

7 RF Exposure

7.1 Exposure Requirements – FCC Parts 2.1091, 15.247(d)

FCC Part 15.247(d) states that SAR evaluation is not required if “Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of CFR 47.”

7.1.1 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

F = Frequency in MHz

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7.1.1.1 Antenna Gain

The maximum Gain measured in Semi-Anechoic Chamber is 8 dBi or 7.08 (numeric).

13.5 dBi or 25.12 (numeric)

21 dBi or 125.89 (numeric)

26 dBi or 398.11 (numeric)

30 dBi or 1000 (numeric)

7.1.1.2 Output Power into Antenna & RF Exposure value at distance >20cm: Mobile

Calculations for this report are based on highest power measurement and all the various antenna gains. Limit for MPE (from FCC part 1.1310 table 1) is 5 mW/cm^2 for professionally installed devices.

The highest output power was 18.67 dBm at 5847.5 MHz using a 5 MHz Bandwidth, that frequency and power will be used for all antenna calculations

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8 dBi Antenna Gain at 5847.5 MHz

Corrected (including cal factors)		
Measurment:	18.67	dBm
The Gain of the antenna:	8.00	dBi
Type of Measurment:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measureing Distance:	3.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be:	0.073620710	Watts
or:	73.62071	mW
or:	73620.71	μ W
or:	18.67	dBm

Frequency range from 10 MHz to 40
GHz:

Frequency:	5847.5	MHz
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Power output with DC and antenna
Gain (EiRP):

Power (dBm):	26.67
Power (mW):	464.515
Power (W):	0.464515

R = distance in	20	cm
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FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0924124	mW/cm ²
Controlled Margin to Limit =	4.9076	mW/cm ²
Uncontrolled Margin to Limit =	0.9076	mW/cm ²

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13.5 dBi Gain Antenna at 5847.5 MHz

Corrected (including cal factors)		
Measurment:	18.67	dBm
The Gain of the antenna:	14.00	dBi
Type of Measurment:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measureing Distance:	3.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be:	0.073620710	Watts
or:	73.62071	mW
or:	73620.71	μ W
or:	18.67	dBm

Frequency range from 10 MHz to 40
GHz:

Frequency:	5847.5	MHz
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Power output with DC and antenna
Gain (EiRP):

Power (dBm):	32.67
Power (mW):	1849.269
Power (W):	1.849269

R = distance in	20	cm
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FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.3679003	mW/cm ²
Controlled Margin to Limit =	4.6321	mW/cm ²
Uncontrolled Margin to Limit =	0.6321	mW/cm ²

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While using the following antenna a minimum separation distance must be at least 30 cm

21 dBi Gain antenna at 5847.5 MHz

Enter the following highlighted
variables:

Corrected (including cal factors)		
Measurment:	18.67	dBm
The Gain of the antenna:	21.00	dBi
Type of Measurment:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measureing Distance:	3.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.073620710 Watts
or: 73.62071 mW
or: 73620.71 μ W
or: 18.67 dBm

Frequency range from 10 MHz to 40
GHz:

Frequency:	5847.5	MHz
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Power output with DC and antenna
Gain (EiRP):

Power (dBm):	39.67
Power (mW):	9268.298
Power (W):	9.268298

R = distance in	30	cm
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FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.8194975	mW/cm ²
Controlled Margin to Limit =	4.1805	mW/cm ²
Uncontrolled Margin to Limit =	0.1805	mW/cm ²

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While using the following antenna a minimum separation distance must be at least 60 cm

26 dBi Gain Antenna at 5847.5 MHz

Corrected (including cal factors)		
Measurment:	18.67	dBm
The Gain of the antenna:	26.00	dBi
Type of Measurment:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measureing Distance:	3.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be:	0.073620710	Watts
or:	73.62071	mW
or:	73620.71	μ W
or:	18.67	dBm

Frequency range from 10 MHz to 40
GHz:

Frequency:	5847.5	MHz
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Power output with DC and antenna
Gain (EiRP):

Power (dBm):	44.67
Power (mW):	29308.932
Power (W):	29.308932

R = distance in	60	cm
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FCC:		
Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.6478696	mW/cm ²
Controlled Margin to Limit =	4.3521	mW/cm ²
Uncontrolled Margin to Limit =	0.3521	mW/cm ²

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While using the following antenna a minimum separation distance must be at least 80 cm

30 dBi Gain Antenna at 5847.5 MHz

Corrected (including cal factors)		
Measurment:	18.67	dBm
The Gain of the antenna:	30.00	dBi
Type of Measurment:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measureing Distance:	3.00	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be:	0.073620710	Watts
or:	73.62071	mW
or:	73620.71	μ W
or:	18.67	dBm

Frequency range from 10 MHz to 40
GHz:

Frequency:	5847.5	MHz
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Power output with DC and antenna
Gain (EiRP):

Power (dBm):	48.67
Power (mW):	73620.710
Power (W):	73.620710

R = distance in	80	cm
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FCC:

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.9153984	mW/cm ²
Controlled Margin to Limit =	4.0846	mW/cm ²
Uncontrolled Margin to Limit =	0.0846	mW/cm ²

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Appendix A

Test Plan

This test report is intended to follow this test plan outlined here in unless other wise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

Test Plan Summary

Table 1: EMC Test Plan Summary FCC& IC

Test	Test Method ANSI C63.10	Test Parameters (from Standard)
Spurious Emission in Received Mode	CFR47 15.109	Class B
Spurious Emission in Transmitted Mode	CFR47 15.209	Class B
Restricted Bands of Operation	CFR47 15.205	Class B
AC Power Conducted Emission	CFR47 15.207	Class B
Occupied Bandwidth	CFR47 15.247 (a2)	500kHz minimum
Maximum Transmitted Power	CFR47 15.247 (b3)	30dBm w/ 6dBi antenna
Peak Power Spectral Density	CFR47 15.247 (e)	8dBm/ 3kHz.
Band edge Measurement	CFR47 15.247 (d)	20dB
RF Exposure	CFR47 15.247 (i), 2.1091	General Population

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