Pro-Dex Oregon Micro Systems™

MAXv

Intelligent 8-Axis Motion Controller for VME Bus

FEATURES

PID update rate of 122 μs 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 feed forward coefficients.

266 MHz, 32-bit RISC processor

- Updates all signals and data points providing superior application control.

4032 Bytes of Dual Port RAM

- Permits rapid data transfer to & from controller.
- Large size accommodates expandability to unique and custom applications.

VME64 Specification

- The 160-pin P1/P2 connectors provide high density connectivity on the back plane.
- VME and VME64 compliant

Controller capabilities

- 6 Channels of general purpose analog input with 16 bit, +/-10 VDC input
- 2 Channels of general purpose analog output with 16-bit +/-10 VDC output.

Motion Feedback

- Support Quadrature Encoder Feed back up to 16 MHz on up to 10 encoder inputs.

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

- Two 68-pin SCSI3 and one 50-pin SCSI2 connectors for high density signal connection on the front panel.
- 16 “user definable” digital I/O.
- P2 connector is 160-pins and supports most of the signals available on the front panel.

ADDITIONAL FEATURES

- Consumes a single VME (6U) slot
- Interface port VME P1 and P2 supports both 96 Pin and 160 pin connectors.
- Supports A16, A24 and A32 Addressing modes.
- Non-Volatile Macro Storage
- VME64bus specification ISO/IEC 15776:2001(E).
- Motion parameters continuously available in shared RAM for real time profile status.
- Electronic “mailbox” in shared RAM for priority commands, i.e. abort
- Patented technology to minimize torque ripple and velocity modulation
- Internal Watchdog timer for safety
- Slip & Stall detection with encoder feedback
- Circular interpolation
- Constant velocity linear interpolation (all axes)
- Axis control signals are also on P1 & P2 connector.
- Output is +/-10V, or Step & Direction per Axis
- Independent home and plus / minus over-travel inputs for each axis
- Commands are intuitive for programming ease.
- Over 150 ASCII character commands, “universal” to current and previous OMS controllers
- Capable of conversion to “user” defined units i.e. inches/ revolutions if desired.
- Person to person toll-free tech support: 800-707-8111

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WEB SITE: www.pro-dex.com

DESCRIPTION

The MAXv family of Motion Controllers brings the Oregon Micro Systems, Inc. (OMS) intelligent motion control technology to a new level of servo applications as well as stepping motors. A much more powerful 266 MHz 32 Bit RISC processor (PowerPC) provides the capability and power for better and more sophisticated application control. This new generation of motion control products provides up to 8 axes of motion control on a single card to VME bus compatible computers. Each axis can be selected by the user to be an open or closed stepper or a high capability servo axis. In addition, independent analog inputs are provided to enable integration of analog parameters such as temperature, pressure, etc., under the control of the running application. Two additional encoder inputs are available for increased precision and control. Two additional general purpose analog outputs are available.

Outputs are provided for 16 bit analog servo output as well as step and direction for stepper system applications. The servo loop is a PID filter with feed-forward coefficients and an update rate of 122 μs on all 8 axes. Independent plus and minus limits, a home switch input, and an auxiliary output provided for each of the 8 axes so that the state of any of them can be monitored by the system at any time. An additional 16 User definable I/O is available for synchronization and control of other events. The voltage range of limit and home circuits has been extended for operation in the 3 to 30 VDC range. Incremental encoder feedback, differential or single ended, is used for all servo axes and is available for position feedback and may also be used for slip or stall detection. Electronic gearing is also available for tracking with another motor or manual input device, such as an independent encoder tracking.

The bus interface uses Shared Memory technology for communication of commands from the host and feedback of motion control parameters. Commands may be written to this Shared Memory by the host, eliminating the communication bottlenecks of single address port-based communications.

The MAXv uses the PowerPC's Message unit including the door-bell technology to alert and flag the host or the Controller. Interrupt control and other data are available through reserved storage regions in the common memory area. These include the interrupt vector, interrupt control and status done flag data, over travel and home switch status, Command Error, an ASCII Command and an ASCII Response Ring Buffer, slip flag for each axis as well as the user definable I/O. Some commands may be passed to the MAXv, by passing the communication channel using the mailbox system. These commands cause an immediate interrupt and may be used for critical commands such as abort. Each axis may perform individual unrelated moves or they can be coordinated as required by the application.

Simple two or three character ASCII commands may be easily sent to the board from any high level language, such as C, C++, or VB. Complex move sequences, time delays, and control of other external events may be programmed through the MAXv interface.

The MAXv controller supports two 68-pin and one 50-pin SCSI type connectors on the front panel as well as a 160-pin connector at P2 for back plane connections. The IOvMAX connection interface module provides an efficient means of connecting the MAXv signals to external devices. It includes two 68-pin connectors and one 50-pin connector, as well as a 100-pin connector that is backwards compatible with the VME58 front panel connector. All signals on this connector module are available on a 180 screw-terminal block.

PROGRAMMING

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

All commands are sent to the controller as two or three character strings. Some of these commands expect one or more numerical operands to follow. These commands are identified with"#" 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 represent the input in Inches, millimeters, revolution, 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 in 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 a comma {,} at the appropriate axis position, with no value parameter. The command may be prematurely terminated with a semicolon (;) i.e. a move requiring only the X and Y axes to move would use the command MRx#,y#; followed by the GO command. Each axis programmed to move will start together upon execution of the GO command. The MAXv can be switched back to independent-axis mode by entering the desire single axis command, such as AX.

PROGRAMMING EXAMPLES

In a typical move requirement where it is desired to home the stage and 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 the PID filter gain values. Perform the homing operation initializing the position counter to zero. Perform a motion to the absolute position of 10,000 and set the done flag for that axis when the move is finished.

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

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

```
AX;
KP2;
KD6;
HN;
AY;
KP2;
KD6;
HN;
AZ;
KP2;
KD6;
HN;
AM;
VL5000,5000,5000;
AC50000,50000,50000;
MA1000,2000,3000;
GO;
ID;
```

The controller would calculate the relative velocities required to perform a straight line move from the current position to the desired position.

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:

```
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

4,294,967,295 pulses (±2,147,483,647)

Accuracy

Position accuracy and repeatability ±0 counts for point to point moves

Velocity accuracy ±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 +/-5% at 1 amp typical
+12VDC at 0.1 amp typical = +/-5%
-12VDC at 0.1 amp typical = +/-10%

Dimensions

6.4” x 9.2” x 0.7”

Limit switch inputs

Input levels 3-30 VDC Input sense (low or high true) selectable by command input for each axis.

Connector

On the front panel there are two shielded 68-Pin SCSI3 connectors for all motor control and one 50-Pin SCSI2 connector for I/O signal. On the back plane interconnect there is a 160-pin P2 connector.

Home switch inputs

Input levels 3-30 VDC 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. The 16 bits are user configurable and are configured as 8 inputs and 8 outputs as defaults from the factory.

Analog outputs (servo)

+/-10V and 0 to +10V, max. One per axis plus two general purposes.

Step pulse output

Pulse width 50% duty cycle. Open collector level signal (TTL).

Direction output

Open collector level signal (TTL).

Encoder feedback

Maximum 16 MHz after 4x quadrature detection.
Differential signal.

Reference

VME64bus Specification ISO/IEC 15776:2001(E)
VME64x Specification ANSI/VITA 1.1-1997

Software

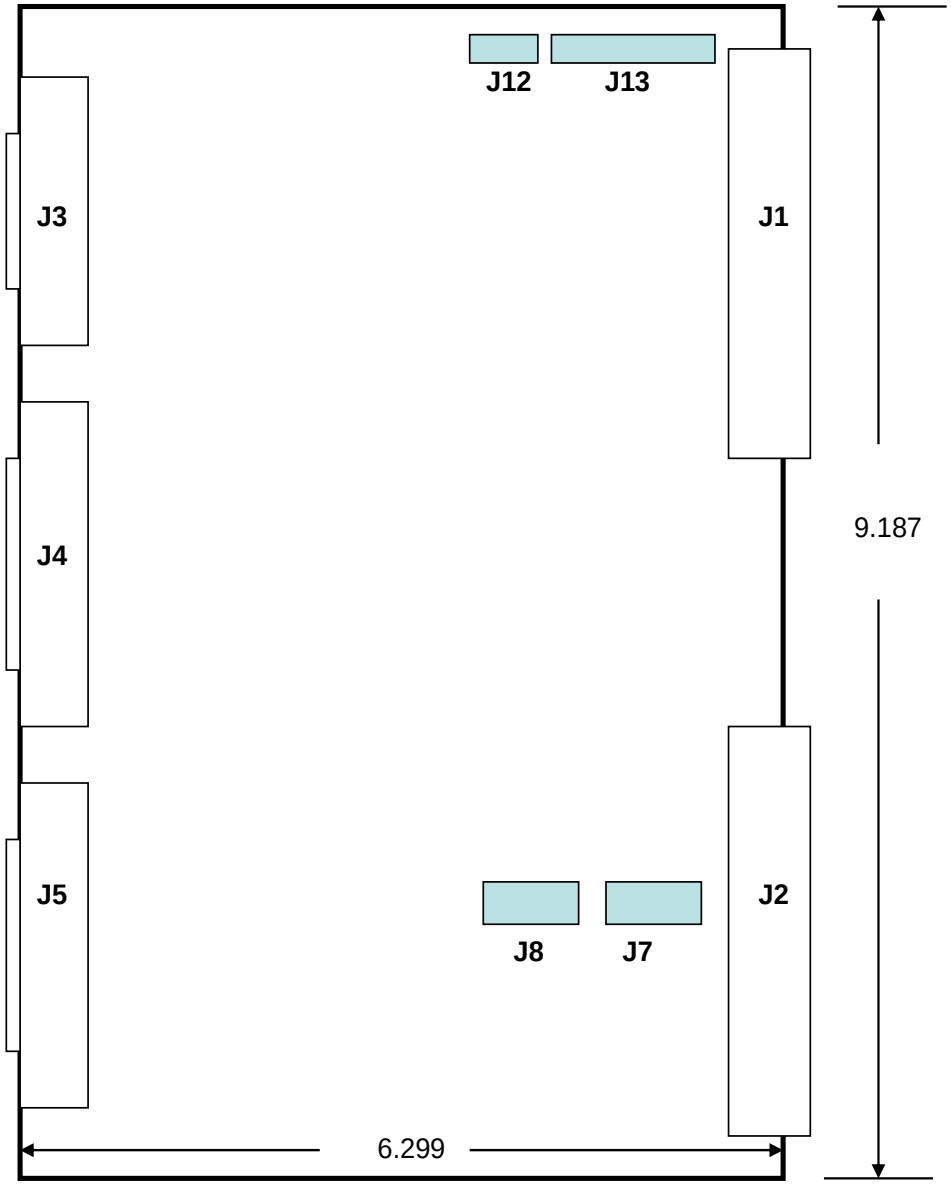
High level expertise not required.
Over 150 ASCII character commands, expanded from current OMS command set.
User Manual included.

J12 = IRQ and Address Mode

J13 = Address and Address Modifier

J7 = P2 I/O or Analog Selection

J8 = P2 Step or Servo Selection



50-Pin General Purpose I/O (J3)					
Pin	**FUNCTION**	**Pin**	**FUNCTION**	**Pin**	**FUNCTION**
1	ADC0	18	Phase A9-	35	GND
2	AGND	19	IO5 Phase B9+	36	IO9
3	ADC2	20	Phase B9-	37	GND
4	AGND	21	IO6/ Index 9+	38	IO10
5	ADC4	22	Index 9-	39	GND
6	AGND	23	IO7	40	IO11
7	DAC8	24	GND	41	GND
8	AGND	25	5VDC	42	IO12
9	IO0/ Phase A8+	26	ADC1	43	GND
10	Phase A8-	27	AGND	44	IO13
11	IO1/ Phase B8+	28	ADC3	45	GND
12	Phase B8-	29	AGND	46	IO14
13	IO2/ Index 8+	30	ADC5	47	GND
14	Index 8-	31	AGND	48	IO15
15	IO3	32	DAC9	49	GND
16	GND	33	AGND	50	12VDC
17	IO4/ Phase A9+	34	IO8		

68-Pin 4 AXIS LIST (J5)			
1	X Phase A+	35	X Index +
2	X Phase A -	36	X Index -
3	X Phase B +	37	X STEP
4	X Phase B -	38	GND
5	Y SERVO	39	X SERVO
6	AGND	40	AGND
7	Y Home	41	X Home
8	Y Dir	42	X Dir
9	Y Aux	43	X Aux
10	GND	44	GND
11	Y Pos Limit	45	X Pos Limit
12	Y Neg Limit	46	X Neg Limit
13	Y Phase A +	47	Y Index +
14	Y Phase A -	48	Y Index -
15	Y Phase B +	49	Y STEP
16	Y Phase B -	50	GND
17	+5V	51	V-BIAS
18	GND	52	GND
19	Z Phase A +	53	Z Index +
20	Z Phase A -	54	Z Index -
21	Z Phase B +	55	Z STEP
22	Z Phase B -	56	GND
23	T SERVO	57	Z SERVO
24	AGND	58	AGND
25	T Home	59	Z Home
26	T Dir	60	Z Dir
27	T Aux	61	Z Aux
28	GND	62	GND
29	T Pos Limit	63	Z Pos Limit
30	T Neg Limit	64	Z Neg Limit
31	T Phase A +	65	T Index +
32	T Phase A -	66	T Index -
33	T Phase B +	67	T Step
34	T Phase B -	68	GND

68-Pin 4 AXIS LIST (J4)			
1	U Phase A+	35	U Index+
2	U Phase A-	36	U Index-
3	U Phase B+	37	U STEP
4	U Phase B-	38	GND
5	V SERVO	39	U SERVO
6	AGND	40	AGND
7	V Home	41	U Home
8	V Dir	42	U Dir
9	V Aux	43	U Aux
10	GND	44	GND
11	V Pos Limit	45	U Pos Limit
12	V Neg Limit	46	U Neg Limit
13	V Phase A +	47	V Index +
14	V Phase A -	48	V Index -
15	V Phase B +	49	V STEP
16	V Phase B -	50	GND
17	+5V	51	V-BIAS
18	GND	52	GND
19	R Phase A +	53	R Index +
20	R Phase A -	54	R Index -
21	R Phase B +	55	R STEP
22	R Phase B -	56	GND
23	S SERVO	57	R SERVO
24	AGND	58	AGND
25	S Home	59	R Home
26	S Dir	60	R Dir
27	S Aux	61	R Aux
28	GND	62	GND
29	S Pos Limit	63	R Pos Limit
30	S Neg Limit	64	R Neg Limit
31	S Phase A +	65	S Index +
32	S Phase A -	66	S Index -
33	S Phase B +	67	S Step
34	S Phase B -	68	GND

MAXv Pin Assignment (P2 Connector)					
Pin	**Row Z**	**Row A**	**Row B**	**Row C**	**Row D**
1	X Phase B -	X Phase B +	+5V	X Index +	X Index -
2	GND	X Step	GND	X Phase A +	X Phase A -
3	ADC0/IO8	X Pos LMT	RSVD	X Dir	X Aux
4	GND	X Neg LMT	A24	X Home	I/O0
5	Y Phase B -	Y Phase B +	A25	Y Index +	Y Index -
6	GND	Y Step	A26	Y Phase A +	Y Phase A -
7	ADC1/IO9	Y Pos LMT	A27	Y Dir	Y Aux
8	GND	Y Neg LMT	A28	Y Home	I/O1
9	Z Phase B -	Z Phase B	A29	Z Index +	Z Index -
10	GND	Z Step	A30	Z Phase A +	Z Phase A -
11	ADC2/IO10	Z Pos LMT	A31	Z Dir	Z Aux
12	GND	Z Neg LMT	GND	Z Home	I/O2
13	T Phase B -	T Phase B	+5V	T Index +	T Index -
14	GND	T Step	D16	T Phase A +	T Phase A -
15	ADC3/IO11	T Pos LMT	D17	T Dir	T Aux
16	GND	T Neg LMT	D18	T Home	I/O3
17	U Phase B -	U Phase B	D19	U Index +	U Index -
18	GND	U Step	D20	U Phase A +	U Phase A -
19	ADC4/IO12	U Pos LMT	D21	U Dir	U Aux
20	GND	U Neg LMT	D22	U Home	I/O4
21	V Phase B -	V Phase B	D23	V Index +	V Index -
22	GND	V Step	GND	V Phase A +	V Phase A -
23	ADC5/IO13	V Pos LMT	D24	V Dir	V Aux
24	GND	V Neg LMT	D25	V Home	I/O5
25	R Phase B -	R Phase B	D26	R Index +	R Index -
26	GND	R Step	D27	R Phase A +	R Phase A -
27	DAC8/IO14	R Pos LMT	D28	R Dir	R Aux
28	GND	R Neg LMT	D29	R Home	I/O6 / 5 AUX
29	S Phase B -	S Phase B	D30	S Index +	S Index -
30	GND	S Step	D31	S Phase A +	S Phase A -
31	DAC9/IO15	S Pos LMT	GND	S Dir	NC
32	GND	S Neg LMT	+5V	S Home	NC

ORDERING INFORMATION				
Model	**Computer Interface**	**Axes**	**Servo/Stepper**	**User I/O**
MAXv-1000	VME Bus	1	User Definable	25
MAXv-2000		2	User Definable	26
MAXv-3000		3	User Definable	27
MAXv-4000		4	User Definable	28
MAXv-5000		5	User Definable	29
MAXv-6000		6	User Definable	30
MAXv-7000		7	User Definable	31
MAXv-8000		8	User Definable	32

ACCESSORIES	
IOvMAX	I/O Breakout Board for MAXv (without Cable)
CBL50-10	I/O cable for IOvMAX - 10 ft
CBL68-10	10 ft cable w/mating connector, 68-pin

3701-2700000
Revision A