

EVALUATION FOR RF RADIATION EXPOSURE

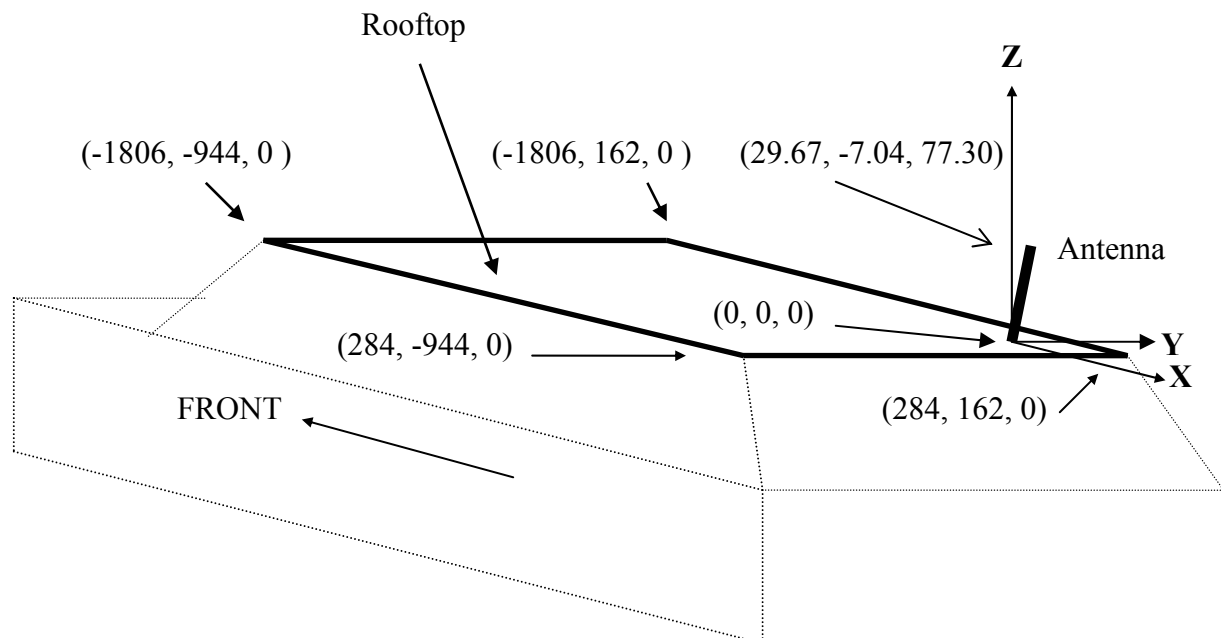
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Shintom Co., Ltd.

The worst-case exposure with the new antenna (Standard type 6) mounted at right rear portion of rooftop of a vehicle is expected to be applied to a person standing at right side of the vehicle. Since the distance between the person and the antenna is kept more than 20 cm, the transceiver is categorized as a mobile device for which the RF radiation exposure shall be evaluated with MPE (Maximum Permissible Exposure).

1. Method

Power Density was calculated by NEC-2 based software for the following condition, which simulates the transceiver (FCC ID: BFYT3017) and the new antenna mounted on vehicle rooftop.

- (1) Transceiver
RF Output Power: 3.0 watts (50 ohms) at the antenna terminal of the transceiver unit
Transmit Frequency: 824.04 MHz to 848.97 MHz
- (2) Cable connecting Antenna to Transceiver Unit
Cable type: 50 ohms Coaxial cable
Cable loss: 1.45dB
- (3) Antenna
Antenna type: Mono pole antenna of quarter wave length
Element length: 83.1 mm
RF voltage applied to Antenna : 10.3644 Volts RMS (3W - 1.45dB at 50 ohms)
- (4) Modeling
The following figure shows the model for the calculation. The rooftop of the vehicle which is simulated by wire grid consisting of 5433 wires works as a ground for the antenna. The radiator of the antenna consists of 40 segments of wire. All dimensions shown in the figure are indicated in mm (millimeter). The worst-case RF exposure is assumed to be occurred at the location of $x=0$ (mm), $y=516$ (mm).



2. Calculation Results

Frequency: 824.04 MHz

Location (x,y,z)			Electric Field	Magnetic Field	Power Density	Power Density	MPE Limit(*)
x(mm)	y(mm)	z(mm)	V/m RMS	A/m RMS	W/(m x m)	mW/(cm x cm)	mW/(cm x cm)
0	516	-100	10.4844	0.0266686	0.279604	0.0279604	0.54936
0	516	-90	10.7579	0.0273563	0.294296	0.0294296	0.54936
0	516	-80	11.0316	0.0280492	0.309428	0.0309428	0.54936
0	516	-70	11.3053	0.0287465	0.324988	0.0324988	0.54936
0	516	-60	11.5785	0.0294468	0.340950	0.0340950	0.54936
0	516	-50	11.8507	0.0301499	0.357297	0.0357297	0.54936
0	516	-40	12.1209	0.0308533	0.373970	0.0373970	0.54936
0	516	-30	12.3887	0.0315557	0.390934	0.0390934	0.54936
0	516	-20	12.6534	0.0322554	0.408140	0.0408140	0.54936
0	516	-10	12.9142	0.0329507	0.425532	0.0425532	0.54936
0	516	0	13.1705	0.0336390	0.443042	0.0443042	0.54936
0	516	10	13.4214	0.0343184	0.460601	0.0460601	0.54936
0	516	20	13.6662	0.0349866	0.478134	0.0478134	0.54936
0	516	30	13.9041	0.0356408	0.495553	0.0495553	0.54936
0	516	40	14.1341	0.0362788	0.512768	0.0512768	0.54936
0	516	50	14.3556	0.0368981	0.529694	0.0529694	0.54936
0	516	60	14.5673	0.0374965	0.546223	0.0546223	0.54936
0	516	70	14.7693	0.0380713	0.562286	0.0562286	0.54936
0	516	80	14.9603	0.0386203	0.577771	0.0577771	0.54936
0	516	90	15.1400	0.0391416	0.592604	0.0592604	0.54936
0	516	100	15.3076	0.0396329	0.606685	0.0606685	0.54936
0	516	110	15.4626	0.0400926	0.619936	0.0619936	0.54936
0	516	120	15.6046	0.0405191	0.632284	0.0632284	0.54936
0	516	130	15.7331	0.0409110	0.643657	0.0643657	0.54936
0	516	140	15.8479	0.0412674	0.654002	0.0654002	0.54936
0	516	150	15.9488	0.0415873	0.663268	0.0663268	0.54936
0	516	160	16.0357	0.0418704	0.671421	0.0671421	0.54936
0	516	170	16.1086	0.0421163	0.678435	0.0678435	0.54936
0	516	180	16.1675	0.0423250	0.684289	0.0684289	0.54936
0	516	190	16.2127	0.0424968	0.688988	0.0688988	0.54936
0	516	200	16.2445	0.0426324	0.692542	0.0692542	0.54936
0	516	210	16.2631	0.0427323	0.694960	0.0694960	0.54936
0	516	220	16.2689	0.0427976	0.696270	0.0696270	0.54936
0	516	230	16.2626	0.0428293	0.696516	0.0696516	0.54936
0	516	240	16.2445	0.0428289	0.695734	0.0695734	0.54936
0	516	250	16.2152	0.0427979	0.693977	0.0693977	0.54936
0	516	260	16.1755	0.0427377	0.691304	0.0691304	0.54936
0	516	270	16.1258	0.0426499	0.687764	0.0687764	0.54936
0	516	280	16.0670	0.0425363	0.683431	0.0683431	0.54936
0	516	290	15.9997	0.0423991	0.678373	0.0678373	0.54936
0	516	300	15.9246	0.0422396	0.672649	0.0672649	0.54936
0	516	310	15.8424	0.0420598	0.666328	0.0666328	0.54936
0	516	320	15.7537	0.0418618	0.659478	0.0659478	0.54936
0	516	330	15.6592	0.0416463	0.652148	0.0652148	0.54936
0	516	340	15.5596	0.0414157	0.644412	0.0644412	0.54936
0	516	350	15.4554	0.0411719	0.636328	0.0636328	0.54936

0	516	360	15.3472	0.0409155	0.627938	0.0627938	0.54936
0	516	370	15.2357	0.0406486	0.619310	0.0619310	0.54936
0	516	380	15.1212	0.0403726	0.610482	0.0610482	0.54936
0	516	390	15.0043	0.0400882	0.601495	0.0601495	0.54936
0	516	400	14.8853	0.0397966	0.592384	0.0592384	0.54936

(*) f/1500, Limit for General Population / Uncontrolled Exposure

Frequency: 836.49 MHz

Location(x,y,z) x(mm) y(mm) z(mm)			Electric Field V/m RMS	Magnetic Field A/m RMS	Power Density W/(m x m)	Power Density mW/(cm x cm)	MPE Limit(*) mW/(cm x cm)
0	516	-100	10.3037	0.0258844	0.266705	0.0266705	0.55766
0	516	-90	10.5494	0.0265147	0.279714	0.0279714	0.55766
0	516	-80	10.7963	0.0271538	0.293161	0.0293161	0.55766
0	516	-70	11.0443	0.0278005	0.307037	0.0307037	0.55766
0	516	-60	11.2928	0.0284547	0.321333	0.0321333	0.55766
0	516	-50	11.5414	0.0291143	0.336020	0.0336020	0.55766
0	516	-40	11.7897	0.0297777	0.351070	0.0351070	0.55766
0	516	-30	12.0371	0.0304442	0.366460	0.0366460	0.55766
0	516	-20	12.2830	0.0311105	0.382130	0.0382130	0.55766
0	516	-10	12.5267	0.0317752	0.398038	0.0398038	0.55766
0	516	0	12.7674	0.0324364	0.414128	0.0414128	0.55766
0	516	10	13.0044	0.0330911	0.430330	0.0430330	0.55766
0	516	20	13.2369	0.0337371	0.446575	0.0446575	0.55766
0	516	30	13.4640	0.0343715	0.462778	0.0462778	0.55766
0	516	40	13.6848	0.0349918	0.478856	0.0478856	0.55766
0	516	50	13.8985	0.0355954	0.494723	0.0494723	0.55766
0	516	60	14.1042	0.0361796	0.510284	0.0510284	0.55766
0	516	70	14.3011	0.0367414	0.525442	0.0525442	0.55766
0	516	80	14.4883	0.0372788	0.540106	0.0540106	0.55766
0	516	90	14.6651	0.0377893	0.554184	0.0554184	0.55766
0	516	100	14.8307	0.0382705	0.567578	0.0567578	0.55766
0	516	110	14.9844	0.0387203	0.580200	0.0580200	0.55766
0	516	120	15.1256	0.0391372	0.591974	0.0591974	0.55766
0	516	130	15.2539	0.0395194	0.602825	0.0602825	0.55766
0	516	140	15.3688	0.0398656	0.612686	0.0612686	0.55766
0	516	150	15.4699	0.0401748	0.621500	0.0621500	0.55766
0	516	160	15.5570	0.0404462	0.629222	0.0629222	0.55766
0	516	170	15.6300	0.0406795	0.635821	0.0635821	0.55766
0	516	180	15.6888	0.0408744	0.641270	0.0641270	0.55766
0	516	190	15.7335	0.0410310	0.645561	0.0645561	0.55766
0	516	200	15.7643	0.0411498	0.648698	0.0648698	0.55766
0	516	210	15.7812	0.0412310	0.650675	0.0650675	0.55766
0	516	220	15.7847	0.0412762	0.651532	0.0651532	0.55766
0	516	230	15.7752	0.0412857	0.651290	0.0651290	0.55766
0	516	240	15.7531	0.0412613	0.649993	0.0649993	0.55766
0	516	250	15.7190	0.0412045	0.647694	0.0647694	0.55766
0	516	260	15.6733	0.0411166	0.644433	0.0644433	0.55766
0	516	270	15.6168	0.0409994	0.640279	0.0640279	0.55766
0	516	280	15.5501	0.0408545	0.635292	0.0635292	0.55766
0	516	290	15.4738	0.0406844	0.629542	0.0629542	0.55766
0	516	300	15.3888	0.0404906	0.623102	0.0623102	0.55766

0	516	310	15.2956	0.0402753	0.616035	0.0616035	0.55766
0	516	320	15.1951	0.0400400	0.608412	0.0608412	0.55766
0	516	330	15.0879	0.0397877	0.600313	0.0600313	0.55766
0	516	340	14.9749	0.0395198	0.591805	0.0591805	0.55766
0	516	350	14.8566	0.0392375	0.582936	0.0582936	0.55766
0	516	360	14.7338	0.0389433	0.573783	0.0573783	0.55766
0	516	370	14.6071	0.0386391	0.564405	0.0564405	0.55766
0	516	380	14.4771	0.0383264	0.554855	0.0554855	0.55766
0	516	390	14.3445	0.0380063	0.545181	0.0545181	0.55766
0	516	400	14.2098	0.0376808	0.535437	0.0535437	0.55766

(*) f/1500, Limit for General Population / Uncontrolled Exposure

Frequency: 848.97 MHz

Location(x,y,z) x(mm) y(mm) z(mm)			Electric Field V/m RMS	Magnetic Field A/m RMS	Power Density W/(m x m)	Power Density mW/(cm x cm)	MPE Limit(*) mW/ (cm x cm)
0	516	-100	9.8234	0.0247651	0.243276	0.0243276	0.56598
0	516	-90	10.0456	0.0253613	0.254769	0.0254769	0.56598
0	516	-80	10.2707	0.0259707	0.266737	0.0266737	0.56598
0	516	-70	10.4984	0.0265899	0.279151	0.0279151	0.56598
0	516	-60	10.7283	0.0272191	0.292015	0.0292015	0.56598
0	516	-50	10.9602	0.0278574	0.305323	0.0305323	0.56598
0	516	-40	11.1936	0.0285023	0.319043	0.0319043	0.56598
0	516	-30	11.4279	0.0291526	0.333153	0.0333153	0.56598
0	516	-20	11.6626	0.0298061	0.347617	0.0347617	0.56598
0	516	-10	11.8969	0.0304602	0.362382	0.0362382	0.56598
0	516	0	12.1301	0.0311131	0.377405	0.0377405	0.56598
0	516	10	12.3615	0.0317619	0.392625	0.0392625	0.56598
0	516	20	12.5901	0.0324043	0.407973	0.0407973	0.56598
0	516	30	12.8151	0.0330377	0.423381	0.0423381	0.56598
0	516	40	13.0354	0.0336588	0.438756	0.0438756	0.56598
0	516	50	13.2502	0.0342653	0.454022	0.0454022	0.56598
0	516	60	13.4585	0.0348538	0.469080	0.0469080	0.56598
0	516	70	13.6592	0.0354217	0.483832	0.0483832	0.56598
0	516	80	13.8515	0.0359665	0.498190	0.0498190	0.56598
0	516	90	14.0344	0.0364855	0.512052	0.0512052	0.56598
0	516	100	14.2071	0.0369762	0.525325	0.0525325	0.56598
0	516	110	14.3689	0.0374364	0.537920	0.0537920	0.56598
0	516	120	14.5188	0.0378639	0.549738	0.0549738	0.56598
0	516	130	14.6564	0.0382570	0.560710	0.0560710	0.56598
0	516	140	14.7811	0.0386141	0.570759	0.0570759	0.56598
0	516	150	14.8924	0.0389340	0.579821	0.0579821	0.56598
0	516	160	14.9899	0.0392157	0.587839	0.0587839	0.56598
0	516	170	15.0735	0.0394584	0.594776	0.0594776	0.56598
0	516	180	15.1428	0.0396618	0.600591	0.0600591	0.56598
0	516	190	15.1980	0.0398257	0.605271	0.0605271	0.56598
0	516	200	15.2390	0.0399503	0.608803	0.0608803	0.56598
0	516	210	15.2659	0.0400359	0.611184	0.0611184	0.56598
0	516	220	15.2790	0.0400835	0.612436	0.0612436	0.56598
0	516	230	15.2786	0.0400937	0.612576	0.0612576	0.56598
0	516	240	15.2650	0.0400676	0.611632	0.0611632	0.56598
0	516	250	15.2387	0.0400069	0.609653	0.0609653	0.56598

0	516	260	15.2002	0.0399130	0.606686	0.0606686	0.56598
0	516	270	15.1500	0.0397871	0.602775	0.0602775	0.56598
0	516	280	15.0888	0.0396313	0.597989	0.0597989	0.56598
0	516	290	15.0171	0.0394478	0.592392	0.0592392	0.56598
0	516	300	14.9356	0.0392384	0.586049	0.0586049	0.56598
0	516	310	14.8451	0.0390043	0.579023	0.0579023	0.56598
0	516	320	14.7461	0.0387486	0.571391	0.0571391	0.56598
0	516	330	14.6394	0.0384731	0.563223	0.0563223	0.56598
0	516	340	14.5257	0.0381792	0.554580	0.0554580	0.56598
0	516	350	14.4058	0.0378701	0.545549	0.0545549	0.56598
0	516	360	14.2802	0.0375468	0.536176	0.0536176	0.56598
0	516	370	14.1497	0.0372118	0.526536	0.0526536	0.56598
0	516	380	14.0150	0.0368663	0.516681	0.0516681	0.56598
0	516	390	13.8766	0.0365126	0.506671	0.0506671	0.56598
0	516	400	13.7353	0.0361528	0.496570	0.0496570	0.56598

(*) f/1500, Limit for General Population / Uncontrolled Exposure

3. Conclusion

The worst-case RF radiation exposure is summarized as follows.

Frequency f (MHz)	Location (mm)	Power Density		MPE Limit (*) mW/(cm x cm)
		W/(m x m)	mW/(cm x cm)	
824.04	(0, 516, 230)	0.696516	0.0696516	0.54936
836.49	(0, 516, 220)	0.651532	0.0651532	0.55766
848.97	(0, 516, 230)	0.612576	0.0612576	0.56598

(*) f/1500, Limit for General Population / Uncontrolled Exposure

As shown in the above summary, the worst-case RF exposure is expected to be less than the MPE limit. Therefore, the transceiver with the new antenna is considered to comply with the Section 2.1091 of FCC rule.