



# PC78

## Intelligent Motion Controller for PC/104 or RS-232

### FEATURES

#### Controller capabilities

- Four axes of stepper control with encoder feedback or servo control
- Encoder feedback to 12MHz

#### Communications

- PC/104 bus
- Stand-alone with RS-232 port with baud rates of 9600 to
- Interrupt or polling communication
- 4 I/O registers for control & status

#### Sophisticated Control Functionality

- 16 bit DAC analog resolution
- Independent and coordinated motion of all axes at the same time
- Slip & Stall detection with encoder feedback
- Crystal controlled step pulse from 0 to 1,044,000 steps per second
- Circular interpolation
- Constant velocity linear interpolation (all axes)
- Electronic gearing

#### 32 bit Processor for Extensive Co-Processing

- Does not burden the host with overhead
- Custom, parabolic, cosine, linear trajectory profiles
- Patented technology to minimize torque ripple and velocity modulation
- Internal watchdog timer for safety

#### Flash Memory

- Field upgradeable firmware within Windows operating systems
- Non-volatile program storage and parameter storage

#### Control signals

- Single high density shielded SCSI3 connector
- Up to 12 user I/O
- Motion Control Output is +/-10V or 0-10V Servo or Step & Direction
- Dedicated home and plus / minus over-travel inputs for each axis

#### OMS - EZ™ Software programming

- High level programming expertise not required
- Over 150 commands, "universal" to all Pro-Dex, Inc. controllers
- Commands are ASCII characters
- Capable of conversion to "user" defined units i.e. inches / revolutions
- Software for WIN95/98, NT, 200 and XP.
- Software supplied at no additional cost

#### Flexible and Expandable

- Conforms 100% to all PC/104 specifications
- Customizable solutions available for your requirements

#### Factory Direct Technical Support

- Person to person toll-free tech support: call 800-707-8111
- Application notes and Documentation on the Web
- Example programs and application code provided
- All OMS Motion, Inc. controls are 100% tested and quality inspected

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## DESCRIPTION

The PC78 is both a PC/104 controller that supports the PC/104 ISA bus standard as well as a stand-alone controller via a RS-232 communication port and is compatible with the PC68 family with 2-4 axes control. The PC78 supports up to 12 general purpose TTL I/O bits, 8 of which are user definable.

The step pulse is a TTL level 50% duty cycle square wave that supports velocities of 0 through 1,044,000 pulses per second. The encoder feedback functionality supports quadrature encoders up to 12 MHz at a 4 times the encoder line resolution and is used as closed-loop feedback for the stepper axes or as independent position feedback. The encoder feedback can provide slip and/or stall detection. Each axis includes dedicated +/- overtravel inputs, a home input, and an auxiliary output.

## PROGRAMMING

PC78 motion controllers are easily programmed with 2 and 3 character ASCII commands through an extensive command structure. The commands are combined into character strings to create sophisticated motion profiles and are passed to the PC78 data register. A separate 'FIFO' command queue for each axis is used to store the parsed commands by the PC78 until they are executed allowing the host to send a complex command sequence and attend to other tasks while the PC78 manages the motion process. These command queues store 200 command and parameter words and include a command loop counter which allows multiple executions of any command string.

The following commands are available in the PC78 family of motion controllers. Some 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. With user units defined, distances, velocity and acceleration parameters may be input in inches, revolutions, etc.\*

Synchronized moves may be made by entering the AA or AM command. This command performs a context switch which allows entering commands of the format MRx#,y#,z#,t#;. Numbers are entered for each axis which is to be 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 PC78 can be switched back to the unsynchronized mode by entering the desired axis command such as AX.

\* The user manual has all commands listed and should be used to program the Motion Controller.

## 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:

Initialize the velocity and acceleration parameters to a low value suitable for homing. Set a PID filter proportional gain of 2 and a derivative gain of 6. Perform the home operation initializing the position counter to zero.

Initialize the velocity and acceleration parameters to perform a faster motion and move to an absolute position of 10,000 counts from home in the positive direction and set the done flag when finished.

The following would be input from the host computer:

```
AX;
VL1000;
AC10000;
KP2;
KD6;
HN;
HM0;
VL5000;
AC50000;
MA10000;
GO;
ID;
```

In a move requiring a three axis coordinated move to a position in free space the following could be used:

```
AX;
KP2;
KD6;
HN;
AY;
KP2;
KD6;
HN;
AZ;
KP2;
KD6;
HN;
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 position.

## **SPECIFICATIONS**

### **Velocity**

0 to 1,044,000 counts per second simultaneous on each axis

### **Acceleration**

0 to 8,000,000 counts per second per second

### **Position range**

67,000,000 counts ( $\pm 33,500,000$ )

### **Accuracy**

Position accuracy and repeatability  $\pm 0$  counts for point to point moves  
Velocity accuracy  $\pm 0.01\%$  for step pulse output

### **Environmental**

Operating temperature range: 0 to 50 °C  
Storage temperature range: -20 to 85 °C  
Humidity: 0 to 90% non-condensing

### **Power**

+5VDC at 1 amp typical

### **Dimensions**

3.550x3.775x0.5 inches high

### **Communication**

PC/104: Meets all signal specifications for PC/104 ISA bus specifications (IEEE P996.1)  
RS-232: Baud rates of 300 to 38.4K

### **Limit switch inputs**

TTL input levels with on board 2.2K pull up resistor, requires only external switch closure to ground or TTL level input signal. Input sense (low or high true) selectable by command input for each axis.

### **Home switch inputs**

TTL input levels with on board 2.2K pull up resistor, requires only external switch closure to ground or TTL level input signal. Input sense (low or high true) selectable by command input for each axis.

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

12 bits of user definable I/O. 8 bits are user configurable as inputs or outputs. One auxiliary output per axis and are fixed as outputs. Factory default is 4 inputs, 4 outputs and 1 auxiliary per axis. (For PC78 models with more than 4 axes, up to twice this number of I/O in the same as described above.)

TTL input levels with on board 2.2K pull up resistor, requires only external switch closure to ground or TTL level input signal.

The auxiliary outputs are TTL open collector outputs (7406, max 48mA). The other outputs are TTL totem pole outputs (74LS243, max 24mA).

### **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**

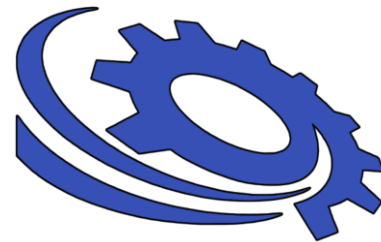
Maximum 12 MHz after 4x quadrature detection  
Differential TTL level signal MC26G32, max 150mA

### **PC/104 interrupt**

Interrupts are user selectable, 2 through 7. The factory default is level 5.

### **PC/104 bus I/O address**

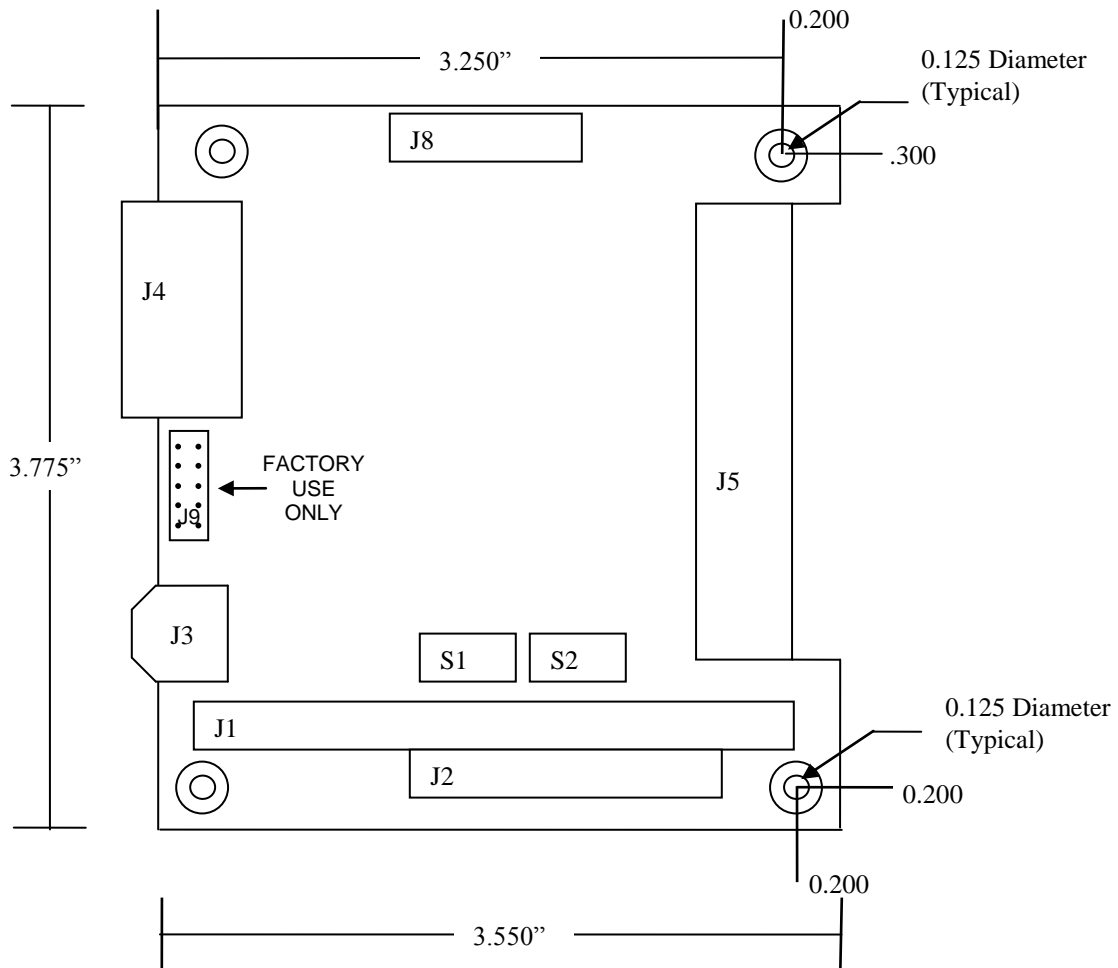
The I/O address block utilizes 4 consecutive addresses and is user selectable. The factory default is 300-303 hex.



*“The Company in Motion”*

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Actual Size Depiction below



**ORDERING INFORMATION**



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| Pro-Dex, Inc. - PC78 Intelligent Motion Controls |           |        |            |              |          |          |
|--|-----------|--------|------------|--------------|----------|----------|
| MODEL  | INTERFACE |        | SERVO AXES | STEPPER AXES |          | USER I/O |
|  | PC/104    | RS-232 |            | CONTROL      | FEEDBACK |          |
| PC78-25  | x         | x      | 2          | 0            | 0        | 12       |
| PC78-26  | x         | x      | 0          | 2            | 2        | 12       |
| PC78-45  | x         | x      | 4          | 0            | 0        | 12       |
| PC78-46  | x         | x      | 0          | 4            | 4        | 12       |

| ACCESSORIES |   |
|-------------|---|
| MODEL       | DESCRIPTION   |
| IO68-M      | I/O Breakout board for standard or expansion PC78 motion control boards |
| CBL68-10    | 10 ft cable w/mating connector 68 pin, (IO68/PC78)                      |
| CDSWSUPP    | DLLs and drivers for Windows NT, 95, 98, 2000 and XP.                   |
| CDMAN       | Electronic Manual 1 per shipment provided, unless otherwise requested   |

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