

MS114E C-809 Motion I/O Interface User Manual

Version: 1.2.0

Date: 10.11.2014



This document describes the following product:

- **C-809.40**
Motion I/O Interface, for Operating PI
Stages with National Instruments PCI-7344
Motion Control Card



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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download on our website (<http://www.pi.ws>).



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1 About this Document

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1.1 Goal and Target Audience of this User Manual

This manual contains information on the intended use of the C-809.40 Motion I/O Interface.

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 our user manuals are available for download (p. 3) on our website.

1.2 Symbols and Typographic Conventions

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

DANGER



Imminently hazardous situation

If not avoided, the hazardous situation will result in death or serious injury.

- Actions to be taken to avoid the situation.

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.	Action consisting of several steps whose sequential order must be observed
2.	
➤	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.

1.3 Figures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

1.4 Other Applicable Documents

For the features and the operation of the NI PCI-7344 Motion Control PCI card, see the original documentation from National Instruments.

The handling of a PI stage is described in the user manual for the stage. The manuals for the stages are available for download on our website. See “Downloading Manuals” (p. 3) for details.

1.5 Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 19).

INFORMATION

For some products (e.g. Hexapod systems and electronics that are delivered with a CD), access to the manuals is password-protected. The password is stored on the CD. Availability of the manuals:

- Password-protected manuals: FTP download directory
- Freely available manuals: PI website
- Follow the corresponding instructions for downloading.

Download freely accessible manuals

1. Open the website <http://www.pi-portal.ws>.
2. Click **Downloads**.
3. Click the corresponding product category.
4. Go to the corresponding product code.
The available manuals are displayed.
5. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

Download password-protected manuals

1. Insert the product CD in the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including **releasenews** in the file name).
4. Find the user name and the password in the section "User login for software download" in the Release News.
5. Open the FTP download directory (<ftp://pi-ftp.ws>).
 - Windows operating systems: Open the FTP download directory in Windows Explorer.

6. Log in with the user name and the password from the Release News.
7. In the directory of the corresponding product, go to the Manuals sub-directory.
8. Copy the desired manual to the hard disk of your PC or to a data storage medium.

2 Safety

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2.1 Intended Use

The C-809.40 is a laboratory device as defined by DIN EN 61010-1. It is intended to be used in interior spaces and in an environment which is free of dirt, oil and lubricants.

In accordance with its design, the C-809.40 is intended for running a wide range of PI micropositioning stages with the PCI-7344 Motion Control 4-channel PCI card from National Instruments (NI). The C-809.40 makes the functionality of the PCI-7344 card available for up to 4 analog or PWM DC servo motors from PI.

The C-809.40 must not be used for purposes other than those named in this user manual.

The C-809.40 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-809.40 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-809.40.

- Only use the C-809.40 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-809.40.

2.2.1 Organizational Measures

User Manual

- Always keep this user manual next to the C-809.40.
If the user manual is lost or damaged, contact our customer service department (p. 19).
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the C-809.40 on to other users, also turn over this user manual as well as other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can lead to serious or fatal injury as well as property damage.
- Only install and operate the C-809.40 after having read and understood this user manual.

Personnel Qualification

The C-809.40 may only be installed, started up, operated, maintained and cleaned by authorized and qualified staff.

2.2.2 Safety Measures during Installation

The C-809.40 requires a supply voltage of 100 to 240 VAC. The supply voltage may cause serious or even lethal injury. Strictly observe the following:

- Install the C-809.40 near the power source so that the power plug can be quickly and easily disconnected from the mains.
- Use the supplied power cord to connect the C-809.40 to the power source.
- If the supplied power cord must be replaced, use a power cord with sufficient ratings.

High temperatures can overheat the C-809.40.

- Set up the C-809.40 with a distance of at least 10 cm to the front and rear panels and at least 5 cm to the sides. If this is not possible, make sure that the area is cooled sufficiently.
- Ensure sufficient ventilation at the place of installation.
- Keep the ambient temperature to a non-critical level (<40° C).
- Make sure that the ventilation holes of the case are always free.

2.2.3 Safety Measures during Maintenance

The C-809.40 requires a supply voltage of 100 to 120 VAC or 220 to 240 VAC (line voltage). Touching the line voltage can result in serious or even lethal injury due to electric shock.

- Remove the power cord from the C-809.40 before you change the line fuses.

The C-809.40 contains electrostatic-sensitive devices (ESD) that can be damaged in the case of short circuits or flashovers.

- Before cleaning the case, disconnect the C-809.40 from the power source by pulling the power plug.

3 Product Description

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3.1 Features and Applications

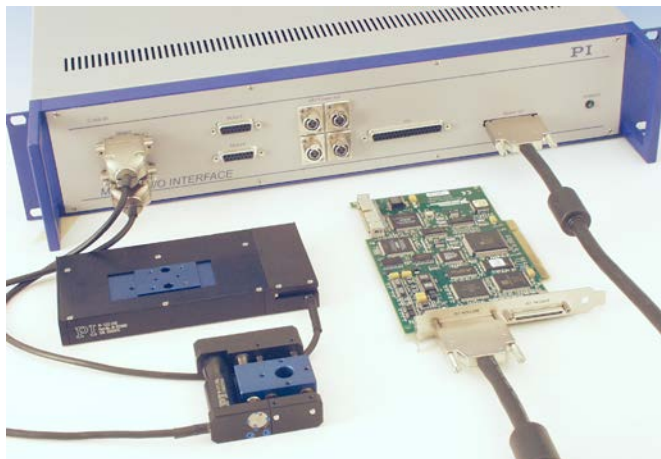


Figure 1: C-809.40 Motion I/O Interface with PCI-7344 Motion Control card from NI and M-122 (top) and M-110 (bottom) stages from PI

The C-809.40 Motion I/O Interface houses adaptor electronics that allows running a wide range of PI micropositioning stages with the PCI-7344 Motion Control 4-channel PCI card from National Instruments (NI). The C-809.40 is designed as a 19" rackmount unit and makes the functionality of the PCI-7344 card available.

With its integrated power supplies the C-809.40 can drive all kinds of DC motors from PI. DC analog motors, with up to 6 W power each, can be driven directly. For stages with integrated PWM amplifiers which are used for more powerful DC motors, the C-809.40 features a 4-channel power supply which provides 24 V per channel. The PWM signals for those stages are generated by the C-809.40 based on analog signals from the NI card¹ (appropriate settings in the host software required).

The C-809.40 is able to operate PI stages with either incremental rotary encoders or linear scales providing position feedback, and with reference and limit switches. PI stages send differential encoder signals to the C-809.40, where they are converted into the single-ended signals needed by the NI card. The C-809.40 offers full access to the NI card via a single-cable² connection. In addition the C-809.40 routes an ample array of the signals on the **Motion I/O** socket from the NI card to a separate **I/O** interface.

¹ Contact PI for the configuration changes required if you want the C-809.40 to receive and route PWM signals generated by the NI card.

² The appropriate cable SHC68-C68-S is available from National Instruments, order number 186380-02 (2 m length) or 186380-0R5 (0.5 m length).

3.2 Product View

3.2.1 Front Panel

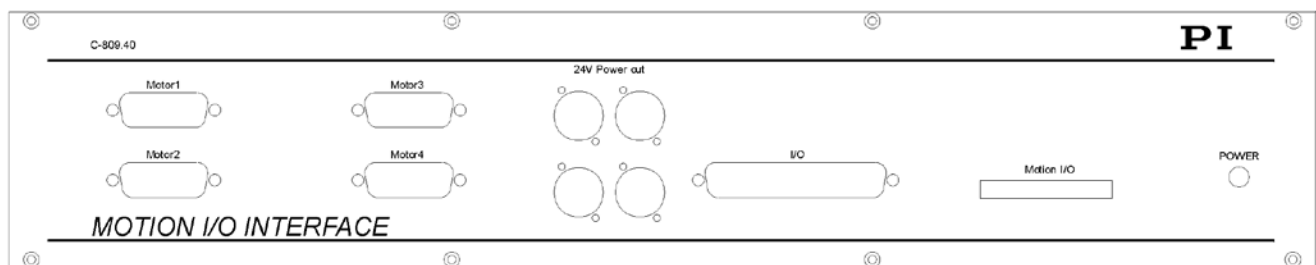


Figure 2: C-809.40 Motion I/O Interface: Front panel

Labeling	Type	Function
Motor1 Motor2 Motor3 Motor4	Sub-D 15 (f) (p. 23)	Connection for PI stages. Only for DC motors! - Output of analog or PWM signals for the driving the stage - Input of the signals of the incremental position sensor - Input of the signals from the limit switches and reference point switch
24V Power out	4 x Switchcraft 3-pin (f) (p. 24)	4 x 24 V supply power output For stages with DC motor and PWM amplifier (e.g. ActiveDrive) only! Use the extension cables that come with the C-809.40 (4 x C-815.PS3).
I/O	Sub-D 37 (f) (p. 26)	Interface for user-specific purposes, e.g. triggering. Duplicates several I/O lines of the Motion I/O socket.
Motion I/O	SCSI4 68-pin (f) (p. 25)	Interface to the NI PCI-7344 Motion Control card
POWER	LED green/off	Power indicator: - Green: C-809.40 is switched on. - Off: C-809.40 is switched off or not connected to the line voltage.

3.2.2 AC Power Connection and On/Off Switch on Rear Panel

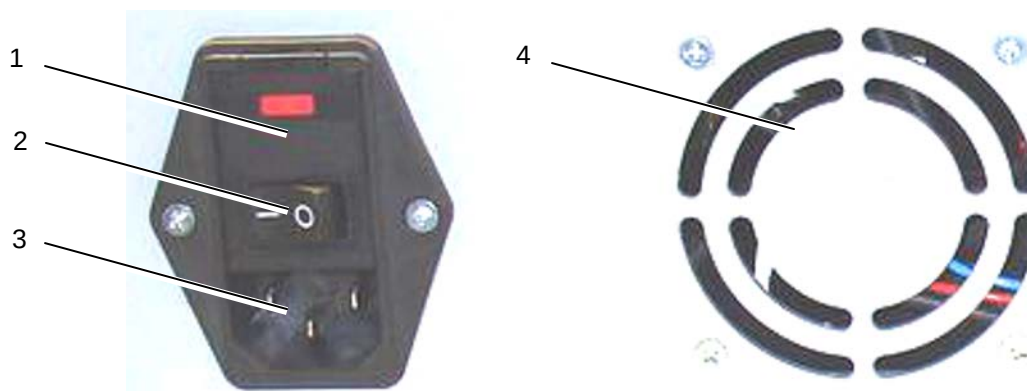


Figure 3: C-809.40 Motion I/O Interface: Rear panel details

- 1 Fuse carrier for line fuses
- 2 On/off switch
- 3 AC power connection
- 4 Ventilation slots for the integrated fan

The C-809.40 is equipped with a wide-range power supply and with fuses that are admissible for a supply voltage of 100 to 120 VAC or 220 to 240 VAC (line voltage).

See “Changing the Line Power Fuses” (p. 17) for fuse replacement.

Labeling	Type	Function
	Toggle switch	On/off switch: ○ position: C-809.40 is switched off. — position: C-809.40 is switched on.

3.3 Scope of Delivery

Item ID	Quantity	Description
C-809.40	1	Motion I/O interface
3763	1	Power cord
C-815.PS3	4	Extension cable for 24 V supply of stages with PWM DC motor, Switchcraft 3-pin/Switchcraft 3-pin, 3 m
MS114E	1	User manual for the C-809.40 (this document)

4 Unpacking

1. Unpack the C-809.40 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 Operation

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5.1 General Notes on Operation

NOTICE



24V Power out only for driving DC motors!

The integrated 24 V 4-channel power supply of the C-809.40 is designed to drive DC motors. Using it for other purposes can cause permanent damage to the C-809.40.

- Use the **24 V Power out** sockets of the C-809.40 only for driving DC motors.

5.2 Quick Start

To operate your motion system using the C-809.40 Motion I/O interface proceed as follows:

1. Install the NI PCI-7344 Motion Control card and associated software as described in the documentation from NI.
2. Make sure that the On/Off switch of the C-809.40 is in the — position (= off; see p. 12).
3. Connect C-809.40 to AC power using the included power cord or a suitably rated power cord (socket on the rear panel, see p. 12). The wide-range power supply works with line voltages from 100 to 240 volts AC at 50 to 60 Hz.

4. Establish the connection between the **Motion I/O** sockets on NI card and C-809.40 using the cable SHC68-C68-S from National Instruments, or equivalent. Cable order number 186380-02 is 2 m in length, 186380-0R5 0.5 m.

Be sure the connectors are properly oriented before attempting to plug them in.

5. Connect up to four PI DC-motor stages to the C-809.40 using the **Motor1** to **Motor4** sockets.

Stages with PWM amplifier (see the stage's user manual for model number and description):

- Connect the stage also to a **24 V Power out** socket using an C-815.PS3 power cable (included in the scope of delivery).

6. Power up the C-809.40 by moving the On/Off switch into the — position (= on).

The POWER LED lights up green.

7. Move the stages: to do this, use the Measurement and Automation Explorer (MAX) software for the NI Motion Control card.

Start MAX. Note that if you start MAX before switching on the C-809.40, the C-809.40 is not recognized by the software. Be sure to select the correct stage configuration in the program so that the proper parameters are passed on to the C-809.40. Note that the NI card must not generate PWM signals, since this is done by the C-809.40, which itself expects analog signalling. For that reason be sure to disable PWM generation in the NI Measurement and Automation software. If for some reason you need the C-809.40 to accept PWM signals from the card, contact PI for reconfiguration information.

5.3 Using the I/O Interface

The C-809.40 offers a separate **I/O** interface that brings out several lines of the **Motion I/O** socket to make them accessible for the user. This interface can be used for special tasks like triggering or measuring, and also gives easy access to some analog input and output lines. The data on all the lines of the C-809.40 **I/O** interface (Sub-D 37(f)) are connected straight through only, not processed by the C-809.40. See the NI software documentation for information on using this lines; for pinouts see p. 26.

6 Maintenance

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6.1 Cleaning the C-809.40

NOTICE



Short circuits or flashovers!

The C-809.40 contains electrostatic sensitive devices that can be damaged by short circuits or flashovers when cleaning fluids enter the case.

- Before cleaning, remove the C-809.40 from the power source by pulling the power plug.
- Prevent cleaning fluid from entering the case.

- When necessary, clean the surfaces of the C-809.40 case with a towel that has been lightly dampened with a mild cleanser or disinfectant.
- Do **not** use any organic solvents.

6.2 Changing the Line Power Fuses

DANGER



Risk of electric shock!

The C-809.40 requires a supply voltage of 100 to 120 VAC or 220 to 240 VAC (line voltage). Touching the line voltage can result in serious or even lethal injury due to electric shock.

- Remove the power cord from the C-809.40 before you change the line fuses.

INFORMATION

Both line fuses of the C-809.40 are active.

- Check both fuses if there is a fault.

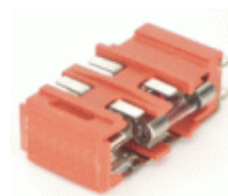
The power connection and line fuses are located on the rear panel of the C-809.40. To access the line fuses, proceed as follows:

1. Switch off the C-809.40 and remove the power cord.
2. Wait a minute to be sure that any residual voltage has dissipated.
3. Pry open the door that covers the fuse carrier and pry out the fuse carrier (see figures below).
4. Be sure to replace both fuses with fuses of the suitable type:

2 x IEC T4AL, 250 V

Note: IEC-standard fuses are designed to carry the nominal current indefinitely. Other fuse rating standards differ.

5. Reinstall the carrier and close the door



7 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. 3) on our website (<http://www.pi.ws>).

8 Technical Data

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8.1 Specifications

8.1.1 Data Table

	C-809.40
Function	Amplifier/Interface for NI PCI-7344 Motion Control 4-channel PCI Card
Axes	4
Max. output power	If all stages connected to the C-809.40 have PWM amplifiers and are supplied by the 24 V power supplies of the C-809.40: 100 VA This value is reduced by 12 VA for every stage which has an analog DC motor and is connected to the C-809.40.
Current limitation (internal)	2 A per channel for analog DC motors (short-circuit proof)
PWM signal	20-22 kHz, TTL
Motor connectors	15-pin (f) sub-D per channel
Motion I/O connector	68-pin SCSI4, works with NI cable SHC68-C68-S
I/O connector	37-pin (f) sub-D
24 V Power out sockets	3-pin Switchcraft, only for driving DC motors
Mass	7.3 kg
Dimensions	450 x 105 x 390 mm
Operating temperature	5 to 40 °C
Operating voltage	100 to 240 V AC at 50 to 60 Hz
Line power fuses	2 x T4AL, 250 V
Max. current consumption	3 A

8.1.2 Maximum Ratings

The C-809.40 is designed for the following operating data:

Maximum Operating Voltage 	Operating Frequency 	Maximum Current Consumption 
100 to 240 V AC	50 to 60 Hz	3 A

8.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the C-884:

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

8.2 Pin Assignment

8.2.1 Motor1 to Motor4

The **Motor1** to **Motor4** sockets follow standard conventions for PI analog and PWM stages. Note that if you operate a stage with integrated PWM amplifier, a C-815.PS3 power cable (included in the scope of delivery) is required in addition to connect to a **24 V Power out** socket (p. 24).

Sub-D 15-pin, female

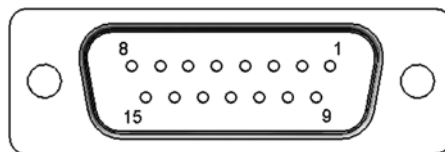


Figure 4: Top view of the socket

Pin	Signal	Function
1	Output	+5 V (TTL; brake)
2	Output	Motor + (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 GND
7	Input	Encoder: A (-)
8	Input	Encoder: B (-)
9	Output	Motor – (for stages without PWM amplifier)
10	GND	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

8.2.2 24 V Power Out

The four **24 V Power out** sockets are interchangeable, ready for use with stages which have a PWM amplifier. No activation is required.

Switchcraft 3-pin, female

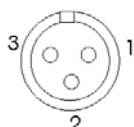


Figure 5: Top view of a 24 V power out socket

Pin	Function
1	GND
2	Output: 24 VDC
3	Not connected

8.2.3 Motion I/O

The 68-pin SCSI4 **Motion I/O** socket is for the cable connecting the C-809.40 with the PCI-7344 Motion Control card. Over this connection, all of the signals required for servo-control of up to four axes are sent and received. The **Motion I/O** socket also carries four analog input channels for the 12-bit A/D converters on the card; these can be programmed as analog feedback or general-purpose analog input. To facilitate access, these lines are duplicated on the 37-pin **I/O** socket (see p. 26).

SCSI4 68-pin, female

Function*	Pin	Pin	Function*
Axis 1 Dir (CCW)**	1	35	Axis 1 Step (CW)**
Digital Ground	2	36	Axis 1 Encoder Phase A
Digital Ground	3	37	Axis 1 Encoder Phase B
Axis 1 Home Switch	4	38	Axis 1 Encoder Index
Trigger 1**	5	39	Axis 1 Forward Limit Switch
Axis 1 Inhibit**	6	40	Axis 1 Reverse Limit Switch
Axis 2 Dir (CCW)**	7	41	Axis 2 Step (CW)**
Digital Ground	8	42	Axis 2 Encoder Phase A
Digital Ground	9	43	Axis 2 Encoder Phase B
Axis 2 Home Switch	10	44	Axis 2 Encoder Index
Trigger 2**	11	45	Axis 2 Forward Limit Switch
Axis 2 Inhibit**	12	46	Axis 2 Reverse Limit Switch
Axis 3 Dir (CCW)**	13	47	Axis 3 Step (CW)**
Digital Ground	14	48	Axis 3 Encoder Phase A
Digital Ground	15	49	Axis 3 Encoder Phase B
Axis 3 Home Switch	16	50	Axis 3 Encoder Index
Trigger 3**	17	51	Axis 3 Forward Limit Switch
Axis 3 Inhibit**	18	52	Axis 3 Reverse Limit Switch
Axis 4 Dir (CCW)**	19	53	Axis 4 Step (CW)**
Digital Ground	20	54	Axis 4 Encoder Phase A
Digital Ground	21	55	Axis 4 Encoder Phase B
Axis 4 Home Switch	22	56	Axis 4 Encoder Index
Trigger 4**	23	57	Axis 4 Forward Limit Switch
Axis 4 Inhibit**	24	58	Axis 4 Reverse Limit Switch
Digital Ground**	25	59	Host +5 V**
Breakpoint 1**	26	60	Breakpoint 2**
Breakpoint 3**	27	61	Breakpoint 4**
Digital Ground**	28	62	Shutdown**
Analog Output 1	29	63	Analog Output 2
Analog Output 3	30	64	Analog Output 4
Analog Output Ground	31	65	Reserved
Analog Input 1**	32	66	Analog Input 2**
Analog Input 3**	33	67	Analog Input 4**
Analog Reference (Output)	34	68	Analog Input Ground**

* Designations as "input" or "output" refer to the NI card.

** Signals duplicated on the **I/O** socket, see p. 26.

8.2.4 I/O

To make them accessible for user-specific purposes such as triggering, several input and output lines from the **Motion I/O** socket (p. 25) are duplicated on the 37-pin sub-D I/O socket of the C-809.40.

Sub-D 37-pin, female

Pin	Function
1	Axis 1 Dir
20	Trigger 1
2	Axis 1 Inhibit
21	Axis1-Step
3	Axis 2 Dir
22	Trigger 2
4	Axis 2 Inhibit
23	Axis2-Step
5	Axis 3 Dir
24	Trigger 3
6	Axis 3 Inhibit
25	Axis3-Step
7	Axis 4 Dir
26	Trigger 4
8	Axis 4 Inhibit
27	Axis4-Step
9	Internal Use
28	Internal Use
10	Internal Use
29	Internal Use
11	Analog Input 1
30	Analog Input 2
12	Analog Input 3
31	Analog Input 4
13	Analog Input Ground
32	Internal Use
14	Internal Use
33	Shutdown
15	Breakpoint1
34	Breakpoint2
16	Breakpoint3
35	Breakpoint4
17	Digital Ground
36	Host +5 V
18	Digital Ground
37	NC
19	NC

9 Old Equipment Disposal

In accordance with applicable EU law, electrical and electronic equipment cannot be disposed of in the member states of the EU with other wastes.

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



10 EC Declaration of Conformity

For the C-809.40, an EC Declaration of Conformity has been issued in accordance with the following European directives:

2006/95/EC, Low Voltage Directive

2004/108/EC, EMC Directive

2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

Safety (Low Voltage Directive): EN 61010-1:2010

EMC: EN 61326-1:2013

RoHS: EN 50581:2012

