Motion Controllers

PI micos

www.pimicos.com // info@pi-usa.us // 508.832.3456 East 949.679.9191 West // www.pi-usa.us

2.028 Controller overview

SMC-series

	Version	Form-Factor	Stepper Motor	DC-brushed Motor	DC-brushless Motor	Piezo-Motor	2-Phase Linear/Torque	3-Phase Linear/Torque	Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	SMC corvus	desktop 19" rack	■						yes / optional	RS-232 Ethernet TCP / IP GPIB	linear interpolation	2 or 3 (n x 3)	2.032
	SMC corvus eco	desktop	■						yes / optional	RS-232 USB	linear interpolation	2 or 3 (n x 3)	2.034
	SMC corvus pci	PCI-board	■						yes / optional	PCI-COM RS-232	Linear interpolation	2 or 3	2.036
	SMC pollux	desktop 19" chassis intelligent motor	■						yes / optional	RS 232 Ethernet TCP/IP USB-cable	point to point	1, daisy chain up to 16	2.038
	SMC hydra	desktop CM / TT 19" RM	■	■	■	■	■	■	yes / optional absolute encoder optional: 1Vpp and RS-422	RS-232 Ethernet TCP/IP	point to point linear interpolation	2	2.040
	SMC pegasus	SMC taurus: desktop SMC pegasus: 19" rack	■				■	■	yes / optional	RS-232	point to point	SMC taurus: 1 SMC pegasus: up to 256	2.042

SM-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	SM-32	PCI-board	■						no	PCI-bus	point to point	3	2.044

LMC-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	LMC-100	pocket / desktop		■	■			■	yes	RS-232 CAN-open	point to point	1	2.045

MoCo-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	MoCo DC	pocket / desktop		■					yes	RS 232 USB-cable	point to point	1, daisy chain up to 16	2.046

MMC-series

	Version	Form-Factor	Stepper Motor	DC-brushed Motor	DC-brushless Motor	Piezo-Motor	2-Phase Linear/Torque	3-Phase Linear/Torque	Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	MMC-100/110	desktop stackable				■			yes incremental RS-422 1Vpp *	USB	point to point	1, daisy chain up to 99	2.048

Piezo-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	PiCo 33 Piezo	desktop				■			no yes	RS-232 USB	point to point point to point	3 3	2.050
	PMA-100	desktop				■			no	PCI-Bus		1	2.051

DMC-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	DMC Controller	PC based PCI-Slot external 19"-chassis	■*	■*	■*	■*	■*	■*	yes	PCI-Bus Ethernet RS-232	Linear interpolation Circular interpolation Contouring independant	1..8	2.052

* in combination with MPA

Delta-Tau-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	Geobrick / Clipper	19" rackmount	■	■	■	■	■	■	yes RS-422 1Vpp	Ethernet USB RS-232	Linear interpolation Circular interpolation Contouring independant	4 / 8	2.054

FlexMotion-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	Flex Motion Controllers	PC based PCI / PXI Slot	■		■				yes	PCI/PXI-Bus	Linear interpolation Circular interpolation Contouring independant	2/4 2/4/6/8	2.056

Power Amplifiers

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	MPA	19" rack	■	■	■	■	■	■	DMC-series			1..8	2.058

Our SMC family of motion controllers is based on modern 32 bit technology which enables performances of stepper motor driven systems which haven´t been possible before. A so-called sin² acceleration offers very smooth acceleration and deceleration of the motors which allows highest performance positioning in the nanometer range. One of the big advantages of our SMC controllers is the possibility to drive the stages with extremly high resolution.

In Figure 1 you can see the measurement results of 100 nm steps driven with a PLS-85 stage with 2 phase stepper motor in open loop (without feedback of an encoder system). The stage is moving these steps with high precision. Driving the stage with 25 nm steps (Figure 2) it is obvious that the step width shows more variations, but in average the value is about 25 ± 5 nm. Positioning in the nm range is normally done with piezo drivers. But even with a standard linear stage like PLS-85 and our SMC-controllers it is possible to push the stage in the nm range. In Figure 3 you can see the result of programmed 10 nm steps measured by an interferometer. The stage is not moving in equal 10 nm steps, but the average motion is in this range. The measurement is limited by the 5 nm resolution of the interferometer. This amazing resolution is not possible with any other typical stage.

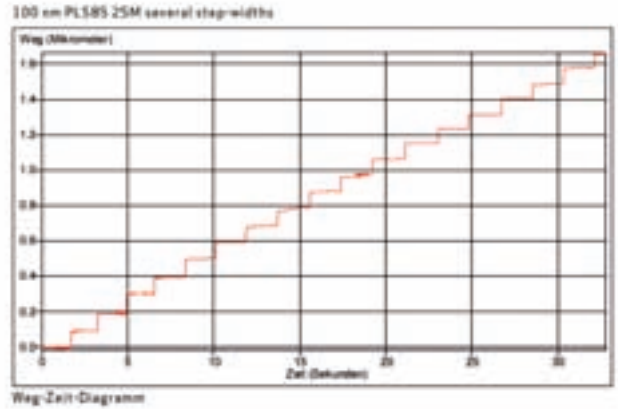

Figure 1: PLS-85, 2 SM open loop, resolution with 100 nm steps

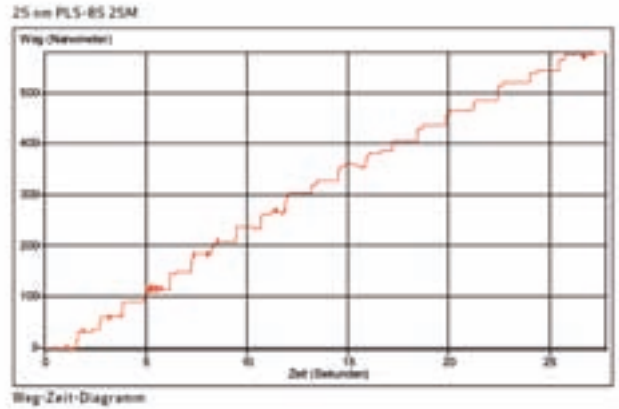

Figure 2: PLS-85, 2 SM open loop, resolution with 25 nm steps

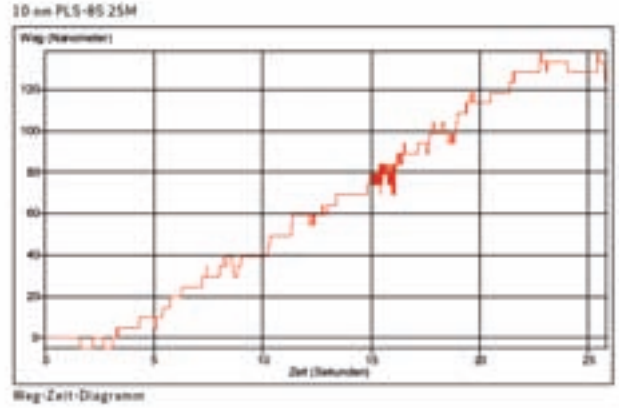

Figure 3: PLS-85, 2 SM open loop, resolution with 10 nm steps

For example, our VT-80 stage can be “positioned” with 100 nm steps (figure 4) but the result is not visible in defined levels and constant step width which is mainly due to the fine pitch leadscrew.

On the other hand the results of a PLS-85 stage shown in Figure 1-3 can be improved by driving the stage in closed loop. One of the advantages of our SMC-controllers is the intelligent control of the stage by using the 1 Vpp interface of a high resolution scale. Figure 5 shows the measurement of a LS-110 stage with a linear scale. The resolution of 50 nm is visible in well defined moving steps. Even changing the load does not disturb the stage positioning. The resolution is limited by the scale system, so using a 2 nm scale enables resolutions of 2 nm which can be influenced by environmental disturbances like temperature drift (for example, a change of 0.01 degree in the temperature is resulting in a stage expansion of about 10 nm).

For these type of applications we designed our ultra-precision stages UPM-160 and NPE-200 or customized granite based setups using Heidenhain Zerodur scales.

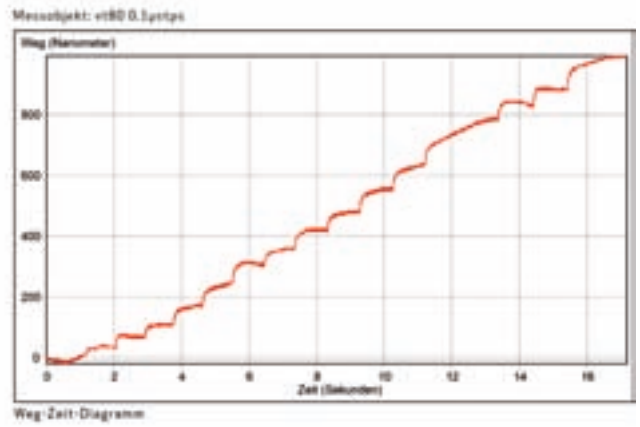

Figure 4: VT-80, 2 SM open loop, resolution with 100 nm steps

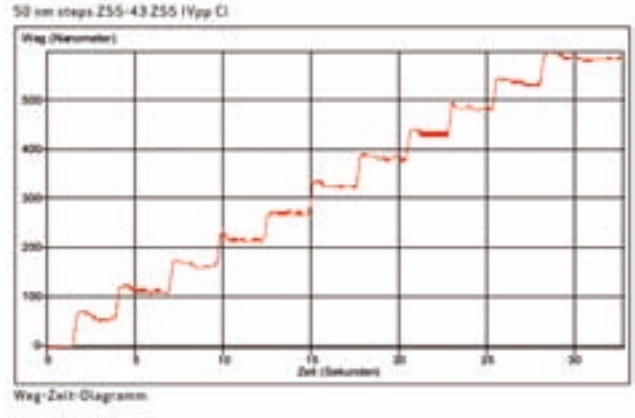

Figure 5: LS-110, 2 SM closed loop 1 Vpp, resolution with 50 nm steps

Speed is one important parameter for setting up a system. Often the maximum speed is required but for other applications it is very important to drive very slow and smooth. Standard stepper motor controllers cannot drive smooth. Even DC servo motors are not able to drive in the low velocity range in a linear and smooth way.

Figure 6 shows the measurement of a PLS-85 stage with linear scale (with a 10 nm encoder resolution).
The speed was set to 100 nm/s, so the stage traveled 360 µm within one hour, or about 10 mm per day. The movement is very smooth.
Figure 7 shows the first 100 nm of the travel.
Here it is important to realize that the interferometer resolution is 5 nm which results in the step-wise diagram. These steps are not coming from the stage. The movement is much smoother. It is very important to understand that the speed is linear and variations are in the 1 nm/s range which is exceptional for a loaded stage with several mm travel range. The results can be also improved by using a better encoder resolution. The result of a UPM-160 stage controlled with 45 nm/s speed is shown in Figure 8. The 450 nm move within 10 seconds is very linear. The interferometer resolution is limiting the interpretation of the picometer-per-second scale.

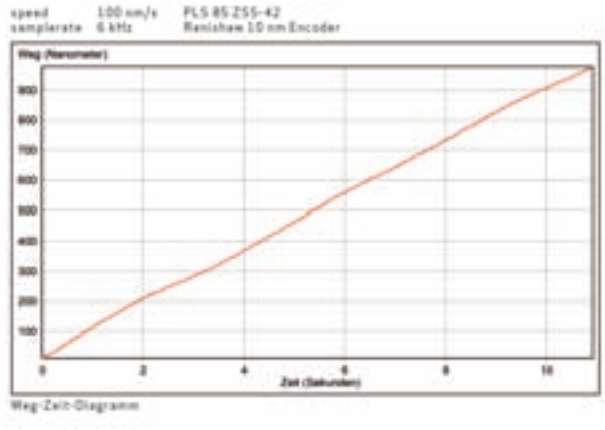

Figure 6: PLS-85, 2 SM closed loop, speed with 100 nm/s

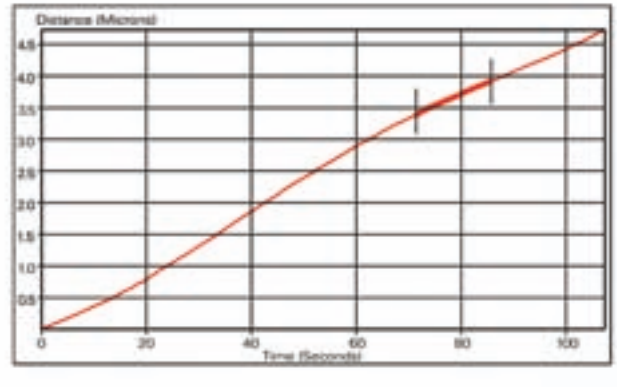

Figure 7: PLS-85, 2 SM closed loop, speed with 100 nm/s

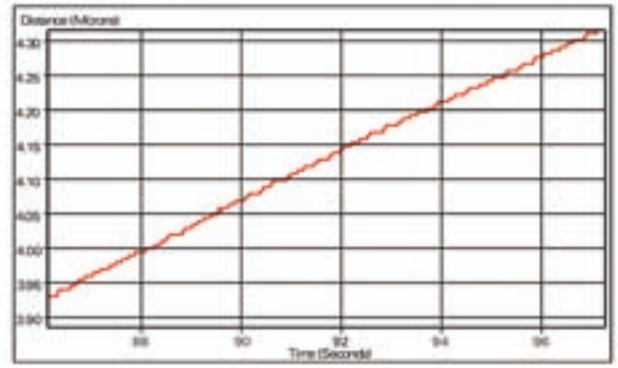

Figure 8: UPM-160, 2 SM open loop, speed with 45 nm/s

Positioning accuracy is normally limited by the quality of the bearings and drive mechanism, so for example errors in the leadscrew pitch are resulting in a positioning error. Figure 9 shows the deviation of the position between desired and measured position. Within a travel range of 100 mm the LS-180 stage has a positioning error of about 32 µm. The measurement shows both travel directions, so that the bidirectional repeatability, which depends on the backlash, can be seen with a value of 1.78 µm.

For some applications it is important to improve the absolute positioning, whereas the bidirectional repeatability is not important. The problem can be solved by using the deviation measurement for a position correction inside the SMC controller (see position correction option in SMC Corvus). The result is presented in Figure 10 which looks crowded at a deviation scale of 3 µm. The deviation is minimized by a factor of 10, eliminating the slope grading. This is a cost effective method to minimize system positioning errors.
By using a linear scale system, the repeatability and accuracy can be further improved.

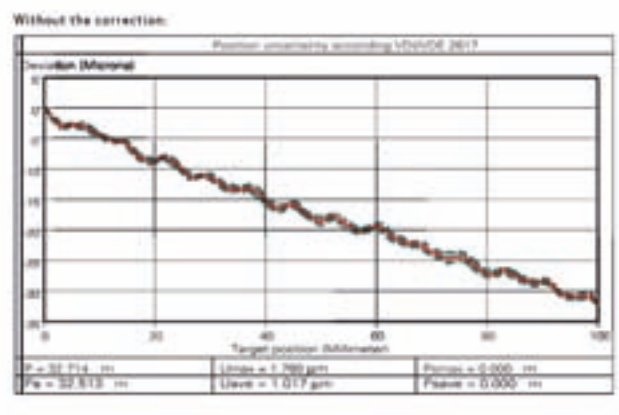

Figure 9: LS-180, 2 SM open loop, positioning error

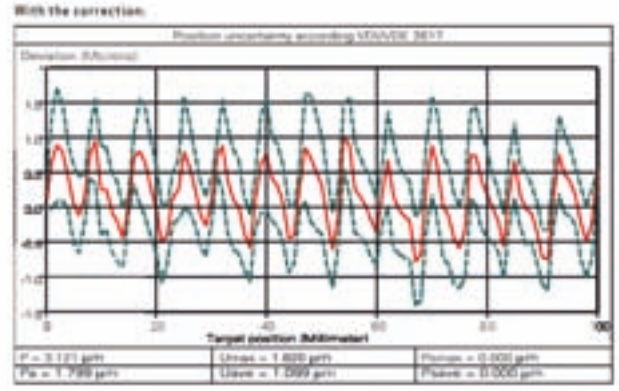

Figure 10: LS-180, 2 SM open loop, position corrected

Pocket Box Controller / Motor & Controller System

KEY FEATURES

- Single axis microstep controller system
- Stand alone system, or with integrated 2-phase stepper motor
- High resolution microstep
- Up to 16 SMC pollux can be combined with only one RS-232 interface
- DSP controller type
- Velocity range <0.1 µm/s... 40 rev/s (200 step motor)
- Serial interface RS-232 19200 Baud
- Venus 2 compatible string based command language
- Windows™ user interface
- 24 VDC power supply (external)
- Synchron motion start commands
- Speed mode
- Closed-loop 1 Vpp interface, optional for NT series
- Mixed configurations (open-loop / closed-loop) possible with NT series
- LabVIEW™ VIs
- Windows DLL and open source project available
- 3 types with different torques / velocities available

TECHNICAL DATA

Axes	1 axis, 2 phase stepper motors
Computer interface	RS-232 19.2 kBaud
Commands	Venus-2 ASCII
Supply voltage	24 VDC
Phase currents	<= 1.2 A/phase
Limit switches	2 per axis software configurable
Velocity range	For 200 step motor <0.1 µm/s .. 13 rev/s TYPE I <0.1 µm/s .. 25 rev/s TYPE II <0.1 µm/s .. 50 rev/s TYPE III
Max. resolution	300 000 positions/rev.
Max linear resolution	1 nm
Program and parameter	Flash memory
Amplifier	24 V bipolar 2 phase, with short-circuit & temperature protection
Version with integrated 2-Phase stepper motor	
Motor torque	160 mNm (Type I) 160 mNm (Type II) 320 mNm (Type III) 900 mNm (Type II HT)
Housing	Pocket desktop (without motor), or motor/controller HxWxD 48x56x97 mm (additional motor shaft 20 mm)
	19" chassis SMC-pollux integration box: 3HE 84TE chassis with 90..230 VAC power
Software Interface	Windows demo program SMC_Pollux DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

Pollux box controller

Pollux motor & controller

Pollux multiaxis desktop

Pollux accessories

The Pollux-Chassis 19 includes power-supply (90-230VAC), RS-232 interface, interlock input, power-mains, netfilter/fuse

7160-9-			

Pocket Box Controller Closed Loop

SMC pollux 16 Axes 19" 4H 84T

Motor & Controller System with VT-80, see page 4.112

SMC pollux network (2-axes), DIN rail

Order No. 7145-9	
Number axes (1..8 axes)	n
Amplifier DC-brush 2 A	0
Amplifier DC-brush 5 A	1
Amplifier 2SM microstep 24 V 2 A	3
Amplifier 3-Phase brushless 24 V 5 A	4
Amplifier DC brush 12 V 1 A	5
Amplifier 3-Phase linear/torque motor	6
Amplifier Piezo-Motor Driver (PMA-100)	7
Interface to NI Flexmotion Controller	0
Interface to DMC PCI controller	1
Interface to DMC Ethernet/RS-232 Controller	2
Interface to Delta-Tau PMac Controller	3
Interface to Delta-Tau UMac Controller	4
Interface to others	9
12 VDC 100 W	0
24 VDC 150 W	1
24 VDC 220 W	2
48 VDC 220 W	3
others	9

USA (East) & CANADA

PI (Physik Instrumente) L.P.
16 Albert St.
Auburn, MA 01501
Tel: +1 (508) 832 3456
Fax: +1 (508) 832 0506
Email: info@pi-usa.us
www.pi-usa.us

USA (West) & MEXICO

PI (Physik Instrumente) L.P.
5420 Trabuco Rd., Suite 100
Irvine, CA 92620
Tel: +1 (949) 679 9191
Fax: +1 (949) 679 9292
Email: info@pi-usa.us
www.pi-usa.us

GERMANY

Headquarters:
PI miCos GmbH
Freiburger Strasse 30
D-79427 Eschbach
GERMANY

Phone: +49 7634 50 57 0
Fax: +49 7634 50 57 393
e-mail: info@pimicos.com
home: www.pimicos.com

Physik Instrumente (PI) GmbH & Co. KG
Auf der Römerstraße 1
76228 Karlsruhe/Palmbach
Tel: +49 (721) 4846-0
Fax: +49 (721) 4846-1019
Email: info@pi.ws
www.pi.ws

Call Us Today

508.832.3456 (East)

949.679.9191 (West)

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