User Manual

E872T0001, valid for E-872.01, E-872.02

LMo, BRo, 2/22/2017

E-872

Q-Motion® Piezomotor Drive Electronics, 1 Channel, 48 V, OEM Board

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Contents

About this Document

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.

Symbol	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
S. 5	Cross-reference to page 5
`SVO?`	Command line or command from PI's General Command Set (GCS) (example: command to get the servo mode)
RS-232	Operating element labeling on the product (example: socket of the RS-232 interface)
Device S/N	Parameter name (example: parameter where the serial number is stored)
Start > Settings	Menu path in the PC software (example: to open the menu, the Start and Settings buttons must be clicked in succession)
5	Value that must be entered or selected via the PC software

Safety

Intended Use

The E-872 is a laboratory device as defined by DIN EN 61010-1. It is intended for open-loop operation of Q-Motion® piezo inertia drives. The E-872 must be installed in a suitable case before start-up.

General Safety Instructions

NOTICE

Electrostatic hazard!

The E-872 contains electrostatically sensitive equipment (ESD) and can be damaged if handled improperly.

- Avoid touching pins and PCB traces.
- Before touching the E-872, discharge yourself of any electric charges appropriately, e.g. by wearing an antistatic wrist strap.
- Only handle and store the E-872 in environments that dissipate existing static charges to earth in a controlled way and prevent electrostatic charges (ESD workplace or electrostatically protected area, in short EPA).

NOTICE

Electromagnetic disturbances!

If the E-872 is operated without a case, live parts are accessible. Electrical, magnetic and electromagnetic fields emitted by live parts can disturb the E-872 and/or the environment.

- Only operate the E-872 when it is installed in a shielded case that fulfills the requirements of electromagnetic compatibility.

NOTICE

Supply voltage too high or incorrectly connected!

Operating voltages that are too high or incorrectly connected can cause damage to the E-872.

- Do **not** exceed the supply voltage range for which the E-872 is specified (see “Operating voltage” in the Data table on p. 10).
- Only operate the E-872 when the operating voltage is properly connected (for pin assignment, see p. 12).

Organizational Measures

User manual

- Always keep this user manual available with the E-872. The latest versions of the user manuals are available for download on our website.
- Add all information from the manufacturer to the user manual, for example supplements or Technical Notes.
- If you give the E-872 to other users, also include 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 result in minor injury and damage to equipment.
- Only install and operate the E-872 after you have read and understood this user manual.

Personnel qualification

The E-872 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

Product Description

Product View

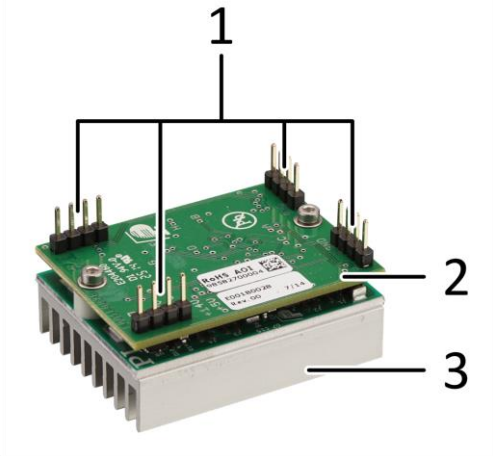

Figure 1: E-872 (bottom view)

1 Pin headers
2 Bottom plate
3 Heat sink

Functional Principles

Block Diagram

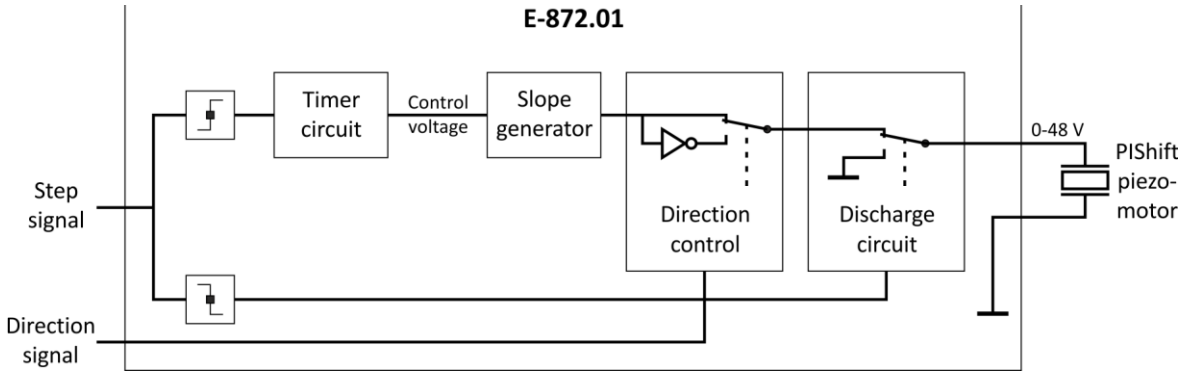

Figure 2: Block diagram for E-872.01

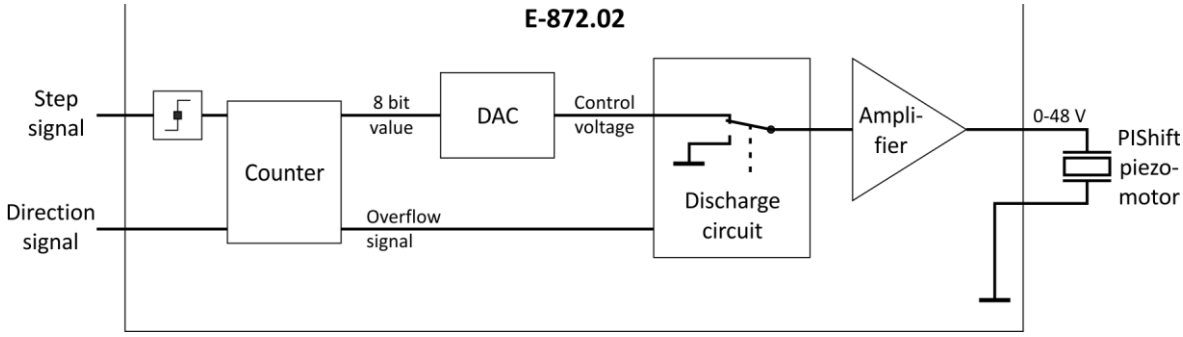

Figure 3: Block diagram for E-872.02

Operation notes

The E-872 generates a modified sawtooth signal and outputs the corresponding piezo voltage. The piezo voltage generates a cyclic alternation of static and sliding friction (“slip phase”) between the moving rod and the piezo actuator of the PIShift drive and thus a continuous feed of the rod.

The output of one period of the modified sawtooth signal generates one "step cycle" of the rod. Depending on the E-872 model, the step cycle is divided into 256 microsteps. See the following sections for details.

The input signal can be noninverted (STEP) or inverted (/STEP) as required, but the unused input should be left unconnected.

Full-cycle operation (E-872.01)

With the E-872.01 model, full-cycle operation is possible only, i.e. every pulse on the step line (J6 control input socket) will cause a complete step cycle. Full-cycle operation is intended for applications where fast motion is important.

The following description assumes noninverted input signals. If you choose to control the E-872 with inverted input signals, the evaluation of the input signal states and edges are inverted accordingly.

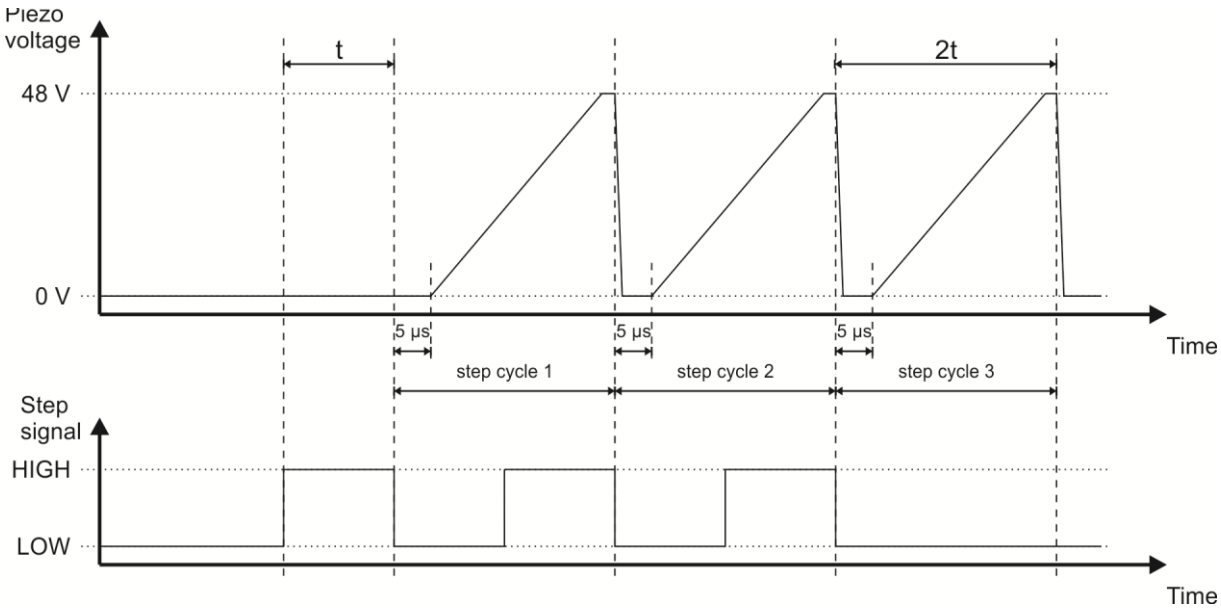

Figure 4: Step signal and piezo voltage. Diagram for positive direction of motion

The duty cycle of the step signal must be 50%. Operation with lower duty cycle values will reduce the drive efficiency and cause choppy motion. For very low step frequencies or single step pulses, the pulse width should not be longer than 2.5 ms.

The slip phase is a fixed 5 µs charge or discharge period, depending on the direction of motion. If the piezo capacitance is very high, the piezomotor may not discharge completely and run at decreased efficiency.

The slip phase of each step is triggered by the falling edge of the step signal. For single step pulses, the step cycle is completed after twice the pulse width from the falling edge of the step pulse. The output voltage is reset to 0 V after each step in any direction.

The maximum step frequency is 20 kHz. Higher step signal frequencies will not damage the driver but will stop the motion of the piezomotor.

Microstepping operation (E-872.02)

With the E-872.02 model, microstepping operation is possible only, i.e. every pulse on the step line (J6 control input socket) will cause one microstep. The microsteps are being counted by an 8 bit counter. Microstepping operation is intended for applications where very precise motion is important.

The following description assumes noninverted input signals. If you choose to control the E-872 with inverted input signals, the evaluation of the input signal states and edges are inverted accordingly.

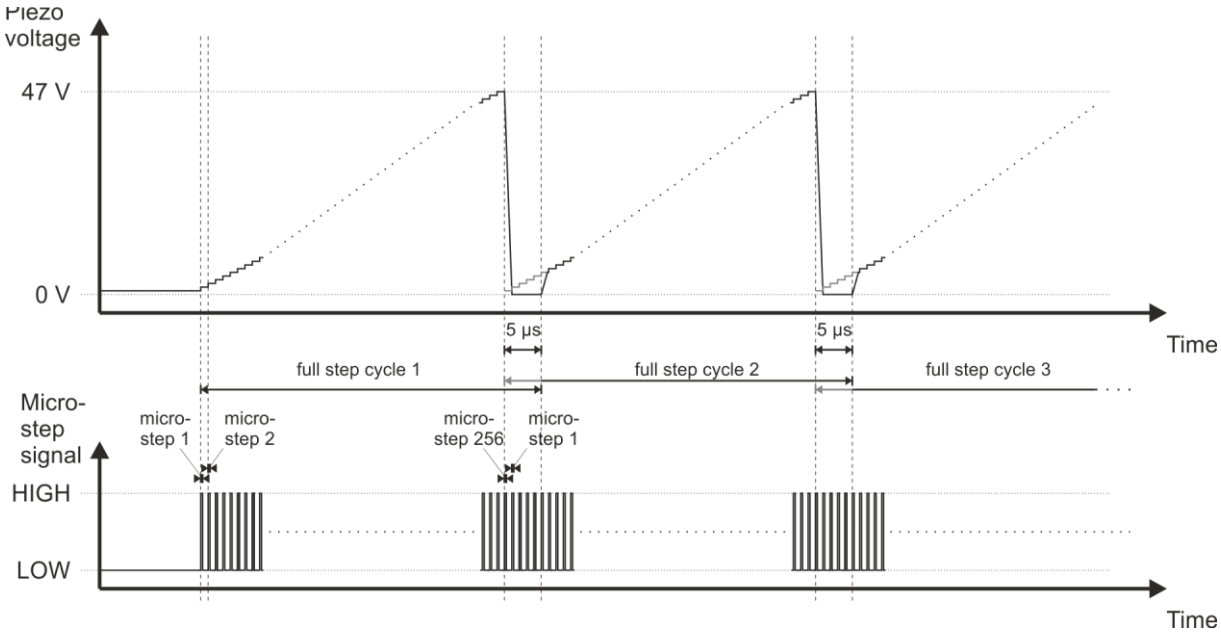

Figure 5: Microstep signal and piezo voltage. Diagram for positive direction of motion

A complete step cycle consists of 256 microsteps. Each microstep is triggered by the rising edge of the step line signal. The piezo output voltage does not reach the supply rails, but swings from approximately +1 V to +47 V and vice versa.

The slip phase of each step cycle is triggered by the overflow signal of the 8 bit counter, i.e. the 256th microstep signal. The output voltage is reset to approximately 1 V after each step cycle in any direction.

The slip phase is a fixed 5 µs charge or discharge period, depending on the direction of motion. If the piezo capacitance is very high, the piezomotor may not discharge completely and run at decreased efficiency. During this phase, the piezo output voltage reaches 0 V or 48 V respectively.

If the microstep signal continues during the slip phase, the E-872.02 will increase the piezo output voltage to the desired value after the slip phase without losing count (see Figure 5). In this case, the slope is low enough for the piezomotor to follow the motion, so the rod will not slip.

Maximum microstep frequency is approximately 5.1 MHz which corresponds to a full-step frequency of 20 kHz. Higher step signal frequencies will not damage the driver but will stop the motion of the piezomotor.

Temperature Sensors

NOTICE

Temperature sensors use default configuration!

The E-872 has two integrated ADM1032 temperature sensors which are accessible via the SMBus protocol on the pin header **J7**. The temperature sensors have not been preconfigured to match your application and thus will not prevent overheating of the E-872.

➢ See the ADM1032 datasheet for instructions on configuration of the temperature sensors.

NOTICE

No integrated overtemperature protection!

The E-872 does not feature on-board overtemperature protection.

➢ Use external hardware for the evaluation of the ADM1032 temperature sensors.

➢ If necessary, include an overtemperature deactivation circuit for the E-872 into your design.

Installation

The E-872 must be installed on another printed circuit board by the four pin headers **J6 – J9**.

Tools and accessories

- Suitable printed circuit board:
  - The printed circuit board has four suitable four-pin header connectors (for position and orientation, see “Dimensions” on p. 11)
  - The components on the printed circuit board do not protrude beyond the header connectors.

Installing the E-872 on a printed circuit board

1. Align the pin headers of the E-872 with the header connectors of the printed circuit board.
2. Push the pin headers into the header connectors.
3. Check that the E-872 is affixed firmly.

Technical Data

Data Table

	E-872.01	E-872.02
Function	Drive electronics for PIShift piezomotors, 1 channel, OEM board with solder pins, for	
	full-cycle operation	microstepping with 8-bit resolution
Amplifier		
Control input	TTL signals for step and direction	
Output voltage	0 to 48 V	0 to 48 V
Max. output current (<8 ms)	600 mA	
Max. full step frequency	20 kHz	20 kHz (corresponds to 5.1 MHz microstep frequency)
Microsteps per step	-	256
Current limitation	Short-circuit-proof	
Miscellaneous		
Contacting	4 x 4-pin headers, 2.54 mm pitch	
Overtemp protection	ADM1032 Programmable temperature sensors with digital output over SMBus	
Mass	39 g	
⚠ Operating voltage	48 V ⎓	
⚠ Max. current consumption	0.62 A	
Stand-by current consumption	<20 mA	
Ambient conditions and classifications		
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	
Operating temperature range	5 to 50°C	
Storage temperature range	0°C to 70°C	
Transport temperature range	–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*	

Dimensions

Dimensions in millimeters, decimal places separated by commas in drawings

Dimensions are identical for E-872.01 and E-872.02.

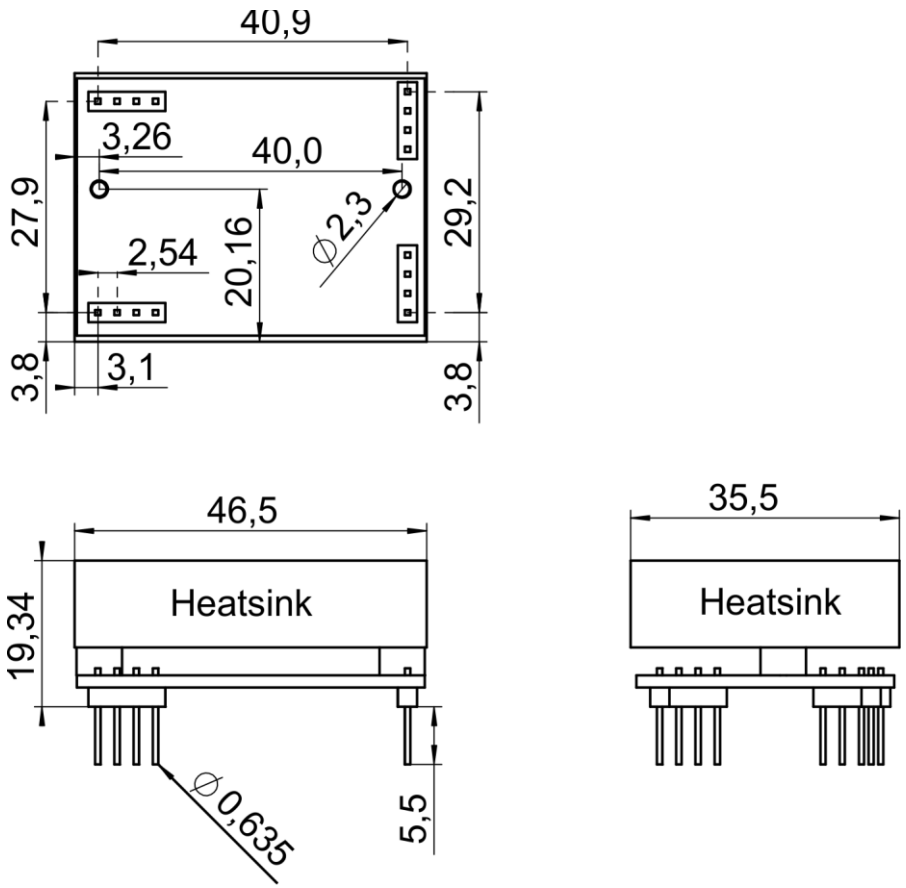

Figure 6: Dimensions of the E-872

Pin Assignment

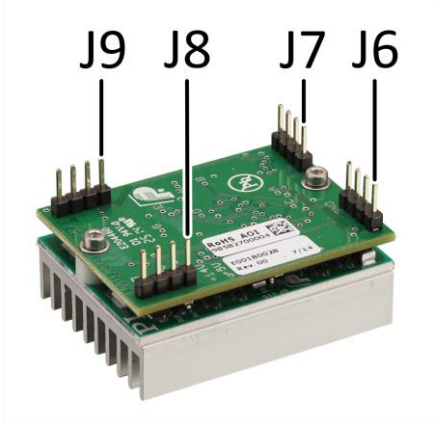

Figure 7: Pin headers, pins 1 marked

J6 Control Input

Pin	Description
1	STEP (TTL)
2	/STEP (TTL)
3	V/D (TTL; direction)
4	GND

J7 Temperature Monitor

Pin	Description
1	GND
2	/ALERT
3	SDATA
4	SCLK

J8 Supply Power

Pin	Description
1	+48 V
2	+48 V
3	GND
4	GND

J9 Motor Output

Pin	Description
1	GND
2	GND
3	Piezo out (0-48 V)
4	Piezo out (0-48 V)

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 Roemerstr. 1

D-76228 Karlsruhe, Germany