

EVALUATION FOR RF RADIATION EXPOSURE

The worst-case exposure with the new antenna (Standard type 5) mounted at rear portion of rooftop of a vehicle is expected to be applied to a person standing at rear 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

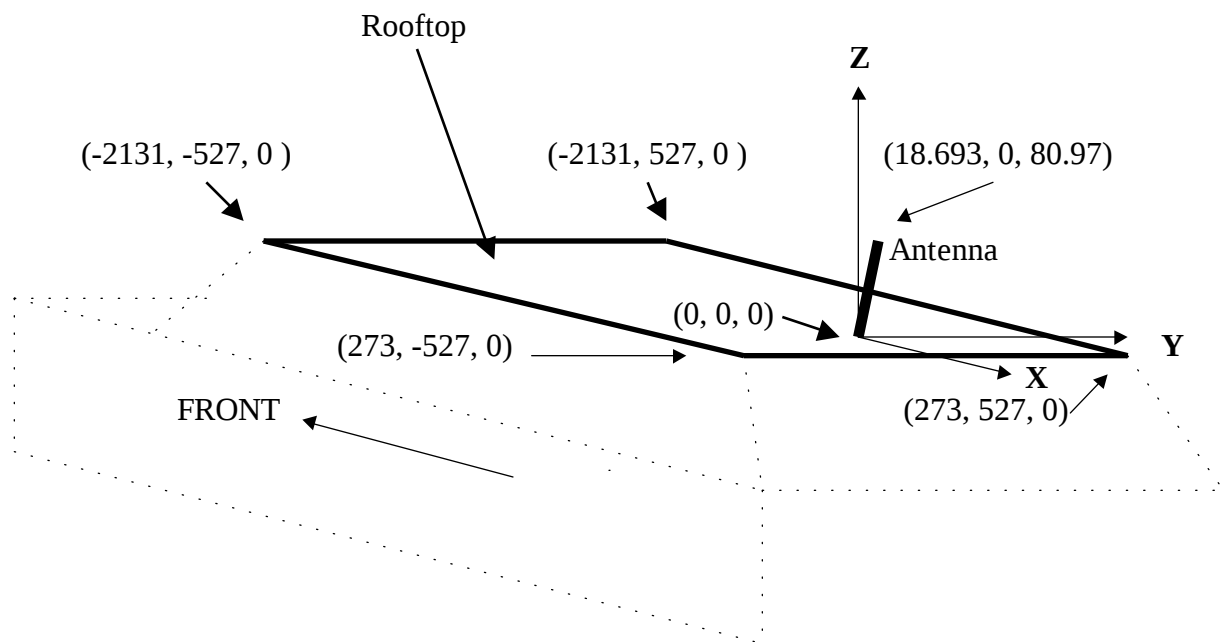
Cable type: 50 ohms Coaxial cable
Cable loss: 1.90dB

(3) Antenna

Antenna type: Mono pole
Element length: 83.10 mm
RF voltage applied to Antenna : 9.84114 Volts RMS (3W-1.90dB 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 4183 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 $x = 660$ (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)
660	0	0	10.6117	0.0265633	0.281882
660	0	50	11.9426	0.0302137	0.360830
660	0	100	13.1488	0.0336053	0.441869
660	0	150	14.1510	0.0364937	0.516422
660	0	200	14.8894	0.0386879	0.576040
660	0	250	15.3355	0.0400908	0.614812
660	0	260	15.3894	0.0402749	0.619807
660	0	270	15.4320	0.0404275	0.623877
660	0	280	15.4633	0.0405487	0.627017
660	0	290	15.4835	0.0406399	0.629248
660	0	300	15.4931	0.0407015	0.630592
660	0	310	15.4921	0.0407338	0.631052
660	0	320	15.4811	0.0407384	0.630675
660	0	330	15.4602	0.0407158	0.629474
660	0	340	15.4298	0.0406673	0.627488
660	0	350	15.3903	0.0405929	0.624737
660	0	400	15.0688	0.0398794	0.600935
660	0	450	14.5738	0.0386840	0.563773
660	0	500	13.9486	0.0371244	0.517833
660	0	310	15.4921	0.0407338	0.631052
660	10	310	15.4907	0.0407412	0.631110
660	20	310	15.4864	0.0407623	0.631261
660	30	310	15.4796	0.0407972	0.631524
660	40	310	15.4709	0.0408454	0.631915
660	50	310	15.4611	0.0409052	0.632439
660	60	310	15.4509	0.0409751	0.633102
660	70	310	15.4412	0.0410533	0.633912
660	80	310	15.4325	0.0411379	0.634861
660	90	310	15.4253	0.0412250	0.635908
660	100	310	15.4200	0.0413125	0.637039
660	110	310	15.4163	0.0413956	0.638167
660	120	310	15.4139	0.0414713	0.639234
660	130	310	15.4120	0.0415345	0.640130
660	140	310	15.4098	0.0415825	0.640778
660	150	310	15.4060	0.0416108	0.641056
660	160	310	15.3994	0.0416157	0.640857
660	170	310	15.3886	0.0415945	0.640081
660	180	310	15.3723	0.0415460	0.638658
660	190	310	15.3493	0.0414672	0.636492
660	200	310	15.3187	0.0413579	0.633549
660	250	310	15.0315	0.0403670	0.606777
660	300	310	14.5384	0.0388089	0.564219

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)
660	0	0	10.6360	0.0262634	0.279338
660	0	50	11.9124	0.0298662	0.355778
660	0	100	13.0924	0.0332642	0.435508
660	0	150	14.0794	0.0361604	0.509117
660	0	200	14.7974	0.0383259	0.567124
660	0	250	15.2092	0.0396446	0.602963
660	0	260	15.2546	0.0398059	0.607223
660	0	270	15.2880	0.0399328	0.610493
660	0	280	15.3097	0.0400276	0.612811
660	0	290	15.3199	0.0400897	0.614170
660	0	300	15.3192	0.0401214	0.614628
660	0	310	15.3077	0.0401227	0.614186
660	0	320	15.2860	0.0400960	0.612907
660	0	330	15.2544	0.0400408	0.610798
660	0	340	15.2134	0.0399601	0.607929
660	0	350	15.1635	0.0398531	0.604312
660	0	400	14.7954	0.0389895	0.576865
660	0	450	14.2713	0.0376918	0.537911
660	0	500	13.6412	0.0361029	0.492487
660	0	300	15.3192	0.0401214	0.614628
660	10	300	15.3154	0.0401229	0.614498
660	20	300	15.3043	0.0401259	0.614099
660	30	300	15.2864	0.0401310	0.613459
660	40	300	15.2627	0.0401395	0.612637
660	50	300	15.2342	0.0401499	0.611652
660	60	300	15.2023	0.0401648	0.610597
660	70	300	15.1686	0.0401826	0.609514
660	80	300	15.1345	0.0402034	0.608458
660	90	300	15.1014	0.0402283	0.607504
660	100	300	15.0705	0.0402546	0.606657
660	110	300	15.0428	0.0402828	0.605966
660	120	300	15.0188	0.0403100	0.605408
660	130	300	14.9986	0.0403357	0.604979
660	140	300	14.9820	0.0403566	0.604623
660	150	300	14.9682	0.0403701	0.604268
660	160	300	14.9563	0.0403736	0.603840
660	170	300	14.9451	0.0403632	0.603232
660	180	300	14.9332	0.0403371	0.602362
660	190	300	14.9191	0.0402938	0.601147
660	200	300	14.9015	0.0402292	0.599475
660	250	300	14.7250	0.0395693	0.582658
660	300	300	14.3759	0.0383921	0.551921

2. Calculation Results (continued)

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)
660	0	0	10.2538	0.0253565	0.260000
660	0	50	11.6140	0.0292371	0.339560
660	0	100	12.9047	0.0329251	0.424889
660	0	150	14.0037	0.0360840	0.505310
660	0	200	14.8154	0.0384577	0.569766
660	0	250	15.2897	0.0399081	0.610183
660	0	260	15.3432	0.0400848	0.615029
660	0	270	15.3832	0.0402238	0.618771
660	0	280	15.4100	0.0403266	0.621433
660	0	290	15.4239	0.0403933	0.623022
660	0	300	15.4253	0.0404252	0.623571
660	0	310	15.4145	0.0404240	0.623116
660	0	320	15.3920	0.0403898	0.621680
660	0	330	15.3583	0.0403244	0.619314
660	0	340	15.3138	0.0402287	0.616054
660	0	350	15.2592	0.0401049	0.611969
660	0	400	14.8518	0.0391095	0.580846
660	0	450	14.2713	0.0376296	0.537023
660	0	500	13.5811	0.0358434	0.486793
660	0	300	15.4253	0.0404252	0.623571
660	10	300	15.4195	0.0404194	0.623247
660	20	300	15.4022	0.0404022	0.622283
660	30	300	15.3739	0.0403740	0.620706
660	40	300	15.3355	0.0403342	0.618545
660	50	300	15.2881	0.0402846	0.615875
660	60	300	15.2329	0.0402265	0.612766
660	70	300	15.1715	0.0401598	0.609284
660	80	300	15.1055	0.0400872	0.605537
660	90	300	15.0366	0.0400087	0.601595
660	100	300	14.9664	0.0399261	0.597550
660	110	300	14.8964	0.0398397	0.593468
660	120	300	14.8278	0.0397513	0.589424
660	130	300	14.7618	0.0396608	0.585465
660	140	300	14.6989	0.0395671	0.581593
660	150	300	14.6395	0.0394717	0.577846
660	160	300	14.5836	0.0393730	0.574200
660	170	300	14.5309	0.0392694	0.570620
660	180	300	14.4806	0.0391605	0.567068
660	190	300	14.4322	0.0390437	0.563486
660	200	300	14.3845	0.0389182	0.559819
660	250	300	14.1293	0.0381155	0.538545
660	300	300	13.8093	0.0370130	0.511124

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	(660, 150, 310)	0.641056	0.0641056	0.54936
836.49	(660, 0, 300)	0.614631	0.0614631	0.55766
848.97	(660, 0, 300)	0.623580	0.0623580	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.