

RF Exposure evaluation

Applicant Data: SIEMENS AG
Östliche Rheinbrückenstr. 50
76187 Karlsruhe
Germany

Product Data: Industrial WLAN Access Point / Client
SCALANCE W700 / MSAX
MSAX-W1-RJ-E2
Siemens

WLAN 2,4 GHz and 5 GHz

mobile 20cm

General Population/Uncontrolled

FCC ID: LYHMSAXV1

IC: 267AA-MSAXV1

Standards
OET Bulletin 65 Edition 97-01 August 1997
RSS-102 Issue 5 – March 2015

FCC CFR 47, Part 2.1091: Radiofrequency radiation exposure evaluation: mobile devices.
FCC CFR 47, Part 2.1307: Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.
FCC CFR 47, Part 2.1310: Radiofrequency radiation exposure limits.

RF Exposure evaluation

Maximum Permissible Exposure

As specified in Chapter e(1) of 47 CFR Part 1.1310 – Limits for Maximum Permissible Exposure (MPE)

Table (i) - Limits for Occupational/ Controlled Exposure

Frequency range (MHz)	Power density (mW / cm ²)
300 – 1500	f/300
1500 - 100000	5.0

Table (ii) – Limits for General Population/ Uncontrolled Exposure

Frequency range (MHz)	Power density (mW / cm ²)
300 – 1500	f/1500
1500 - 100000	1.0

As specified in Chapter 4 of RSS-102, Issue 5 – Exposure Limits

Table 4 - RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency range (MHz)	Power density (W / m ²)	Power density (mW / cm ²)
300-6000	0.02619 f ^{0.6834}	mW/cm ² =W/m ² *0.1
6000-150000	10	1.0

Table 6 – RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency range (MHz)	Power density (W / m ²)	Power density (mW / cm ²)
100-6000	0.6455 f ^{0.5}	mW/cm ² =W/m ² *0.1
6000-150000	50	1.0

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Calculations

Equation OET bulletin 65, page 18, edition 97-01:

$$S = P * G / (4 * \pi * R^2)$$

$$R = \sqrt{ (P * G / S_{lim} * 4 * \pi) }$$

$$G = S_{lim} * 4 * \pi * R^2 / P$$

Where:

S = power density (mW/cm²)

P = power input to the antenna (mW)

G = power gain of the antenna (mW)

R = distance to the centre of radiation of the antenna (cm)

S_{lim} = FCC / IC Limit (mW/cm²)

Simultaneous Transmission Considerations

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria.

$$\sum_{1}^N \frac{S_{eqn}}{S_{Limn}} = \frac{S_{eq1}}{S_{Lim1}} + \frac{S_{eq2}}{S_{Lim2}} + \dots + \frac{S_{eqN}}{S_{LimN}} \leq 1$$

Where:

S_{eq} = S = power density (mW/cm²)

S_{lim} = FCC / IC Limit (mW/cm²)

RF Exposure evaluation

Assessment

For FCC

				G	tested	P		P*G	S	Sim	Seq / Sim	
for Antennas (dBi)	Operational Bands	Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain -numeric- (mW)	Output Power -conducted- (dBm)	Output Power -conducted- (mW)	Output power (EIRP) (dBm)	Output Power (EIRP) (mW)	Power Density value (mW/cm ²)	FCC Limit (mW/cm ²)	Relative Power Density value	Margin to FCC Limit (mW/cm ²)
<6	802.11ax20	2412 - 2462	6	3.9811	19.00	79.43	25.00	316.23	0.0629	1.0000	0.0629	0.9371
<6	802.11b	2412 - 2462	6	3.9811	16.80	47.96	22.80	190.55	0.0379	1.0000	0.0379	0.9621
<6	802.11g	2412 - 2462	6	3.9811	19.60	91.20	25.60	363.08	0.0722	1.0000	0.0722	0.9278
<6	802.11n20	2412 - 2462	6	3.9811	19.20	83.18	25.20	331.13	0.0659	1.0000	0.0659	0.9341
<6	802.11ax40	2422 - 2452	6	3.9811	17.40	54.95	23.40	218.78	0.0435	1.0000	0.0435	0.9565
<6	802.11n40	2422 - 2452	6	3.9811	17.70	58.88	23.70	234.42	0.0466	1.0000	0.0466	0.9534
<9	802.11ax20	2412 - 2462	9	7.9433	17.00	50.12	26.00	398.11	0.0792	1.0000	0.0792	0.9208
<9	802.11b	2412 - 2462	9	7.9433	14.60	28.84	23.60	229.09	0.0456	1.0000	0.0456	0.9544
<9	802.11g	2412 - 2462	9	7.9433	17.70	58.88	26.70	467.74	0.0931	1.0000	0.0931	0.9069
<9	802.11n20	2412 - 2462	9	7.9433	17.20	52.48	26.20	416.87	0.0829	1.0000	0.0829	0.9171
<9	802.11ax40	2422 - 2452	9	7.9433	15.40	34.67	24.40	275.42	0.0548	1.0000	0.0548	0.9452
<9	802.11n40	2422 - 2452	9	7.9433	15.80	38.02	24.80	302.00	0.0601	1.0000	0.0601	0.9399
<14	802.11ax20	2412 - 2462	14	25.1189	13.10	20.42	27.10	512.86	0.1020	1.0000	0.1020	0.8980
<14	802.11b	2412 - 2462	14	25.1189	10.70	11.75	24.70	295.12	0.0587	1.0000	0.0587	0.9413
<14	802.11g	2412 - 2462	14	25.1189	13.70	23.44	27.70	588.84	0.1171	1.0000	0.1171	0.8829
<14	802.11n20	2412 - 2462	14	25.1189	13.20	20.89	27.20	524.81	0.1044	1.0000	0.1044	0.8956
<14	802.11ax40	2422 - 2452	14	25.1189	12.50	17.78	26.50	446.68	0.0889	1.0000	0.0889	0.9111
<14	802.11n40	2422 - 2452	14	25.1189	12.80	19.05	26.80	478.63	0.0952	1.0000	0.0952	0.9048
<8	B1-802.11a	5180 - 5240	8	6.3096	20.70	117.49	28.70	741.31	0.1475	1.0000	0.1475	0.8525
<8	B3-802.11a	5745 - 5825	8	6.3096	22.40	173.78	30.40	1096.48	0.2181	1.0000	0.2181	0.7819
<8	B1-802.11n20	5180 - 5240	8	6.3096	20.40	109.65	28.40	691.83	0.1376	1.0000	0.1376	0.8624
<8	B3-802.11n20	5745 - 5825	8	6.3096	22.00	158.49	30.00	1000.00	0.1989	1.0000	0.1989	0.8011
<8	B1-802.11n40	5180 - 5240	8	6.3096	21.80	151.36	29.80	954.99	0.1900	1.0000	0.1900	0.8100
<8	B3-802.11n40	5745 - 5825	8	6.3096	23.10	204.17	31.10	1288.25	0.2563	1.0000	0.2563	0.7437
<8	B1-802.11ac20	5180 - 5240	8	6.3096	20.40	109.65	28.40	691.83	0.1376	1.0000	0.1376	0.8624
<8	B3-802.11ac20	5745 - 5825	8	6.3096	22.20	165.96	30.20	1047.13	0.2083	1.0000	0.2083	0.7917
<8	B1-802.11ac40	5180 - 5240	8	6.3096	21.80	151.36	29.80	954.99	0.1900	1.0000	0.1900	0.8100
<8	B3-802.11ac40	5745 - 5825	8	6.3096	23.20	208.93	31.20	1318.26	0.2623	1.0000	0.2623	0.7377
<8	B1-802.11ac80	5210	8	6.3096	20.40	109.65	28.40	691.83	0.1376	1.0000	0.1376	0.8624
<8	B3-802.11ac80	5775	8	6.3096	22.60	181.97	30.60	1148.15	0.2284	1.0000	0.2284	0.7716
<8	B1-802.11ax20	5180 - 5240	8	6.3096	20.10	102.33	28.10	645.65	0.1284	1.0000	0.1284	0.8716
<8	B3-802.11ax20	5745 - 5825	8	6.3096	21.80	151.36	29.80	954.99	0.1900	1.0000	0.1900	0.8100
<8	B1-802.11ax40	5180 - 5240	8	6.3096	21.50	141.25	29.50	891.25	0.1773	1.0000	0.1773	0.8227
<8	B3-802.11ax40	5745 - 5825	8	6.3096	22.70	186.21	30.70	1174.90	0.2337	1.0000	0.2337	0.7663
<8	B1-802.11ax80	5210	8	6.3096	20.20	104.71	28.20	660.69	0.1314	1.0000	0.1314	0.8686
<8	B3-802.11ax80	5775	8	6.3096	22.30	169.82	30.30	1071.52	0.2132	1.0000	0.2132	0.7868
<9	B1-802.11a	5180-5240	9	7.9433	19.70	93.33	28.70	741.31	0.1475	1.0000	0.1475	0.8525
<9	B3-802.11a	5470-5725	9	7.9433	22.40	173.78	31.40	1380.38	0.2746	1.0000	0.2746	0.7254
<9	B1-802.11n20	5180-5240	9	7.9433	19.30	85.11	28.30	676.08	0.1345	1.0000	0.1345	0.8655
<9	B3-802.11n20	5470-5725	9	7.9433	22.00	158.49	31.00	1258.93	0.2505	1.0000	0.2505	0.7495
<9	B1-802.11n40	5180-5240	9	7.9433	20.90	123.03	29.90	977.24	0.1944	1.0000	0.1944	0.8056
<9	B3-802.11n40	5470-5727	9	7.9433	23.10	204.17	32.10	1621.81	0.3226	1.0000	0.3226	0.6774
<9	B1-802.11ac20	5180-5240	9	7.9433	19.90	97.72	28.90	776.25	0.1544	1.0000	0.1544	0.8456
<9	B3-802.11ac20	5470-5728	9	7.9433	22.20	165.96	31.20	1318.26	0.2623	1.0000	0.2623	0.7377
<9	B1-802.11ac40	5180-5240	9	7.9433	20.90	123.03	29.90	977.24	0.1944	1.0000	0.1944	0.8056
<9	B3-802.11ac40	5470-5729	9	7.9433	23.20	208.93	32.20	1659.59	0.3302	1.0000	0.3302	0.6698
<9	B1-802.11ac80	5210	9	7.9433	16.70	46.77	25.70	371.54	0.0739	1.0000	0.0739	0.9261
<9	B3-802.11ac80	5775	9	7.9433	26.00	398.11	35.00	3162.28	0.6291	1.0000	0.6291	0.3709
<9	B1-802.11ax20	5150 - 5250	9	7.9433	19.20	83.18	28.20	660.69	0.1314	1.0000	0.1314	0.8686
<9	B3-802.11ax20	5725 - 5850	9	7.9433	21.80	151.36	30.80	1202.26	0.2392	1.0000	0.2392	0.7608
<9	B1-802.11ax40	5150 - 5250	9	7.9433	20.40	109.65	29.40	870.96	0.1733	1.0000	0.1733	0.8267
<9	B3-802.11ax40	5725 - 5850	9	7.9433	22.70	186.21	31.70	1479.11	0.2943	1.0000	0.2943	0.7057
<9	B1-802.11ax80	5210	9	7.9433	16.50	44.67	25.50	354.81	0.0706	1.0000	0.0706	0.9294
<9	B3-802.11ax80	5775	9	7.9433	20.50	112.20	29.50	891.25	0.1773	1.0000	0.1773	0.8227
Distance to Antenna (R) in cm: 20												

Simultaneous (if applicable):

	WLAN 2,4 GHz	WLAN 5 GHz
(Seq / S _{lim})	0.1171	0.6291
Sum	0.7463	
Limit	1	
Conclusion	passed	

Note 1: only worst-case values are listed in the table above

Note 2: the duty cycle correction factor is already included in the measurement values

RF Exposure evaluation

For ISED

				G	tested	P		P*G	S	Slim	Seq / Slim	
for Antennas (dBi)	Operational Bands	Frequency (MHz)	Antenna Gain (dBi)	Antenna Gain -numeric- (mW)	Output Power -conducted- (dBm)	Output Power -conducted- (mW)	Output Power (EIRP) (dBm)	Output Power (EIRP) (mW)	Power Density value (mW/cm ²)	IC Limit (mW/cm ²)	Relative Power Density value	Margin to IC Limit (mW/cm ²)
<6	802.11ax20	2412	6	3,9811	19,00	79,43	25,00	316,23	0,0629	0,5366	0,1172	0,4737
<6	802.11b	2412	6	3,9811	16,80	47,86	22,80	190,55	0,0379	0,5366	0,0706	0,4987
<6	802.11g	2412	6	3,9811	19,60	91,20	25,60	363,08	0,0722	0,5366	0,1346	0,4644
<6	802.11n20	2412	6	3,9811	19,20	83,18	25,20	331,13	0,0659	0,5366	0,1228	0,4707
<6	802.11ax40	2412	6	3,9811	17,40	54,95	23,40	218,78	0,0435	0,5366	0,0811	0,4931
<6	802.11n40	2412	6	3,9811	17,70	58,88	23,70	234,42	0,0466	0,5366	0,0869	0,4900
<9	802.11ax20	2412	9	7,9433	17,00	50,12	26,00	398,11	0,0792	0,5366	0,1476	0,4574
<9	802.11b	2412	9	7,9433	14,60	28,84	23,60	229,09	0,0456	0,5366	0,0849	0,4910
<9	802.11g	2412	9	7,9433	17,70	58,88	26,70	467,74	0,0931	0,5366	0,1734	0,4435
<9	802.11n20	2412	9	7,9433	17,20	52,48	26,20	416,87	0,0829	0,5366	0,1546	0,4537
<9	802.11ax40	2412	9	7,9433	15,40	34,67	24,40	275,42	0,0548	0,5366	0,1021	0,4818
<9	802.11n40	2412	9	7,9433	15,80	38,02	24,80	302,00	0,0601	0,5366	0,1120	0,4765
<14	802.11ax20	2412	14	25,1189	13,10	20,42	27,10	512,66	0,1020	0,5366	0,1901	0,4346
<14	802.11b	2412	14	25,1189	10,70	11,75	24,70	295,12	0,0587	0,5366	0,1094	0,4779
<14	802.11g	2412	14	25,1189	13,70	23,44	27,70	588,84	0,1171	0,5366	0,2183	0,4195
<14	802.11n20	2412	14	25,1189	13,20	20,89	27,20	524,81	0,1044	0,5366	0,1946	0,4322
<14	802.11ax40	2412	14	25,1189	12,50	17,78	26,50	446,68	0,0889	0,5366	0,1656	0,4477
<14	802.11n40	2412	14	25,1189	12,80	19,05	26,80	478,63	0,0952	0,5366	0,1775	0,4414
<8	B1-802.11a	5180	8	6,3096	12,90	19,50	20,90	123,03	0,0245	0,9047	0,0271	0,8802
<8	B3-802.11a	5745	8	6,3096	22,40	173,78	30,40	1096,48	0,2181	0,9710	0,2246	0,7529
<8	B1-802.11n20	5180	8	6,3096	12,50	17,78	20,50	112,20	0,0223	0,9047	0,0247	0,8824
<8	B3-802.11n20	5745	8	6,3096	22,00	158,49	30,00	1000,00	0,1989	0,9710	0,2049	0,7721
<8	B1-802.11n40	5180	8	6,3096	13,30	21,38	21,30	134,90	0,0268	0,9047	0,0297	0,8779
<8	B3-802.11n40	5745	8	6,3096	23,10	204,17	31,10	1288,25	0,2563	0,9710	0,2639	0,7147
<8	B1-802.11ac20	5180	8	6,3096	12,60	18,20	20,60	114,82	0,0228	0,9047	0,0252	0,8819
<8	B3-802.11ac20	5745	8	6,3096	22,20	165,96	30,20	1047,13	0,2083	0,9710	0,2145	0,7627
<8	B1-802.11ac40	5180	8	6,3096	13,30	21,38	21,30	134,90	0,0268	0,9047	0,0297	0,8779
<8	B3-802.11ac40	5745	8	6,3096	23,20	208,93	31,20	1318,26	0,2623	0,9710	0,2701	0,7088
<8	B1-802.11ac80	5180	8	6,3096	12,90	19,50	20,90	123,03	0,0245	0,9047	0,0271	0,8802
<8	B3-802.11ac80	5745	8	6,3096	22,60	181,97	30,60	1148,15	0,2284	0,9710	0,2352	0,7426
<8	B1-802.11ax20	5180	8	6,3096	12,40	17,38	20,40	109,65	0,0218	0,9047	0,0241	0,8829
<8	B3-802.11ax20	5745	8	6,3096	21,80	151,36	29,80	954,99	0,1900	0,9710	0,1957	0,7810
<8	B1-802.11ax40	5180	8	6,3096	12,80	19,05	20,80	120,23	0,0239	0,9047	0,0264	0,8808
<8	B3-802.11ax40	5745	8	6,3096	22,70	186,21	30,70	1174,90	0,2337	0,9710	0,2407	0,7373
<8	B1-802.11ax80	5180	8	6,3096	12,80	19,20	20,60	114,82	0,0228	0,9047	0,0252	0,8819
<8	B3-802.11ax80	5745	8	6,3096	22,30	169,82	30,30	1071,52	0,2132	0,9710	0,2195	0,7579
<9	B1-802.11a	5180	9	7,9433	11,90	15,49	20,90	123,03	0,0245	0,9047	0,0271	0,8802
<9	B3-802.11a	5745	9	7,9433	22,40	173,78	31,40	1380,39	0,2746	0,9710	0,2828	0,6964
<9	B1-802.11n20	5180	9	7,9433	11,60	14,45	20,60	114,82	0,0228	0,9047	0,0252	0,8819
<9	B3-802.11n20	5745	9	7,9433	22,00	158,49	31,00	1258,93	0,2505	0,9710	0,2579	0,7206
<9	B1-802.11n40	5180	9	7,9433	12,20	16,60	21,20	131,83	0,0262	0,9047	0,0290	0,8785
<9	B3-802.11n40	5745	9	7,9433	23,10	204,17	32,10	1621,81	0,3226	0,9710	0,3323	0,6484
<9	B1-802.11ac20	5180	9	7,9433	11,60	14,45	20,60	114,82	0,0228	0,9047	0,0252	0,8819
<9	B3-802.11ac20	5745	9	7,9433	22,20	165,96	31,20	1318,26	0,2623	0,9710	0,2701	0,7088
<9	B1-802.11ac40	5180	9	7,9433	12,20	16,60	21,20	131,83	0,0262	0,9047	0,0290	0,8785
<9	B3-802.11ac40	5745	9	7,9433	23,20	208,93	32,20	1659,59	0,3302	0,9710	0,3400	0,6409
<9	B1-802.11ac80	5180	9	7,9433	11,80	15,14	20,80	120,23	0,0239	0,9047	0,0264	0,8808
<9	B3-802.11ac80	5745	9	7,9433	26,00	398,11	35,00	3162,28	0,6291	0,9710	0,6479	0,3419
<9	B1-802.11ax20	5180	9	7,9433	11,50	14,13	20,50	112,20	0,0223	0,9047	0,0247	0,8824
<9	B3-802.11ax20	5745	9	7,9433	21,80	151,36	30,80	1202,26	0,2392	0,9710	0,2463	0,7319
<9	B1-802.11ax40	5180	9	7,9433	11,80	15,14	20,80	120,23	0,0239	0,9047	0,0264	0,8808
<9	B3-802.11ax40	5745	9	7,9433	22,70	186,21	31,70	1479,11	0,2943	0,9710	0,3030	0,6768
<9	B1-802.11ax80	5180	9	7,9433	11,60	14,45	20,60	114,82	0,0228	0,9047	0,0252	0,8819
<9	B3-802.11ax80	5745	9	7,9433	20,50	112,20	29,50	891,25	0,1773	0,9710	0,1826	0,7937

Distance to Antenna (R) in cm: 20

Simultaneous (if applicable):

	WLAN 2,4 GHz	WLAN 5 GHz
(Seq / Slim)	0.2183	0.6479
Sum	0.8662	
Limit	1	
Conclusion	passed	

Note 1: only worst-case values are listed in the table above

Note 2: the duty cycle correction factor is already included in the measurement values