

5.4a Vee Dipole Mounted Over Ground

Bending the dipole in the E -plane gives us some control over its pattern by eliminating the null in the E -plane. When we locate the vee dipole over a large ground, for example in an array of dipoles, we can control the beamwidth and achieve equal beamwidths in both planes. By raising the dipole above $\lambda/4$ the pattern spreads in the H -plane and produces a dip at broadside even when the dipole has no tilt so that the pattern peak occurs in the H -plane. A pattern null forms at broadside in the limit of $\lambda/2$ height above the ground plane.

A number of cases were computed whose results are summarized in Table 1 of the peak directivity in the E - and H -planes and Table 2 of the beamwidths in the principal planes.

Table 1 Peak Directivity (dB) of Vee Dipole Located over Ground Plane for Heights in λ

Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.20	0	8.09	8.09	0.225	0	7.80	7.80
0.20	5	8.08	8.08	0.225	5	7.83	7.83
0.20	10	8.04	8.04	0.225	10	7.81	7.81
0.20	15	7.96	7.96	0.225	15	7.77	7.77
0.20	20	7.85	7.85	0.225	20	7.70	7.70
0.20	25	7.70	7.70	0.225	25	7.59	7.59
0.20	30	7.52	7.52	0.225	30	7.46	7.46
0.20	35	7.31	7.31	0.225	35	7.30	7.30
0.20	40	7.08	7.08	0.225	40	7.12	7.12
0.20	45	6.83	6.83	0.225	45	6.92	6.92
0.20	50	6.57	6.57	0.225	50	6.72	6.72
				0.225	55	6.52	6.52
				0.225	60	6.33	6.33
Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.25	0	7.45	7.45	0.275	0	7.03	7.13
0.25	5	7.50	7.50	0.275	5	7.11	7.16
0.25	10	7.52	7.52	0.275	10	7.16	7.18
0.25	15	7.51	7.51	0.275	15	7.19	7.19
0.25	20	7.47	7.47	0.275	20	7.18	7.18
0.25	25	7.40	7.40	0.275	25	7.14	7.14
0.25	30	7.31	7.31	0.275	30	7.08	7.08
0.25	35	7.19	7.19	0.275	35	7.00	7.00
0.25	40	7.05	7.05	0.275	40	6.90	6.90
0.25	45	6.90	6.90	0.275	45	6.78	6.78
0.25	50	6.74	6.74	0.275	50	6.66	6.66
0.25	55	6.58	6.58	0.275	55	6.53	6.53
0.25	60	6.43	6.43	0.275	60	6.41	6.41
Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.30	0	6.50	6.94	0.325	0	5.85	6.85
0.30	5	6.62	6.94	0.325	5	6.02	6.83
0.30	10	6.72	6.93	0.325	10	6.16	6.80
0.30	15	6.77	6.91	0.325	15	6.26	6.76
0.30	20	6.80	6.89	0.325	20	6.33	6.71
0.30	25	6.80	6.85	0.325	25	6.36	6.65
0.30	30	6.77	6.79	0.325	30	6.37	6.58
0.30	35	6.72	6.73	0.325	35	6.36	6.51

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0.30	40	6.66	6.66	0.325	40	6.32	6.42
0.30	45	6.57	6.57	0.325	45	6.26	6.34
0.30	50	6.48	6.48	0.325	50	6.20	6.25
0.30	55	6.38	6.38	0.325	55	6.13	6.16
0.30	60	6.28	6.28	0.325	60	6.05	6.07
Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.35	0	5.04	6.86	0.375	0	4.32	6.97
0.35	5	5.26	6.82	0.375	5	4.45	6.91
0.35	10	5.45	6.77	0.375	10	4.61	6.83
0.35	15	5.61	6.71	0.375	15	4.78	6.75
0.35	20	5.72	6.64	0.375	20	4.96	6.66
0.35	25	5.81	6.56	0.375	25	5.10	6.57
0.35	30	5.86	6.48	0.375	30	5.20	6.47
0.35	35	5.88	6.39	0.375	35	5.26	6.37
0.35	40	5.87	6.30	0.375	40	5.30	6.26
0.35	45	5.85	6.20	0.375	45	5.31	6.16
0.35	50	5.82	6.10	0.375	50	5.31	6.05
0.35	55	5.77	6.01	0.375	55	5.29	5.95
0.35	60	5.72	5.92	0.375	60	5.26	5.86

Table 2 3-dB Beamwidth of Vee Dipole Located over Ground Plane for Heights in λ

Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.20	0	67.7	108.1	0.225	0	70.2	113.7
0.20	5	68.3	106.6	0.225	5	70.4	112.0
0.20	10	69.3	105.3	0.225	10	71.1	110.4
0.20	15	70.8	104.2	0.225	15	72.2	109.0
0.20	20	72.9	103.2	0.225	20	73.8	107.8
0.20	25	75.6	102.3	0.225	25	75.9	106.7
0.20	30	79.1	101.6	0.225	30	78.6	105.7
0.20	35	83.6	101.0	0.225	35	82.1	104.9
0.20	40	89.3	100.5	0.225	40	86.3	104.3
0.20	45	96.5	100.1	0.225	45	91.5	103.7
0.20	50	106.1	99.8	0.225	50	97.7	103.3
				0.225	55	105.3	103.0
				0.225	60	114.6	102.7
Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.25	0	73.5	120.0	0.275	0	77.8	125.9
0.25	5	73.3	118.1	0.275	5	77.1	124.3
0.25	10	73.6	116.3	0.275	10	76.9	122.7
0.25	15	74.3	114.7	0.275	15	77.2	121.0
0.25	20	75.4	113.2	0.275	20	77.9	119.4
0.25	25	77.1	111.9	0.275	25	79.2	117.8
0.25	30	79.3	110.7	0.275	30	80.9	116.5
0.25	35	82.0	109.8	0.275	35	83.2	115.3
0.25	40	85.4	108.9	0.275	40	86.0	114.3
0.25	45	89.4	108.2	0.275	45	89.3	113.4
0.25	50	94.1	107.6	0.275	50	93.1	112.6
0.25	55	99.6	107.1	0.275	55	97.5	112.0
0.25	60	105.8	106.7	0.275	60	102.2	111.5

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Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.30	0	83.2	130.8	0.325	0	90.1	134.8
0.30	5	82.1	129.4	0.325	5	88.5	133.6
0.30	10	81.4	128.1	0.325	10	87.3	132.5
0.30	15	81.2	126.7	0.325	15	86.6	131.4
0.30	20	81.5	125.4	0.325	20	86.4	130.3
0.30	25	82.4	124.0	0.325	25	86.8	129.2
0.30	30	83.7	122.8	0.325	30	87.8	128.1
0.30	35	85.6	121.5	0.325	35	89.2	127.1
0.30	40	87.9	120.4	0.325	40	91.2	126.1
0.30	45	90.7	119.3	0.325	45	93.7	125.2
0.30	50	94.0	118.4	0.325	50	96.6	124.4
0.30	55	97.7	117.7	0.325	55	99.8	123.1
0.30	60	101.6	117.1	0.325	60	103.3	123.1
Height	Tilt	E-plane	H-plane	Height	Tilt	E-plane	H-plane
0.35	0	98.5	138.2	0.375	0	105.8	141.1
0.35	5	96.5	137.2	0.375	5	104.7	140.3
0.35	10	94.9	136.3	0.375	10	103.7	139.4
0.35	15	93.7	135.3	0.375	15	102.6	138.6
0.35	20	93.1	134.3	0.375	20	101.6	137.8
0.35	25	93.0	133.4	0.375	25	101.2	137.0
0.35	30	93.6	132.5	0.375	30	101.3	136.2
0.35	35	94.6	131.6	0.375	35	102.1	135.4
0.35	40	96.3	130.8	0.375	40	103.4	134.8
0.35	45	98.4	130.1	0.375	45	105.3	134.1
0.35	50	101.0	129.4	0.375	50	107.7	133.5
0.35	55	104.0	128.8	0.375	55	110.5	133.0
0.35	60	107.2	128.2	0.375	60	113.6	132.5

The following three patterns of the vee dipole show combinations that produce nearly equal beamwidths.

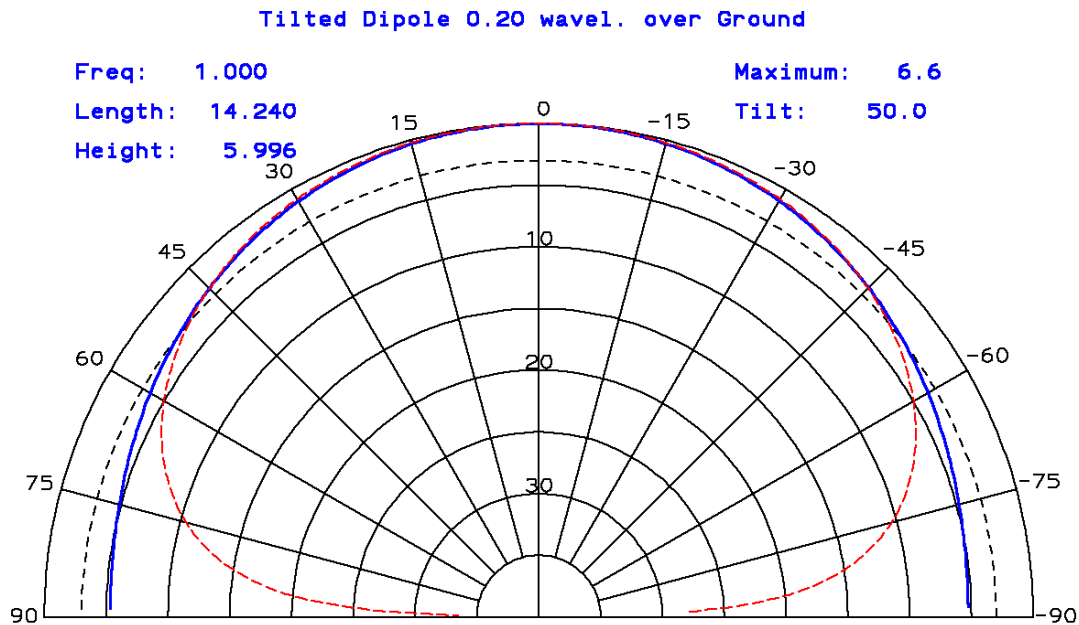


Figure 1 Tilted Dipole over Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed) units cm and Frequency 1 GHz Height = 0.20λ Tilt = 50°

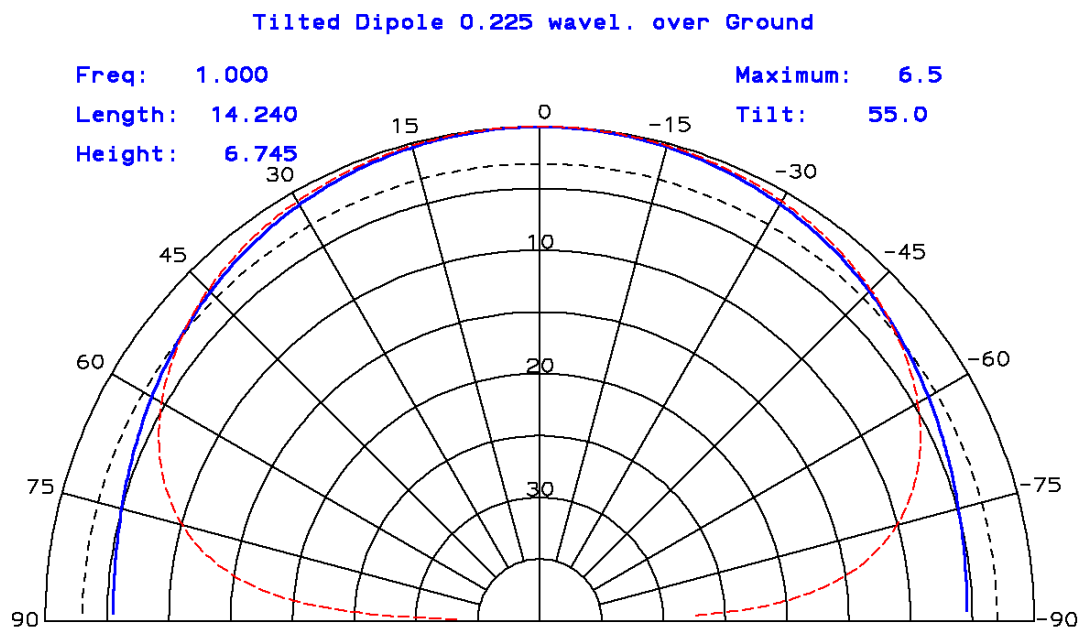


Figure 2 Tilted Dipole over Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed) units cm and Frequency 1 GHz Height = 0.225λ Tilt = 55°

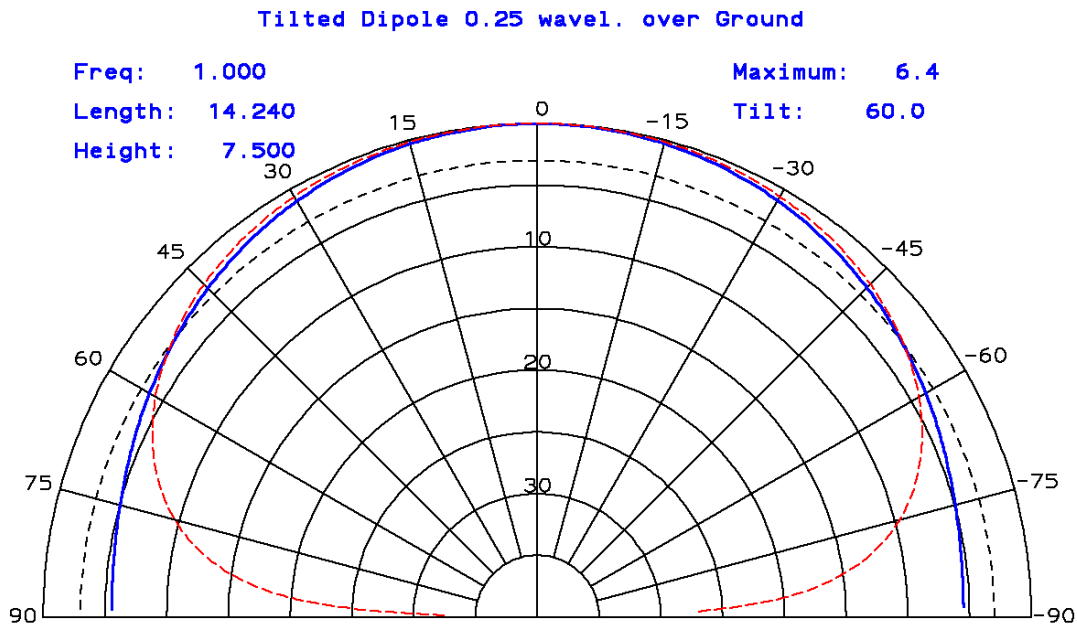


Figure 3 Tilted Dipole over Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed) units cm and Frequency 1 GHz Height = 0.25λ Tilt = 60°

Raising the dipole higher than $\lambda/4$ above ground causes a broadside pattern dip and widens the *H*-plane beam as shown in Figure 4 of a horizontal dipole 0.375λ over a ground plane.

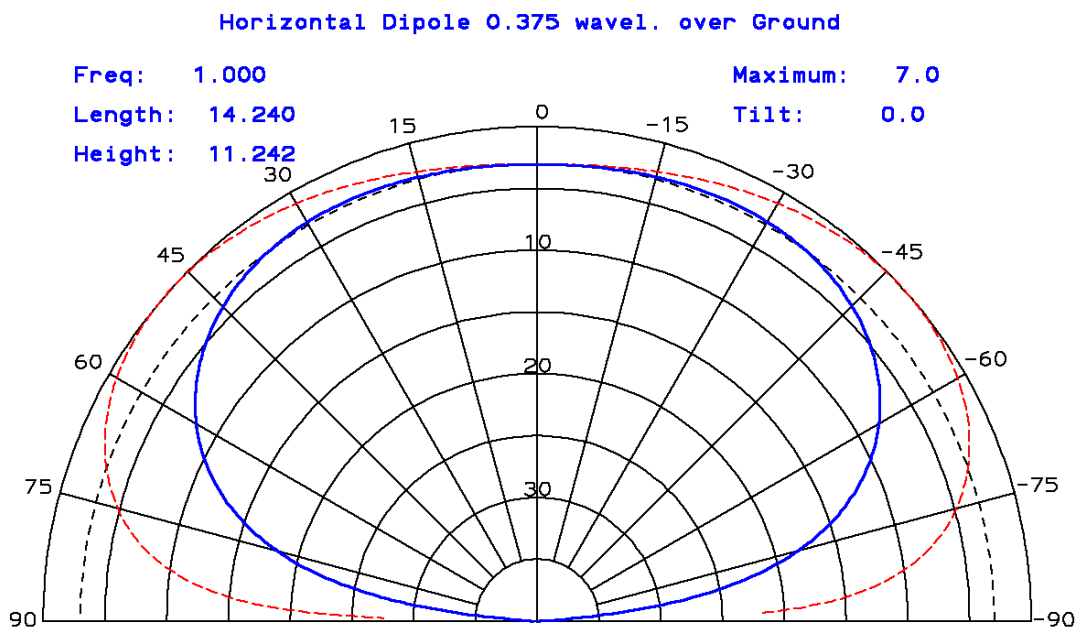


Figure 4 Horizontal Dipole located 0.375λ above Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed)

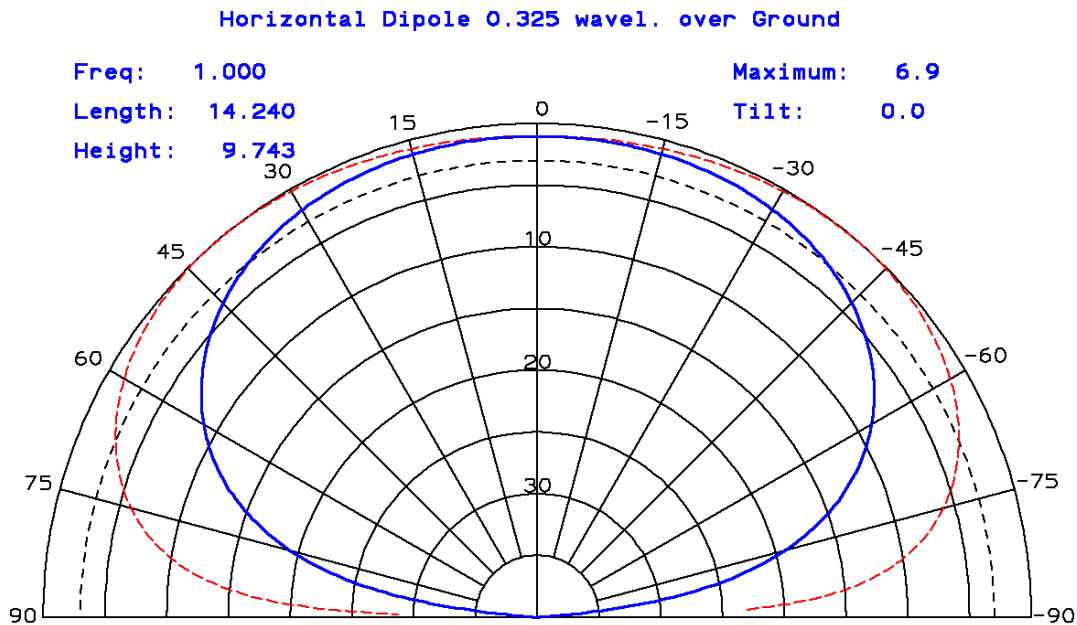


Figure 5 Horizontal Dipole located 0.325λ above Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed)

Tilting the dipole reduces its effective height and reduces the dip at broadside when located greater than $\lambda/4$ over ground. Consider Figure 5 where the horizontal dipole is 0.325λ over ground. When the dipole is tilted, the 1 dB dip at broadside for the horizontal dipole is eliminated in Figure 6 for tilt equal 35° .

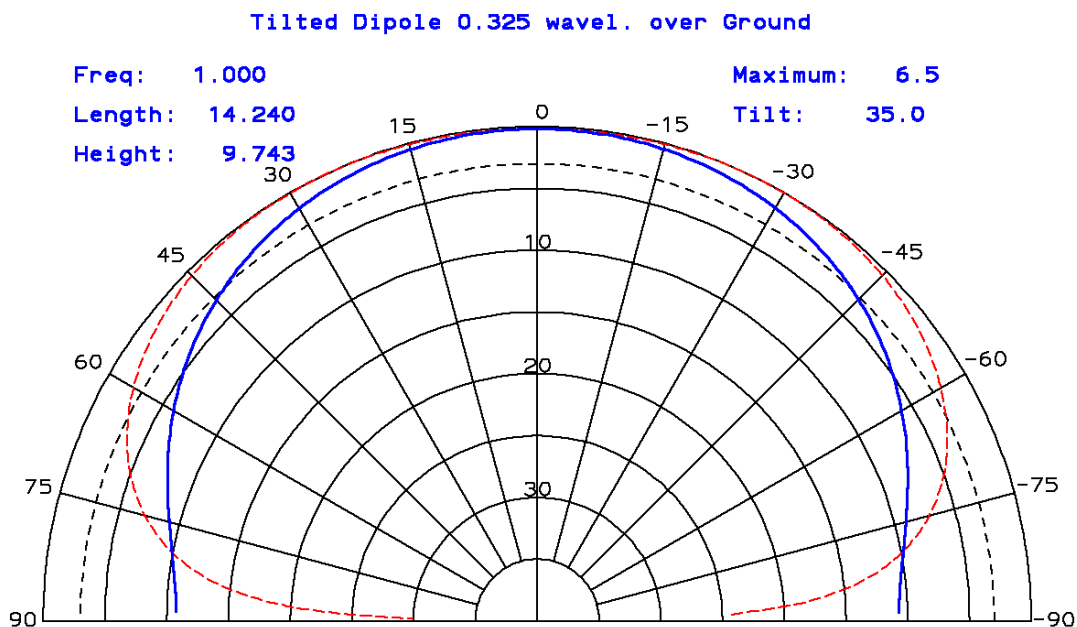


Figure 6 Tilted Dipole located 0.325λ above Ground Plane *E*-plane Blue (solid) and *H*-plane Red (dashed) units cm and Frequency 1 GHz Tilt = 35°