# MC-90 driver
LEGS-Drive® serie
Manual

High resolution driver stage
with low standby power consumption
for Piezolegs motors
with step/direction interface

The MC-09-14 is a compact piezo motor driver module for high precision and highly dynamic piezo axis. It is designed especially for the LEGS-Drive® Serie from Piezomotor AB Uppsala. You can drive e.g. the LL10, LT20/40/80, LTC20/40/300/450, LS10/15, LR10/50/80 and LW20 motors and allso our piezomotor driven products.
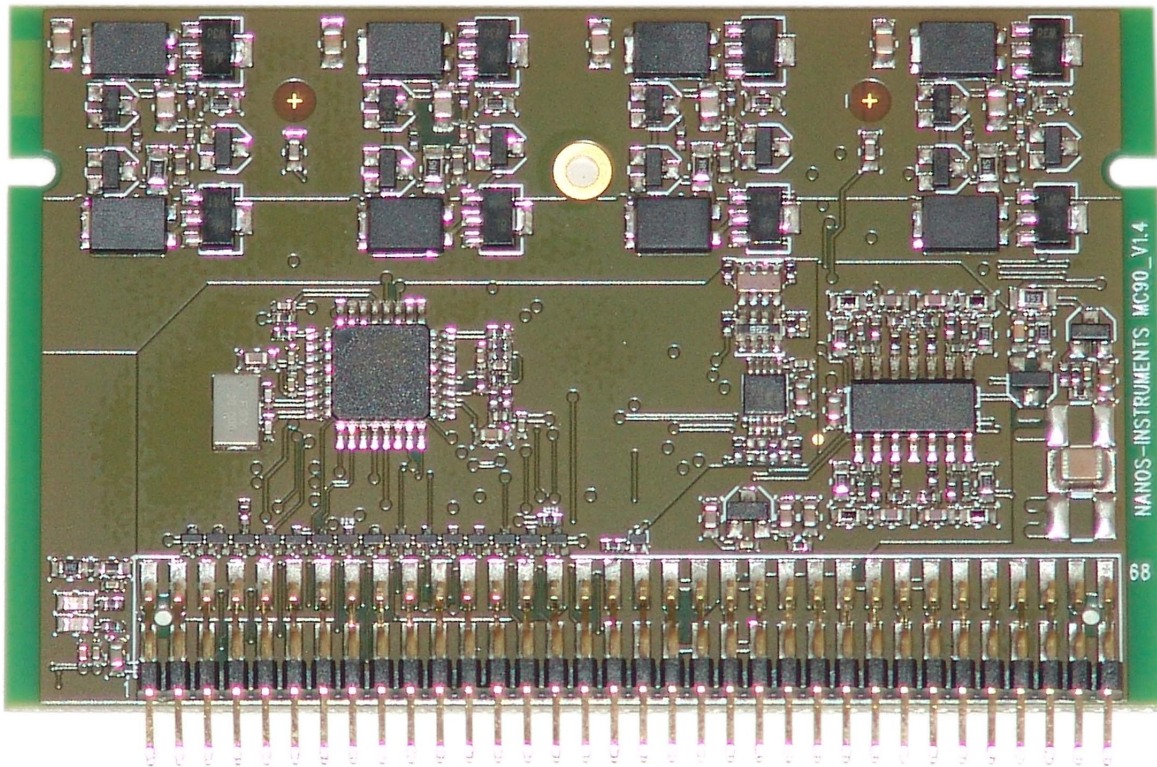
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1) Features

It is an analog powerstage with step/dir interface
The resolution is 3 nm (firmware version 0.7) or down to 0.7 nm. (firmware version 0.8)
Note that the maximum driving frequency is lower and you don´t have the full speedrange
with the version 8.

Driving frequency is up to 3khz. (Version 7)
Step/dir frequency is up to 98kHz. Waveform update rate is 98kHz

The Power supply is 5V +/-5% (max 50mA) and 48V +/-5% (max 0,01 to 03A depending on
the motor and frequency).

It has an enable function to reduce power and heat.
It has a parking funktion.

LED red shows an overheat at the amplifirer.
LED green shows that the Powerstage is on. Otherwise it is parked.

Dimensions are 80*50*5.3 mm
Designed for up to 20W heat transport from the back side.
RoHS Compliant
Low EME design for ease of use

68 pin connector (Samtec MMT-134-02-S-DH-K)
A horizontal connector is avaliable on request

Socket board connector: Samtec MMS-134-02-L-DV straight
Fischer Elektronik BLY4-068 right angle

2) Life support policy

NANOS-Instrumentsl GmbH does not authorize or warrant any of its products for use in life
support systems, without the specific written consent of NANO-Instruments GmbH
Life support systems are equipment intended to support or sustain life, and whose failure to
perform, when properly used in accordance with instructions provided, can be reasonably
expected to result in personal injury or death.

3) Mechanical Dimension
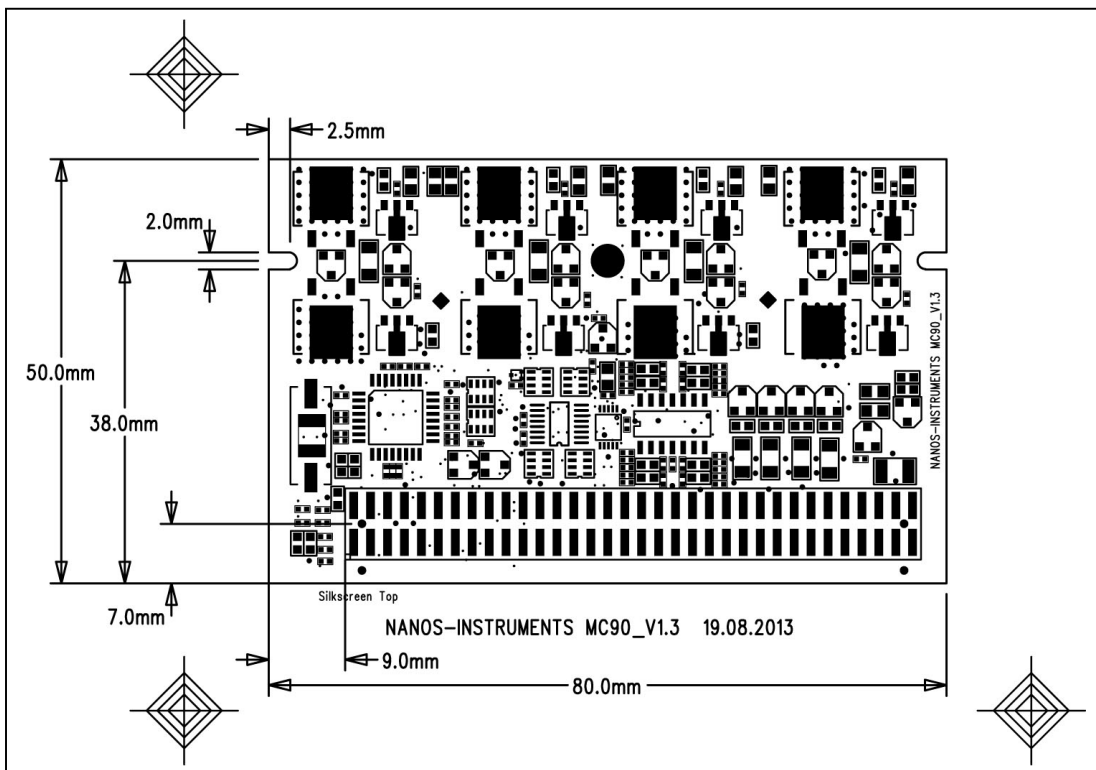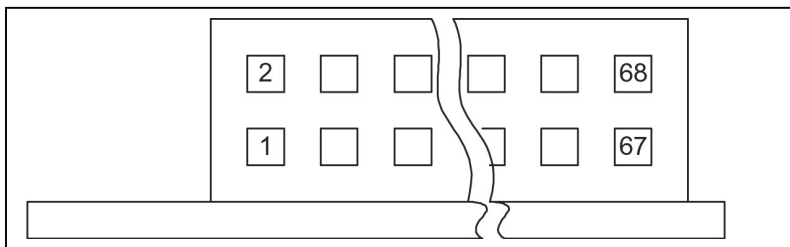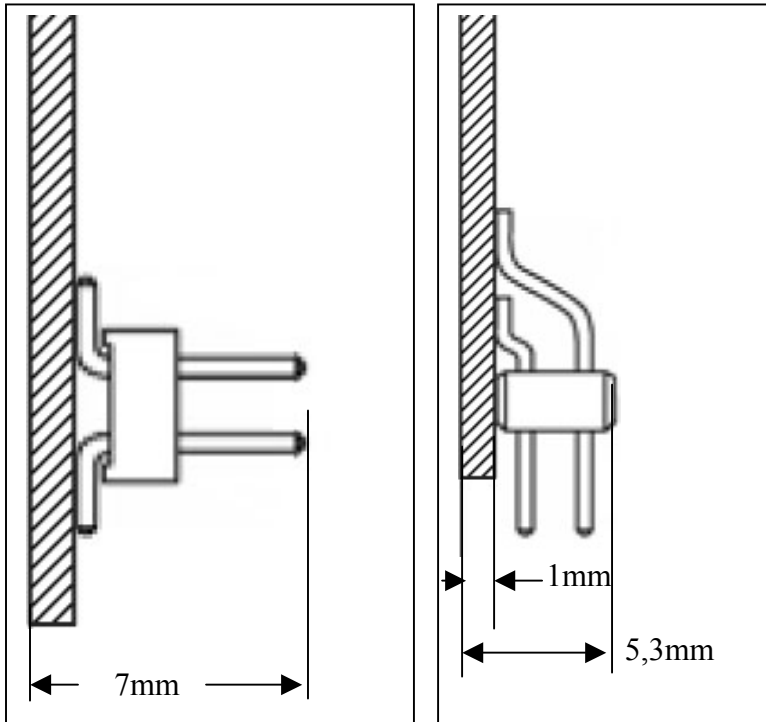
4) Pinning

Pin	Number	Funktion
+5V	1 (3 is not connectet anymore)	5V logic power supply input. use a precise and stable regulator if possible.
GND	2, 4, 6, 8, 10,61, 62	Digital and motor GND
VM/	5,7 (9 is nc)	Motor supply voltage 48V +/-5%
Step_ENN	11	Digital out: 1 when ready to run, 0 when parked or overheated
SCK	12	Digital In: Serial clock for SPI operation. Do not connect in step/direction mode.
SCSN	13	Digital In: Serial chip select for SPI operation. Do not connect in step/direction mode.
SDO	14	Digital Out: Serial data output for SPI operation. Do not connect in step/direction mode
USER0	15	to be defined / OEM use
SDI	16	Digital In: Serial data input for SPI operation. Do not connect in step/direction mode.
NRESET	17	Digital In: Module reset – leave open for normal operation
STEP	18	Digital In. Step input
USER1*	19	Digital In. 0 = high resoultion 1 = standard resolution. internal pull-up
DIR	20	Digital In: Direction input
USER2	21	to be defined / OEM use
MODE0	22	Digital In: Selection of wave form in Step/Direction mode
USER3	23	to be defined / OEM use
MODE1	24	Digital In: Selection of wave form in Step/Direction mode
RESO	25	Digital In: microstep resolution 0
RES1	26	Digital In: microstep resolution 1
MODE2	27	Digital In: Selection of operation mode: 1 = Enable powerstage and initiate phase voltages. 0 = Park the motor (all phases at 0V) and disable powerstage. If external SPI activity is detected, then powerstage is activated.
N_STAGE	28	Digital In. 1= Disable Powerstage. 0= enable
V_Servo*	31	to be defined / OEM use
MOT4	37, 38, 39, 40	Motor phase 4 output
MOT3	41, 42, 43, 44	Motor phase 3 output
MOT2	49,50,51,52	Motor phase 2 output
MOT1	53,54,55,56	Motor phase 1 output

5) Operational Ratings

The operational ratings show the intended / the characteristic range for the values and should be used as design values. In no case shall the maximum values be exceeded.

Symbol	Parameter	Min	Typ	Max	Unit
VM	power supply voltage for operation	45,6	48	70	V
VM option	Variable power supply with variable motor voltage	30	48	70	V
+5V	Voltage for logic and analog input If the servo input is used it must be stable	4,5	5	5,5	V
I	Motor current (RMS) ; take care of the driver heat and transport the heat. It is depending of the motor capaticy, the driving frequence and the voltage.	0	0,2	1	A
I +5	Power supply current +5V		0,05		A
I STB	Standby power supply VS	0	0,05		A
fStep	Step frequencey (input)	0	120	500	kHz
th	Step pulse high time	100			ns
TS2D	Direction change to step delay (direction setup time)	2			µs
TENV	Environment temperature	-25		80	°C

6) Power supply requirements

The motor supply voltage of the MC-090 is 48V DC +/-5%, in postitionig modus 10mA, parked 0mA, full speed of a singel 10Nmotor (LL) to 300mA (15W)depending on the motor capacitance and frequency. As an approximation, P [Watt] = 4*freq*cap*VM*VM.

The module is not protected against wrong polarity. A +5VDC supply is needed as well. Use +-5% if possible, max. 100mA.

Note:
At power ON, the capacitors for 5V (10 µF) and VM (2 µF) will be loaded at a current decided by the external power supply.

If 5V is first at the board the driver will be enabled by the µController after 70ms.
When the VM volatage will be later switched on the µcontroller will do an reset and start new.

7) Motor connection

This module is designed especially for PiezoLEGS motors. The heat dissipation in the driver depends on waveform cycle frequency, the VM voltage and the motor capacitance. As an approximation, P [Watt] = 4*freq*cap*VM*VM.

8) Step/Dir mode

In Step/Direction mode, the full capabilities of the module can be used, e.g. different waveforms and highest step resolution. However, the maximum motor velocity which can be achieved for a given microstep resolution is limited by the maximum step frequency.
To use the Step / Direction interface, connect the inputs as follows:

Signal name	Pin number	connection
MODE2	27	Digital In.When this pin is low, the motor will be parked and SPI is set to slave. When pin is set high, SPI is set to master and the motor is unparked/powered up.
STEP_ENN	11	Digital out: 1 when ready to run, 0 when parked or overheated
USER0	15	Digital In. 0= servo voltage enabled; 1 or open disabled internal pull-up
STEP	18	Digital In. Step input
USER1	19	Digital In. 0 = high resoultion 1 = standard resolution. internal pull-up
DIR	20	Digital In: Direction input
MODE0	22	Digital In: Selection of wave form in Step/Direction mode
MODE1	24	Digital In: Selection of wave form in Step/Direction mode
RES0	25	Digital In: Selection of step/direction microstep resolution
RES1	26	Digital In: Selection of step/direction microstep resolution
N_STAGE	28	Digital In. Disable Powerstage 0 or open = enable
Vservo	31	Analog In. +/- 10 V. servo voltage (OEM)

Note: Pins 12, 13, 14 and 16 must not be connected in this mode!
Pin 15/19/31 (USER0/USER1/ V_{servo}) is avaliable in firmware 0.9 (OEM)

signal timing:

	Min
t_{S2D}	2µs
t_{D2S}	0µs
th	100ns
tl+th	2 µs

Step pulse

Direction
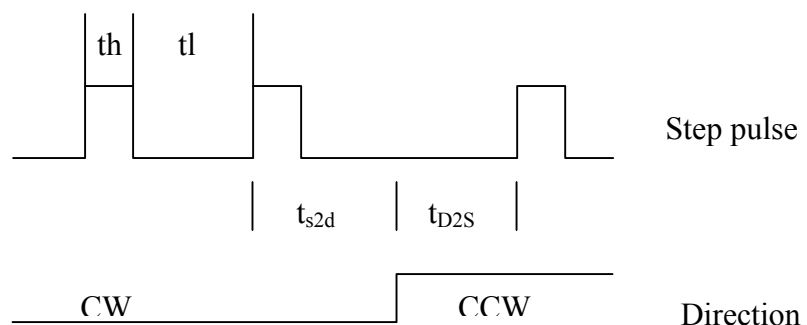
8) Servo voltage operation

Pin 15/19/31 (USER0/USER1/ V_{servo}) is avaliable in firmware 0.9.
More information are coming soon.

10) Resolution and Waveform settings

The different waveforms and resolutions stored in the internal ROM are selected by digital inputs. MODE0 and MODE1 set the waveforms and RES0 and RES1 the microstep resolutions. Please be careful not to exceed the maximum allowed motor velocity in these modes, in order not to damage the motor and heat disatation of the driver board.

Wave Mode	Microstep resolution	MODE1	MODE0	RES1	RES0	USER1	USER0	firmware	Note
Delta	2048	1	1	1	1	x	x	0.7	1
Delta	1024	1	1	1	0	x	x	0.7	1
Delta	512	1	1	0	1	x	x	0.7	1
Delta	256	1	1	0	0	x	x	0.7	1
Delta	256	1	0	1	1	x	x	0.7	1
Delta	128	1	0	1	0	x	x	0.7	1
Delta	64	1	0	0	1	x	x	0.7	1
Delta	32	1	0	0	0	x	x	0.7	1
Rhomb	2048	0	1	1	1	x	x	0.7	2
Rhomb	1024	0	1	1	0	x	x	0.7	2
Rhomb	512	0	1	0	1	x	x	0.7	2
Rhomb	256	0	1	0	0	x	x	0.7	2
Rhomb_F	256	0	0	1	1	x	x	0.7	3
Rhomb_F	128	0	0	1	0	x	x	0.7	3
Rhomb_F	64	0	0	0	1	x	x	0.7	3
Rhomb_F	32	0	0	0	0	x	x	0.7	3
Delta	8192	0	1	1	1	x	x	0.8	4
Delta	8192	0	1	1	0	x	x	0.8	5
Delta	8192	0	1	0	1	x	x	0.8	1
Delta	4096	0	1	0	0	x	x	0.8	1

Notes:
1) Strong linear motion.
2) Faster than Delta for light load. Also good for rotating motors.
3) This waveform is considered obsolete. Use Delta instead.
4) Stepping on every 4th pulse. (32768/4)
5) Stepping on every 2nd pulse.(16384/2)

A change of waveform and resolution can be done at any point. It may take up to 14 µs to set, during which time the driver may continue to use the old parameters

10 Revision

10.1) Dokumenten Revision

Version	Comment	Description
0	internal Release	not to give out

10.2) Hartware Revision

Version	Comment	Description
1.10	internal Release	design only
1.12	1.2013	changes in the resistors at the powerstage. Ref voltage.
1.13	9.2013	changing connector J200, R200/2001/203/203/216/ R1
1.14	4.2015	lower power consumption,

10.3) Firmware Revision

Version	Comment	Describtion
0.1	internal Release	design only
0.6	released version	Until 03.2013. Fast 11 Bit resolution (2048 microsteps). Overheat signal.
0.7	released version	Powerstage disabled when motor parked. Standard version
0.8	special version	13Bit resolution (8192 microsteps), available on request.

Ordercode :   MC90-14-V7 for fast 11Bit (3nm)
MC90-14-V8 for highresolution 13Bit (0,7nm)

Take a look to the MC101-Closed loop driver with Step/Dir interface and our Piezomotor driven products. We integrated different own encodersystems with high resolution, nearly zero drift and smales warming.