EMC Related Formulae

Log↔Linear Voltage

dBμV to Volts	$V = 10^{((dBmV - 120)/20)}$
Volts to dBμV	$dBmV = 20\log(V) + 120$
dBV to Volts	$V = 10^{(dBV/20)}$
Volts to dBV	$dBV = 20\log(V)$
dBV to dBμV	$dBmV = dBV + 120$
dBμV to dBV	$dBV = dBmV - 120$

Log↔Linear Power

dBm to Watts	$W = 10^{((dBm - 30)/10)}$
Watts to dBm	$dBm = 10\log(W) + 30$
dBW to Watts	$W = 10^{(dBW/10)}$
Watts to dBW	$dBw = 10\log(W)$
dBW to dBm	$dBm = dBW + 30$
dBm to dBW	$dBW = dBm - 30$

Log↔Linear Current

dBuA to uA	$mA = 10^{(dBmA/20)}$
uA to dBuA	$dBmA = 20\log(mA)$
dBA to A	$A = 10^{(dBA/20)}$
A to dBA	$dBA = 20\log(A)$
dBuA to dBA	$dBA = dBmA - 120$
dBA to dBuA	$dBmA = dBA + 120$

Log↔Linear Impedance

dB(ohms) to ohms	$Z = 10^{(dB(ohms)/20)}$
ohms to dB(ohms)	$dB(ohms) = 20\log(Z)$

Term Conversion

dBm to dBuV	$dBmv = 90 + 10\log(Z) + dBm$	
dBuV to dBm	$dBm = dBmV - 90 - 10\log(Z)$	
dBuA to dBm	$dBm = dBmA + 10\log(Z) - 90$	
dBm to dBuA	$dBmA = dBm - 10\log(Z) + 90$	
dBuA to dBuV	$dBmV = dBmA + 20\log(Z)$	
dBuV to dBuA	$dBmA = dBmV - 20\log(Z)$	
Volts to Amps & Watts	$A = \frac{V}{Z}$	$W = \frac{V^2}{Z}$
Amps to Volts & Watts	$V = A * Z$	$W = A^2 * Z$
Watts to Volts & Amps	$V = \sqrt{W * Z}$	$A = \sqrt{\frac{W}{Z}}$

RF related, Field Strength & Power Density

dBuV/m to V/m	$V/m = 10^{(((dBmV/m) - 120)/20)}$
V/m to dBuV/m	$dBmV/m = 20\log(V/m) + 120$
dBuv/m to dBmW/m2	$dBm/m^2 = dBmV/m - 115.8$
dBmW/m2 to dBuV/m	$dBmV/m = dBm/m^2 + 115.8$
dBuV/m to dBuA/m	$dBmA/m = dBmV/m - 51.5$
dBuA/m to dBuV/m	$dBmV/m = dBmA/m + 51.5$
dBuA/m to dBpT	$dBpT = dBmA/m + 2$
dBpT to dBuA/m	$dBmA/m = dBpT - 2$
W/m2 to V/m	$V/m = \sqrt{(W/m^2) * 377}$
V/m to W/m2	$W/m^2 = \frac{(V/m)^2}{377}$
wound coil Flux Density	$mT = \frac{4p\,(turns)(amps)}{20(radius, m)}$
uT to A/m	$A/m = \frac{mT}{1.25}$
A/m to uT	$mT = 1.25 * (A/m)$

Antenna (Far Field)

Gain, dBi to numeric

$$Gain_{numeric} = 10^{(dBi/10)}$$

Gain, numeric to dBi

$$dBi = 10\log(Gain_{numeric})$$

Gain, dBi to Antenna Factor

$$AF = 20\log(MHz) - dBi - 29.79$$

Antenna Factor to gain in dBi

$$dBi = 20\log(MHz) - AF - 29.79$$

Field Strength given Watts, Numeric Gain, Distance in meters

$$V/m = \frac{\sqrt{30 * watts * Gain_{numeric}}}{Meters}$$

Field Strength given Watts, dBi gain, Distance in meters

$$V/m = \frac{\sqrt{30 * watts * 10^{(dBi/10)}}}{Meters}$$

Transmit Power needed, given desired V/m, Antenna numeric gain, Distance in meters.

$$watts = \frac{(V/m * meters)^2}{30 * Gain_{numeric}}$$

Transmit Power needed, given V/m, Antenna dBi gain, Distance in meters

$$watts = \frac{(V/m * meters)^2}{30 * 10^{(dBi/10)}}$$

Amplitude Modulation

Peak power, given CW power and modulation %.(sine wave AM)

$$W_{peak} = W_{CW}\,(1 + (Mod\% * 0.01))^2$$

Average power, given CW power level and modulation % (sine wave AM)

$$W_{avg} = \frac{W_{cw} * (2 + (Mod\% * 0.01)^2)}{2}$$

Average power, given peak power and modulation %

$$W_{avg} = \frac{W_{peak} * (2 + (Mod\% * 0.01)^2)}{2 * (1 + (Mod\% * 0.01))^2}$$

Current Probe

dB(ohm) to Zt (transfer impedance)

$$Z_t = 10^{(dB(ohm)/20)}$$

Zt to dB(ohm)

$$dB(ohm) = 20\log(Z_t)$$

Conductance (Gt) in dB(s) to transfer impedance, (Zt) in dB(ohms)

$$Z_t = -G_t$$

Transfer Impedance in Zt (dB(ohms)), to Conductance in Gt (dB(s))

$$G_t = -Z_t$$

Power needed for BCI Probe (50Ω), given voltage level into 50Ω load (V) and Probe Insertion Loss I_L .

$$watts = 10^{((I_L + 10\log(V^2/50))/10)}$$

Watts needed for 150 Ohm EM Clamp

$$watts = 10^{((I_L + 10\log(V^2/150))/10)}$$

Conducted current level using current measuring probe given probe factor in dB(ohm) and probe terminal voltage in dBuv

$$dBmA = dBmV - dB(ohm)$$

Conducted current level, given probe factor in Zt (ohms) and terminal voltage in dBuv

$$dBmA = dBmV - 20\log(Z_t)$$

dB calculations

Compute db delta (volts) $dB = 20\log\left(\frac{V_1}{V_2}\right)$

Compute dB delta (amps) $dB = 20\log\left(\frac{A_1}{A_2}\right)$

Compute dB delta (watts) $dB = 10\log\left(\frac{W_1}{W_2}\right)$

compute new voltage w/ db delta

$$V_{new} = 10^{\left(\frac{(dB\Delta + 20\log(V_{given})}{20}\right)}$$

compute new wattage w/ db delta

$$W_{new} = 10^{\left(\frac{(dB\Delta + 10\log(W_{given})}{10}\right)}$$

VSWR/reflection coefficient/return loss

VSWR given Fwd/Rev Power

$$VSWR = \frac{1+\sqrt{\frac{P_{rev}}{P_{fwd}}}}{1-\sqrt{\frac{P_{rev}}{P_{fwd}}}}$$

VSWR given reflection coefficient

$$VSWR = \frac{1+r}{1-r}$$

Reflection coefficient, ρ, given Z1/Z2 ohms

$$r = \left|\frac{Z_1 - Z_2}{Z_1 + Z_2}\right|$$

Reflection coefficient, ρ, given fwd/rev power

$$r = \sqrt{\frac{P_{rev}}{P_{fwd}}}$$

Return Loss, given fwd/rev power

$$RL(dB) = 10\log\left(\frac{P_{fwd}}{P_{rev}}\right)$$

Return Loss, given VSWR

$$RL(dB) = -20\log\left(\frac{VSWR-1}{VSWR+1}\right)$$

Return Loss, given reflection coefficient

$$RL(dB) = -20\log(r)$$

Mismatch loss, given fwd/rev power

$$ML(dB) = 10\log\left(\frac{P_{fwd}}{P_{fwd} - P_{rev}}\right)$$

Mismatch loss, given reflection coefficient

$$ML(dB) = -10\log(1 - r^2)$$

Misc

Linear interpolation with log of freq

$$Value = \frac{Log(F_X / F_L)}{Log(F_U / F_L)} * (X_U - X_L) + X_L$$

where F_L = lower frequency
F_U = Upper frequency
X_L = Value at lower frequency
X_U = Value at upper frequency
F_X = Frequency of desired value

TEM Cell Power Needed

$$Watts = \frac{(V * Height * 0.5)^2}{Z}$$

where V = field strength in V/m
Z = TEM cell impedance in ohms