

LDS Series

LASER SCALE FOR POSITIONING APPLICATIONS

Model LDS-3000 Laser Doppler Scale

Precision Positioning Systems for IBM PC Compatibles

FEATURES

- Inherent high accuracy and high resolution.
- No need fear periodic calibration.
- Non-contact devices eliminate wear.
- Orthogonality of positioning system determined by mirrors not X-Y stages when using a flat-mirror target.
- No mounting stress on scale.
- No thermal expansion on scale.
- No need for machined flat surface for mounting scale saving installation costs.
- Higher loop gain possible for closed loop servo control.
- Optional hermetic seals for hostile environments.

Description

The LDS-3000 Series Laser PC Positioning Systems provide high speed, high resolution and high accuracy; positioning for single or multiple axis applications, using an IBM compatible PC as the controller. The system is ideal for applications such as Precision XY Stages, Servo Stages, Servo Track Writers, and Linear Measuring Devices. The LDS3000 is compact, easy to install, and cost effective. A PC compatible plug-in board is provided for direct interface to an IBM compatible PC.

The Model IPP32 PC Board is a plug-in board, which occupies one full sized slot on the PC ISA Bus. The board digitizes the output of an Optodyne Laser Doppler Displacement Meter and provides a 32-bit parallel target position in units of 1/256, or 1/128, or about 0.1 micrometers (2.5 nanometers).

The 32 bit position data may be read over the PC backplane and/or output to the

position error connector on the top of the board. This parallel output can also be used to close the positioning loop in a servo control system.

An additional board (P-501) is available that does not provide the closed loop capability, but can be used for applications where only the displacement is to be read over the PC backplane.

System Components

L-109 Laser Head -HeNe Laser Head, ruggedized for direct installation in machine tool and other positioning applications. Contains HeNe Tube, Optics a Photodetector Receiver, and electronics.

R-102A Retroreflector - 1/2" diameter retroreflector without post or base. Used to return the laser beam back to the Laser Head receiving aperture on a path parallel to the input beam, regardless of the angle of incidence. Movement of the retroreflector determines displacement measurement.



LD-21RS Cable Set-Connects the Laser Head to the IPB Power Box.

IPB Power Box - Supplies the +15VDC and driver signal to the L-109 Laser Head, and passes the laser output directly to the IPP32 or P-501 Board.

IPP32 32-Bit Parallel Board - Board plugs into an IBM PC and processes information directly from the Laser Head. The data can be clocked as high as 900 kHz. There is also a 32-bit position connector that allows the board to be used in closed loop applications, providing a 32-bit error signal. There is a basic DOS program in the system user manual. This software allows simple operation of the board.

The board contains several command and status registers through which its operation

may be controlled and interrogated. It is also capable of generating interrupt requests based on internal and external events.

The IPP32 provides an Offset Register, which may be written to by the PC. This register may be used to set the position counter to a pre-terminated value and/

or to establish a reference for the position error output, which then functions as the error signal input to an external servo loop.

P-501 28-Bit Plug-in Board - The measured position is maintained by a 28 bit counter and an 8-bit A1D which can only be read over the PC backplane. It is compatible with ISA specifications, making it suitable for use with almost all PC compatible computers.

The resolution is 1/256 or 2.5nm.

Systems Configuration

The system configurations below provide information on selection of the proper board for your application.

Model LDS-3000-P

This version of the system uses the IPP32 Board with a 32-bit parallel bus for additional functions, and includes:

- *L-109 Laser Head*
- *R-102A Retroreflector*
- *LD-21R Cable Set*
- *LD-21S Cable Set*
- *IPB Power Cox*
- *IPP32 32-Bit Parallel Board*

Model LDS-3000-C

This version of the system uses the P501 Board that allows reading of the position only from the PC backplane, and includes:

- *L-109 Laser Head*
- *R-102A Retroreflector*
- *LD-21RS Cable Set*
- *IPB Power Box*
- *P-501 28-Bit Plug-in Board (with no parallel output)*

System Options

The following options can be used with either the **LDS-3000-C** or the **LDS-3000-P** versions of the system

ER-400 Extended Range - Extends the range of the laser system to 400 inches.

ER-2000 Extended Range - Extends the range of the laser system to 2,000 inches.

L-109N Narrow Beam Laser Head -Similar to the L-109, but designed to be used with flat mirror targets. The narrow beam heads used with flat mirrors allow simultaneous x-y measurement across flat mirror surfaces. Beam diameter is 0.5mm, and the beam divergence is 1 mrad. Due to the divergence of the beam, the alignment tolerance is relatively large.

LD51S 90-Degree Beam Bender -Fixed 90-degree mirror used to reflect the laser beam 90 degrees from the incident beam.



HIS – Reference Mrker for Home

Positioning – An electro-optical device used to determine home position. A knife-edge connected to the carriage is passed through an IR light beam, and a TTL output pulse is

sent to your controller, to set the desired function. Position repeatability is better than 1 μ m. The home position signal is a square wave, with a 120-Ohm termination. The rise time is 15 nsec and the width is approximately 5msec. Other wave shapes are available.

The following option can be used only with the LDS-3000-C version of the system

ATCC - Automatic Temperature and Pressure Compensation for P-501 28-

Bit Plug-In Board - Automatic pressure and temperature compensation consists of an air pressure sensor, an air temperature sensor, and a material temperature sensor. This is a board that occupies an ISA bus half-sized slot in your PC.

Use of flat-Mirror Targets for X-Y Stages

In a two axis system (e.g. an X-Y stage) as shown in Figs. 1-1 and 1-2, the X-reflector can be allowed to move in the Y direction without affecting the signal strength of the X-measurement. Consequently, both reflectors in a 2-axis system can be mounted on the same moving part to minimize Abbé offset error. Defining the measurement as the point where the axis beams intersect, the measurement is essentially independent of yaw motion of the moving stage.

Contrast this system to a 2 axis system using retroreflectors, the X-axis retroreflector must be mounted on a part of the stage that moves in the X-direction and not in the Y -direction.

The Y-axis retroreflector must also be mounted on a different part of the stage that is allowed to move in the Y -direction and not the X-direction. These constraints prevent 2-axis measurements from being made on the same part of the stage. Furthermore, there will be some geometry error inherent to the system if it is not perfectly rigid.

However, the flat-mirror arrangement, in fig. 1-1, needs a large space for the interferometer and optics. The laser beams are also exposed making laser beam paths vulnerable.

The LDS laser head, in fig. 1-2, can be incorporated in a new design with the two

laser heads mounted underneath the X-Y stage. This laser head configuration allows measurement of the two flat-mirrors from inside the stage rather than from outside as in the conventional flat mirror/laser head configuration.

This arrangement has all of the advantages of flat-mirror reflector but without the disadvantages of the large external space requirement and beam vulnerability.

The laser head does produce heat (typically 10-20W), which may cause thermal distortion of the stage. Care must be taken to either properly isolate the heat source or allowance for the system to reach thermal equilibrium after power-up.

Block Diagram Model LDS-3000

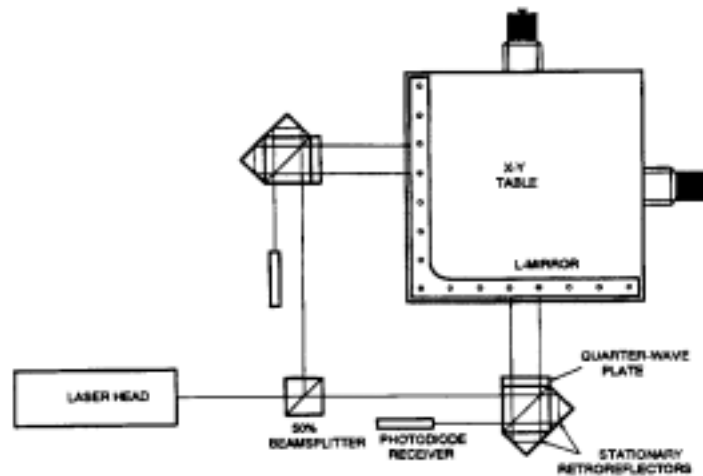
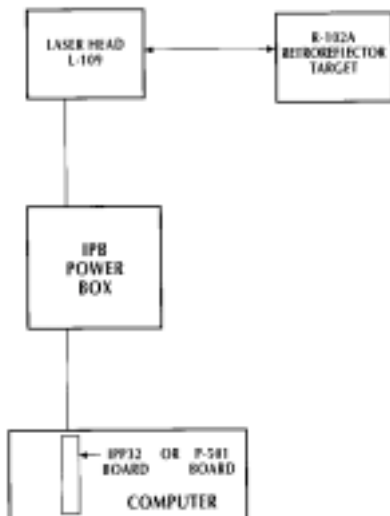


Fig. 1-1: X-Y Stage Measurement with Interferometers

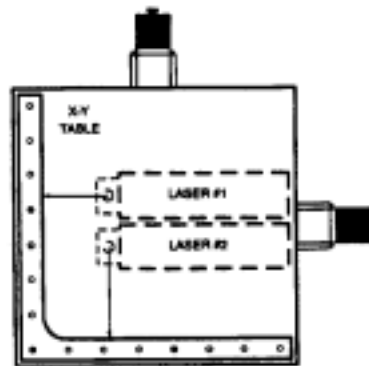


Fig. 1-2: X-Y Stage Measurement with LDS Narrow Beam Laser Beneath the Stage.

Specifications:

L-109 Laser Head:

Resolution: 0.1 microinches
Laser: 0.5 mw HeNe
Laser Stability: 0.1 ppm.

System Accuracy:

Resolution ± 1 ppm x travel (typical).

Range: 40 inches.
400 inches (optional)
2,000 inches (optional)

Dimensions: 2" x 2" x 8.5".

Retroreflector: 0.5 inches

Operating Environment:

Temperature: 60-90 degrees F
Altitude: 0 to 10,000 feet.
Humidity: 0-95% (Non-Condensing).

IHS Home Position Signal

Output: TTL Square Wave
Termination: 120 Ohms
Rise Time: 15 nsec
Pulse Width: 5 msec
Repeatability: $> 1\mu\text{m}$

IPP32 IBM 32-Bit Parallel Board

Position Counter Data Format:

32-bit two's complement digital word.

Position Counter Units:

Equal to system resolution.

Sample Delay:

Position counters readable 1.5 msecond
After sample command.

Slew Rate:

23.3 inches per second.

Resolution:

0.1 Microinche (0.0025 μm)

Position Error Data Format:

32-bit two's complement digital word.

Position Error Units:

Equal to system resolution.

Update Time:

0.200 mseconds after falling edge of Error
Clock.

Hold Response Time:

0.267 mseconds after falling edge of Hold.

Update Rate and Error Clock:

937.5 kHz

Data Age:

Less than or equal to 3.4 mseconds

P-501 28-Bit Plug-In Board

Position Counter Data Format:

28-bit two's complement digital word, and
8-bit ADC.

Resolution: 6 microinches

Slew Rate: 45 ips

ATCC Automatic Pressure and Temperature Compensation

(For use with P-501 Board Only)

Temperature:

Range: 60-90°F (15-32 °C)

Accuracy: 0.18°F (0.1 °C) for both air
temperature and material temperature sensor

Pressure:

Range: 25-32 in Hg (635-813 mm Hg)

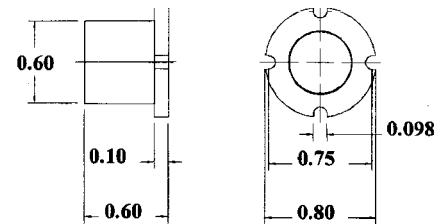
Accuracy: 0.05 in Hg (1.3 mm Hg)

Cable: 4 ft., standard (1.25m)

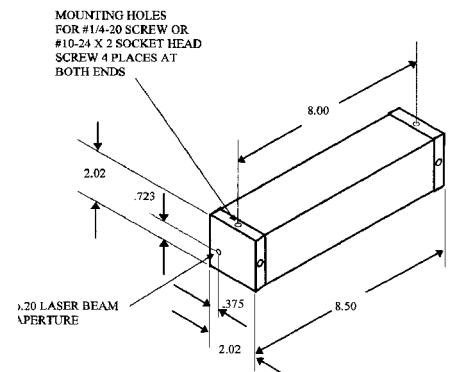
12, 36, ft available (3.5, 11m)

Application Support

Optodyne's qualified team of engineering
professionals to assure that your application
receives full benefit from your laser system
provides engineering support.



R-102A Retroreflector



UNITS: INCHES

L-109 Laser Head



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