

ELECTRICITY CONSUMPTION METER

How is the current measured?



Formulas To Consider



Real Power (P)

This is the power used by the device to produce electrical output. It is expressed in kW.

$$\text{Real Power} = \text{Voltage (V)} \times \text{Current (I)} \times \cos\Phi$$

Apparent Power (S)

It is defined as the product of the Root-Mean-Square (RMS) Voltage and the RMS Current. This can also be defined as the resultant of real and reactive power. It is expressed in kVA.

$$\text{Apparent Power} = \text{Voltage (V)} \times \text{Current (I)}$$

With the help of the formulas above, we can obtain:

Power Factor (pf)

The ratio of the real power to the apparent power in a circuit is called the power factor.

$$\text{Power Factor} = \text{Real Power} / \text{Apparent Power}$$

~ Default Power Factor (pf) value = 0.85 ~

ACS712 - CURRENT SENSOR

The ACS712 Current Sensor is a Hall Effect current sensor that accurately measures current when induced. The magnetic field around the AC wire is detected which gives the equivalent analog output voltage. The analog voltage output is then processed by the microcontroller to measure the current flow through the load.

CURRENT MEASUREMENT BY ACS712

The output from the ACS712 Current Sensor is an AC voltage wave. We have to calculate the "rms" current.

This can be done by:

1. Measuring the peak to peak voltage (V_{pp})
2. Dividing the peak to peak voltage (V_{pp}) by 2 to get peak voltage (V_p)
3. Multiplying it by 0.707 to get the "rms" voltage (V_{rms})
4. Then multiply the Sensitivity of the current sensor (ACS712) to get the "rms" current.



$$V_p = V_{pp}/2$$

$$V_{rms} = V_p \times 0.707$$

$$I_{rms} = V_{rms} \times 66$$

Power and Energy Calculation

Being a household user, the real power (kW) is our main concern. To calculate the real power we need to measure the "rms" voltage, "rms" current and power factor (pF).

$$\text{Real Power (W)} = V_{rms} \times I_{rms} \times Pf$$

$$V_{rms} = 230V \text{ (known)}$$

$$Pf = 0.85 \text{ (known)}$$

$$I_{rms} = \text{reading from the current sensor (unknown)}$$