Servo & Stepper Motor Controllers
Motion Control Solutions for DC Motors, Stepping Motors & Piezo Motors
Selection Guide: Motor Controllers
For Servo Motors and Stepper Motors, Piezo Motors and Hybrid Systems

PI offers a large variety of innovative motion control solutions for precision micropositioning devices from classical stepper motors, ceramic linear motors to fast voice-coil-driven scanners and complex Hexapod 6-degree-of-freedom robots. Standard controllers handle up to 18 axes. Custom systems have been built capable of coordinating up to 273 axes.

<table>
<thead>
<tr>
<th>Models</th>
<th>Description</th>
<th>Axes</th>
<th>Output for Motor Types</th>
<th>PC Interfaces</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-184</td>
<td>Drivers for PILine® ultrasonic piezo linear motors</td>
<td>1</td>
<td>PILine® ultrasonic piezomotor</td>
<td>–</td>
<td>1-36</td>
</tr>
<tr>
<td>C-185</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-663</td>
<td>Mercury™ stepper motor controller compact, networkable, economical</td>
<td>1, to 16 **</td>
<td>2-phase-stepper</td>
<td>RS-232, USB</td>
<td>4-112</td>
</tr>
<tr>
<td>C-863</td>
<td>Mercury™ DC-Servo motor controller compact, networkable, economical</td>
<td>1, to 16 **</td>
<td>DC-servo</td>
<td>USB, RS-232</td>
<td>4-114</td>
</tr>
<tr>
<td>C-843</td>
<td>PCI bus controller card, integrated linear amplifier and PWM outputs, also drives the V-106 voice coil scanners</td>
<td>2, 4</td>
<td>DC-servo, voice coil</td>
<td>PCI Bus</td>
<td>4-120</td>
</tr>
<tr>
<td>C-848</td>
<td>Servo-motor controller, 19”-package, integrated linear amplifier and PWM outputs</td>
<td>2, 4</td>
<td>DC-servo</td>
<td>RS-232, TCP/IP</td>
<td>4-122</td>
</tr>
<tr>
<td>C-880</td>
<td>Automation platform, very flexible, optional photometer and photonics alignment routines</td>
<td>4 - 18</td>
<td>DC-servo, piezo, voice coil</td>
<td>RS-232, TCP/IP</td>
<td>4-124</td>
</tr>
<tr>
<td>C-702</td>
<td>Motion Controller &amp; Driver for Simultaneous Operation of Closed-Loop DC Servo Motors and Piezo Actuators</td>
<td>2</td>
<td>DC-servo (PWM) / piezo</td>
<td>TCP/IP, RS-232, VGA, Keyboard</td>
<td>4-118</td>
</tr>
<tr>
<td>C-867</td>
<td>High-speed, closed-loop controller/driver for closed-loop PILine® piezomotors, networkable</td>
<td>1 to 16 **</td>
<td>PILine® ultrasonic piezomotor</td>
<td>USB, RS-232</td>
<td>4-116</td>
</tr>
<tr>
<td>E-861</td>
<td>Networkable Controller for NEXACT® Linear Motors and Positioners</td>
<td>1 to 16 **</td>
<td>NEXACT® piezo stepping motors</td>
<td>USB, RS-232</td>
<td>1-20</td>
</tr>
</tbody>
</table>

** networkable, on single interface

Piezo Drivers / Servo Controllers: See Page 2-99 ff
Accessories, p. 4-126
PI offers a large variety of innovative motion control solutions for precision positioning. Included products range from compact, single-axis controllers for DC servomotors, stepper motors and piezomotors, to complex multi-axis control systems for parallel-kinematics, 6-DOF Hexapods. PI’s novel dual-loop hybrid controller combines the advantages of electromagnetic motors and piezo technology. Custom motion control systems have been built capable of coordinating up to 273 axes.

Positioning and Sequencing: Automation System Solutions from PI

The motion controllers shown here are specially designed for PI micropositioning systems. With PI mechanics, the comprehensive palette of software, and all necessary cables included, plug-and-play operation is the rule. With some controllers, it is possible to network up to 16 axes or more for simple system scalability. In addition to standard systems, custom systems have been assembled with control for several hundred axes.

Integrated Drivers

All PI motor controllers are equipped with integrated servo-amplifiers and/or drivers in order to simplify system design and reduce costs. In addition, the DC-motor controllers offer PWM outputs for use with external amplifiers or with the integrated amplifiers in PI’s direct-drive, ActiveDrive™ stages, such as the M-511.PD.

Range of Motion Controllers

- Choice of Different Control Strategies
- Stepper Motor Controllers
- DC-Motor Controllers
- Dual Servo-Loop Hybrid Controllers
- Drivers / Controllers for Ceramic Ultrasonic Servo-Drives
- Controllers for PiezoWalk® Stepping Motors (see p. 1-3 ff)
- Six Degree-of-Freedom Hexapod Controllers
- Automation Platform
- Custom Controllers with up to 273 Channels

Developed for automation applications, the PIMotion&Vision™ system features a large number of drivers for real-time image processing. Up to 80 axes, switching functions and photometer signals can be included in the processing algorithms. The software supports functions ranging from autofocus, edge alignment and displacement measurement with micron accuracy, as well as complex alignment routines in six degrees of freedom.
C-663 Mercury™ Step Controller
1-Axis Networkable Stepper-Motor Controller

The Mercury™ Step stepper motor controller is the perfect solution for cost-effective and flexible motion control applications where a precision positioner is to be controlled by a PC or PLC (programmable logic controller). The C-663 supplements the successful C-863 Mercury™ servo motor controller.

Microstepping of 1/16 full step (up to 6400 steps/rev. with PI stepper motors) provides for ultra-smooth, high-resolution motion.

External control

Multi-Axis Control, Combination of DC & Stepper Motors
The networking feature allows the user to start out with one Mercury™ controller and add more units later for multiaxis setups.

Software Package and Interface Options

Easy data interchange with laptop or PC is possible via the USB interface. To facilitate industrial applications, an RS-232 interface is also standard.

The included software supports networking of multiple controller devices. LabVIEW™ drivers and Windows DLLs allow for easy programming and integration into your system. Mercury™ Step controllers can also be operated using the PI General Command Set (GCS) via a DLL. PI-GCS allows networking of different PI-controllers such as piezo drivers and multi-axis servo controllers with minimal programming effort.

Application Examples

- Flexible automation
- Handling
- Quality control
- Testing equipment
- Photonics applications
- Fiber positioning

Ordering Information

C-663.10
Mercury™ Step Stepper Motor Controller with Wide-Range Power Supply, 24 V

C-819.20
2-Axis Analog Joystick for Mercury™ Controller

C-819.20Y
Y-Cable for Connecting 2 Controllers to C-819.20

C-170.IO
I/O cable, 2 m, open end

C-170.PB
Push Button Box, 4 Buttons and 4 LEDs
**Technical Data**

<table>
<thead>
<tr>
<th>Model</th>
<th>C-663.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Stepper motor controller, stand-alone capability</td>
</tr>
<tr>
<td>Drive type</td>
<td>2-phase stepper motor</td>
</tr>
<tr>
<td>Channels</td>
<td>1</td>
</tr>
</tbody>
</table>

**Motion and control**

<table>
<thead>
<tr>
<th>Trajectory profile modes</th>
<th>Trapezoidal, point-to-point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microstep resolution</td>
<td>1/16 full step</td>
</tr>
<tr>
<td>Limit switches</td>
<td>2 x TTL, programmable</td>
</tr>
<tr>
<td>Reference switches</td>
<td>1 x TTL, programmable</td>
</tr>
<tr>
<td>Motor brake</td>
<td>1 x TTL, programmable</td>
</tr>
</tbody>
</table>

**Electrical properties**

| Operating voltage              | 15 to 30 V |
| Current limitation per motor phase | 1000 mA |

**Interface and operation**

| Interface/Communication        | USB, RS-232 (bus architecture) |
| Motor connector                | Sub-D 15 (f) |
| Controller network             | Up to 16 units* on single interface |
| I/O ports                      | 4 analog/digital in, 4 digital out |
| Command set                    | Mercury™ native command set, GCS |
| User software                  | MMCRun, PIMikroMove® |
| Software drivers               | GCS (PI General Command Set)-DLL, LabVIEW drivers, native Mercury™ DLL |
| Supported functionality        | Start-up macro |
| Manual control                 | Joystick, Y-cable for 2D motion, pushbutton box |

**Miscellaneous**

| Operating temperature range   | 0 to 50 °C |
| Mass                          | 0.3 kg |
| Dimensions                    | 130 x 76 x 40 mm³ |

*16 with USB; 6 with RS-232 (depending on RS-232 output driver of PC)
C-863 Mercury™ Servo Controller
1-Axis DC-Servo-Motor Controller with Network Feature

The latest generation Mercury™
C-863 servo motor controller is
even more powerful and versatile than its predecessors. Easy
data interchange with laptop or PC is possible via the USB
interface. The RS-232 interface provides for easy integration in
industrial applications. The compact design with its inte-
grated amplifier makes it ideal for building high-performance,
cost-effective micropositioning systems.

Flexible Automation
The Mercury™ offers a number of features to achieve automation and handling tasks in
research and industry in a very cost-effective way. Programming is facilitated by the high-
level mnemonic command language with macro and compound-command functionality. Macros can be stored in the non-volatile memory for later recall.

Stand-alone capability is pro-
vided by a user-programmable autostart macro to run automation tasks at power up (no run-
time computer communication required!).

For easy synchronization of motion with internal or external trigger signals four input and four output lines are provided.

Multi-Axis Control, Combination of DC & Stepper Motors
Up to 16 C-863 Mercury™ DC servo controllers and C-663 stepper motor controllers can be daisy-chained and addressed via the same interface.

The networking feature allows the user to start out with one controller and add more units later for multiaxis setups.

Easy Programming
All servo and stepper motor controllers of the Mercury™ family can be operated using the PI general command set (GCS). PI-GCS allows networking of different controller units, both for piezo-based and motorized positioning units, with minimal programming effort. In addition, the C-863 can be programmed using the native command set of previous Mercury™ controllers.

Cost-Saving Due to Integrated Amplifier and PWM Outputs
The unique Mercury™ concept combines a high-performance motion controller and an integrated power amplifier in a small package. Additional PWM control outputs allow the direct operation of any DC-motor-driven PI micro-positioning system—even high-speed stages such as the M-500 ActiveDrive™ Translation Stages—reducing costs, increasing reliability and simplifying the setup.

Contents of Delivery
Each controller is delivered with a wide-range power sup-
ply, RS-232 communication cable, a daisy-chain network cable and a comprehensive software package.
Technical Data

**Model**
C-863.10

**Function**
DC-servo-motor controller, 1 channel

**Motion and control**

- **Servo characteristics**: P-I-D servo control, parameter change on-the-fly
- **Trajectory profile modes**: Trapezoidal, point-to-point
- **Encoder input**: AB (quadrature) single-ended or differential TTL signal, 20 MHz
- **Stall detection**: Servo off, triggered by programmable position error
- **Input limit switch**: 2 x TTL (pull-up/pull-down, programmable)
- **Input reference switch**: 1 x TTL
- **Motor brake**: 1 x TTL, software controlled

**Electrical properties**

- **Output power**: max. 30 W (PWM)
- **Output voltage**: 0 to 15 V
- **Current**: 80 mA + motor current (3 A max.)

**Interfaces and operation**

- **Communication interfaces**: USB, RS-232 (9-pin [m] sub-D)
- **Motor connector**: 15-pin (f) sub-D
- **Controller network**: Up to 16 units on single interface
- **I/O ports**: 4 analog/digital in, 4 digital out (TTL)
- **Command set**: Mercury Command Set, GCS (via DLL)
- **User software**: PIMikroMove®, MMCRun
- **Software drivers**: GCS (PI General Command Set)-DLL, LabVIEW drivers, native Mercury™ DLL
- **Supported functionality**: Start-up macro; internal safety circuitry: watchdog timer
- **Manual control (optional)**: 2-axis joystick, Y-cable for 2D motion, pushbutton box

**Miscellaneous**

- **Operating voltage**: 15 to 30 V
  - included: external power supply, 15 V / 2 A
- **Operating temperature range**: +5 to +50 °C
- **Mass**: 0.3 kg
- **Dimensions**: 130 x 76 x 40 mm
The C-867 piezo motor controller and the M-664 low-profile positioner with integrated PILine® ceramic linear drive

The C-867 controller was especially designed for closed-loop positioning systems equipped with PILine® piezo linear motor drives. In addition to the digital servo-controller, the compact case also contains the driver electronics for the piezo ceramic motors.

The controller can be operated by a host PC either via a USB port or an RS-232 interface. Alternatively, stand-alone operation is possible by uploading macro command sequences to the internal non-volatile memory, or through a joystick or a push-button box.

**Highly Specialized PID Servo-Controller**

The C-867 is based on a highly specialized DSP (Digital Signal Processor) to handle the PID servo-control algorithm as well as other system functions. Because of the motion properties typical for ultrasonic piezomotors, the controller has a number of advanced features, including dynamic control parameter adaption. By automatically switching between gainsets for dynamic and static operation optimized settling behavior of a couple of 10 milliseconds is achieved. The broadband encoder input (50 MHz) allows the use of high resolution encoders with the outstanding high accelerations and velocities PILine® drives deliver.

The integrated drivers are fine-tuned to the connected drives before delivery in order to provide optimal system performance.

**Software / Programming**

In addition to the user software for setup, system optimization and operation, comprehensive LabVIEW and DLL libraries are provided.

The PI MikroMove™ user software provides the PI TuningTool for system performance optimization. Graphic displays show the system’s behaviour and facilitate parameter setting.

**Advantages of PILine® Micro Positioning Systems**

PILine® ultrasonic ceramic drives provide several advantages over classical motors and drives:

- Smaller dimensions
- Self-locking when powered down; no holding current
- High acceleration up to 5 g
- High velocity up to 500 mm/s
- No leadscrews, gears or other mechanical components, no wear or maintenance
- No lubricants
- Non-magnetic and vacuum compatible operating principle

**Application Examples**

- Biotechnology
- Fiber positioning
- Automation
- Photonics / integrated optics
- Quality assurance testing
- Testing equipment

**Ordering Information**

**C-867.161**

Piezomotor Controller with Drive Electronics, Networkable, for PILine® Systems with P-661 Motors

**C-867.164**

Piezomotor Controller with Drive Electronics, Networkable, for PILine® Systems with P-664 Motors

**C-867.D64**

Piezomotor Controller with Drive Electronics, Networkable, for PILine® Systems with M-674 RodDrive

**Accessories:**

- **C-819.20**
  2-Axis Analog Joystick
- **C-819.20Y**
  Y-Cable for Connecting 2 Controllers to C-819.20
- **C-170.PB**
  Push Button Box, 4 Buttons and 4 LEDs

Ask about custom designs!
### Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>C-867.161</th>
<th>C-867.164</th>
<th>C-867.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Controller and drive electronics for PILine® piezomotors / systems</td>
<td>Controller and drive electronics for PILine® piezomotors / systems</td>
<td>Controller and drive electronics for PILine® piezomotors / systems</td>
</tr>
<tr>
<td>Drive type</td>
<td>PILine® P-661 motors</td>
<td>PILine® P-664 motors</td>
<td>PILine® RodDrive M-674, 2 x P-664</td>
</tr>
<tr>
<td>Channels</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Motion and control</td>
<td>Programmable PID V-f filter, parameter changes on the fly</td>
<td>Programmable PID V-f filter, parameter changes on the fly</td>
<td>Programmable PID V-f filter, parameter changes on the fly</td>
</tr>
<tr>
<td>Trajectory profile modes</td>
<td>Trapezoidal</td>
<td>Trapezoidal</td>
<td>Trapezoidal</td>
</tr>
<tr>
<td>Encoder input</td>
<td>A/B differential signals, 50 x 10^6 impulse/s</td>
<td>A/B differential signals, 50 x 10^6 impulse/s</td>
<td>A/B differential signals, 50 x 10^6 impulse/s</td>
</tr>
<tr>
<td>Stall detection</td>
<td>Servo off, triggered by programmable position error</td>
<td>Servo off, triggered by programmable position error</td>
<td>Servo off, triggered by programmable position error</td>
</tr>
<tr>
<td>Limit switch</td>
<td>2 TTL (programmable)</td>
<td>2 TTL (programmable)</td>
<td>2 TTL (programmable)</td>
</tr>
<tr>
<td>Reference switch</td>
<td>1 TTL (active high/low, programmable)</td>
<td>1 TTL (active high/low, programmable)</td>
<td>1 TTL (active high/low, programmable)</td>
</tr>
</tbody>
</table>

### Electrical Properties

<table>
<thead>
<tr>
<th>Output power</th>
<th>5 W</th>
<th>10 W</th>
<th>15 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td>120 V_{pp}, 42 V_{rms}</td>
<td>188 V_{pp}, 60 V_{rms}</td>
<td>190 V_{pp}, 67 V_{rms}</td>
</tr>
</tbody>
</table>

### Interfaces and Operation

<table>
<thead>
<tr>
<th>Communication interfaces</th>
<th>USB, RS-232</th>
<th>USB, RS-232</th>
<th>USB, RS-232</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor connector</td>
<td>MDR14</td>
<td>MDR14</td>
<td>MDR14</td>
</tr>
<tr>
<td>Controller network</td>
<td>Up to 16 units on single interface</td>
<td>Up to 16 units on single interface</td>
<td>Up to 16 units on single interface</td>
</tr>
<tr>
<td>U/O ports</td>
<td>4 analog/digital in, 4 digital out on mini DIN 9-pin digital: TTL analog: 0 to 5 V</td>
<td>4 analog/digital in, 4 digital out on mini DIN 9-pin digital: TTL analog: 0 to 5 V</td>
<td>4 analog/digital in, 4 digital out on mini DIN 9-pin digital: TTL analog: 0 to 5 V</td>
</tr>
<tr>
<td>Command set</td>
<td>PI General Command Set (GCS)</td>
<td>PI General Command Set (GCS)</td>
<td>PI General Command Set (GCS)</td>
</tr>
<tr>
<td>User software</td>
<td>PI MikroMove™</td>
<td>PI MikroMove™</td>
<td>PI MikroMove™</td>
</tr>
<tr>
<td>Software drivers</td>
<td>GCS-DLL, LabVIEW drivers</td>
<td>GCS-DLL, LabVIEW drivers</td>
<td>GCS-DLL, LabVIEW drivers</td>
</tr>
<tr>
<td>Supported functionality</td>
<td>Start-up macro; macro; data recorder for recording parameters as motor input voltage, velocity, position or position error</td>
<td>Start-up macro; macro; data recorder for recording parameters as motor input voltage, velocity, position or position error</td>
<td>Start-up macro; macro; data recorder for recording parameters as motor input voltage, velocity, position or position error</td>
</tr>
<tr>
<td>Manual control</td>
<td>Pushbutton box, joystick (for 2 axes), Y-cable for 2D motion</td>
<td>Pushbutton box, joystick (for 2 axes), Y-cable for 2D motion</td>
<td>Pushbutton box, joystick (for 2 axes), Y-cable for 2D motion</td>
</tr>
</tbody>
</table>

### Miscellaneous

<table>
<thead>
<tr>
<th>Operating Voltage</th>
<th>12 VDC from external power supply (included)</th>
<th>12 VDC from external power supply (included)</th>
<th>12 VDC from external power supply (included)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>300 mA without motor</td>
<td>300 mA without motor</td>
<td>300 mA without motor</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>+5 to +40 °C</td>
<td>+5 to +40 °C</td>
<td>+5 to +40 °C</td>
</tr>
<tr>
<td>Mass</td>
<td>950 g</td>
<td>950 g</td>
<td>950 g</td>
</tr>
<tr>
<td>Dimensions</td>
<td>174 x 104 x 63 mm (without ground connection, rubber feet)</td>
<td>174 x 104 x 63 mm (without ground connection, rubber feet)</td>
<td>174 x 104 x 63 mm (without ground connection, rubber feet)</td>
</tr>
<tr>
<td></td>
<td>182 x 104 x 74 mm</td>
<td>182 x 104 x 74 mm</td>
<td>182 x 104 x 74 mm</td>
</tr>
</tbody>
</table>
C-702 Hybrid System Controller

High Velocity-Constancy for Nanometer-Precision Hybrid DC/Piezo Nanopositioning Systems

The C-702 digital hybrid motion controller has been designed for precision control of the M-511.HD (see p. 4-46) and M-714 (see p. 4-62) nanopositioning stages. Both are based upon the PI hybrid drive technology integrating piezoelectric and motorized drive components to form one motion system. The result is a nanopositioning system for high loads that can follow a motion profile with nanometer position accuracy and high constancy of velocity over several millimeters of travel.

Application Examples

- Surface Inspection
- Microscopy
- Laser technology
- Interferometry
- Metrology

Highly Effective Servo-Control for a Complex Drive Technology

The optimized interaction between the piezoelectric and motorized drive components to make them a single motion unit requires a high-speed sensor as well as powerful control algorithms. The digital, 2-channel, C-702 controller, based on modern CPU technology with a real time operating system, has been designed for this task. It is able to read the position signals with virtually no delay and process the data immediately. The integrated piezo amplifiers use a high-resolution 24-bit DAC to fully support the high position resolution of the piezo actuators. The new ultra-fast broadband SSI interface for the optical linear encoder supports stage velocities of 300 mm/s at a resolution of 2 nm. With special cabling, external sensor signals, like those from an interferometer, can be used for servo-control via an SSI interface.

One Controller for One Motion System

In PI hybrid systems, the motor-leadcrew and piezo actuator are fully integrated to form one motion system. The motor and piezo act together at all times. The result is far more than a coarse-adjust/fine-adjust system: effects like startup stick/slip and backlash can be completely compensated and a motion profile with high constancy of velocity can be followed. Because of the high-piezo stiffness, setting to a few nanometers only takes a few milliseconds, significantly faster than with conventional, higher-inertia, linear-motor-driven stages. Furthermore, minimal increments in the range of the sensor resolution can be reliably executed. To allow high velocities beyond 100 mm/sec and nanometer-range incremental resolution, position information must be transmitted and processed very rapidly and a complex control algorithm is required.
6PI Hybrid drive combines DC motor and piezo actuator with integrated, internal, high-resolution sensor in one servo loop.

**Technical Data**

**Model**

C-702.00

**Function**

Motion Controller for Hybrid Nanopositioning Systems

**Drive type**

DC motor (PWM)/piezo

**Channels**

2

**Motion and control**

**Servo characteristics**

PID V-ff filter, notch filter, hysteresis setting (motor); proportional-integral (P-I) algorithm with notch filter (piezo)

**Sampling rate**

10 kHz

**Trajectory profile modes**

Trapezoidal, S-curve

**Processor**

32-bit Intel Celeron

**Position range**

32 bit

**Limit switches**

2 lines per axis

**Reference switch**

1 line per axis

**Motor brake**

Software programmable

**Electrical properties**

**Operating voltage**

24 VDC (via M-500.PS wide range power supply*)

**Output power/channel**

PWM: 19.5 kHz, 10-bit resolution

**Piezo voltage**

±36 V (24-bit resolution)

**Power consumption**

< 25 W

**Interfaces and operation**

**Communication interfaces**

TCP/IP, RS-232, VGA, Keyboard

**Motor connector**

Sub-D connector, 26-pin**

**Encoder input**

Serial SSI interface for incremental encoder

**Controller network**

via TCP/IP

**I/O ports**

8 TTL inputs, 8 TTL outputs

**Command set**

ASCII, PI General Command Set (GCS)

**User software**

PIMikroMove*

**Software drivers**

GCS (PI General Command Set)-DLL, LabVIEW™ drivers

**Supported functionality**

Autostart macro, user-programmable macro

**Miscellaneous**

**Operating temperature range**

+10 to +50 °C

**Mass**

1.35 kg

**Dimensions**

130 x 205 x 76 mm

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*M-500.PS: wide range power supply, 100 to 250 VAC, 50 to 60 Hz

**Sub-D 26 contains connection for motor, piezo, reference and limit switches and sensor, internal heat sink with very silent fan
C-843 DC-Servo-Motor Controller

Servo Motion Controller/Driver PCI Board for 2 or 4 Axes

The C-843 PCI motion controller card drives up to 4 axes of micropositioning equipment. Because there is no need for external servo-amplifiers, this new card is a very cost-effective, easy-to-set-up solution.

On-Board Servo-Amplifiers

Unlike other PCI controller cards, the new C-843 comes with on-board, low-noise linear amplifiers for the small DC motors used in most compact micropositioning stages and actuators.

In addition, PWM outputs are available to drive more powerful equipment (all direct-drive translation and rotation stages from PI feature the integrated ActiveDrive™ PWM amplifiers, and also connect to the C-843 with no external power amplifiers).

The PWM mode and linear amplifier mode can be programmed individually for each of the 4 (or 2) channels.

High-Performance PID Control

The C-843 employs a fast DSP (digital signal processor) providing high-performance PID motion control with many options for trajectory generation and filter settings for superior positioning and tracking accuracy. Position, velocity, acceleration and several other motion parameters can be programmed individually for each axis on-the-fly. High-bandwidth counters (5 MHz) support differential encoder feedback (incremental rotary encoders or linear scales) for fast and accurate positioning.

I/O for Flexible Automation

In addition to 3 TTL inputs per channel for limit and reference signals, 16 more I/O lines are available for flexible automation tasks (trigger functions, etc.). The C-843 also features motor-brake output lines (e.g. for M-531.DDB stages).

High-Speed Buffering

The integrated 32 k-sample trace memory allows online buffering (read and write) at integer multiples of the servo-loop time of up to four independent system variables (positions, velocities, internal register contents, etc.) This allows the observation of the motion system and also performing customized trajectory profiles.

PI General Command Set (GCS)

The comprehensive command structure is based on the PI General Command Set (GCS). With GCS the development of custom application programs is simplified, because the commands for all supported devices are identical in syntax and function. PI controllers for nanopositioning systems, for piezomotors and servo or stepper motors can be commanded with GCS.

Software / Programming

In addition to the user software for setup, system optimization and operation, comprehensive LabVIEW and DLL libraries are provided. The user-friendly PI MikroMove™ provides a convenient interface for stage operation including tuning tool, joystick operation, terminal and macro editor.

Communications to/from the board consist of packet-based messages passed via memory access. An interrupt line is provided so that the chipset can signal the PC when special conditions arise, such as reception of an encoder index pulse. For system programmers the C-843 offers direct access to the DSP.

Ordering Information

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-843.21</td>
<td>DC-Motor Controller PCI PC Board, 2-Axis</td>
</tr>
<tr>
<td>C-843.41</td>
<td>DC-Motor Controller PCI PC Board, 4-Axis</td>
</tr>
<tr>
<td>C-843.JS</td>
<td>Joystick and PCI Interface Board for C-843 Motor Controller</td>
</tr>
</tbody>
</table>

Two and Four Axis Version

Very Cost-Effective: Servo Amplifiers On-Board

Additional PWM Outputs for High-Power Motors

Trapezoidal Curve, S-Curve and Velocity Profile

32 kSamples RAM for High-Speed Buffer Operations

16 I/O Lines for Flexible Automation

Fast PCI Communication, 120 µs for Position Read

Motor-Brake Control Output

Extensive Software Support

General Command Set (GCS) Compatible

The C-843.41 DC-motor controller board with the M-110.DG linear stage, M-235.5DG heavy duty linear actuator, M-511.DD direct drive translation stage and M-501.1DG vertical stage. No external amplifier is required to drive any of these or other PI stages. Small motors are driven through the C-843’s onboard linear amplifiers, direct-drive PI stages (e.g. M-511.DD) employ ActiveDrive™ controlled off the C-843’s PWM outputs.
The Tuning Tool which is integrated in PMikroMove® demonstrates acquiring and displaying step and settle data of micropositioning systems. Controls allow adjustment of the PID parameters for best performance.

### Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>C-843</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>PC plug-in DC-servo-motor controller board, 32-bit plug-and-play PCI-bus interface, supported by main boards with 3.3 V and 5 V PCI bus connectors (universal card)</td>
</tr>
<tr>
<td>Axes</td>
<td>2 (C-843.21); 4 (C-843.41)</td>
</tr>
<tr>
<td>Servo characteristics</td>
<td>Programmable PID V-ff filter, parameter changes on-the-fly</td>
</tr>
<tr>
<td>Profile modes</td>
<td>Trapezoidal, S-curve, velocity profile</td>
</tr>
<tr>
<td>Output power / resolution</td>
<td>Analog 6 watts/channel (drawn directly from PC power supply), 12-bit D/A converters, PWM 10-bit, 24.5 kHz</td>
</tr>
<tr>
<td>Current limitation</td>
<td>500 mA per channel (short-circuit-proof)</td>
</tr>
<tr>
<td>Encoder input</td>
<td>AB (quadrature) differential TTL signals, 5 x 10⁶ counts/s</td>
</tr>
<tr>
<td>Stall detection</td>
<td>Servo off, triggered by programmable position error</td>
</tr>
<tr>
<td>Limit switches</td>
<td>2 TTL / axis (active high/low, programmable)</td>
</tr>
<tr>
<td>Reference switches</td>
<td>1 TTL / axis (active high/low, programmable)</td>
</tr>
<tr>
<td>I/O ports</td>
<td>8 TTL inputs, 8 TTL outputs</td>
</tr>
<tr>
<td>Motor connectors</td>
<td>15-pin (f) sub-D per channel (2 on board + 2 on bracket for C-843.41)</td>
</tr>
<tr>
<td>Interface/communication</td>
<td>PC PCI bus</td>
</tr>
<tr>
<td>Command set</td>
<td>PI General Command Set (see p. A-8)</td>
</tr>
</tbody>
</table>
C-848 DC-Servo-Motor Controller

DC Motor Controller for 2 or 4 Axes

The C-848 is a flexible, multi-purpose, rackmount positioning and motion controller for DC servo-motors. It is designed for general positioning and automation tasks in research and industry.

Flexible Multi-Processor Architecture

Based on a dual-processor structure, the C-848 offers the flexibility expected in today’s demanding prototyping and high-precision production environment.

In parallel with the general processor handling communication and macro execution, a fast DSP motion-control chipset is dedicated to trajectory generation and servo-control.

In addition to three inputs per channel for limit switches and home position, eight TTL inputs and eight TTL outputs are available for flexible automation.

The C-848 also offers advanced motion control features such as:

- Linear interpolation
- Trajectory generation for trapezoidal and s-curve profiles
- Electronic gearing
- Real-time reference and limit position capture

Integrated Servo-Amplifiers/-PWM Output

Integrated, low-noise, linear power amplifiers allow operation of any PI micropositioning system without additional external amplifiers, reducing costs and simplifying the setup. In addition to the linear amplifiers, PWM (pulse width modulation) output signals are available to drive PI micropositioning stages equipped with ActiveDrive™ motors.

PI General Command Set (GCS)

The comprehensive command structure is based on the PI General Command Set (GCS). With GCS the development of custom application programs is simplified, because the commands for all supported devices are identical in syntax and function. PI controllers for nanopositioning systems, for piezomotors and servo or stepper motors can be commanded with GCS.

Software / Programming

In addition to the user software for setup, system optimization and operation, comprehensive LabView™ and DLL libraries are provided.

Control of the C-848 is provided either through the RS-232 or an optional TCP/IP interface. For manual control, the unit can be operated with a C-819.10 joystick.

The C-848 can also run in stand-alone mode, and a standard computer keyboard and monitor can be connected for direct programming.

Ordering Information

C-848.23
DC Servo Motor Controller, 2 Channels, 19" Rack Mount, RS-232

C-848.43
DC Servo Motor Controller, 4 Channels, 19" Rack Mount, RS-232

Accessories
C-819.10
Analog Joystick

Simultaneous Operation of up to 4 DC Servo-Motors/-Positioning Stages or Voice-Coil Scanners

- Powerful Macro Command Language
- 16 I/O Lines for Flexible Automation
- Electronic Gearing
- Extensive Software Support
- RS-232 and Optional IEEE 488 Interface
### Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>C-848.43</th>
<th>C-848.23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>DC-servo-motor controller</td>
<td>DC-servo-motor controller</td>
</tr>
<tr>
<td>Drive type</td>
<td>DC servo-motors</td>
<td>Voice-Coil Linear Drives</td>
</tr>
<tr>
<td>Channels</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**Motion and control**

- **Servo characteristics**: Programmable PID V-ff filter, 100 μs per active axis, parameter changes on the fly
- **Trajectory profile**: Linear interpolation, trapezoidal, s-curve, electronic gearing
- **Processor**: Dual Processor: CPU 133 MHz and Motion chip, 2.5 kHz servo update rate
- **Encoder input**: AB (quadrature) differential TTL signal, 5 MHz
- **Stall detection**: Servo off, triggered by programmable position error
- **Limit switches**: 2 TTL lines per axis, programmable
- **Reference switch**: 1 TTL line real-time position capture per axis
- **Motor brake**: TTL, software programmable

**Electrical properties**

- **Operating voltage**: Wide-range power supply, 100 to 240 VAC, 50 to 60 Hz
- **Output power/channel**: Analog H-bridge ±12 V, 5 W/channel, 12-bit D/A converters, 10-bit output for PWM drivers, 24.5 kHz
- **Output voltage/channel**: Analog: ±10.5 V, PWM: TTL for SIGN and MAGN
- **Current limitation**: 1 A per channel (short-circuit proof)

**Interfaces and operation**

- **Communication interfaces**: RS-232 standard (cable included), RS-232 standard (cable included),
- **Motor connector**: Sub-D connector, 15-pin
- **Controller network**: Via TCP/IP option
- **I/O ports**: 8 TTL inputs, 8 TTL outputs
- **Command set**: PI General Command Set (GCS)
- **User software**: C-848 Control user software, PI Mikromove®
- **Software drivers**: LabView™ driver, DLL & COM for C, BASIC for Windows
- **Supported functionality**: Autostart macro, user-programmable macro Monitor and keyboard connectors Motor-Brake Control
- **Manual control**: Joystick via controller or host PC

**Miscellaneous**

- **Temperature range**: +10 to +50 °C
- **Mass**: 8.2 kg
- **Dimensions**: 447 x 450 x 90 mm (19-inch rackmount)
C-880 Automation Platform
Flexible, Modular Controller for up to 18 Axes

The C-880 Automation Platform is a modular and highly versatile system for complex multi-axis positioning and automation tasks. It was conceived for applications ranging from photonics alignment and packaging to biotechnology. Based on a rugged industrial PC, it offers the flexibility expected in today's demanding prototyping and high-precision production environment.

A variety of models and options are available, making it possible to control nanopositioning systems with up to 18 axes. Servo-motors, voice coil-drives and piezo actuators/stages can be combined in almost any combination. Available options include photometer cards for fully automated fiber alignment, a relay board for flexible automation, an integrated screen and keyboard for stand-alone operation, and a manual control pad.

PI General Command Set (GCS)
The comprehensive command structure is based on the PI General Command Set (GCS). With GCS the development of custom application programs is simplified, because the commands for all supported devices are identical in syntax and function. PI controllers for nanopositioning systems, for piezomotors and servo or stepper motors can be commanded with GCS.

Software / Programming
In addition to the user software for setup, system optimization and operation, comprehensive LabView and DLL libraries are provided.

Accessories for Flexible Automation
To live up to its name of "Automation Controller", a variety of options and high-level drivers are available for the C-880:

- C-880.TCP
  TCP/IP interface card, allowing operation of more than one C-880 from a single PC interface.

- C-880.R8
  Relay Board which can switch power on up to 8 channels. The high-power capacity (24 V, 1 A) can be used to directly drive loads like pneumatic valves, magnets, relays, etc.

- F-206.MC6
  Interactive manual control pad. This option allows easy manual control of any 6 motorized axes in the system using control knobs with programmable step-sizes.

Ordering Information

C-880.00
Automation Platform, Chassis with Power Supply, RS-232 Interface

C-880.00D
Automation Platform, Chassis with Power Supply, RS-232 Interface with Front-Panel Keypad and LCD Monitor

Options:
- C-842.23
  DC-Servo Motion Controller, 2 Channels, ISA-Bus
- C-842.43
  DC-Servo Motion Controller, 4 Channels, ISA-Bus
- E-760.3Si
  NanoCube® Piezo Controller, ISA-Bus PC Plug-In Board, Photometer IR Range
- E-760.3SV
  NanoCube® Piezo Controller, ISA-Bus PC Plug-In Board, Photometer Visible Range

Accessories:
- C-880.TCP
  TCP/IP Interface Card
- F-206.iiU
  Photometer Card, IR Range, 2 Channels
- F-206.VVU
  Photometer Card, Visible Range, 2 Channels
- F-206.MC6
  Manual Control Pad for 6 Channels
- C-880.R8
  Relay Board for 8 Relays

Application Examples

- Biotechnology
- Fiber positioning
- Flexible automation
- Semiconductor testing
- Micro-assembly
- Photonics / integrated optics
- Quality assurance testing

Fiber alignment configuration example. Top: C-880.00D equipped with F-206.3RU IR-photometer card, 2 x C-842.43 servo-motor control cards and an E-760.3Si piezo controller card. Bottom left: M-511.00 precision translation stage with 0.1 μm linear encoder for rapid loading/unloading; F-131.36D fiber alignment system with 15 mm travel range in X/Y/Z and 1 nm resolution. Bottom right: M-501.1PD precision vertical stage with 0.008 μm encoder resolution; M-061.PD rotation stage and the F-210 fiber rotator.
Technical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>C-880.00</th>
<th>C-880.00D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Multi-Axis Automation Platform</td>
<td>Multi-Axis Automation Platform with Front-Panel Keyboard and LCD Monitor</td>
</tr>
<tr>
<td>Drive type</td>
<td>with C-842.23/C-842.43: Servo-Motors, Voice Coil Drives with E-760.3S0: Piezo Drives</td>
<td></td>
</tr>
<tr>
<td>Channels</td>
<td>Up to 18 Axes with (servo-motors, voice coil drives), and Piezo Actuators (max. 6 piezo axes)</td>
<td></td>
</tr>
</tbody>
</table>

### Motion and control

#### Servo characteristics
- C-842.23 & C-842.43: Programmable 32-bit PID V-ff filter, 100 μs per active axis, parameter changes on the fly
- E-760: Analog proportional-integral (P-I) algorithm with notch filter

#### Trajectory profile modes
- Linear interpolation, trapezoidal, s-curve, electronic gearing

#### Processor
- CPU 133 MHz
- C-842.23 & C-842.43: motion chip, 2.5 kHz servo update rate
- E-760: DSP

### Electrical properties

#### Operating voltage
- 100 to 250 VAC, 50/60 Hz

#### Output power per channel
- C-842.23 & C-842.43: analog H-bridge with ±12 V output, 5 W/channel, 12-bit D/A converters, 10-bit output for PWM drivers, 24.5 kHz
- E-760: 9 W peak, 3 W continuous

#### Output voltage / channel
- C-842.23 & C-842.43: analog: ±10.5 V
- PWM mode: TTL level for SIGN and MAGN
- E-760: -20 to 120 V

#### Current limitation
- C-842.23 & C-842.43: 1 A/channel (short-circuit proof)
- E-760: 90 mA peak, 30 mA continuous

### Interfaces and operation

#### Communication interfaces
- RS-232 standard, including cable

#### Motor connector
- Sub-D 15-pin; Piezo: Sub-D, 25-pin

#### Controller network
- Via TCP/IP option

#### I/O ports
- C-842.23 & C-842.43: 8 TTL inputs, 8 TTL outputs
- C-880.R8: 8 channels, 60 W max., 24 V/channel, 1 A/channel

#### Command set
- PI General Command Set (GCS), ASCII Communications

#### User software
- PI MikoMove®

#### Software drivers
- GCS-DLL, LabVIEW® drivers

#### Supported functionality
- Autostart macro, user-programmable macros, Monitor and keyboard connectors, Motor-brake control, Switching of high-power relays, Read-out of analog interface boards (photometer cards)

#### Manual control
- Manual control pad (F-206.MC6 option)

### Miscellaneous

#### Operating temperature range
- +10 to +50 °C

#### Dimensions
- 19-inch case, 450 mm x 460 mm x 180 mm

C-880 Configuration Software makes for quick and easy on-site upgrades
Motor Cables

All PI micropositioners come with the appropriate motor cables. The cables shown here are available as replacements or can be used as extension cables.

C-815.38
Motor Cable, 3 m, sub-D 15-pin (f) / 15-pin (male)

C-815.83
Motor Cable, 10 m, sub-D 15-pin (f) / 15-pin (male)

C-815.62
Motor Cable, 3 m, 10-pin (Flat Ribbon)/15-pin (male)