Multi-Phase Power Analyzer Delivers Accuracy And Many Standard Features

After acquiring some essential IP from Voltech,[ref] Tektronix has introduced its first power analyzer, a precision, multiphase instrument known as the PA4000. In terms of product marketing strategy, the PA4000 rounds out the Tektronix portfolio of oscilloscope-based power test offerings, which according to the company, enables an end-to-end solution that provides the performance to measure for conformance to regulatory standards or to meet other customer-specific requirements. As for the power analyzer itself, the PA4000 aims to compete with the existing high-end power analyzers by offering excellent accuracy (0.04% basic accuracy for voltage and current) in combination with numerous standard features that would be optional (or non-existent) on competing instruments (Figs. 1 and 2.)

The PA 4000 is based on a platform developed by Voltech, which is exiting the power analyzer business as a result of its agreement with Tektronix (except that Voltech will continue to service its installed base of power analyzer equipment.) The PA4000 is offered with a choice of one to four channels, allowing users to tailor the instrument to single- or multi-phase measurements. What's more, a customer who initially purchases a PA4000 with fewer than four channels can insert additional channels later. Since nearly all features are standard, pricing essentially varies with the number of channels purchased.

Each channel can measure voltages up to 1000 V rms or 2000 V peak along with currents up to 30 A rms or 200 A peak. What's more, each channel has two internal current shunts built in to enable very high measurement accuracy over the full current-measurement range. Ken Price, a product planner at Tektronix, points out that these built-in dual shunts are a new and unique feature in the power analyzer industry. More on that topic shortly.

The PA4000's accuracy is abetted by a unique DSP algorithm that reliably locks onto the signal under test even in the presence of transients and noise. As Price explains, this feature is "more sophisticated than just tracking zero crossings." Each channel features precision matched voltage and current pairs with high-resolution 14-bit ADCs and bandwidth to 1 MHz. In addition, the inputs, measurement circuitry and algorithms are tolerant of crest factors up to 10. One more benefit is the unit's fast autoranging capability, which allows it to quickly adapt to changing signals without leaving gaps in the measured data.

Perhaps the most interesting aspect of the PA4000 is its use of dual Spiral Shunt current shunts, which give power electronics engineers stable, precise current measurements even on highly distorted power waveforms common in many applications. Each channel features a 30-A shunt for measuring currents up to 30 A rms or 200 A peak and a 1-A rms shunt that provides optimal resolution at lower currents. Tektronix has applied for a patent on the design of these shunts, which maximize stability over changes in temperature, current level, frequency and other factors to enable the 0.04% current-measurement accuracy.

According to Price, among the design features contributing to the shunt's precise and stable characteristics are a physical design that cancels inductance, a burn-in process that mitigates the impact of aging and other effects, and use of a controlled-speed fan within the analyzer to maintain a constant operating temperature for the shunts.

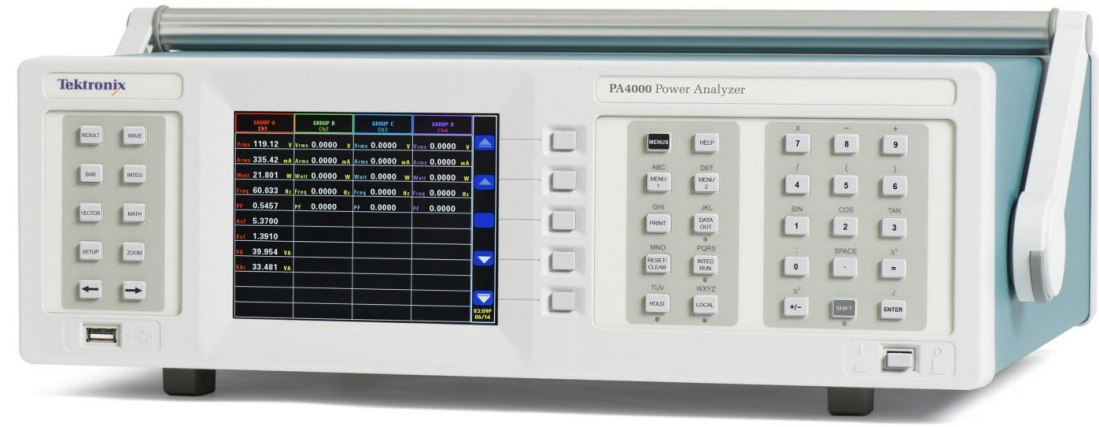
In addition to their accuracy, the presence of two shunts within each channel distinguishes the PA4000 from other high-end instruments on the market. "Some of the other high-end power analyzers give you a choice of shunts, but you can only have one kind of shunt per instrument," says Price. He also notes that some of the existing analyzers simply rely on external current sensors. But the inclusion of two current sensors per channel was very much in keeping with the philosophy taken in developing this instrument. "Rather than making everything optional, we tried to make as many features as possible standard," explains Price.

Meanwhile, the PA4000 does accommodate external current transducers (CTs) for measurements above 30 A rms. And the company offers several high accuracy fixed-core CTs (sourced from vendors such as LEM and AEMC) for measurements up to 1000 A. Some of these external CTs require a ±15-V power source, which is offered as one of the instrument's two optional features. (The other is the GPIB interface.)

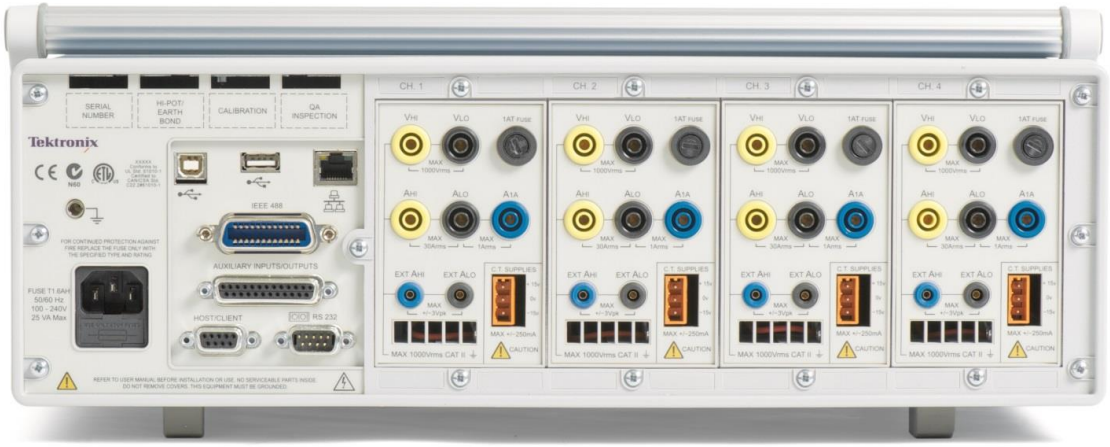
In addition to the advanced hardware and measurement capabilities, the PA4000 provides many software features to support user productivity. To save engineers setup time and reduce errors, the PA4000 offers a set of application-specific measurement modes such as standby current, motor drive and ballast. Among the many features that come standard are the LAN, USB, and RS-232 interfaces. In addition, software for controlling the analyzer, downloading measurements, and logging on a PC is also included in the package. The Tektronix

PA4000 Power Analyzer will be available worldwide beginning this month with pricing starting at $10,500 (see the table.)

Reference: Tektronix Enters Power Analyzer Market, March 18, 2013, press release



(a)



(b)

Fig. 1. The PA4000 power analyzer enables power system designers to perform pre-compliance testing to regulatory standards for efficiency, standby current, and harmonics. The instrument boasts high accuracy (0.04% for voltage and current), application-specific test modes, and a full set of standard features including communication interfaces and PC-based software. Depending on the number of channels purchased, the analyzer will allow either single-phase, or three-phase measurements. Front (a) and rear (b) views of the instrument are shown here.

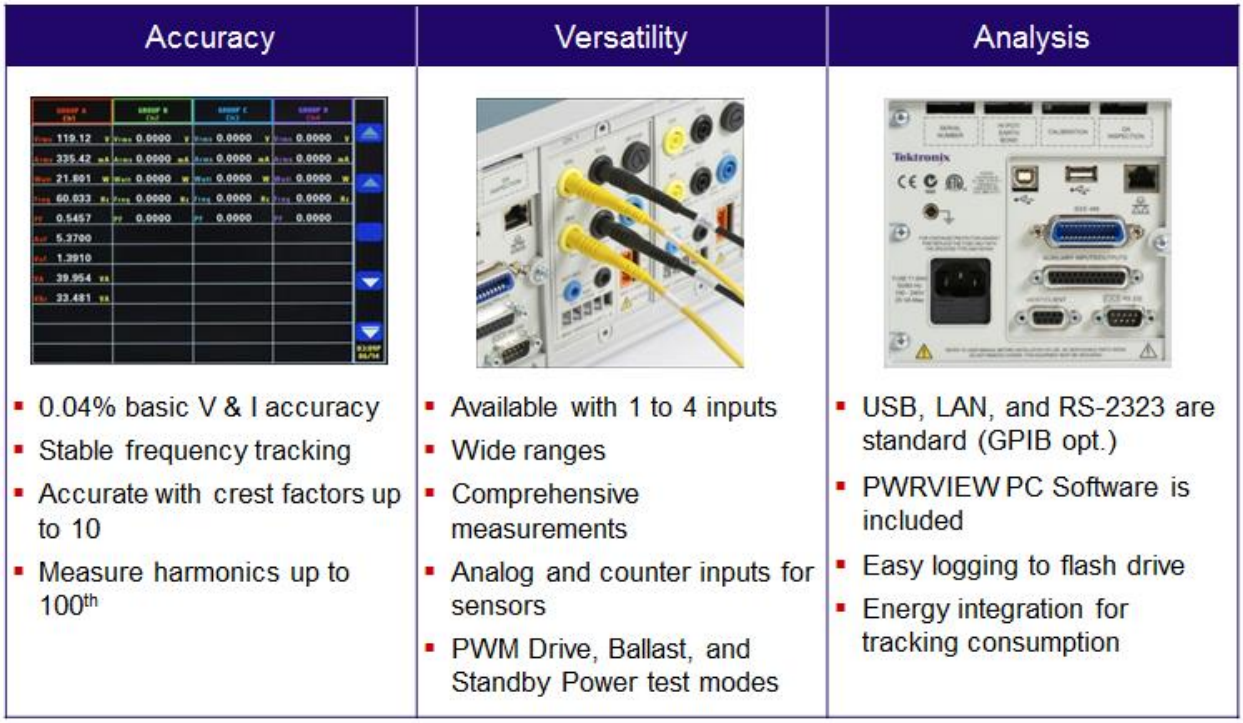
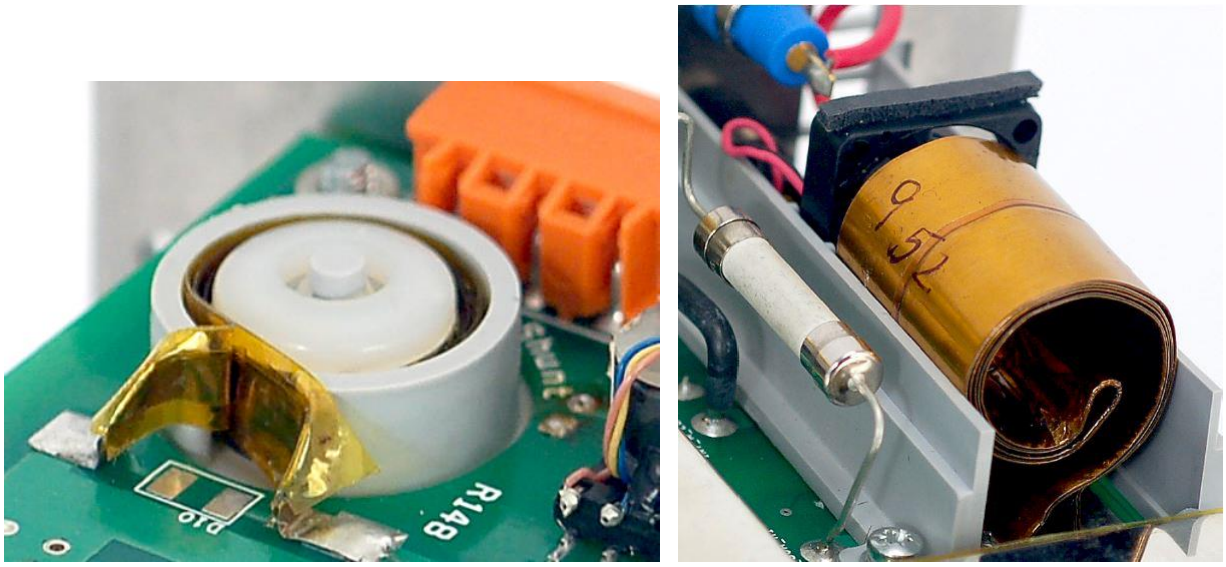


Fig. 2. An overview of key features offered by the PA4000.



(a) (b)

Fig. 3. Each channel of the PA4000 features two internal Spiral Shunts for measuring current at levels up to 1 A (the smaller shunt shown in a) and 30 A rms (the larger shunt pictured in b.) (Images not shown to scale.) With their unique design, burn-in process, and variable-speed forced air cooling, these current transducers maximize stability over changes in temperature, current level, frequency and other factors to enable the 0.04% current-measurement accuracy.

Table. A list of key specifications and pricing for the PA4000 power analyzer. Nearly all features are standard with the exception of the GPIB interface and the ±15-V power supply for external current transducers. (The ±15-V power supply option is not listed here, but it may be visible in the rear view of the instrument shown in Fig .1, if you enlarge the figure and look for the three-pin connector labeled "C.T. Supplies" in the lower righthand corner of each channel.)

	PA4000 1CH	PA4000 2CH	PA4000 3CH	PA4000 4CH
Inputs	1	2	3	4
Voltage Input Range	Up to 1000 V_{rms}, 2000 V_{peak}			
Basic Voltage Accuracy	0.04%			
Current Input Range	0.025 A_{rms} to 30 A_{rms} with 2 built-in shunts			
Basic Current Accuracy	0.04%			
Measurements	V_{rms}, I_{rms}, VA, VAR, W, PF, Freq, Whr, VAhr, THD, TIF, etc.			
Measurement Bandwidth	DC - 1 MHz			
Automatic Modes	PWM Motor Drive, Lamp Ballast, Standby Current, Energy Integration			
Connectivity	USB, LAN, RS-232 (GPIB Optional)			
Software	PWRVIEW software for remote control and data acquisition			
Warranty	Three Years			
US MSRP	$10,500	$13,400	$16,200	$18,900