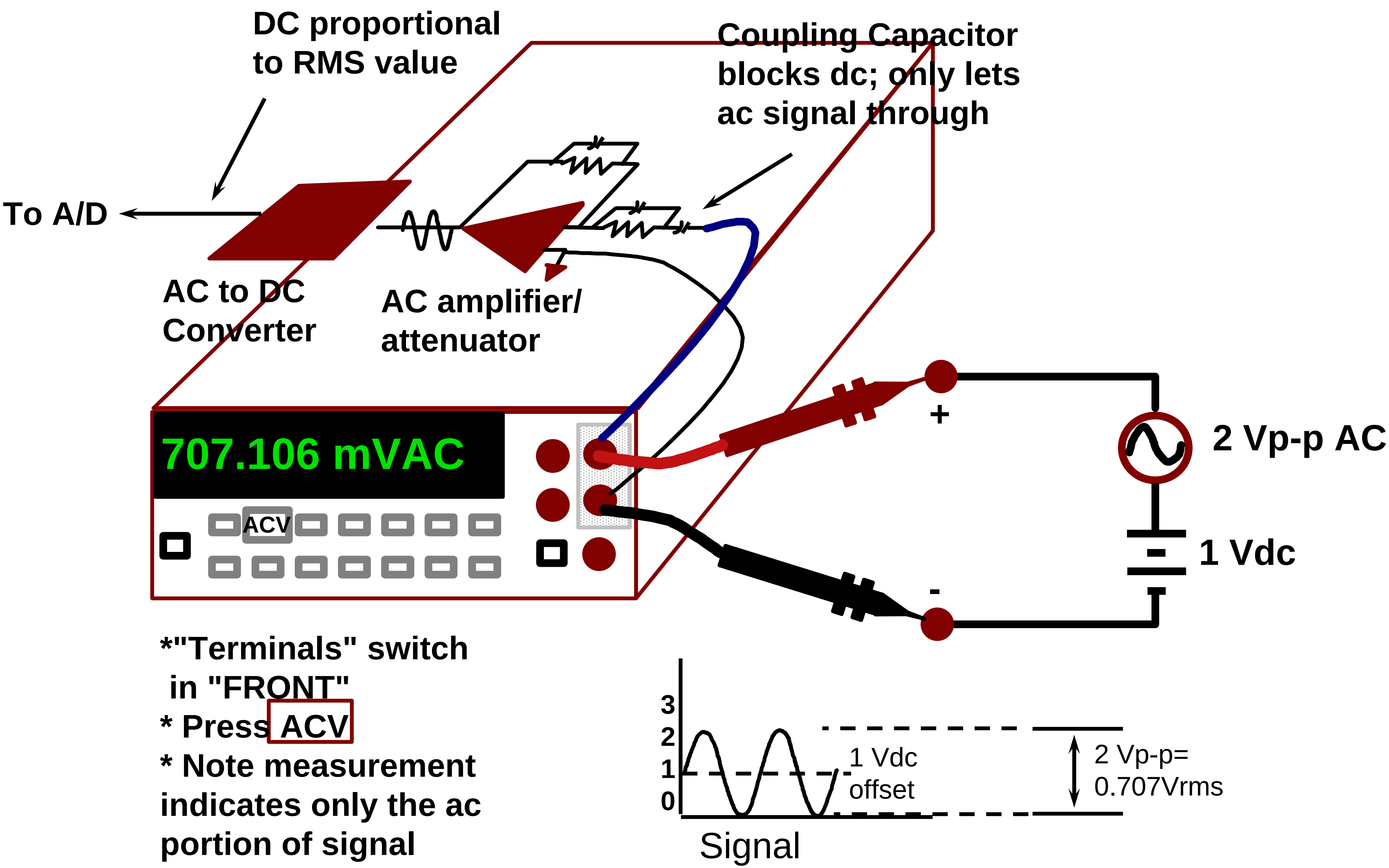
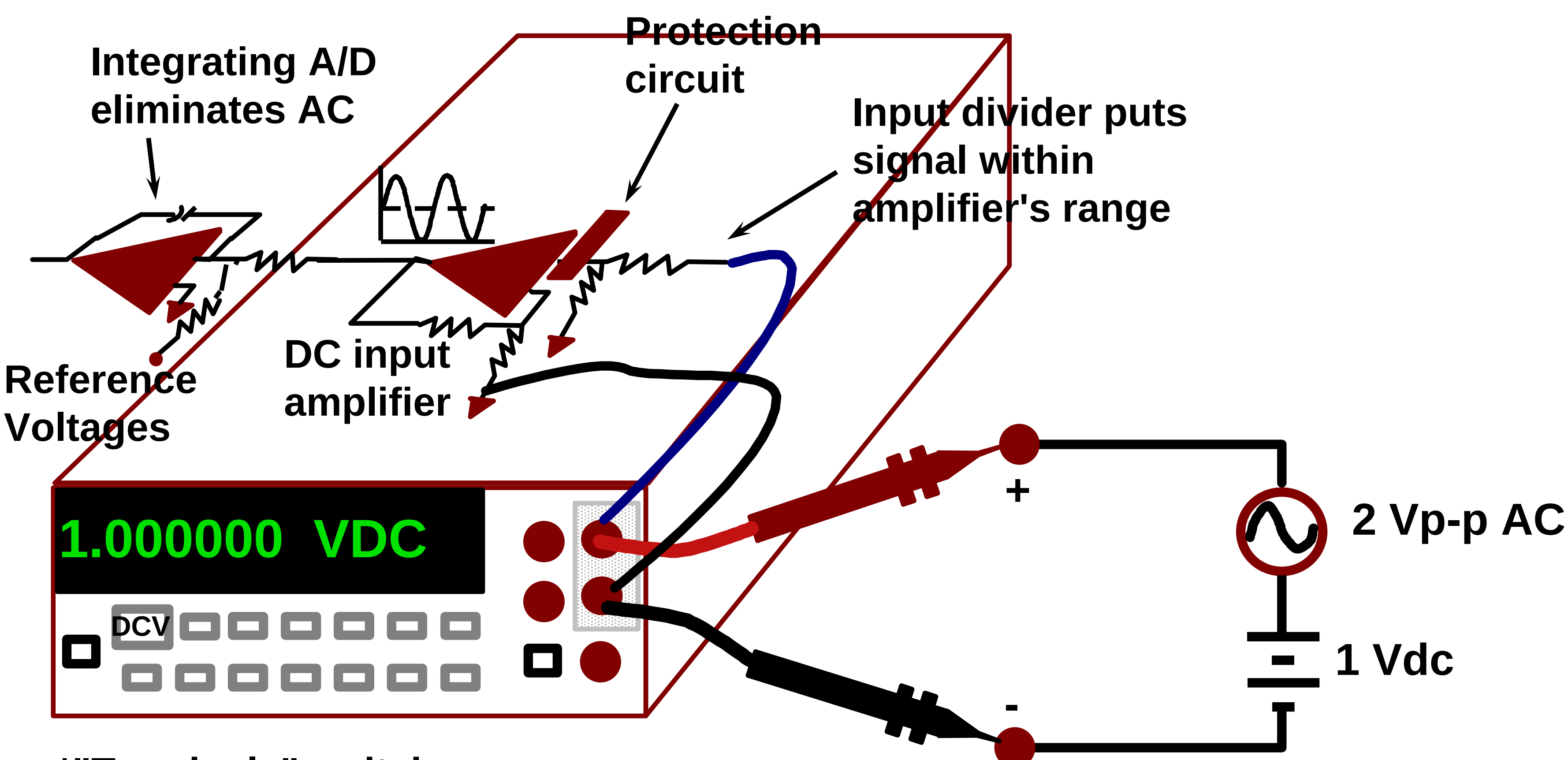
Measuring ACV

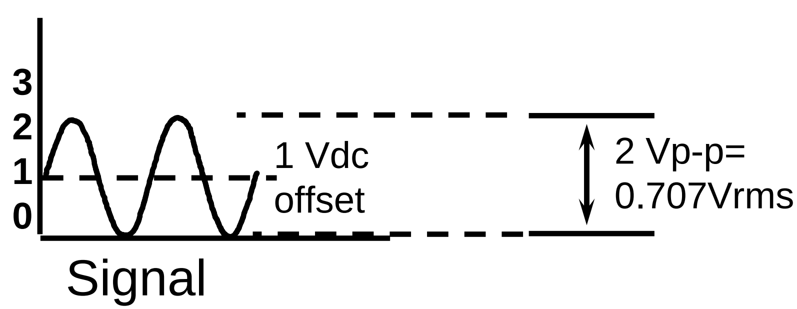


*"Terminals" switch in "FRONT"
* Press ACV
* Note measurement indicates only the ac portion of signal

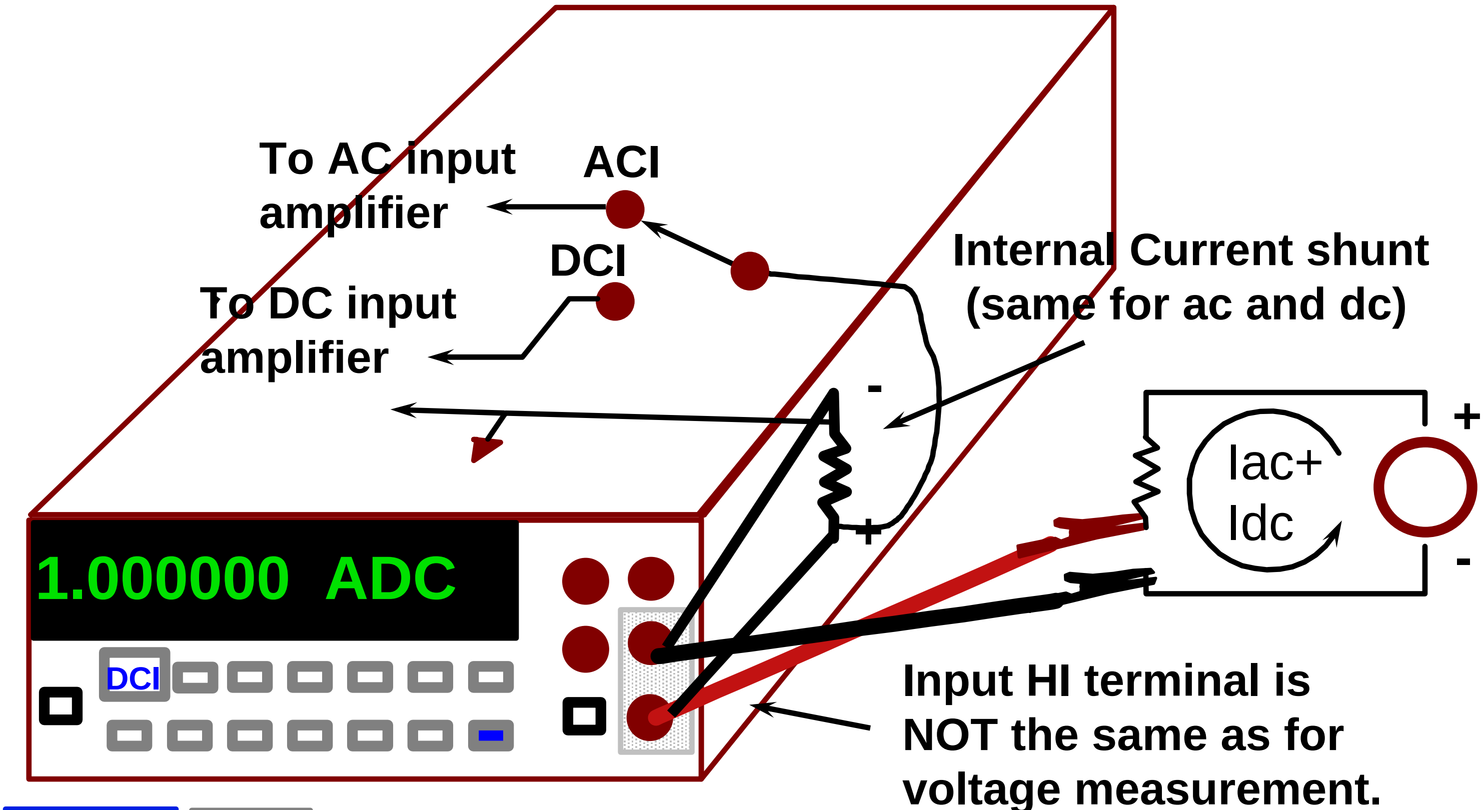
Measuring DCV



*"Terminals" switch
 in "FRONT"
* Press DCV
* Note measurement indicates only the dc portion of signal

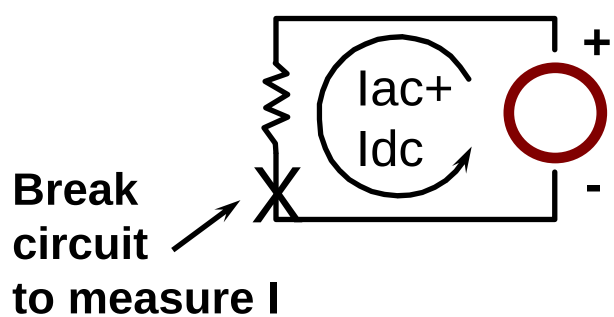


Measuring CURRENT



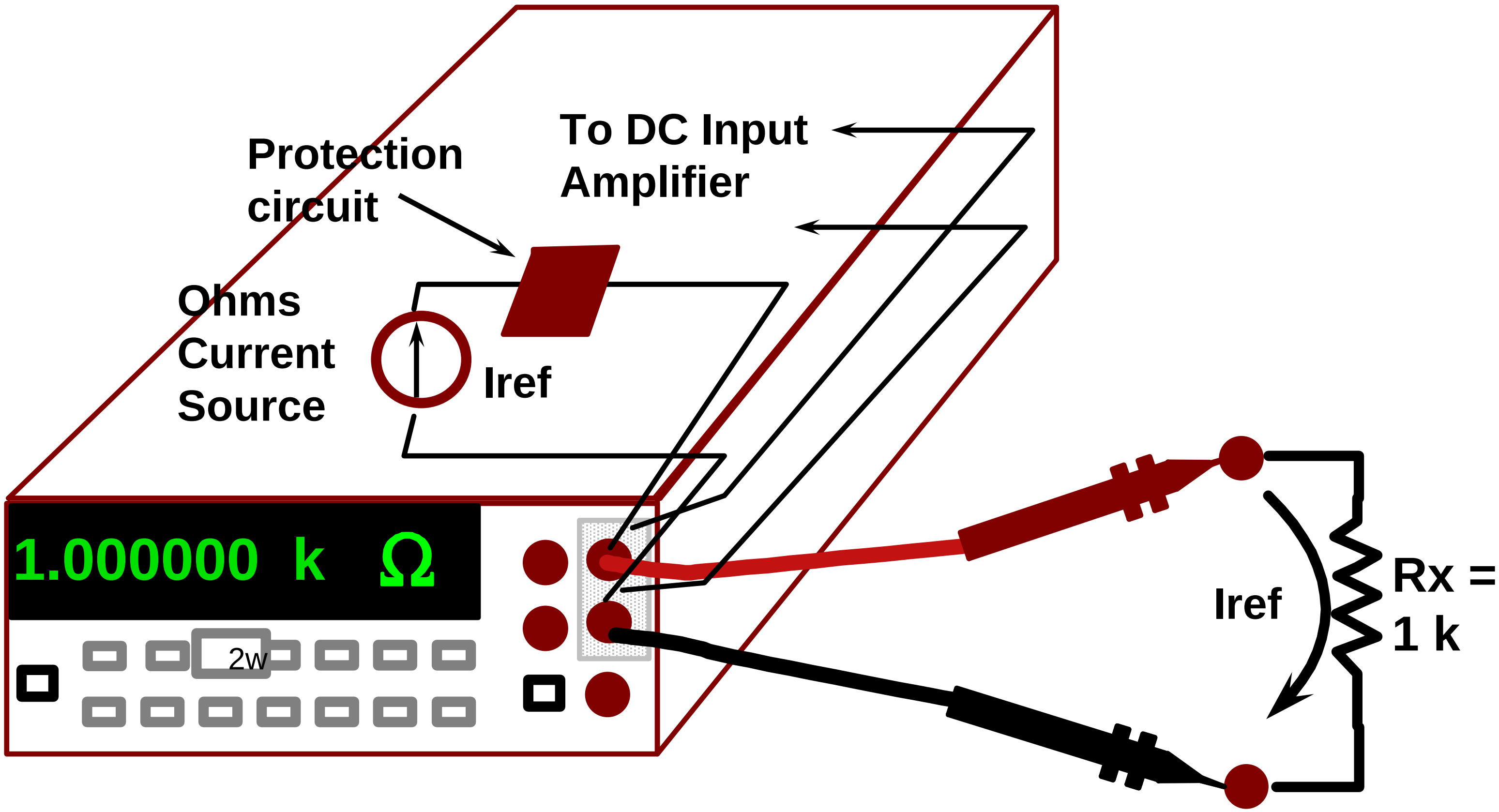
*** SHIFT** **DCV** = **Measure DCI**

*** SHIFT** **ACV** = **Measure ACI**



* Never hook current leads directly across a voltage source.

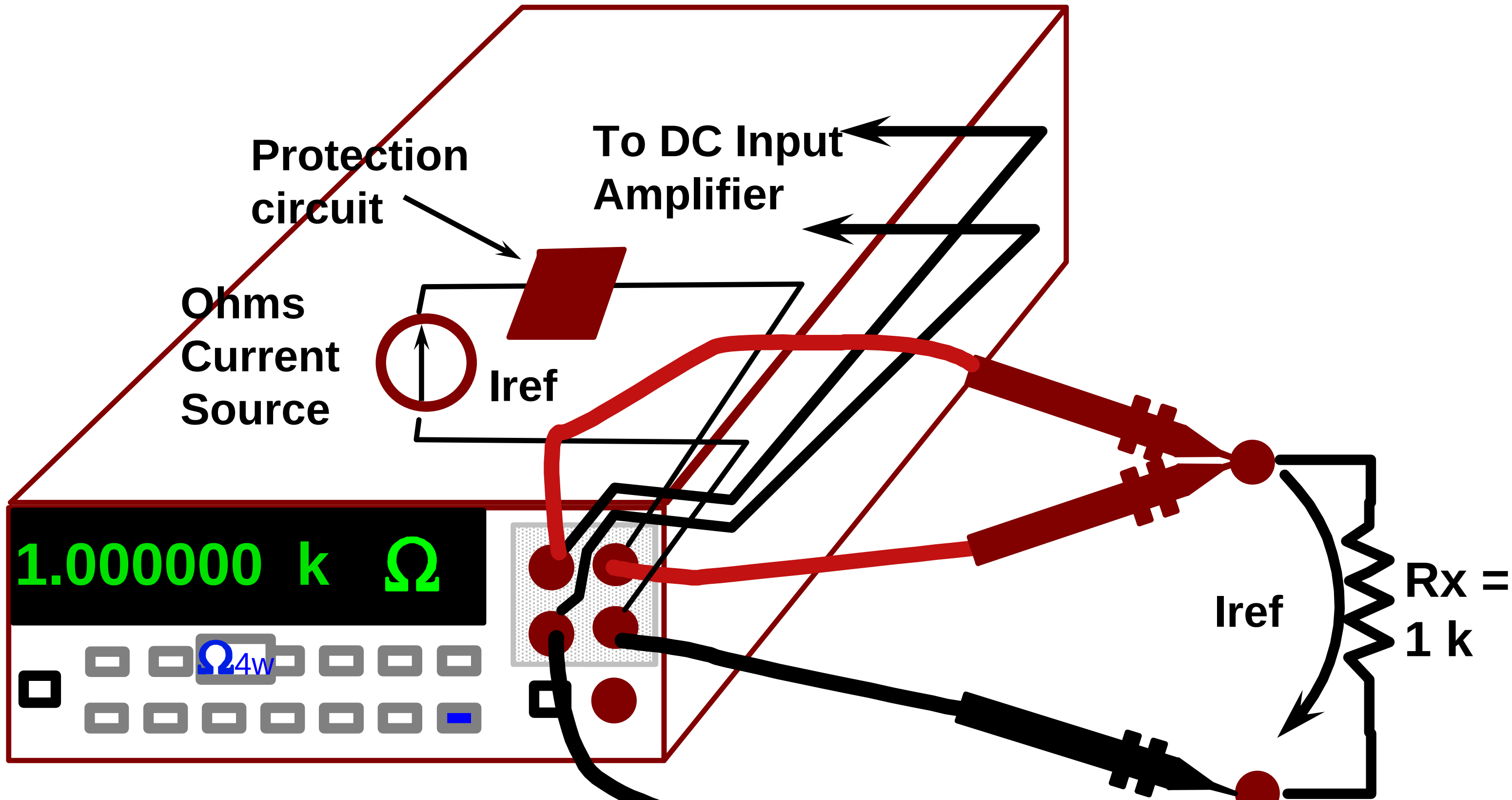
Measuring Resistance
Two-Wire Technique



*"Terminals" switch in "FRONT"
* Press 2W
* Since voltage is sensed at front terminals, measurement includes all lead resistance

* To eliminate the lead resistance:
* Short leads together
* Press Null
* Original value will now be subtracted from each reading

Measuring Resistance
Four-Wire Technique



* Turn off "Null"
*"Terminals" switch in "FRONT"
* Press 4W
* Voltage is now sensed directly at the resistor, so lead resistance is not a factor

* Because input impedance of DC Input Amplifier is so high, no current flows through sense leads, hence no lead resistance error

RMS: Root-Mean-Square

* RMS is a measure of a signal's average power. Instantaneous power delivered to a resistor is: $P = [v(t)]^2/R$. To get average power, integrate and divide by the period:

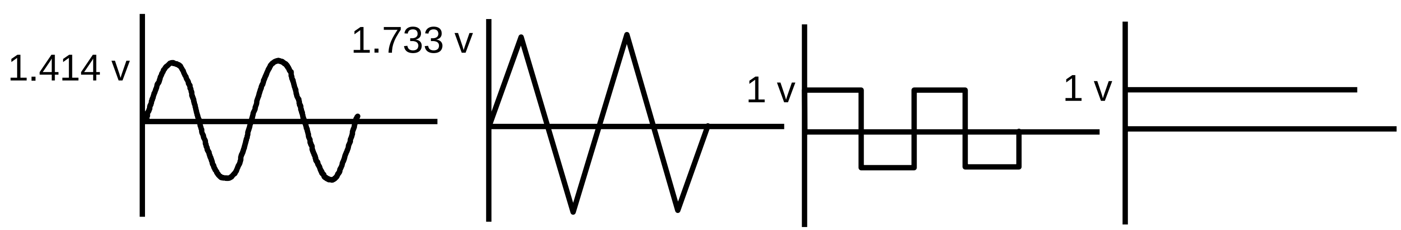
$$P_{avg} = \frac{1}{R}\left(\frac{1}{T}\int_{t_0}^{t_0+T}[v^2(t)]\,dt\right) = \frac{(V_{rms})^2}{R}$$

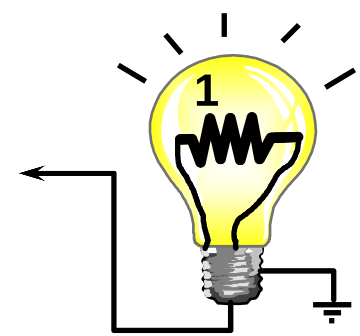
Solving for Vrms:

$$V_{rms} = \sqrt{\left(\frac{1}{T}\int_{t0}^{t0+T}[v^2(t)]\,dt\right)}$$

* An AC voltage with a given RMS value has the same heating (power) effect as a DC voltage with that same value.

* All the following voltage waveforms have the same RMS value, and should indicate 1.000 VAC on an rms meter:



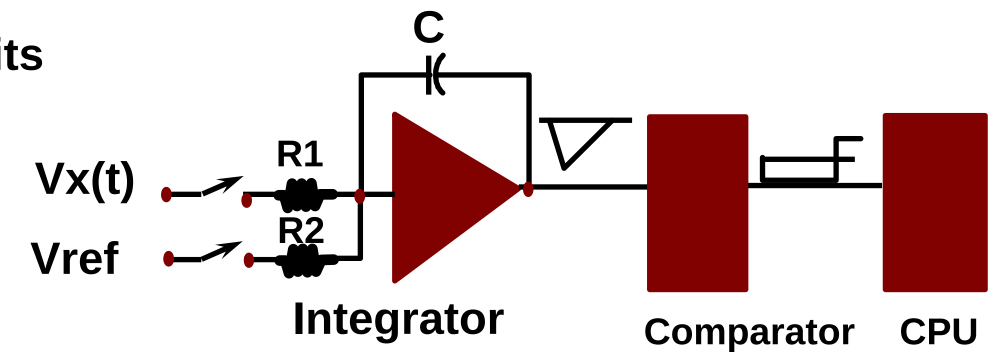


Waveform	Sine	Triangle	Square	DC
Vpeak	1.414	1.733	1	1
Vrms	1	1	1	1

All = 1 WATT

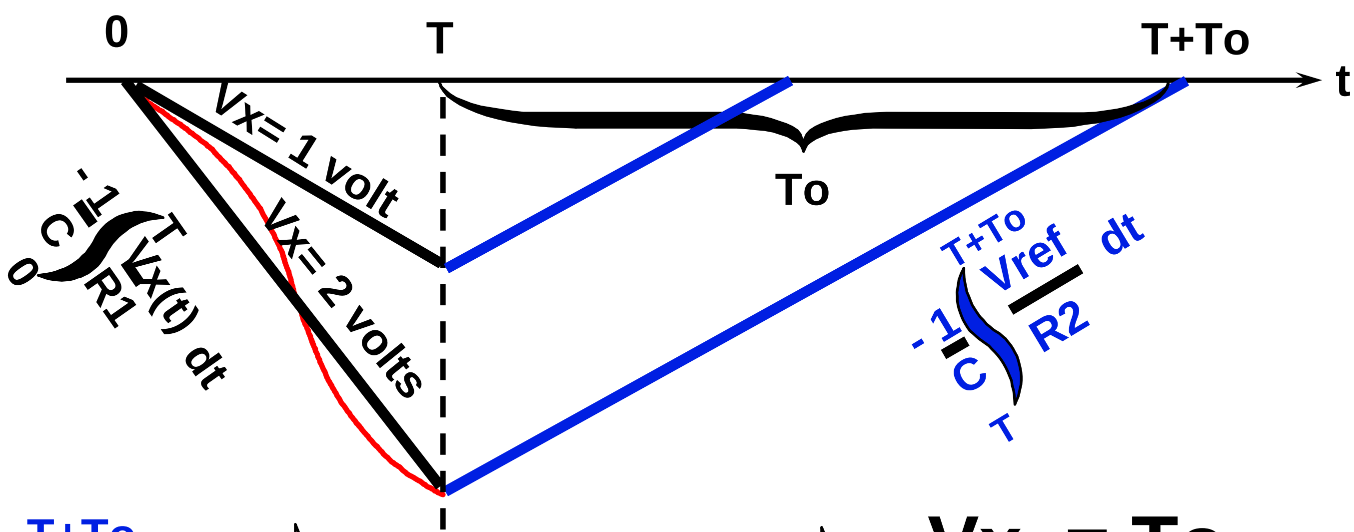
Integrating A/D

1) Converts voltage to time to digits
2) Integrator is a
line-frequency filter
3) Integrator is
a low-pass filter



Integrator:

$$V_{out} = -\frac{1}{C}\int_0^T i(t)\,dt$$



If R1=R2 $\int_0^T V_x\,dt = \int_T^{T+T_o} -V_{ref}\,dt$ ⇒ $T \cdot V_x = T_o \cdot (-V_{ref})$ ⇒

$$\frac{V_x}{-V_{ref}} = \frac{T_o}{T}$$

T is fixed at one cycle of 50 Hz or 60 Hz to eliminate line noise; Vref is fixed; R, C and Time are all ratioed, so accuracy is excellent.

The DIGITAL MULTIMETER

Hints for Accurate Measurements:

Measure as near full scale as possible

Measure a RATIO rather than an absolute value