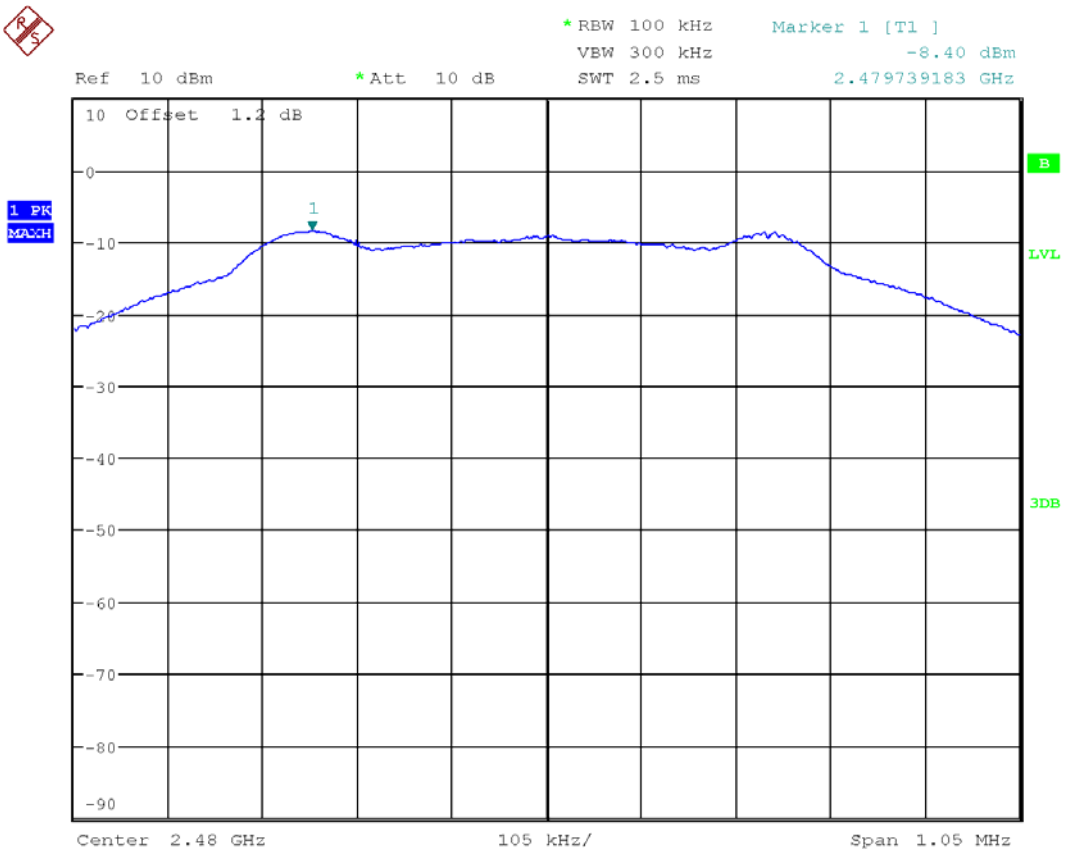
Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	R&S	FSU50	U544	2020-06-05

16.6 Test Results

Channel Frequency (MHz)	*Power Spectral Density (dBm)*	*Result*
2402	-8.24	PASS
2440	-8.32	PASS
2480	-8.40	PASS




RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
-8.32 dBm
2.440240625 GHz
Ref 10 dBm
Att 10 dB
10 Offset 1.2 dB
1 PK
MAXH
B
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.44 GHz
105 kHz/
Span 1.05 MHz


RBW 100 kHz
VBW 300 kHz
SWT 2.5 ms
Marker 1 [T1]
-8.40 dBm
2.479739183 GHz
Ref 10 dBm
Att 10 dB
10 Offset 1.2 dB
1 PK
MAXH
B
LVL
3DB
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Center 2.48 GHz
105 kHz/
Span 1.05 MHz

17 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**