USEFUL FORMULA AND DEFINITIONS **AP120**

Calculating RF Power at a Distance from a Transmitter

To calculate the RF power Pr and Voltage V (into 50ohms) available at a distance d from a transmitter which is radiating a power Pt from an isotropic antenna with a unity gain (0dBi)

$$Pr = \frac{Pt\ \lambda^2}{(4\ \pi\ d)^2} \quad \text{Watts}$$

Were $\lambda = c / f$ metres

λ = the wave length at frequency f
c = the velocity of light ($300 * 10^6$) m/sec

For a transmitter operating on 458.525MHz with a ERP of 0.5W

$$= \frac{300 * 10^6}{458.525 * 10^6}$$

$$= 0.654 \text{ meters}$$

$$Pr = \frac{0.5 * 0.654^2}{157.9 * d^2}$$

$$= \frac{0.00135}{d^2} \quad \text{Watts}$$

The field strength in Volts can calculated from Ohms Law:

$$\text{Power} \quad Pr = \frac{V^2}{R} \quad \text{Volts}$$

$$V = \sqrt{(R * Pr)} \quad \text{Volts}$$

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If the terminating impedance = 50ohms

$$V = \frac{\sqrt{(50 * 0.00135)}}{d} \text{ Volts}$$

$$= \frac{0.259}{d} \text{ Volts}$$

An isotropic antenna radiates power with equal intensity in all directions. However a dipole antenna radiates with a toridiale pattern like a ring doughnut, concentrating the power mainly at right angles with zero radiation at the ends. Therefore the maximum field is greater than it would be for an isotropic antenna fed with the same power.

A half wave dipole has a maximum gain of 2.15dB relative to isotropic.

Definitions

dB A dB is the logarithmic value of the ratio of the output power to the input power:

= 10 Log (Pout/Pin)
= 20 Log (Vout/Vin) if the impedances are the same

dBd Ratio of the antenna gain against a unity gain dipole.

dBi Ratio of the antenna gain against an ideal isotropic antenna..
For a unity gain dipole dBi = dBd - 2.15dB

dBm The logarithmic ration of power relative 1mW in 50 ohms
0dBm = 1mW in 50 ohms

dBW The logarithmic ration of power relative 1W in 50 ohms
0dBW = 1W in 50 ohms
0dBW = 30dBm

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Power Conversion Table

The tables are based on a 50 ohm terminating impedance

dBuV	Voltage	dBm	Power	
0	1.00uV	-107	20.00fW	
10	3.16uV	-97	200.00fW	
20	10.00uV	-87	2.00pW	
30	31.60uV	-77	20.00pW	
40	100.00uV	-67	200.00pW	
50	316.20uV	-57	2.00nW	EMC Test Limit
60	1.00mV	-47	20.00nW	
70	3.16mV	-37	200.00nW	
80	10.00mV	-27	2.00uW	
90	31.62mV	-17	20.00uW	
101	112.20mV	-6	250.00uW	MPT1340
107	223.90mV	0	1.00mW	MPT1344 MPT1349
114	501.20mV	7	5.00mW	ETSI300-220 MPT1328
117	707.90mV	10	10.00mW	ETSI300-220
121	1.12V	14	25.00mW	ETSI300-220
127	2.24V	20	100.00mW	ETSI300-328
134	5.01V	27	500.00mW	ETSI300-220 MPT1329
137	7.08V	30	1.00W	MPT1349
140	10.00V	33	2.00W	MPT1349

Frequency Bands

3KHz	to 300KHz	LF	Low Frequency
300KHz	to 3Mz	HF	High Frequency
3MHz	to 300MHz	VHF	Very High Frequency
300MHz	to 3Ghz	UHF	Ultra High Frequency

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