How are you measuring that power consumption?

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Power and current consumption is an important topic for designs ranging from small, battery-powered devices to large motors, appliances, and industrial equipment. One of the many tasks that engineers have to do is analyze the likely consumption of various potential designs, to establish the locus of performance, price, and power tradeoffs.

For AC-line powered devices, it's not too difficult to measure power. You can get a rough answer with a unit such as the Kill A Watt from P3 International (here, $20 to $60, depending on model, see Figure), or go for a more sophisticated instrument that gives you more details of average, peak, real, and reactive power.

If you make your own power meter, you'll almost always use an isolated transducer for safety, based on some variation of a coil; for the active circuitry, I like analog RMS-to-DC converter ICs: they do one thing, they do it well, fast, inexpensively, and need little power themselves.

The situation is more challenging when measuring power consumption of smaller, battery-powered devices, where current can zoom over orders of magnitude in milliseconds, from a few microamps to milliamps to amps, and back. For example, how do you assess the power situation in an energy-harvesting data acquisitions system? To save power, many products have complicated power-saving states and sequences, with active, sleep, idle, and quiescent modes - and their various ICs usually
have their own state machine sequencing to minimize their individual power and energy use.

Of course, any good engineer will first run design simulations to get a sense of what overall power usage will be, as well as data on tradeoffs that can be made to reduce that consumption. But there comes a time when you have to get real and actually measure power consumption on a prototype, both chip-by-chip and for the product in its entirety.

Usually, the current reading is picked off by a series resistor in the supply line—that technique certainly works, but even picking the "best" resistor value has some tradeoffs between sensitivity and wasted power. The dynamic range of the voltage across the resistor spans a pretty wide range, so you need a sensitive meter/data acquisition front end with good ranging and resolution. Also, the voltage can change fairly quickly, so you need a fast meter or front end digitizer. It's one of those things that seems easy, until you start to do it.

How have you measured the actual power (current) used by your design? Do you use the resistive shunt as a transducer, or something else? What about the instrument itself: what's your preferred solution?