

Miniaturization Technology Provides Next Generation Laser Power Measurement

Traditional laser power measurement instruments, which consist of a sensor head connected to separate meter electronics, can be difficult for system builders to embed into their own equipment, and may even waste valuable space in laboratory applications. Now, Coherent has applied microelectronics miniaturization technology to provide a next generation laser power measurement solution where the entire meter is miniaturized and encapsulated within a USB 2.0 or RS-232 cable connector. The result is a power measurement tool that is smaller and more economical, yet with no sacrifice in performance.

Traditional Power Meters

The most common embodiment of laser power measurement instrumentation consists of a sensor head which connects by a cable to a separate meter. The laser power sensor itself is usually either a thermopile or semiconductor photodiode. Meter electronics are available offering a wide range of choices in terms of capabilities, features and price. For example, the simplest products may provide little more than just a power readout, while high end meters may have various display options (digital for precision and analog style for laser optimization), and a host of other functions including data logging and statistical analysis capabilities, as well as various computer interface options.

In some applications, especially those in which the meter is permanently embedded within a system, this traditional configuration may present disadvantages in terms of size or cost. Some meter providers have developed simplified interface modules for these uses. These are more compact units that replace the traditional meter, and which lack a display and may eliminate some of the more sophisticated functions, such as data logging and statistics.

While more economical and smaller than traditional meters, these interface modules do not directly address the former's main limitations. Specifically, they must still

be mechanically mounted somewhere within the system and require input and output connectors (from the sensor head and to the control computer). All this takes space and has associated cost for the system builder. In addition, the sensor head and the meter electronics must each be individually calibrated on two separate calibration stations. This introduces additional measurement uncertainty into the system.

OEMs, system builders and laboratory users have all told us that the interface module approach is not an ideal solution for their needs. Some of these users have addressed the problem themselves, designing their own signal processing electronics to take the raw, analog input from a basic thermopile sensor head (which provides a calibrated, raw voltage output), to produce a calibrated power measurement. This requires amplifying the input signal from the sensor, performing an analog-to-digital conversion, and then transmitting the digital signal to a host computer. This approach enables the designer to integrate the power meter with other system electronics, and can even be done at the board level for maximum space savings.

The downside of this approach is that the user must gain all the knowledge that power meter manufacturers already have in terms of processing the sensor signal with high precision, low noise and good stability. Furthermore, the user now assumes all the responsibility for ensuring accurate calibration and final measurement accuracy. Issues that must be dealt with in particular include utilizing the proper analog-to-digital resolution, supplying clean power to the device, and minimizing noise in the amplifier.

The PowerMax Solution

Coherent developed the PowerMax series of sensors specifically to meet the needs of all those who require highly compact signal processing electronics, and who want to view and analyze sensor readings on a computer, rather than a dedicated instrument. Coherent PowerMax products are the world's first laser power sensors that utilize state of the art microelectronics

miniaturization techniques to integrate an entire instrument *inside* a USB 2.0 or RS-232 cable connector. With this unique innovation, PowerMax-USB/RS sensors have all the signal processing and power measurement electronics normally contained in a LabMax™ meter, but they now connect directly to a PC with plug and play functionality, and no external meter.

PowerMax products address all the issues previously identified with either mounting or powering separate meter electronics. Yet, they do not require the user or system builder to develop their own electronics. The PowerMax-USB is a totally plug-and-play device, which even draws its power from the USB connection, and the only requirement for PowerMax RS-232 sensors is a +5 VDC power input.

While they offer greater simplicity and lower cost, PowerMax sensors do not sacrifice performance. For example, each sensor has built in, individually calibrated wavelength compensation, and the electronics provide all the measurement performance and accuracy of Coherent LabMax meters. Furthermore, since the sensor and meter electronics are integrated, only a single calibration is required, thus reducing cost of ownership for those who have their systems recalibrated annually.

The PowerMax-RS (RS-232) is primarily intended for those who wish to embed power measurement capability within an automated laser processing station, such as for cutting, welding, marking, scribing or inspection. These types of systems are often controlled by computers running a custom (non-Windows) operating system, and which communicate with the various sensors and controls in the equipment through serial links and commands.

PowerMax-USB sensors are also ideal for other embedded applications, such as power measurement in manufacturing lines, laser burn-in racks and long-term reliability test benches. And even lab users that utilize other computer controlled instrumentation may find the lower cost and smaller size of the product advantageous. The PowerMax-USB is also an attractive alternative for field service personnel, since it eliminates the need to carry a separate meter, and technicians typically already have a laptop computer.

Flexible Software Functionality

Coherent's PowerMax PC applications software provides a virtual instrument interface for all PowerMax sensors. This software enables the operator to take laser power readings, log data and compute measurement statistics. Beam position sensing is even supported for quadrant thermopiles.

The graphic shows the main front panel of the PowerMax PC software (Figure 1). This screen provides an instantaneous readout of power, as well as some basic measurement statistics (minimum, maximum, mean, standard deviation, etc.), and also enables the user to input various measurement parameters, such as sampling interval. If more than one PowerMax-USB sensor is connected to a single computer, then multiple instances of this screen can be opened at once to view the readings from each sensor simultaneously (Figure 2). Additionally, the output of multiple sensors can be displayed together in a single screen allowing synchronized ratiometry to be performed, as shown in Figure 3.

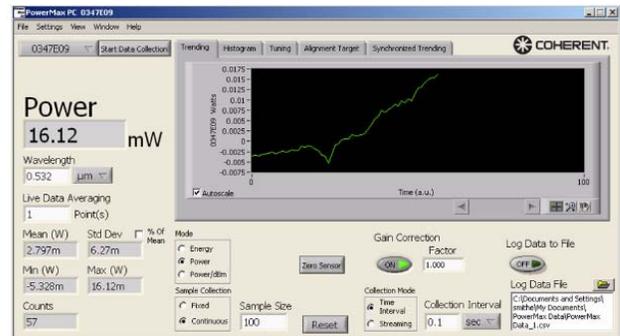


Figure 1: PowerMax PC Software Main Panel

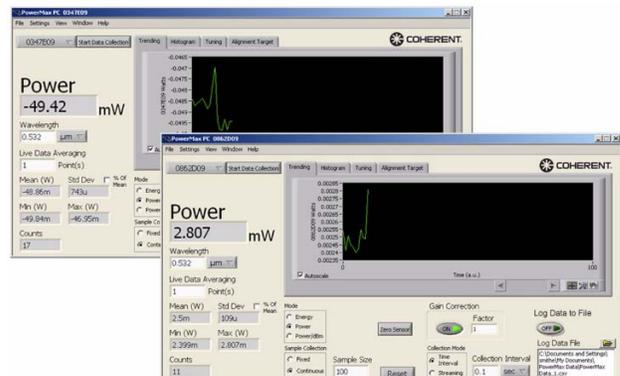


Figure 2: PowerMax PC Operating with Multiple Sensors

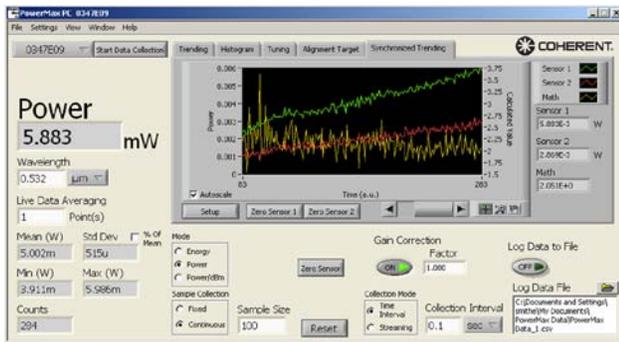


Figure 3: PowerMax PC Operating with Two Sensors in Ratiometry Mode

For system integrators and others who wish to write their own software, an extensive set of host interface commands is available to control all aspects of power meter operation. Specifically, the supplied DLL driver supports simple ASCII remote interfacing host commands on both the PowerMax-USB and PowerMax-RS sensors. To further simplify the interface with the PowerMax-USB sensors, these are also recognized by Windows as a COM port, making it easy to address ASCII commands to them (Figure 4). In addition, a National Instruments LabView™ driver is supplied for easy LabView integration.

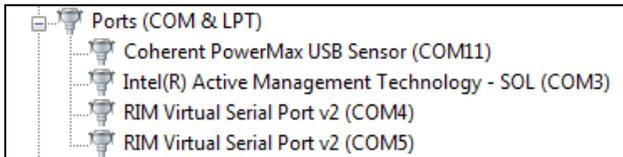


Figure 4: PowerMax-USB Connects as COM port (Shown in Windows Device Manager)

In conclusion, PowerMax sensors represent a significant step forward in convenience and ease of use in laser power measurement. With their unique combination of small size, high performance and lower cost, these products should benefit a wide range of users, including systems integrators, field service personnel and even laboratory users.