

RF Exposure evaluation

Applicant Data: SIEMENS AG
Oestliche Rheinbrueckenstrasse 50
76187 Karlsruhe
Germany

Product Data: Industrial WLAN Access Point / Client
MSAX65-W1-M12-E2
SIEMENS

802.11 ax/ac/a/h/n Mode: 5.15~5.35 GHz and 5.47~5.85 GHz
802.11 ax/b/g/n Mode: 2400~2483.5 MHz

mobile device >20cm

General Population/ Uncontrolled Exposure Use

FCC ID: LYHMSAX65V1

IC: 267AA-MSAX65V1

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 (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

RF Exposure evaluation

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

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)	Minimum Distance to be ensured cm (FCC)	Maximum Gain to be ensured dBi (FCC)
ISM band g-mode (1 Mbit)	2412	9	7,9433	16,50	44,67	25,50	354,81	0,0706	1,0000	0,0706	0,9294	5,3137	20,5127
ISM band g-mode (6 Mbit)	2412	9	7,9433	19,40	87,10	28,40	691,83	0,1376	1,0000	0,1376	0,8624	7,4199	17,6127
ISM band n-mode [20 MHz]	2412	9	7,9433	19,00	79,43	28,00	630,96	0,1255	1,0000	0,1255	0,8745	7,0859	18,0127
ISM band n-mode [40 MHz]	2422	9	7,9433	17,60	57,54	26,60	457,09	0,0909	1,0000	0,0909	0,9091	6,0311	19,4127
ISM band ax-mode [20 MHz]	2412	9	7,9433	19,10	81,28	28,10	645,65	0,1284	1,0000	0,1284	0,8716	7,1680	17,9127
ISM band ax-mode [40 MHz]	2422	9	7,9433	17,40	54,95	26,40	436,52	0,0868	1,0000	0,0868	0,9132	5,8938	19,6127
U-NII Subband 1 a-mode	5240	8	6,3096	20,20	104,71	28,20	660,69	0,1314	1,0000	0,1314	0,8686	7,2510	16,8127
U-NII Subband 1 n-mode [20 MHz]	5240	8	6,3096	19,70	93,33	27,70	588,84	0,1171	1,0000	0,1171	0,8829	6,8453	17,3127
U-NII Subband 1 n-mode [40 MHz]	5230	8	6,3096	22,90	194,98	30,90	1230,27	0,2448	1,0000	0,2448	0,7552	9,8945	14,1127
U-NII Subband 1 ac-mode [20 MHz]	5240	8	6,3096	19,70	93,33	27,70	588,84	0,1171	1,0000	0,1171	0,8829	6,8453	17,3127
U-NII Subband 1 ac-mode [40 MHz]	5230	8	6,3096	20,10	102,33	28,10	645,65	0,1284	1,0000	0,1284	0,8716	7,1680	16,9127
U-NII Subband 1 ac-mode [80 MHz]	5210	8	6,3096	19,80	95,50	27,80	602,56	0,1199	1,0000	0,1199	0,8801	6,9246	17,2127
U-NII Subband 1 ax-mode [20 MHz]	5240	8	6,3096	19,60	91,20	27,60	575,44	0,1145	1,0000	0,1145	0,8855	6,7670	17,4127
U-NII Subband 1 ax-mode [40 MHz]	5230	8	6,3096	20,80	120,23	28,80	758,58	0,1509	1,0000	0,1509	0,8491	7,7695	16,2127
U-NII Subband 1 ax-mode [80 MHz]	5210	8	6,3096	19,60	91,20	27,60	575,44	0,1145	1,0000	0,1145	0,8855	6,7670	17,4127
U-NII Subband 3 a-mode	5785	8	6,3096	22,60	181,97	30,60	1148,15	0,2284	1,0000	0,2284	0,7716	9,5586	14,4127
U-NII Subband 3 n-mode [20 MHz]	5785	8	6,3096	22,00	158,49	30,00	1000,00	0,1989	1,0000	0,1989	0,8011	8,9206	15,0127
U-NII Subband 3 n-mode [40 MHz]	5795	8	6,3096	23,10	204,17	31,10	1288,25	0,2563	1,0000	0,2563	0,7437	10,1250	13,9127
U-NII Subband 3 ac-mode [20 MHz]	5745	8	6,3096	22,00	158,49	30,00	1000,00	0,1989	1,0000	0,1989	0,8011	8,9206	15,0127
U-NII Subband 3 ac-mode [40 MHz]	5795	8	6,3096	24,80	302,00	32,80	1905,46	0,3791	1,0000	0,3791	0,6209	12,3139	12,2127
U-NII Subband 3 ac-mode [80 MHz]	5775	8	6,3096	22,60	181,97	30,60	1148,15	0,2284	1,0000	0,2284	0,7716	9,5586	14,4127
U-NII Subband 3 ax-mode [20 MHz]	5785	8	6,3096	22,50	177,83	30,50	1122,02	0,2232	1,0000	0,2232	0,7768	9,4492	14,5127
U-NII Subband 3 ax-mode [40 MHz]	5795	8	6,3096	22,80	190,55	30,80	1202,26	0,2392	1,0000	0,2392	0,7608	9,7813	14,2127
U-NII Subband 3 ax-mode [80 MHz]	5775	8	6,3096	22,50	177,83	30,50	1122,02	0,2232	1,0000	0,2232	0,7768	9,4492	14,5127

Minimum Distance to be ensured: 20 cm

Maximum Gain to be ensured: 14 dBi

Simultaneous (if applicable):

	1 st Technology ISM band g-mode (6 Mbit)	2 nd Technology UNII-Subband 1 n- mode [40 MHz]	3 rd Technology UNII-Subband 3
(S _{eq} / S _{lim})	0,2565	0,2448	0,3791
Sum of (S _{eq} / S _{lim}) 1 st +3 rd	0,5167		
Sum of (S _{eq} / S _{lim}) 1 st +2 nd	0,3824		
Limit	1,0		
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

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)	S _{lim} (mW/cm ²)	Seq / S _{lim}	Margin to IC Limit (mW/cm ²)	Minimum Distance to be ensured cm (IC)	Maximum Gain to be ensured dBi (IC)
ISM band g-mode (1 Mbit)	2412	9	7.9433	16.50	44.67	25.50	354.81	0.0706	0.5366	0.1315	0.4660	7.2539	17.8092
ISM band g-mode (6 Mbit)	2412	9	7.9433	19.40	87.10	28.40	691.83	0.1376	0.5366	0.2565	0.3990	10.1291	14.9092
ISM band n-mode [20 MHz]	2412	9	7.9433	19.00	79.43	28.00	630.96	0.1255	0.5366	0.2339	0.4111	9.6732	15.3092
ISM band n-mode [40 MHz]	2422	9	7.9433	17.60	57.54	26.60	457.09	0.0909	0.5381	0.1690	0.4472	8.2216	16.7215
ISM band ax-mode [20 MHz]	2412	9	7.9433	19.10	81.28	28.10	645.65	0.1284	0.5366	0.2394	0.4082	9.7852	15.2092
ISM band ax-mode [40 MHz]	2422	9	7.9433	17.40	54.95	26.40	436.52	0.0868	0.5381	0.1614	0.4513	8.0344	16.9215
U-NII Subband 1 a-mode	5240	8	6.3096	12.30	16.98	20.30	107.15	0.0213	0.9119	0.0234	0.8905	3.0580	24.3120
U-NII Subband 1 n-mode [20 MHz]	5240	8	6.3096	11.90	15.49	19.90	97.72	0.0194	0.9119	0.0213	0.8924	2.9203	24.7120
U-NII Subband 1 n-mode [40 MHz]	5230	8	6.3096	12.60	18.20	20.60	114.82	0.0228	0.9107	0.0251	0.8878	3.1675	24.0063
U-NII Subband 1 ac-mode [20 MHz]	5240	8	6.3096	12.10	16.22	20.10	102.33	0.0204	0.9119	0.0223	0.8915	2.9884	24.5120
U-NII Subband 1 ac-mode [40 MHz]	5230	8	6.3096	12.50	17.78	20.50	112.20	0.0223	0.9107	0.0245	0.8883	3.1312	24.1063
U-NII Subband 1 ac-mode [80 MHz]	5210	8	6.3096	11.90	15.49	19.90	97.72	0.0194	0.9083	0.0214	0.8888	2.9261	24.6949
U-NII Subband 1 ax-mode [20 MHz]	5180	8	6.3096	11.80	15.14	19.80	95.50	0.0190	0.9047	0.0210	0.8857	2.8983	24.7778
U-NII Subband 1 ax-mode [40 MHz]	5230	8	6.3096	12.10	16.22	20.10	102.33	0.0204	0.9107	0.0224	0.8903	2.9903	24.5063
U-NII Subband 1 ax-mode [80 MHz]	5210	8	6.3096	11.80	15.14	19.80	95.50	0.0190	0.9083	0.0209	0.8893	2.8926	24.7949
U-NII Subband 3 a-mode	5785	8	6.3096	22.60	181.97	30.60	1148.15	0.2284	0.9756	0.2341	0.7472	9.6772	14.3056
U-NII Subband 3 n-mode [20 MHz]	5785	8	6.3096	22.00	158.49	30.00	1000.00	0.1989	0.9756	0.2039	0.7767	9.0313	14.9056
U-NII Subband 3 n-mode [40 MHz]	5795	8	6.3096	23.10	204.17	31.10	1288.25	0.2563	0.9768	0.2624	0.7205	10.2445	13.8108
U-NII Subband 3 ac-mode [20 MHz]	5785	8	6.3096	22.00	158.49	30.00	1000.00	0.1989	0.9756	0.2039	0.7767	9.0313	14.9056
U-NII Subband 3 ac-mode [40 MHz]	5795	8	6.3096	24.80	302.00	32.80	1905.46	0.3791	0.9768	0.3881	0.5977	12.4593	12.1108
U-NII Subband 3 ac-mode [80 MHz]	5775	8	6.3096	22.60	181.97	30.60	1148.15	0.2284	0.9745	0.2344	0.7461	9.6829	14.3005
U-NII Subband 3 ax-mode [20 MHz]	5785	8	6.3096	22.50	177.83	30.50	1122.02	0.2232	0.9756	0.2288	0.7524	9.5664	14.4056
U-NII Subband 3 ax-mode [40 MHz]	5795	8	6.3096	22.80	190.55	30.80	1202.26	0.2392	0.9768	0.2449	0.7376	9.8967	14.1108
U-NII Subband 3 ax-mode [80 MHz]	5775	8	6.3096	22.50	177.83	30.50	1122.02	0.2232	0.9745	0.2291	0.7513	9.5721	14.4005

Minimum Distance to be ensured: 20 cm

Maximum Gain to be ensured: 14 dBi

Simultaneous (if applicable):

	1 st Technology ISM band g-mode (6 Mbit)	2 nd Technology UNII-Subband 1 n- mode [40 MHz]	3 rd Technology UNII-Subband 3
(S _{eq} / S _{lim})	0,1376	0,0251	0,3881
Sum of (S _{eq} / S _{lim}) 1 st +3 rd	0,5257		
Sum of (S _{eq} / S _{lim}) 1 st +2 nd	0,1627		
Limit	1,0		
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