Maximum Permissible Exposure (MPE) Calculations

15.407: U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a ``general population/uncontrolled'' environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

E=√(30*P*G)/d and S=E^2/3770

where

E=Field Strength in Volts/meter
P=Power in Watts
G=Numeric Antenna Gain
d=Distance in meters
S=Power Density in mW/cm^2

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

d=√((30*P*G)/(3770*S))

Changing to units of power in mW and distance in cm, using:

P(mW)=P(W)/1000 d(cm)=100*d(m)

yields

d=100*√((30*(P/1000)*G)/(3770*S))
d=0.282*√(P*G/S)

where

d=Distance in cm
P=Power in mW
G=Numerica Antenna Gain
S=Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P(mW)=10^(P(dBm)/10) G(numeric)=10^(G(dBi)/10)

yields

d=0.282*10^((P+G)/20)/√S Equation (1)

and

s=((0.282*10^((P+G)/20))/d)^2 Equation (2)

where

d=MPE distance in cm
P=Power in dBm
G=Antenna Gain in dBi
S=Power Density in mW/cm^2

Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

S=1mW/cm^2 maximum. The highest supported antenna gain is 6 dBi (9dBi with beamforming). Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

MPE Calculations:

Frequency (MHz)	Power Density (mW/cm^2)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5260	1	19.7	6	**5.44**	20	14.56
5270	1	19.9	6	**5.56**	20	14.44

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)	Limit (mW/cm ^2)	Margin (mW/cm ^2)
5260	20	19.7	6	**0.07**	1	0.93
5270	20	19.9	6	**0.08**	1	0.92

Appendix C: Test Equipment/Software Used to perform the test

Equip No	Manufacturer	Model	Description	Cal Due Date
30562	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	6/26/2014
46702	Stanley	33-605	10 Meter Tape Measure	11/1/2013
32806	Sunol Sciences	JB1	Combination Antenna	1/24/2014
27234	York	CNE V	Comparison Noise Emitter	
41929	Newport	iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	12/12/2013
25651	Micro-Coax	UFB311A-1-3150-504504	Rf Coaxial Cable 315.0 in to 18GHz	2/13/2014
8320	Times Microwave Systems	RG-214	3 ft RG-214 Cable	11/19/2013
47410	Agilent	N9038A	EMI Receiver	1/15/2014
21116	Micro-Coax	UFB311A-0-3540-520520	RF Coaxial Cable, to 18GHz, 354 in	2/20/2014
18313	HP	8447D	RF Preamplifier	1/8/2014
8195	TTE	H613-150K-50-21378	Hi Pass Filter - 150KHz cutoff	1/4/2014
8496	Fischer Custom Communications	FCC-450B-2.4-N	Instrumentation Limiter	5/20/2014
47300	Agilent Technologies	N9038A	MXE EMI Receiver 20Hz to 26.5 Ghz	11/13/2013
49560	Bird	5-T-MB	5W 50 Ohm BNC Termination 4GHz	8/9/2014
27234	York	CNE V	Comparison Noise Emitter	
45990	Fischer Custom Communications	F-090527-1009-1	Line Impedance Stabilization Network	6/21/2014
45991	Fischer Custom Communications	F-090527-1009-2	Lisn Adapter	6/21/2014
21606	Coleman	RG-223	4ft BNC cable	10/31/2013
41928	Newport	iBTHP-5-DB9	5 inch Temp/RH/Press Sensor w/20ft cable	4/12/2014
5687	Fluke	73 III	Digital Multimeter	9/11/2013
35248	Stanley	33-696	5 Meter Tape Measure	7/9/2014
39110	Coleman	RG-223	25 ft BNC cable	11/29/2013
30526	Midwest Microwave	TRM-2048-MC-BNC-10	50 Ohm Terminator, BNC w/chain	3/11/2014
44038	Fischer Custom Communications	F-071115-1057-1	Balanced Telecom Impedance Stabilization Network	5/29/2014
4003	Fischer Custom Communications	FCC-801-M2-32A	CDN, 2-LINE, 32A	3/14/2014