

# PROJECT PROFILE

## SYSTEM AND SUBASSEMBLY TEST

### Test systems run hot and cold

#### DEVICE UNDER TEST

DC-DC power supplies with inputs ranging from 10 V to 450 V and outputs ranging from 0.5 V to 100 V. Each design requires a full suite of tests for DC and AC parameters over a wide temperature range.

#### THE CHALLENGE

Automatically perform engineering evaluations of DC-DC power supplies based on customer specifications. DC measurements include voltage and current as well as line and load regulation. AC measurements include ripple voltage, switching frequency, and swept-frequency gain and phase. (The online version of this article contains a complete list: [www.tmworld.com/archives](http://www.tmworld.com/archives).)

#### THE TOOLS

- AE Techron: power amplifier. [www.aetechron.com](http://www.aetechron.com).
- Agilent Technologies: data-acquisition/switch system (4); power supplies. [www.agilent.com/find/power](http://www.agilent.com/find/power).
- AP Instruments: network analyzer card. [www.apinstruments.com](http://www.apinstruments.com).
- Kikusui: electronic load. [www.kikusui.co.jp](http://www.kikusui.co.jp).
- LeCroy: digital oscilloscope. [www.lecroy.com](http://www.lecroy.com).
- National Instruments: graphical programming software. [www.ni.com](http://www.ni.com).
- Omega Engineering: temperature controller. [www.omega.com](http://www.omega.com).

#### PROJECT DESCRIPTION

Engineers who need a custom DC-DC converter can specify a Vicor supply online ([www.vicorpower.com](http://www.vicorpower.com)). From the online information, an expert system develops and ranks several designs for a design engineer to review. After the engineer selects one design, Vicor's production line builds 10 units. The company's engineers then test the converters before shipment to the customer.

In the past, an engineer could spend a few days making the necessary measurements. To reduce the test time, Vicor engineers built two automated test stands. Called Design Introductory Verification and Analysis (DIVA), these systems measure all parameters specified in the converter's data sheet for each new design.

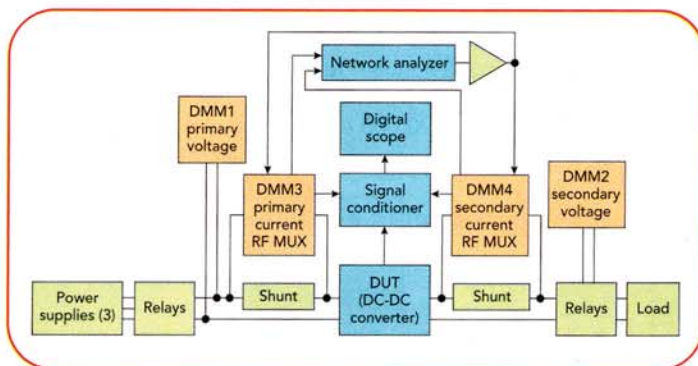
Each DIVA system contains four DMM/switch units that make DC voltage and current measurements with five-digit resolution. Digital I/O lines in the switch units control relays that apply power and connect loads to the DUT. RF multiplexers in two DMMs connect instruments to the DUT. Electronic loads let the systems measure output current even when the output voltage is 0 V (short circuit).

The RF muxes route signals to an oscilloscope that digitizes the DUT's output. Engineers can then measure AC parameters such as output ripple voltage, peak overshoot, and time to settle. The scope extracts DC levels from noisy signals with its internal digital filters. After downloading the filtered signal from the scope, a PC further filters the signal and performs the measurements. Software produces 3-D plots of several parameters, such as output voltage as a function of both input voltage and load impedance.

Each DIVA test system has a network analyzer that measures a converter's gain and phase response versus frequency, which ensures the design has ample gain and phase margin for sta-

ble operation. PC software extracts the crossover frequency and phase margin of a DUT's feedback network; software performs data reduction.

The test systems measure all parameters at the extremes of input voltage, load, and temperature. Their design is unusual because of how they control the DUT's temperature. Rather than use a thermal chamber, the systems contain a test fixture with a direct-contact thermal interface. The thermal interface uses electric heater elements to raise the DUT's temperature to 100°C. Liquid nitrogen cools the DUT to -55°C. A cover over the DUT



An automated system tests power supplies for DC and AC parameters based on customer specifications.

purged with dry nitrogen minimizes ice and condensation build-up. The system performs all measurements at 25°C before and after adjusting the temperature to the extremes.

#### RESULTS

Engineers use the DIVA systems to ensure that a design meets all customer specifications before Vicor builds a full production run. From the measurements, software produces test data in Excel format, complete with many 2-D and 3-D plots. It also produces a 60-page test report for each module.

A complete evaluation takes about 3 hrs. "Prior to development of the systems, a Vicor engineer would spend several days making the measurements manually," noted principal product line engineer Bob Pauplis. "Now, we perform all tests consistently. We just enter a converter's serial number into the system and it does the rest."—Martin Rowe, Senior Technical Editor