

APPLICATION CASE HISTORY

PC-based power-supply tester slashes setup time to minutes

As a manufacturer of dc/dc power supplies, Calnex Mfg Co Inc (Pleasant Hill, CA) owns some sophisticated automatic test equipment. But because the production department uses it all day long, engineers developing new designs who would like to test them on that equipment must wait until night or when a new test program is holding up a shipment. Further, when working with traditional benchtop instruments, chief engineer Steve Hageman found that setting them up and diddling multiple knobs took an inordinate amount of time in the design and analysis of his circuits. Tired of that situation, he created a PC-based test system—and instead of spending half an hour or longer setting up a new test, the new system allows him to change operating parameters in minutes.

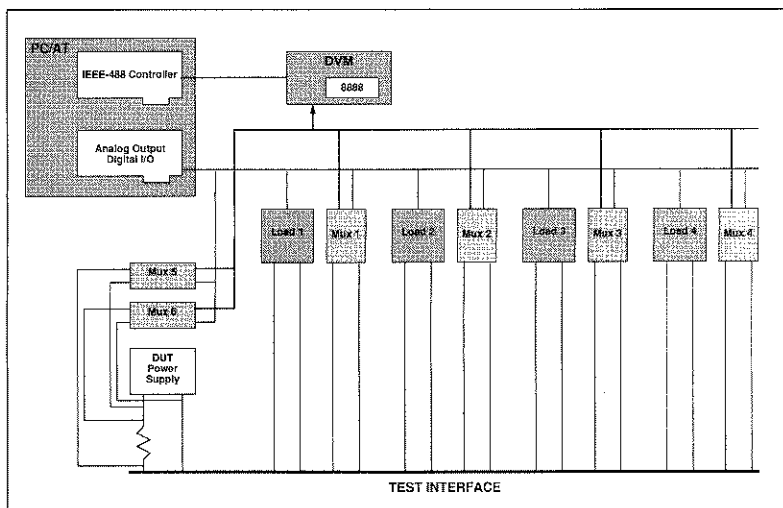
In originally configuring the system, Steve came up with several basic design criteria. The system must handle all dc parametric testing—such as regulation and efficiency—he normally does when developing of a new supply, and the system must be able to handle four power-supply outputs (Fig 1). It must

be programmable in QuickC, his current favorite language, and must transfer collected data into Tech*Graph*Pad for graphing. The system must be easily programmable but also run in an interactive mode. Finally it must be easy enough to build so that another engineer can clone additional copies.

Given these guidelines, Steve configured a system in which a power supply feeds a voltage to the dc/dc under test, which in turn drives one or more from a set of four loads. Then a digital voltmeter makes readings on both sides of the loads. With this setup he can not only program the loads from the PC, he can compare the power input to output and determine efficiency as well as make other parametric readings.

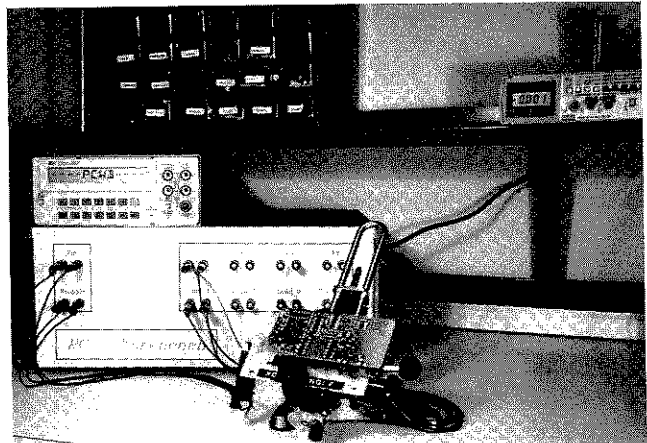
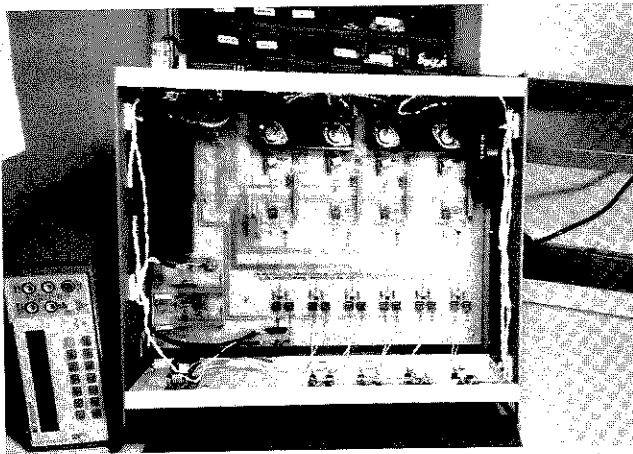
In constructing the system, he first looked for commercially available parts. He found plenty of power sources from which to drive the dc/dc converters and chose a Kikusui 72V/8A supply, which features analog-programmable voltage and current set-points. He didn't, however, locate any suitable low-power loads and instead built a set of isolated loads (see reference) that provide the required accuracy at a reasonable price. They operate from 0-5A/50V and 50W maximum per load, parallelable to a maximum of 20A and 200W per system. This capacity covers everything he does now as well as projected needs for the next several years. To get the analog voltages to program both the DUT power source and the loads, he selected a MetraByte DDA-06, which features six 12-bit analog outputs.

Besides the lack of appropriate loads, another interesting void in the marketplace at that time concerned a PC-based DVM card. A/D cards didn't have the required input ranges (at least 4-1/2 digits from 200 mV to 72V full scale), and he found no PC plug-in autoranging multiple-input DVMs. The most cost-effective solution was to work with a conventional standalone DVM and build a multiplexer so it could read various signals. The same DDA-06 that programs the loads also has 24 digital I/O lines, which Steve uses to



A digital I/O card controls the multiplexers and the power supply that drives the dc/dc under test; a standalone multimeter measures the resulting voltages and currents.

■ POWER-SUPPLY TEST STATION



An internal view of the completed power-supply test station (left) shows the input multiplexers (bottom), isolated loads (top) and related control circuitry. A front view (right) shows the tester in operation.

control a multiplexer of his own design; its six inputs attach to the four output voltages from the loads along with the input voltage and input current to the dc/dc converter.

To make the actual readings of these parameters, Steve feeds the mux inputs to an HP 3478A DVM, which he terms "an outstandingly documented unit that comes with an IEEE-488 interface for less than \$1000." It, in turn, connects to the host PC through a Capital Equipment 488 controller card, which he chose "because it comes with all the drivers I'll ever need at no extra charge."

Multilevel software

To control various hardware elements, Steve wrote a set of C-callable routines that handle low-level functions such as setting D/As and digital outputs. He then combined those routines into medium-level routines that set the loads and read a specific output voltage. Finally, top-level routines combine all the primitive functions into one subroutine call that, for example, can check the load regulation on a given output. He combined the subroutines into a library and simply links them into the test program. This software arrangement allows him to write test programs with as few as five or six lines of code.

In addition, using C's `fprintf` routine Steve can write a simple 5- or 10-line program that reads a given performance parameter and writes the reduced data directly to disk. Then he uses Binary Engineering's Tech*Graph*Pad to graph the result. With this combination, he can produce all the graphs needed for a dc/dc's datasheet in 2 hrs vs the 5 hrs needed before.

To make operation easy for untrained operators and to allow quick setups during circuit development, Steve wrote a mouse-

driven user-interface that allows interactive setup and monitoring of all loads and multiplexer data. The screen also displays calculated data such as input and output power, efficiency and delta output voltage. This mode of operation has saved Steve uncounted hours of diddling control knobs to change the loading on a DUT. Further, operators can save test setups for a specific power supply model on a disk file. When run on a Compaq Portable III, the system's user-interface screen updates roughly twice a second, which is fast enough to give the feel of continuous readings.

The system has been in place for almost two years, and Steve's bench productivity has nearly doubled because of decreased test setup time. He can change from one model of dc/dc to another in minutes instead of a half hour or more. "With the changeover so easy," he adds, "I no longer look for excuses or put little jobs off, I just do them on the spot and get them out of the way."

Encouraged by this system's success, Steve's firm built a PC-based calibration stand for the production department. It allows manufacturing personnel to get immediate feedback on how well they've assembled products, and they also tweak any trim pots necessary to bring units into calibration. As a result of this immediate feedback, production yields have risen steadily. A turn-on yield of <90% is now totally unacceptable, and the number of 100% yield jobs is climbing to well over half of all jobs—before the system was implemented, Steve estimates that not even 10% of the jobs yielded 100%. **PE&IN**

Reference

Hageman, S C, "Test DC/DC converters with an isolated load," *Electronic Design*, Nov 23, 1988, pgs 123-126.