BY JOSHUA ISRAELSOHN, CONTRIBUTING TECHNICAL EDITOR

Honest energy, part two: Readers respond

Reader response to the last installment of Analog Domain (**Reference 1**) has been both strong and informative—so much so that I'd like to share some of the feedback with you. One reader asks whether home and business owners can borrow compensation schemes that industrial sites exploit, specifically, compensation capacitors for inductive loads. This kind of apparatus works well in industrial applications because the loads are essentially large, fixed, and predictable. Still, the industrial-plant operator must bear the cost of the switching apparatus and of the capacitor bank to abide by standard terms that utilities impose on such customers.

Home and nonindustrial business owners rarely present large inductive loads to the grid. The primary inductive loads in typical households include subhorsepower fuel and circulating pumps for heating systems; compressor motors for refrigerators; and drive motors for dishwashers, washing machines, and clothes driers. All of these comparatively modest loads exhibit small duty cycles, which reduces the benefit of compensating them with expensive apparatus.

Nonetheless, millions of these appliances exist, and the aggregate load is hardly negligible. An economic-compensation scheme that some modern motion-control ICs provide is *electronic* PFC (power-factor correction) as part of their front-end power-management capability. These devices are finding their ways into some of the most energy-efficient air conditioners, washing machines, and other home appliances on the market.

Another reader correctly points out that I had neglected to mention harmonic distortion in load currents—a term modern grid-current measurements include. In this more complete model, the grid-load vector, S, is the sum of three other terms: the real power, P; the reactive power, Q; and the distortion factor, D (**Figure 1**). The D vector does not lie parallel to either axis because a time-domain transform of the frequency-domain data reveals both in-phase and quadrature components with respect to the real power vector.

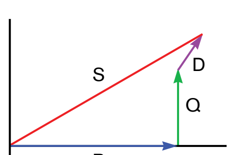

Figure 1 The grid-load, S, is the vector sum of real, reactive, and harmonic power terms, P, Q, and D, respectively.

Though a negligible concern decades ago, the harmonic content of mains-load current has grown due to the growing prevalence of electronic systems and, in particular, switch-mode supplies. The European Union has led the world in establishing limits on the harmonic content of load currents through standards such as EN 61000-3-2, which defines four load-device classes and the limits on their load-current spectra extending to the 39th harmonic. The influence of this standard extends beyond Europe: OEMs find it economic to ship standards-compliant products worldwide rather than maintain different designs and inventory for different geographic regions.

A third reader suggests that I had not made sufficiently clear in text what the table revealed: Though a typical CFL's (compact fluorescent lamp's) power factor is a disappointing 0.56, on a per-lumen basis, the lamp still improves on a tungsten-filament bulb's grid use by slightly more than a factor of two. Some electronic ballast chips for office-type fluorescent fixtures include PFC, but I've not yet seen the function in CFLs. Let me know whether you do.

This same reader notes a California Energy Commission report that EPRI Solutions and the Lawrence Berkeley National Laboratory prepared (**Reference 2**). I found good introductions to EN 61000-3-2 and -4-13 available from Reo UK Ltd (**references 3** and **4**).EDN

ACKNOWLEDGMENTS

The author thanks readers Jay Salsburg, Mike Patnode, Rich Bingham, M Simon, John Wendler, Tim Hughes, Pen Jennings, and Nick Jancewicz for their feedback and insights. He regrets that space does not allow even brief discussion of all the questions and related topics they raised.

Joshua Israelsohn is a co-founder of JAS Technical Media, where he manages technical-communication services. You can find his contact information at www.jas-technicalmedia.com/contact.

MORE AT EDN.COM

For a list of references in this column, go to the Web version at www.edn.com/080529ji.