

EVALUATION FOR RF RADIATION EXPOSURE (STANDARD TYPE 4, 594N)

The worst-case exposure with the new antenna (Standard type 4, 594N) mounted at left rear portion of rooftop of a vehicle is expected to be applied to a person standing at left 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

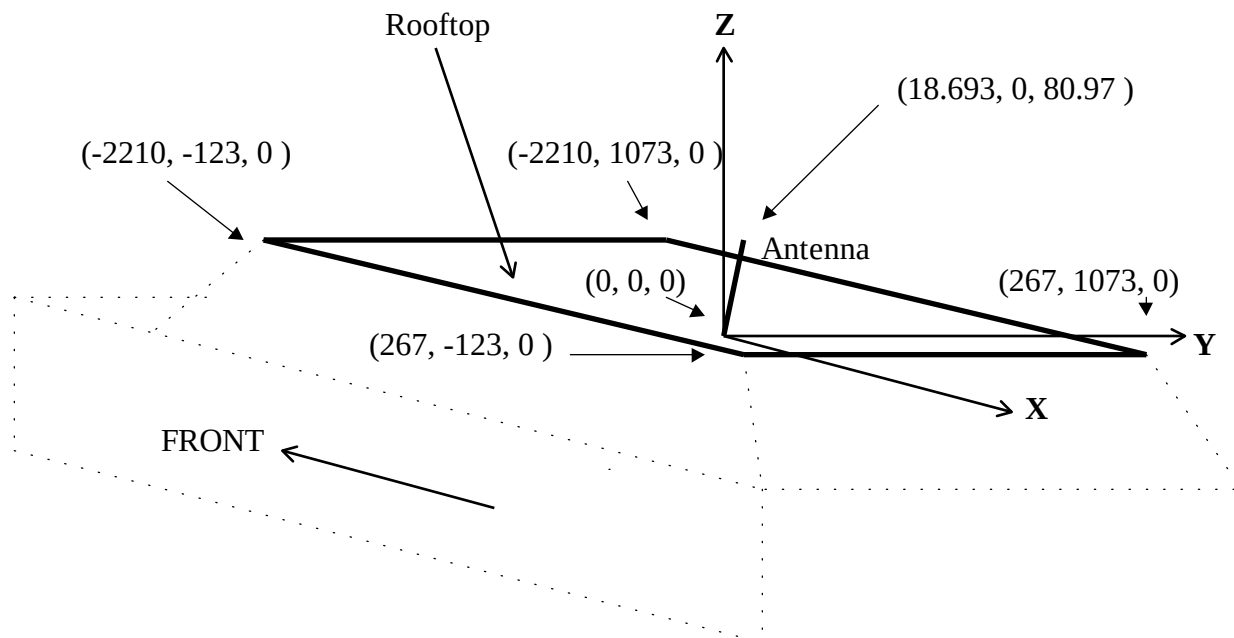
Cable type: 50 ohms Coaxial cable
Cable loss: 2.30dB

(3) Antenna

Antenna type: Mono pole (Standard type 4, 594N)
Element length: 83.10 mm
RF voltage applied to Antenna : 9.39822 Volts RMS (3W - 2.30dB 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 4868 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), and $y=-488$ (mm).



2. Calculation Results

Frequency: 824.04 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)
0	-488	0	13.0101	0.0341824	0.444716
0	-488	50	14.5117	0.0382223	0.554671
0	-488	100	15.7471	0.0415150	0.653741
0	-488	150	16.6264	0.0438490	0.729051
0	-488	200	17.1155	0.0451480	0.772731
0	-488	210	17.1669	0.0452858	0.777417
0	-488	220	17.2034	0.0453847	0.780771
0	-488	230	17.2252	0.0454449	0.782797
0	-488	240	17.2328	0.0454684	0.783548
0	-488	250	17.2264	0.0454554	0.783033
0	-488	260	17.2065	0.0454071	0.781297
0	-488	270	17.1735	0.0453251	0.778391
0	-488	280	17.1277	0.0452102	0.774347
0	-488	290	17.0698	0.0450635	0.769225
0	-488	300	17.0000	0.0448861	0.763064
0	-488	350	16.4894	0.0435849	0.718689
0	-488	400	15.7508	0.0416954	0.656736
0	-488	450	14.8404	0.0393616	0.584142
0	-488	500	13.8154	0.0367235	0.507350
-350	-488	240	13.6822	0.0359417	0.491762
-300	-488	240	14.4501	0.0381273	0.550943
-250	-488	240	15.0606	0.0402933	0.606841
-200	-488	240	15.6304	0.0420125	0.656672
-150	-488	240	16.2083	0.0432334	0.700740
-100	-488	240	16.7376	0.0442031	0.739854
-50	-488	240	17.1000	0.0449967	0.769444
-40	-488	240	17.1453	0.0451228	0.773644
-30	-488	240	17.1812	0.0452345	0.777183
-20	-488	240	17.2076	0.0453309	0.780036
-10	-488	240	17.2247	0.0454090	0.782156
0	-488	240	17.2328	0.0454684	0.783548
10	-488	240	17.2321	0.0455077	0.784193 (Max)
20	-488	240	17.2229	0.0455261	0.784091
30	-488	240	17.2055	0.0455234	0.783253
40	-488	240	17.1803	0.0454993	0.781692
50	-488	240	17.1477	0.0454537	0.779426
100	-488	240	16.8871	0.0449394	0.758896
150	-488	240	16.5028	0.0440791	0.727429
200	-488	240	16.0408	0.0430317	0.690263
250	-488	240	15.5229	0.0418299	0.649321
300	-488	240	14.9500	0.0404221	0.604310
350	-488	240	14.3254	0.0387946	0.555748

2. Calculation Results (continued)

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)
0	-488	0	12.2450	0.0325576	0.398668
0	-488	50	13.5356	0.0359607	0.486750
0	-488	100	14.5571	0.0386522	0.562664
0	-488	150	15.2588	0.0404944	0.617896
0	-488	200	15.6350	0.0414663	0.648326
0	-488	210	15.6732	0.0415620	0.651410
0	-488	220	15.6998	0.0416265	0.653528
0	-488	230	15.7152	0.0416616	0.654720
0	-488	240	15.7197	0.0416675	0.655001
0	-488	250	15.7137	0.0416451	0.654399
0	-488	260	15.6976	0.0415969	0.652971
0	-488	270	15.6717	0.0415227	0.650731
0	-488	280	15.6364	0.0414240	0.647722
0	-488	290	15.5920	0.0413019	0.643979
0	-488	300	15.5390	0.0411568	0.639536
0	-488	350	15.1545	0.0401249	0.608073
0	-488	400	14.5968	0.0386486	0.564146
0	-488	450	13.8953	0.0368041	0.511404
0	-488	500	13.0775	0.0346611	0.453281
-350	-488	240	12.8841	0.0338287	0.435852
-300	-488	240	13.3984	0.0357765	0.479348
-250	-488	240	13.8903	0.0374376	0.520019
-200	-488	240	14.4367	0.0386249	0.557616
-150	-488	240	14.9890	0.0395995	0.593557
-100	-488	240	15.4172	0.0405269	0.624811
-50	-488	240	15.6531	0.0412856	0.646248
-40	-488	240	15.6784	0.0413975	0.649047
-30	-488	240	15.6974	0.0414920	0.651317
-20	-488	240	15.7103	0.0415691	0.653063
-10	-488	240	15.7176	0.0416276	0.654286
0	-488	240	15.7197	0.0416675	0.655001
10	-488	240	15.7169	0.0416886	0.655216
20	-488	240	15.7097	0.0416934	0.654991
30	-488	240	15.6984	0.0416823	0.654345
40	-488	240	15.6836	0.0416574	0.653338
50	-488	240	15.6655	0.0416205	0.652006
100	-488	240	15.5428	0.0413472	0.642651
150	-488	240	15.3957	0.0410890	0.632594
200	-488	240	15.2247	0.0408443	0.621842
250	-488	240	14.9772	0.0403695	0.604622
300	-488	240	14.5921	0.0394299	0.575365
350	-488	240	14.0478	0.0379683	0.533371

(Max)

2. Calculation Results (continued)

Frequency: 848.97 MHz

Location (x, y, z)			Electric Field (V/m RMS)	Magnetic Field (A/m RMS)	Power Density W/(m x m)
x(mm)	y(mm)	z(mm)			
0	-488	0	11.5315	0.0305635	0.352443
0	-488	50	12.5297	0.0332027	0.416020
0	-488	100	13.2706	0.0352082	0.467234
0	-488	150	13.7256	0.0364719	0.500599
0	-488	160	13.7829	0.0366340	0.504923
0	-488	170	13.8295	0.0367671	0.508471
0	-488	180	13.8658	0.0368714	0.511251
0	-488	190	13.8921	0.0369484	0.513291
0	-488	200	13.9089	0.0369988	0.514613
0	-488	210	13.9167	0.0370239	0.515251
0	-488	220	13.9158	0.0370247	0.515228
0	-488	230	13.9068	0.0370027	0.514589
0	-488	240	13.8900	0.0369592	0.513363
0	-488	250	13.8661	0.0368954	0.511595
0	-488	300	13.6526	0.0363135	0.495774
0	-488	350	13.3151	0.0353916	0.471243
0	-488	400	12.8828	0.0342188	0.440834
0	-488	450	12.3691	0.0328328	0.406112
0	-488	500	11.7785	0.0312452	0.368022
-350	-488	210	11.5867	0.0308502	0.357452
-300	-488	210	12.0219	0.0324671	0.390316
-250	-488	210	12.5440	0.0336428	0.422015
-200	-488	210	13.1043	0.0345917	0.453300
-150	-488	210	13.5514	0.0355615	0.481908
-100	-488	210	13.8083	0.0364647	0.503516
-50	-488	210	13.9146	0.0370130	0.515021
-40	-488	210	13.9222	0.0370574	0.515921
-30	-488	210	13.9259	0.0370790	0.516358
-20	-488	210	13.9261	0.0370794	0.516371
-10	-488	210	13.9229	0.0370602	0.515985
0	-488	210	13.9167	0.0370239	0.515251
50	-488	210	13.8555	0.0367225	0.508809
100	-488	210	13.7968	0.0365777	0.504655
150	-488	210	13.8071	0.0368427	0.508691
200	-488	210	13.8663	0.0372778	0.516905
210	-488	210	13.8737	0.0373393	0.518034
220	-488	210	13.8767	0.0373827	0.518749
230	-488	210	13.8744	0.0374049	0.518971
240	-488	210	13.8655	0.0374028	0.518609
250	-488	210	13.8493	0.0373745	0.517611
300	-488	210	13.6387	0.0368065	0.501993
350	-488	210	13.2047	0.0355656	0.469633

(Max)

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	(10, -488, 240)	0.784193	0.0784193	0.54936
836.49	(10, -488, 240)	0.655216	0.0655216	0.55766
848.97	(230, -488, 210)	0.518971	0.0518971	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.