

FSA™ Based PDPA and LDV Systems

*Flow Velocity and Particle Size
Measurement Systems*



Versatility

Accuracy

Ease of Use

Robustness

These are qualities that our customers look for in a Phase Doppler Particle Analyzer (PDPA) or Laser Doppler Velocimeter (LDV) instrument. PDPA/LDV systems from TSI offer proven technology, which allows the user to make reliable measurements in the widest variety of applications. Broad-based innovation is required to maintain this market-leading position.

TSI originated the single-receiver, three-detector scheme; launched optical fiber technology for transmitter and receiver systems; and offered the first digital signal processors for accurate particle size and velocity measurements.

TSI also introduced two signal processing techniques for measuring velocity and size; pioneered the concept of adapting processing algorithms to match signal characteristics and the information needed; and were first to utilize burst centering, dynamic sampling rate optimization and SNR-based burst detection. Moreover, we introduced unique, innovative techniques for validating data and removing trajectory dependent influences on particle size measurements.

TSI PDPA/LDV systems have long been the standard for flow and spray measurement instrumentation. Continuous innovation makes them the most versatile, accurate PDPA/LDV systems available.

The FSA Based PDPA/LDV System offers:

- a quantum leap in capability, performance and ease-of-use
- the most powerful velocity and size measurement system available
 - concepts and ideas covered by four separate patents
 - robust design for a wide range of applications

This unique PDPA/LDV system combines the following subsystems to provide unparalleled performance and operating ease:

- FSA™ Multi-bit Digital Processor
- Fiberlight™ Multi-color Beam Separator
- Fiberoptic transmitter and transceiver probes
- Fiberoptic couplers
- PDM multi-color scattered light separation and photodetector system
- EIC Multi-channel External Input Device
- Optimized fiberoptic receiver probes



Fiberlight Multi-color Beam Separator

The unique, compact fiberlight Multi-color Beam Separator generates the laser beams needed for one-, two- or three-component PDPA/LDV systems. It provides high transmission efficiency, yet is very easy to set up. Ergonomically designed fiberoptic couplers simplify fiber coupling while ensuring maximum, repeatable light transmission.

Fiberoptic Transmitter and Transceiver Probes

TSI continues to exploit its extensive experience in building fiberoptic PDPA/LDV systems with the design of transmitting and receiving probes. These probes make it simple to customize measuring volume parameters and are easy to use. They incorporate rotating mounts with graduated scales for accurate positioning of the probe relative to the flow coordinates. The TR 60 and TM 50 series probes have user-friendly adjustment mechanisms that facilitate precise beam crossing, essential for accurate measurements in internal flows bounded by complex wall geometries. More details and complete specifications can be found in the *Fiber Optic Probes for PDPA/LDV Systems* brochure.

New Optimized Fiberoptic PDPA Receiver Probes

A unique fiberoptic receiver system for PDPA applications has also been developed. The new design implements an optimized detector arrangement to validate size measurements. The geometry of the receiver probe is optimized to cover larger size ranges without sacrificing measurement resolution, while never requiring the use of aperture masks. Matched detector areas eliminate biases found in other phase Doppler receivers. TSI's patented Intensity Validation* uses signals from the Fiberoptic receiver probe to eliminate trajectory bias. This results in far more reliable data, and direct feedback on system performance.

PDM Scattered Light Separation and Photodetector System

The Photo-Detector Module (PDM) systems offer enhanced scattered light separation. They are optimized for the best dynamic and operating size ranges, yet provide the freedom to adjust system parameters easily. The light-bar approach is used to allow changing from phase Doppler mode to single-probe backscatter LDV mode in seconds. The new, compact, high-frequency-response photodetectors that convert the scattered light to electrical signals exploit the latest advances in photon-counting PMT technology. A matched set of PMTs is used for phase Doppler measurements and a computer-controlled laser diode calibration system helps optimize operating parameters.

FSA™ Multi-bit Digital Processor

The FSA Multi-bit Digital Processor represents a revolutionary concept in signal processing, derived from our unmatched experience in applying both digital FFT and correlation techniques. It is the only processor to combine both of these innovative approaches, along with patented techniques to deliver multi-bit digitization, high maximum Doppler frequency, true SNR-based burst detection, dynamic optimized burst sampling, burst centering, short transit time burst processing, digital firmware-based processing (DSP), FireWire® data transfer and many other unique features. The FSA signal processor works together with the fiberoptic receiver probes and the PDM to perform intensity validation. The cumulative result is a robust, powerful system that provides accurate size and velocity information, even in the most demanding applications. More information and full specifications can be found in the *FSA Multi-bit Digital Processors* brochure.



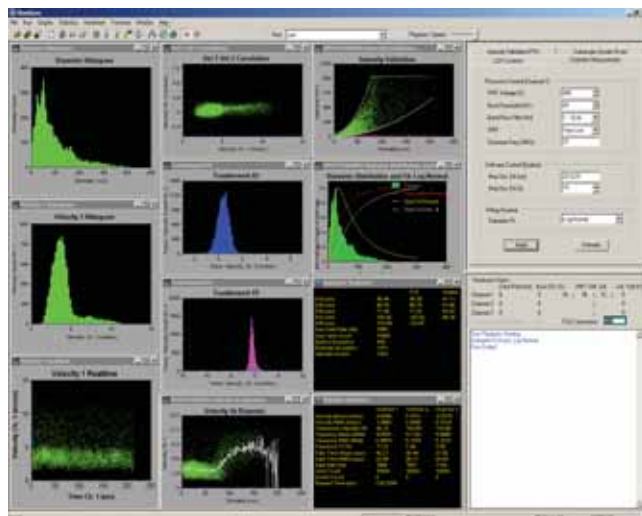
New FLOWSizer™ Data Acquisition and Analysis Software

The new FLOWSizer software package controls system set-up, as well as data acquisition, analysis and display. Data are transferred between the FSA processor and the external computer using FireWire® (IEEE 1394) technology. Designed for Windows® XP platform, the FLOWSizer software incorporates various new concepts and ideas. These include a unique scan capture traverse control and an enhanced intensity validation scheme which leads to better size validation. These features, along with on-line determination of probe volume size, enable the most accurate diameter statistics, volume flux, LWC, and concentration measurements.

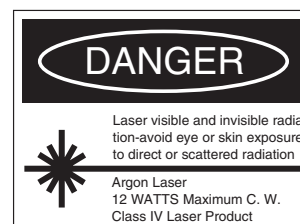
The FLOWSizer software also incorporates a method for automating and optimizing system parameters for mapping velocity and particle size fields. Details of flow and particle dynamics, and their evolution, are presented via graphical and tabular displays. Software tools are provided to optimize system parameters and geometry for various PDPA applications.

EIC External Data Collection System

A compact multi-channel interface lets the user combine pressure, temperature and similar analog or digital data with velocity and size information. For periodic or pulsatile flows, the device also collects encoder or phase angle information for phase-locked data acquisition and analysis. Results can be overlaid, binned, averaged, and mapped to an arbitrary zero point.



Windows is a registered trademark of Microsoft Corporation.
FireWire is a registered trademark of Apple Computer Inc.
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