**Movement & Positioning News**
**M&P 19, 1995, Text Only Version**

**Contents:**



# It's Show time

PI will exhibit at the following shows:

LASER ´95, Munich
19.06 -23.06.95
Hall 02, Booth H10

Productronica, Munich
07.11. - 10.11.95

 

# News from PI Ceramic

### PL-031.12 Piezoelectric Multilayer Contraction Actuators

PI Ceramic introduces the new **PL-031.12** multi-layer contraction actuators. They can be used for pulling force generation, for example as actuators in multi-channel adaptive optics mirror applications. PL-031.12 make use of the $d_{31}$ piezo effect. They contract when a voltage is applied. PL-031.12 multi-layer contraction actuators are significantly less sensitive to pulling forces than conventional $d_{33}$ actuators since the actuator is strained along the ceramic layers, rather than perpendicular to the layers as with classic stacked actuators. PL-031.12 are co-fired multi-layer actuators with 40 µm layers.

### PL-031.12 Technical Data:

| | |
|---|---|
| Dimensions: | 4x2x12 mm [± 0.2 mm] |
| Operating voltage: | 0 to 100 V |
| Contraction: | 5 µm [± 20 %] |
| Capacitance: | 880 nF [± 20 %] |
| Loss factor: | $20x10^{-3}$ |

Photo: PL-031.12 Multilayer contraction actuator.

 

# New LabView Driver Extends Application Range of F-603 LightLine Fiber Positioner

PI offers a new LabView driver for the F-603 LightLine fiber positioner for additional flexibility. The new driver will be available in July '95 and will operate both IEEE 488 and RS-232 computer interfaces. Besides the basic LightLine commands a series of complex functions for automation tasks such as the Array Fast Scan and the 3D-AutoMax function (finds maximum intensity in a user defined 3D window) will be available.
The new driver complements the LightLine concept: a mechanical unit that allows computer control of all functions, a fully motorized travel range (PiezoWalk drive system), new functions for new applications implemented at any time.

While conventional fiber positioning systems can become out-dated shortly after the purchase, the EPROM/software operated LightLine gets better and more flexible with time.

**Advantage for PI Customers**: Since software is easily upgraded LightLine can be changed to meet future needs, to protect your investment.

 

# New DC-Motor Drives for M-125/150/155 Linear Stages

PI now offers new DC motor drives for the M-125, M-150 and M-155 (25, 50 and 100 mm) linear stages. The new drives complete the line of stepper drives and DC motor/gear head drives available to this point.

**Advantage**: The new drives extend the application range of the linear stages by increasing velocity and improving repeatability.

Three versions are available:

A) 3 watt motor with backlash-free gear head
B) 6 watt motor direct drive
C) 30 watt motor direct drive

| Drive | Resolution [µm] | $V_{max}$ [mm/s] | Fits DC-Motor Controller |
|---|---|---|---|
| A | < 0.05 | 1.5 | All PI controllers |
| B | 0,25 | 15 | C-832, C-804.50, C-808, other controllers w/additional amplifier |
| C | 0,25 | 40 | C-804.50, C-808, other controllers w/additional amplifier |

The new drive units are equipped with 15 pin D-Sub connectors. Part numbers for the linear stages are as follows.

Version A)

M-125.11: Linear stage, 25 mm travel, 3 W motor w/gear head
M-150.11: Linear stage, 50 mm travel , " "
M-155.11: Linear stage, 100 mm travel, " "

Version B)

M-125.40: Linear stage, 25 mm travel, 6 W motor, direct drive
M-150.40: Linear stage, 50 mm travel , " "
M-155.40: Linear stage, 100 mm travel, " "

Version C)

M-125.30: Linear stage, 25 mm travel, 30 W motor, direct drive
M-150.30: Linear stage, 50 mm travel, " "
M-155.30: Linear stage, 100 mm travel, " "

 

# PI ISO 9001 certified.

Over the last few years, ISO 9000 has become a magic buzzword.
It is a new quality standard established by the International Standard Organization (ISO), now accepted by more than 70 countries around the world.

ISO 9000 means total quality in design/manufacturing/service. The idea behind ISO 9000 is improvement and standardization of quality systems throughout the industry to reduce failure rates from “percent” to “parts per million”.

If manufacturer A buys from ISO 9000 certified supplier B, A can significantly reduce costs for inspection since the parts from B already comply with a high quality standard. At the same time, supplier B can save money because of reduced warranty repairs.

Achieving ISO 9000 certification requires a great deal of time and energy. All processes from design to delivery have to be well defined according to certain schedules. ISO 9000 means integrating quality procedures throughout each process rather than checking for poor quality at the end of the process. ISO 9000 also requires that every employee be well educated in the new quality system.

**Advantage for PI customers**: further improved quality without additional costs.

 

# New Accessories for F-603 LightLine Fiber Positioner

The following new accessories are available for the F-603 LightLine fiber positioner:

| | |
|---|---|
| F-603.07 | Photodiode for IR range |
| F-603.11 | Objective holder W 0.8 x 1/36 |
| F-603.12 | Objective holder M19 x 0.75 |
| F-603.13 | Objective holder M25 x 0.75 |
| F-603.14 | Objective holder M26 x 0.75 |
| F-603.20 | Vacuum Waveguide Mount |
| F-603.21 | FC Connector |
| F-603.22 | Fiber Holder |

## Bildunterschriften:

F-603.11 Objective Holder W 0.8 x 1/36”
F-603.20 Vacuum Waveguide Mount
F-603.21 FC Connector
F-603.22 Fiber Holder

 

# P-735 X-Y-F Monolithic Piezo Stage for Deep Etch X-Ray Lithography at Jenoptik Systems Technology Division

The new Jenoptik X-ray scanner was developed for manufacturing microstructures up to 1000µm thick from X-ray sensitive polymer film (resist). The scanner will mainly be used for microsystems technology, a future key industry. One of the basic microsystems technologies is the LIGA process (LIGA = German acronym for Lithographie, Galvanoformung, Abformung). By means of synchrotron radiation , the shadow of an absorber relief (mask) is projected onto the resist.

LIGA allows the fabrication of three-dimensional microstructures such as micro motors and micro gears with extreme structural heights and high aspect ratios. Figure 1 shows a micro gear, manufactured with LIGA.

Three dimensional structures require a multi-exposure system. Between the exposures the resist has to be removed and reinstalled. Perfect alignment between the mask and the resist is required for high accuracy structures. For this task the PI P-735 X-Y-Φ monolithic piezo stage is used in combination with a CCD camera (see figure 2). P-735 offers a linear travel range of 100x100 µm and a rotary range of 1 mrad. Wire EDM (electric discharge machining) cut flexures provide accuracy second to none. The EDM technology allows manufacturing of all moving and non moving parts from one piece (monolithic) of aluminum, eliminating friction backlash and play.

The excellent repeatability of **40 nm and 0.25 mrad** is a requirement for microstructures with sub-micron accuracy.

Figure 1, Micro Gears
Figure 2, P-735 X-Y-Φ Piezo Stage in the Jenoptik X-ray Scanner.

 

# F-603 LightLine Fiber positioner for Testing of IOCs (Integrated Optic Circuits)

A research team at the opto-electronic group "Aufbau- und Verbindungstechnik" of the Fraunhofer Institute for Reliability and Micro-Integration (IZM) Berlin, Germany successfully employs F-603 LightLine fiberpositioners for research on fiber-to-fiber, fiber-to-IOC (Integrated Optic Circuit) and fiber-to-IOEC (Integrated Opto Electronic Circuit) coupling.

Positioning systems for these research applications have to meet the following requirements:

- Position resolution of 10 nm for fiber-to-waveguide coupling.
- Positioning range of several mm with sub-micrometer repeatability and zero backlash due to the typical distance of 150 to 250 µm between the tracks in the waveguide.

Optimization of the positioning process can only be achieved by measuring and monitoring optical intensity and power distribution of the fiber/chip interface during the process.

After considering several options, the IZM found that the F-603 LightLine fiber positioning system would best meet these requirements. Two F-603 are used to test splice properties between polarization preserving fibers and passive IOCs. Melting splices and splices with newly developed inorganic glue are tested for attenuation as a function of polarization.

Figure 1 shows a 1:4 chip, as used for the tests. The fiber-to-waveguide coupling has to be perfect on both sides of the chip to gain valuable and repeatable results. Therefore a fully automated precision positioning system such as the F-603 is required.

Conventional fiber positioning systems with automated travel ranges on the order of 50 µm cannot be used on the side with the 4 outputs since distance between the outputs is relatively large due to the outer diameter of the fibers.

The F-603 LightLine offers 6 mm travel and 10 nm resolution in X, Y and Z, ideal for integrated optics. In addition to the automatic alignment function, a scan function is available for areas up to 6 x 6 $mm^2$.

 

The integrated photo detector (visible or IR range) allows for automated intensity distribution measurements with sub-micron resolution.

Figure 2 shows intensity distribution of an 1:4 IOC recorded and printed with the standard LightLine software. The the software also offers a store to disk function for future manipulation of the data.

Figure 1, 1:4 Integrated Optic Chip,
Figure 2, Intensity distribution at the output of a 1:4 IOC, measured with F-603

 

# PI continues Expansion

On May 4, 1995 managing directors Dr. Karl Spanner and Liselotte Lossau turned the first sod for the new PI / Polytec building. The building will be completed February 28, 1996. With 5500 square meters, it will double the office space available to both companies.

Advantages for PI customers: The additional space will be used to further extend the PI R&D department. Also, a new test lab will be built. This new lab will meet standards set by the German PTB (national institute of standards and technology) e.g. temperature stability of 0.1° C, important for sub-nanometer range measurements.

Furthermore the new building will be equipped with new demo-, training and meeting-rooms. Aside from PI, the Polytec electronics and optics manufacturing will move into the new building.

Photo: Managing Directors Liselotte Lossau and Dr. Karl Spanner.

 

# 25 Years of PI

This fall the PI employees will celebrate the 25th anniversary of business. Following are some milestones in the PI history.

| | |
|---|---|
| 1969/1970 | Physik Instrumente (PI) founded in the Munich area. |
| 1976 | First complete catalog with 230 pages and 1000 photos. |
| 1977 | Move to Waldbronn, close cooperation with Polytec, Dr. Karl Spanner managing director. |
| 1978 | First English catalog, increased research on the piezo sector, increased foreign activities |
| 1979 | Introduction of stepping motor controllers, piezo steppers, strip piezos, piezos for medical applications. |
| 1980/1 | First activities in the **USA** and **Japan** |
| 1982 | Introduction of piezos for adaptive optics, fiber positioning systems, sensor equipped piezos for closed loop operation. |
| 1983 | First office/manufacturing building together with Polytec, piezos for semiconductor manufacturing, precision machining. |
| 1986 | Addition of three more stories on top of the PI/Polytec building<br>Introduction of low voltage (100 V) Piezos |
| 1987 | Introduction of DC-motor controllers for PCs |
| 1988 | Introduction of monolithic piezo stages for industrial applications. |
| 1988/9 | Piezo Guide brochure in **English, French and German.** |
| 1990 | First 300 page hard cover catalog in English and German. |
| 1993 | Founding of PI daughter companys PI Ceramic (Germany),<br>Polytec PI S.A. (Paris, France together with Polytec)<br>PI Polytec KK (Tokyo, Japan)<br>Introduction of the fully digitally controlled fiber positioning system LightLine, |
| 1994 | Buy out of Lambda Photometrics, England, (with Polytec).<br>Introduction of capacitive displacement sensors |
| 1995 | Start of the new building (see article “PI continues Expansion”) |

Over the last 25 years PI has operated according to the motto: quality, service, stability, continuous growth. In contrast to competitors, PI never had to lay off employees due to a poor economy.

If you buy from PI today, our service policy and technical assistance will make sure that your investment will be protected tomorrow.

 

 

# New C-804.50 DC-Motor Controllers with integrated 30 Watt amplifiers

The new C-804.50 is the latest member of the C-800 family of 4- channel DC-motor controllers. C-804.50 is based on the C-804.20 motor controllers but it supplies output power of 30 watts (10 times the power of the C-804.20). The C-804.50 is well suited for linear and rotary positioners with fast direct drives. (See article "New DC-Motor Drives for M-125/150/155 linear stages" and "New DC-Motor/Encoder Drive Units")

Figure: C-804.50

 

# New C-842 DC-Motor Controller for PCs

The new C-842 PC plug-in board motor controller is the optimal solution for applications where a multi-axis precision positioner has to be computer controlled by a PC. Integrated amplifiers (!) allow operation of PI micropositioning systems with motor/gear head drives without additional external amplifiers, reducing costs and simplifying the set-up.

The C-842 motor controller offers the following advantages:

- Simultaneous control of up to 4 DC servo-motors
- Digital PID control with individual setting of all parameters by software
- Integrated amplifiers for motors up to 3 watts
- PC bus compatible, less costly than bench-top controllers.
- Extensive, easy-to-use programming language
- Powerful software with drivers for C, PASCAL and BASIC included
- Hardware interrupts for process control
- Extremely fast communication with optional Hex commands
- Compatible with all motorized PI micropositioners
- Integrated I/O lines for flexible automation

C-842 will be available in fall 1995.

 

 

# Visit the PI Booth at LASER ´95

LASER is the most important show for lasers and electro-optics in Europe. This year, the biennial show will take place at the Munich fair grounds, Munich, Germany. The exhibition will be open June 19 to June 23. As always, PI will exhibit new products at this show. Aside from the standard piezo actuator and precision positioner product lines, the new M-800 Hexapod 6-degrees-of-freedom micropositioning system will be displayed. This system was recently awarded the coveted Photonics Circle of Excellence Award at the CLEO show in Baltimore, USA. In addition to the M-800, other new micropositioning products will be shown, and the F-603 fiber positioning system with new, extremely fast scanning and automatic alignment software will be demonstrated. Together with sister company Polytec, PI will exhibit on close to 300 square meters in Hall 10, booth H10.

 

**Several Examples:**

**Line Scan**: 1D Scan, graphic data output, data storage to disk.

**Line Fast Scan**: As above, no graphic data output during scan for reduced scan time.

**Array Scan**: 2D Scan, graphic data output, data storage to disk.

**Array Fast Scan**: As above, no graphic data output during scan for reduced scan time.

**2D-AutoMax**: Finds maximum intensity within a pre-defined 2D window.

**3D-AutoMax**: Finds maximum intensity within a pre-defined 3D window.

Parameters such as window size, resolution, etc. are user selectable.

# All-Fiber Q-Switched Laser Based on PI P-244 Piezos

A research team from the National Optics Institute (Quebec, Canada) reports the development of an all-fiber Q-switching device for fiber lasers (patent pending). This novel optical fiber modulator uses a PI P-244.17 translator to move a dielectric pad into intimate contact with the surface of a side-polished fiber. When the pad is rapidly moved away from the fiber, the switch opens and a so-called Q-switched giant laser pulse is generated. Applications for Q-switched fiber laser sources are in scientific and industrial areas, including nonlinear optics, telecommunication and remote sensing.

The key to the successful operation of any Q-switch device is to open it fast enough to follow the intrinsically fast dynamic of the laser. For the NOI laser, a maximum switching time of a few tens of nanoseconds was specified. Because the required displacement of the pad is very small, typically less than 100 nm, and the “switching” begins at zero velocity, the initial acceleration alone determines the switching speed of the device. PI preloaded piezoelectric translator P-244.17 was chosen for this critical application because it can easily produce very high accelerations, says laser product engineer Gilles Larose. Interferometric measurements at NOI showed that peak accelerations of 180 km/s$^2$ (18,000 g!) can be attained at the surface of a free standing pad. The 10 µm displacement range of the P-244.17 was also considered essential to allow enough room for active compensation of the thermally induced device length variations. Reliability

 

studies are under way with nearly one billion pulses completed at 50 Hz without change in performance. The piezoelectric Q-switch is the heart of an erbium-doped Q-switched fiber laser developed at NOI.

Photo: Q-Switched Erbium Fiber Laser. Courtesy of NOI.

Drawing: Schematic representation of the Q-switched erbium fiber laser. Or if enough space: Top view of optical module showing the laser diode and the Q-switch piezo modulator.

 

# New DC-Motor/Encoder Drive Units

The new C-136.10, C-138.10 and C-142.10 DC-motor drive units offer the following advantages:

- Compact design
- Compatible with most PI linear/rotary stages
- Integrated differential drivers for the encoder output signals for motor cables up to 10 m
- Integrated 15 pin D-Sub connector for motor power, encoder signals and limit switches
- 12 V operating voltage

| Drive Units | C-136.10 | C-138.10 | C-142.10 |
|---|---|---|---|
| Resolution [°/Encoder pulse] | 0.006 | 0.18 | 0.18 |
| $V_{max}$ [RPM] | 3.3 | 100 | 100 |
| Power [Watts] | 3 | 6 | 30 |
| Torque [Ncm] | 10 | 2 | 6 |
| Fits PI Motor Controller | All PI DC-Motor Controllers | C-832, C-808, C-804.50 [1)] | C-808, C-804.50 [1)] |

[1)] Other controllers with additional amplifiers

# It’s Show time

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