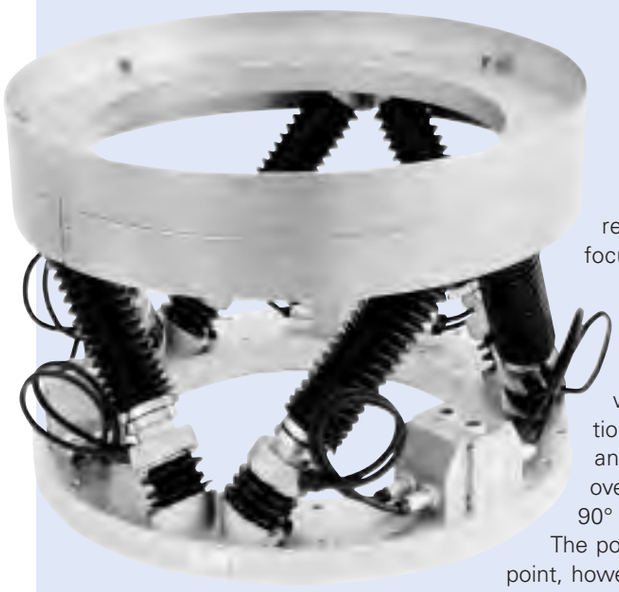
Where did we come from?

Pointing a big eye at the sky



PI Custom water-proof Hexapod for Vertex, for micrometer-accurate positioning of the secondary reflector

ALMA plans to research the origins of the earth using a massive array of 12-meter (39 ft) radio telescopes built by Vertex Antennentechnik in Duisburg, Germany. And PI will be at the focus.

ALMA, a joint project of the European Southern Observatory (ESO) and the US National Science Foundation (NSF), aims to establish what will be the world's highest-elevation full-time observatory, to be situated in the Atakama Desert in Chile.

ALMA is an acronym for "Atakama Large Millimeter Array." With its 64 twelve-meter antennas spread out over an area 10 kilometers (6 miles) in diameter, it will able to produce images with a resolution today unobtainable. By synchronous analysis of the signals from the antennas, data from a given object will be as sharp as if obtained from a single telescope with a diameter of 3 km (10,000 ft).

To obtain this level of quality, each 12-meter antenna may deviate only minimally from its ideal shape: the surfaces must stay within 18 µm of their nominal positions. The resulting precision is sufficient to resolve a 5 mm copper disk at 200 km.

The signals from the primary antenna are reflected to a secondary reflector at the focus. The relative position of this reflector may shift slightly due to changes in wind or gravitational loading as the antenna sweeps over angles of up to 90° across the sky. The position of the focal point, however, must be stable. In order to achieve the necessary orientation of the secondary reflector, its position must be trimmed in five dimensions: three linear and two rotational. That job is accomplished by a PI Hexapod, specially designed to mate with the system and achieve the required accuracy while meeting the stringent loading and environmental requirements.

PI has been supplying Hexapods for optical and radio telescopes since 1994. These applications, which start out as purely scientific, have extremely high requirements for accuracy, resolution, reproducibility, stiffness and, of course, reliability of both the mechanics and the controllers—all under the harshest of environmental conditions. The design work done for these scientific applications has again and again proved of value in our daily life: for example in designing Hexapods for metrology of complex shapes like turbine blades, in antenna technology (telecommunications satellites) and medical technology (mechanical simulation or operating room robots).

A major advantage of the Hexapod design lies in its drive principle, in which six parallel linear actuators drive the platform in six different directions at once. This gives the system maximum potential.

Axes of rotation, for example, are not implemented with a rotating shaft or gombus, but are freely definable in space. And the mass being moved is a function of the platform and its load alone, unlike systems with a stack of linear and rotational stages loading each other down. This makes the dynamic characteristics of all axes virtually identical. In addition, the symmetrical arrangement of the drives provides maximum stiffness. PI's standard Hexapod (the M-850), itself with height and diameter of 350 mm (14 in) and weighing only 17 kg (37 lbs), can lift 200 kg (440 lbs) and has a stiffness of 100 N/µm (570 lbf / thousandth inch). A comparable stacked system would be much heavier and occupy many times as much space. These characteristics make Hexapod technology indispensible in applications like radio and optical astronomy.

With this planned array of 64 radio telescopes, not only is ALMA breaking new ground for science, but so is PI—in terms of the extreme climatic conditions in which its Hexapods will be performing under load.

ALMA in the Chilean desert (truck for size comparison)

FIND PI AT

Semicon West, San Francisco, CA (USA)
July 22-24, 2002

Photonics Korea 2002, Seoul (Korea)
September 2002

ECOC Copenhagen (Denmark)
September 09-11, 2002

NFOEC, Dallas, TX (USA)
September 17-18, 2002

Diskcon, San Jose, CA (USA)
September 18-19, 2002

Photonex in Coventry (UK)
October 17-18, 2002

electronica München (Germany)
November 12-15, 2002

BIAS 2002 in Milan (Italy)
November 19-23, 2002

NEWS
Movement & Positioning
PI
www.pi.ws
Issue 2/2002

EDITORIAL

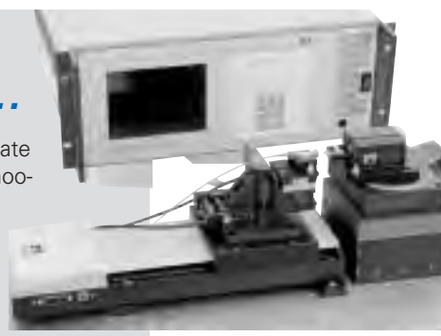
The year 2001 was shaped politically by the terrorist attacks of September 11 and their consequences. Economically, it was a year of recession and saw the collapse of the telecommunications market, in which a good many investors lost large amounts of money, and a large number of wage earners lost their jobs.

For PI, the year 2001 was a year of great upheaval and investment. Almost simultaneously, new buildings were being built at three sites. At the new company headquarters in Karlsruhe, Germany alone, over 15 million euro was invested in buildings and equipment. An extension with over 5,000 m² (54,000 ft²) of useable space has just been finished for PI Ceramic in Lederhose, Germany and is now ready for occupation. And in Auburn, Massachusetts USA, our subsidiary Polytec PI Inc. moved into its own new building at the end of December.

In addition to the purely material investments, a lot of time and money was invested in the reorganization of our manufacturing processes. Our manufacturing was organized into sections operating virtually independently, in accordance with the concept of the Fraunhofer Institute for Manufacturing Engineering and Automation (IPA.) With the help of Japanese/German consultants, Kaizen workshops were regularly held in order to increase quality and efficiency in a continuous-improvement process. Phrases such as "Kanban" and "Demand Flow Technology" are now everyday words at PI.

Invigorated in this way, we are now able to tackle the challenges of the future.

C-880 Multi-Axis Automation Controller – All for one…



Configuration example from the field of fiber optics:
A C-880 controls a combination of (on the left, from bottom to top)
M-521.DD (translation stage with 250 mm scanning range in X),
2x M-111.1DG (small translation stages with 5 mm scanning range in Y and Z),
Nanocube P-611 (piezo NanoPositioning stage 100 µm in X,Y and Z) and (on the right)
M-501.1PD (vertical stage with 12.5 mm travel range in Z), an M-061.DG (rotatary stage) and a fiber rotator F-210.DG1 (rotation about the X-axis)

… and one for all. No, we are not going to tell you the story of the famous adventures of the Three Musketeers, nor are we going to attempt the impossible and try to make a connection between these gentlemen and PI's new Multi-Axis Automation Controller. But the maxim applies nevertheless: see for yourself.

C-880 Multi-Axis Automation Controller—19 motion axes—19 times more flexible

All for one—the C-880 is designed as an automation platform for widely different applications. It offers the possibility of combining up to 19 axes, or of combining axes with additional function modules, to create an single control unit incorporating all hardware and software. The C-880 is based on the same controller hardware as the PI Hexapod F-206 and M-850 positioning systems.
The C-880 consists of a basic unit incorporating any of the available options. The basic unit is also available with optional front panel display and a softkey keyboard.
The Multi-Axis Automation Controller is itself controlled by a host PC. All the functions of the Automation Controller are controlled over a single RS-232 or by GPIB / IEEE488 port and software.

C-880 Multi-Axis Automation Controller— you can run piezo drives with nanometer resolution along side 300 mm motorized stages.

One for all—the C-880's strength lies in the fact that it can control and combine almost the complete range of drive options offered by PI, each with its own advantages. More particularly, you can have travel of 300 mm with a resolution of one nanometer. To facilitate the control of the drive units, the C-880 basic unit is equipped with the appropriate controller cards. In choosing the relevant control cards, you are limited only by the number of available slots in the basic module.
If you want to determine which combinations are optimal for your application, call your PI sales engineer.

C-880 Multi-Axis Automation Controller—multifunctional accessories for user- specific applications

The modularity of the C-880 is not limited to the choice of drives; it also applies to the system accessories.
For fiber optic applications such as alignment tasks, a photometer card is available. It enables you to combine a system designed for rapid and effective scanning with alignment software routines that meet to your specific requirements. In such cases, the manual control option for up to 12 axes can also prove useful.
Moreover, the C-880 can also be used for general microhandling tasks. With the power switch card general switching and pneumatic functions can be easily implemented. You can read more about this, and about the integration of vision systems in one of the future editions of Movement and Positioning.

Ask for our comprehensive product description for the C-880 Multi-Axis Automation Controller!

Dr. Rainer Glöss, Dr. Gabriela Kolbe and Kurt Zimmermann— the development team with the C-880.

C-880 Multi-Axis Automation Controller—multifunctional software and drivers

In order that you can fully use its diverse and complex features, the C-880 is supplied complete with comprehensive software tools. These comprise a user interface and a configuration program as well as driver and programming libraries for LabView™, Visual Basic and C++.

C-880 Multi-Axis Automation Controller— All for one— One for all

PI General Command Set Compatible

C-880 Drive Examples

P-611 NanoCube PZT NanoPositioning System. High-speed scanning, nanometer-level precision

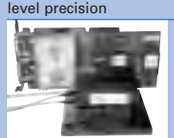
M-230 through M-235 Linear actuators. 50 nm min. incremental motion

M-110 series miniature translation stages. 60 x 62 mm footprint, 50 nm min. incremental motion

F-130 low-inertia hybrid photonics alignment system. PZT-drives / servo-motors

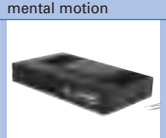
M-665 PZT linear motor translation stage. Compact, self-braking

M-501 elevator stage. 12.5 mm vertical travel, < 0.1 µm min. inc. motion

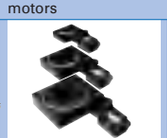


V-106 Voice-Coil-driven XY scanner. 6 mm travel, up to 5 Hz scanning rate. Direct-output metrology

M-500 series translation stages, 100 to 300 mm travel. High load, high resolution



M-605 compact translation stage. 50 mm travel, direct output metrology



M-060 to M-062 series rotation stages. Compact, high resolution

M-126 compact translation stage. 25 mm travel, < 0.1 µm resolution

F-210 fiber rotator. Compact, high resolution

PI

NanoPositioner in the Deutsches Museum

The Deutsches Museum (one of the largest museums of science and technology in the world) in Munich is preparing for the future. To celebrate its centenary, it is creating a New Technologies Centre—a forum dedicated to science and technology and their importance in the future.

The New Technologies Centre focuses on the key technologies of the 21st century: digital, software-supported technology on the one hand, and genetic engineering and nanotechnology on the other.

An important component of the New Technologies Centre, apart from the visitors' laboratory and changing special exhibitions, is the "fishbowl" research laboratory with live links to the science theater.

A central element in the laboratory will be an atomic-force microscope. It will give visitors a better understanding of a tool which is indispensable in nanotechnology and genetic engineering.

For this special application, the Deutsches Museum chose a specially configured atomic force microscope from WITec, a company in Ulm, Germany. And the scanning unit in this microscope is a PI NanoPositioner and Scanner of the P-500 series, a unit also used in other WITec microscopes.

The acqisition of this atomic force microscope was made possible by the generous support of both WITec Wissenschaftliche Instrumente Technologie GmbH and Physik Instrumente (PI) GmbH & Co. KG.

Turret and objectives of a WITec atomic force microscope with P-527 NanoPositioner.

Inroduced at the OFC

The Photonics Process Platform:

A multi-vendor platform solution for real-world production applications
Open-architecture approach lets integrators choose best-of-breed subsystems

The photonics industry's needs for systems integration include:

- *The traditional need* of independent systems integrators for a cost-effective, low time-to-market software and hardware architecture for photonics process applications whichthat can incorporate best-of-breed equipment from diverse manufacturers.
- *The emerging need* of integrators operating within photonics device manufacturers for a platform solution that minimizes programming requirements. The Photonics Process Platform is intended to address these needs. Through its open, extensible architecture and unique high-level, menu-driven *Automated Sequencer* approach, it allows the integrator to utilize best-of-breed subsystems cost-effectively and develop supportable, production-worthy applications rapidly.

The Photonics Process Platform is a flexible platform-level solution that both professional and in-house integrators can use to quickly and cost-effectively construct flexible, supportable automated production tools. It integrates subsystems in the fields of pick-and-place robotics, alignment microrobotics, laser drivers, metrology, video, switches and others from the wealth of those in the industry.

A programming-free *Automated Sequencer* software package from L-3 Communications Analytics Corporation is at the heart of a collaborative demonstration of a real-world multi-vendor flexible platform unveiled at OFC 2002. The team effort also includes:

- FANUC Robotics (pick-and-place robotics)
- PI (NanoAutomation® microrobotics),
- Ixion Technologies (photonics packages),
- National Instruments (analog, digital and video interface hardware and software)
- Technical Manufacturing Corporation (ergonomic vibration-isolation table)

The result is a uniquely versatile approach for rapid development of photonics production automation for packaging and characterization —without programming, and without the compromises inherent in single-vendor, vertically-integrated options.

Figure 1. The Photonics Production Platform allows cost-effective integration of best-of-breed automation subsystems without programming. As exhibited at OFC 2002, shown working together above are:

FANUC LR Mate 100iB pick-and-place robot, which serves Ixion packages containing an optical I/O chip

PI F-206 alignment microrobot inset into a TMC isolation table.

A machine-vision camera monitors the operation, verifying device placement. System automation is sequenced by a menu-driven sequencing software package by L-3 Communications Analytics

Integrating multiple PolytecPI HexAlign™ 6-DoF Micro-Hexapod alignment engines and FANUC Robotics' new LR Mate 100iB robot for assembly / material handling, the platform can accommodate virtually any photonic device. The demo displayed at OFC 2002 also showed Ixion's optical packages, featuring the latest in ceramic design and lightweight, high thermal packaging concepts.

Advantages of the joint system:

- Ideal platform for professional systems integrators and in-house integration efforts
- Select best-of-breed subsystems; integrate with a mouse-click—no more single-source compromises!
- Single- or dual-microrobot configurations accommodate virtually any photonic device
- Ergonomic, thermally-stable, low-profile design
- Economically reconfigurable as devices or production needs change
- Ideal for packaging and test applications for MEMS, waveguides, SOAs, laser diodes, DWDM passive devices...
- Five- or six- axis industrial robot with 65,000 hour MTBF

PUBLISHER

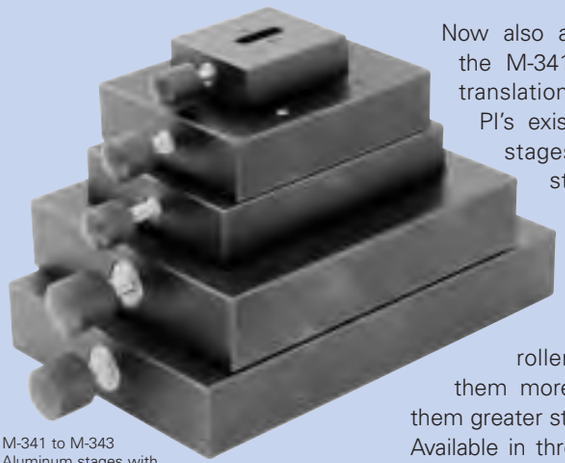
Physik Instrumente (PI) GmbH & Co. KG
Römerstrasse 1 · 76228 Karlsruhe, Germany

Responsible for the contents: Dr. Karl Spanner

Editorial staff: Steffen Arnold

Production: Systemedia, Pforzheim, Germany

IUM - ALUMINIUM - ALUMINIUM - ALU



M-341 to M-343
Aluminum stages with
crossed roller bearings

Now also available in aluminum: the M-341 to M-343 series of translation stages supplement PI's existing range of manual stages with models constructed of stress-relieved aluminum.

These translators, as well as the ones made of steel, are available with crossed roller bearings to make them more durable and to give them greater straightness of travel.

Available in three widths (30, 54 and 80 mm) and with travel ranges from 5 mm to 50 mm, the stages can be used in a wide spectrum of applications.

The M-341 to M-343 series are equipped with standard fine-pitch screw drives with a pitch of 0.5 mm / turn. This is sufficient for many applications and keeps the purchase price down. Of course, we can also build them with micrometer drives or, for some versions, with our DC-Mikes (motorized micrometer drive).

Up up and away with the Apollo controller

Just the performance, that is—not the price. The PI Apollo Controller (C-630.32) is an inexpensive controller for all PI positioners with 2-phase stepper motors (".2S" versions).

Now, all of PI's micropositioner lines feature less-expensive versions with stepper motors.

Stepper motors bring price advantage

PI uses stepper motors only for systems without position feedback. This keeps costs down, since the motor does not have to be equipped with an encoder. In addition, the cost of ownership of stepper motors is low: they have no moving contacts that regime regular maintenance.

Micro-step operation for high-resolution and position accuracy

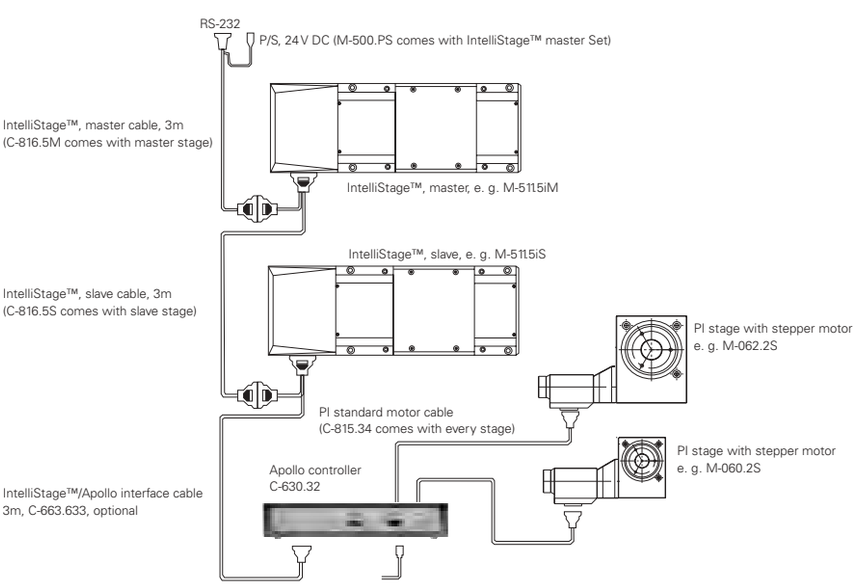
Resolutions of up to 20,000 steps per revolution can be obtained with PI motors and controllers. This makes 50 nm resolution and 200 nm unidirectional repeatability quite feasible, as demonstrated by high-precision PI stepper motor positioners such as the M-235.52S-series Mikes (motorized micrometers).

Flexible networking for process automation with IntelliStage™

Compatibility with our IntelliStage™ line was a major consideration in the development of the Apollo controller. IntelliStage™ is the line of linear stages with integrated controllers, travel ranges up to 300 mm (M-522.5iM, M-521.51M and M-531.5iM), extremely good flatness of 1 µm per 100 mm travel and repeatabilities of 0.2 µm. Intellistages can be daisy-chained in a network off a single host PC serial port. That network can now be expanded to include Apollo controllers with, for example, rotary stages. A typical 4-axis network is shown in the illustration. Such a network can control up to 9 stepper-motor-driven axes.

Typical network configuration including Apollo controller

Network diagram of illustrated system



P-733 for ultra-high vacuum (down to 10^{-6} hPa). The choice of material also allows use in electron beam and other environments where the assembly must be completely non-magnetic and non-magnetizable.

Vacuum Nano-Stages

For many years, PI has enjoyed great success in the special development of custom designed piezo stages with flexures suitable for use in a vacuum. In the future, PI will offer standardized modifications to the P-733 and P-517 to P-528 series for such applications. The advantage of this standardized solution is that it is cost-efficient to produce them in larger series and the customer benefits from PI's vacuum expertise.

All components were tested and selected for their suitability for use in vacuum by means of the certification system of the DLR (German Aerospace Center), which specifies the maximum outgassing rate.

The piezo stages are supplied for two pressure ranges:

- ***High-vacuum range, compatible down to 10^{-6} mbar (hPa) (1.5×10^{-8} psi)***
- ***Ultra-high-vacuum range below 10^{-9} mbar (hPa) (1.5×10^{-11} psi).***

The ultra-high-vacuum version is further distinguished by its use of non-magnetic materials.

This new vacuum series is supplemented by standardized vacuum-compatible connectors.

We offer the choice of either Lemo- or sub-D connectors.

With these new products, PI is able to fulfill a great many customer requests and also meet the current demands of the semiconductor industry. A low outgassing rate, certified by a renowned institute, is indispensable in research and industry.

Of course, in the future, we will continue to offer custom designs in response to special customer requests, wherever technically feasible.

How can one improve the Mercury™ Controller, the universal single-channel motor controller, even more?

The product already offers (almost) everything required for industrial positioning:

- Easy to program
- Motion parameters can be stored for operation without host PC
- Compact case
- Up to 16 axes can be daisy-chained for flexible automation tasks
- Low price and extremely high reliability

The few remaining wishes are now fulfilled by the Mercury™ II (C-862.00):

- 8 digital I/O channels
- 3 analog inputs
- Industrial case with mounting brackets
- Low dissipation due to use of DC/DC converter
- Address setting via external DIP switch

Mercury™ II Controllers in a network

Most important is the fact that the Mercury™ II (product code C-862.00) is **100% compatible with its predecessors**—it even costs the same. It can therefore be operated in the same network. So you don't have to forego any of the Mercury's valued advantages.

Furthermore, the Mercury™ II offers you, the user, features which further simplify its operation. These include externally accessable DIP switches for setting the network address, thus obviating the need to open the case. The network cable between the Mercury™ II controllers is now a standard RS-232 cable, which is cheaper to buy in various lengths (naturall, the network cable for the Mercury's predecessor is also included).

A significant improvement, and one introduced in response to numerous customer requests, is the provision of 4 digital inputs and 4 digital outputs as well as three analog 8-bit inputs from (firmware version 7). The Mercury™ Controller can thus be easily and completely **integrated into your existing application environment,** especially since the software includes comprehensive libraries and drivers.

HEADQUARTERS

GERMANY
Physik Instrumente (PI)
GmbH & Co.
Auf der Römerstrasse 1
76228 Karlsruhe
Tel: +49 (721) 4846-0
Fax: +49 (721) 4846-100
Email: info@pi.ws
http://www.pi.ws

GERMANY
PI Ceramic GmbH
Lindenstrasse
07589 Lederhose
Tel: +49 (36604) 882-0
Fax: +49 (36604) 882-25
Email: info@piceramic.de
http://www.pi.ws

GERMANY
Berlin Sales Office
Polytec - Physik Instrumente
Vertriebs- und Beratungsbüro Berlin
Schwarzschildstrasse 1
12489 Berlin
Tel: +49 (30) 6392-5140
Fax: +49 (30) 6392-5141
Email: piBerlin@pi.ws
http://www.pi.ws

SUBSIDIARIES

USA West (Mexico)
Polytec PI, Inc.
1342 Bell Avenue, Suite 3A
Tustin, CA 92780
USA
Tel: +1 (714) 850 1835
Fax: +1 (714) 850 1831
Email: info@polytecpi.com
http://www.polytecpi.com

USA East (Canada)
Polytec, PI, Inc.
16 Albert St.
Auburn, MA 01501
USA
Tel: +1 (508) 832 3456
Fax: +1 (508) 832 0506
Email: info@polytecpi.com
http://www.polytecpi.com

JAPAN
PI-Polytec Co., Ltd.
2-38-5 Akebono-cho
Tachikawa-shi
Tokyo 190-0012
Tel: +81 (42) 526 7300
Fax: +81 (42) 526 7301
Email: info@pi-polytec.co.jp

JAPAN
PI-Polytec Co. Ltd.
Hanahara Dai-ni Building, #703
4-11-27 Nishinakajima,
Yodogawa-ku, Osaka-shi
Osaka 532-0011
Tel: +81 (66) 6304 5605
Fax: +81 (66) 6304 5606
Email: info@pi-polytec.co.jp

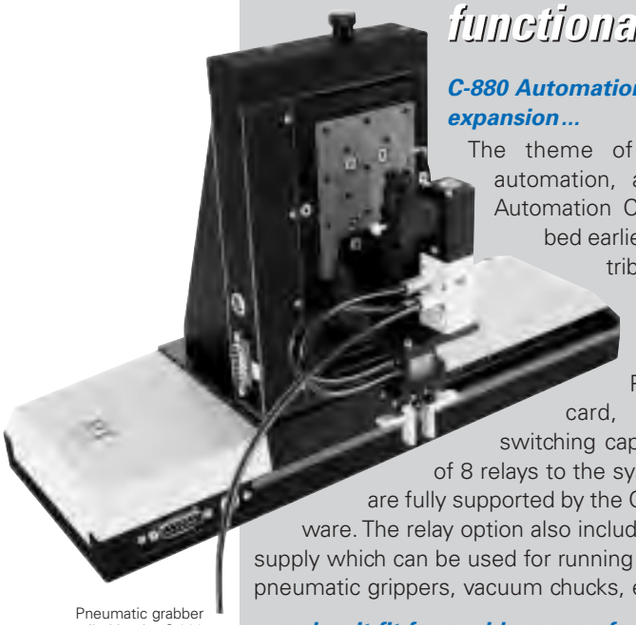
GREAT BRITAIN
Lambda Photometrics Ltd.
Lambda House
Batford Mill
Harpenden, Hertfordshire
AL5 5BZ
Tel: +44 (1582) 76 43 34
Fax: +44 (1582) 71 20 84
Email: info@lambdaphoto.co.uk
http://www.lambdaphoto.co.uk

FRANCE
Polytec PI S.A.
32 rue Delizy
F-93694 Pantin Cedex
Tel: +33 (1) 48 10 39 30
Fax: +33 (1) 48 10 08 03
Email: pi.phot@polytec-pi.fr
http://www.polytec-pi.fr

ITALY
Physik Instrumente (PI) S. r. l.
Via E. De Amicis, 2
I-20091 Bresso (MI)
Tel: +39 (02) 665 011 01
Fax: +39 (02) 665 014 56
Email: info@pionline.it
http://www.pionline.it

More PI News: Click here: http://www.pi.ws/e_news

Now with relay switching functionality



Pneumatic grabber controlled by the C-880 controller with the C-880. R8 Power Switch card. It is operated as a complete system with the two M-505.4PD stages providing motion axes in the horizontal direction and the M-605.2DD in the vertical direction.

C-880 Automation Controller expansion…

The theme of this issue is automation, and PI's C-880 Automation Controller described earlier is a major contribution. Now the C-880 is being expanded with the optional Power Switch card, which adds switching capability of blocks of 8 relays to the system. The relays are fully supported by the C-880 driver software. The relay option also includes a 24 V power supply which can be used for running solenoid valves, pneumatic grippers, vacuum chucks, etc.

…makes it fit for a wide range of new tasks

Photonics packaging is not the only application for this system. In the semi-conductor industry, lining wafers up to a guide or picking up parts in a vacuum chuck are examples of pre-positioning processes that can now also be controlled by the C-880. More classical examples are pick-and-place operations involving control of grippers. Or in biotechnology, the positioning of a pipette to within a few micrometers followed by a carefully controlled dosing operation. All such positioning and switching operations can now be controlled in one unit: the C-880 Automation Controller.

The world's biggest piezos?

No! Although PI enjoys being responsible for a number of sensational innovations in nano-scanning technology, what you see here are "only" two granite pillars, each around 3 m high. Only recently erected, they now adorn the entrance area of our new company headquarters in Karlsruhe, Germany. The pillars are a kinetic sculpture by the artist Christian Tobin **(www.c-tobin.de).** The pillars of „emerald pearl", a chrystaline magma from southern Norway, each weighs over 5 tonnes and rotates about its longitudinal axis on a film of water at almost 4 bar (60 psi). The sculpture was inaugurated as part of the dedication celebrations in June.

Christian Tobin produced this work of art for the entrance to our new company headquarters in Karlsruhe, Germany.

PI General Command Set

PI has introduced a common command set which is to be valid over the full range of multi-axis closed-loop systems. Known as the PI General Command Set, it follows the time-proven structure that was introduced with the M-850 and F-206 Hexapod systems.

Unified command structure—simplified programming tools

The PI General Command Set means that in the future you can program high-resolution piezo systems in exactly the same way that you program multi-axis Hexapods or stacked micropositioning systems. Even if the different devices are connected to different controllers, they are still controllable using the same commands. When producing application-specific software, the user/programmer does not need to "change gears" when going from one device to another, because they all understand the same command language. This is a very interesting development, as it makes it possible to communicate with a wide range of devices using a single software interface, such as LabView™.

In developing the PI General Command Set, care was taken to avoid the square-peg, round-hole problem. Taking compatibility too far would have meant the loss of many useful features of other command sets, such as the speed advantage of binary commands or the short ASCII codes used in single-axis systems. For those who need them, the native command sets are all still available.

The switch from a multitude of different command sets to the PI General Command Set (implemented in software libraries, LLB, DLLs) is to achieve compatibility between the different systems. When PI introduces new controllers, it is important that our customers see a high degree of compatibility to their current systems and software. This compatibility is also implemented in the DLLs.

Newly developed systems will always support the PI General Command Set, but each will still retain its own optimized individuality.

Commands consisting of very short strings, like those used with the primarily one-axis serial networkable controllers (Mercury™ and Apollo/Intellistage™, assure rapid communication over an RS-232 link. However, these networks can also be commanded using the PI General Command Set. The commands are then transmitted via a software library—with some speed penalty but with the advantage of compatibility.

More PI News: Click here: http://www.pi.ws/e_news