










Motion Controllers

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: 1 Vpp 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	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
	SM-32	PCI-board	■						no	PCI-bus	point to point	3	2.044

LMC-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
	LMC-100	pocket / desktop		■	■			■	yes	RS-232 CAN-open	point to point	1	2.045


MoCo-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
	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

Piezo-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
	PMA-100	desktop			■			no	PCI-Bus		1	2.051

DMC-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	
													

*in combination with MPA

Delta-Tau-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	
													

FlexMotion-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	
													

Power Amplifiers

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

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MPA POWER AMPL.

SOFTWARE

2.030 SMC Technical information

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 \sin^2 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 extremely 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.

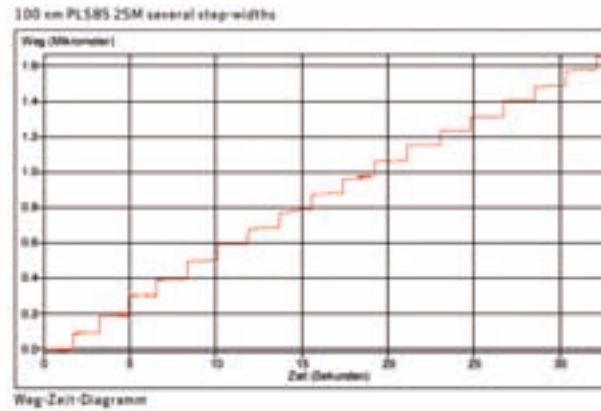


Figure 1: PLS-85, 2 SM open loop, resolution with 100 nm steps

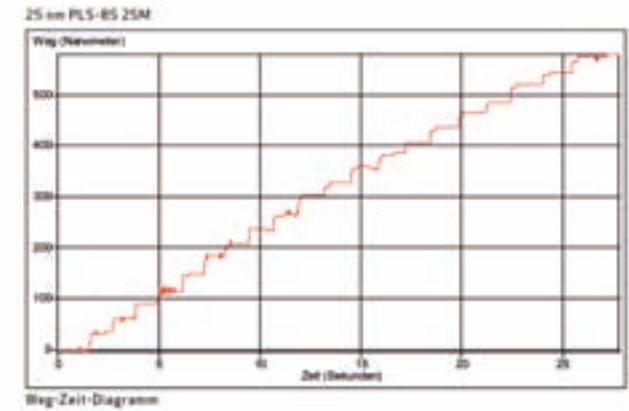


Figure 2: PLS-85, 2 SM open loop, resolution with 25 nm steps

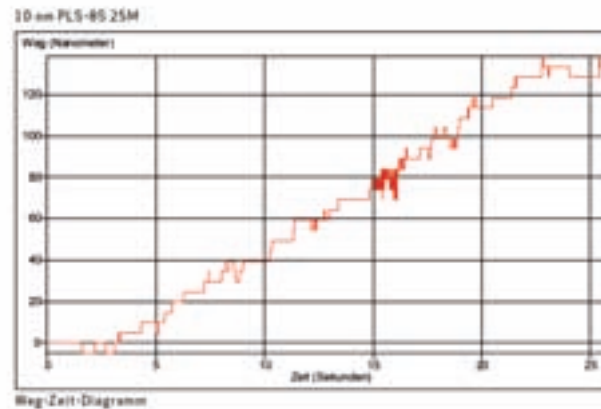


Figure 3: PLS-85, 2 SM open loop, resolution with 10 nm steps

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- SMC hydra
- SMC pegasus
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- MoCo DC
- MMC-100/110
- PiCo 33 Piezo
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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.

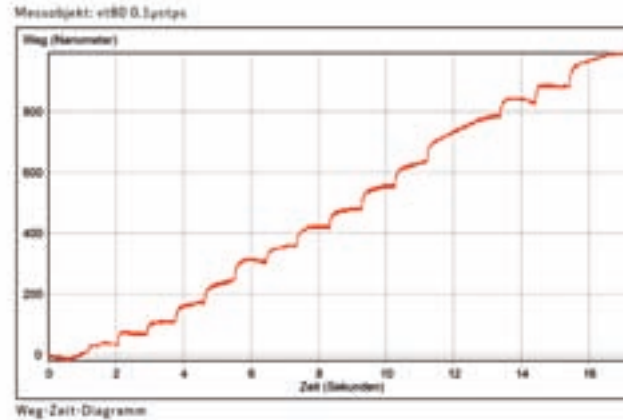


Figure 4: VT-80, 2 SM open loop, resolution with 100 nm steps

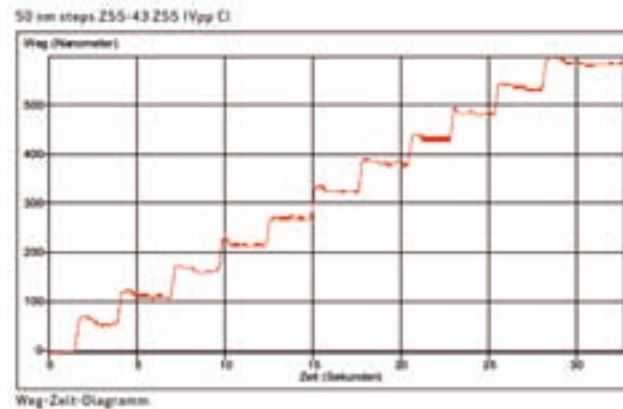


Figure 5: LS-110, 2 SM closed loop 1 Vpp, resolution with 50 nm steps

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.

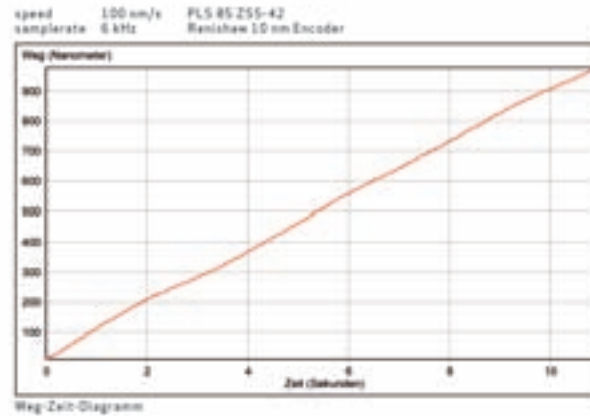


Figure 6: PLS-85, 2 SM closed loop, speed with 100 nm/s

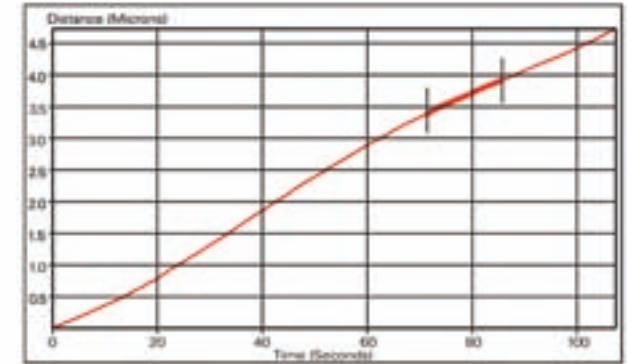


Figure 7: PLS-85, 2 SM closed loop, speed with 100 nm/s

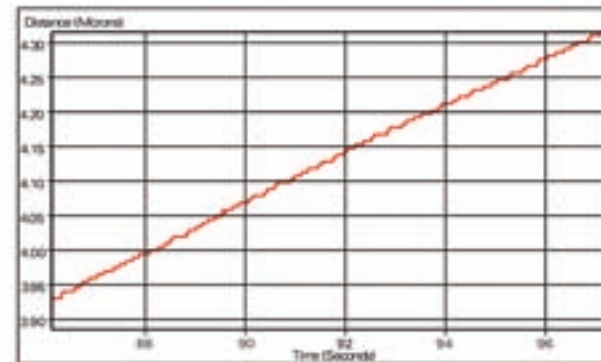


Figure 8: UPM-160, 2 SM open loop, speed with 45 nm/s

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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.

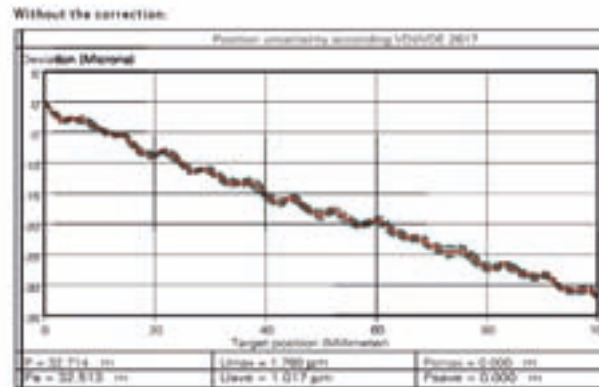


Figure 9: LS-180, 2 SM open loop, positioning error

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.

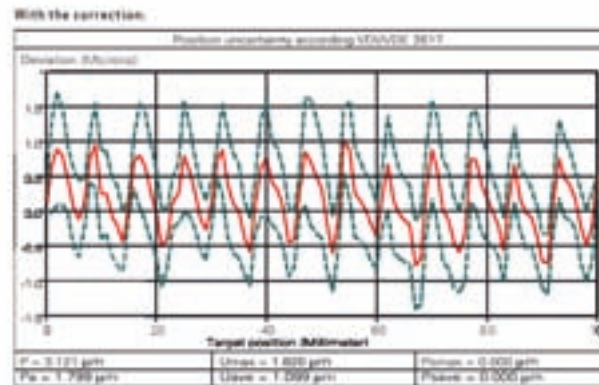


Figure 10: LS-180, 2 SM open loop, position corrected



Rack 19" 2HE



Joystick (optional)

KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 48 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 $\mu\text{m/s}$... 45 rev/s (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & \sin^2 acceleration
- Position compare output ≤ 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input
- Serial interface RS-232 upto 115.6 Kbaud
- Ethernet interface 10Base TCP/IP
- GPIB (IEEE-488) interface
- Venus-1 compatible string based command language

TECHNICAL DATA

Axes	2 or 3 axes 2 phase stepper motors
Computer interface	RS-232 up to 115.2 kBaud, optional: Ethernet 10Mbit
Commands	Venus-1 ASCII
Supply voltage	90-250 VAC 50-60 Hz
Cooler	Integrated
Power configuration	Desktop 50W standard, max. 100W 2/3 axes 19" 2 HE rackmount, max. 240W 2/3 axes 19" 2 HE rackmount, max. 500W 2/3 axes
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range	<0.1 $\mu\text{m/s}$.. 45 rev/s (200 step motor)
Program and parameter	Flash memory
Diagnostics	LED at the front with 2 user LEDs, acoustic messages with integrated buzzer
Amplifier	48V bipolar 2 Phase, with short-circuit & temperature protection
Phase-current	max. 2.5 - 3 A
Housing	Desktop HxBxT 70x240x305 mm
Software interface	Windows demo program WINPOS-light DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and Demoapplication

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- Flex Controllers
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SMC corvus

2 axes SMC corvus microstep controller 48 V 50 W with RS-232	001
2 axes SMC corvus NET microstep controller 48 V 50 W with RS-232 and Ethernet TCP/IP	003
3 axes SMC corvus microstep controller 48 V 50 W with RS-232	002
3 axes SMC corvus NET microstep controller 48 V 50 W with RS-232 and Ethernet TCP/IP	004

SMC corvus options

Power amplifier	Power amplifier 100 W (desktop/2HE/3HE)	101
	Power amplifier 150 W (2HE/3HE)	102
	Power amplifier 240 W (2HE/3HE)	103
	Power amplifier 500 W (3HE)	104
19" 84TE Rackmount	19" 84TE rackmount 19" 2HE	121
	19" 84TE rackmount 19" 3HE	122
Closed-loop	For quadrature encoders RS422 per axis	115
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	116
Joystick	2 axes	106
	3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	Digital I/O	112
	3 x inputs (5- 24V) 3 x outputs (5- 24V) with position compare trigger output and position capture functionality	
StPCor	static position correction (incl. stage measurement) per axis	118
SMC corvus GPIB	GPIB (IEEE-488) interface	123
Winpos	Full version software	124
Brake logic	Brake logic for one axis and power output (24V 0.4A)	125
Emergency stop	Emergency stop button with interface and cable l=3 m	128

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Front Panel



Back Panel



Front Panel

KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 24 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 μm/s... 15 rev/s (standard) 25 rev/s (with speed upgrade) (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & sin² acceleration
- Position compare output = 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input or integrated 2/3 axes joystick
- Serial interface RS-232 115 KBaud
- USB interface
- Venus-1 compatible string based command language

TECHNICAL DATA

Axes	2 or 3 axes 2 phase stepper motors
Computer Interface	RS-232 up to 115.2 kBaud USB interface
Commands	
Supply voltage	90-250 VAC 50-60 Hz
Power supply	24 VDC 40 W
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range standard	<0.1 μm/s .. 15 rev/s (200 step motor) <0.1 μm/s .. 25 rev/s (200 step motor) speed upgrade
Program and parameter	Flash memory
Amplifier	24 V bipolar 2 phase, with short-circuit & temperature protection
Phase current	Max. 1.5 A
Housing	Desktop 65x225x216 mm [HxWxD]
Software interface	Windows demo program WINPOS DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application



Back Panel with joystick

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SMC hydra

SMC pegasus

SM-32

LMC-100

MoCo DC

MMC-100/110

PiCo 33 Piezo

PMA-100

DMC Controller

Geobrick / Clipper

Flex Motion Controllers

MPA

SMC corvus eco

2 axes SMC corvus eco microstep controller	006
3 axes SMC corvus eco microstep controller	007
2 axes SMC corvus eco microstep controller & joystick	008
3 axes SMC corvus eco microstep controller & joystick	009

SMC corvus eco options

Speed upgrade	Max speed 25 rev/s (200 step motor)	204
Closed-loop	For quadrature encoders RS422 per axis	201
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	202
Joystick	External 2 axes	106
	External 3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	3 x inputs (5- 24 V) 3 x outputs (5- 24 V) with position compare trigger output and position capture functionality	203
StPCor	static position correction (incl. stage measurement) per axis	118
Winpos	Full version software	124
Emergency stop	Emergency stop button with interface and cable l=3	128

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KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 24 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 $\mu\text{m/s}$... 15 rev/s (standard) 25 rev/s (with speed upgrade) (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & \sin^2 acceleration
- Position compare output = 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input or integrated 2/3 axes Joystick
- Serial interface RS-232 115 Kbaud
- USB interface
- Venus-1 compatible string based command language
- 12 V PC
- PCI plug-in board with onboard microstepping power amplifiers
- Motor power 12 V (PC power supply), or optional external 24 V power supply
- Communication via PCI-Com-bridge, assures software compatibility to SMC corvus and SMC corvus eco



Joystick

TECHNICAL DATA

Axes	3 axes 2 phase stepper motors
Computer interface	pci-COM bridge 115.2 Kbaud
Commands	Venus-1 ASCII
Supply voltage	12 V PC or external up to 24 V DC
Power configuration	12 V PC, max. 30 W 2/3 axes 24 V external, max. 30 W 2/3 axes
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range	<0.1 $\mu\text{m/s}$.. 15 rev/s (200 step motor) <0.1 $\mu\text{m/s}$.. 25 rev/s (200 step motor) speed upgrade
Program and parameter	Flash memory
Amplifier	12 V..24 V bipolar 2 Phase, with short-circuit & temperature protection
Phase current	Max. 1.5 A
Housing	Pci slot HxB 99x184 mm
Software interface	Windows demo program WINPOS DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

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SMC corvus pci

2 axes SMC corvus pci microstep controller	002
3 axes SMC corvus pci microstep controller	001

SMC corvus pci options

Speed upgrade	Max speed 25 rev/s (200 step motor)	113
Closed-loop	For quadrature encoders RS422 per axis	115
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	116
Joystick	2 axes	106
	3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	3 x inputs (5- 24V) 3 x outputs (5- 24V) with position compare and position capture functionality	112
StPCor	static position correction (incl. stage measurement) per axis	118
Winpos	Full version software	124
Emergency stop	Emergency stop button with interface and cable l = 3 m	128
ext. power supply	24V DC/60 W	126
Joystick	Interface SMCpci	105

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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 <math><0.1 \mu\text{m/s}</math>... 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 $<0.1 \mu\text{m/s} \dots 13 \text{ rev/s}$ TYPE I $<0.1 \mu\text{m/s} \dots 25 \text{ rev/s}$ TYPE II $<0.1 \mu\text{m/s} \dots 50 \text{ rev/s}$ 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

Type I	511
Type II	512
NT-Type I	516
NT-Type II	517
NT-closed loop 1Vpp Type I	514
NT-closed loop 1Vpp Type II	515
Type I OEM	518
NT-Type I OEM	519

Pollux motor & controller

Type I (160 mNm)	501
Type II (160 mNm)	502
Type III (320 mNm)	503
Type II HT (900 mNm)	504

Pollux multiaxis desktop

Pollux 6 axis desktop	557
Pollux 3 axis desktop TCP/IP	558
Pollux 4 axis desktop TCP/IP	559
Pollux NT 3 axis desktop closed-loop	564

Pollux accessories

Interfacing	RS-232 cable RJ45-RJ45, 0.5 m length to combine 2 pollux controller	524
	RS-232 cable DSub9-RJ45, 2 m length for PC connection	520
	Ethernet TCP/IP Interface DIN-Rail	545
Power supply	60 W, 90-264 VAC	522
Mounting	DIN rail mounting-kit	530
Modular chassis	4 Axes chassis 19" 3HE 84TE	550
	8 Axes chassis 19" 3HE 84TE	551
	12 Axes chassis 19" 3HE 84TE	552
	16 Axes chassis 19" 4HE 84TE	553
	CL 4 Axes chassis 19" 3HE 84TE	554
	CL 6 Axes chassis 19" 3HE 84TE	555
	CL 8 Axes chassis 19" 4HE 84TE	556
Ethernet TCP/IP Interface for pollux chassis	544	

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



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

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MoCo DC

MMC-100/110

PiCo 33 Piezo

PMA-100

DMC Controller

Geobrick / Clipper

Flex Motion Controllers

MPA

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SMC hydra CM



SMC hydra CM

KEY FEATURES

- 2 axes motion controller
- High resolution microstep amplifier for DC brush, 2-phase stepper, 2- and 3-phase linear / torque motors (BLDC), 4-phase piezo motor
- Motor type software configurable (except piezo motor)
- 24 V / 48 V bus-voltage up to 500 W
- Motorola power PC with 760 Mips
- Closed-loop with absolute encoder (multiturn)
- Closed-loop with incremental encoder 1Vpp or RS-422
- Encoder based trigger output
- Position capture input
- Linear interpolation
- Ethernet 10/100 MBit
- RS-232 up to 115.2 kbaud
- VENUS-3 compatible string based command language
- Handwheel (Can-Bus)
- Joystick (Can-Bus)
- Linear 4 Phase Piezo Amplifier (no PWM, for electrical noise sensitive applications)

Available soon:

- Digital IO expansion (Can-Bus)

TECHNICAL DATA	
Axes	2
Computer interface	Ethernet 10/100 MBit ; RS-232 interface 115.2 kBaud
Commands	Venus-3 ASCII
Motortypes	Stepper, linear and torque motors 1, 2 and 3 phase and piezo motors, up to 10 A phase current Servo motors up to 200 W
Input / output	6x inputs, optically isolated, 5-24 V 1x input for emergency (optically isolated) 4x 10 bit analog outputs 1x open drain output (100mA) fast trigger output 400 kHz / trigger input (10 kHz)
Memory	Parameter & program 8 MByte
Operating system	Realtime
Encoder Interface	1Vpp 12 bit sin-cos interpolator 150 kHz RS-422 quadrature 16 MHz
Trigger-out / capture-in	Position compare output max. 400 kHz Position capture input max 10 kHz 4M captures (only available with Delta-Star interface)
Operation	Open loop and closed-loop PID standard or PID adaptive
Amplifier principle	Digital MOS-FET, galvanically isolated, 24 / 48 V Analog, galvanically isolated, 48 V 1A
Power supply	Hydra CM : 24 VDC 48 V 360 Watt (optional) Hydra TT : 90-260 VAC 300 Watt Hydra RM: 90-260 VAC 1000 Watt

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CAN-Joystick



SMC hydra TT rear



Special motor with absolute encoder



CAN-handwheel

SMC hydra

2 Axes SMC hydra CM Motion Controller 24 V	600
2 Axes SMC hydra TT Motion Controller 24 V	601
2 Axes SMC hydra TT Motion Controller 48 V	602
2 Axes SMC hydra CM Motion Controller 48 V	603
4 Axes SMC Hydra RM 19" Motion Controller 24V	604
4 Axes SMC Hydra RM 19" Motion Controller 48V	605
2 Axes SMC hydra CM piezo	606
2 Axes SMC hydra TT piezo	607

SMC hydra options

Motors	2SM with absolute encoder & gearbox 5 Nm	610
	2SM with absolute encoder & gearbox 12 Nm	611
	Motor cable for motor with absolute encoder	620
Power supply	CM power supply 24 V 60 W	627
	CM Power supply 24 V 120 W	626
	CM Power supply 48 V 120 W	625
Closed-loop	Encoder interface Delta-Star 1Vpp & RS-422 (with trigger out and capture in)	631
	Encoder interface Delta-Star Eco 1Vpp & RS-422 (without trigger)	632
Manual device	CAN-joystick 2 axes	633
	CAN-handwheel 2 axes	636
Trigger out capture in	Trigger cable Mini-HDMI-DB9	634
	Trigger cable Mini-HDMI-BNC	635

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SMC pegasus 19" chassis

KEY FEATURES

- Analog joystick port
- Manual handwheel port
- SPS in-/outputs
- Limit switch inputs
- Enable input
- Potential-free emergency contacts
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- RS-232 interface
- ASCII command-set VENUS-2
- Windows™ user-interface
- Programming interface (32-bit DLL) with examples (sourcecode)

TECHNICAL DATA

Axes	1 to 32
Computer interface	RS-232 19.2 KBaud
Commands	Venus-2 ASCII
Amplifier voltage	48 VDC
Phase currents	1.5 / 2 / 5 / 10 A/phase
Limit switches	2 per axis, software configurable
Velocity range	< 0.1 μm/s .. 37.5 rev/s (2 step motor) < 0.1 μm/s .. 500 mm/s (linear motor)
Program and parameter	Flash memory
Amplifier	48 V, bipolar 2-phase stepper, 2-phase linear / torque motor, 3-phase linear / torque motor with short-circuit & temperature protection
Housing	19" 84TE 4 HE
Software interface	Windows™ demo program SMC pegasus DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

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SMC pegasus

19" 4HE rackmount, 240 W	304
19" 4HE rackmount, 500 W	305
19" 4HE rackmount, 1000 W	306
Com module RS-232/CAN	311
Axis module 1.5 A	312
Axis module 2.5 A	313
Axis module 5 A	314
Axis module 10 A	315

SMC pegasus options

Closed-loop RS422 for interpolated encoders 5 V RS422	120
Closed-loop 1 Vss with integrated interpolator 12-bit	121
Handwheel for one axis	122
CAN bus extension	320

ordering as follows:

1x SMC pegasus 19" 3HE rackmount, 300 W	304
1x SMC Com-module RS-232/CAN	311
1x SMC pegasus axis module 1.5 A	312
1x SMC pegasus axis module 2.5 A	313
1x SMC pegasus axis module 10 A	315
2x SMC pegasus closed-loop 1Vpp with integrated interpolator	121
1x SMC taurus, 100 W	321
1x closed-loop 1 Vss with integrated interpolator 12-bit	121

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KEY FEATURES

- 3 axes microstep controller system
- Microsteps down to 1/64 (software configuration)
- PCI plug-in board with onboard microstepping power amplifiers
- Motor power 12 V (PC power supply)
- Fast PCI slot communication
- 36 W max. power, 1.8 A per axis
- 32 bit step counter
- Trajectory generation with on board processor
- DLLs for all Windows™ versions, DOS, Linux
- Trajectory mode
- Point to point, trapezoidal and 3 axes contouring (PvT mode)
- Programming examples for VC5, VB5, Delphi, visual studio, LabVIEW™

Available soon:

- PCI Express (a new PCI slot standard)
- Desktop with USB interface
- continues path control

SM-32 pci

3 axes pci microstep controller 001

SM-32 accessories

Cable splitting 3 axes PI miCos DB9f (SMC compatible) l=0.4 m 010

Cable splitting 3 axes PI miCos HD15f l=3 m 011

Others interfaces on request.

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TECHNICAL DATA

Axes	3 axes 2 phase bipolar stepper motors
Computer interface	Pci port
Supply voltage	12 V PC
Power configuration	36 W max. power, 1.8 A per axis
Limit switches	2 per axis, software configurable
Trajectory mode	Point to point
Frequency	Up to 16 kHz in full-step
Program	Flash memory
Amplifier	12 V
Connector	DB25 female
Form factor	Pci slot: 110 x 18 mm
Software interface	Windows demo program SM32 DLLs, demo applications (DOS/C/Delphi/VB) LabVIEW™ VIs and demo application



LMC-100 Front

KEY FEATURES

- Single axis servo controller for brush DC-motors, 3 phase brushless DC-motors, linear and torque motors
- RS-232 interface for 1 axis, CANopen for multi axes applications
- SimplIQ programming language, extensive mnemonic command set
- onboard programming, event triggered with subroutines
- Single axis point to point
- Servo-mode current, velocity and position
- Advanced filtering and gain scheduling
- RS-422 encoder feedback (up to 20 MHz)
- 1 Vpp encoder feedback with internal interpolation up to x4096 max. 250 kHz
- 2 limit-switch inputs
- 1 analog input 14 bit
- 2 free digital inputs, 2 digital power outputs
- Position compare (trigger out) & position capture

LMC-100 Controller

LMC-100 controller 2.5A	001
LMC-100 controller OEM 2.5A	002
LMC-100 controller 5A	003
LMC-100 controller OEM 5A	004

Accessories

Power supply	24V DC 65W 2.7A , 90-264 VAC	100
	24V DC 120W 5A , 90-264 VAC	101
Interfacing	Daisy chain gateway RS-232-CAN	110
	USB-CAN interface	111

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TECHNICAL DATA

Axes	1 axis RS-232 , up to 127 with CANopen
Computer interface	RS-232, CANBUS (CANopen DS402, DS305)
Commands	Simply IQ ASCII
Supply voltage	12..24 VDC
Motor current	cont. 2.5A, peak 5A / cont. 5A, peak 10A
Limit switches	2, npn / pnp type 5..24 VDC
Digital input	2, npn / pnp type 5.. 24 VDC
Digital output	2 x 12..24 V DC 0.5 A open collector
Analog output	1 x 14 bit +/- 10V DC
Encoder interface	RS-422 max 20 MHz 1Vpp x 4096 interpolation max-250 kHz emulated encoder output RS-422
Program and parameter	Flash memory
Amplifier	PWM 22 kHz
Position / speed / current-loop	4 kHz / 8 kHz / 16 kHz
Housing	desktop / OEM-PCB
Software interface	Windows setup and configuration tool Automatic and manual tuning, analysis and debugging WINDOWS DLL

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Desktop Single Axis

KEY FEATURES

- Single axis DC controller system
- Cost effective, stand alone controller
- Up to 16 MoCo DC can be combined with only one RS-232 interface
- LM629 servo controller for simultaneous control of position, velocity, acceleration and torque
- Position compare output (≤ 1 kHz)
- With PID filtering
- PWM control of motor current for high efficiency
- Up to 3 A continuous current and up to 24 V motor supply
- Serial interface RS-232
- On-board control language with over 50 commands
- 24 VDC power supply (external)
- LabVIEW™ VIs

TECHNICAL DATA

Axes	1 axis, DC motors brushed types
Computer interface	RS-232 up to 38.4k
Commands	ASCII 2 letter mnemonic
Supply voltage	24 VDC
Motor current	< 3 A
Limit switches	Positive and negative limit switch input, optically isolated, wide voltage range
Position counter	32-bit position control 2 000 000 000 steps in each direction with software adjustment endless motion possible
Program and parameter	EEPROM for permanent storage of motion parameters and programs
Amplifier	PWM control of motor current for high efficiency
Closed-loop	Single-ended or diff. encoder inputs, up to 1 MHz, index capability
Status display	Large, two-digit LED for command address and error code display
Housing	Pocket-desktop
Inputs	4, pnp optoisolated
Outputs	4, open-collector 0.5 A 24 VDC
Analog inputs	4, open-collector 0.5 A 24 VDC
Analog output	1, 0-5 V 8bit resolution
Option	-Break output -Manual control -Open frame version
Software interface	LabVIEW™ VIs and demo application



Screenshots MoCo VIs for LabVIEW™

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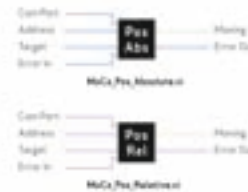
MoCo dc controller

MoCo dc pocket desktop controller 021

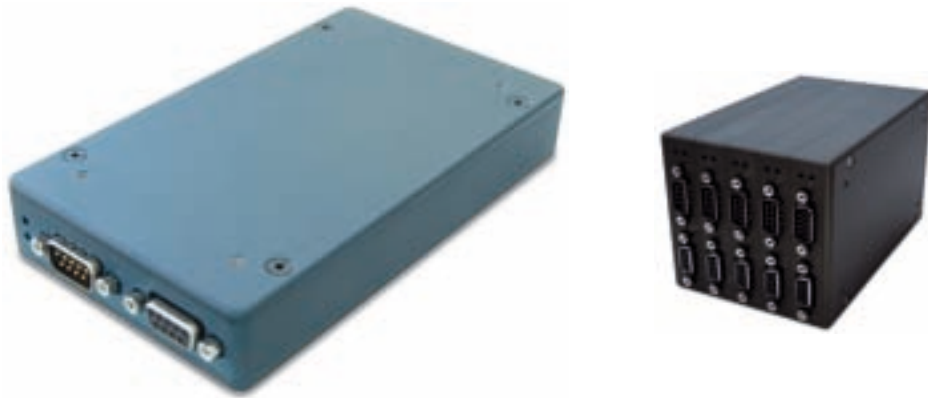
MoCo dc accessories

Power supply 002

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Some examples of MoCo VIs for LabView(TM)



MMC100/110

KEY FEATURES

- Integrated controller / driver for PI miCos stick-slip piezo motors
- Compact, modular design allows for bench-top or standard 2U height rack mounting
- Configurable as a standalone unit or stackable up to 99 axes
- Open-loop / closed-loop operation
- Open-loop resolution of less than 1 nm
- Closed-loop resolution dependent on the encoder (typically 5 nm)
- A quad B differential encoder feedback
- USB interface (one interface for up to 99 axes)
- Windows™ GUI, DLL and LabVIEW™ VI

TECHNICAL DATA

Number of axes	1 (stackable upto 99)	
Motor type	Stick-slip motors 1 and 2 Phase	
Computer interface	USB 2.0 compliant	
Commands	ASCII-commands	
Trajectory mode	Trapezoidal velocity profile	
Resolution open-loop	<1nm	
Resolution closed-loop	MMC-100 5 nm	MMC-110 <1 nm
Velocity	MMC-100 <=2-3 mm/s	MMC-110 > 10 mm/s
Servo clock	10 kHz	
Trajectory update	1 kHz	
Power supply	Regulated 5V DC (1A per module/axis)	
Enclosure dimensions	145x85x25 mm	
Software interface	MMC-100 MCP, DLL, LabVIEW™ VI's	

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MMC-100 controller

MMC-100 1 axis , USB, 15 W power supply	0110
MMC-100 2 axes , USB, 15 W power supply	0210
MMC-100 3 axes , USB, 15 W power supply	0310
MMC-100 4 axes , USB, 36 W power supply	0420
MMC-100 5 axes , USB, 36 W power supply	0520
MMC-100 6 axes , USB, 36 W power supply	0620

MMC-110 controller

MMC-110 1 axis , USB, 15 W power supply	1110
MMC-110 2 axes , USB, 15 W power supply	1210
MMC-110 3 axes , USB, 15 W power supply	1310
MMC-110 4 axes , USB, 36 W power supply	1420
MMC-110 5 axes , USB, 36 W power supply	1520
MMC-110 6 axes , USB, 36 W power supply	1620

MMC-100/110 accessories

Closed-Loop RS422 interface per axis	0001
--------------------------------------	------

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KEY FEATURES

- Special design for piezo driven step motor
- Manual control by keypads, or via RS-232
- Works with batteries or external power supply
- Operates with up to 3 axes
- Customized designs
- USB-interface optionally (see Piezo RS-232)

PiCo piezo controller

PiCo 33 piezo controller RS 232	001
PiCo 33 Piezo controller USB	003
PiCo 33 Piezo controller USB closed-loop	011

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TECHNICAL DATA

	PiCo 33 RS-232	PiCo 33 USB	PiCo 33 USB Closed Loop
Power supply	Batterie AC adapter worldwide	USB interface	AC adapter worldwide
Operation mode local	Keyboard		
Computer interface	RS-232-interface	USB 1.1 Interface	USB 2.0 interface
Connections, motor output	RS-232-interface DB9m, 3 axis DB9f	USB B 3 axis DB9f	USB B 3 x MMCX per axis
Speed modes	"Fast" "Slow" ("Fast"/2) "Single step"	0...1000 (0..1.0 mm/s)	0...255 (0..1 mm/s)
Data rate	19200 baud		
Compatibility	for DOS, Win 95, Win 2000, Win XP and Win NT executable software with action buttons DLL with sourcecode Vb, C and Delphi		
Mass	340 gr	150 gr	470 gr
Dimensions	157 x 99 x 39 mm	118 x 86 x 26 mm	124 x 170 x 55 mm
Delivery includes	RS-232 connecting cable	USB cable	USB cable
		AC adapter worldwide	AC adapter worldwide
	Battery		



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Geobrick / Clipper

Flex Motion Controllers

MPA

KEY FEATURES

- Single axis piezo motor (inertial or stick-slip) driver
- Interfaces directly with a stepper motor controller
- Standard pulse and direction interface
- Typical open loop step resolution of 1.5 nm
- Typical maximum velocity of 2-3 mm/s
- No setup or adjustments required
- Universal power supply included

PMA-100

PMA-100 standard

001

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TECHNICAL DATA

Motor type	1phase piezo ceramic motors inertial or stick-slip
Bus voltage	5 VDC (36 V internally)
Control signal	Clock/direction (TTL or open-collector)
Typical step size	1.5 nm (This value varies depending on the stage type, load size and a number of other mechanical factors)
Maximum velocity	About 2-3 mm/s (depends mainly on the piezo motor characteristics)



DMC Ethernet / RS-232

KEY FEATURES

- 62.5 μ s (250 μ s) microsecond per axes servo update rate
- Up to 8 axes of motion control
- Controls servo motors, step motors, and hydraulics
- Maximum encoder input rate up to 22 MHz (Accelera)
- Non-volatile program memory
- Multitasking of four independent programs
- Modes of motion: jogging, point to point positioning, linear and circular interpolation, electronic gearing and cam, and contouring
- Optoisolated inputs for home, abort, limits (except pci low cost)
- Digital I/O and analog inputs
- High speed position capture
- High speed encoder compare output
- Programmable event triggers (trip points)
- I/O functions and timers for executing PLC tasks
- Easy programming language plus software tools for quick start-up and tuning
- Contour mode for profiling along computer generated paths such as parabolic or spherical profiles
- Error handling including programmable software limits, automatic error shut-off, amplifier enable, user-defined error subroutines, and watchdog timer

Possible configurations

	DMC pci-eco	DMC pci-accelera	DMC Ethernet / RS-232
Form factor	PCI card	PCI card	19" card
Communication interface	PCI bus	PCI bus	Ethernet & RS-232
Number of axes	1..4	1..4	1..8
Max encoder frequency	12 MHz	22 MHz	12 MHz
Servo update rate	1-2 axis 250 μ s 3-4 axis 374 μ s	1-2 axis 62 μ s 7-8 axis 187 μ s	1-2 axis 250 μ s 7-8 axis 625 μ s
Digital inputs	8 TTL	8..16 optically isolated	8..16 optically isolated
Digital output	8..16 TTL	8..16 TTL	8 Highside driver 8 TTL (5..8 axes)
Analog inputs	no	8	no, optional
Dual encoder	no	yes	yes

TECHNICAL DATA

Axes	1-8 axes per card, pci-eco 1-4 axes
Computer interface	PCI-bus / Ethernet / RS-232
Commands	ASCII 2 letter mnemonic
Position range	\pm 2,147,483,647 counts/move; automatic rollover;
Acceleration/deceleration	1,024 to 67,107,840 counts/sec ² mm
Motor command signal	+/-10 V 16-bits, Clock/Dir
Step motor control mode	Full, half, or microstep
Encoder Interface	RS-422
Analog inputs	8, \pm 10 V; 12-bit resolution (16-bit optional)
Dedicated inputs per axes	Forward and reverse limits, high-speed position latch, home.
Dedicated outputs per axes	Analog motor command, pulse and direction, amplifier enable, encoder output compare.
Software Interface	Plug and Play: utilities for all Windows™ versions .net libraries and DLL, Linux, demo applications C and LabVIEW™ VIs



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Order No.	7110-9-	0		
DMC pci-eco (1..4 axes)		2		
DMC pci-accelera (1..8 axes)		3		
DMC Ethernet/RS-232 (1..8 axes)		4		
DMC Ethernet/USB (1..8 axes)		5		
number axes		n		

PI miCos MPA Power Amplifier Systems, see page 2.060



MC geobrick lv 8 axes control & amp

KEY FEATURES

- 4 or 8 axes of simultaneous control (0.1 ms update time)
- 80 MHz CPU optional 240 MHz
- Ethernet TCP/IP, USB and RS-232 communication interface
- All axes independent or coordinated in any combination
- Multitasking of up to 256 motion and 64 asynchronous PLC programs
- Easy-to-use, high-level programming language
- Linear, circular, rapid, B-spline, Hermite-spline interpolation modes
- True S-curve accel/decel for jerk-limited profiles
- Dynamic multi-move lookahead for robust acceleration control
- Coordinate system translation and rotation, 2D and 3D
- Embedded forward and inverse kinematics routines for Non-Cartesian geometries (PI miCos Hexapod series and PI miCos SpaceFAB series)
- Hardware position capture and compare circuits for high precision
- Windows™ PEWin User-Interface

TECHNICAL DATA

	MC clipper LD DC	MC geobrick LV DC
Axes	4 / 8	
Computer interface	Ethernet TCP/IP 100Mbit, USB-2.0, RS-232	
Supply voltage	90-250 VAC 50-60 Hz	
Power configuration	100 W	240W (others available see options)
Limit switches	2 x npn normally closed	2 x npn/pnp normally closed
Encoder interface	RS-422	RS-422 & 1Vpp x 4096 interpolator
Trajectory mode	Linear, circular, rapid, B-spline, Hermite-spline interpolation modes	
Digital inputs		16 optocoupler npn/pnp 12-24 VDC
Digital outputs		8 highside/lowside 0.5A outputs
Position range	32 bit	
Amplifier	linear amplifier (no PWM)	direct digital PWM
Program and parameter	flash memory, 256 motion programs and 64 PLC's	
Motor current	0.5 A continues	5 A continues 15 A peak
CPU type	DSP 80 MHz / 240 MHz	
Housing	19" 2HE	19" 4HE

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MC clipper LD 8 axes control board

Delta-Tau controller

MC-Clipper LD 80MHz 8 axes DC-brush controller	001
MC-Clipper LD 80MHz 4 axes DC-brush controller	002
MC-Clipper LD 240MHz 8 axes DC-brush controller	011
MC-Geobrick LV 80MHz 8 axes DC-brush controller	101
MC-Geobrick LV 80MHz 4 axes DC-brush controller	102
MC-Geobrick LV 240MHz 8 axes DC-brush controller	111

MC-Geobrick offers many custom made version with mixed motor configurations, please consult PI miCos for a detailed offer.

Delta-Tau accessories

Geobrick LV 1Vpp x 4096 Interface 4 axes
Geobrick LV Absolute Encoder Interface 4 axes (EnDat 2.2 or BISS_C) to be defined at ordering time
Geobrick LV Analog Input 8 channel, 12 Bit +/-10V
Geobrick LV IO expansion 8 outputs 16 inputs
Geobrick LV bus voltage 24 VDC 500W
Geobrick LV bus voltage 48 VDC 500W
Geobrick LV bus voltage 48 VDC 1000W
Hexpod inverse and forward kinematics (model dependent)
Spacefab inverse and forward kinematics (model dependent)

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MC-clipper LD:

- build-in linear servo brush amplifiers (no PWM) Icont. < 0.5A per axis
- 12 VDC power-supply 30 W

MC-geobrick LV:

- build-in direct digital PWM amplifiers for DC-brush, 2Phase stepper, 3Phase BLDC, 3 phase linear and torque motors
- I cont. 5A, I peak 15 A per axis
- 24 VDC power-supply 240 W, 16 digital inputs, 8 digital outputs

Optional:

- analog inputs 8 x 12 bit ± 10 VDC
- additional 16 digital inputs / 8 outputs
- 1Vpp sin-cos encoder interpolator x 4096
- Absolute encoder interface (Endat/BISS)
- 24/48 VDC power supply 500 W or 1000 W



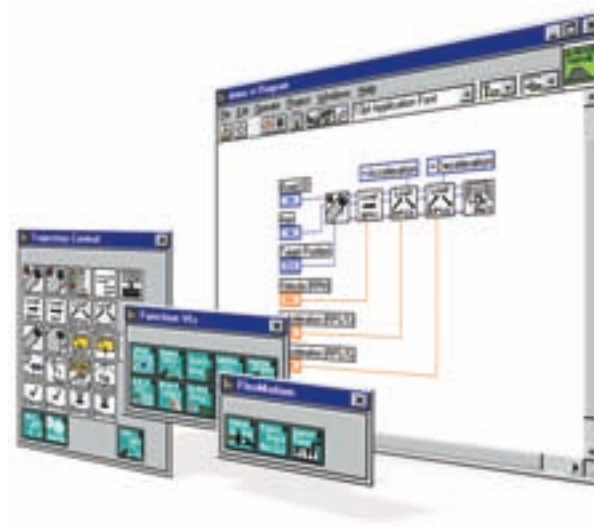
FlexMotion pci

KEY FEATURES

- Stepper / Servo 4/8-axes controller (National Instruments)
- Real-time CPU, onboard multitasking real-time operating system, DSP
- Closed-loop control
- 62 μs PID loop update rate
- Quadrature encoder or analog feedback
- 32 digital I/O lines, 4 analog inputs / outputs
- High speed position capture inputs
- Modes of motion: point-to-point positioning, multi axes vector space control, linear, circular, spherical and helical interpolation, jogging, electronic gearing
- Blended-motion profiles
- National Instruments RTSI bus for synchronizing motion and measurement
- Software: NI-MAX, NI motion, DLLs (for Windows programming), C/C++ libraries, VIs (for LabVIEW™, LabWindows/CVI™)

TECHNICAL DATA

	NI-735x	NI-734x
Axes	2 / 4 / 6 / 8	2 / 4
Computer interface	PCI / PXI bus	
Limit switches	2 x software configurable	
Encoder interface	RS-422, max. 20 MHz	
Trajectory mode	Linear, circular, spherical, helical interpolation	
Digital IO	4 ports 8 bit TTL SW configurable	
Analog inputs	4 x 12 bit ±10V	4 / 8 x 12 bit ±10V
Position range	32 bit	
Motor command signal	±10 V 16-bits and Clock/Dir	
Servo control mode	PID, PIVff, s-curve, dual loop	



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High Performance Controller 735x series

NI pci-7352, 2-axes servo / step controller	440-02
NI pxi-7352, 2-axes servo / step controller	540-02
NI pci-7354, 4-axes servo / step controller	440-04
NI pxi-7354, 4-axes servo / step controller	540-04
NI pci-7356, 6-axes servo / step controller	440-06
NI pxi-7356, 6-axes servo / step controller	540-06
NI pci-7358, 8-axes servo / step controller	440-08
NI pxi-7358, 8-axes servo / step controller	540-08

Mid-Range Controller 734x series

NI pci-7342, 2 axes servo / step controller	916-02
NI pci-7344, 4 axes servo / step controller	916-04

778xxx-

NI pxi-7344, 4 axes servo / step controller:
order no.: 777935-01

Accessories:
Cable SH68-C68-S 68-Pin VHDCI to 68-Pin, D-Type, 2 m:
order no: 186381-02



Possible configurations (number of axes in a 19" chassis 3HE or 4HE)

Amplifier	Type 0	Type 1	Type 3	Type 4	Type 6	Type 7
Interface 0	1-4	1-4	1-6	1-4	1-6	1-8
Interface 1	1-8	1-4	1-8	1-4	1-6	1-8
Interface 2	1-8	1-6	1-8	1-4	1-6	1-8
Interface 3	1-8	1-6	1-8	1-4	1-6	1-8
Interface 4	1-8	1-64	1-8	1-4	1-6	1-8

TECHNICAL DATA

Amplifier	Type 0	Type 1	Type 3	Type 4	Type 6	Type 7 (see PMA-100)
Motor type	DC Brush	DC Brush	2Phase Stepper	DC Brushless	3 Phase linear & torque motors	1 Phase Piezo-Ceramic motors
Amplifier principle	4Q-Linear current/torque control	4Q-PWM 50 kHz current/torque control	PWM current control micro-stepping x250	4Q-PWM 50 kHz current/torque control	4Q-PWM 22 kHz current/torque control	micro-stepping
Bus voltage	11-30 VDC	11-70 VDC	11-42 VDC	11-70 VDC	11-48 VDC	5 VDC (36 V internally)
Continuous current	2 A	5 A	2 A	5 A	5 A	
Peak current	3 A	10 A		10 A	10 A	
Control signal	±10 VDC	±10 VDC	clock/direction	±10 VDC	±10 VDC	clock/direction

- APPLICATIONS
- CONTROLLERS**
- ROBOTICS
- LINEAR STAGES
- ROTATION STAGES
- PIEZO STAGES
- MANUAL STAGES
- ACCESSORIES
- APPENDIX

- SMC-SERIES
- Technical Info
- SMC corvus
- SMC corvus eco
- SMC corvus pci
- SMC pollux
- SMC hydra
- SMC pegasus
- SM-32
- LMC-100
- MoCo DC
- MMC-100/110
- PiCo 33 Piezo
- PMA-100
- DMC Controller
- Geobrick / Clipper
- Flex Motion Controllers
- MPA**

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)

