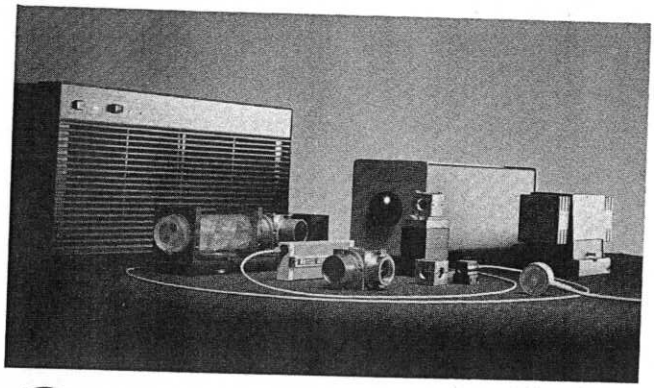
DIMENSIONAL MEASUREMENTS

Laser Interferometry Measurement Systems

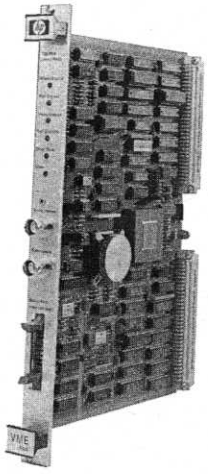
HP 5527B, 5528A, VMEbus, 5501A

- High accuracy and resolution
- High stability and repeatability
- Fast axis velocity
- Multiple optics
- Automatic compensation
- Remote sensing with fiber optics



NEW

HP 5527B system with the new HP 5517C laser head, 5507B electronics, HP 10780C receiver and the 10780F remote receiver.



HP 10895A VME laser axis board.

Precision Positioning Products

Hewlett-Packard precision positioning systems combine Michelson interferometery with a highly stabilized, two-frequency HeNe laser to measure linear distance, pitch, roll and yaw, flatness, straightness, squareness and parallelism. These systems also have the capability to compensate for changes in the refractive index of air. The resolution is 10 nm to 2.5 nm (0.4 to 0.1 microinches). Hewlett-Packard's patented two-frequency design makes measurements over distances up to 80 meters (260 feet).

These systems offer a wide selection of measurement optics and electronics that include the new HP 10780F Remote Receiver. The high sensitivity receivers permit measurements in six degrees of freedom. Applications range from OEM precision positioning stages such as IC wafer stepper systems, IC inspection and repair systems, and flat panel systems, to optical and magnetic servo track writers, as well as precision cutting and measuring machines, to general-purpose metrology.

Each system is made up of optics, electronics and laser heads. The optics are common to all systems. The electronics of the HP 5527B, VMEbus, and HP 5501A are designed to be built into precision positioning systems.

The HP 5528A Laser Measurement System is a single axis, easy-to-use, transportable measurement system with a wide range of applications. Examples of its use are fabrication (calibration of machine tools and coordinate measuring machines), manufacturing (precision alignment and positioning), R&D (non-contact measurements), and metrology (calibration of scales, gauges and surface plates).

System Components

HP laser transducer systems use common optics. Only the laser heads and the electronics, differ between systems. Outputs available are position, position error, A quad B, up/down pulse, and motor-drive. The technical data sheet for each system provides detailed information.

The optics and laser head for the HP 5528A are unique to that system but are compatible with the transducer system for special applications.

Laser Heads

Four laser heads are recommended for HP transducer systems; these are the HP 5517A, HP 5517B (500 mm/second axis velocity), 5517C (700 mm/sec) and HP 5501B.

The total accuracy of a transducer system is the sum of the errors from the laser head, the choice of optics, and the effects of the environment. All HP laser heads have a vacuum wavelength accuracy of ±0.1ppm (±0.02ppm with factory calibration to MIL-STD 45662A) and a demonstrated MTBF greater than 50,000 hours.

Optics

A variety of optics are available to optimize optical layout for a system. The HP 10702A Linear Interferometer is the basic measurement optic, and it is used with the HP 10703A Retroreflecter. The smaller HP 10705A Single Beam Interferometer and the HP 10704A Retroreflector are used where space is limited and low mass is required.

Plane mirror interferometers are normally required for X-Y stages and offer twice the resolution, at half the axis velocity of linear and single beam interferometers. The HP 10706B High Stability Plane Mirror Interferometer is insensitive to thermal effects and thus offers excellent stability. The HP 10715A Differential Interferometer offers the highest thermal stability.

The HP 10716A High Resolution Plane Mirror interferometer offers twice the resolution (2.5nm) with half the axis velocity of the other plane mirror interferometers.

Electronics

The electronics are the most significant differentiator of the transducer systems. Four basic outputs are available. Both open-loop measurement data and position error data for custom closed-loop positioning are available from all three transducer systems. A-quad-B with up/down pulse outputs, are available with the HP 5501A Transducer System's electronics. Closed-loop in the form of ±10V, PWM, and 16-bit binary, are available to drive motor amplifiers. These outputs are found on the HP 10936B Servo-Axis Board which is part of the HP 5527B Transducer System's electronics. Real-time 32-bit position output is available from the HP 10932B Axis Board - also part of the HP 5527B electronics. The new HP 10780C Receiver and the new HP 10780F Remote Receiver each work with all three systems.

Improving Accuracy and Repeatability

Maximum accuracy and repeatability requires compensation for certain parameters. HP laser interferometer systems depend on the high accuracy of the laser's wavelength. However, the wavelength of light in air depends upon the air's refractive index, which is a function of air temperature, pressure, and composition. In addition to the wavelength of light effects, errors can result from thermal expansion of the workpiece. To take full advantage of Hewlett-Packard's high wavelength stability, the HP 10717A Wavelength Tracker compensates for changes in the air's refractive index, and the new HP 10780F Remote Receiver eliminates thermal effects due to the receiver electronics. Product Note 5527A-2, describes in detail how to achieve maximum accuracy and repeatability. Further details on the transducer systems are provided on the following pages.