MS205Equ

C-863 Mercury Controller

Short Version of the User Manual

Version: 2.0.0 Date: 22.03.2013

This document describes the following product:

- **C-863.11**
  Mercury DC Motor Controller, 1 Channel, with Wide-Range Power Supply

The detailed version of this user manual is included as a PDF file on the product CD and can be downloaded from our website.

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Contents

1 About this Document

In this Chapter

1.1 Goal and Target Audience of this User Manual

The short version of the MS205E user manual includes the following information on the intended use of the C-863:

- Product description and technical data of the C-863
- Installation instructions for the C-863
- Start-up instructions for the C-863
- Command overview
- Instructions for adapting settings
- Cleaning instructions for the C-863
- Overview for troubleshooting

In the detailed MS205E user manual, which is included as a PDF file on the product CD, you can find all other information and instructions regarding operation and maintenance as well as command and parameter descriptions. This short version refers to information that is only included in the detailed version of the user manual.

It assumes that the reader has a fundamental understanding of basic servo systems as well as motion control concepts and applicable safety procedures.

The latest versions of the user manuals are available for download (p. 5) on our website.

If you have questions, contact our customer service department (p. 91).

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

NOTICE

Dangerous situation

If not avoided, the dangerous situation will result in damage to the equipment.

➢ Actions to take to avoid the situation.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant
▪	List item
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning sign on the product which refers to detailed information in this manual.
Start > Settings	Menu path in the PC software (example: to open the menu, the ***Start*** and ***Settings*** menu items must be clicked in succession)
SV0?	Command line or a command from PI's General Command Set (GCS) (example: command to get the servo mode).
Device S/N	Parameter name (example: parameter where the serial number is stored)
5	Value that must be entered or selected via the PC software

1.3 Definition

Term	Explanation
PC software	Software that is installed on the PC.
Firmware	Software that is installed on the controller.
Volatile memory	RAM module in which the parameters are saved when the controller is switched on (working memory).
Non-volatile memory	EEPROM memory chip (read-only memory), from which the default values of the parameters are loaded to the volatile memory when the controller is started.
Axis	Also referred to as "logical axis". The logical axis reflects the motion of the stage in the firmware of the C-863. For stages that allow motion in several directions (e. g. in X, Y and Z), each direction of motion corresponds to a logical axis.
Stage	Mechanical system connected to the C-863. For stages having just one motion axis the designation "axis" is synonymous with "stage". Stages that allow motion in several axes are also designated as "multiaxis stages". For these stages, a distinction must be made between the individual axes. In this manual, actuators, i. e. drive components without a moving platform (e. g. precision linear actuators), are designated as stages as well.
Daisy chain	Wiring diagram by which one controller is connected to the next in sequence (series connection principle). Here the first controller is connected directly to the PC. The additional controllers are always connected to the ones that precede them so that a chain is formed. The signal to and from a controller goes to the PC via the previous controllers.
Incremental position sensor	Sensor (encoder) for capturing changes of position or changes of angle. Signals from the incremental position sensor are used for axis position feedback. After switching on the controller a reference point definition must be performed before absolute target positions can be commanded and reached.
Control value	The control value is the input for the PWM converter of the C-863. The PWM converter converts the control value into the PWM signal for the stage.
Dynamics profile	Comprises the target position, velocity, and acceleration of the axis calculated by the profile generator of the C-863 for any point in time of the motion. The calculated values are called "commanded values".
GCS	PI General Command Set; command set for PI controllers. Piezo drivers and servo controllers can be operated conjointly with minimal programming effort thanks to the GCS.

1.4 Other Applicable Documents

The devices and software tools which are mentioned in this documentation are described in their own manuals.

Description	Document
Detailed user manual for the C-863.11	MS205E User Manual
Mercury GCS LabVIEW driver library	MS206E Software Manual
PI GCS 2.0 DLL for C-x63.11	MS212E Software Manual
GCS array data format description	SM146E Software Manual
PIMikroMove	SM148E Software Manual
PIStageEditor software for the management of stage databases	SM144E Software Manual
PI Update Finder: Search and download updates	A000T0028 Technical Note
PI Update Finder: Updating PC without Internet connection	A000T0032 Technical Note
Adapting software that was written for C-863.10 for use with C-863.11	A000T0029 Technical Note

INFORMATION

Model C-663.11 intended for operation with stepper motors is described in a separate manual (MS208E).

1.5 Downloading Manuals

INFORMATION

If a manual is missing on our website or if there are problems in downloading:

➢ Contact our customer service department (p. 91).

The current versions of the manuals are found on our website. To download a manual, proceed as follows:

1. Open the website **http://www.pi-portal.ws**.
2. Click ***Downloads***.
3. Click the corresponding category (e. g. ***C Motion Controllers***).
4. Click the corresponding product code (e. g. ***C-863.11***).

   An overview of the available file types is shown for the selected product.
5. If ***(0 Files)*** is shown in the ***Documents*** line, log in as follows to display and download the documents:

   a) Insert the product CD in the corresponding PC drive.
   b) Open the ***Manuals*** directory.
   c) Open the Release News (e. g. ***C-663.11_Releasenews_V_x_x_x.pdf***) on the CD of the product.
   d) Find the user name and password in the **User login for software download** section in the Release News.
   e) In the ***User login*** area on the left margin in the website, enter the user name and the password in the corresponding fields.
   f) Click ***Login***.

   If ***Documents (0 Files)*** is still being displayed, no manuals are available:

   – Contact our customer service department (p. 91).
6. Click ***Documents***.
7. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

2 Safety

In this Chapter

2.1 Intended Use

The C-863 is a laboratory device as defined by DIN EN 61010. It is intended to be used in interior spaces and in an environment which is free of dirt, oil, and lubricants.

Appropriate to its design, the C-863 is intended for the operation of PI stages equipped with DC motors or voice coil drives.

The C-863 is intended for closed-loop operation with incremental position sensors. In addition, it can read and process the reference point and limit switch signals from the stage connected.

The C-863 may only be used in compliance with the technical specifications and instructions in this user manual. The user is responsible for process validation.

2.2 General Safety Instructions

The C-863 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the C-863.

- Only use the C-863 for its intended purpose, and only use it if it is in a good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the C-863.

- Install the C-863 near the power source so that the power plug can be quickly and easily disconnected from the mains.
- Use the supplied components (power supply, adapter and power cord (p. 16)) to connect the C-863 to the power source.

- If one of the supplied components for connecting to the power source has to be replaced, use a sufficiently dimensioned component.

2.2.1 Organizational Measures

User manual

- Always keep this user manual next to the C-863.
  If the user manual is lost or damaged, contact our customer service department (p. 91).
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the C-863 on to other users, also turn over this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. If your user manual is incomplete and is therefore missing important information, property damage can result.
- Only install and operate the C-863 after having read and understood this user manual.

Personnel qualification

The C-863 may only be started up, operated, maintained and cleaned by authorized and qualified staff.

2.2.2 Safety Measures during Installation

- Install the C-863 near the power source so that the power plug can be quickly and easily disconnected from the mains.
- Only use cables and connections that meet local safety regulations.

Connecting a stage with stepper motor to a DC motor controller can cause irreparable damage.

- Only connect to the C-863 a stage with DC motor or voice coil drive.

Connecting the USB and RS-232 interfaces of the controller to the PC at the same time can damage the PC or the controller.

- Connect either the USB or the RS-232 interface to the PC.

The output voltage on the **Motor +** and **Motor -** pins of the **DC Motor only** socket can be as high as the supply voltage provided by the power supply. Stages without PWM amplifier are connected to these pins and can be damaged by output voltage that is too high.

- Connect a power supply whose output voltage does **not** exceed the permissible operating voltage of the stage.

Unsuitable settings made to the servo-control parameters of the C-863 can cause the stage to oscillate. Oscillations can damage the stage and/or the load affixed to it.

- Secure the stage and all loads adequately.

2.2.3 Safety Measures during Start-Up

When the system settings in the non-volatile memory are changed, the original settings will be lost. Unfavorable settings can cause stage oscillation, worse settling behavior and reduced positioning accuracy.

- Only change the internal system settings for the C-863 in the non-volatile memory when necessary.
- Contact our customer service department (p. 91) if you are not sure whether a change to the system settings is necessary.

Selecting an incorrect stage type in the PC software can cause damage to the stage.

- Make sure that the stage type selected in the PC software matches the stage connected.

2.2.4 Safety Measures during Operation

Unsuitable settings made to the servo-control parameters of the C-863 can cause the stage to oscillate. Oscillations can damage the stage and/or the load affixed to it.

- If the stage is oscillating (unusual operating noise), immediately switch off the servo mode or disconnect the C-863 from the power source.
- Only switch on the servo mode after you have modified the servo-control parameter settings of the C-863; see "Optimizing Servo-Control Parameters" (p. 64).

The collision of a moving part at the end of the travel range, or with an obstacle, as well as high acceleration, can cause damage to or considerable wear on the mechanical system.

- Prevent motions in open-loop operation.

- If motions in open-loop operation are necessary:
  - Set the control value with the SMO command so that the axis moves with low velocity.
  - Stop the axis in time. For this purpose, use the #24, STP or HLT command, or set the control value to zero with the SMO command.
- Do **not** disable via parameter setting the evaluation of the limit switch signals by the C-863.
- Check the function of the limit switches at about 10 % to 20 % of the maximum velocity.
- In the event of a malfunction of the limit switches, stop the motion immediately.
- Ensure that the end of the travel range is approached at low velocity.
- If the moving part or the load mounted on it collides with an obstacle, switch off the motor.
- If possible, adjust the soft limits in the software used for commanding motion to your mechanical system.
- Determine the maximum velocity for your application.

If no joystick is connected to the C-863, activating the joystick in the software can cause unintentional motion of the axis connected.

- Activate the joystick in the software only if a joystick is actually connected to the C-863.

If the servo mode is switched off, e. g. after a motion error occurs, the brake of the stage can be deactivated by command. Deactivating the brake can cause the stage to move unintentionally.

- Secure the stage against unintentional motions before you deactivate the brake by command!

2.2.5 Safety Measures during Maintenance

The C-863 comprises electrostatic sensitive devices.

- Do **not** open the case of the C-863.
- Before cleaning, disconnect the C-863 from the power source by pulling the power plug.

3 Product Description

In this Chapter

3.1 Features and Applications

The Mercury DC motor controller is the perfect solution for designing cost-efficient and flexible positioning systems in which a precision stage is to be controlled with a PC or a programmable controller. In addition to the C-863, the Mercury line comprises the successful C-663 Mercury Step stepper motor controller. The controllers of the Mercury line use the same command sets and can be networked with each other.

The product features of the C-863 include:

- RS-232 and USB interfaces
- Stand-alone operation
- Daisy chain networking for multi-axis operation
- Compatible and networkable with all Mercury line controllers, including Mercury Step
- Joystick connection for manual operation
- Non-volatile macro memory
- Parameter changing during operation
- TTL inputs for limit and reference point switches
- Control signal for motor brake
- Programmable in-/outputs

Multi-axis operation of DC and stepper motors

The C-863.11 Mercury DC motor controller has the same command set as the C-663.11 Mercury Step stepper motor controller. Up to 16 Mercury controllers (for DC and stepper motors) can be networked and operated via the same computer interface.

Mercury networks are flexible and can also be expanded later on.

Flexible automation

The C-863 presents a number of performance characteristics that make cost-effective implementation of automation and processing tasks in both research and industry possible. With the easily understandable programming language macros can be saved in the non-volatile memory.

A programmable start-up macro makes stand-alone operation possible: The automatic execution of internal instruction cycles is even performed without external communication upon switching-on.

Four I/O lines each are used at any one time to easily synchronize motion cycles with internal or external events. A joystick can be connected for manual control.

User-Friendly: Comprehensive software package and two interfaces

The controller has a USB interface for easy data exchange with laptop or PC. An RS-232 interface is also available standard.

The software provided enables the networked operation of multiple controllers. LabVIEW drivers and a program library make programming system integration easier. The Mercury controllers can be actuated with the PI General Command Set (GCS) directly. With PI GCS different PI controllers, like piezo controllers and servo controllers, can be operated conjointly with minimal programming effort.

3.2 Model Overview

In addition to the C-863.11 DC motor controller the C-663.11 model for stages with stepper motor is also part of the Mercury controller model series.

INFORMATION

The hardware of the C-863.11 DC motor controller is identical to the hardware of the C-863.10 DC motor controller. The two models differ in their firmware and use different command sets. The C-863.10 and the C-863.11 cannot be networked together.

By installing the appropriate firmware a C-863.10 can be converted into a C-863.11.

- If you want to convert a C-863.10 into a C-863.11, contact the customer service department (p. 91).
- If you want to use software that you have written for the C-863.10 with the C-863.11, read A000T0029 Technical Note.
- For further questions contact our customer service department (p. 91).

3.3 Product View

3.3.1 Front Panel

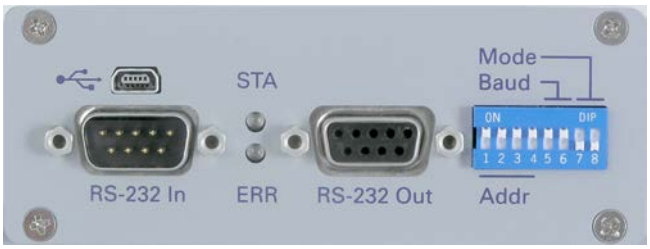


Figure 1: C-863 Mercury DC motor controller, front view

Labeling	Type	Function
RS-232 In	Sub-D 9(m) (p. 101)	Serial connection to the PC or to the previous controller in a daisy chain network; do not connect to the PC if the USB interface is already connected.
RS-232 Out	Sub-D 9(f) (p. 101)	Serial connection to the subsequent controller in a daisy chain network
	Mini-USB type B	Universal serial bus for connecting to the PC; do not connect if **RS-232 In** is already connected.

Labeling	Type	Function
STA	LED green/off	Controller state: ▪ Green: C-863 is ready for normal operation ▪ Off: C-863 is not connected to the supply voltage or is in firmware update mode (selection via DIP switch 8)
ERR	LED red/off	Error indicator: ▪ Continuously lit: Error (error code ≠ 0) ▪ Off: No error (error code = 0) The error code can be queried with the ERR? command. The query resets the error code to zero and the LED is switched off.
Mode, **Baud**, **Addr**	8-bit DIP switch (p. 42)	Setting the device address, the baud rate for communication with the PC, the limit switch signal logic and the update mode.

3.3.2 Rear Panel

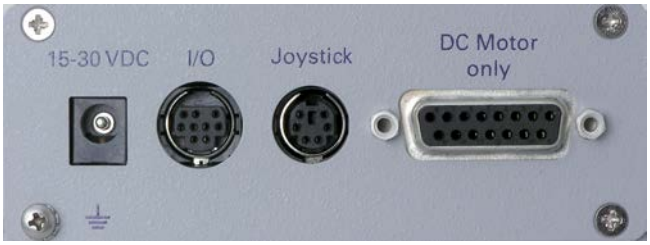


Figure 2: C-863 Mercury DC motor controller, rear view

Labeling	Type	Function
15-30 VDC	Barrel connector socket (input) (p. 102)	Connection for the supply voltage
I/O	Mini-DIN socket, 9-pin (p. 98)	Digital in-/outputs: ▪ Outputs: Triggering external devices ▪ Inputs: Use in macros or as switch signals Analog inputs: ▪ Use in macros or for scanning processes
Joystick	Mini-DIN socket, 6-pin (p. 99)	Analog joystick ▪ Inputs for signals from the joystick axes and buttons ▪ Output for the supply voltage of the joystick

Labeling	Type	Function
DC motor only	Sub-D 15(f) (p. 97)	Stage connection Only for DC motors! ▪ Output of PWM signals for the stage ▪ Input of the signals of the incremental position sensor ▪ Input of the signals from the limit switches and reference point switch
	Screw and flat washer	Ground connection (p. 34) If potential equalization is required, the screw can be connected to the grounding system.

3.4 Scope of Delivery

Order Number	Items
C-863.11	Mercury DC motor controller
C-890.PS	Wide-Range Power Supply for Mercury Controller
3763	Power cord
C-815.34	RS-232 Null-Modem Cable, 3 m, 9/9-pin
C-862.CN	Network Connecting Cable for Mercury, 30 cm
000014651	USB cable (type A to Mini-B) for connection to the PC
C-663.CD1	Mercury product CD with software and user manuals for Mercury products The Mercury product CD applies to the C-663.11 and the C-863.11.
MS205Dqu	Short version of the user manual for the C-863.11

3.5 Accessories

Order Number	Description
C-815.38	Motor Cable, 3 m, Sub-D, 15-pin (m/f)
C-862.CN2	Network Connecting Cable for Mercury, 180 cm
C-819.20	2-Axis Analog Joystick for Mercury Controller, details see "Joystick Devices Available" in the detailed MS205E manual
C-819.20Y	Y cable for connecting 2 controllers to C-819.20 joystick
C-819.30	3-Axis Analog Joystick, details see "Joystick Devices Available" in the detailed MS205E manual
C-170.PB	Pushbutton Box, 4 Buttons and 4 LEDs. Connection to the **I/O** socket of the C-863, sends 4 TTL input signals and displays the state of the 4 digital outputs via the LEDs. 
C-170.IO	I/O cable, 2 m, open end (p. 98)

To order, contact our customer service department (p. 91).

3.6 Functional Principles

You can find information on the following topics in the detailed MS205E manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5):

- **Block diagram** of the C-863
- **Commandable elements of the C-863** and their identifiers:
  - Logical axis
  - Analog inputs
  - Digital in- and outputs
  - Joystick devices
  - Data recorder tables
  - Controller address
- Overview of **important components of the firmware**
- **Operating modes**: Closed-loop and open-loop operation
- **Physical units**: Supported units of length for positions and possible adaptations
- Possibilities for **triggering motions** in closed-loop and open-loop operation: Motion commands via communication interface or from controller macros, joystick control
- **Generation of dynamics profile**: Calculation of target position, velocity and acceleration of the axis at any point in time during the motion (dynamics profile) in closed-loop operation
- **Servo algorithm and other control value corrections**: PID servo algorithm, offset correction and feed-forward control of the velocity in closed-loop operation; notch filter
- **On-target state**
- **Reference point switch detection**
- **Limit switch detection**
- **Travel range and soft limits**
- **Reference point definition**: Reference move (default) or manual setting of absolute position

3.7 Communication Interfaces

Communication interfaces available

The C-863 can be controlled with ASCII commands from a PC: Connecting to the PC can be effected via a direct connection or via a daisy chain network. The following interfaces of the C-863 can be used for direct connection to the PC:

- Serial RS-232 connection
- USB connection

Only one of the two interfaces may be connected to the PC at all times.

Default communication settings

Interface	Property	Default value
RS-232	Baud rate	38400 Settings for DIP switches 5 and 6; see "Baud Rate" (p. 44) Other: 8 data bits and 1 stop bit, without parity; internal buffers do not require a handshake

Daisy chain network

Using a daisy chain network, up to 16 controllers can be connected to the PC via a single RS-232 or USB connection. Interlinking occurs in series. See also "Definition" (p. 3).

3.8 Overview of PC Software

The following table shows the PC software that is included in the product CD. The given operating systems stand for the following versions:

- Windows: versions XP, Vista and 7
- Linux: Kernel 2.6, GTK 2.0, glibc 2.4

PC software	Operating system	Short description	Recommended use
Dynamic program library for GCS	Windows, Linux (USB only in Windows)	Allows software programming for the C-863 with programming languages such as C++. The functions in the dynamic program library are based on the PI General Command Set (GCS).	For users who would like to use a dynamic program library for their application. Is required for PIMikroMove. Is required for LabVIEW drivers if communication is to be established via USB or a daisy chain network.
LabVIEW drivers	Windows, Linux	LabVIEW is a software for data acquisition and process control (must be ordered separately from National Instruments). The C-863 LabVIEW software is a collection of virtual instrument drivers (VI drivers) for the C-863 controller. These drivers support the GCS.	For users who want to use LabVIEW to program their application.
PIMikroMove	Windows	Graphic user interface for Windows with which the C-863 and other controllers from PI can be used. ▪ The system can be started without programming effort ▪ Graph of motions in open-loop and closed-loop operation ▪ Macro functionality for storing command sequences on the PC (host macros) ▪ Joystick support ▪ Complete environment for command entry, for trying out different commands No command knowledge is necessary to operate PIMikroMove. PIMikroMove uses the dynamic program library to supply commands to the controller.	For users who want to perform simple automation tasks or test their equipment before or instead of programming an application. A log window showing the commands sent makes it possible to learn how to use the commands.
PITerminal	Windows	Basic graphic user interface for Windows, which can be used for nearly all PI controllers (see the description of the ***Command Entry*** window in the PIMikroMove user manual).	For users who want to send GCS commands directly to the controller.
PIStageEditor	Windows	Program for opening and editing stage databases.	For users who want to deal intensively with the contents of stage databases.

PC software	Operating system	Short description	Recommended use
PI Update Finder	Windows	Checks the PI software installed on the PC. If more current versions of the PC software are available on the PI server, downloading is offered.	For users who want to update the PC software.
TMS320F28xx Updater	Windows	Program for user support when updating firmware.	For users who want to update the firmware.
USB driver	Windows	Driver for the USB interface	For users who want to connect the controller to the PC via the USB interface.

3.9 Stage Databases

You can select a parameter set appropriate for your stage from a stage database in the PC software from PI. The software transfers the values of the selected parameter set to the volatile memory of the controller.

Database file name	Editable?	Description
PIStages2.dat	No, updates can be downloaded from the PI website (p. 30).	Includes parameter sets for all standard stages from PI; is automatically saved to the PC during the installation of the software.
PI_UserStages2.dat	Yes, new parameter sets can be created, edited and saved (p. 78).	Is created when you make a connection to your stage using the PC software for the first time (i. e. when selecting the stage in PIMikroMove or when using the commands VST? or CST).
M-xxx.dat	No, you receive updates from our customer service department (p. 91).	Includes the parameter set for a custom stage, for installation see "Installing a Custom Stage Database" (p. 32).

You can find further information in the user manuals for PIMikroMove, PIStageEditor and the PI GCS program library.

4 Unpacking

1. Unpack the C-863 with care.
2. Compare the contents against the items covered by the contract and against the packing list.
3. Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Quick Start

NOTICE

Incorrect wiring!

Connecting the USB and RS-232 interfaces of the controller to the PC at the same time can damage the PC or the controller.

- ➢ Connect either the USB or the RS-232 interface to the PC.

NOTICE

Oscillations!

Unsuitable settings made to the servo-control parameters of the C-863 can cause the stage to oscillate. Oscillations can damage the stage and/or the load affixed to it.

- ➢ Secure the stage and all loads adequately.
- ➢ If the stage is oscillating (unusual operating noise), immediately switch off the servo mode or disconnect the C-863 from the power source.
- ➢ Only switch on the servo mode after you have modified the servo-control parameter settings of the C-863; see "Optimizing Servo-Control Parameters" (p. 64).
- ➢ If, due to a very high load, oscillations occur already during the reference move, follow the instructions for the reference move in "Troubleshooting" (p. 85).

The aim of quick start is to start in the PIMikroMove PC software initial test motions of a stage that is connected to a non-networked C-863.

1. Install the following on the PC:
   - the PC software and the USB drivers from the product CD
   - updates for PC software and PIStages2.dat stage database
   - if provided separately by PI: custom stage database(s)

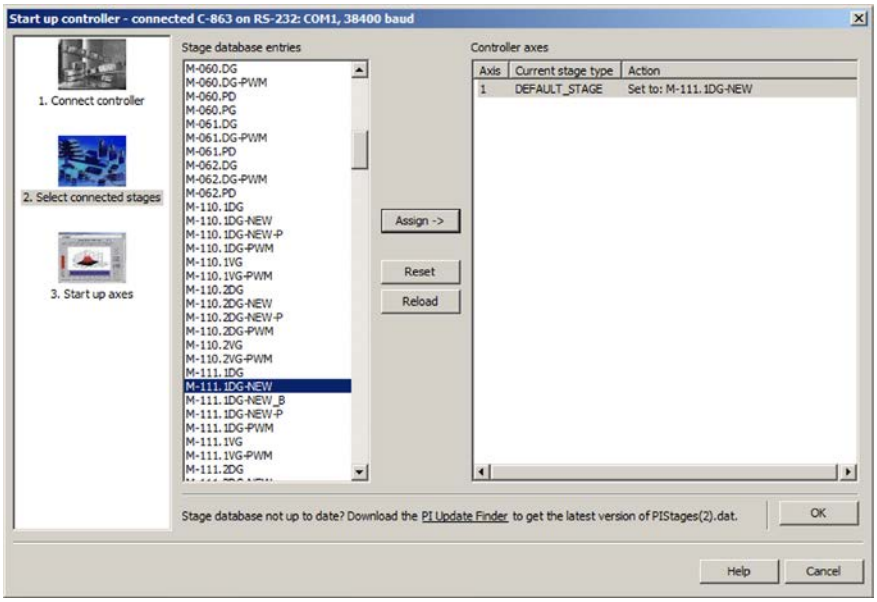
   Details see "Installing the PC Software" (p. 29).
2. Connect the C-863 via screw designated with the ground connection symbol to the grounding system (p. 34).

3. Connect the following to the C-863:
   - the included wide-range-input power supply (**not** connected to the wall socket via the power cord) to the **15-30 VDC** connection. Details see "Connecting Power Supply".
   - the stage to the **DC Motor only** socket. Details see "Connecting Stage" (p. 35).
   - the PC via the RS-232 interface (**RS-232 In** socket) **or** via the USB interface. Details see "Connecting PC" (p. 36).
4. Check the DIP switch settings (p. 42) and adapt them to your application if necessary. Controller address 1 must be set.
5. Switch on the C-863 (p. 45) by connecting the power cord of the wide-range-input power supply to the power socket.
6. Start PIMikroMove on the PC.
7. Establish communication between the C-863 and the PC in PIMikroMove via the RS-232 interface or the USB interface. Details see "Establishing Communication" (p. 46).
8. If in PIMikroMove the ***Select connected stages*** step is displayed, select the stage type of the stage connected:

   If on the right in the window in the ***Controller axes*** list the correct stage type is already listed in the ***Current stage type*** column:
   - Click on ***OK***.

   If the listed stage type is not correct:

   a) Mark the stage type in the ***Stage database entries*** list.
   b) Click ***Assign***.
   c) Confirm the selection with ***OK*** to load the parameter settings for the selected stage type from the stage database to the volatile memory of the C-863.



After clicking ***OK*** the ***Start up controller*** window goes to the ***Start up axes*** step.

9. In the ***Start up axes*** step, execute the reference move for the axis so that the controller knows the absolute axis position:

   – If you want to start the reference move to the reference point switch, click on ***Ref. switch***.

   – If you want to start the reference move to the negative limit switch, click on ***Neg. limit***.

   – If you want to start the reference move to the positive limit switch, click on ***Pos. limit***.

   If a warning message appears indicating that the servo mode is switched off:

   – Switch on the servo mode by clicking on the ***Switch on servo*** button.

The axis executes the reference move.

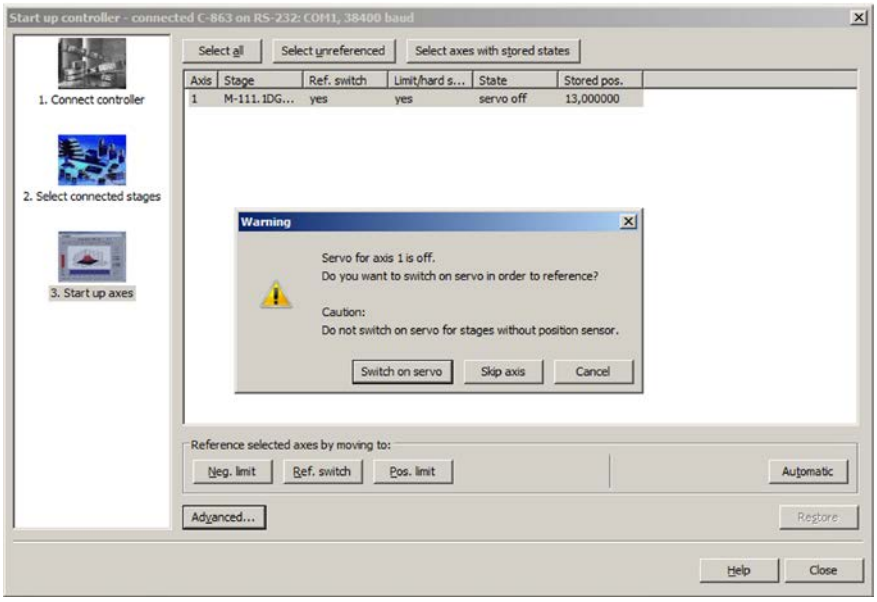


Figure 3: Start up controller – Start up axes

10. After a successful reference move, click on ***OK*** > ***Close***.

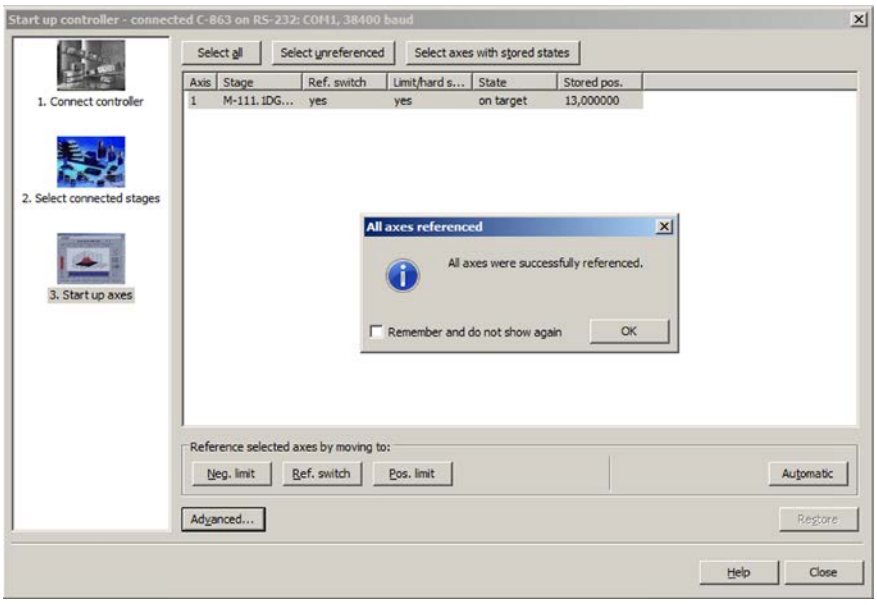


Figure 4: Start up controller – All axes referenced

The main window of PIMikroMove opens.

11. Start a few test motions of the axis.

    In the main window of PIMikroMove you can execute, for example, steps with a certain step size by clicking the corresponding arrow keys for the axis.

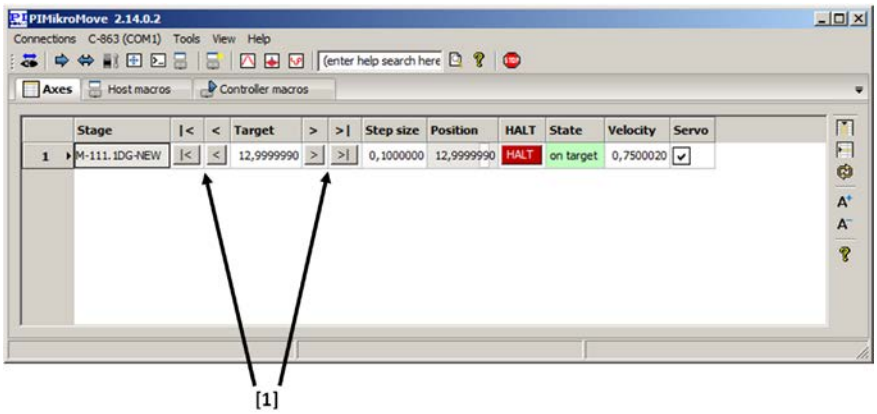


Figure 5: Main window of PIMikroMove; [1] arrow keys for motion

6 Installation

In this Chapter

6.1 Installing the PC Software

Communication between the C-863 and a PC is required to configure the C-863 and to command motions using the commands fo the GCS. Various PC software applications are available for this purpose.

6.1.1 Performing the Initial Installation

Accessories

- PC with a Windows operating system (XP, Vista, 7) or Linux operating system
- Product CD (included in the scope of delivery)

Installing the PC software on Windows

1. Start the installation wizard by double-clicking the  icon or the ***setup.exe*** file in the installation directory (root directory of the CD).
2. Follow the instructions on the screen.
   You can choose between the default installation (typical) or the user-defined installation (custom). With the default installation (recommended), the following components are installed among others:
   - LabVIEW drivers
   - Dynamic program library for GCS
   - PIMikroMove

3. If you want to connect the controller to the PC via the USB interface:
   a) Start the installation of the USB drivers by clicking on ***Yes*** in the particular dialog window.
   b) Follow the instructions on the screen.

Installing the PC software on Linux

1. Unpack the tar archive from the /linux directory of the product CD to a directory on your PC.
2. Open a terminal and go to the directory to which you have unpacked the tar archive.
3. Log on as a superuser (root rights).
4. Enter ./INSTALL to start the installation.
   Pay attention to lower and upper case when entering commands.
5. Follow the instructions on the screen.

You can select individual components for installation.

6.1.2 Installing Updates

PI is constantly improving the PC software.

➢ Always install the latest version of the PC software and the PIStages2.dat stage database.

Prerequisite

✓ Active connection of the PC to the Internet.

– If your PC does not have an Internet connection:
  You have the A000T0032 Technical Note for the PI Update Finder on hand. You can find the document either on the product CD or in our Update Portal (http://www.update.pi-portal.ws) in the zip file for the PI Update Finder.

✓ If your PC uses a Windows operating system:

– If the PI Update Finder program is not on your product CD:
  You have downloaded the PI Update Finder from our Update Portal (http://www.update.pi-portal.ws) and unpacked it from the zip file into a directory on your PC.

– You have the A000T0028 Technical Note for the PI Update Finder on hand. You can find the document either on the product CD or on in the zip file that you have downloaded for the PI Update Finder.

✓ If your PC uses a Linux operating system:

– You have the user name and password for the C-863 at hand. Both of these can be found in the file "C-863 Releasenews_V_x_x_x.pdf" (x_x_x: version number of the CD) in the \Manuals folder on the product CD.

Updating the PC software and PIStages2.dat on Windows

➢ Use the PI Update Finder:

– If the PC to be updated has an active connection to the Internet: Follow the instructions in the A000T0028 Technical Note (TECHNICAL_NOTE_PI_UPDATE_FINDER_xx.pdf).

– If the PC to be updated has no active connection to the Internet: Follow the instructions in the A000T0032 Technical Note.

Updating the PC software on Linux

1. Open the PI website (http://www.pi-portal.ws).
2. Click ***Downloads***.
3. In the ***User login*** area on the left margin, enter the user name and password from the "C-663.11_Releasenews_V_x_x_x.pdf" file on the product CD.
4. Click ***Login***.
5. Click the category ***C Motion Controllers***.
6. Click ***C¬863 > C¬863.11 > software*** (if you click ***Documents***, the latest versions of the corresponding manuals are displayed).
7. Underneath the latest CD mirror, click the ***Download*** button (also contains the manuals).
8. Save the downloaded archive file on the PC.
9. Unpack the file to a separate installation directory.
10. In the directory with the unpacked files, go to the linux subdirectory.
11. Unpack the archive file in the linux directory by entering the command tar -xvpf <name of the archive file> on the console.
12. Read the accompanying information (readme file) on the software update.
13. Log onto the PC as a superuser (root rights).
14. Only install the update if it is a good idea for your application.

Updating PIStages2.dat on Linux

1. Open the PI website (http://www.pi-portal.ws).
2. Click ***Downloads***.
3. In ***User login*** area on the left margin, enter your username and password from the "C-663.11_Releasenews_V_x_x_x.pdf" file on the product CD.
4. Click ***Login***.
5. Click on the ***General Software*** category.
6. Click on ***PI Stages***.
7. Click on ***pistages2*** or on the ***Download*** button below it.
8. Log onto the PC as a superuser (root rights).
9. Install the downloaded pistages2.dat file on the PC. You can select between the following options:
   - Save the pistages2.dat file in the /usr/local/PI/pi_gcs_translator/ directory.
   - Save the pistages2.dat file in the directory where you unpacked the Linux software from the product CD. The path is /<UnpackingDirectory>/pi_stages2_dat. In this subdirectory start the INSTALL.pi_stages2_dat script.

6.1.3 Installing a Custom Stage Database

With a custom stage, you will receive, if necessary, a file from PI with a custom stage database. You have to install this file on your PC so that you can load the parameter values for the custom stage in the C-863.

Installing a custom stage database on Windows

1. Open the \PI\GCSTranslator directory on your PC:

   If you are working with PIMikroMove:

   a) From the main window of PIMikroMove open via the ***Connections*** > ***Search for controller software*** menu item the ***Version Information*** window.
   b) In the ***Version Information*** window, click on the ***Show GCS PATH…*** button to open the \PI\GCSTranslator directory in Windows Explorer.

   The path where the \PI directory is located was defined during the installation of the PC software, normally C:\Documents and Settings\All Users\Application Data (Windows XP) or C:\ProgramData (Windows Vista, Windows 7).
2. Copy the stage database file to the \PI\GCSTranslator directory on your PC.

INFORMATION

If the \PI\GCSTranslator directory is not present on your PC:

For an executable file (.exe) to be able to access a stage database, both files have to be in the same directory.

Installing a custom stage database on Linux

1. Log onto the PC as a superuser (root rights).
2. Copy the stage database file to the /usr/local/PI/pi_gcs_translator/ directory.

6.2 Mounting the C-863

The C-863 can be used as bench-top device or mounted in any orientation on a surface.

INFORMATION

The C-863 is stackable and can be installed in a control cabinet.

Figure 6: C-863.11: Mounting strips with recesses (see arrows)

Tools and accessories

- Appropriate screws; see dimensional drawing (p. 96).
- Suitable screwdriver

Mounting the C-863 on a surface

1. Make the necessary holes in the surface.

   The arrangement of the recesses in the mounting strips of the C-863 can be found in the dimensional drawing (p. 96).

2. Mount the C-863 to the recesses in the mounting strips with two suitable screws each per side (see figure).

6.3 Grounding the C-863

The C-863 is not grounded via the power supply connector.

If a potential equalization is required:

- ➢ Connect the screw designated with the ground connection symbol (see figure) on the rear panel of the case of the C-863 to the grounding system.

6.4 Connecting the Power Supply to the C-863

NOTICE

Motor damage due to excessively high operating voltage!

The output voltage on the **Motor +** and **Motor -** pins of the **DC Motor only** socket can be as high as the supply voltage provided by the power supply. Stages without PWM amplifier are connected to these pins and can be damaged by output voltage that is too high.

- ➢ Connect a power supply whose output voltage does **not** exceed the permissible operating voltage of the stage.

Prerequisites

- ✓ The power supply is **not** connected to the power socket via the power cord.

Tools and accessories

- ▪ Included 15 V wide-range-input power supply (for line voltages between 100 and 240 volts alternating current voltage at 50 or 60 Hz) or other suitable power supply that supplies 15 to 30 volts direct current voltage.

Connecting the power supply to the C-863

- ➢ Connect the power supply to the **15-30 VDC** connection of the C-863.

6.5 Connecting the Stage

NOTICE

Damage if a wrong motor is connected!

Connecting a stage with stepper motor to a DC motor controller can cause irreparable damage.

➢ Only connect to the C-863 a stage with DC motor or voice coil drive.

INFORMATION

The C-863 supports stages with a PWM amplifier as well as stages without a PWM amplifier. Separate lines on the **DC Motor only** socket (p. 97) are available for both stage versions. The selection of the proper lines must be ensured via the connector of the stage. With stages from PI the proper connection is ensured.

Prerequisite

✓ The C-863 is switched off, i. e. the power supply is **not** connected to the power socket with the power cord.

Tools and accessories

- If the distance between the C-863 and the stage is too great:
  motor cable C-815.38, 3 m, available as an optional accessory (p. 16)

Connecting the stage

➢ Connect the stage to the **DC Motor only** socket of the C-863.

6.6 Connecting the PC

The communication between the C-863 and a PC is necessary to configure the C-863 and send motion commands using the commands of the GCS. The C-863 has the following interfaces for this purpose:

- RS-232 interface
- USB interface

In this section, you will learn how to make the proper cable connections between the C-863 and a PC as well as in a daisy chain. All other steps required for establishing communication between the C-863 and PC are described in the following sections:

- "Establishing Communication via RS-232" (p. 46)
- "Establishing Communication via USB" (p. 48)
- "Establishing Communication for Networked Controllers" (p. 49)

INFORMATION

Using a daisy chain network, up to 16 controllers can be connected to the PC via a single RS-232 or USB connection.

6.6.1 Connecting to the RS-232 Interface

NOTICE

Incorrect wiring!

Connecting the USB and RS-232 interfaces of the controller to the PC at the same time can damage the PC or the controller.

➢ Connect either the USB or the RS-232 interface to the PC.

Prerequisites

✓ The PC has a free RS-232 interface (also called a "serial interface" or "COM port", e. g. COM1 or COM2).

Tools and accessories

- RS-232 null-modem cable (C-815.34 included in the scope of delivery)

Connecting the C-863 to the PC

➢ Connect the **RS-232 In** socket on the front panel of the C-863 and the RS-232 interface of the PC (a Sub-D 9(m) panel plug) to the null-modem cable.

6.6.2 Connecting to the USB Interface

NOTICE

Incorrect wiring!

Connecting the USB and RS-232 interfaces of the controller to the PC at the same time can damage the PC or the controller.

➢ Connect either the USB or the RS-232 interface to the PC.

Prerequisites

✓ The PC has a free USB interface.

Tools and accessories

- USB cable (type A to Mini-B) for connecting to the PC (order number 000014651; included in the scope of delivery)

Connecting the C-863 to the PC

➢ Connect the USB socket of the C-863 and the USB interface of the PC with the USB cable.

6.6.3 Setting Up a Daisy Chain Network

INFORMATION

Interlinking in a daisy chain occurs in series. See also "Definition" (p. 3). Here the first controller is connected directly to the PC.

INFORMATION

The DIP switches of the C-863 must be set accordingly:

➢ Set a unique address for each controller in a daisy chain network. In doing so, one of the controllers must have the address 1. This controller does not have to be the one directly connected to the PC. Details see "Controller Address" (p. 43).

➢ Set the same baud rate for every controller in a daisy chain network. Details see "Baud Rate" (p. 44).

Tools and accessories

- A network cable for every controller to be connected to the network. Currently available:
  - C-862.CN, 30 cm, included in the scope of delivery
  - C-862.CN2, 180 cm, available as an optional accessory (p. 16)

Interlinking the controllers

- ➢ Set up the controller chain. For this purpose, always connect the **RS-232 Out** connection of the previous controller via the network cable to the **RS-232 In** connection of the subsequent controller.
- ➢ Connect the first controller of the chain to the PC.
  - Use the RS-232 interface (p. 36).

  or

  - Use the USB interface (p. 37).

INFORMATION

A C-863.11 can be operated in a common daisy chain network with the following controllers:

- C-663.11 Mercury Step stepper motor controller
- PILine® piezomotor controllers of the C-867 series
- E-861 NEXACT® controller

6.7 Connecting an analog joystick - see detailed manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

6.8 Connecting digital in- and outputs - see detailed manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

6.9 Connecting signal sources - see detailed manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

7 Start-Up

In this Chapter

7.1 General Notes on Start-Up

NOTICE

Damage due to disabled limit switch evaluation!

The collision of a moving part at the end of the travel range, or with an obstacle, as well as high acceleration, can cause damage to or considerable wear on the mechanical system.

- Prevent motions in open-loop operation.
- If motions in open-loop operation are necessary:
  - Set the control value with the SMO command so that the axis moves with low velocity.
  - Stop the axis in time. For this purpose, use the #24, STP or HLT command, or set the control value to zero with the SMO command.
- Do not disable the evaluation of the limit switches by the C-863 via parameter setting.
- Check the function of the limit switches at about 10 % to 20 % of the maximum velocity.
- In the event of a malfunction of the limit switches, stop the motion immediately.

7.2 Adapting the DIP Switch Settings

7.2.1 General Procedure

INFORMATION

Changed DIP switch settings become effective after the C-863 is switched on.

➢ If you have changed the DIP switch settings while the C-863 was switched on, switch the C-863 off and back on again to activate the new settings.

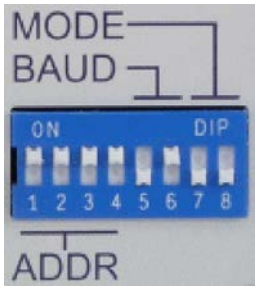


Figure 7: DIP switches: switch up = ON; switch down = OFF

Switches	Function
1 to 4	Controller address (p. 43); 16 possible combinations
5 and 6	Baud rate (p. 44)
7	Logic level of the limit switches (p. 44)
8	Update mode (p. 45)

Prerequisite

✓ The C-863 is switched off, i.e. the power supply is **not** connected to the power socket with the power cord.

Adapting the DIP switch settings

➢ Put the individual DIP switches in the correct position for your application. Details are given in the following tables.

7.2.2 Controller Address

Address*	S1	S2	S3	S4
1	**ON**	**ON**	**ON**	**ON**
2	ON	ON	ON	OFF
3	ON	ON	OFF	ON
4	ON	ON	OFF	OFF
5	ON	OFF	ON	ON
6	ON	OFF	ON	OFF
7	ON	OFF	OFF	ON
8	ON	OFF	OFF	OFF
9	OFF	ON	ON	ON
10	OFF	ON	ON	OFF
11	OFF	ON	OFF	ON
12	OFF	ON	OFF	OFF
13	OFF	OFF	ON	ON
14	OFF	OFF	ON	OFF
15	OFF	OFF	OFF	ON
16	OFF	OFF	OFF	OFF

*Factory settings are shown in bold.

INFORMATION

A unique address must be set for each controller in a daisy chain network. In doing so, one of the controllers must have the address 1. This controller does not have to be the one directly connected to the PC.

INFORMATION

A non-networked controller must have the address 1, if

- it is to be used in PIMikroMove.
- it is to be used in LabVIEW.
- it is to be addressed with the PITerminal without specifying the target address; in this case, in the responses of the C-863 target and sender addresses (p. 69) are omitted as well.

7.2.3 Baud Rate

Baud rate*	S5	S6
9600	ON	ON
19200	ON	OFF
38400	**OFF**	**ON**
115200	OFF	OFF

*Factory settings are shown in bold.

INFORMATION

The same baud rate must be set for every controller in a daisy chain network.

7.2.4 Logic Level of the Limit Switches

Limit switches (hardware setting)*	S7
Active low	ON
Active high	**OFF**

*Factory settings are shown in bold.

INFORMATION

The C-863 can be adapted via DIP switch 7 and the ***Limit Mode*** parameter (ID 0x18) to the logic level of the limit switches of the stage connected (active high or active low). In order for the stage to be able to move, the DIP switch **and** parameter settings must correspond to the logic level of the limit switches.

DIP switch 7 is preset for using active high signals (e. g. for DC motor stages from PI). If you select your PI stage from a stage database in the PC software from PI, the ***Limit Mode*** parameter is already set correctly.

7.2.5 Update Mode

Update mode	S8
Firmware update	ON
Normal operation	**OFF**

*Factory settings are shown in bold.

INFORMATION

If the C-863 is in the firmware update mode (DIP switch 8 in "ON" (upper) position), all LEDs remain deactivated after switching on the C-863.

7.3 Switching on the C-863

INFORMATION

The C-863 is intended for closed-loop operation with incremental position sensors (servo mode On). After switching-on, open-loop operation is enabled by default (servo mode Off).

- Get the current operating mode with the `SV0?`, `#4` or `SRG?` commands.
- Enable closed-loop operation with the `SV0` command.
- If necessary, program a start-up macro that starts the C-863 via the `SV0` command in closed-loop operation; see "Setting up a start-up macro" in the detailed version of the user manual MS205E.
- Prevent motions in open-loop operation.

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 41).
- ✓ The C-863 has been installed properly (p. 29).
- ✓ You have set the DIP switches of the C-863 in accordance with your application (p. 42).

Switching on the C-863

- Connect the power cord of the power supply with the power socket.

  The C-863 copies information from the nonvolatile memory to the volatile memory.

  The **STA** LED on the front panel of the C-863 displays the state of the C-863:

  - green: C-863 is ready for normal operation
  - off: If DIP switch 8 is in the "ON" (upper) position, the C-863 is in firmware update mode. Otherwise the C-863 might be defective.

- If DIP switch 8 is in the "OFF" (lower) position and the **STA** LED does not light after switching-on, contact our customer service department (p. 91).

7.4 Establishing Communication

The procedure for PIMikroMove is described in the following.

INFORMATION

Use the ***USB Daisy Chain*** and ***RS-232 Daisy Chain*** tabs in the PC software for establishing communication only if you have actually connected a daisy chain network to the PC.

INFORMATION

A non-networked controller must have the address 1, if it is to be used in PIMikroMove. Details see "Controller Address" (p. 43).

7.4.1 Establishing Communication via RS-232

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 41).
- ✓ The C-863 is connected to the RS-232 interface of the PC (p. 36).
- ✓ You have made the following settings with the respective DIP switches prior to switching on the C-863 (p. 42):
  - controller address = 1
  - appropriate baud rate

- ✓ The C-863 is switched on (p. 45).
- ✓ The PC is switched on.
- ✓ The required software is installed on the PC (p. 29).
- ✓ You have read and understood the manual of the used PC software. The software manuals are found on the product CD.

Establishing communication

1. Start PIMikroMove.

   The ***Start up controller*** window opens with the ***Connect controller*** step.

   – If the ***Start up controller*** window does not automatically open, select the ***Connections > New...*** menu item in the main window.

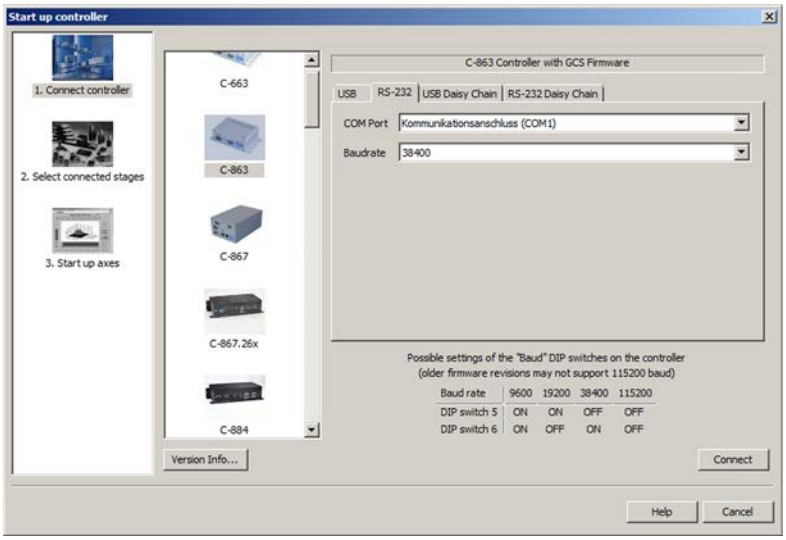


Figure 8: Start up controller – Connect controller

2. Select ***C-863*** in the field for controller selection.
3. Select the ***RS-232*** tab on the right side of the window.
4. In the ***COM Port*** field, select the COM port of the PC to which you have connected the C-863.
5. In the ***Baudrate*** field, set the value that is set with DIP switches 5 and 6 of the C-863.

   This adapts the baud rate of the PC to the baud rate of the C-863.
6. Click ***Connect*** to establish communication.

If communication has been successfully established, the ***Start up controller*** window switches to the ***Select connected stages*** step.

7.4.2 Establishing Communication via USB

INFORMATION

If the controller is connected via the USB connection and switched on, the USB interface in the PC software is also shown as a COM port.

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 41).
- ✓ The C-863 is connected to the USB interface of the PC (p. 37).
- ✓ Prior to switching on the C-863, you have set the DIP switches for the controller address to the address 1 (p. 42).
- ✓ The C-863 is switched on (p. 45).
- ✓ The PC is switched on.
- ✓ The required software and USB drivers are installed on the PC.
- ✓ You have read and understood the manual of the used PC software. The software manuals are found on the product CD.

Establishing communication

1. Start PIMikroMove.

   The ***Start up controller*** window opens with the ***Connect controller*** step.

   – If the ***Start up controller*** window does not automatically open, select the ***Connections > New...*** menu item in the main window.

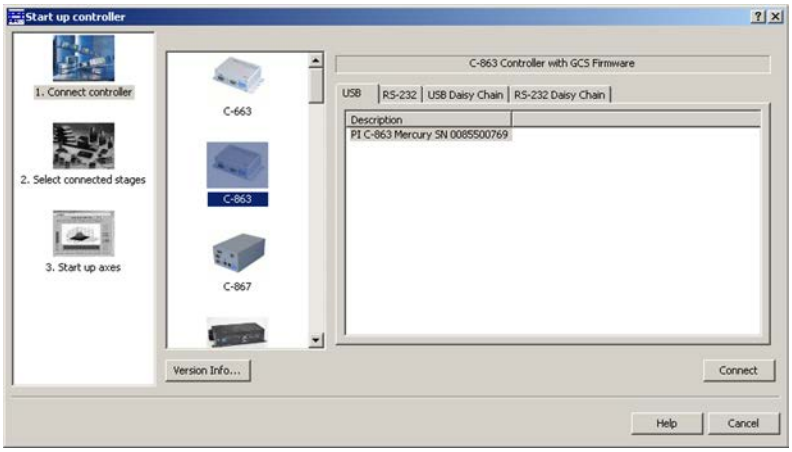


Figure 9: Start up controller – Connect controller

2. Select ***C-863*** in the field for controller selection.
3. Select the ***USB*** tab on the right side of the window.
4. On the ***USB*** tab, select the connected C-863.
5. Click ***Connect*** to establish communication.

If communication has been successfully established, the ***Select connected stages*** dialog opens.

➢ If communication could not be established, look for a solution to the problem in "Troubleshooting" (p. 85).

7.4.3 Establishing Communication for a Networked Controller

The procedure for PIMikroMove and for PITerminal is described in the following.

INFORMATION

If you are establishing communication with a networked controller via PITerminal, the address of the controller to be addressed is required in every command line. Details see "Target and Sender Address" (p. 69).

➢ Use PITerminal to test communication with networked controllers.

INFORMATION

The RS-232 output lines of some PCs are not adapted for the maximum number of 16 controllers in a network. If you have connected a daisy chain network to such a PC via the RS-232 interface, communication malfunctions may occur (e. g. timeout). In case of communication malfunctions:

1. Disconnect the null-modem cable from the **RS-232 In** socket of the controller which is connected to the PC.
2. Connect the daisy chain network to the PC via the USB interface of this controller.

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 41).
- ✓ You have set up a daisy chain network (p. 37).
- ✓ Prior to switching-on you have properly set on each networked C-863 the DIP switches for the controller address (p. 43) and the baud rate (p. 44).
- ✓ Every controller in the daisy chain network is switched on (p. 45).
- ✓ The PC is switched on.
- ✓ The required software is installed on the PC (p. 29).
- ✓ If you have connected the first controller in the chain to the PC via the USB interface: The USB drivers are installed on the PC (p. 29).
- ✓ You have read and understood the manual of the used PC software. The software manuals are found on the product CD.

Establishing communication with PIMikroMove

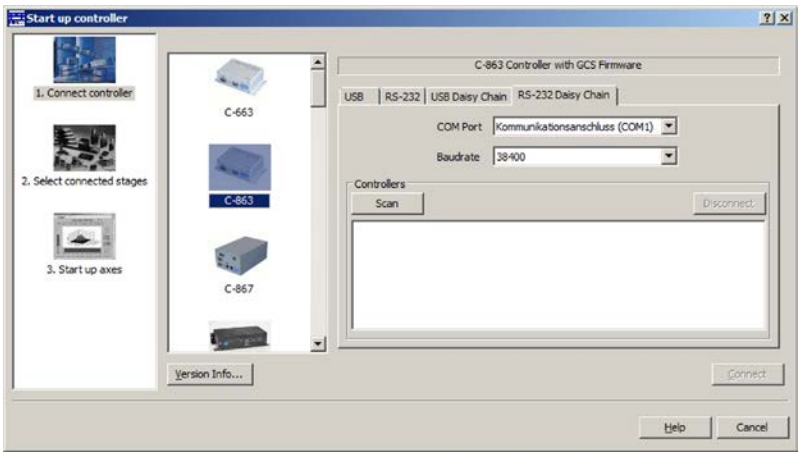
1. Start PIMikroMove.

   The ***Start up controller*** window opens with the ***Connect controller*** step.

   – If the ***Start up controller*** window does not automatically open, select the ***Connections > New...*** menu item in the main window.

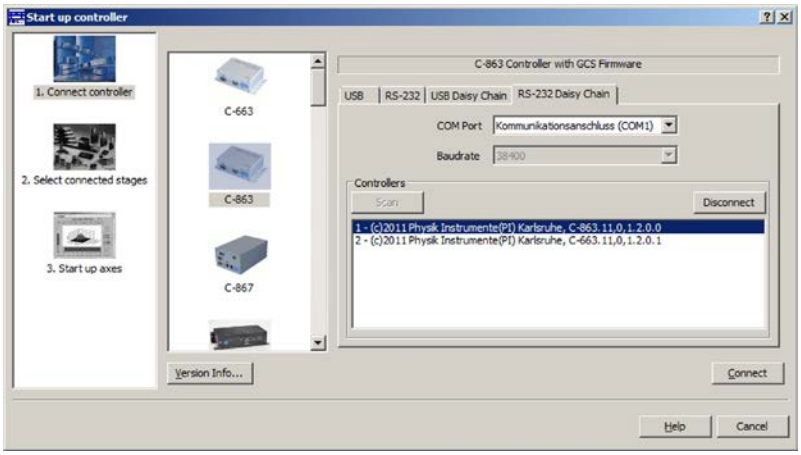
2. Select the appropriate controller type in the field for controller selection.

In the example in the following figures, there is a daisy chain network from a C-863.11 with the controller address 1 and a C-663.11 with the controller address 2. If you want to connect the C-863.11 first, select ***C-863***.



3. Select the appropriate tab on the right side of the window:
   - If you have connected the first controller in the chain to the PC via the RS-232 interface, select the ***RS-232 Daisy Chain*** tab.
   - If you have connected the first controller in the chain to the PC via the USB interfaces, select the ***USB Daisy Chain*** tab.
4. Make the settings for the interface in the tab selected:
   - ***RS-232 Daisy Chain*** tab:
     - In the ***COM Port*** field, select the PC COM port to which you have connected the C-863.
     - In the ***Baudrate*** field, set the value which is set with DIP switches 5 and 6 of the C-863.
   - ***USB Daisy Chain*** tab:
     - In the top section of the tab, select the C-863 connected.

5. In the bottom section of the tab, click on the ***Scan*** button to list every controller in the daisy chain network.



6. Select a controller from the list. The selection must match the controller type that you selected in step 2.
7. Click ***Connect*** to establish communication with the controller selected.

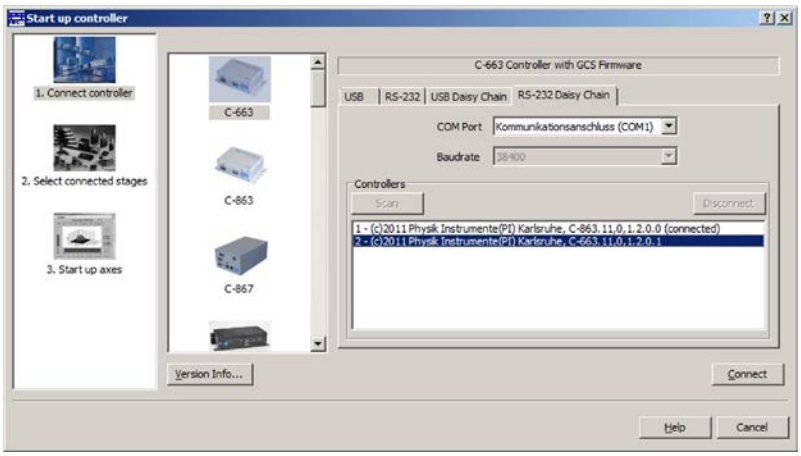
   If communication has been successfully established, the ***Select connected stages*** dialog opens.

   – Proceed further as described in "Starting Motions" (p. 55).

   or

   – Close the ***Select connected stages*** window by clicking on the ***Cancel*** button.
8. If you want to connect an additional controller of the daisy chain network, select the ***Connections > New...*** menu item in the main window.
9. Execute again steps 2, 6 and 7 in the order indicated.

In the following figure, the ***C-663*** is to be connected as well.



10. Repeat steps 8, 2, 6 and 7 for every additional controller of the daisy chain network, which you want to connect.

If you want to terminate communication with one of the controllers of the daisy chain network:

- In the main window, select the ***Connections > Close*** menu item for the corresponding controller.

Establishing communication with PITerminal

INFORMATION

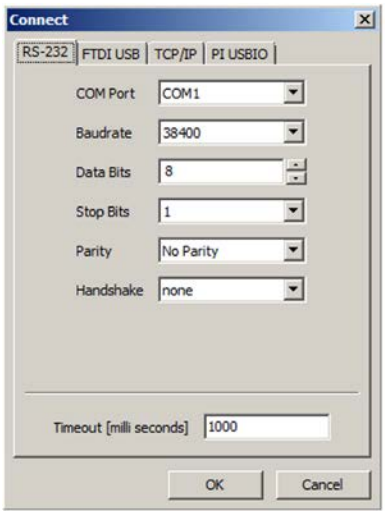
Via the ***Mercury*** button, PITerminal supports controllers with older firmware versions that are not compatible with GCS.

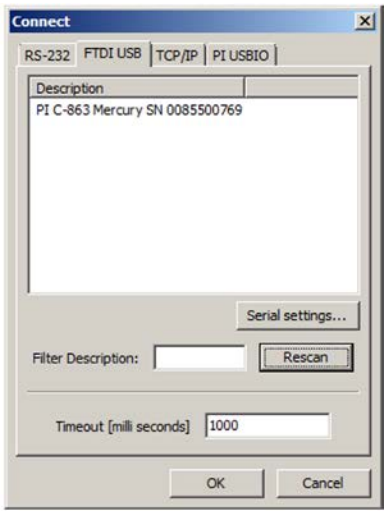
- Make sure that the **Mercury** button is ***not*** enabled in PITerminal.

1. Start PITerminal.
2. Click on ***Connect…***.

   The ***Connect*** window opens.

3. In the ***Connect*** window, select the ***RS-232*** or ***FTDI USB*** tab, depending on via which interface you have connected the first controller in the chain to the PC.

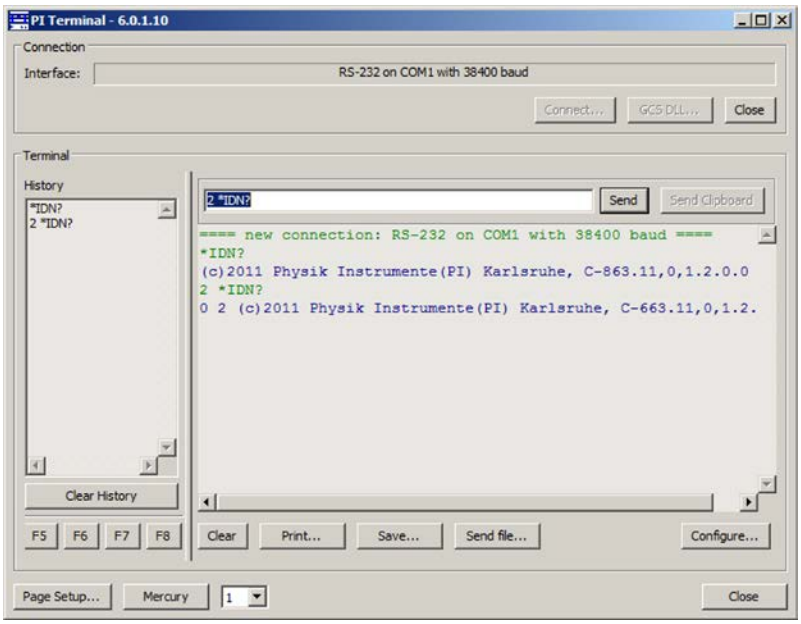




4. Make the settings for the interface in the selected tab:
   - ***RS-232*** tab:
     - In the ***COM Port*** field, select the PC COM port to which you have connected the C-863.
     - In the ***Baudrate*** field, set the value which is set with DIP switches 5 and 6 of the C-863.
   - ***FTDI USB*** tab:
     - Select the connected C-863.
5. Click ***OK*** to establish communication.
6. Send the `*IDN?` command for every controller in the daisy chain network to check the communication.

   In the example in the following figure, the daisy chain comprises one C-863.11 with the controller address 1 and one C-663.11 with the controller address 2. Send:
   - `*IDN?` to query the device identification string of the controller with the address 1; the controller address is not required (because = 1)
   - `2 *IDN?` to query the device identification string of the controller with the address 2.

Further information see "Target and Sender Address" (p. 69).



7.5 Starting Motions

In the following, PIMikroMove is used to move the stage. Here the program guides you through the following steps so that you do not have to deal with the respective GCS commands:

- Adapting the parameter settings of the C-863 to the connected stage by loading a parameter set from a stage database
- Switching on the servo mode (closed-loop operation)
- Executing a reference move; details see "Reference Point Definition".

NOTICE

Selection of an incorrect stage type

Selecting an incorrect stage type in the PC software can cause damage to the stage.

➢ Make sure that the stage type selected in the PC software matches the stage connected.

NOTICE

Oscillations!

Unsuitable settings made to the servo-control parameters of the C-863 can cause the stage to oscillate. Oscillations can damage the stage and/or the load affixed to it.

- Secure the stage and all loads adequately.
- If the stage is oscillating (unusual operating noise), immediately switch off the servo mode or disconnect the C-863 from the power source.
- Only switch on the servo mode after you have modified the servo-control parameter settings of the C-863; see "Optimizing Servo-Control Parameters" (p. 64).
- If, due to a very high load, oscillations occur already during the reference move, follow the instructions for the reference move in "Troubleshooting" (p. 85).

INFORMATION

Parameter values from the stage database are only loaded to the volatile memory of the controller.

INFORMATION

The C-863 has a nonvolatile memory for parameter values. Therefore, after switching-on, the correct parameter settings for the stage connected may already be loaded.

- However, if you have loaded a parameter set from the stage database and overwritten the original settings of the C-863 in the volatile memory in the process, avoid saving the new settings in the nonvolatile memory of the C-863. The original settings are active again after the C-863 has been switched off and on again or been rebooted.

INFORMATION

If in PIMikroMove the ***Select connected stages*** step is not displayed, the controller has probably already loaded the correct parameter settings for the stage type connected.

1. Check during the ***Start up axes*** step whether the correct stage type is at mid-range of the window in the ***Stage*** column.
2. If the stage type is not correct, click ***Select connected stages*** in the left area of the ***Start up controller*** window for changing the stage type.

Prerequisites

- ✓ You have read and understood the General Notes on Start-Up (p. 41).
- ✓ PIMikroMove is installed on the PC (p. 29).
- ✓ You have read and understood the PIMikroMove manual. The manual is found on the product CD.
- ✓ You have installed the latest version of the *PIUserStages2.dat* stage database on the PC (p. 31).
- ✓ If PI has provided you with a custom stage database for your stage, then you have installed this database on your PC (p. 32).
- ✓ You have installed the stage in the same manner as it will be used in your application (corresponding load and orientation).
- ✓ You have connected the stage to the C-863 (p. 36).
- ✓ You have established communication between the C-863 and the PC with PIMikroMove via TCP/IP, RS-232 or USB (p. 48).

Starting motions with PIMikroMove

1. If in PIMikroMove the ***Select connected stages*** step is displayed, select the stage type of the stage connected:

   If on the right in the window in the ***Controller axes*** list the correct stage type is already listed in the ***Current stage type*** column:

   – Click on ***OK***.

   If the listed stage type is not correct:

   a) Mark the stage type in the ***Stage database entries*** list.
   b) Click ***Assign***.
   c) Confirm the selection with ***OK*** to load the parameter settings for the selected stage type from the stage database to the volatile memory of the C-863.

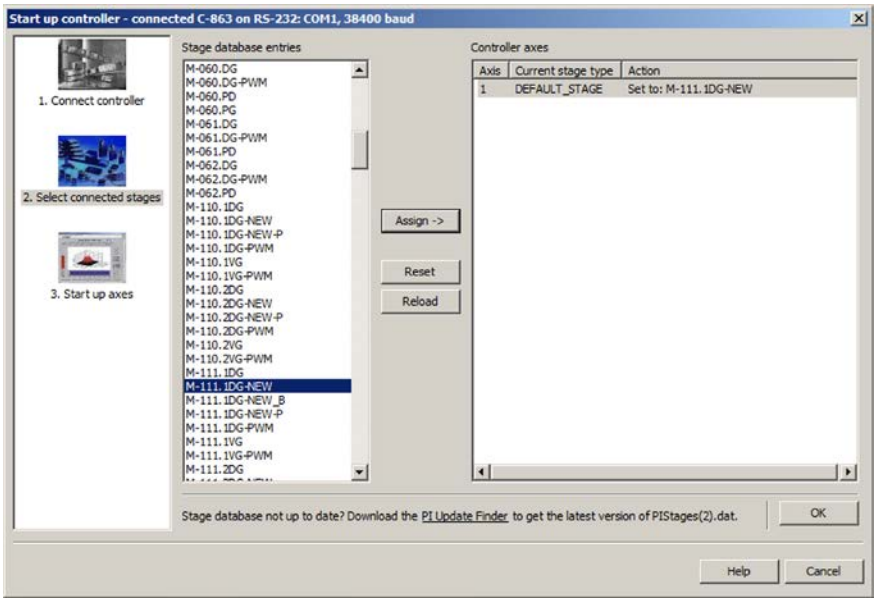


Figure 10: Start up controller – Select connected stages

After you have clicked ***OK***, the ***Start up controller*** window goes to the ***Start up axes*** step.

2. In the ***Start up axes*** step, execute the reference move for the axis so that the controller knows the absolute axis position:

   – If you want to start the reference move to the reference point switch, click on ***Ref. switch***.

   – If you want to start the reference move to the negative limit switch, click on ***Neg. limit***.

   – If you want to start the reference move to the positive limit switch, click on ***Pos. limit***.

   If a warning message appears indicating that the servo mode is switched off:

   – Switch on the servo mode by clicking on the ***Switch on servo*** button (closed-loop operation).

The axis executes the reference move.

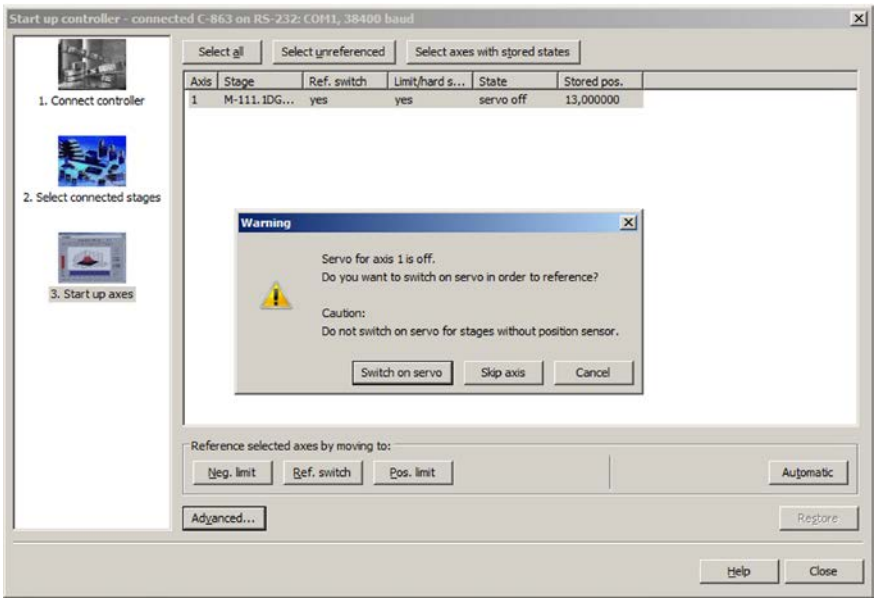


Figure 11: Start up controller – Start up axes

3. After a successful reference move, click ***OK > Close***.

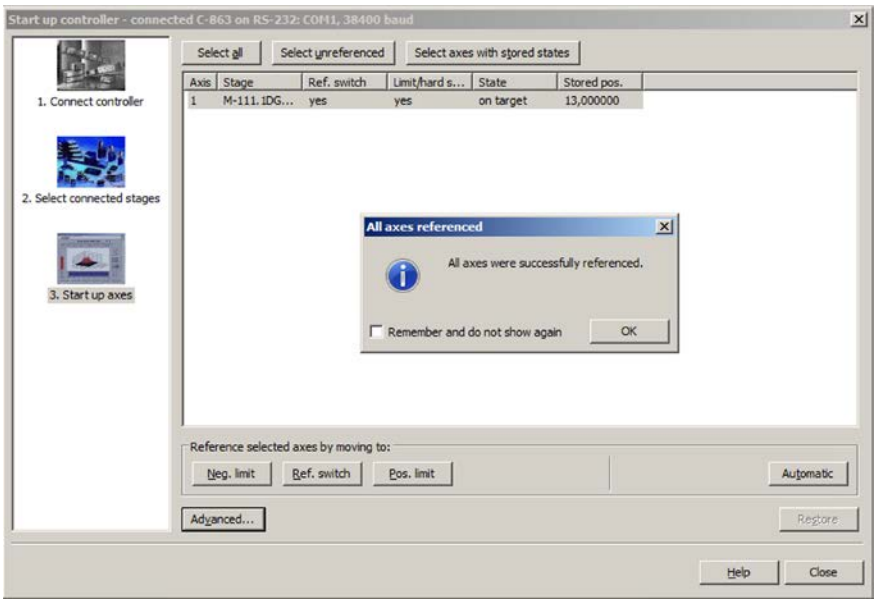


Figure 12: Start up controller – All axes referenced

The main window of PIMikroMove opens.

4. Start a few test motions of the axis.

   In the main window of PIMikroMove you can execute, for example, steps with a certain step size by clicking the corresponding arrow keys for the axis.

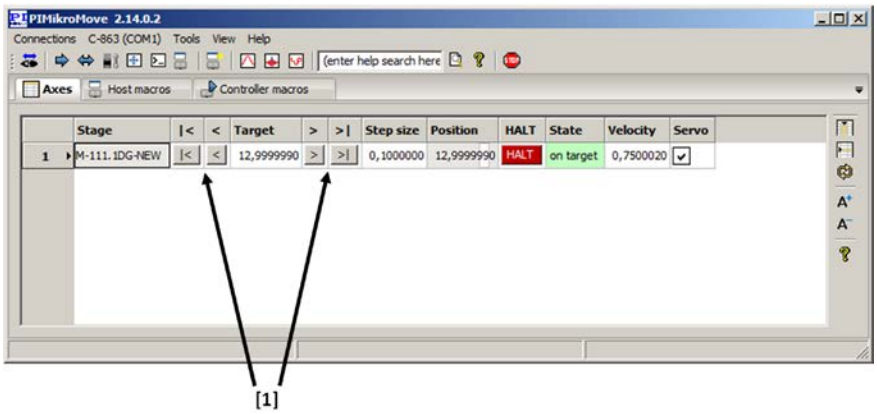


Figure 13: Main window of PIMikroMove; [1] arrow keys for motion

7.6 Recording the Step Response

With the recording of the step response, you determine the settling behavior of the stage in closed-loop operation. The procedure for PIMikroMove is described in the following.

Prerequisite

- ✓ With PIMikroMove you have started initial motions (p. 55).
- ✓ All devices are still ready for operation.

Measuring the step response

1. In the main window of PIMikroMove, open the ***Data Recorder*** window via the ***C-863 > Show/Hide data recorder*** menu item.

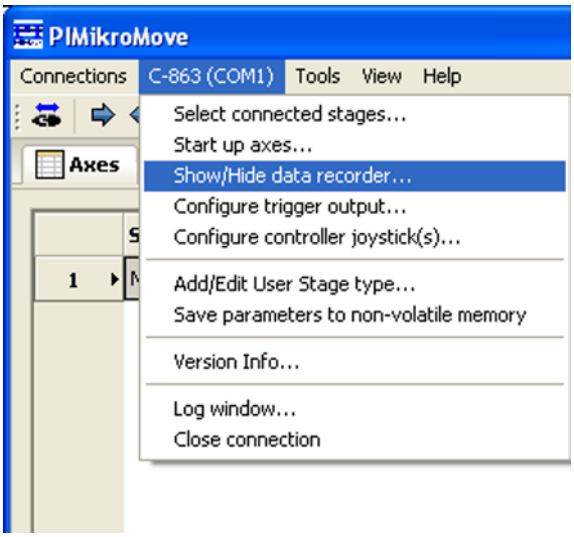


Figure 14: PIMikroMove: Show/Hide data recorder

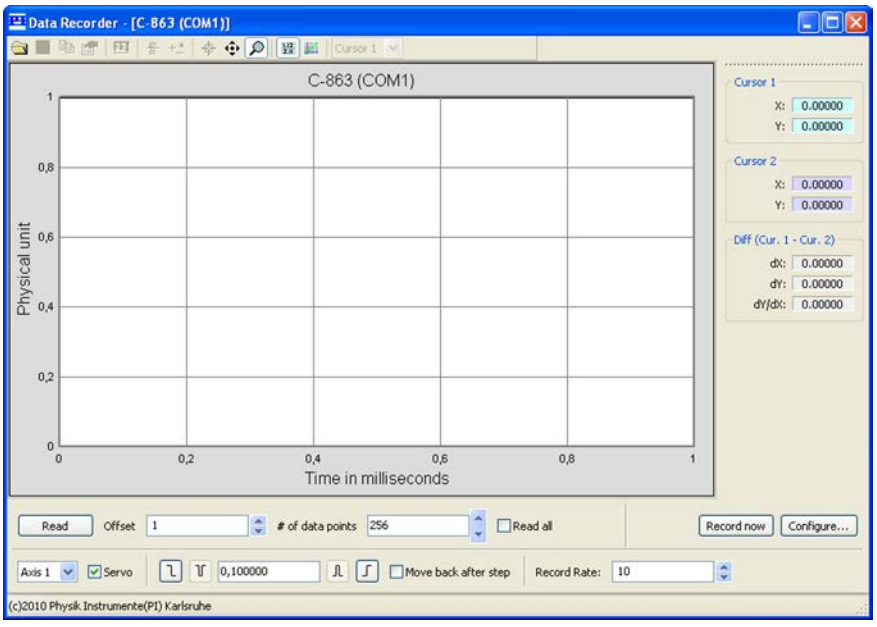


Figure 15: PIMikroMove: Data recorder

2. With the ***Servo*** check box, make sure that the servo mode is switched on.
   - If the ***Servo*** check box is not checked, the servo mode is switched off. Check the check box to switch on the servo mode.

3. Configure the data recorder.

   a) In the ***Data Recorder*** window, adapt, if required, the settings like the amplitude of the step to be executed, the record table rate and for the graph, the number of data points to be read.
   b) Click on the ***Configure…*** button and make sure that "Commanded Position of Axis" and "Actual Position of Axis" are selected as quantities to be recorded.

   Details see PIMikroMove user manual (SM148E).

4. Start the step in positive direction, as well as the recording, by clicking on the  button.

   The axis executes the step and the step response is recorded and displayed graphically.

5. Check the displayed step response on the basis of the following figures.

   a) If the result is satisfactory (i.e. minimum overshoot, settling time not too long), you already have optimal parameter settings. In this case, no further action is necessary.
   b) If the result is not satisfactory, change the settings of the P-I-D controller (p. 64).

Examples

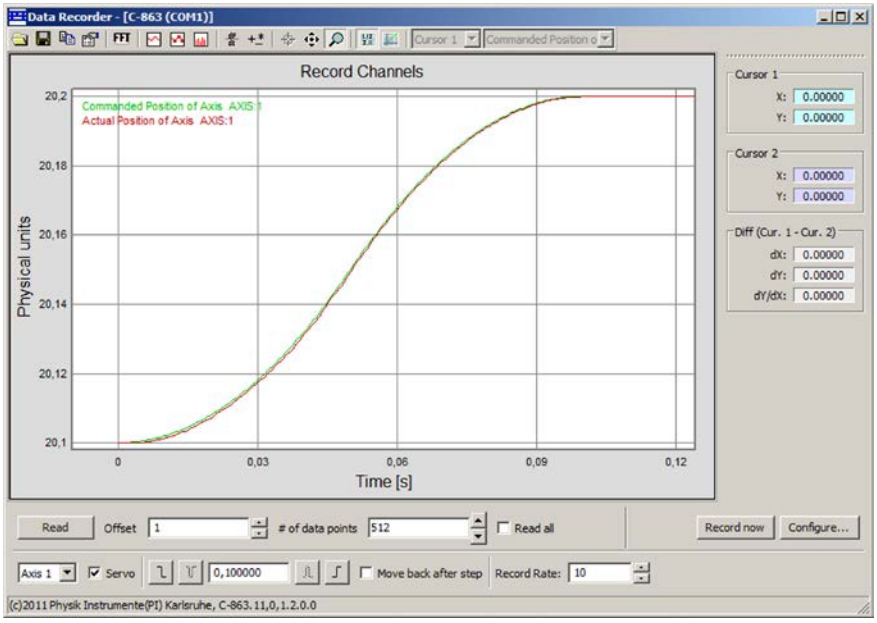


Figure 16: PIMikroMove: Data recorder with graphical display of an optimal settling behavior (commanded and actual position coincident)

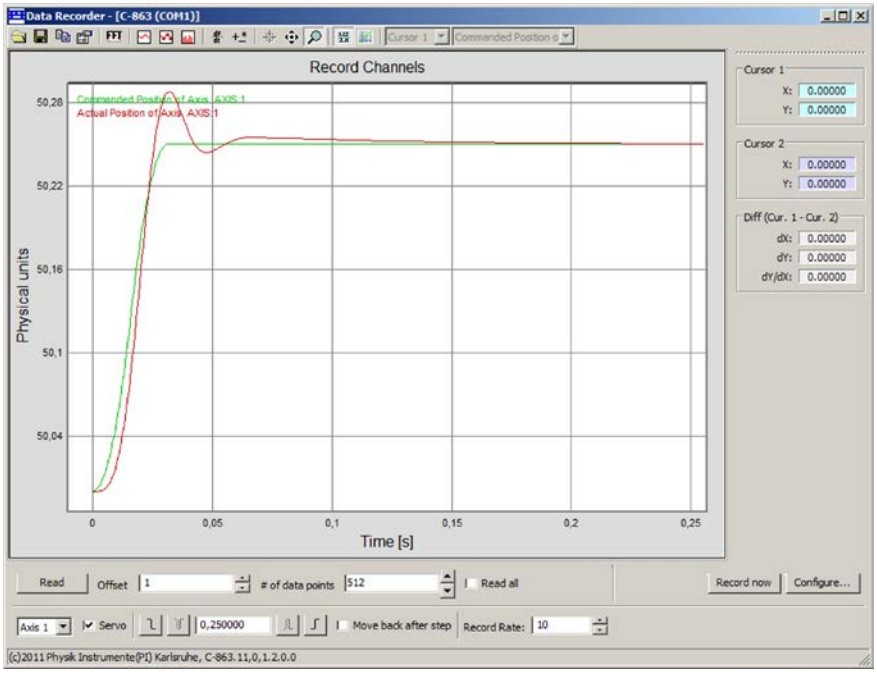


Figure 17: PIMikroMove: Data recorder with graphical display of an overshoot

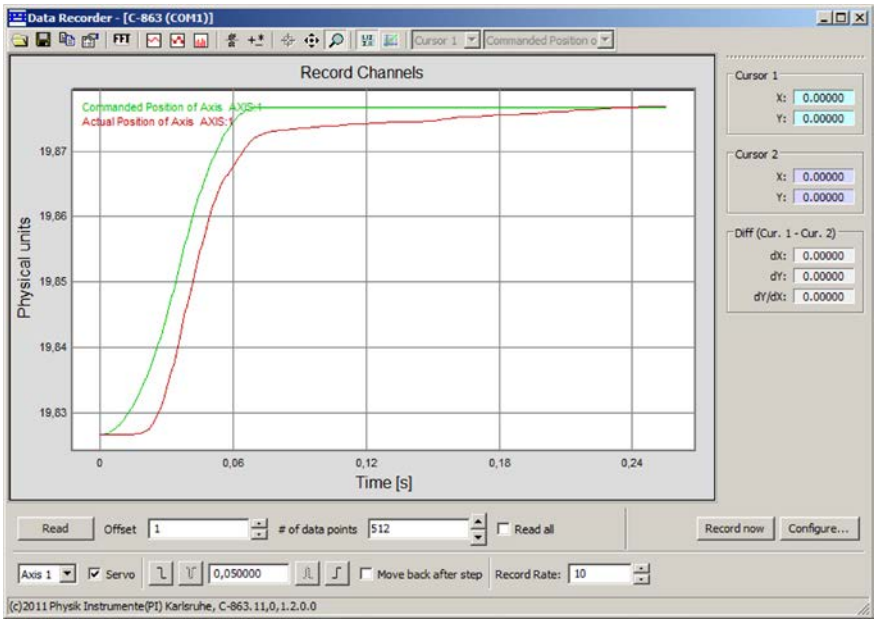


Figure 18: PIMikroMove: Data recorder with graphical display of a to slow step-and-settle

7.7 Optimizing the Servo-Control Parameters

Adjusting the P-I-D controller optimizes the dynamic properties of the system (overshoot and settling time). The optimum P-I-D controller setting depends on your application and your requirements.

As a rule, optimization is done empirically and involves the following parameters. Details see "Servo Algorithm and Other Control Value Corrections" in the detailed version of the user manual MS205E:

- ***P-Term*** (0x1)
- ***I-Term*** (0x2)
- ***D-Term*** (0x3)
- ***I-Limit*** (0x4)

The behavior of the stage is monitored under various values in closed-loop operation.

In the following, PIMikroMove is used for optimizing the P-I-D servo-control parameters.

Prerequisite

✓ The recorded step response (p. 60) of the stage has not turned out satisfactorily.

or

✓ The stage oscillates (unusual operating noise) with the current servo-control parameters.

Adjusting the P-I-D controller

1. In the main window of PIMikroMove, open the single axis window for the connected stage by selecting the stage in the ***View > Single Axis Window*** menu.
2. Expand the view of the single axis window by clicking on the **>** button at the right edge of the window.

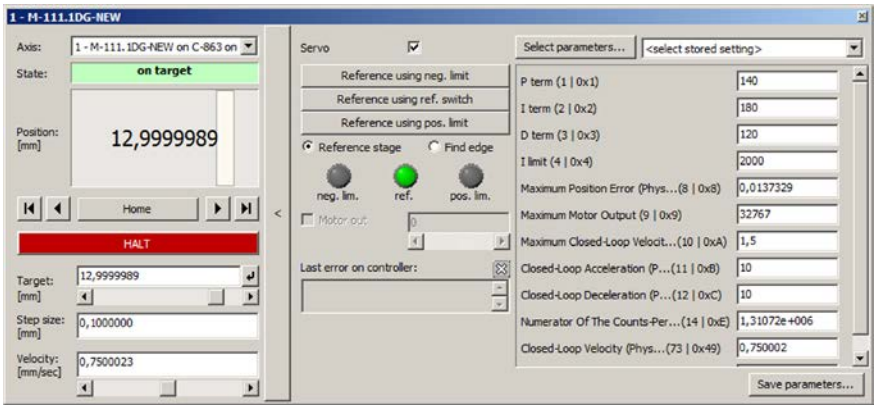


Figure 19: PIMikroMove: Expanded single axis window

3. Enter new values for the servo-control parameters:
   a) If the parameter to be modified is not included in the list on the right side of the window, click on ***Select parameters...*** and add it to the list.
   b) Type the new parameter value into the appropriate input field in the list.
   c) Press the Enter key of the PC to transfer the parameter value to the volatile memory of the controller. When this is done, the entry changes its color from blue to black.
4. In the ***Data Recorder*** window, record the step response (p. 60) of the stage again.

If the result is not satisfactory:

➢ Enter different values for the servo-control parameters and record the step response again.

If you are satisfied with the result and want to keep the new servo-control parameter settings:

- Save the new settings. You have the following options:
  - Save a new parameter set in the PI_UserStages2.dat stage database on the PC. See "Creating or Modifying a Stage Type" (p. 78).
  - Transfer the current values of **all** parameters from the volatile to the nonvolatile memory of the C-863 (p. 77).

8 Operation

In this Chapter

8.1 Motion errors - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.2 Data Recorder - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.3 Digital output signals - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.4 Digital input signals - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.5 Analog Input Signals - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.6 Joystick control - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

8.7 Controller Macros - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

9 GCS Commands

In this Chapter

9.1 GCS Syntax for Syntax Version 2.0 - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

9.2 Target and sender address - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

9.3 Variables - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

9.4 Command Overview

The commands listed in the following are described in the detailed MS205E user manual, which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

Command	Format	Description
#4	#4	Request Status Register
#5	#5	Request Motion Status
#7	#7	Request Controller Ready Status
#8	#8	Query If Macro Is Running
#24	#24	Stop All Axes
*IDN?	*IDN?	Get Device Identification
ACC	ACC {<AxisID> <Acceleration>}	Set Closed-Loop Acceleration
ACC?	ACC? [{<AxisID>}]	Get Closed-Loop Acceleration
ADD	ADD <Variable> <FLOAT1> <FLOAT2>	Add and Save To Variable
BRA	BRA {<AxisID> <BrakeState>}	Set Brake Activation State
BRA?	BRA? [{<AxisID>}]	Get Brake Activation State
CPY	CPY <Variable> <CMD?>	Copy Into Variable
CST?	CST? [{<AxisID>}]	Get Assignment Of Stages To Axes
CSV?	CSV?	Get Current Syntax Version
CTO	CTO {<TrigOutID> <CTOPam> <Value>}	Set Configuration Of Trigger Output
CTO?	CTO? [{<TrigOutID> <CTOPam>}]	Get Configuration Of Trigger Output
DEC	DEC {<AxisID> <Deceleration>}	Set Closed-Loop Deceleration
DEC?	DEC? [{<AxisID>}]	Get Closed-Loop Deceleration
DEL	DEL <uint>	Delay The Command Interpreter
DFH	DFH [{<AxisID>}]	Define Home Position
DFH?	DFH? [{<AxisID>}]	Get Home Position Definition
DIO	DIO {<DIOID> <OutputOn>}	Set Digital Output Lines
DIO?	DIO? [{<DIOID>}]	Get Digital Input Lines
DRC	DRC {<RecTableID> <Source> <RecOption>}	Set Data Recorder Configuration
DRC?	DRC? [{<RecTableID>}]	Get Data Recorder Configuration

Command	Format	Description
DRR?	DRR? [<StartPoint> <NumberOfPoints> [{<RecTableID>}]]	Get Recorded Data Values
DRT	DRT {<RecTableID> <TriggerSource> <Value>}	Set Data Recorder Trigger Source
DRT?	DRT? [{<RecTableID>}]	Get Data Recorder Trigger Source
ERR?	ERR?	Get Error Number
FED	FED {<AxisID> <EdgeID> <Param>}	Find Edge
FNL	FNL [{<AxisID>}]	Fast Reference Move To Negative Limit
FPL	FPL [{<AxisID>}]	Fast Reference Move To Positive Limit
FRF	FRF [{<AxisID>}]	Fast Reference Move To Reference Switch
FRF?	FRF? [{<AxisID>}]	Get Referencing Result
GOH	GOH [{<AxisID>}]	Go To Home Position
HDR?	HDR?	Get All Data Recorder Options
HLP?	HLP?	Get List of Available Commands
HLT	HLT [{<AxisID>}]	Halt Motion Smoothly
HPA?	HPA?	Get List Of Available Parameters
JAS?	JAS? [{<JoystickID> <JoystickAxis>}]	Query Joystick Axis Status
JAX	JAX <JoystickID> <JoystickAxis> <AxisID>	Set Axis Controlled By Joystick
JAX?	JAX? [{<JoystickID> <JoystickAxis>}]	Get Axis Controlled By Joystick
JBS?	JBS? [{<JoystickID> <JoystickButton>}]	Query Joystick Button Status
JDT	JDT {<JoystickID> <JoystickAxis> <uint>}	Set Joystick Default Lookup Table
JLT	JLT <JoystickID> <JoystickAxis> <Addr> <floatn>	Fill Joystick Lookup Table
JLT?	JLT? [<StartPoint> <NumberOfPoints> [{<JoystickID> <JoystickAxis>}]]	Get Joystick Lookup Table Values
JON	JON {<JoystickID> <uint>}	Set Joystick Activation Status
JON?	JON? [{<JoystickID>}]	Get Joystick Activation Status
JRC	JRC <Jump> <CMD?> <OP> <Value>	Jump Relatively Depending On Condition
LIM?	LIM? [{<AxisID>}]	Indicate Limit Switches

Command	Format	Description
MAC	MAC <keyword> {<parameter>} Especially: MAC BEG <macroname> MAC DEF <macroname> MAC DEF? MAC DEL <macroname> MAC END MAC ERR? MAC NSTART <macroname> <uint> [<String1> [<String2>]] MAC START <macroname> [<String1> [<String2>]]	Call Macro Function
MAC?	MAC? [<macroname>]	List Macros
MEX	MEX <CMD?> <OP> <Value>	Stop Macro Execution Due To Condition
MOV	MOV {<AxisID> <Position>}	Set Target Position
MOV?	MOV? [{<AxisID>}]	Get Target Position
MVR	MVR {<AxisID> <Distance>}	Set Target Relative To Current Position
ONT?	ONT? [{<AxisID>}]	Get On-Target State
POS	POS {<AxisID> <Position>}	Set Real Position
POS?	POS? [{<AxisID>}]	Get Real Position
RBT	RBT	Reboot System
RMC?	RMC?	List Running Macros
RON	RON {<AxisID> <ReferenceOn>}	Set Reference Mode
RON?	RON? [{<AxisID>}]	Get Reference Mode
RPA	RPA [{<ItemID> <PamID>}]	Reset Volatile Memory Parameters
RTR	RTR <RecordTableRate>	Set Record Table Rate
RTR?	RTR?	Get Record Table Rate
SAI	SAI {<AxisID> <NewIdentifier>}	Set Current Axis Identifiers
SAI?	SAI? [ALL]	Get List Of Current Axis Identifiers
SEP	SEP <Pswd> {<ItemID> <PamID> <PamValue>}	Set Nonvolatile Memory Parameters
SEP?	SEP? [{<ItemID> <PamID>}]	Get Nonvolatile Memory Parameters

Command	Format	Description
SMO	SMO {<AxisID> <ControlValue>}	Set Open-Loop Control Value
SMO?	SMO? [{<AxisID>}]	Get Control Value
SPA	SPA {<ItemID> <PamID> <PamValue>}	Set Volatile Memory Parameters
SPA?	SPA? [{<ItemID> <PamID>}]	Get Volatile Memory Parameters
SRG?	SRG? {<AxisID> <RegisterID>}	Query Status Register Value
STE	STE <AxisID> <Amplitude>	Start Step And Response Measurement
STP	STP	Stop All Axes
SVO	SVO {<AxisID> <ServoState>}	Set Servo Mode
SVO?	SVO? [{<AxisID>}]	Get Servo Mode
TAC?	TAC?	Tell Analog Channels
TAV?	TAV? [{<AnalogInputID>}]	Get Analog Input Voltage
TIO?	TIO?	Tell Digital I/O Lines
TMN?	TMN? [{<AxisID>}]	Get Minimum Commandable Position
TMX?	TMX? [{<AxisID>}]	Get Maximum Commandable Position
TNR?	TNR?	Get Number Of Record Tables
TRO	TRO {<TrigOutID> <TrigMode>}	Set Trigger Output State
TRO?	TRO? [{<TrigOutID>}]	Get Trigger Output State
TRS?	TRS? [{<AxisID>}]	Indicate Reference Switch
TVI?	TVI?	Tell Valid Character Set For Axis Identifiers
VAR	VAR <Variable> <String>	Set Variable Value
VAR?	VAR? [{<Variable>}]	Get Variable Value
VEL	VEL {<AxisID> <Velocity>}	Set Closed-Loop Velocity
VEL?	VEL? [{<AxisID>}]	Get Closed-Loop Velocity
VER?	VER?	Get Versions Of Firmware And Drivers
WAC	WAC <CMD?> <OP> <Value>	Wait For Condition
WPA	WPA <Pswd> [{<ItemID> <PamID>}]	Save Parameters To Nonvolatile Memory

9.5 Error Codes - see detailed user manual

The error codes of the PI General Command Set are listed in the detailed MS205E user manual which is included as a PDF file on the product CD.

10 Adapting Settings

In this Chapter

10.1 Changing Parameters in the C-863

You can find descriptions and information on the following topics in the detailed MS205E manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5):

- Overview: **General commands for parameters**
- Overview: **Special commands for parameters**
- **Saving parameter values in a text file**

➢ Follow the instructions in the following sections for changing the parameters in the C-863.

NOTICE

Improper parameter settings!

The values in the nonvolatile memory are loaded to the volatile memory as default values when switching on or rebooting the C-863 and take effect immediately.

Improper parameter settings can cause damage to the stage connected.

➢ Only change parameters after careful consideration.

➢ Save the current parameter values to the PC before you perform changes in the nonvolatile memory.

Available parameters

The parameters available for adapting the C-863 to your application depend on the firmware of your C-863.

➢ Send the `HPA?` command to obtain a list of all available parameters with a short description.

Parameters in the nonvolatile memory

- Send the SEP? command to obtain a list of parameter values in the nonvolatile memory.

INFORMATION

The parameter values in the nonvolatile memory are automatically loaded to the volatile memory when switching on or rebooting the C-863.

- Change the parameters in the nonvolatile memory only if you are sure that the C-863 functions correctly with the parameter values.

- Change the parameters in the nonvolatile memory with the SEP command.

Parameters in the volatile memory

- Send the SPA? command to obtain a list of parameter values in the volatile memory.
- Change the parameters in the volatile memory with the SPA command.

  - and/or -

- Change selected parameters in the volatile memory with special commands.

If you are working with PIMikroMove:

1. In the main window of PIMikroMove, open the single axis window for the connected stage by selecting the stage in the ***View > Single Axis Window*** menu.
2. Expand the view of the single axis window by clicking on the **>** button at the right edge of the window.
3. If the parameter to be modified is not included in the list on the right side of the window, click on ***Select parameters...*** and add it to the list.
4. Type the new parameter value into the appropriate input field in the list.
5. Press the Enter key of the PC to transfer the parameter value to the volatile memory of the controller. When this is done, the entry changes its color from blue to black.

Writing parameters from the volatile memory to the non-volatile memory

1. Change the parameters in the volatile memory with the SPA command.
2. Check whether the C-863 is operating correctly with the modified parameters.
   - If yes:
     Write the modified parameter values to the non-volatile memory with the WPA command.
   - If no:
     Change and check the parameters in the volatile memory again.

If you are working with PIMikroMove:

➢ Write the updated values of all parameters to the non-volatile memory:

a) In the main window of PIMikroMove, select the ***C-863 > Save parameters to non-volatile memory*** menu item.
b) When prompted, enter the password 100.

Writing parameters from the nonvolatile memory to the volatile memory

INFORMATION

➢ Use this procedure only if you are sure that the C-863 functions correctly with the parameter values from the nonvolatile memory.

➢ Write the parameter values from the nonvolatile memory to the volatile memory with the RPA command.

10.2 Creating or Modifying a Stage Type

You can select a parameter set appropriate for your stage from a stage database in the PC software from PI. The software transfers the values of the selected parameter set to the volatile memory of the controller. Further information see "Stage Databases" (p. 20).

The PI_UserStages2.dat stage database is intended for creating, editing and storing new parameter sets. This can be required in the following cases, for example:

- You want to operate a stage with different servo-control parameters than those of the PIStages2.dat stage database.
- You want to adapt the soft limits of the stage to your application.
- You have a custom stage.

INFORMATION

You can create a new stage type with utmost ease by modifying in PIMikroMove an existing stage type and saving it under a new name.

INFORMATION

If a stage type with the same name is present in the PIStages2.dat and PI_UserStages2.dat stage databases, the parameter settings from PIStages2.dat are always loaded when selecting the stage type in the PC software. The parameter settings from PI_UserStages2.dat are not used in this case.

➢ When saving stage types only assign names that are **not** already used in the PIStages2.dat stage database.

In the following, PIMikroMove is used for creating a new stage type and for modifying an existing stage type.

Prerequisite

✓ PIMikroMove is installed on the PC (p. 29).

✓ You have read and understood the PIMikroMove manual. The manual is found on the product CD.

✓ You have installed the latest version of the PIStages2.dat stage database on the PC (p. 30).

✓ If PI has provided you with a custom stage database for your stage, then you have installed this database on your PC (p. 32).

✓ You have established communication (p. 46) between the C-863 and the PC with PIMikroMove.

Creating a stage type in a stage database

1. Select an appropriate stage type in PIMikroMove in the ***Select connected stages*** step:

   a) Mark the stage type in the ***Stage database entries*** list.
   b) Click ***Assign***.
   c) Confirm the selection with ***OK*** to load the parameter settings for the selected stage type from the stage database to the volatile memory of the C-863.

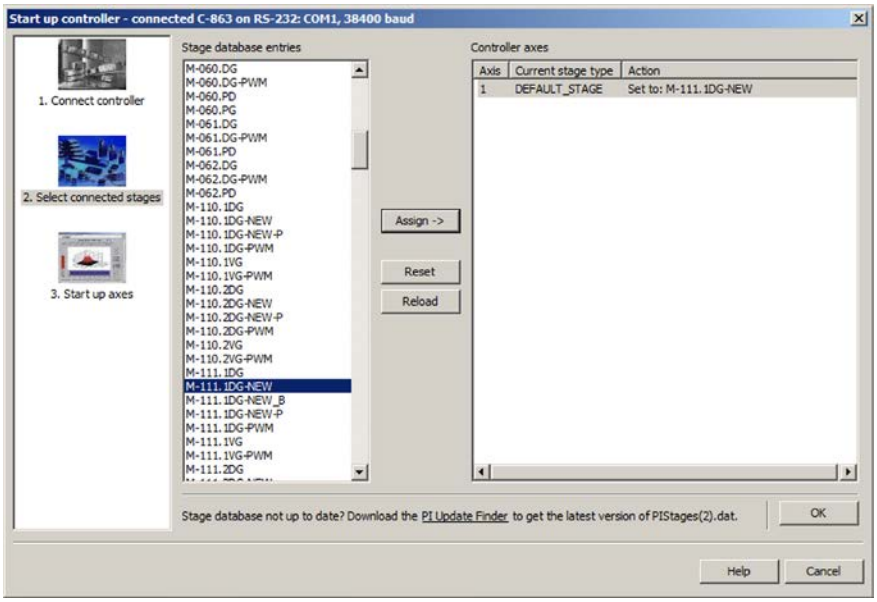


Figure 20: Start up controller – Select connected stages

After clicking ***OK*** the ***Start up controller*** window switches to the ***Start up axes*** step.

2. In the ***Start up axes*** step, click on ***Close*** to close the ***Start up controller*** window.

3. In the main window of PIMikroMove, open the single axis window for the stage type selected by selecting the stage type in the ***View > Single Axis Window*** menu.

4. Expand the view of the single axis window by clicking on the **>** button at the right edge of the window.

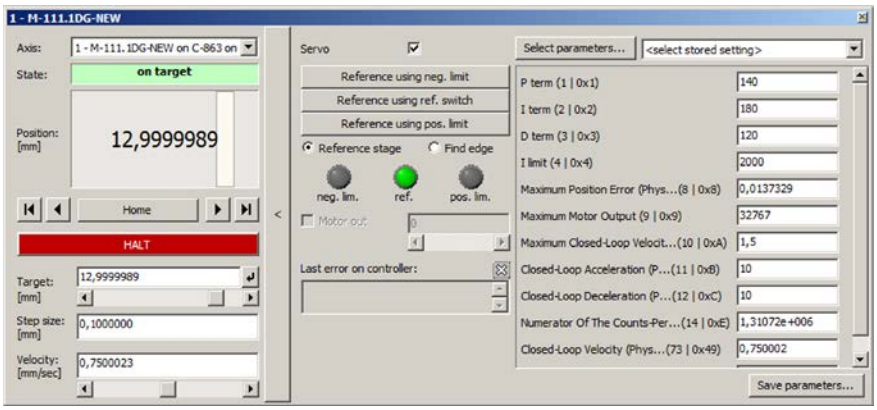


Figure 21: PIMikroMove: Expanded single axis window

5. Enter new values for the stage parameters:

   a) If the parameter to be modified is not included in the list on the right side of the window, click on ***Select parameters...*** and add it to the list.
   b) Type the new parameter value into the appropriate input field in the list.
   c) Press the Enter key of the PC to transfer the parameter value to the volatile memory of the controller. When this is done, the entry changes its color from blue to black.

6. Click the ***Save parameters…*** button below the parameter list.

   The ***Save Parameters as User Stage Type*** dialog opens.

7. In the ***Save Parameters as User Stage Type*** dialog, save the modified parameter values as a new stage type:

   a) Leave the entry in the ***Parameters of axis:*** field unchanged.
   b) Enter the name for the new stage type in the***Save as:*** field.
   c) Click on ***OK***.

   The new stage type has been saved in the PI_UserStages2.dat stage database. The display of the stage type connected has been updated in the single axis window and in the main window of PIMikroMove. The new stage type is available with immediate effect for selection in the ***Select connected stages*** step too.

Modifying a stage type in a stage database

1. In the ***Select connected stages*** step in PIMikroMove, select a stage type which you created earlier as described above. Proceed with the selection as in step 1 of the **Creating a stage type in a stage database** instruction.
2. Execute steps 2 to 6 from **Creating a stage type in a stage database**.
3. In the ***Save Parameters as User Stage Type*** dialog, save the modified parameter values as a new stage type:

   a) Leave the entry in the ***Parameters of axis:*** field unchanged.
   b) Leave the entry in the ***Save as:*** field unchanged.
   c) Click on ***OK***.
   d) In the ***Stage type already defined*** dialog, click on ***Change settings***. The ***Save Parameters as User Stage Type*** dialog closes automatically after a short time.

   The parameter values of the stage type have been updated in the PI_UserStages2.dat stage database and in the main window of PIMikroMove.

10.3 Parameter Overview - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

11 Maintenance

In this Chapter

11.1 Cleaning the C-863

NOTICE

Short circuits or flashovers!

The C-863 contains electrostatic sensitive devices that can be damaged by short circuits or flashovers when cleaning fluids enter the case.

- ➢ Before cleaning, remove the C-863 from the power source by pulling the power plug.
- ➢ Prevent cleaning fluid from entering the case.

- ➢ When necessary, clean the surfaces of the C-863 case with a towel that has been lightly dampened with a mild cleanser or disinfectant.
- ➢ Do **not** use any organic solvents.

11.2 Updating Firmware - see detailed user manual

You can find information on this topic in the detailed MS205E user manual which is included as a PDF file on the product CD and can be downloaded from our website (p. 5).

12 Troubleshooting

Problem	Possible Causes	Solution
The stage does not move	The cable is not connected correctly	➢ Check the cable connections.
	The stage or the stage cable is defective	➢ If available, replace the defective stage with another stage and test the new combination.
	Stage not connected to power supply	Stages with integrated PWM amplifier are supplied via a separate power supply. ➢ If the stage has an integrated PWM amplifier, connect it to a suitable power supply. ➢ Make sure that the power supply is functioning properly.
	Limit switch signal logic set incorrectly	In order for the stage to be able to move, all settings of the C-863 must correspond to the limit switch logic level of the stage; see "Limit Switch Detection". ➢ Set DIP switch 7 appropriately; see "Logic Level of the Limit Switches" (p. 44). ➢ Set the ***Limit Mode*** parameter (ID 0x18) appropriately; see "Changing Parameters: General Procedure".
	Limit switch signals not compatible with the C-863	Stages from third-party suppliers may use unsuitable limit switch signals. ➢ Contact the customer service department (p. 91) and the manufacturer of the stage.
	Incorrect configuration	➢ Check the parameter settings of the C-863 with the SPA? (volatile memory) and SEP? (non-volatile memory) commands. Details about parameter settings see "Adapting settings" (p. 75).
	Incorrect command or incorrect syntax	➢ Send the ERR? command and check the error code this returns.

Problem	Possible Causes	Solution
	Incorrect axis commanded	An axis identifier is even required in commands on systems with only one axis. ➢ Make sure that the correct axis identifier is used and that the commanded axis belongs to the correct stage.
	Joystick control is enabled	Motion commands are not allowed when a joystick is enabled for the axis. ➢ Disable the joystick with the `JON` command.
Stage executes unintentional motion	Joystick is not connected, but enabled in the C-863	➢ Enable the joystick in the software only if a joystick is actually connected to the C-863.
	Joystick not calibrated	➢ Calibrate the joystick.
	Start-up macro is executed	➢ Check whether a macro is specified as a start-up macro and, if necessary, cancel the selection of the start-up macro.
	Stage brake deactivated with the `BRA` command while servo mode switched off	➢ Secure the stage against unintentional motions before you deactivate the brake by command!
Stage is oscillating or positioned inaccurately	The load was changed.	➢ Readjust the system according to the changed load (p. 64).

Problem	Possible Causes	Solution
Stage is oscillating already during the reference move	Very high load on the stage	In case of a very high load, proceed with PIMikroMove during the reference move as follows: 1. Do **not** start the reference move in the ***Start up axes*** step, but click on ***Close*** to close the ***Start up controller*** window instead. 2. In the main window, open the single axis window for the stage connected by selecting the stage in the ***View > Single Axis Window*** menu. 3. Expand the view of the single axis window by clicking on the **>** button at the right edge of the window. 4. With the ***Servo*** check box, make sure that the servo mode is switched on. 5. Start the reference move by clicking on one of the ***Reference…*** buttons. 6. If the stage is oscillating: Immediately stop the reference move in the ***Reference Axes*** dialog, close the dialog and switch off the servo mode by removing the check from the respective check box in the single axis window. 7. Enter new values for the servo-control parameter, see "Optimizing the Servo-Control Parameters" (p. 64). 8. Re-start the reference move. 9. If the stage is still oscillating, repeat steps 6 to 8 until the reference move is finished successfully without oscillations.

Problem	Possible Causes	Solution
Communication with the controller fails	The wrong communication cable is used or it is defective	➢ Use a null-modem cable for the RS-232 connection (p. 36). ➢ If necessary, check whether the cable works on a fault-free system.
	USB driver not installed	In order to be able to establish communication between C-863 and PC via USB interface, drivers from the product CD have to be installed. If communication via USB cannot be established or the PC operating system reports that new hardware was found: 1. Log in on the PC with administrator rights. 2. Insert the product CD in the drive of the PC. 3. Follow the instructions on the PC screen or open the ***Properties of PI C-863 controllers*** window in the appropriate manner. 4. Select the drivers in the \USB_Driver directory on the product CD when prompted to do so. If the C-863 is still not detected by the PC after successfully installing the drivers: ➢ Pull the USB cable off of the C-863 and plug it back in.
	Baud rate not configured correctly	➢ Check the settings of DIP switches 5 and 6 for the baud rate (p. 44). ➢ In a daisy chain network make sure that the same baud rate is set for every controller.
	Controller address not configured correctly	➢ Check the settings of DIP switches 1 to 4 for the controller address (p. 43).
	A different program is accessing the interface.	➢ Close the other program.

Problem	Possible Causes	Solution
	Problems with special software	➢ Check whether the system works with different software, such as a terminal program or a development environment. You can test the communication by starting a terminal program (such as e. g. PI Terminal) and entering `*IDN?` or `HLP?`. ➢ Make sure that you end the command with an LF (line feed). A command is not executed until the LF has been received.
The customer software does not run with the PI drivers	Incorrect combination of driver routines/Vis	➢ Check whether the system works with a terminal program. If so: ➢ Read the information in the corresponding software manual and compare the sample code on the product CD with your program code.
LEDs do not light up even though the C-863 is switched on	Firmware update mode set	1. Switch off the C-863 by pulling the power cord of the power supply. 2. Set DIP switch 8 on the C-863 to normal operation (p. 45) (OFF) position. 3. Switch on the C-863 by connecting the power cord of the power supply to the power socket.

If the problem that occurred with your system is not listed in the table above or it cannot be solved as described, contact our customer service department (p. 91).

13 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (mailto:info@pi.ws).

If you have questions concerning your system, have the following information ready:

- Product codes and serial numbers of all products in the system
- Firmware version of the controller (if present)
- Version of the driver or the software (if present)
- Operating system on the PC (if present)

The latest versions of the user manuals are available for downloading (p. 5) on our website.

14 Technical Data

In this Chapter

14.1 Specifications

14.1.1 Data Table

	C-863.11
Function	DC servo-motor controller, 1 channel
Channels	1
Motion and control	
Servo characteristics	PID controller, parameter changes on the fly
Servo cycle time	50 µs
Profile generator	Trapezoid velocity profile
Encoder input	AB (quadrature) single-ended or differential TTL signal acc. to RS-422; 60 MHz
Stall detection	Servo off, triggered by programmable position error
Limit switches	2 × TTL (polarity programmable)
Reference point switch	1 × TTL
Motor brake	1 × TTL, software controlled
Electrical properties	
Max. output voltage*	0 to ±15 V for direct control of DC motor
Max. output power	30 W
Current limitation	2 A

Interface and operation	
Communication interfaces	USB; RS-232, Sub-D 9-pin (m)
Motor connector	Sub-D 15-pin (f)
Controller network	Up to 16 units** on a single interface
I/O ports	4 analog/digital in, 4 digital out (TTL), 5 V TTL
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Software drivers	LabVIEW driver, shared libraries for Windows and Linux
Supported functionality	Point-to-point motion, start-up macro, data recorder for recording parameters as motor input voltage, velocity, position or position error; internal safety circuitry: watchdog timer
Manual control	Optional: Pushbutton box, joystick (for 2 axes), Y-cable for 2-D motion
Miscellaneous	
Operating voltage	15 to 30 V, in the scope of delivery: external power supply 15 V / 2 A
Max. operating current	80 mA plus motor current (max. 3 A)
Operating temperature range	5 to 50°C
Ground	0.3 kg
Dimensions	130 mm × 76 mm × 40 mm

* The output voltage depends on the connected power supply.

** 16 units via USB; 6 units via RS-232.

14.1.2 Maximum Ratings

The C-863 is designed for the following maximum ratings:

Input on:	**Maximum Operating Voltage** ⚠	**Operating Frequency** ⚠	**Maximum Current Consumption** ⚠
Barrel connector socket	30 V	⎓	3 A

Output on:	Maximum Output Voltage ⚠	Maximum Output Current ⚠	Maximum Output Frequency ⚠
Sub-D 15-pin (f): pins 2 and 9	= operating voltage	2.5 A	36 kHz (PWM)
Sub-D 15-pin (f): pins 3 and 11	5 V TTL	10 mA	36 kHz (PWM)

14.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the C-863:

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	Highest relative humidity 80% for temperatures up to 31°C Decreasing linearly to 50% relative humidity at 40°C
Storage temperature	0°C to 70°C
Transport temperature	–25°C to +85°C
Overvoltage category	II
Protection class	I
Degree of pollution	2
Measurement category	I
Degree of protection according to IEC 60529	IP20

14.2 System Requirements

The following system requirements must be met to operate the C-863:

- PC with Windows (XP, Vista, 7) or Linux operating system
- Communication interface to the PC:
  - Free COM port on the PC

  - or -

  - USB A socket on the PC
- C-863 with power supply
- Mechanical system (stage) with DC motor
- RS-232 null-modem cable or USB cable for connecting the controller to the PC
- Product CD with PC software

14.3 Dimensions

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

Standard tolerance according to DIN ISO 2768 - f - H

Roughness Ra 1.6

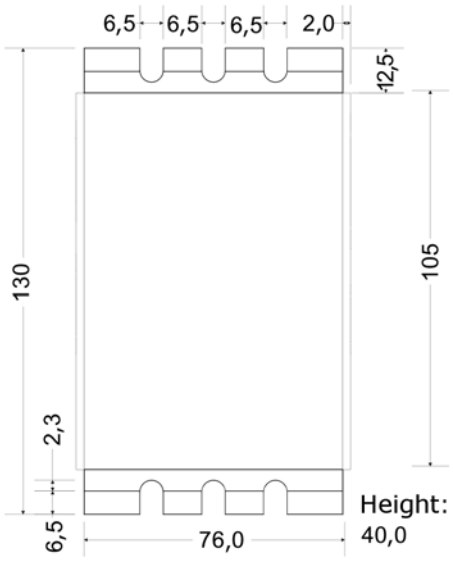


Figure 22: C-863, dimensions in millimeters

14.4 Pin Assignment

14.4.1 DC Motor only

Sub-D socket, 15-pin, female

Pin	Function
1	Output: Programmable motor brake (0 or + 5 V)
2	Output: Motor + (differential; power PWM); for stages without PWM amplifier
3	Output: PWM magnitude (TTL); for stages with PWM amplifier
4	Output: +5 V
5	Input: Positive limit switch
6	GND limit switch
7	Input: Encoder: A (-)
8	Input: Encoder: B (-)
9	Output: Motor – (differential; power PWM); for stages without PWM amplifier
10	Power GND
11	Output: PWM sign (TTL); for stages with PWM amplifier
12	Input: Negative limit switch
13	Input: Reference point switch
14	Input: encoder: A (+) / ENCA
15	Input: encoder: B (+) / ENCB

14.4.2 I/O

Mini-DIN socket, 9-pin, female

Figure 23: I/O socket, Mini-DIN, 9-pin

Pin	Function
1	Input 1 (analog: 0 to 5V / digital: TTL)
2	Input 2 (analog: 0 to 5V/ digital: TTL)
3	Input 3 (analog: 0 to 5V/ digital: TTL)
4	Input 4 (analog: 0 to 5V/ digital: TTL)
5	Output 1 (digital: TTL)
6	Output 2 (digital: TTL)
7	Output 3 (digital: TTL)
8	Output 4 (digital: TTL)
9	Vcc (5 V)

14.4.3 C-170.IO Cable for Connecting to the I/O Socket

Mini-DIN connector, 9-pin, male, open end

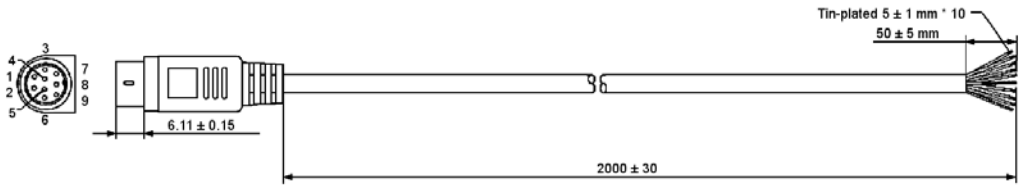


Figure 24: C-170.IO cable

Specifications

Temperature range: -25 °C to +85 °C
Nominal current: 1 A AC/DC
Insulation resistance: 50 MW min.
Nominal voltage: 50 V AC/DC
Voltage impulse: 500 V AC for 1 minute

Pin	Wire color	Function on the I/O socket of the C-863
1	black	Input 1 (analog: 0 to 5V / digital: TTL)
2	white	Input 2 (analog: 0 to 5V / digital: TTL)
3	red	Input 3 (analog: 0 to 5V / digital: TTL)
4	yellow	Input 4 (analog: 0 to 5V / digital: TTL)
5	purple	Output 1 (digital, TTL)
6	blue	Output 2 (digital, TTL)
7	green	Output 3 (digital, TTL)
8	brown	Output 4 (digital, TTL)
9	gray	Vcc (5V)
Sheath	Shield, coated black (thicker than the wire connected to pin 1)	GND

14.4.4 Joystick

Mini-DIN socket, 6-pin, female (PS/2)

Figure 25: Front view of Mini-DIN socket

Pin	Function
1	GND
2	Input: axis 1 of joystick device 2 (-10 to 10 V)
3	Output: Vcc (3.3 V)
4	Input: axis 1 of joystick device 1 (0 to 3.3 V)
5	Not connected
6	Input: joystick button 1 of joystick device 1 (0 or 3.3 V)

14.4.5 C-819.20Y Cable for C-819.20 Joystick

The C-819.20Y cable makes it possible to connect 2 controllers to the C-819.20 joystick.

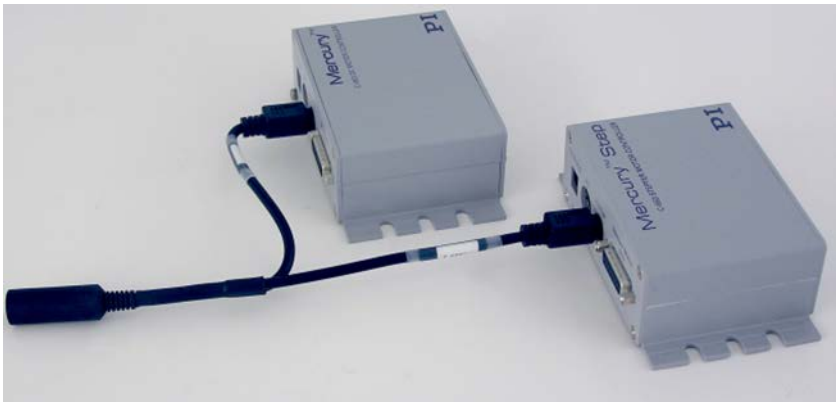


Figure 26: Y cable C-819.20Y for joystick with 2 controllers

Mini-DIN connector, 6-pin, female on 2 Mini-DIN connectors, 6-pin, male

Mini-DIN 6-pin, female (to joystick)	Signal	Mini-DIN, 6-pin, male, X branch (to controller 1)	Mini-DIN, 6-pin, male, Y branch (to controller 2)
Pin 1	GND	Pin 1	Pin 1
Pin 2	Button for joystick Y axis	Not connected	Pin 6
Pin 3	Joystick power source	Pin 3	Not connected
Pin 4	Joystick X axis	Pin 4	Not connected
Pin 5	Joystick Y axis	Not connected	Pin 4
Pin 6	Button for joystick X axis	Pin 6	Not connected

14.4.6 RS-232 In and RS-232 Out

RS-232 In: Sub-D panel plug, 9-pin, male

RS-232 Out: Sub-D socket, 9-pin, female

Pin	Function
1	Not connected
2	RxD (PC to controller)
3	TxD (controller to PC)
4	Not connected
5	GND
6	Not connected
7	Not connected
8	Not connected
9	Not connected

INFORMATION

The pins of the **RS-232 In** and **RS-232 Out** sockets are connected together in the C-863 1:1.

INFORMATION

In a daisy chain network that is connected to the PC via the RS-232 interface of the first controller, only the PC feeds the RxD line. Depending on how performant the RS-232 driver of the PC is, the range of the network may be limited to 6 devices.

INFORMATION

The C-863 copies every signal that it receives from the PC via USB to the RxD line of the **RS-232 In** and **RS-232 Out** sockets. The C-863 copies the signal of the TxD line via USB to the PC.

14.4.7 Power Supply Connection 15-30 VDC

Barrel connector socket

Pin	Function
Center pin	Input: 15 to 30 VDC
Outer conductor	GND (power)

15 Old Equipment Disposal

In accordance with the applicable EU law, electrical and electronic equipment may not be disposed of with unsorted municipal wastes in the member states of the EU.

When disposing of your old equipment, observe the international, national and local rules and regulations.

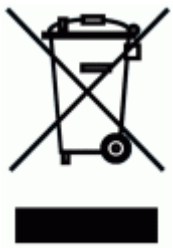
To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have old PI equipment, you can send it postage-free to the following address:

Physik Instrumente (PI) GmbH & Co. KG

Auf der Römerstr. 1

D-76228 Karlsruhe, Germany



16 EC Declaration of Conformity

PI

Declaration of Conformity

according to DIN EN ISO/IEC 17050-1:2005

Manufacturer:	**Physik Instrumente (PI) GmbH & Co. KG**
Manufacturer's Address:	Auf der Roemerstrasse 1 D-76228 Karlsruhe, Germany

CE

The manufacturer hereby declares that the product

Product Name: **Mercury DC Motor Controller, 1 Channel**

Model Numbers: **C-863**

Product Options: **all**

complies with the following European directives:

2004/108/EC, EMC Directive

2011/65/EC, RoHS Directive

The applied standards certifying the conformity are listed below.

Electromagnetic Emission: EN 61000-6-3:2007, EN 55011:2009

Electromagnetic Immunity: EN 61000-6-1:2007

November 20, 2012
Karlsruhe, Germany

Norbert Ludwig
Managing Director

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PIEZO NANO POSITIONING