Power and Voltage Ratios Expressed in Decibels (dB's)

1 Bel = log(Power2 / Power1)

1 decibel = 1 dB = 0.1 Bel, hence 10 dB = 1 Bel

To express a Power Ratio in dB's, use dB = 10 log(Power2 / Power1)

Let Power2 =2 Power1
Power Ratio in dB's = 10 log(2 Power1 / Power1) = 10 log(2) = +3.01

Let Power2 = 0.5 Power1
Power Ratio in dB's = 10 log(0.5 Power1 / Power1) = 10 log(0.5) = -3.01
-3 dB is often expressed as "3 dB Down" which is the half power point (Power2 = 1/2 Power1)

Let Power2 = Power1
Power Ratio in dB's = 10 log(Power1 / Power1) = 10 log(1) 0
dB = 0 does not imply zero power but rather a power ratio of one-to-one
dB = 0 can be used as a zero reference; that is to say, set your reference level to a particular value and then use the dB scale to refer all other values to that reference level.

Examples: Reference Level = 400 watts.
200 watts = -3 dB
800 watts = +3 dB
400 watts = 0 dB
4000 watts = +l0 dB
40 watts = -l0 dB
650 watts = +2.1 dB
65 watts = -7.9 dB
l00 watts= -6 dB
2,500,000 watts = +38 dB

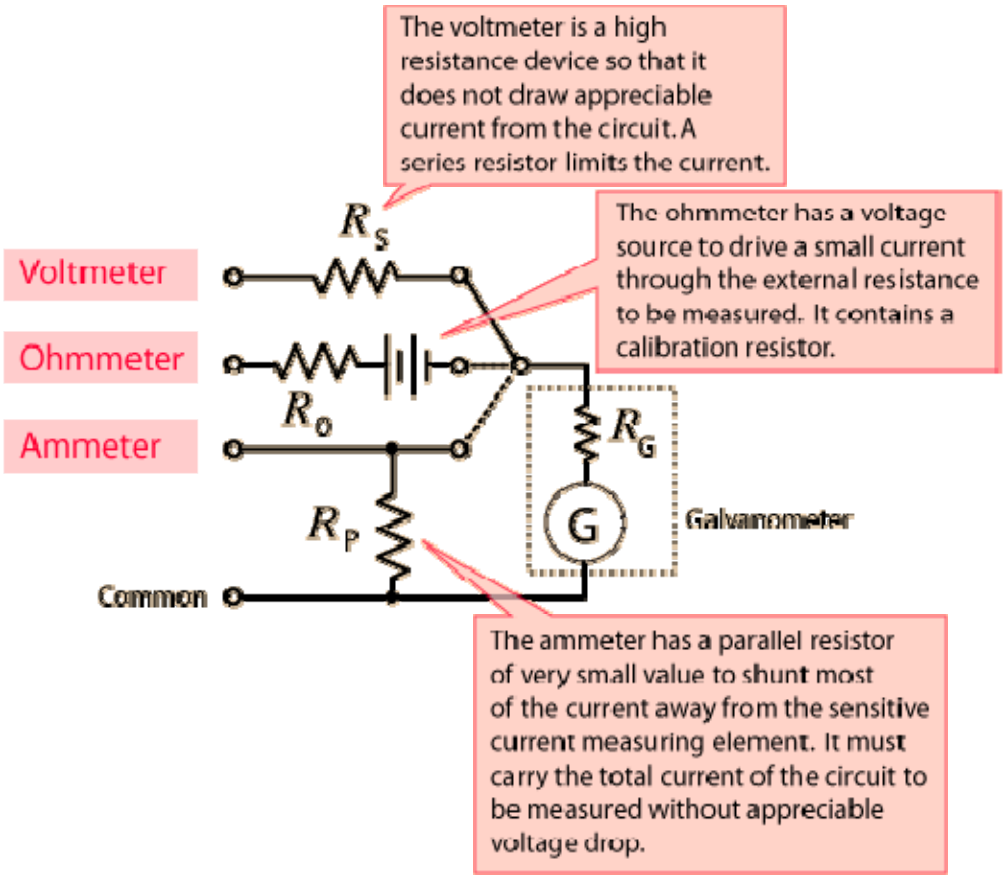
Note: A reference of 1 milliwatts is used for dBm's
1 milliwatts = 10 log(1 / 1) = 0 dBm
5 milliwatts = 10 log(5 / 1) = +7 dBm
500 milliwatts = +27 dBm
0.001 milliwatts = -30 dBm

For Voltage, Power = IE = (E/R)E = E^2/R

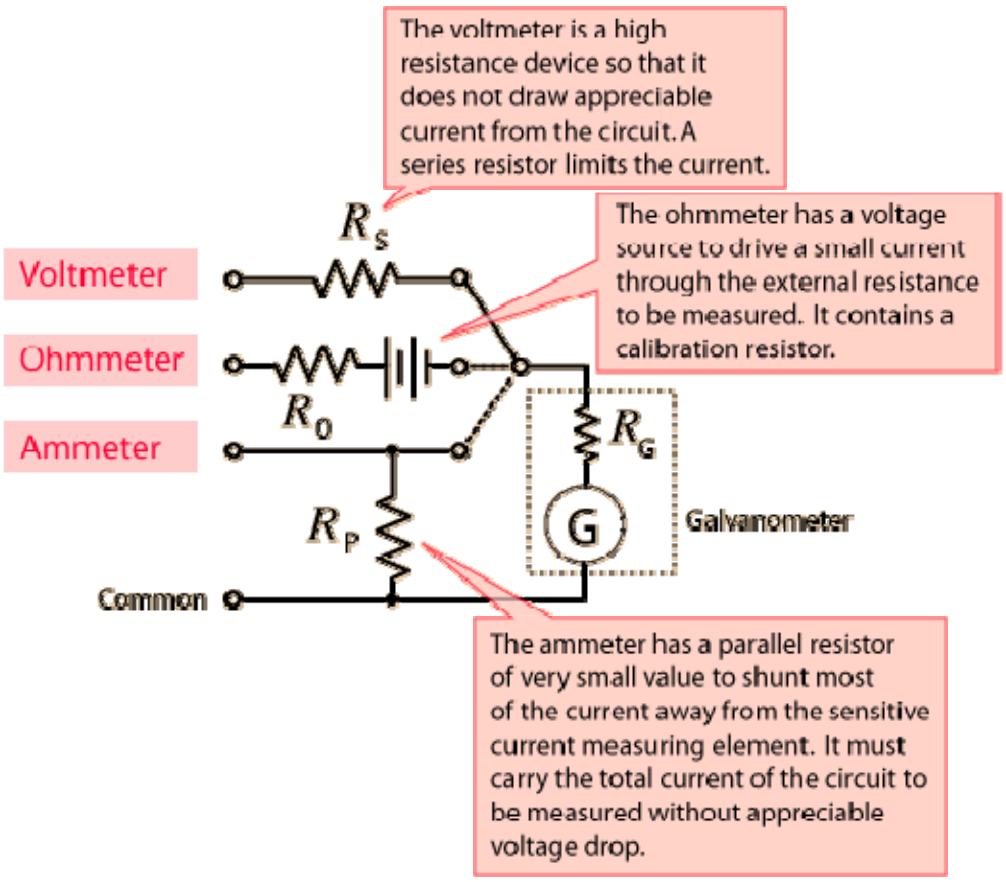
To express a Voltage Ratio in dB's, use dB = 10 log($Power_2$ / $Power_1$) = 10 log[(E_2^2/R) / E_1^2/R)]
10 log[(E_2^2/R) / E_1^2/R)] = 10 log(E_2^2 / E_1^2) = 20 log(E_2 / E_1)

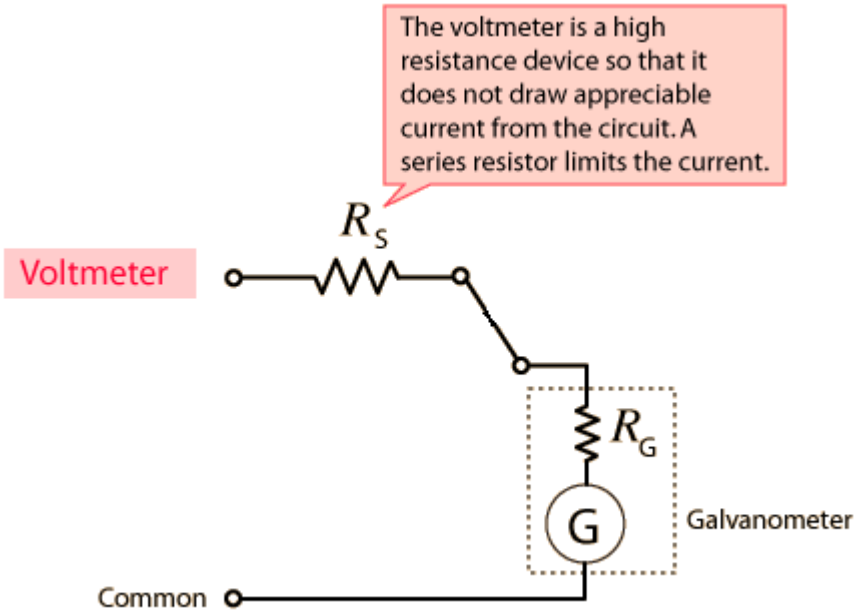
For Power Ratio dB = +3, 20 log(E_2 / E_1) = +3
For Power Ratio dB = -3, 20 log(E_2 / E_1) = -3
For Power Ratio db = 0, 20 log(E_2 / E_1) = -0.15 and E_2 / E_1 = 0.707 = SQRT(2) / 2

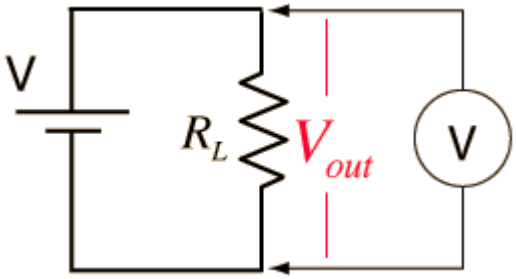
Galvanometer Based Multimeter
Voltmeter, Ammeter, Ohmmeter



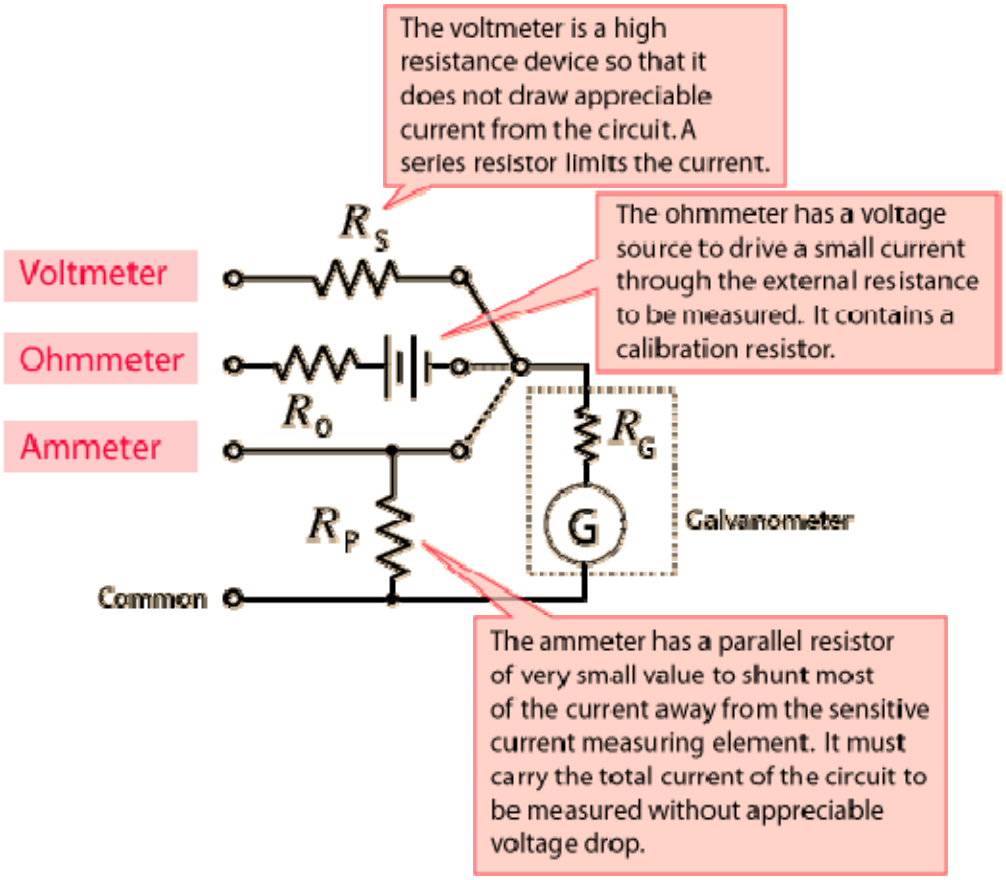
http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/galvan.html

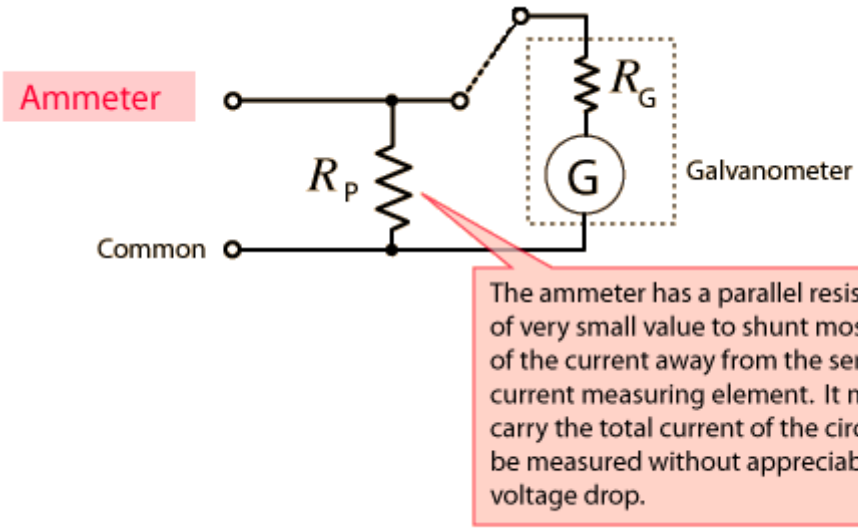


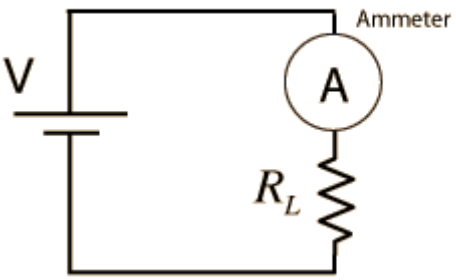




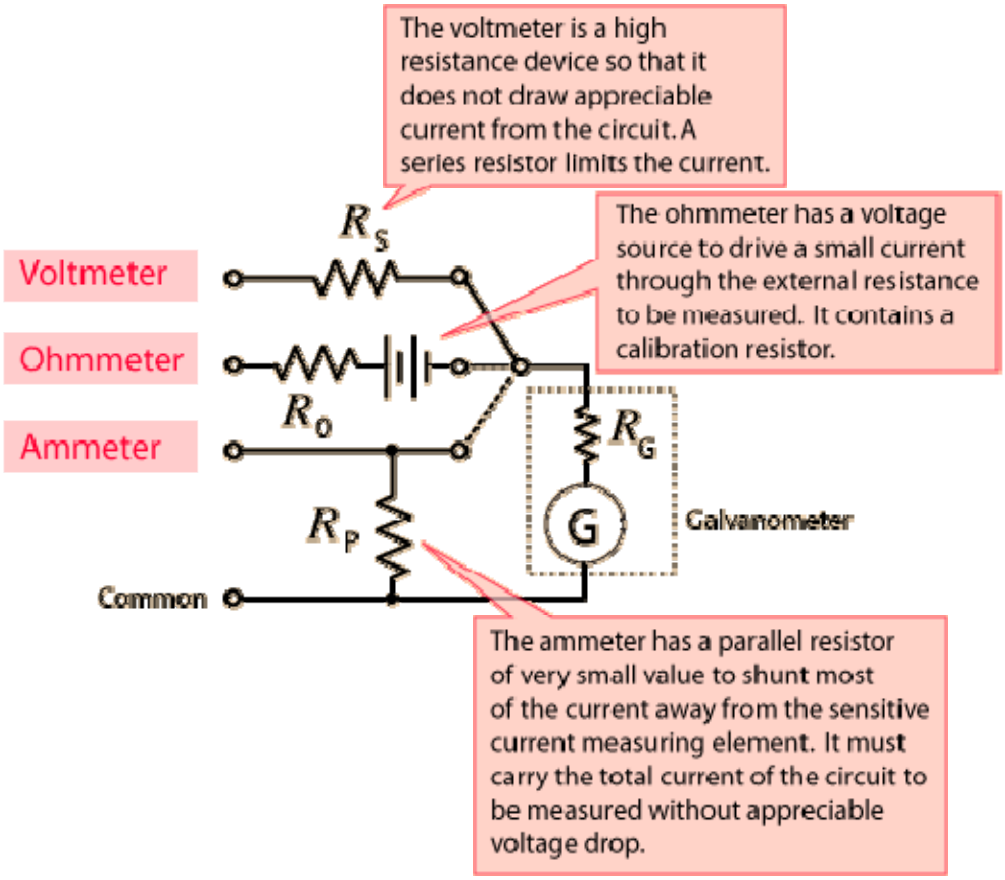
A voltmeter is connected in parallel with the circuit element (R_L) to measure voltage.

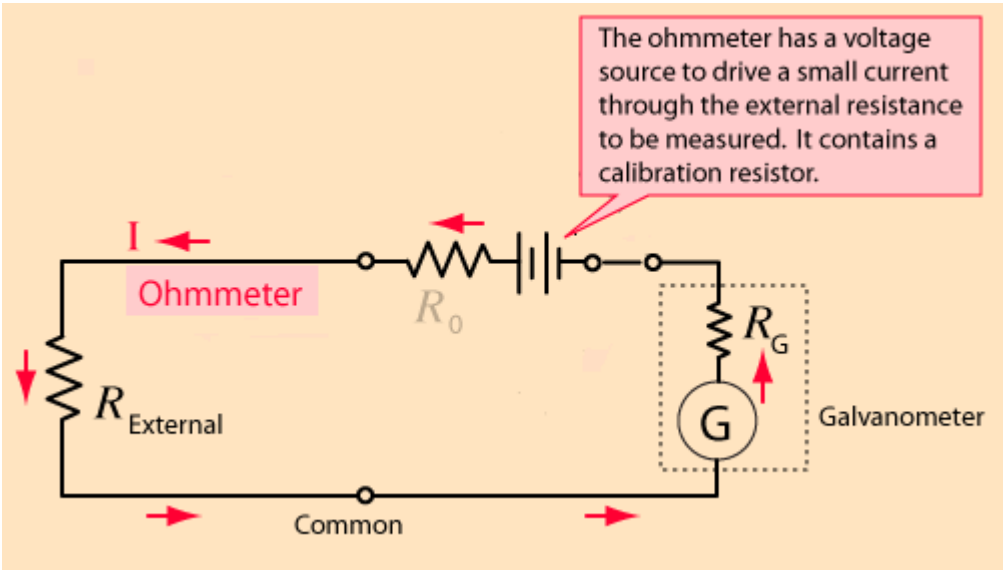






A ammeter is always connected in series with the circuit element (R_L) to measure current.



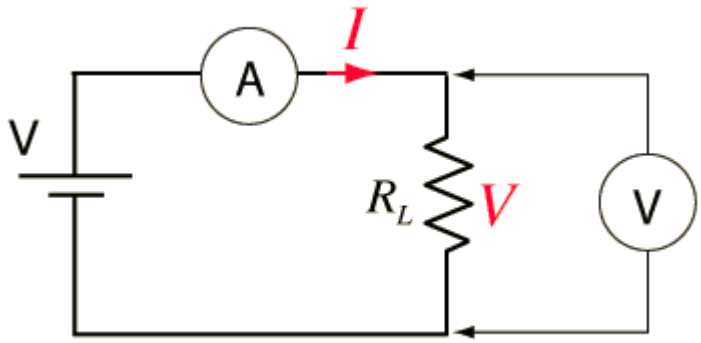


The circuit element (R_L) must be disconnect from the circuit in order to measure resistance with an ohmmeter.

In lieu of an *ohmmeter*,

an *ammeter* is placed in series with the circuit element of interest R_L and the current is noted;

and a *voltmeter* is connected in parallel with the circuit element R_L and the voltage is noted.



The Resistance R_L equal to $R_L = \frac{V}{I}$