Field Strength vs. Radiated Power

1. Explanation of terms

G: antenna gain [dB]

d: distance from antenna [m]

ERP: effective radiated power [W]

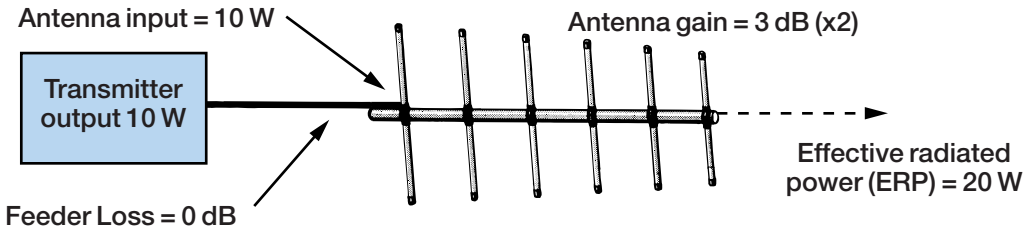
e: electric field strength [V/m]

2. ERP – Effective Radiated Power:

The effective radiated power represents the power that you would have to put into an antenna in order to obtain the same field strength. An antenna with a gain of 3 dB concentrates the radiated power in a given direction so that the power density in this direction is 3 dB higher than it would have been using an dipole antenna. As a power increase of 3 dB is equal to the power being doubled, the effective radiated power for a 3 dB antenna is two times the power input to the antenna.
Effective radiated power vs. antenna gain and input power is given in below scheme.

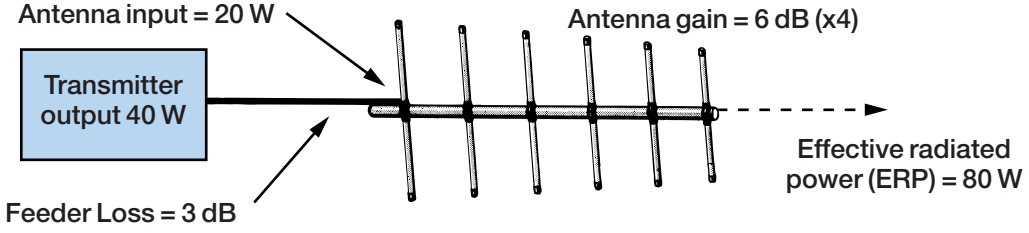
ERP	GAIN (dB)						
Power Input Factor	**0 (1)**	**3 (2)**	**6 (4)**	**10 (10)**	**13 (20)**	**16 (40)**	**20 (100)**
1 W	1	2	4	10	20	40	100
10 W	10	20	40	100	200	400	1000
100 W	100	200	400	1000	2000	4000	10000

Example 1



All of the power leaving the transmitter arrives at the antenna input (10 W). This antenna has a gain of 3 dB (x2) so, the effective radiated power will be 20 W (in the direction of maximum radiation).

Example 2



Due to feeder loss, only half of the power leaving the transmitter arrives at the antenna input (20 W). This antenna has a gain of 6 dB (x4) so, the effective radiated power will be 80 W (in the direction of maximum radiation).

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3. Field strength vs. ERP in Volt per metre (V/m)

ERP	Distance (d) from antenna										
(watt)	2 m	4 m	6 m	8 m	10 m	15 m	20 m	40 m	60 m	100 m	200 m
1	3.5	1.8	1.2	0.9	0.7	0.5	0.4	0.18	0.12	0.07	0.04
2	5.0	2.5	1.7	1.2	1.0	0.7	0.5	0.25	0.17	0.10	0.05
4	7.0	3.5	2.3	1.8	1.4	0.9	0.7	0.35	0.23	0.14	0.07
6	8.6	4.3	2.9	2.1	1.7	1.1	0.9	0.43	0.29	0.17	0.09
8	9.9	5.0	3.3	2.5	2.0	1.3	1.0	0.50	0.33	0.20	0.10
10	11.1	5.5	3.7	2.8	2.2	1.5	1.1	0.55	0.37.	0.22	0.11
15	13.6	6.8	4.5	3.4	2.7	1.8	1.4	0.68	0.45	0.27	0.14
20	15.7	7.8	5.2	3.9	3.1	2.1	1.6	0.78	0.52	0.31	0.16
25	17.6	8.8	5.9	4.4	3.5	2.3	1.8	0.88	0.59	0.35	0.18
30	19.2	9.6	6.4	4.8	3.8	2.6	1.9	0.96	0.64	0.38	0.19
35	20.8	10.4	6.9	5.2	4.2	2.8	2.1	1.04	0.69	0.42	0.21
40	22.2	11.1	7.4	5.5	4.4	3.0	2.2	1.11	0.74	0.44	0.22
45	23.5	11.8	7.8	5.9	4.7	3.1	2.4	1.18	0.78	0.47	0.24
50	24.8	12.4	8.3	6.2	5.0	3.3	2.5	1.24	0.83	0.50	0.25
60	27.2	13.6	9.1	6.8	5.4	3.6	2.7	1.36	0.91	0.54	0.27
70	29.4	14.7	9.8	7.3	5.9	3.9	2.9	1.47	0.98	0.59	0.29
80	31.4	15.7	10.5	7.8	6.3	4.2	3.1	1.57	1.05	0.63	0.31
90	33.3	16.6	11.1	8.3	6.7	4.4	3.3	1.66	1.11	0.67	0.33
100	35.1	17.6	11.7	8.8	7.0	4.7	3.5	1.76	1.17	0.70	0.35
200	49.6	24.8	16.5	12.4	9.9	6.6	5.0	2.48	1.65	0.99	0.50
400	70.2	35.1	23.4	17.6	14.0	9.4	7.0	3.51	2.34	1.40	0.70
600	86.0	43.0	28.7	21.5	17.2	11.5	8.6	4.30	2.87	1.72	0.86
800	99.3	49.6	33.1	24.8	19.9	13.2	9.9	4.96	3.31	1.99	0.99
1000	111.0	55.5	37.0	27.7	22.2	14.8	11.1	5.55	3.70	2.22	1.11
2000	157.0	78.5	52.3	39.2	31.4	20.9	15.7	7.85	5.23	3.14	1.57
4000	222.0	111.0	74.0	55.5	44.4	29.6	22.2	11.10	7.40	4.44	2.22

Field Strength

The above table is based on a formula that gives an approximate guide to local field strength. This is useful when dealing with local electromagnetic compatibility (EMC) problems.

Note: ERP is Effective Radiated Power

Field strength (e)
Volt per metre (V/m)

$$e = \frac{7.02\sqrt{ERP}}{d}$$

At a distance (d)
Measured in meters

$$d = \frac{7.02\sqrt{ERP}}{e}$$

Source radiating (ERP)
Measured in watt

$$ERP = \left(\frac{ed}{7.02}\right)^2$$