



# MAXp

## Intelligent 8-Axis Motion Controller for

### FEATURES

- **PID update rate of 122 ms on all 8 axes**  
Delivers exceptional servo control on multi-axis applications. Identical outcomes when utilizing one or all axes of motion. Configurable PID filter with feedforward coefficients.
- **266 MHz, 32-bit RISC processor**  
Updates all signals and data points providing superior application control. An order of magnitude faster than our competition.
- **64k Shared Memory**  
Permits rapid data transfer to & from controller. Large size accommodates expandability to unique and custom applications.
- **PCI Universal Bus - 3.3 or 5.0 volts**  
PCI Rev 2.2 compliant. Compatible with current and future PCI bus computers.
- **Memory**  
8 Mb System Memory.
- **Controller capabilities**  
4 Channels of general purpose Analog Input, with 16 bit, 0-10 VDC input
- **Motion Feedback**  
Support Quadrature Encoder Feed back up to 8 MHz.
- **Sophisticated Control Functionality**  
16 bit DAC analog resolution. Step pulses from 0 to 4,176,000 steps per second (+/- 0 steps). Backlash compensation. Custom, Parabolic, "S"-curve & Linear trajectory profiles. Real time encoder position capture. S-Curve with 4-quadrant jerk parameters.
- **Control signals**  
Opto-isolated Digital I/O. High density shielded 120 pin connector

#### Additional Features

- All communication via Device Driver and Driver Support DLL.
- Dual Port RAM is utilized
- PCI 33 MHz Target Device
- Independent and coordinated motion of all axes.
- Slip & Stall detection with encoder feedback.
- Patented technology to minimize torque ripple and velocity modulation.
- Many control signals are opto-isolated.
- Independent home, positive and negative over-travel inputs.
- Non-volatile macro storage, parameter storage.
- 120 Pin I/O Breakout Module
- Field upgradable firmware
- Firmware upgrades and enhancements
- Customizable solutions available for your requirements
- Example programs and application code provided
- Web page support for downloading software and documentation
- All OMS controls are 100% burned-in, tested and quality inspected
- Person to person toll-free tech support - call 800-707-8111

## **DESCRIPTION**

The MAXp is a full length PCI bus motion controller that conforms to the PCI Local Bus specification, rev 2.2. The MAXp is capable of up to 8-axis of control of which each axis can be configured as an open loop Stepper, a closed loop Stepper, or a Servo axis.

The MAXp is powered by a PowerPC processor. This high performance processor provides a 64-bit Floating Point processor and is clocked at 264MHz. This provides the MAX with the pure processing power to update every signal of the controller, i.e. I/O bits, direction, limits, etc., at rates of 122µs.

The MAXp supports 16 general purpose digital I/O signals which are opto-isolated for optimum noise immunity. The home and overtravel inputs are also Opto-isolated. In addition it has four general purpose Analog inputs that can be used to sense Pressure Transducers, Dial Switches, etc. These analog inputs have 16-bit of resolution with 0-10 VDC input.

Each Axis has servo output signal capability; configured as a +/- 10V or 0-10V signal and is driven by a 16-bit DAC. The servo control loop is a PID filter with feedforward coefficients and an update rate of 122µs. The step pulse is a TTL level, 50% duty cycle square wave that supports velocities of 0 through 4,176,00 pulses per second. Encoder feedback functionality supports quadrature encoders up to 8 MHz and is used as the servo feedback, as feedback for the stepper axes or as independent position feedback. Encoder feedback is also used to provide slip and or stall detection. Every axis includes dedicated +/- Overtravel inputs, a Home input, and an Auxiliary output. The MAXp is available in several different models that support a different number of Axes.

## **PROGRAMMING**

MAXp motion controllers are easily programmed with ASCII character commands through an extensive command structure. These commands are combined into character strings to create sophisticated motion profiles with features of I/O and other functionality. A separate FIFO command queue for each axis is used to store the commands once they are parsed by the MAXp. The commands are executed sequentially, allowing the host to send a complex command sequence and attend to other tasks while the MAXp manages the motion process. These command queues store 800 command values and include a command loop counter which allows multiple executions of any command string.

All commands are sent to the controller as two or three character ASCII strings. Some of these commands expect one or more numerical operands to follow. These commands are identified with a '#' after the command. The '#' indicates a signed integer input parameter or a signed fixed point number of the format ##.# when user units are enabled. User Units define, distances, velocity and

acceleration parameters and may be inputted in inches, millimeters, revolutions, etc.

Synchronized moves may be made by entering the AA or AM command mode. This form of the command performs a context switch that allows entering commands of the format

MRx#,y#,z#,t#; u#, v#, r#, s#;

Numbers are entered for each axis commanded to move. An axis may be skipped by entering the comma with no parameter. The command may be prematurely terminated with a ";", i.e. a move requiring only the X and Y axes would use the command MRx#,y#; followed by the GO command. Each axis programmed to move will start together upon executing the GO command. The MAXp can be switched back to the independent-axis mode by entering the desired single axis command such as AX.

## **PROGRAMMING EXAMPLES**

In a typical move requirement where it is desired to home the stage then move to a specified position, the following will demonstrate the programming for a single axis:

- Initialize the velocity and acceleration parameters to a suitable value. Set a PID filter gain values. Perform the home operation initializing the position counter to zero. Perform a motion to an absolute position of 10,000 and set the done flag for that axis when the move is finished.

The following would be input from the host computer:

```
AX
VL5000 AC50000
KP20 KI1 KD45 HN
HM0
MA10000 GO ID
```

In a move requiring a three axis coordinated move to a select position the following commands could be used:

```
AM
VL5000,5000,5000;
AC50000,50000,50000;
MT1000,2000,3000; GO ID
```

The controller would calculate the relative velocities required to perform a straight line move from the current position to the desired absolute position so that all axes arrive at their destinations at the same time.

The following demonstrates cutting a hole with a 10,000 count radius using constant velocity contouring and circular interpolation:

- The contouring velocity is set to 1000 counts per second. A contour is defined beginning at coordinates 0,0 on the Z and T axes.

- Auxiliary output on the X axis is turned on, which could turn on the cutting torch or laser starting the cut at the center of the circle.
- A half circle is cut from the center to the outside of the hole positioning the cutting tool at the start of the hole.
- The hole is then cut, the torch turned off, the stage stopped and the contour definition completed.
- The stage is then positioned and the contour definition executed.

The following would be input from the host computer:

```
AA
CV1000; CD,,0,0; AN0;
CR0,5000,-3.1415926;
CR0,0,-6.2831853;
AF0; MT-10,10000;
CE
MT,,-1000,0; GO
CX
```

## **SPECIFICATIONS**

### **Velocity**

0 to 4,176,000 pulses per second simultaneous on each axis

### **Acceleration**

0 to 8,000,000 pulses per second per second

### **Position range**

128,000,000 pulses ( $\pm 67,000,000$ )

### **Accuracy**

Position accuracy and repeatability  $\pm 0$  counts for point to point moves

Velocity accuracy  $\pm 0.01\%$  of peak velocity in jog mode.

### **Environmental**

Operating temperature range: 0 to 50 degrees centigrade

Storage temperature range: -20 to 85 degrees centigrade

Humidity: 0 to 90% non-condensing

### **Power**

+5VDC  $\pm 5\%$  at 1 amp typical  
 +3.3VDC  $\pm 0.3\%$  at amps typical  
 +12VDC at 0.1 amp typical =  $\pm 5\%$   
 -12VDC at 0.1 amp typical =  $\pm 10\%$

### **Dimensions**

12.283" x 4.200" x 0.475"  
 312 mm x 106mm x 12.06 mm

### **Communication Interface**

Meets all signal specifications for PCI bus specifications Rev. 2.2.

### **Limit switch inputs**

Opto-isolated TTL input levels (Opto, max 50mA). Input sense (low or high true) selectable by command input for each axis.

### **Connector**

Single HI Density Shielded 120 Pin Connector for all motor control functions. Mating Connector and Strain Relief Hood. Separate 25 Pin DB25 Sub connector for all Digital I/O functions.

### **Home switch inputs**

Opto-isolated TTL input levels (Opto, max 50mA). Input sense (low or high true selectable by command input for each axis.

### **User definable I/O**

Up to 16 bits of user definable Digital I/O. All bits are opto-isolated. 16 bits are user configurable that are configure as 8 inputs and 8 outputs from the factory. The optocoupler is a Sharp PC3Q67Q with a maximum input forward current of 50mA and a maximum output emitter-collector voltage of 35V and 50mA collector current.

### **Analog outputs**

$\pm 10V$  and 0 to  $+10V$ , max. 1mA each..

### **Step pulse output**

Pulse width 50% duty cycle. Open collector TTL level signal (7406, max 48mA).

### **Direction output**

Open collector TTL level signal (7406, max 48mA).

### **Encoder Feedback**

Maximum 8 MHz after 4x quadrature detection. Differential TTL level signal (MC26C32, max 15mA)

### **Reference**

PCI specification, Rev. 2.2.  
 PCB mechanical specification, IEEE 1101.1, 1101.10 and P1101.11

### **Software**

High level expertise not required.

Over 200 ASCII character commands, expanded from current OMS command set.

Software drivers and DLLs for Windows<sup>®</sup> provided at no additional cost.

User Manual included

Servo Tuning Assistant software tools included at no additional cost.

Support software available for download at our web-site ([www.OMSmotion.com](http://www.OMSmotion.com))

**120-Pin CONTROL SIGNAL CONNECTOR (J2)**

Description	PIN	PIN	Description
Step- R	2	1	Step-S
Direction - R	4	3	Direction-S
Phase A +R	6	5	+5 VDC
Phase A - R	8	7	Phase A +S
Phase B +R	10	9	Phase A - S
Phase B - R	12	11	Phase B +S
Index +R	14	13	Phase B - S
Index - R	16	15	Index +S
T-Negative Limit	18	17	Index - S
Analog Input 2	20	19	Z-Negative Limit
Ground	22	21	T-Positive Limit
Analog Input 3	24	23	U-Positive Limit
Ground	26	25	V-Positive Limit
Analog Input 4	28	27	R-Positive Limit
U-Negative Limit	30	29	S-Positive Limit
Step- U	32	31	Step- V
Direction - U	34	32	Direction-V
+5 VDC	36	35	+5 VDC
Phase A +U	38	37	Phase A +V
Phase A - U	40	39	Phase A - V
Phase B +U	42	41	Phase B +V
Phase B - U	44	43	Phase B - V
Index +U	46	45	Index +V
Index - U	48	47	Index - V
Z-Positive Limit	50	49	X-Positive Limit
R-Servo	52	51	Y- Positive Limit
Ground	54	53	U-Home
S-Servo	56	55	V- Home
Ground	58	57	R-Home
Analog Input 1	60	59	S-Home

**120-Pin CONTROL SIGNAL CONNECTOR (J2)**

Description	PIN	PIN	Description
Step-Z	62	61	+5 VDC
Direction -Z	64	63	Step- T
Phase A +Z	66	65	Direction - T
Phase A - Z	68	67	Phase A +T
Phase B +Z	70	69	Phase A - T
Phase B - Z	72	71	Phase B+T
Index +Z	74	73	Phase B - T
Index - Z	76	75	Index +T
Y-Negative Limit	78	77	Index - T
T-Servo	80	79	X-Home
Ground	82	81	Y-Home
U-Servo	84	83	Z-Home
Ground	86	85	Auxiliary - V
V-Servo	88	87	Auxiliary - R
T-Home	90	89	Auxiliary - S
V-Negative Limit	92	91	Step -Y
R-Negative Limit	94	93	Direction -Y
S-Negative Limit	96	95	Step -X
Phase A +X	98	97	Direction -X
Phase A -X	100	99	Phase A + Y
Phase B +X	102	101	Phase A -Y
Phase B - X	104	103	Phase B +Y
Index +X	106	105	Phase B -Y
Index - X	108	107	Index + Y
X Negative Limit	110	109	Index - Y
X-Servo	112	111	Auxiliary - X
Ground	114	113	Auxiliary - Y
Y-Servo	116	115	Auxiliary - Z
Ground	118	117	Auxiliary - T
Z-Servo	120	119	Auxiliary - U

**25-Pin Digital I/O Connector (J5)**

Description	PIN	PIN	Description
Ground	1	2	I/O 8
I/O 0	3	4	I/O 9
I/O 1	5	6	+5 VDC
+5 VDC	7	8	I/O 10
I/O 2	9	10	I/O 11
I/O 3	11	12	+5 VDC
Ground	13	14	I/O 12
I/O 4	15	16	I/O 13
I/O 5	17	18	+5 VDC
+5 VDC	19	20	I/O 14
I/O 6	21	22	I/O 15
I/O 7	23	24	Ground
Ground	25	26	No Connect

**ORDERING INFORMATION**

Model	Computer Interface	Axes	Servo / Stepper	User I/O
MAXp-1000	Universal PCI	1	User Definable	17
MAXp-2000		2	User Definable	18
MAXp-3000		3	User Definable	19
MAXp-4000		4	User Definable	20
MAXp-5000		5	User Definable	21
MAXp-6000		6	User Definable	22
MAXp-7000		7	User Definable	23
MAXp-8000		8	User Definable	24

**ACCESSORIES**

IOMAX	I/O Breakout Board for MAXp (Without cable)
CBLMAXp25-6	I/O Cable for IOMAXp - 6 Foot
CBLMAXp25-10	I/O Cable for IOMAXp - 10 Foot
CBLMAX-3	3 ft cable w/mating connector, 120pin (MAXp)
CBLMAX-6	6 ft cable w/mating connector, 120pin (MAXp)
CDSWSUPP	DLL's and drivers for Win 2000/XP & NT
CDMAN	1 Manual & corresponding disk per shipment provided unless otherwise requested



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