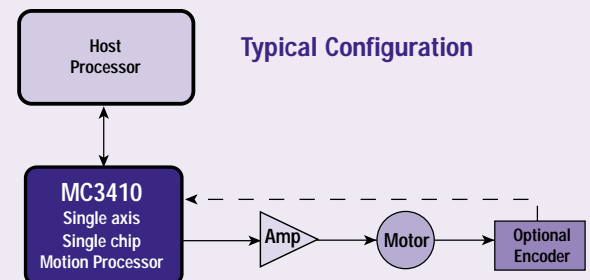# Pilot™ Motion Processor
# For Microstepping Motion Control
# MC3410

## Features

- Available in 1-axis configuration.
- Supports 2 and 3-phase stepping motors.
- Programmable microstepping rate from 1 to 256 microsteps per full step.
- Motion profiles include S-curve, trapezoidal, velocity contouring and user-defined.
- Asymmetric acceleration and deceleration to custom program a trapezoidal motion profile.
- Velocity and acceleration changes on-the-fly for trapezoidal and velocity contouring profiles.
- Incremental encoder quadrature input and parallel input for absolute encoder or resolver for on-the-fly motor stall detection.
- Parallel and Serial (point-to-point or multi-drop) communications interface.
- Trace capabilities for system performance checks, maintenance and diagnostics.
- Encoder rate of 5.0 Mcounts/sec allows use of fine resolution feedback devices for reading motor position.
- 8-bit, 80kHz PWM* or 16-bit DAC motor output to amplifier.
- Advanced breakpoint capability allows precise sequencing of events.
- PLC-style programmable inputs and outputs, including a per-axis programmable input and output.
- 256 16-bit word I/O locations for user-defined peripherals.
- 8 general-purpose 10-bit analog inputs.
- Two directional limit switches, index input, home and at-rest indicator.
- Axis settled indicator and tracking window in addition to automatic motion error detection.
- Comprised of a 132-pin device (surface mount CMOS technology).
- Available in commercial and industrial temperature versions.



### Typical Configuration



## General Description

The Pilot MC3410 single-axis, single chip motion processor for microstepping motion control is ideal for embedded systems in industrial control, automation and robotic applications. The chip is a 132-pin device, surface mount CMOS technology and powered by 5 volts. The motion processor is driven by a host microprocessor through an asynchronous bi-directional serial port, giving users the ability to offload resource intensive motion control functions from the application's host.

The MC3410 outputs the PWM or DAC-compatible motor command signal needed to directly drive the windings of a stepping motor. A programmable microstepping rate can be specified to designate the desired number of microsteps per full step, from 1 to 256. The chip operates in an open loop mode where the motor command is driven from the output of the trajectory generator. Optional encoder feedback provides on-the-fly motor stall detection and allows the chip to detect when the stepping motor has lost steps during a motion. Trace capabilities provide on-the-fly data storage for analyzing system performance and performing maintenance and diagnostics.

\* 10-bit, 20kHz PWM output version also available.

With over 115 commands, PMD's instructions set offers flexibility and versatility to board designers and software application programmers. Instructions are used to initialize and control the motion processor. User-selectable profiling modes supported by the motion processor include S-curve, trapezoidal, velocity contouring and user-defined. The MC3410 accepts input parameters such as position, velocity and acceleration from the host and generates a corresponding trajectory.

The motion processor accepts feedback from an incremental encoder, up to 5 megacounts per second or from an absolute encoder or resolver, up to 160 megacounts per second, to read the current position. 16-bit DAC or 8-bit, 80kHz* PWM-compatible output signals are supported.

Multiple breakpoints offer precise sequencing and control of events by the application program. PLC-style instructions are provided, which operate on inputs and set outputs. The instructions use Event, Activity and Signal registers. Input signals include two limit switches (one for each direction of travel), home indicator and a general-purpose programmable input. An at-rest output signal is provided, along with one general-purpose programmable output signal is also provided. Eight general-purpose analog (0-5 V) and 256 (16-bit wide) general-purpose discrete inputs/outputs are available.

# Technical Specifications

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|---|---|
| **Available configurations** | 1 axis |
| **Operating modes** | ***Open loop*** (motor command is driven from output of trajectory generator and microstep generator, encoder input used for stall detection) |
| **Position range** | -2,147,483,648 to +2,147,483,647 counts |
| **Velocity range** | -32,768 to +32,767 counts/sample with a resolution of 1/65,536 counts/sample |
| **Acceleration and deceleration ranges** | -32,768 to +32,767 counts/sample$^2$ with a resolution of 1/65,536 counts/sample$^2$ |
| **Jerk range** | 0 to 1 counts/sample$^3$, with a resolution of 1/ 4,294,967,296 counts/sample$^3$ |
| **Profile mode** | ***S-curve point-to-point*** (Velocity, acceleration, jerk and position parameters)<br>***Trapezoidal point-to-point*** (Velocity, acceleration, deceleration and position parameters)<br>***Velocity-contouring*** (Velocity, acceleration and deceleration parameters)<br>***User-defined*** (Velocity, acceleration, jerk, time and position parameters) |
| **Motor output modes** | **PWM:** 80kHz, 8-bit *<br>**DAC:** 16 bits |
| **Maximum encoder rate** | **Incremental:** 5 Mcounts/sec<br>**Parallel-word:** 160.0 Mcounts/sec |
| **Parallel encoder word size** | 16 bits |
| **Parallel encoder read rate** | 20 kHz (reads axis every 50 µsec) |
| **Profile calculation timing range** | 150 µsec to 3,355 msec |
| **Minimum profile calculation time** | 150 µsec nominal (exact time is 153.6 µsec) |
| **Limit switches** | 2; one for each direction of travel |
| **Position-capture triggers** | 2; index and home signals |
| **Capture trigger latency** | 50 nsec |
| **Analog input** | 8 10-bit analog inputs |
| **User-defined discrete I/O** | 256 16-bit wide user-defined I/O |
| **Number of host instructions** | 116 |

* The MC3410 can also be ordered with a 20kHz, 10-bit PWM output. Contact PMD for information.

MC3410DS2.0-1202

# Environmental and Electrical Ratings

| | |
|---|---|
| **Storage Temperature ($T_s$)** | -55º C to 150º C |
| **Operating Temperature ($T_a$)** | 0º C to 70º C** |
| **Power Dissipation ($P_d$)** | 400 mW |
| **Nominal Clock Frequency ($F_{clk}$)** | 20.0 MHz |
| **Supply Voltage Limits ($V_{CC}$)** | -0.3 V to +7.0 V |
| **Supply Voltage Operating Range ($V_{CC}$)** | 4.75 V to 5.25 V |

** An industrial version with an operating range of -40º C to 85º C is also available. Please contact PMD for more information.