

FCC and ISED Test report for subparts 15C, section 15.247(d); RSS-Gen

Product name : Sleep Robot
Applicant : Somnox
FCC ID : 2ASNCLF048418
ISED ID : 24848-LF048418

Test report No. : 201100888 01 V2.00

Laboratory information

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Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

Testing Location

Test Site	KIWA Telefication BV
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	26-01-2021	First draft	PS
v1.00	26-05-2021	First release	PS
V2.00	01-11-2021	Additional test performed	KK

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(d) 15.209 (a)	RSS-Gen §8.9	Radiated spurious emissions	3.1	Pass
15.205 (a)	RSS Gen §8.10	Spurious emissions in the restricted bands	3.1	Pass

1 General Description

1.1 Applicant

Client name: Somnox
Address Stationsplein 45 A4.004
Zip code: 3013 AK, Rotterdam
Telephone: +31 (0)6 144 10 124
E-mail: stijn@somnox.com
Contact name: Mr. Stijn Antonisse

1.2 Manufacturer

Manufacturer name: Somnox
Address: Stationsplein 45 A4.004
Zip code: 3013 AK, Rotterdam
Telephone: +31 (0)6 144 10 124
E-mail: stijn@somnox.com
Contact name: Mr. Stijn Antonisse

1.3 Tested Equipment Under Test (EUT)

Product name: Sleep Robot
Brand name: Somnox
FCC ID: 2ASNCLF048418
ISED ID: 24848-LF048418
Product type: Digital Transmission System (DTS) equipment
Model(s): --
Batch and/or serial No. --
Software version: --
Hardware version: --
Date of receipt 12-01-2021
Tests started: 01-03-2021
Testing ended: 21-04-2021

1.4 Product specifications of Equipment under test

Tx Frequency:	BLE, BT, 802-11b, 802-11n: 2400 – 2483.5 MHz
Rx frequency:	BLE, BT, 802-11b, 802-11n: 2400 – 2483.5 MHz
Antenna type	Integral (part of radio module)
Antenna gain	Not provided
Type of modulation:	BLE: GFSK BT: acc. To Bluetooth spec. Other: acc. to IEEE 802-11 b/n standards

1.5 Environmental conditions

Test date	15-01-2021	26-01-2021	21-04-2021
Ambient temperature	21.4 °C	18.1 °C	20.9 °C
Humidity	53.0 % RH	38.5 % RH	32.1 % RH

1.6 Measurement standards

- ANSI C63.10:2013
- KDB 558074 D01 V05R02

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247(d)
- RSS-Gen Issue 5

1.8 Observation and remarks

The sample incorporates a certified radio module (FCC ID 2AC7Z-ESP32WROVERE)

To set channels, test mode and power use has been made of the EspRFtestTool (made by Espressif)

The power settings during the tests were set as follows:

WiFi 802-11b ; 12x0.25 (attenuation dB)

WiFi 802-11n: 0x0.25 (attenuation in dB)

BLE : 8 (power level)

BT : 8 (power level)

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards"*.

All conducted tests are performed by:

Name : ing P.A. Suringa

Review of test methods and report by:

Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 01-11-2021

Name : ing. R. van Barneveld

Function : Test Engineer

Signature :



2 Test configuration of the Equipment Under Test

2.1 Test mode

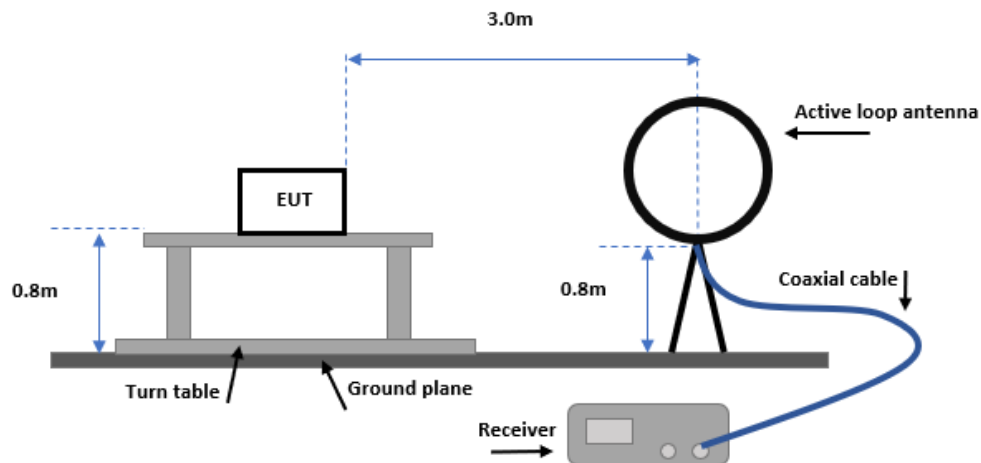
The applicant provided test mode firmware with which it was possible to configure the radio to transmit continuously.

2.2 Tested channels

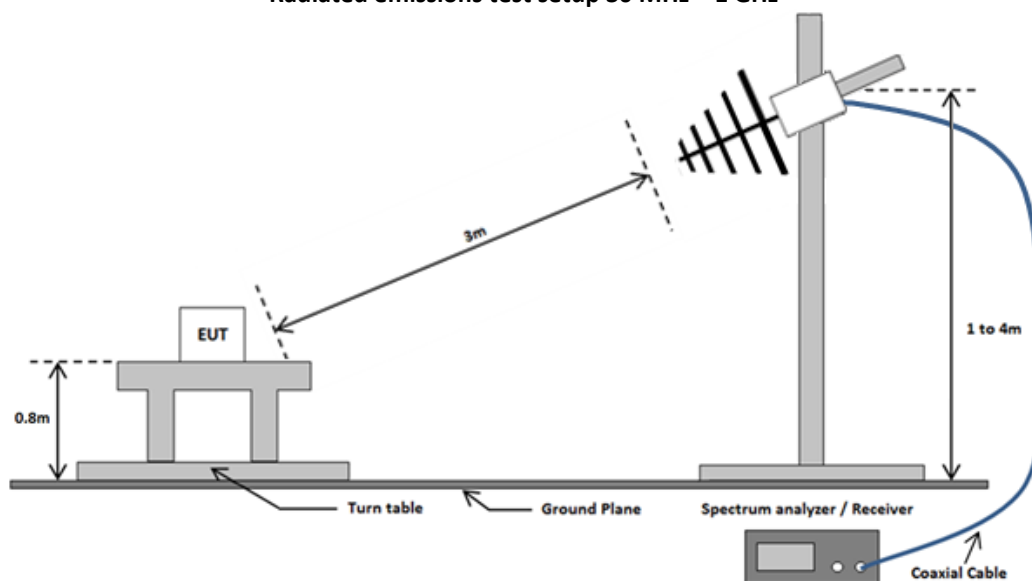
Technology	Channel #	Frequency (MHz)
Bluetooth Low Energy	37	2402
	19	2440
	39	2480
Bluetooth Classic	0	2402
	40	2440
	79	2480
IEEE 802-11b	1	2412
	6	2437
	11	2462
IEEE 802-11n	1	2412
	6	2437
	11	2462

2.3 Test setups

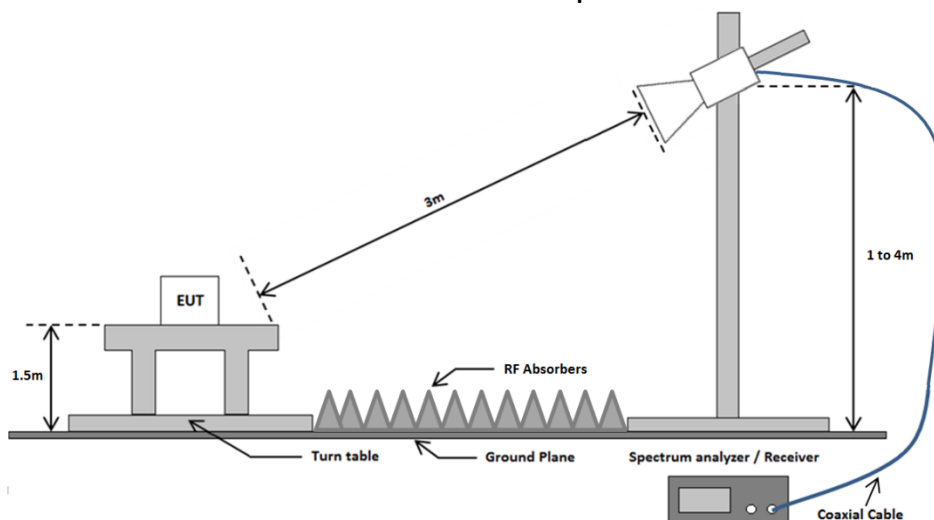
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz – 1 GHz



Radiated emissions test setup above 1 GHz



2.4 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.1
Software	D.A.R.E Instruments	Radimation	2019.1.8	3.1
Biconilog Antenna	Chase	CBL6112A	TE00967	3.1
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.1
Semi Anechoic Chamber	ETS Lindgren	FACT5		3.1
Active loop antenna	EMCO	6502	TE11171	3.1
High pass filter	Wainwright instruments	WHK10-2520-3000-18000	TE01146	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	TE11175	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	TE 00818	3.1
Preamplifier 18-26 GHz	Miteq	JS4-18004000-33-8P	TE 11131	3.1

2.5 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Spurious emissions (incl. spurious emissions in the restricted bands)

3.1.1 Limit

§ 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the RF power shall be at least 20 dB attenuation below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either a conducted or radiated measurement.

§15.205(c)

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.1.4 Test procedure

According to ANSI C63.10: 2013; sections 5.6, 6.6

IRN 026_14.1 Radiated electrical disturbance (V per m); methods 1, 2, 3,

IRN 027_08 Radiated magnetic disturbance ; method 1

3.1.5 Test results of the radiated spurious emission measurements

See next pages.

3.1.6 Measurement uncertainty

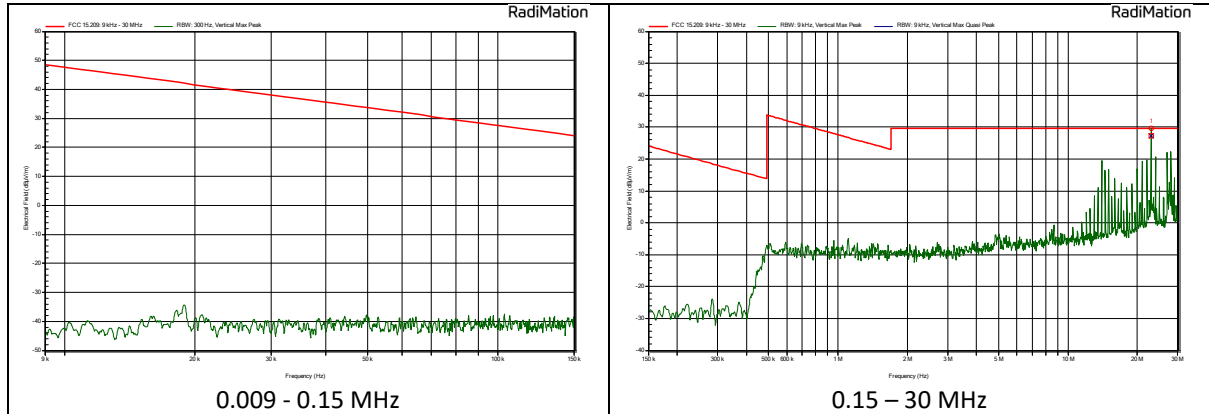
Horizontal polarization	
0.09 – 30 MHz	+1.5/-1.6 dB
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
1000 – 18000 MHz	5.7 dB
18000 – 26000 MHz	4.9 dB
Vertical polarization	
0.09 – 30 MHz	+1.5/-1.6 dB
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB
1000 – 18000 MHz	5.7 dB
18000 – 26000 MHz	4.9 dB

3.1.7 Plots

3.1.7.1 802-11b

0.09 – 30 MHz

Channel 6 (2437 MHz)

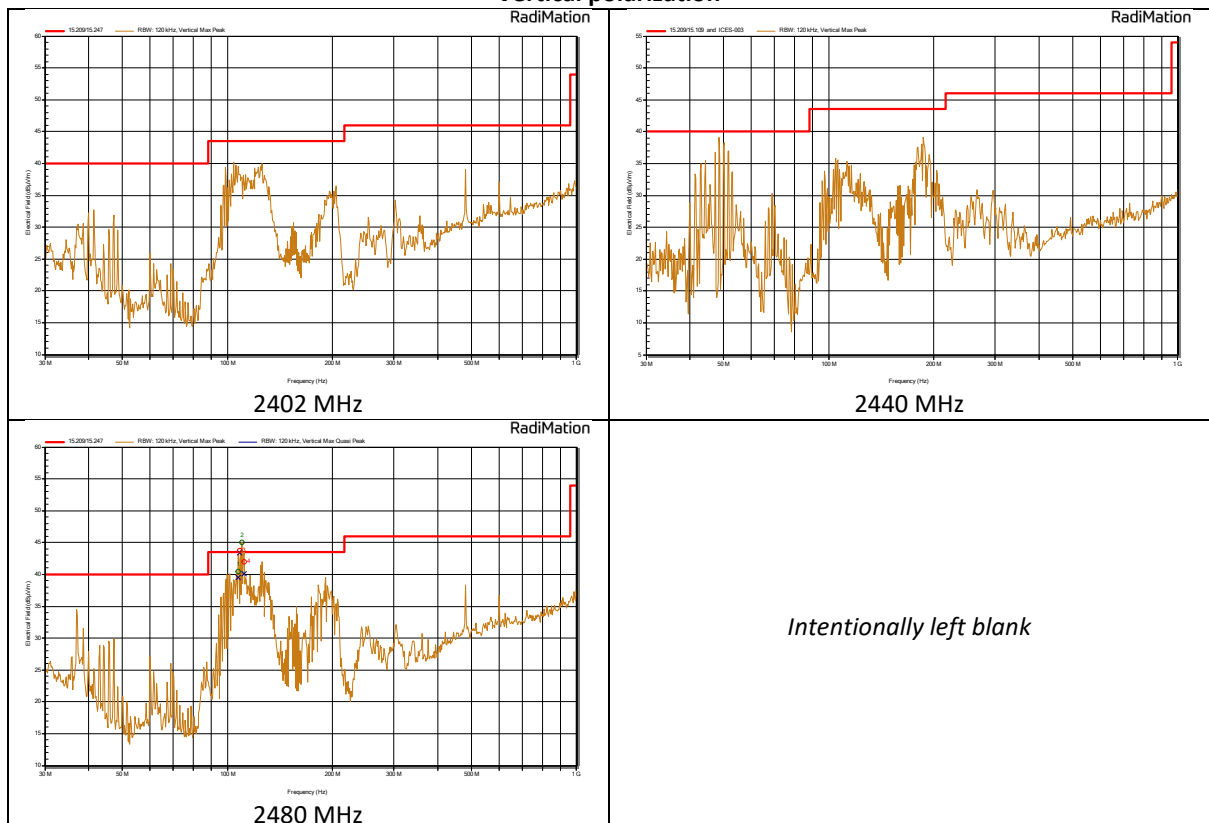


Final measurement

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Polarization
22,955 MHz	29,5 dBμV/m	27,3 dBμV/m	29,5 dBμV/m	Pass	1 m	Vertical

30 -1000 MHz

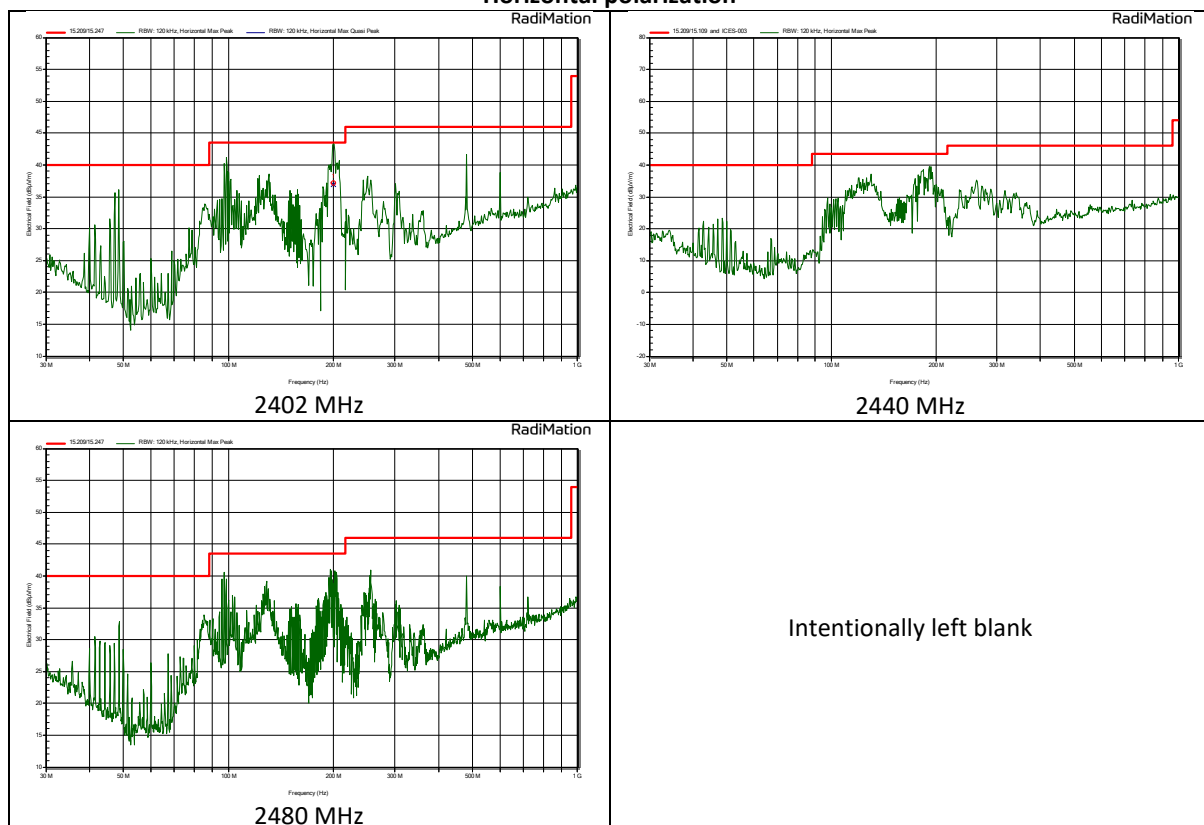
Vertical polarization



Final measurement high channel

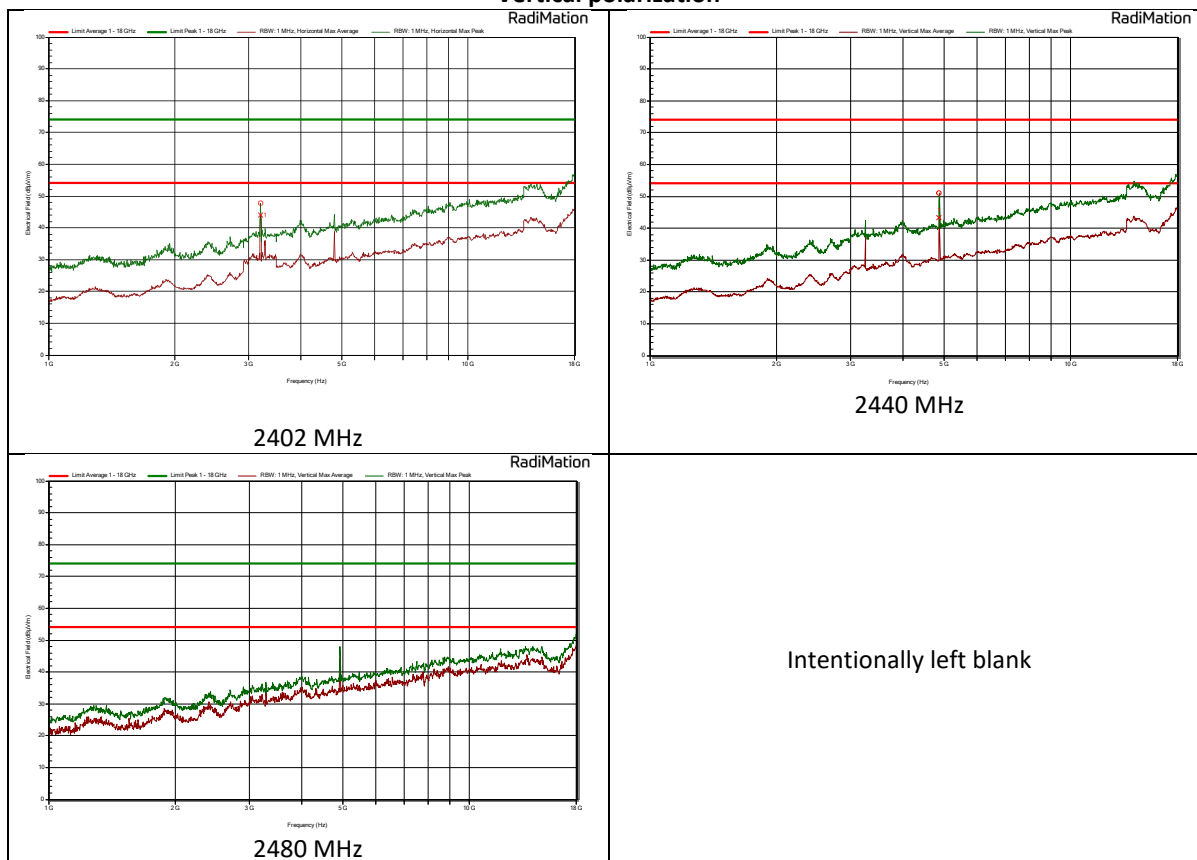
Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height
107,183 MHz	40,5 dB μ V/m	39,5 dB μ V/m	43,5 dB μ V/m	Pass	1,5 m
111,462 MHz	42 dB μ V/m	40,1 dB μ V/m	43,5 dB μ V/m	Pass	1,5 m
109,904 MHz	45,1 dB μ V/m	--	--	--	1 m
108,597 MHz	43,7 dB μ V/m	43,4 dB μ V/m	43,5 dB μ V/m	Pass	1,5 m

Horizontal polarization

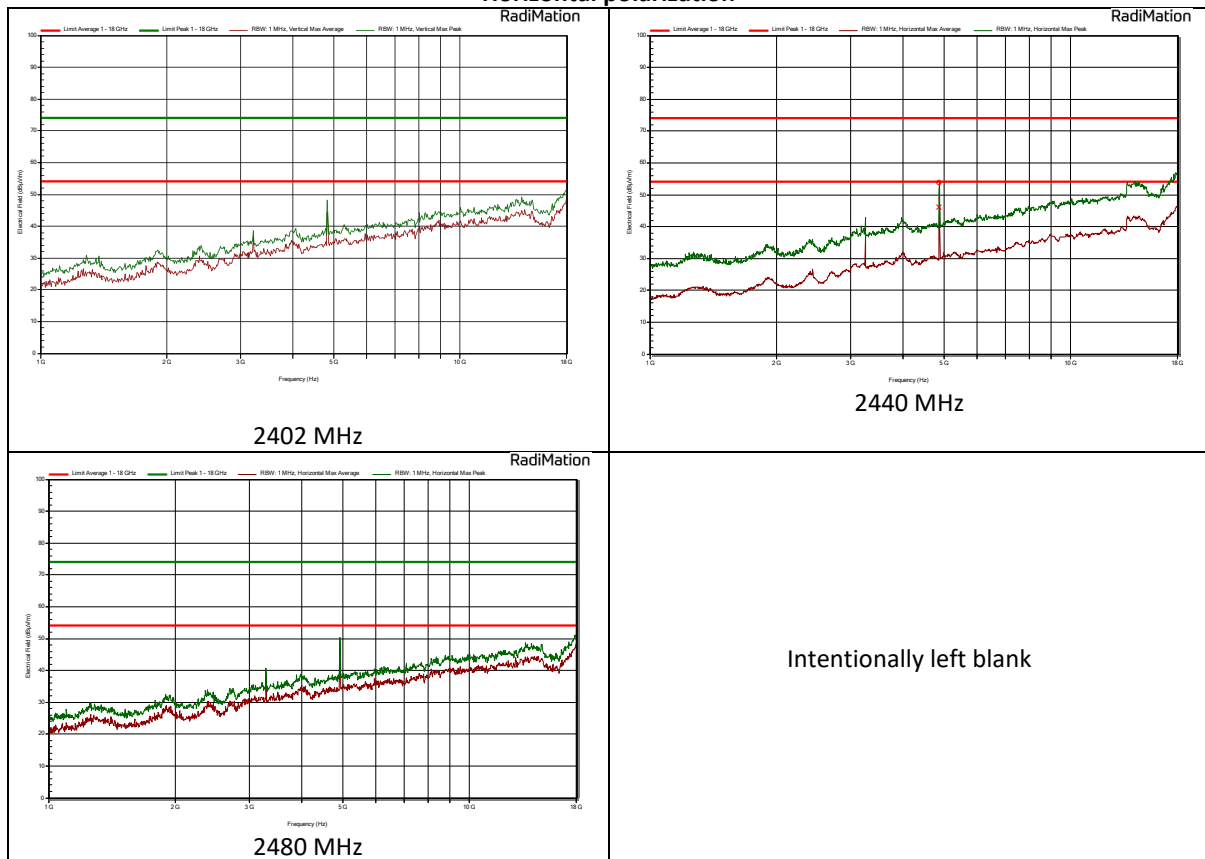


1 – 18 GHz

Vertical polarization

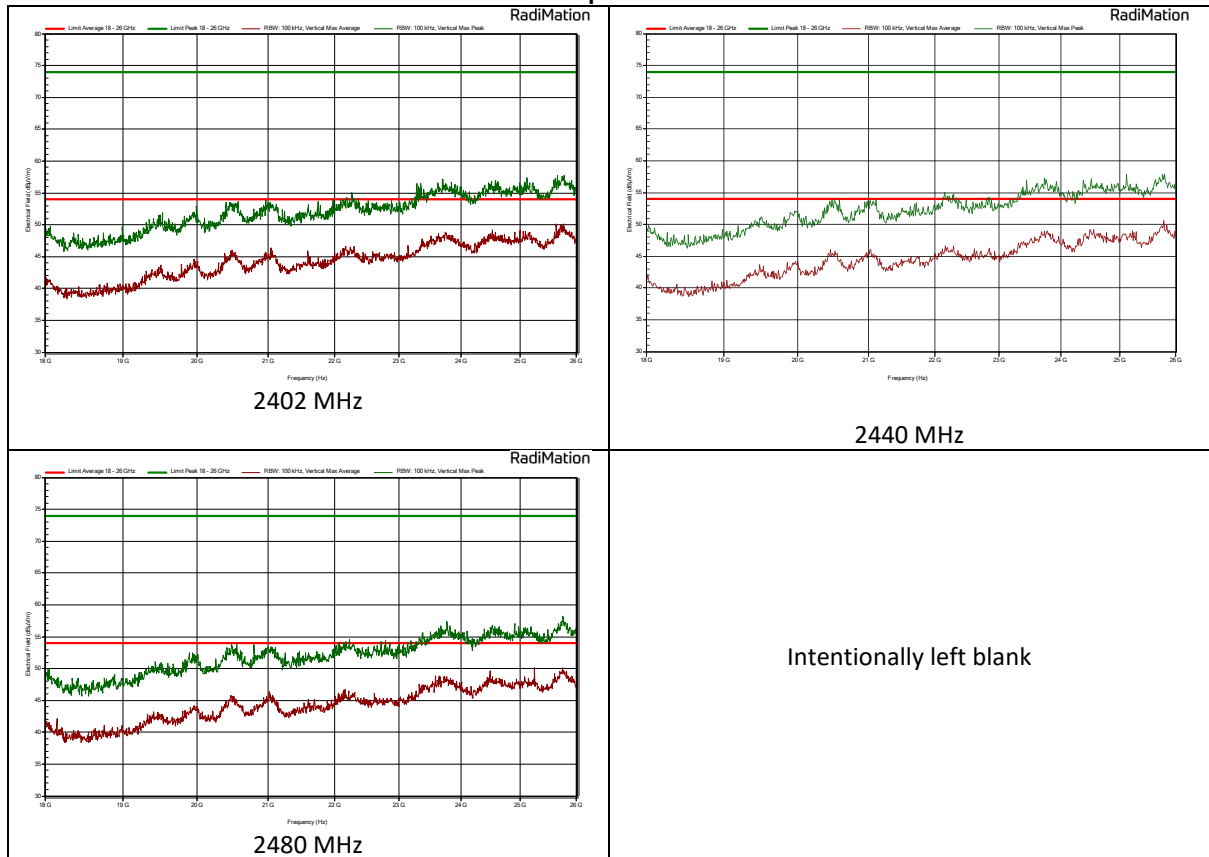


Horizontal polarization

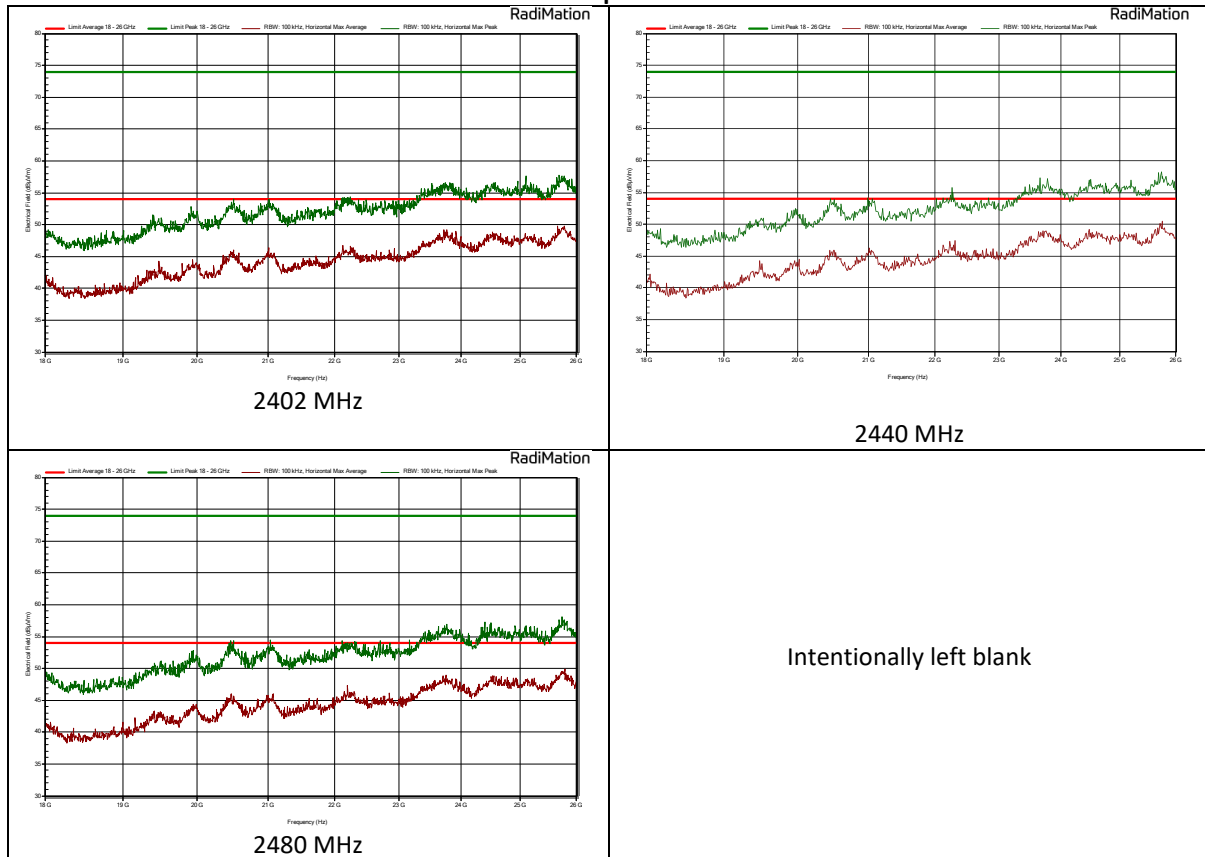


18 – 26 GHz

Vertical polarization



Horizontal polarization



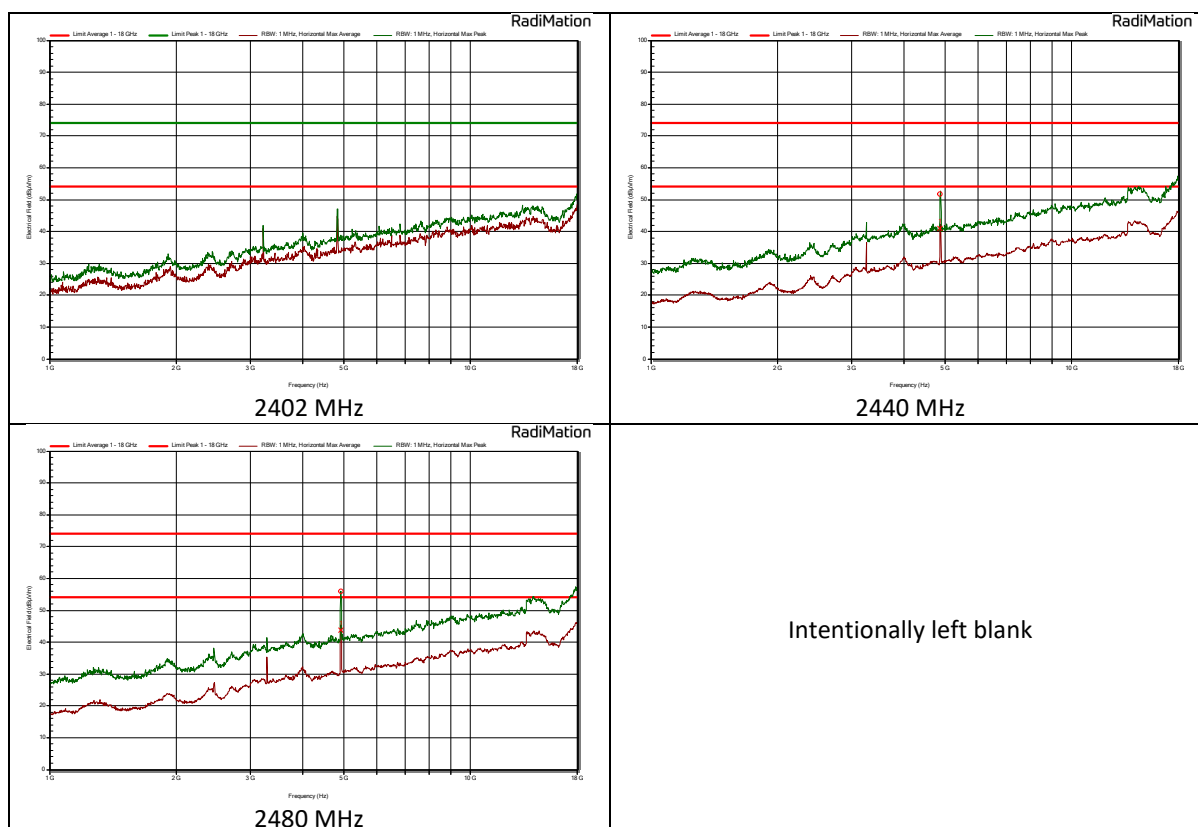
3.1.7.2 802-11 n

0.03 – 1 GHz

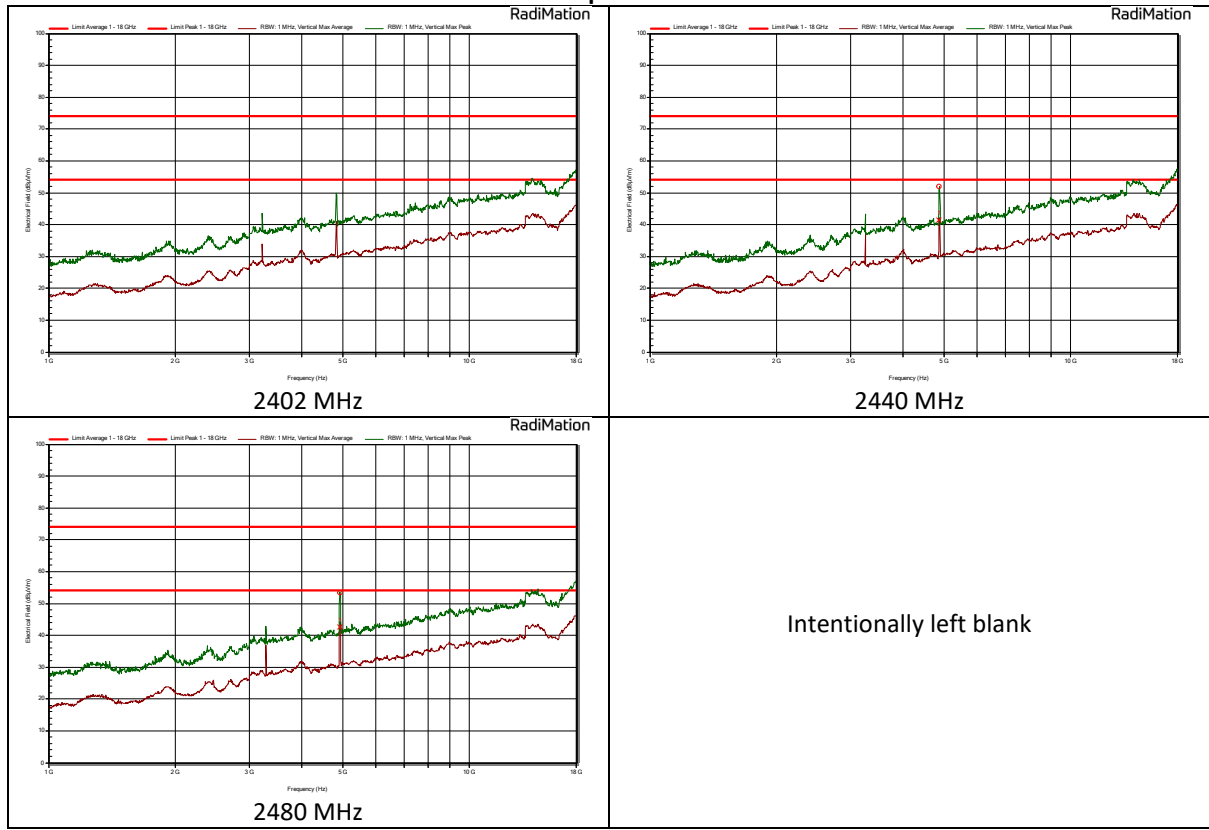
See measurement results 802-11 b

1 -18 GHz

Horizontal polarization

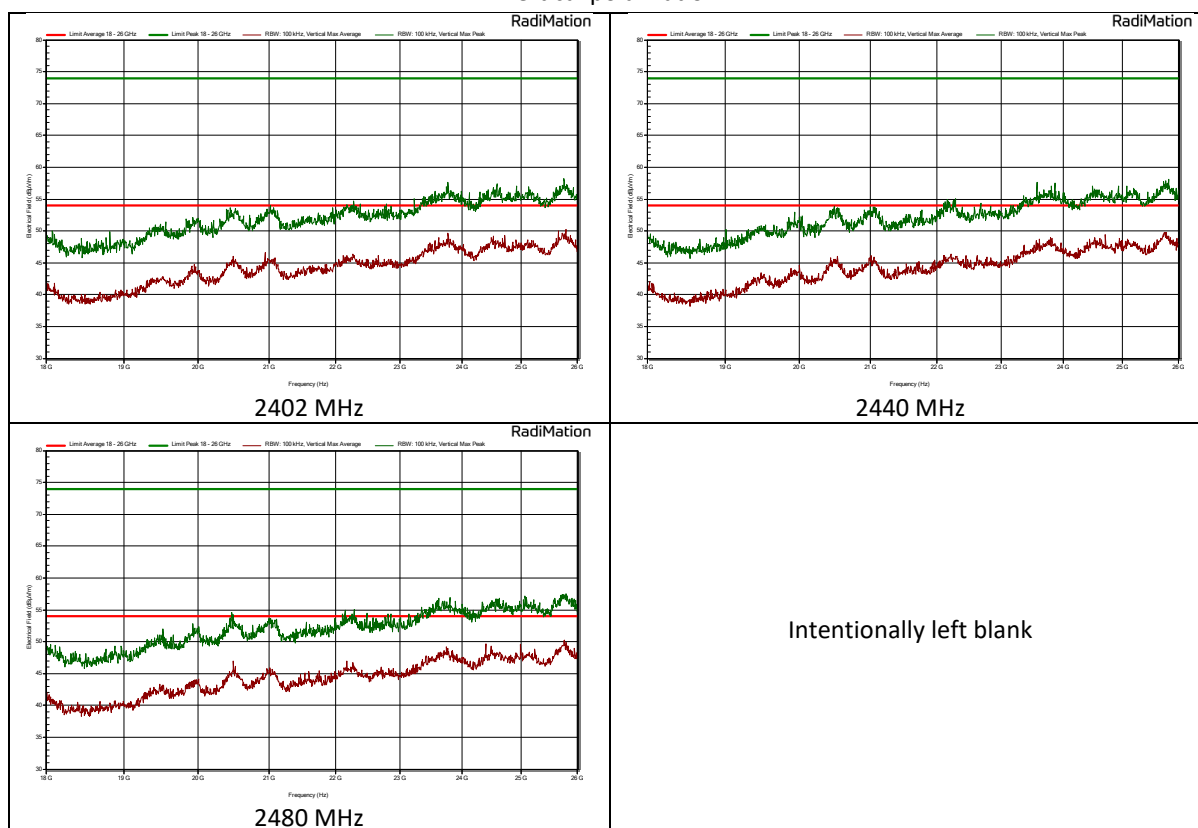


Vertical polarization

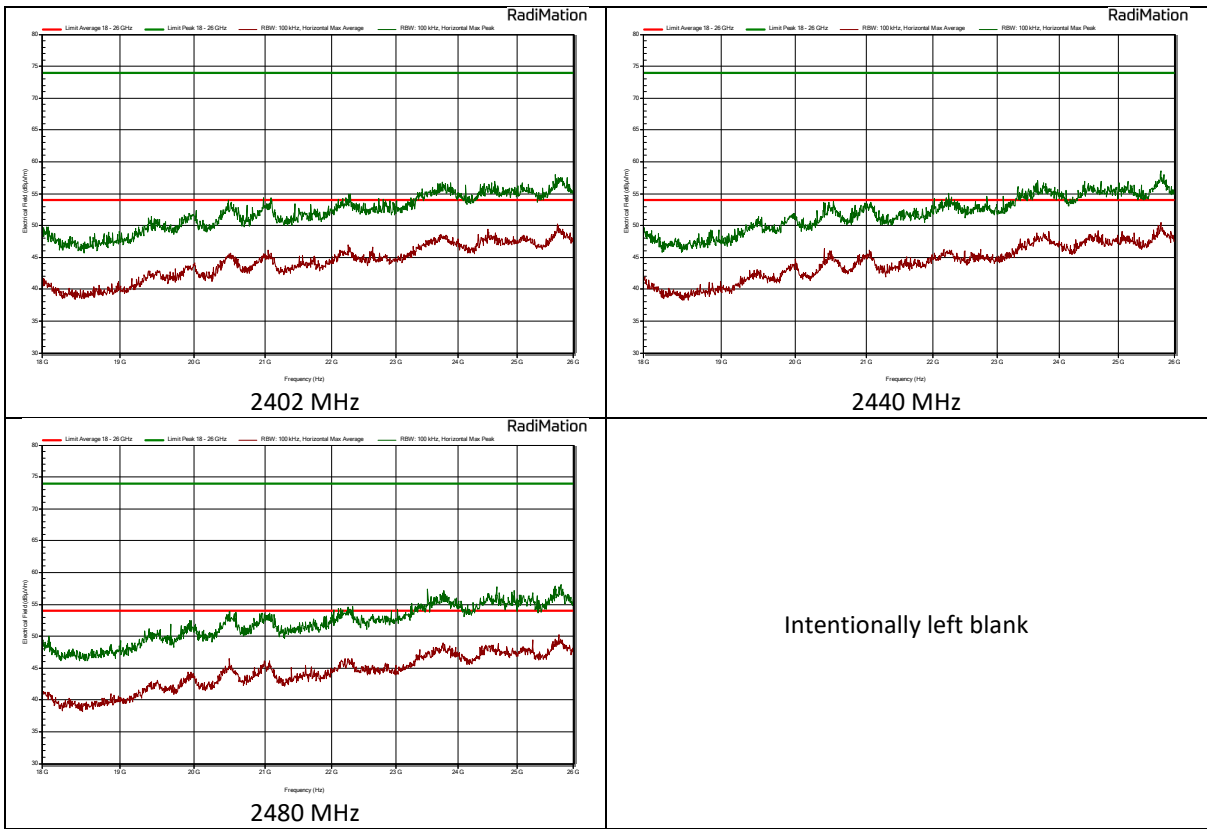


18 -26 GHz

Vertical polarization



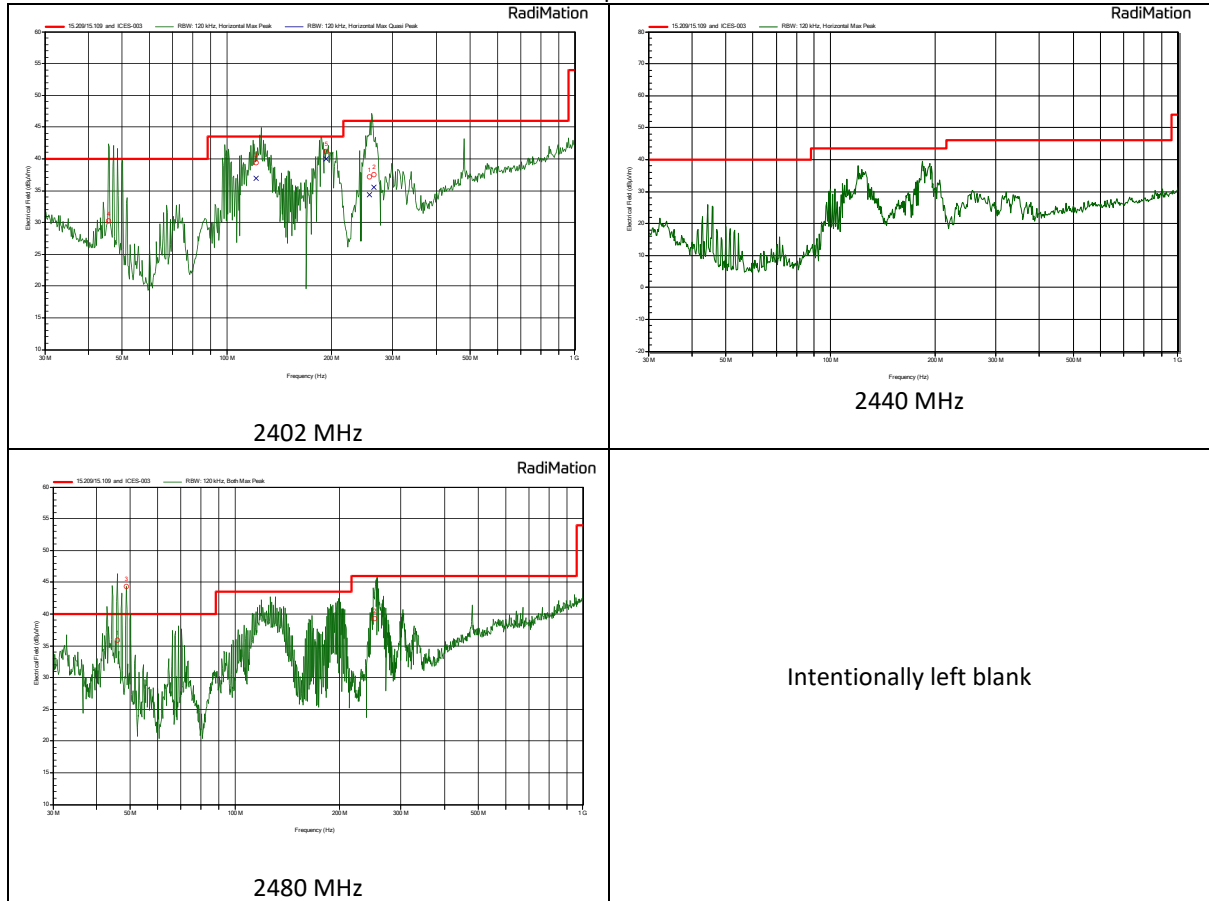
Horizontal polarization



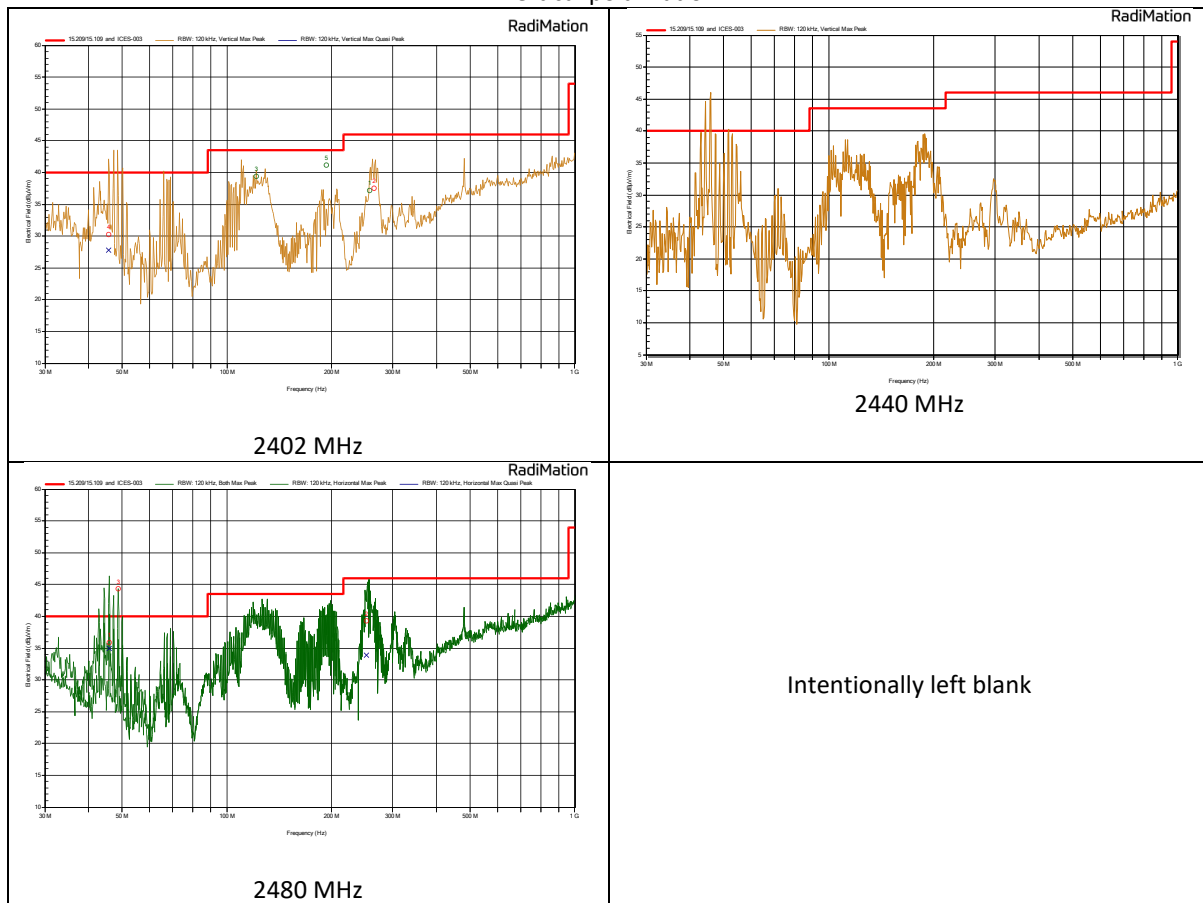
3.1.7.3 BLE

0.03 – 1 GHz

Horizontal polarization



Vertical polarization



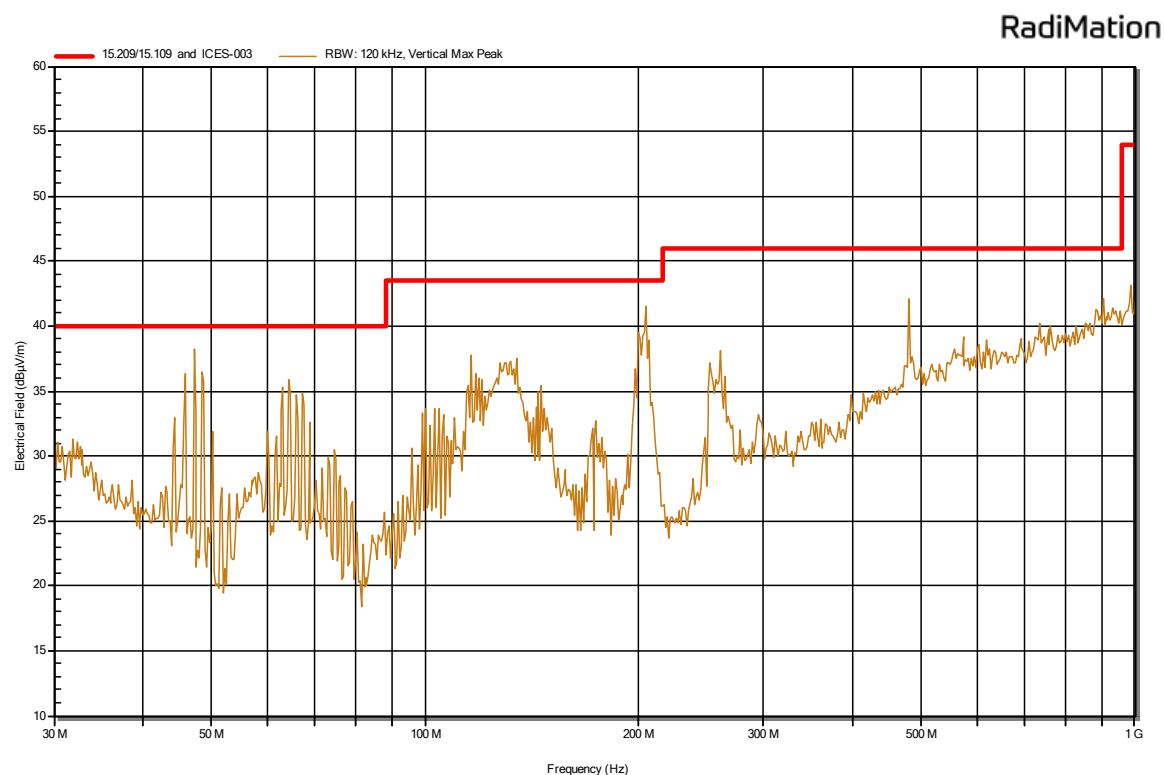
Final measurements Low channel

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Polarization
257,322 MHz	37,2 dBμV/m	34,4 dBμV/m	46 dBμV/m	Pass	1 m	Horizontal
264,396 MHz	37,5 dBμV/m	35,5 dBμV/m	46 dBμV/m	Pass	1 m	Horizontal
121,47 MHz	39,4 dBμV/m	36,9 dBμV/m	43,5 dBμV/m	Pass	3 m	Horizontal
45,803 MHz	30,3 dBμV/m	27,8 dBμV/m	40 dBμV/m	Pass	1,5 m	Vertical
192,931 MHz	41,2 dBμV/m	39,9 dBμV/m	43,5 dBμV/m	Pass	2 m	Horizontal

Final measurements high channel

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Polarization
45,875 MHz	35,9 dBμV/m	34,9 dBμV/m	40 dBμV/m	Pass	4 m	Horizontal
251,679 MHz	39,2 dBμV/m	33,9 dBμV/m	46 dBμV/m	Pass	1 m	Horizontal
48,67 MHz	44,3 dBμV/m	43,4 dBμV/m	40 dBμV/m	Pass (See next page)	2,5 m	Vertical

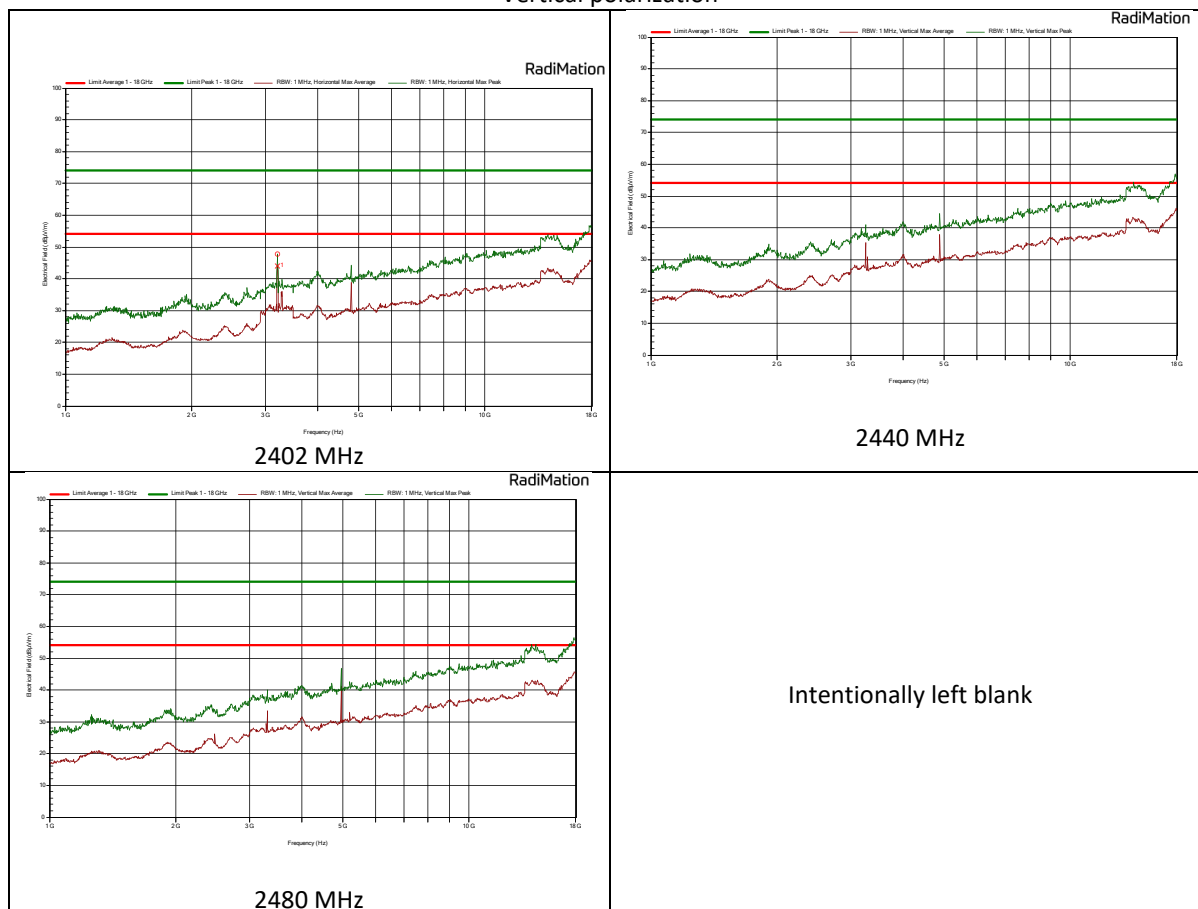
High channel additional measurement



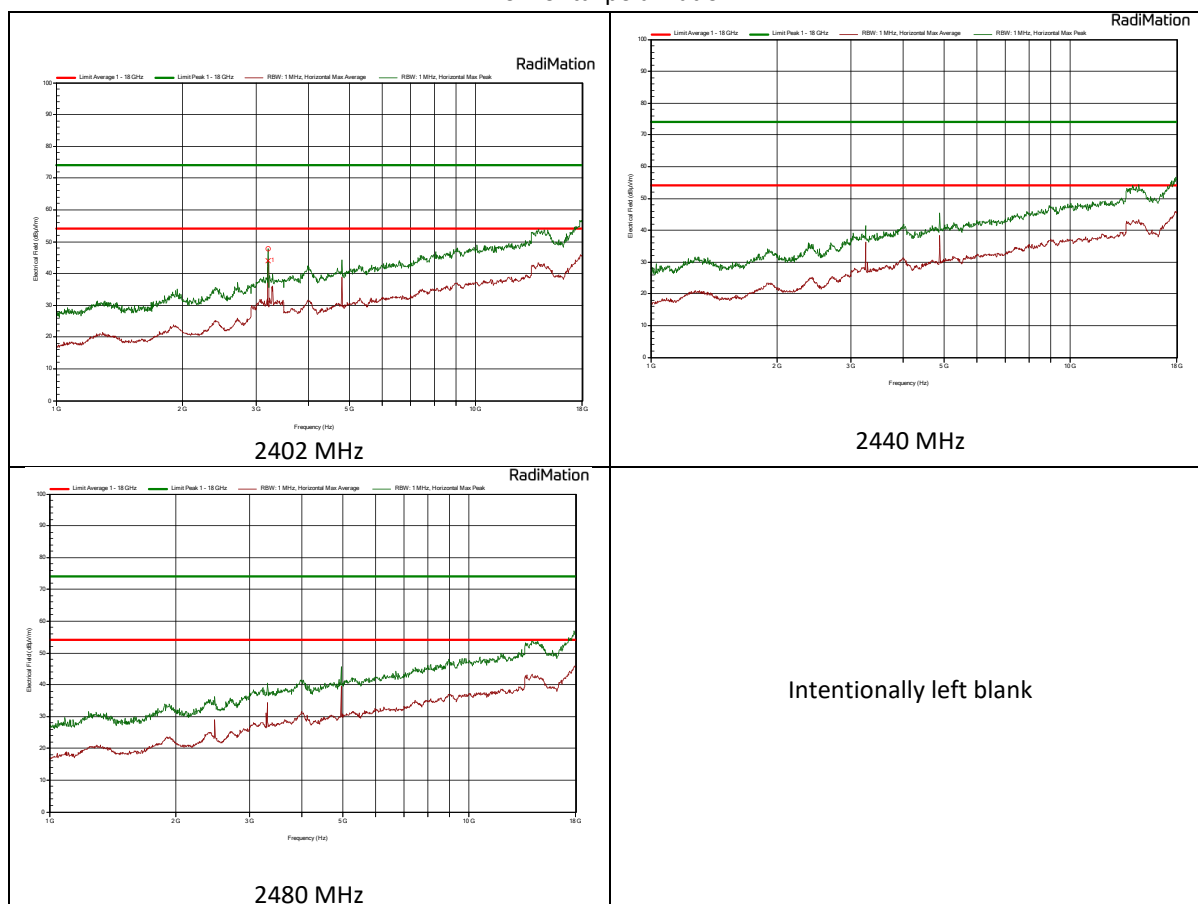
Fixed antenna height (2.5 m); Absorbing clamp applied

1 – 18 GHz

Vertical polarization

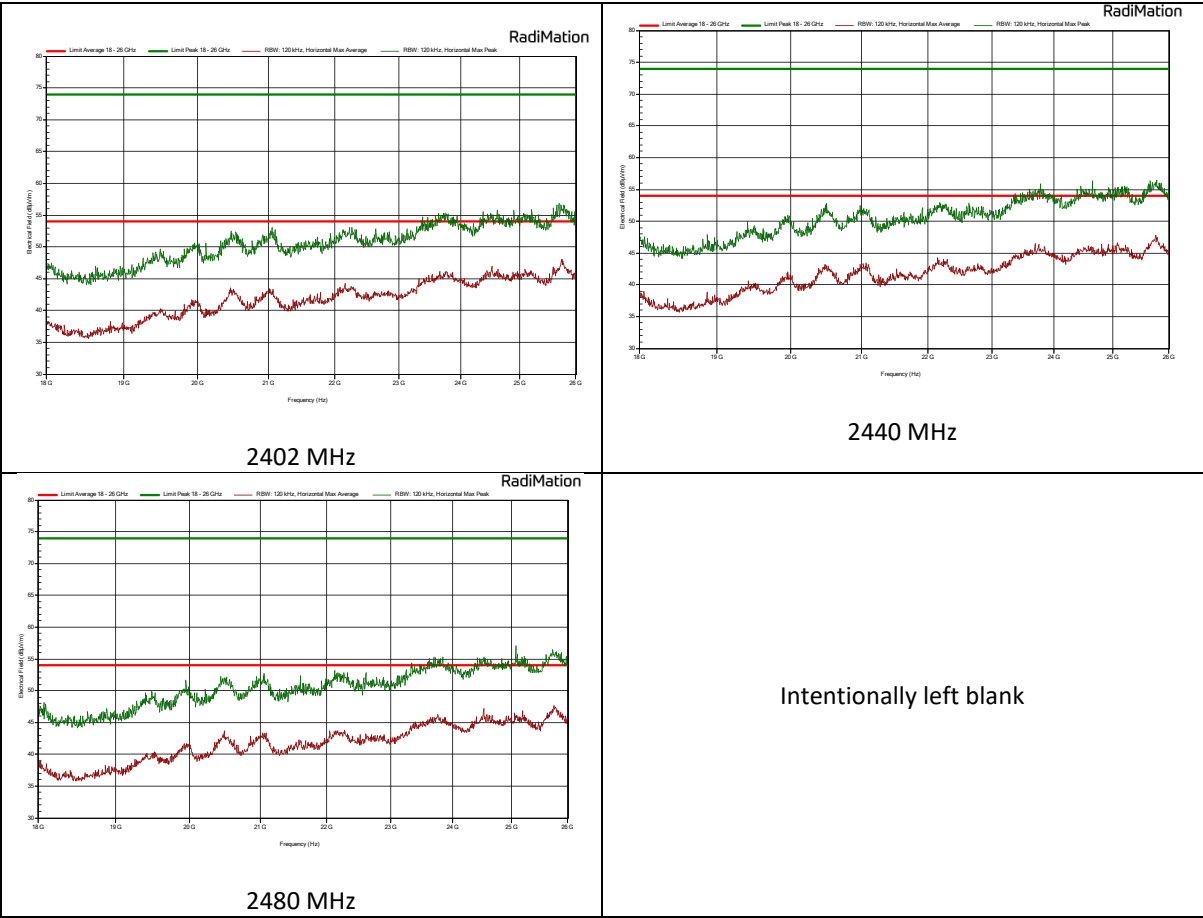


Horizontal polarization

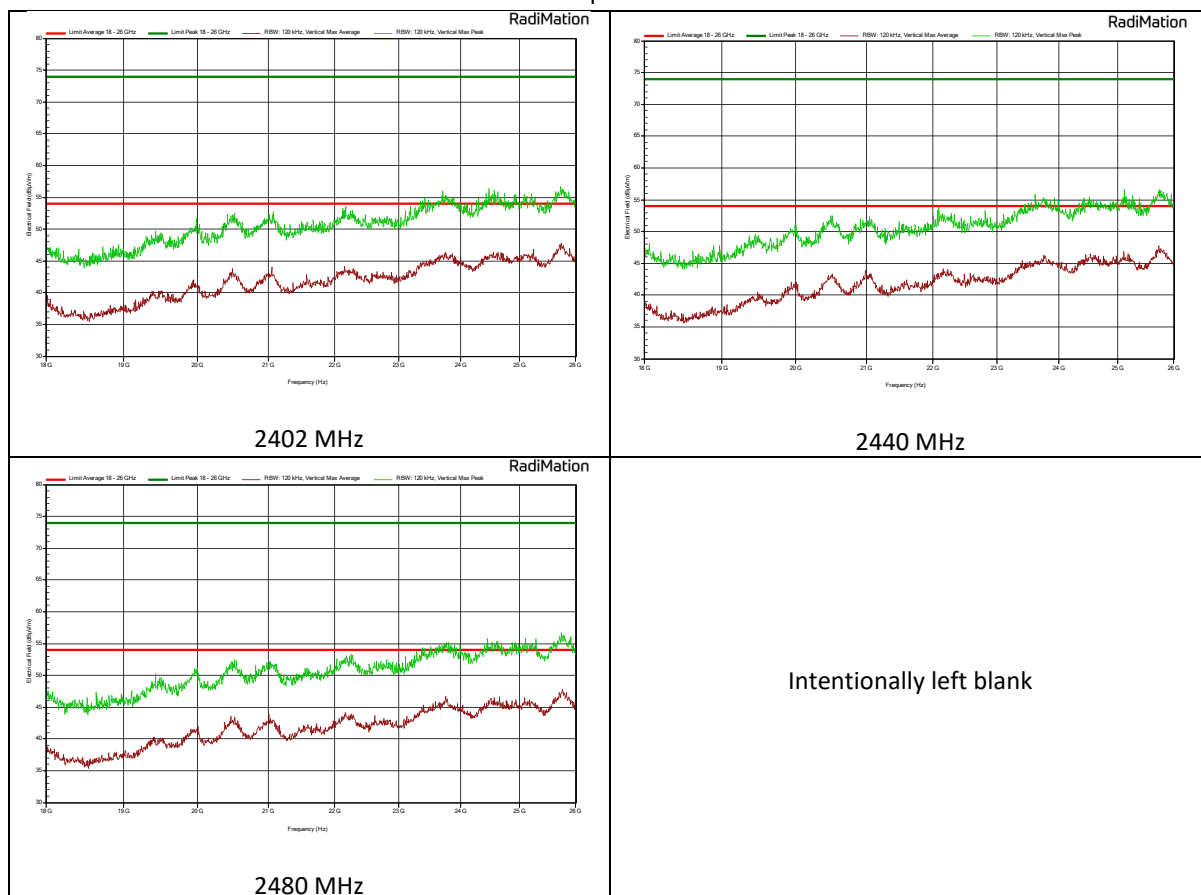


18 -26 GHz

Horizontal polarization



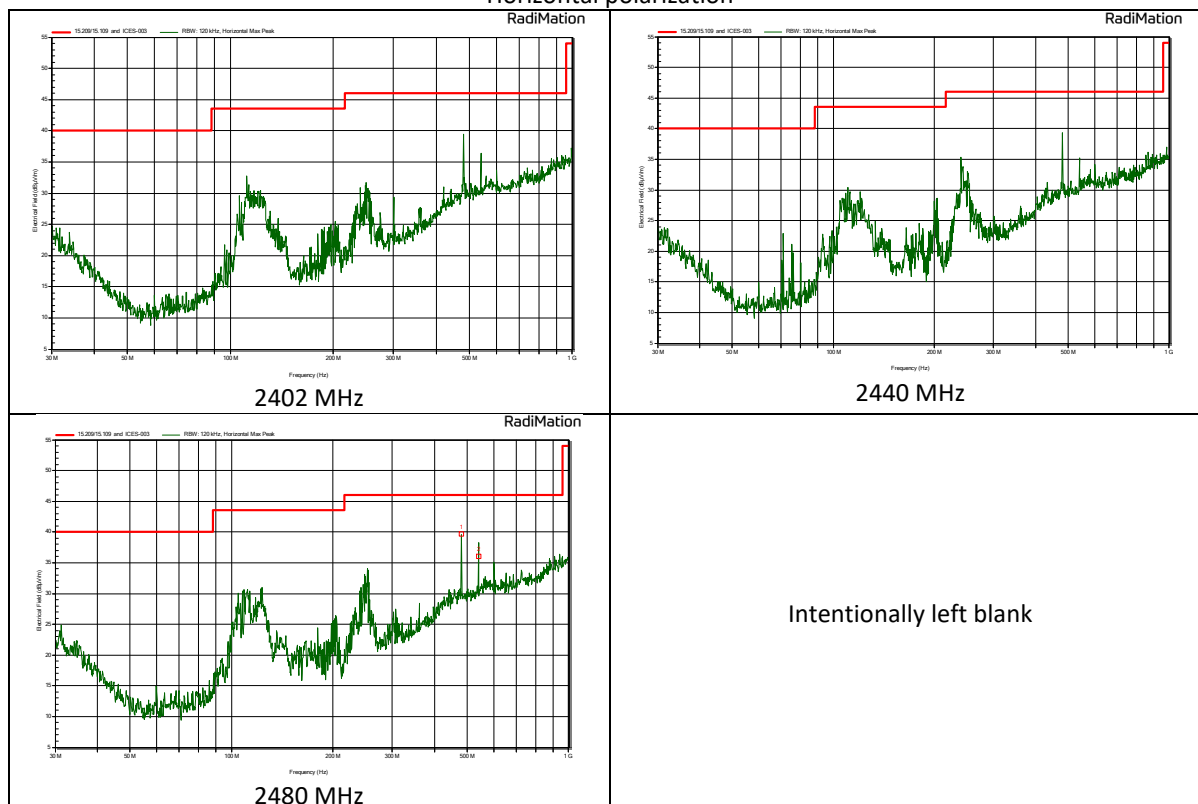
Vertical polarization



3.1.7.4 Bluetooth Classic

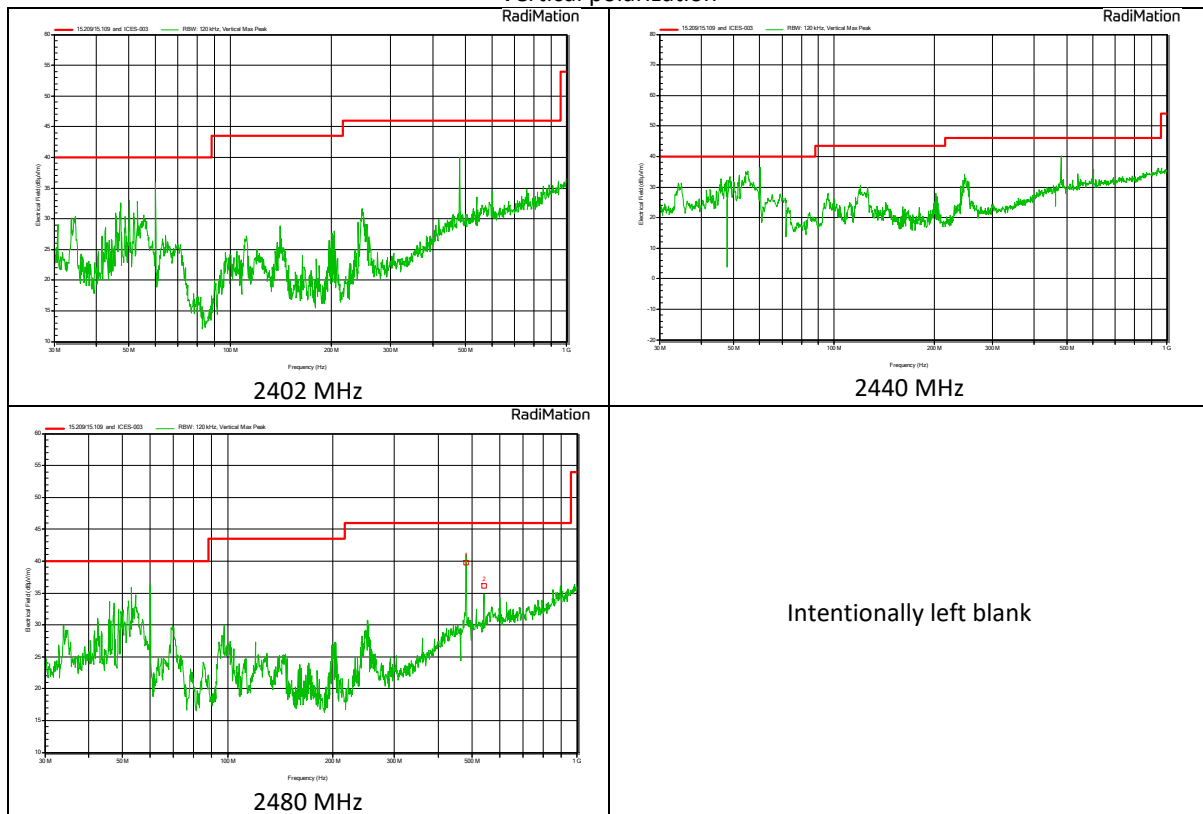
0.03 – 1 GHz

Horizontal polarization



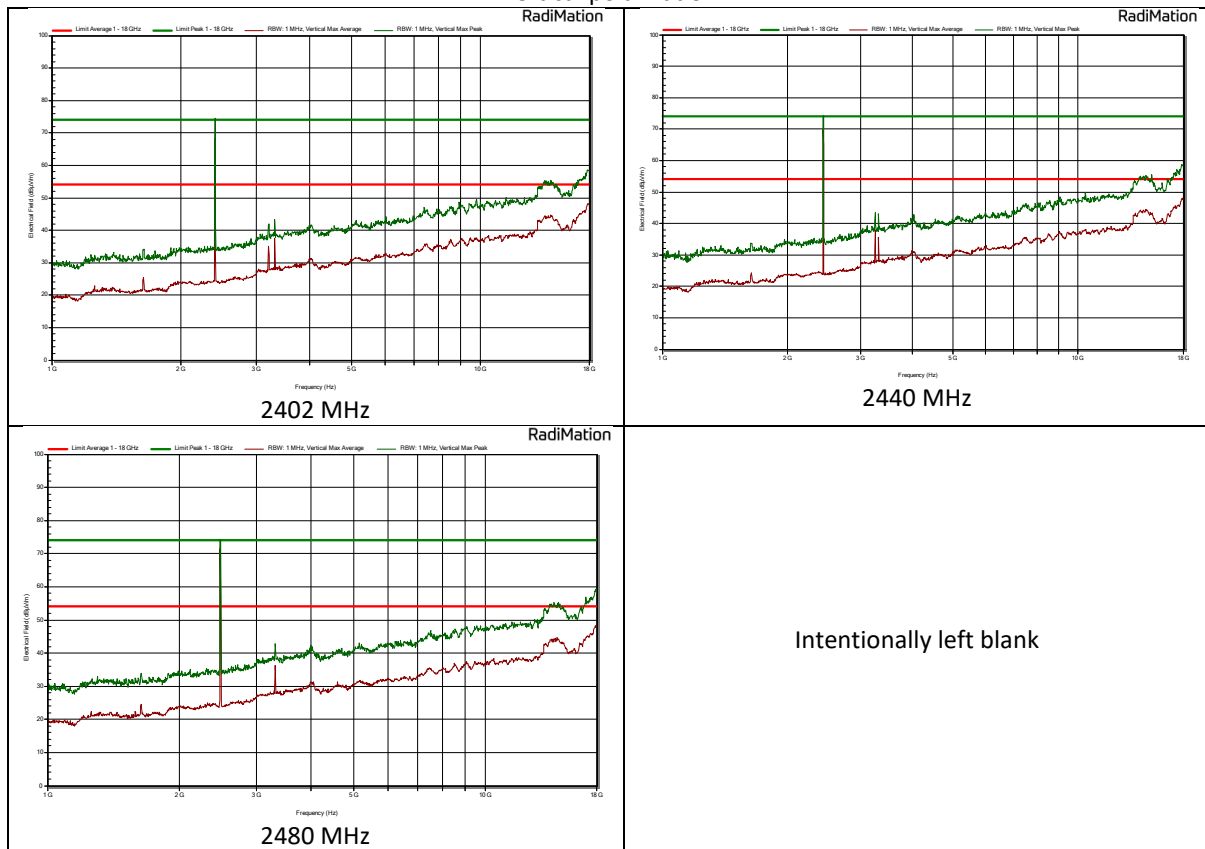
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Status	Angle	Height	Polarization
1	480,015 MHz	39,7 dBμV/m	46 dBμV/m	Pass	320 degrees	1 m	Vertical
2	540,018 MHz	36,1 dBμV/m	46 dBμV/m	Pass	231 degrees	1,5 m	Horizontal

Vertical polarization



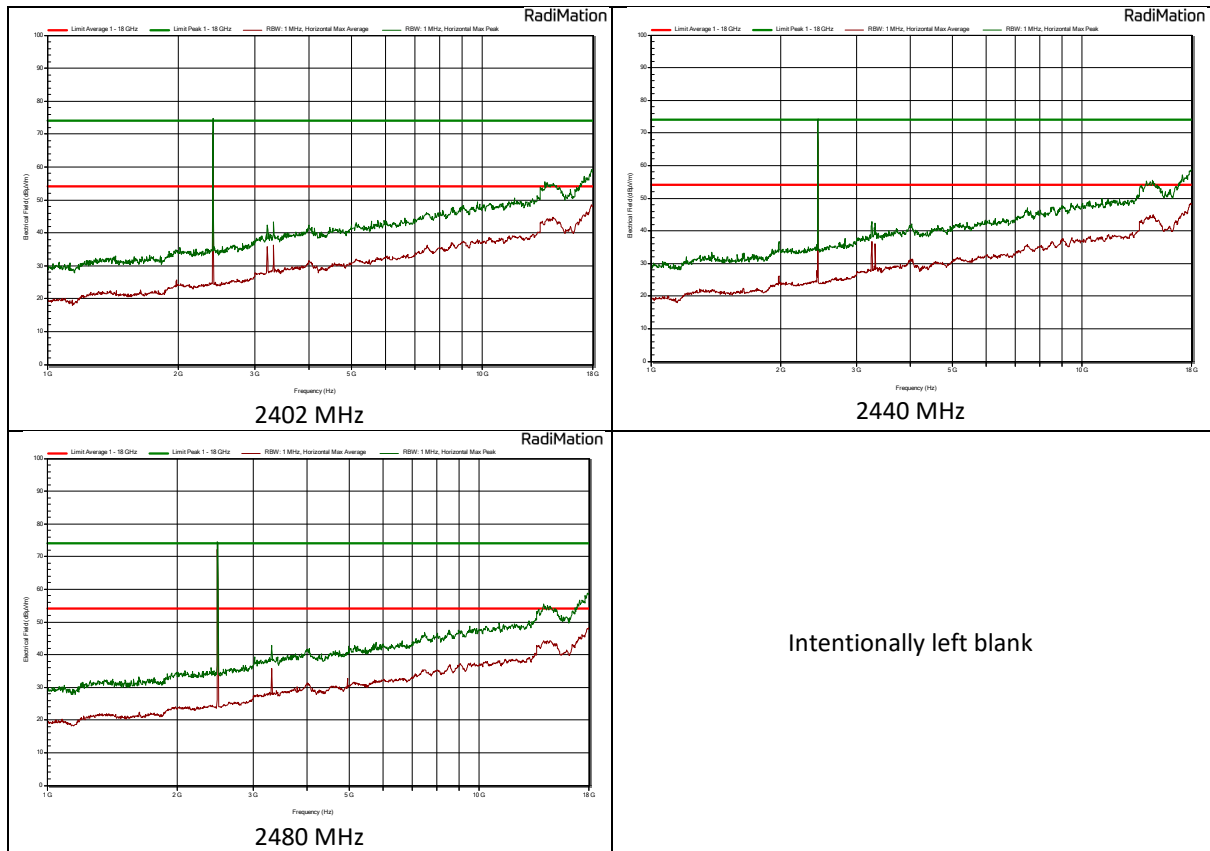
1 – 18 GHz

Vertical polarization



Note: the peak seen in the plots is the fundamental frequency and is not subject to the limit.

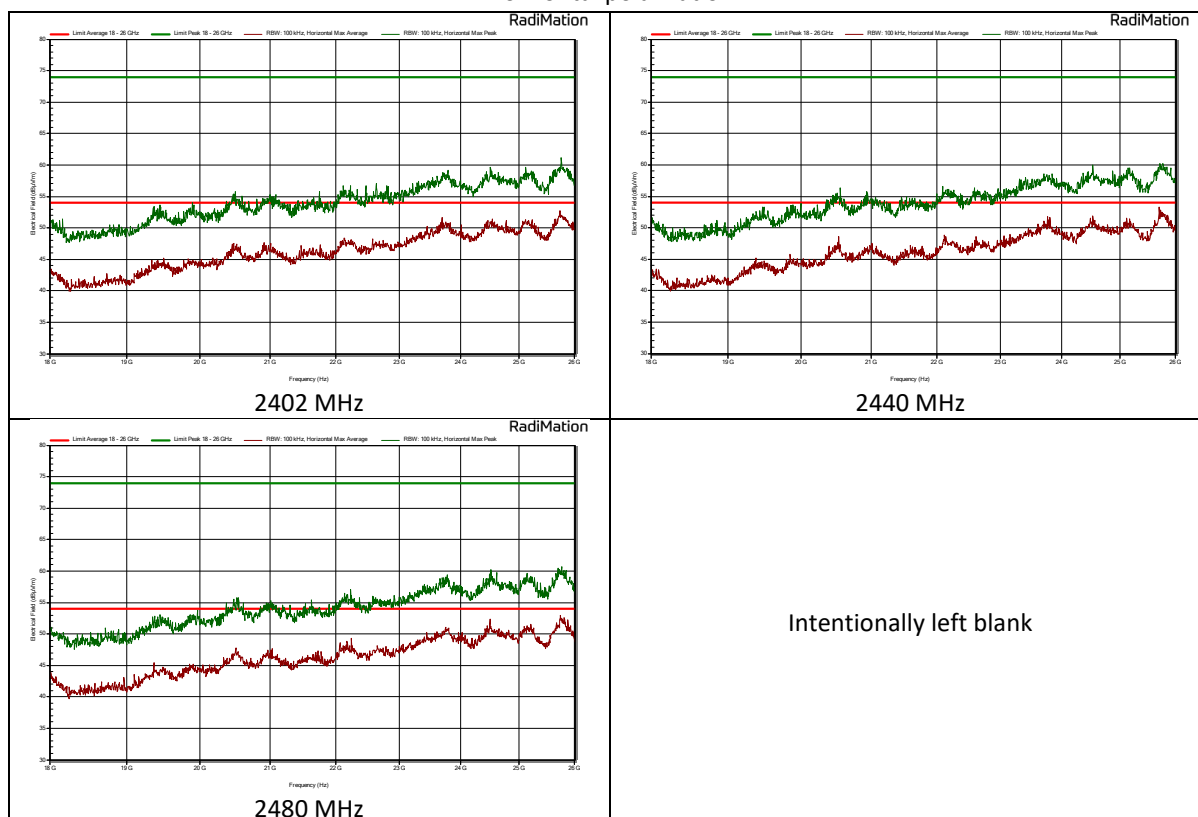
Horizontal polarization



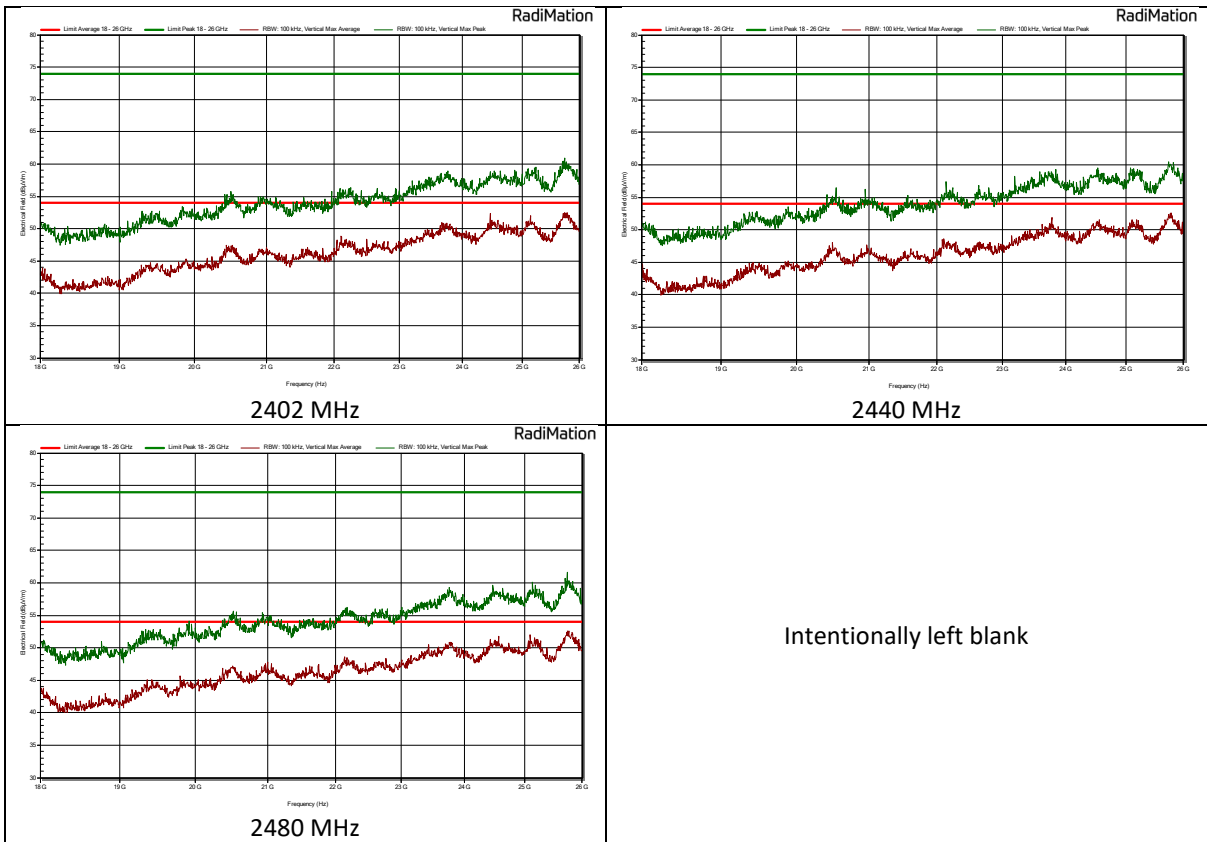
Note: the peak seen in the plots is the fundamental frequency and is not subject to the limit.

18 -26 GHz

Horizontal polarization



Vertical polarization



4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Field Strength Measurement:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} + \text{Corr. (dB)}$$

Where:

E = Electric field strength

U = Measuring receiver voltage

AF = Antenna factor

CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).

Linear interpolation will be used for frequencies in between the values in the table.

Tables shows an extract of the values.

Frequency (Mhz)	AF (dB/m)	Cable loss (dB)	Corr. (dB)
	TE 00967 Chase CBL6112A SN: 2308	Id: SAR cable	
30	18,6	0,68	19,28
100	10,7	1,15	11,85
150	10,6	1,41	12,01
200	9,3	1,63	10,93
250	12,6	1,93	14,53
300	13,3	2,12	15,42
350	14,6	2,2	16,8
400	15,5	2,29	17,79
450	16,9	2,53	19,43
500	17,5	2,67	20,17
550	18,4	2,9	21,3
600	18,8	3,02	21,82
650	19,2	3,09	22,29
700	19	3,22	22,22
750	19,8	3,56	23,36
800	19,7	3,69	23,39
900	20,4	3,81	24,21
950	20,8	3,91	24,71
1000	21,2	4,3	25,5

Frequency (Mhz)	AF (dB/m)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
1000	23,6	40,4	2,0	66
1500	25,1	40,5	2,4	68
2000	27,1	40,5	2,7	70,3
2500	28,6	40,7	3,2	72,5
3000	30,5	40,7	3,2	74,4
3500	31,2	40,7	3,4	75,3
4000	32,7	40,9	4,9	78,5
4500	32,4	40,9	4,4	77,7
5000	33,2	40,7	4,6	78,5
5500	34,0	40,5	4,5	79
6000	34,6	40,0	5,2	79,8
6500	34,3	39,4	5,9	79,6
7000	35,2	38,6	5,7	79,5
7500	36,4	39,2	5,9	81,5
8000	37,0	38,9	6,3	82,2
8500	37,5	38,4	6,4	82,3
9000	38,1	37,4	6,5	82
9500	37,8	37,0	7,1	81,9
10000	38,2	36,5	7,3	82
10500	38,1	36,7	7,6	82,4
11000	38,3	36,9	8,3	83,5
11500	38,5	37,6	8,1	84,2
12000	39,1	38,3	8,4	85,8
12500	38,7	38,5	8,3	85,5
13000	39,2	38,9	9,2	87,3
13500	40,5	40,2	8,3	89
14000	41,1	40,0	8,2	89,3
14500	41,4	40,1	8,2	89,7
15000	40,2	41,4	8,3	89,9
15500	37,9	41,4	8,6	87,9
16000	37,5	42,8	9,2	89,5
16500	38,6	42,3	8,8	89,7
17000	41,1	43,1	9,4	93,6
17500	42,7	43,2	9,4	95,3
18000	44,0	44,2	9,8	98

Frequency (Mhz)	AF (dB/m)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
18000	31,3	26,2	9,8	67,3
19000	31,5	26,1	9,6	67,2
20000	31,7	25,9	11	68,6
21000	31,9	24,3	10,7	66,9
22000	32,1	18,3	10,5	60,9
23000	32,2	18,9	10,8	61,9
24000	32,3	23,6	11,4	67,3
25000	32,4	24,5	11,6	68,5
26000	32,5	25,3	11,7	69,5