# Better, Safer Power Generation Measurements in Less Time

*by John Demcko and John Jensen*

If you're trying to boost efficiency in an electric power plant, the solution might be sitting in one of your labs already. Dynamic signal analyzers (DSAs) have been helping power plant engineers monitor and diagnose vibration problems for years, and now they're expanding into both electrical tests and new areas of electromechanical testing, too.

Making these tests with a DSA delivers five major benefits:

1. You can make measurements using much smaller test transients, putting less electrical and mechanical stress on the machine under test.

2. The DSA can do all the data capture, which previously required strip chart recorders, digital oscilloscopes and analog or digital tape recorders. One instrument will often do everything you need.

3. You can easily view test results in either the time or frequency domains. Frequency domain measurements provide better phase accuracy than you can get with graphical measurement techniques in the time domain.

4. Display markers help you extract detailed information from digitized time and frequency records quickly and accurately.

5. In addition to all these benefits, DSAs often reduce test times, too.

The list of ways you can apply DSAs in power plants tests is even longer than the list of benefits. Here's a quick look:

- **Power system stabilizer tuning:** This was one of the early DSA successes we had at Arizona Public Service (see figure 1). Using the DSA's random noise stimulus instead of the stepped sine method we'd used previously, we cut the test time from 3 or 4 hours to 14 minutes and subjected the machine to much less potential stress.
- **Grounding resistor sizing:** In this application, we used a DSA to make on-line impedance measurements to check for proper grounding in a turbine generator auxiliary system. The technique delivered accurate measurements while isolating the test personnel from high voltages.
- **Power line quality:** DSAs can measure line frequencies and harmonics with accuracy of better than 0.1%.
- **Relative and absolute phase measurements:** The accuracy of phase measurements is one key factor in converting many users to DSA. Plus, coupling a DSA with an HP precision global position system makes it possible to perform grid stability analysis and fault location to within ±200 feet.
- **Measuring power or rotor angle:** A good DSA equipped with an appropriate transducer can deliver accuracy better than 0.5 degrees in these measurements, compared to the

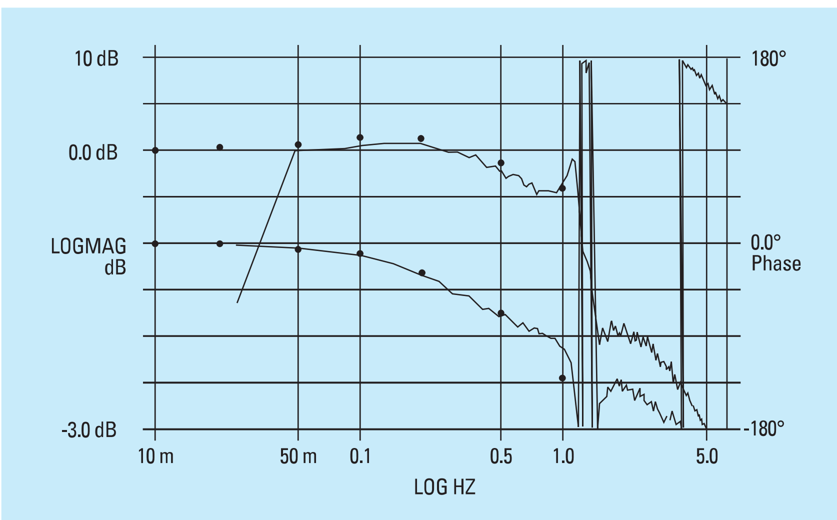



Figure 1A:
Comparing DSA and stepped-sine testing

In this test on a generator operating at 246 MW, the DSA measurement clearly shows a local mode between 1.0 and 1.1 Hz. The stepped sine measurement (represented by the eight gain and phase points) missed this critical information completely.

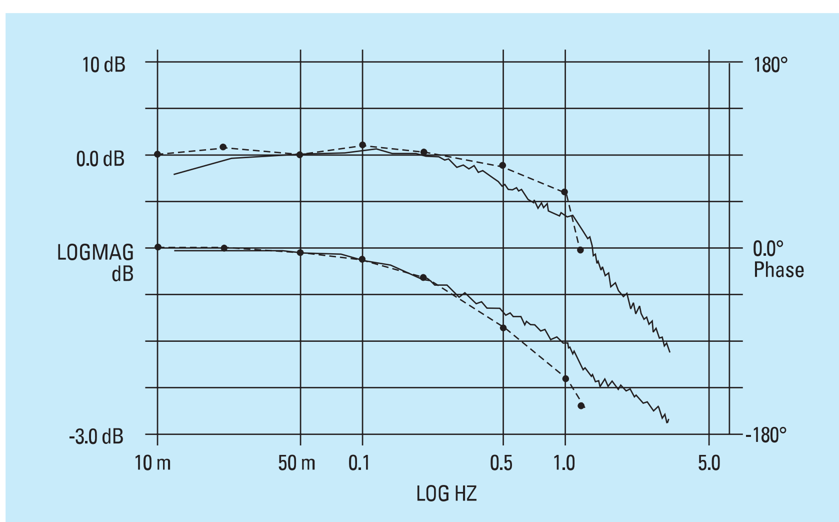
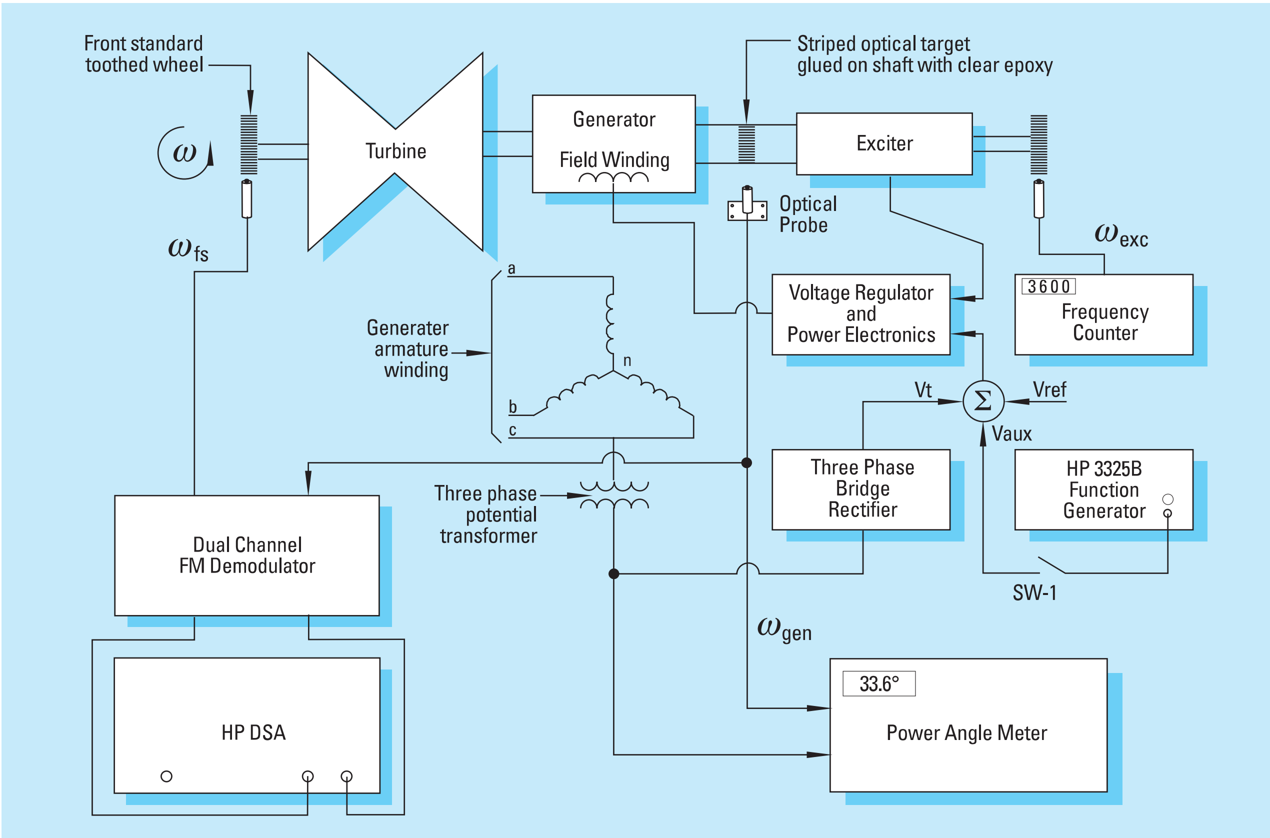



Figure 1B:
Frequency response at different operating levels

With the output reduced to 150 MW, the local mode shown in Figure 1a is no longer visible.




5 degrees offered by the old strobe and chalk line approach. DSAs deliver much more information, too, including key parameters such as overshoot and settling time. And the DSA is much safer, since test personnel don't need to be near an operational machine in order to make measurements. Figure 2 shows a typical instrumentation setup for measuring power angle.

- **Apparent impedance measurements:** Estimating worst-case impedance can leave a lot of money on the table by causing you to run significantly below safe power transfer limits. Improved measured accuracy can give you a better idea of apparent impedance over a range of frequencies, which can lead to more informed and consequently more efficient utilization of generating capacity. This is a great example of how better measurements can boost your bottom line.
- **Shaft torque and subsynchronous vibration:** DSAs provide better monitoring of these two major sources of turbine fatigue and failure.
- **Rotor torsional resonance testing:** Engineers at a number of generating facilities have explored different ways to measure torsional resonances, relying on narrow frequency resolution and other DSA features to provide accurate data for in-depth modal analysis.

If you'd like to learn more about these tests and other aspects of using DSAs in power generation tests, ask for a copy of a white paper we've prepared entitled "Power Generation Measurements with HP Dynamic Signal Analyzers." It describes each of these measurements and explains how a DSA can deliver better results in less time. The publications referenced in the paper also provide more information. ■

Figure 2: Instrumentation for measuring power angle and torsional vibration

**Here's a typical collection of sensors and measurement hardware needed to measure both power angle and torsional vibration.**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***To receive a copy of the white paper discussing power generation tests, check 1 on the Reply Card.***