

Things *That* Work!



Tested by Home Power

P3 INTERNATIONAL'S KILL A WATT WATT-HOUR METER

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Most *Home Power* readers are hip to the fact that the first step in designing a renewable energy system is a thorough evaluation of the electrical loads that the system will power. P3 International is now manufacturing a low-cost, watt-hour meter that will help you determine which of your appliances are keepers, and which ones ought to be relocated to your favorite recycling center.

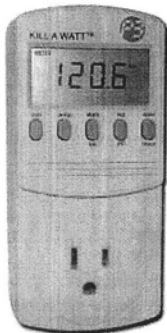
If you live off grid or are aiming to, every dollar spent on efficient appliances will save you roughly three to five dollars in PV system component costs. The exact figure depends on a number of variables, including the appliances involved, the system's geographic location, array shading, and other system design specifics.

If you live on the grid, your home is undoubtedly equipped with a utility KWH meter that measures the cumulative electrical energy consumed by all the appliances in your home. Each utility bill shows your home's monthly KWH energy use, and often breaks this figure down into average daily KWH use. But how do you find out how much energy individual appliances are using? Watt-hour meters let you do just that.

The power drawn by a given appliance (volts x amps) can be calculated using a digital multimeter. But an accurate measurement of the energy (volts x amps x time) that an appliance consumes requires a watt-hour meter. This is especially true for appliances that cycle on and off, such as refrigerators or pumps.

Several manufacturers make watt-hour meters for residential or office use. P3's Kill A Watt meter (model P4400) is new to this lineup. It's ETL listed for safety. At US\$49.95 (manufactured in Taiwan), this feature-packed meter comes in at a little over half the cost of the nearest priced competition. But how does it measure up?

Not for Use with (Some) Inverters! We received two Kill A Watt meters from C. Crane Company for testing. The meter packaging included the following sticker: "Not for use with inverters." I contacted P3 International, and spoke with an applications engineer about this warning. He said that P3 had not anticipated the use of the meter in



P4400 Tolerance Specs

Function	Normal	Maximum
RMS Voltage (Vrms)	0.2%	1.0%
RMS Current (Arms)	0.3%	1.0%
Watts (W)	0.5%	2.0%
Volt-amps (VA)	0.5%	2.0%
Frequency (Hz)	±0.1	±1.2
Power Factor (PF)	±0.01	±0.03
Kilowatt Hours (KWH)	0.5%	2.0%

conjunction with modified square wave inverters. The loss than ideal waveform of these inverters resulted in the failure of one of the unit's resistors.

We tested the meter on the grid, and on sine wave inverters manufactured by Exeltech, Statpower, and Xantrex. The Kill A Watt meter operated without problems on the waveforms of all these units. The P4400 has a six-month warranty that does cover failures resulting from use of the meter with modified square wave inverters. P3 informed me that the meter has been redesigned, and the new version of the meter will operate on modified-square waveforms. (But we hope this doesn't keep you from purchasing a sine wave inverter!)

Design Features

The meter is designed to be plugged directly into a 120 VAC, three-prong (grounded) electrical receptacle. The appliance being tested is in turn plugged into the receptacle on the front of the meter. In most cases, this arrangement works fine. But some receptacles are located behind the appliance (refrigerators are a prime example.) In this case, a short extension cord will allow you to place the meter in a more convenient location.

The Kill A Watt meter was designed from the ground up for its intended use. A custom designed, integrated circuit samples voltage and current 2,048 times per second. The meter uses an 8 bit CPU with a 12 bit analog-to-digital converter and an 8 channel multiplexer. The meter's electronics are housed in an attractive-looking, custom enclosure with a fairly large LCD display. The buttons for changing meter functions are easy to use and have a positive feel.

Product Specs

For the price, the P4400 meter is loaded with measurement capabilities. The meter measures AC volts, AC amps, watts, volt-amps, frequency, power factor, kilowatt-hours (up to 9,999 KWH), and elapsed time (up to 9,999 hours).

The table details the tolerance specs of the meter. Normal operating ranges are defined by the manufacturer as 90 to 125 VAC, and 0.2 to 15 amps. I checked these specifications with a Fluke 87 digital multimeter and a Fluke 43B AC power quality analyzer. Note that loads drawing 0.2 amps (23.4 watts at 117 VAC) or less are operating outside of the normal window. But the maximum inaccuracy of the P4400 is only two percent when measuring outside of its normal range. This is more than adequate for home or office use.

Current & Voltage Limits

The Kill A Watt meter has a maximum current rating of 15 amps. The P3 International applications engineer I spoke with stated that the meter would accurately measure loads up to 15 amps (at 120 VAC). If loads greater than 15 amps are powered via the meter, the unit's display will flash and a warning tone will sound. The P4400 can withstand a maximum current of 29 amps for about one second before an overcurrent protection fuse blows. (This fuse is not user serviceable.) Data for loads above 15 amps will not be accurate, so there's no reason to push it and operate the meter above this 15 amp threshold.

The meter has a specified upper voltage limit of 125 VAC. In some locations, grid voltage can be higher than this value either regularly or sporadically. The P3 engineer informed me that higher voltages only affected accuracy. The meter is in fact designed to withstand up to 250 VAC for one minute.

What's Missing?

The one feature I really missed on this watt-hour meter was a surge or peak power function. This data is important when specifying an appropriate inverter for a given combination of loads. A peak power function would be a great addition.

The meter's memory is volatile. If you unplug the unit or power is lost during measurement, the data will be lost. So remember to record your measurements before unplugging the unit. Also, the display is not illuminated. While this isn't a big deal, a backlit display would make the meter easier to use in some locations.

Nice Tool

P3 International's Kill A Watt meter will provide you with accurate appliance energy consumption data whether you buy electricity from a utility or make your own. At less than US\$50, this meter is an outstanding value. The information it provides will help you easily identify inefficient electrical appliances. In most cases, your energy savings will quickly recoup the cost of purchasing the meter, and allow you to save energy (and money) year after year.