

# Ensemble™

## Multiaxis Motion Controller Software

Up to 10 axes of coordinated motion

Multiple 10-axis systems can be controlled by a single PC via Ethernet or USB

Controller architecture capable of coordinating motion of up to five independent tasks

Capable of driving and controlling linear or rotary brushless, DC brush servo, and micro-stepping motors

Complete motion capabilities include: point-to-point, linear and circular interpolation, electronic gearing, velocity profiling

Program in AeroBASIC™ with the IDE, Microsoft .NET including C#, VB.NET®, Managed C++, or LabVIEW® over Ethernet or USB from Windows® 2000 or Windows® XP

Remote ASCII interface provided for Windows® or non-Windows® programs (including Linux) to command the Epaq through standard Ethernet, RS-232 port, and optional IEEE-488

Advanced Windows®-based remote diagnostics, tuning, and programming interface software

Axis jogging/control with optional joystick

The Ensemble™ is Aerotech's next-generation, multi-axis controller for moderate- to high-performance applications with high speed communication through 10/100 Base T Ethernet or USB interfaces. It offers easy to use, affordable multi-axis motion programming for laboratory experimentation, production testing, or advanced OEM automated manufacturing systems.



### Versatile Stand Alone Multiaxis Control

With the Ensemble Stand-Alone Controller, up to ten axes of synchronized motion are offered in a distributed network of panel-mounted drives. This is excellent for applications where drives must be embedded into a machine at various locations or where panel space is at a premium. For desktop and rack-mount installations, the Ensemble is offered in a stand-alone 6-axis unit with integrated drives. Three additional panel mounted linear or PWM drives may be added externally to the six-axis unit for up to nine axes of motion control. The Ensemble can control any Aerotech brushless, brush, or stepper motors or stages in any combination. The simple parameter interface also allows easy integration to third-party motors and stages. The controller encoder interface includes TTL quadrature input or analog encoder input. Multiple Ensemble controllers can be controlled from a single Windows® PC through Ethernet or USB, allowing many more than ten axes of motion to be operated from one host PC.

### Powerful and Intuitive Programming Functionality

Unlike most controllers on the market today, there is no need to understand a cryptic command set to generate motion. The intuitive interface allows a user to begin programming immediately. Ensemble online help further simplifies writing motion programs and includes many functional examples that can be easily modified for customer applications.

The Ensemble Integrated Development Environment software offers a graphical user interface in Windows® featuring an intuitive Program Editor, Variable Output window, Compiler Output window, Task State monitor, Network Explorer, and Solution Explorer. This interface enables users to easily monitor all aspects of their positioning system, no matter how complex. The Axis

## Ensemble DESCRIPTION

Control and Diagnostic screen interfaces are further supplemented by a fully functional Autotuning utility that minimizes startup time and allows easy optimization of motion axes. System diagnostics are easily read from the interface. The Windows-based remote software package is included with each unit, which allows the user to upload/download programs, modify parameter files, and analyze motion with Aerotech's advanced graphical tuning package, all from the convenience of a remote PC.

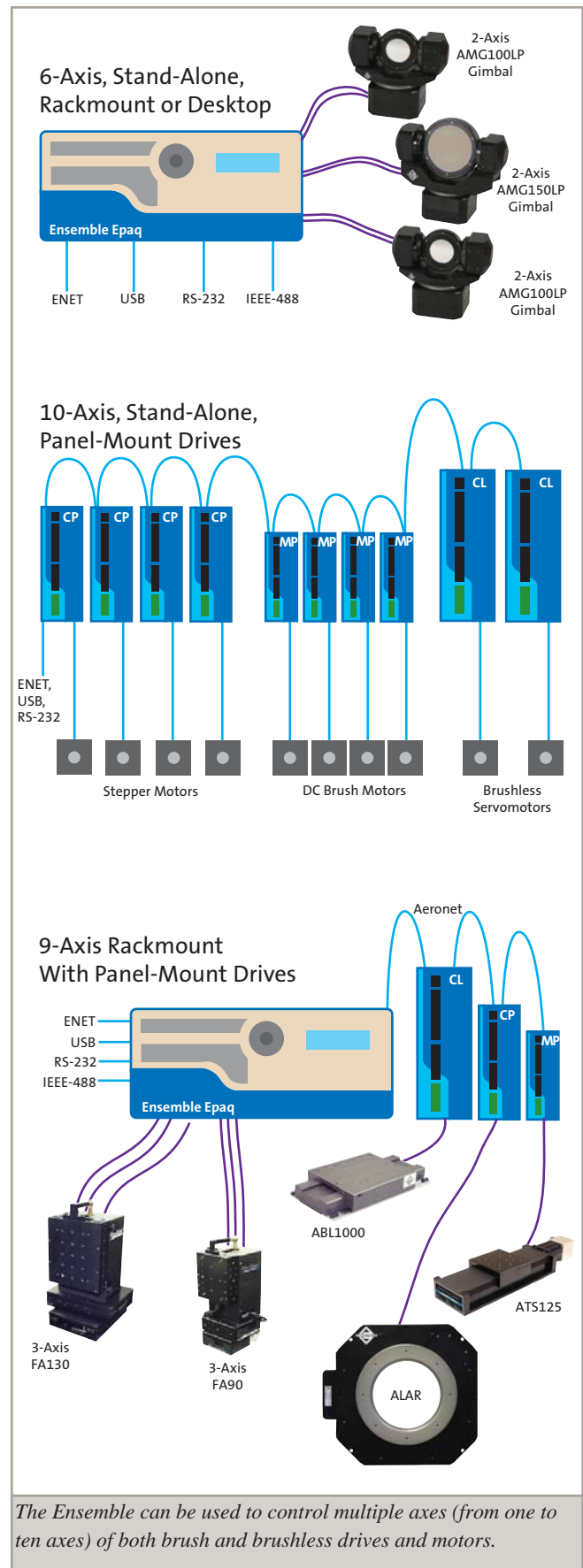
Each Ensemble axis uses the processing power of a 225 MHz double precision, floating-point DSP to offer exceptional performance in a variety of applications, including point-to-point motion, linear and circular interpolation, multiaxis error correction, 2D error mapping, direct commutation of linear and rotary brushless servomotors, and on-board servo autotuning. High-speed interrupts and data logging capabilities provide a real-time link to external systems. The Ensemble also offers high-speed position latching capability and optional single-axis PSO (Position Synchronized Output). Whether the requirement is simple point-to-point motion or complex velocity profiled contours with output on the fly, Ensemble ensures peak performance for critical applications.

### Flexible Drives

Because the Ensemble can control many different types of motors, users have excellent flexibility in their motion system design. High accuracy linear motor air-bearings can be controlled from the same controller running lower precision drives with servo or stepper motors. Parameters are easily reconfigured for these various motors and feedback devices, so customers can adapt to changing system needs.

### Enhancing a Legacy of Success

Although Ensemble is envisioned as a general-purpose, stand-alone controller, it carries forward a legacy of success built from Aerotech's hugely successful A3200 and Soloist™ controllers. It offers enhanced capabilities that will make it an ideal choice for many aggressive motion control applications. The Ensemble motion control architecture builds upon the Soloist intuitive graphical user interface, while offering advanced features appropriate for multiaxis control. Ease of use is further improved with pre-coded LabVIEW® VIs, AeroBASIC™ programming functionality, .NET tools for C#, VB.NET, and managed C++ compatibility.



# Ensemble™ Epaq

## Stand-Alone, Multi-Axis Motion Controller

Up to six integrated drives in one stand-alone controller

Additional external drive axes can be added to provide up to nine axes of coordinated motion

Controller architecture capable of coordinating motion of up to five independent tasks

Capable of driving and controlling linear or rotary brushless, DC brush servo, and micro-stepping motors

Complete motion capabilities include: point-to-point, linear and circular interpolation, electronic gearing, velocity profiling

Program in AeroBASIC™ with the IDE, Microsoft .NET including C#, VB.NET®, Managed C++, or LabVIEW® over Ethernet or USB from Windows® 2000 or Windows® XP

Remote ASCII interface provided for Windows® or non-Windows® programs (including Linux) to command the Epaq through standard Ethernet, RS-232 port, and optional IEEE-488

Advanced Windows®-based remote diagnostics, tuning, and programming interface software

Front panel display and control pad for convenient menu-driven axis control and status checking

Axis jogging/control with optional joystick



The Ensemble™ Epaq is Aerotech's next-generation, stand-alone controller for moderate- to high-performance applications. It offers functionality appropriate for applications from basic laboratory experimentation and general purpose positioning to advanced OEM systems at an affordable price.

### Versatile, Stand-Alone, Multi-Axis Control

With the Ensemble Epaq laboratory controller, up to six axes of motion control are offered in one integrated, stand-alone package. If customers need higher current or voltage levels than the integrated amplifiers can provide, standard Aerotech Ensemble MP, Ensemble CL, or Ensemble CP drives can be interfaced to the Epaq externally to operate motors up to 30 A peak power. The Epaq also can daisy chain three extra drives so the customer can command up to nine axes of coordinated motion under program control. This flexible configuration style allows users to seamlessly mix and match drive types (linear versus PWM, brush or brushless, stepper, etc.) within the same positioning system using a common programming and control platform. Multiple Epaqs can be controlled from one Windows PC through Ethernet or USB. Optional on-board encoder interpolation offers the user programmable axis resolution (assuming a sine-wave encoder input signal), including the ability to change interpolation (multiplication) values through software.

### Powerful and Intuitive Programming Functionality

Unlike most controllers on the market today, there is no need to understand a cryptic command set to generate motion. The intuitive interface allows a user to begin programming immediately. Ensemble online help further

## Ensemble Epaq DESCRIPTION

simplifies writing motion programs and includes many functional examples that can be easily modified for customer applications.

The Ensemble with Integrated Development Environment software offers a graphical user interface in Windows®, featuring an intuitive Program Editor, Variable Output window, Compiler Output window, and Task State monitor. This interface enables users to easily monitor all aspects of their positioning system, no matter how complex. The Axis Control and Diagnostic screens are further supplemented by a fully functional Autotuning utility that minimizes startup time and allows easy optimization of motion axes. System diagnostics are easily read from the interface. The Windows-based remote software package is included with each unit, which allows the user to upload/download programs, modify parameter files, and analyze motion with Aerotech's advanced graphical tuning package, all from the convenience of a remote PC.

Whether operated in stand-alone mode through the front panel or by remote control through Ethernet or USB, the full functionality of the Ensemble Epaq is available. On-board configuration and monitoring utilities simplify remote communications. To allow easy serial connectivity and ease of use, the Epaq features an RS-232 port (additional RS-232 port is an option) and an optional IEEE-488 port.

### Advanced DSP Control

The Ensemble Epaq uses the processing power of multiple 225 MHz double precision, floating-point DSPs to offer exceptional performance in a variety of applications, including point-to-point motion, linear and circular interpolation, single- and multi-axis error correction, direct commutation of linear and rotary brushless servomotors, and on-board servo autotuning. High-speed interrupts and data logging capabilities provide a real-time link to external systems. The Ensemble Epaq also offers high-speed position latching capability and optional single-axis PSO (Position Synchronized Output). Whether the requirement is simple point-to-point motion or complex velocity profiled contours with output on the fly, Ensemble ensures peak performance for critical applications.

### Integral Drives

Brushless servo, DC brush servo, and microstepping drives are integrated into the Ensemble Epaq compact frame. The Epaq can control any combination of up to six integral drives, while the Ensemble architecture is capable of further expansion (with external stand-alone, single-axis drive units) to up to nine total axes. Because the Epaq can control many different types of motors, customers have excellent flexibility in their system designs. High accuracy linear motor air-bearings can be controlled from the same controller running lower precision drives with servo or stepper motors. Parameters are easily reconfigured for these various motors and feedback devices, so customers can adapt to changing system needs.

### Expanded Input/Output Capability

Each Epaq features an optional IEEE-488 parallel port, second RS-232 port, and axis expansion port. On a per axis basis the Epaq also features an optional I/O package offering eight digital inputs and outputs, one 12-bit  $\pm 10$  VDC analog input, one 16-bit  $\pm 5$  VDC output, a configurable brake output, a second TTL encoder input for dual loop control, and either a second marker input or PSO output. This optional I/O package can be added to each axis so numerous I/O can be connected to the Epaq.

### Enhancing a Legacy of Success

Although Ensemble is envisioned as a general-purpose, stand-alone controller, it carries forward a legacy of success built from Aerotech's hugely successful A3200 and Soloist™ controllers. It offers enhanced capabilities that make it an ideal choice for many aggressive motion control applications. The Ensemble motion control architecture builds upon the Soloist intuitive graphical user interface, while offering advanced features appropriate for multiaxis control. Ease of use is further improved with pre-coded LabVIEW® VIs, AeroBASIC™ programming functionality, .NET tools for C#, VB.NET, and managed C++.

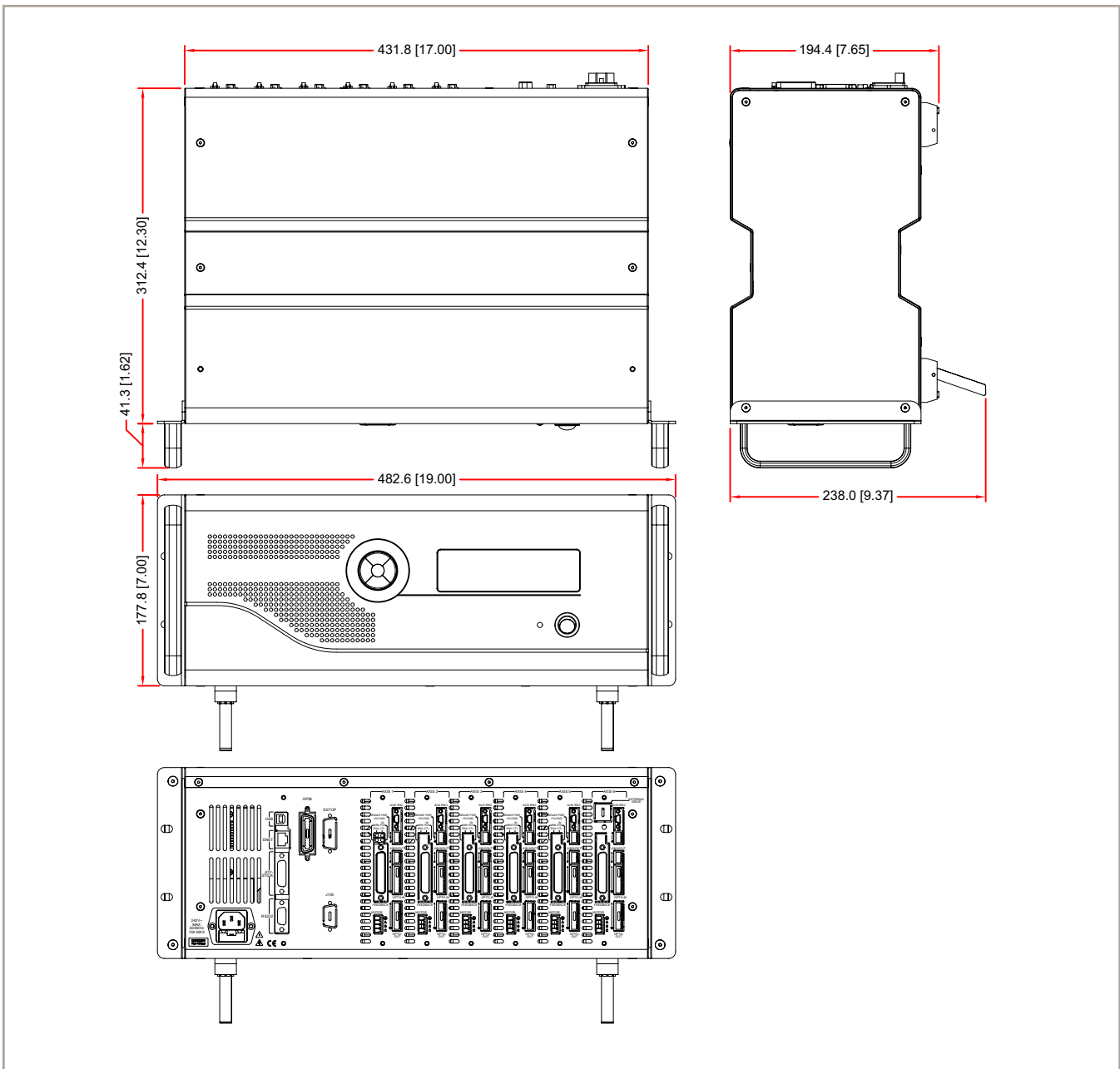
## Ensemble Epaq SPECIFICATIONS

Feature	Details	
<b>Axes</b>	One to six axes (motion controller can accommodate up to nine)	
<b>Axis Loop Type/Update Rate</b>	PID loop with up to 20 kHz servo update rate with feedforward; four user-configurable digital filters (e.g., notch, low pass)	
<b>On-Board Memory</b>	Program Storage	2 MB flash memory for user programs, parameters, miscellaneous storage
	Program Execution	8 MB RAM
<b>Driver Type Compatibility</b>	Brushless (linear or rotary) servo with on-board commutation DC brush servo Stepper/microstepper (on-board commutation)	
<b>Position Feedback</b>	6-channel encoder interface, differential RS-422 signal, sine, cosine, and marker; 20 MHz input data rate; optional onboard analog encoder interpolation (of up to 1024-times encoder multiplication)	
<b>Position Modes</b>	Absolute, incremental, dynamic trajectory correction	
<b>Motion Types</b>	Independent Motions	Point-to-point incremental; target position or velocity; velocity profiles; time based; free run
	Coordinated Motions	Advanced queuing and deferred execution features for simultaneous command execution
	Interpolated Motions	Up to 6-axis linear and circular interpolation
	Digitally Geared Motions	Gearing with optional auxiliary encoder input
	Advanced Features	Automatic PID loop gain computation (autotuning)
	Contouring	Cubic spline curve-fitting; velocity profiling
	Error Mapping	1D and 2D error mapping; backlash compensation
<b>Acceleration Profiles</b>	Linear and jerk limiting parabolic; independent acceleration and deceleration profiles possible	
<b>Acceleration Ramp</b>	Rate, time, or distance based; independent acceleration and deceleration capability	
<b>Programmable Multitasking</b>	Up to 5 independent tasks	
<b>Programming</b>	Command Set	AeroBASIC™, LabVIEW®, VB.Net, C#, Managed C++
	Interface	On-board menu-driven program selection from front panel; program editing and download with Windows® PC through Ethernet or USB to Host PC, or ASCII commands via RS-232, IEEE-488, or Ethernet
<b>Command Execution Modes</b>	AUTO	Program runs complete upon startup
	SINGLE	Full debug capability to step, step over, step into individual program lines
	IMMEDIATE	Commands are executed upon entry
	JOG	Axes controlled with jog pad on front panel or optional joystick
	REMOTE	Command execution controlled by remote host through Ethernet, RS-232, or IEEE-488 communications port via ASCII strings
<b>Process Time</b>	Command execution up to 1000 lines of code per 1 ms (from command sent to motion start); read request @ 1 ms; average is 7 µs per program line (e.g., c = a + b)	
<b>Input/Output</b>	Standard	Included with each amplifier axis: CW, CCW, and Home limits; sin, cos, marker, Hall effects, Estop, encoder fault, brake, motion overtemp; 1 channel of 16-bit A/D per axis (±10 VDC); each Epaq includes joystick interface and optional RS-232 and GPIB
	Optional IO Board (can be added to each amplifier axis)	Eight opto-inputs with the IO board option; eight opto-outputs with the IO board option; sinking and sourcing configurable with parameters; 5-24 VDC can be used with any IO pins; single axis PSO (each axis with optional IO; one additional 12-bit (±10 VDC) input and one additional 16-bit (±5 VDC) output; brake relay: 0.5 amp solid-state relay available with option board; secondary TTL RS-422 auxiliary encoder input; position latch with 50 ns position capture latency
<b>Encoder Inputs</b>	TTL RS-422 standard (also on optional IO auxiliary encoder input); optional amplified sine encoder input on primary encoder channel; programmable resolution up to 1024 times the analog encoder resolution; 40 MHz TTL RS-422 square wave primary or auxiliary encoder; 250 kHz amplified sine primary (with optional onboard encoder multiplier)	
<b>Additional Interfaces</b>	Serial	10/100 Base T Ethernet communication interface for system setup, application networking, Epaq-to-Epaq communications, embedded programming, immediate commands, and Modbus over TCP; USB communication interface for system setup, application networking, Windows® PC control interface; RS-232 port with programmable baud rate, length, parity, stop bits (second RS-232 port optional)
	Machine Control	Estop discrete input to stop all axes
	Display	Backlit 8 x 40 character LCD
	Keypad	5-key input pad
<b>Other IO</b>	Parallel	One optional GPIB (IEEE-488)
<b>Environmental Limits</b>	Operating temperature 0 to 50°C (32 to 122°F); Humidity: 10 to 85% noncondensing	
<b>Power Output Capability</b>	600 watt, 24-90 VDC power supply for bus power to axis drives; optional 24 VDC	
<b>Weight</b>	10 kg (22 lb) (600 W power supply and 6 amplifiers installed)	
<b>Footprint</b>	436.9 mm (17.2 in) wide x 312.4 mm (12.3 in) deep x 177.8 mm (7.0 in) high	
<b>Power Input</b>	110-230 VAC nominal input voltage (50/60 Hz) (auto ranging)	
<b>Mounting Options</b>	Desktop standard; rack-mount kit optional	

## Ensemble Epaq SPECIFICATIONS

Integrated Amplifier Electrical Specifications		
Output Voltage	VDC	24 V, 48 V, 54 V, 90 V options
Peak Output Current	A <sub>pk</sub>	10
Continuous Output Current	A	5
PWM Switching Frequency	kHz	20
Power Amplifier Bandwidth	kHz	Software Selectable
Minimum Load Inductance	mH	0.1
Operating Temperature	°C	0 to 50
Storage Temperature	°C	-30 to 85
Weight	kg	0.5

## Ensemble Epaq DIMENSIONS



## Epaq ORDERING INFORMATION

## Ordering Example

Ensemble Epaq	-S	/24	/1-MP10I	/2-MP10	/3-MP10	/4-MP10	/5-MP10	/6-MP10
Base	Package	Bus Power Supply	Axis 1 Amp	Axis 2 Amp	Axis 3 Amp	Axis 4 Amp	Axis 5 Amp	Axis 6 Amp
	-S	/24LP	/1-MP10I	/2-MP10	/3-MP10	/4-MP10	/5-MP10	/6-MP10
	-R	/24	/1-MP10MI	/2-MP10I	/3-MP10I	/4-MP10I	/5-MP10I	/6-MP10I
		/48		/2-MP10M	/3-MP10M	/4-MP10M	/5-MP10M	/6-MP10M
		/54		/2-MP10MI	/3-MP10MI	/4-MP10MI	/5-MP10MI	/6-MP10MI
		/90		/2-BLANK	/3-BLANK	/4-BLANK	/5-BLANK	/6-BLANK
				/2-BLANKW	/3-BLANKW	/4-BLANKW	/5-BLANKW	/6-BLANKW

## Ordering Example (continued)

/US-115VAC	/Brake-2	/JBV
Line Cord	Brake Options	Options
/ENGLAND	/Brake-1	/JBV
/GERMANY	/Brake-2	/JI
/ISRAEL	/Brake-3	/ESTOP0
/Australia	/Brake-4	/ESTOP1
/INDIA	/Brake-5	/GPIB
/US-115VAC	/Brake-6	/EXTAMP
/US-230VAC		/SLIDE
/NO-LINECORD		/CNC5
		/RS232-2

## Rack or Desk-Mount (must select one)

-S	Desktop Epaq (contains desktop related components)
-R	Rack-mount Epaq (contains rack-mount related components)

## Standard or Blank Front Panel (must select one)

-FPD	Standard front panel (with keypad and display )
-FPDE	Standard front panel (with keypad, display, and ESTOP switch)
-FPB	Blank front panel (without display or keypad)
-FPBE	Blank front panel with ESTOP switch (without display or keypad)

## Bus Power Supply

/24LP	24 V @ 22 A low power supply for up to 3 axes; not valid with /ESTOPx or /BRAKE-x options
/24	24 V @ 25 A supply for up to 6 axes; required with /ESTOP0, /ESTOP1, /BRAKE-x options
/48	48 V @ 12.5 A supply for up to 6 axes; required with /ESTOP0, /ESTOP1, /BRAKE-x options
/54	54 V @ 11 A supply for up to 6 axes; required with /ESTOP0, /ESTOP1, /BRAKE-x options
/90	90 V @ 11 A supply for up to 6 axes; not valid with /ESTOP or /BRAKE-x options; if brake control is needed, an external BRAKE24-2 must be used

## Axis 1 Amplifier Options (must select one)

/1-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/1-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O

## Axis 2 Amplifier Options (must select one)

/2-MP10	Digital PWM amplifier, 10 A peak, 5 A continuous
/2-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/2-MP10M	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU
/2-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O
/2-BLANK	No amplifier
/2-BLANKW	No amplifier; prewired only

## Axis 3 Amplifier Options (must select one)

/3-MP10	Digital PWM amplifier, 10 A peak, 5 A continuous
/3-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/3-MP10M	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU
/3-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O
/3-BLANK	No amplifier
/3-BLANKW	No amplifier; prewired only

## Epaq ORDERING INFORMATION

### Axis 4 Amplifier Options (must select one)

/4-MP10	Digital PWM amplifier, 10 A peak, 5 A continuous
/4-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/4-MP10M	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU
/4-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O
/4-BLANK	No amplifier
/4-BLANKW	No amplifier; prewired only

### Axis 5 Amplifier Options (must select one)

/5-MP10	Digital PWM amplifier, 10 A peak, 5 A continuous
/5-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/5-MP10M	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU
/5-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O
/5-BLANK	No amplifier
/5-BLANKW	No amplifier; prewired only

### Axis 6 Amplifier Options (must select one)

/6-MP10	Digital PWM amplifier, 10 A peak, 5 A continuous
/6-MP10I	Digital PWM amplifier, 10 A peak, 5 A continuous with I/O
/6-MP10M	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU
/6-MP10MI	Digital PWM amplifier, 10 A peak, 5 A continuous with 1024X MXU with I/O
/6-BLANK	No amplifier
/6-BLANKW	No amplifier; prewired only

### Line Cord (must select one)

/ENGLAND	U.K. line cord
/GERMANY	German line cord
/ISRAEL	Israel line cord
/AUSTRALIA	Australia line cord
/INDIA	India line cord
/US-115VAC	U.S. 115 VAC line cord
/US-230VAC	U.S. 230 VAC line cord
/NO-LINECORD	No line cord

### Brake Options (up to 2 selections allowable)

/BRAKE-1	Axis 1 wired for 24 V/1 A brake (/24LP not allowed)
/BRAKE-2	Axis 2 wired for 24 V/1 A brake (amp must have "I" or "MI" option, /24LP not allowed)
/BRAKE-3	Axis 3 wired for 24 V/1 A brake (amp must have "I" or "MI" option, /24LP not allowed)
/BRAKE-4	Axis 4 wired for 24 V/1 A brake (amp must have "I" or "MI" option, /24LP not allowed)
/BRAKE-5	Axis 5 wired for 24 V/1 A brake (amp must have "I" or "MI" option, /24LP not allowed)
/BRAKE-6	Axis 6 wired for 24 V/1 A brake (amp must have "I" or "MI" option, /24LP not allowed)

### Options (multiple selections allowable)

/JBV	Joystick with 5 ft cable
/JI	Industrial joystick with 5 ft cable
/ESTOP0	Disconnect AC to motor power supply; requires -FPDE or -FPBE options, and /24 or /48 or /54 options
/ESTOP1	Disconnect AC to motor power supply using power relay; user connection via rear panel 15D 24V connector; requires /24, /48, or /54 option
/GPIB	IEEE-488 GPIB interface (talker/listener)
/EXTAMP	External amplifier interface
/SLIDE	Chassis slides (rack-mount only)
/CNC5	This allows command of more than 4 axes in a single coordinated move
/RS232-1	Second optional RS-232 port
/CNC5	This allows for the command of more than four axes in a single coordinated move
/RS232-2	This is a second optional RS-232 port

### Ensemble Software

ENSEMBLE-SOFTWARE-IDE	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; Includes C# and .NET samples
ENSEMBLE-SOFTWARE-IDE-LAB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; Includes C#, .NET, and LABVIEW 8.2 samples
ENSEMBLE-SOFTWARE-IDE-APPLIB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; Includes C#, .NET samples and source code.
ENSEMBLE-SOFTWARE-IDE-APPLIB-LAB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; Includes C#, .NET samples and source code, and LABVIEW 8.2 samples
ENSEMBLE-SOFTWARE-SUB	One Year subscription to software for new downloads

# Ensemble™ CP/MP/CL

## Networked, Panel-Mount Drives

Network drives through a high-speed serial interface to coordinate up to ten axes of motion

Select linear (CL) or pulse width modulation (CP/MP) amplifiers

Coordinate motion using up to five independent tasks

Drive and control linear or rotary brushless, DC brush servo, and micro-stepping motors

Command various motion types including: point-to-point, linear and circular interpolation, electronic gearing, and velocity profiling

Program in AeroBASIC™, Microsoft .NET (C#, VB.NET, and Managed C++), or LabVIEW® from Windows® using a standard USB or Ethernet connection

Remotely command drives over Ethernet or RS-232 with an ASCII interface available for both Windows® and non-Windows® programs (including Linux)

Diagnose, tune, and program through an advanced Windows-based interface

The Ensemble™ is Aerotech's next-generation, multi-axis controller for moderate- to high-performance applications. Versatility, power, and affordability make the Ensemble ideal for applications from basic laboratory experimentation and general-purpose positioning to advanced OEM systems.

### Versatile, Flexible, Stand-Alone Multi-axis Control

Network multiple drives for up to ten axes of coordinated motion and seamlessly mix and match amplifier (linear versus PWM) and motor types (brush, brushless, or stepper)



From Left to Right: Ensemble CP, Ensemble MP, Ensemble CL.

within the same positioning system using a common programming and control platform. High-accuracy linear motor air-bearings can be directed from the same controller running lower precision drives with servo or stepper motors. Each drive can be reconfigured to accept different motors and feedback devices, allowing customers to adapt to changing system needs. Optional on-board encoder interpolation provides programmable axis resolution, including the ability to change interpolation (multiplication) values through software.

### Powerful and Intuitive Programming

Monitor and control all aspects of the positioning system, no matter how complex, through the Ensemble HMI Integrated Development Environment software. An included Autotuning utility minimizes startup time by allowing easy optimization of motion axes. Functional programs that can be modified and used in customer applications are included in the online help. Pre-coded LabVIEW® VIs, AeroBASIC™ programming functionality, .NET tools for C#, VB.NET, and managed C++ make the Ensemble even easier to use.

### Advanced DSP Control

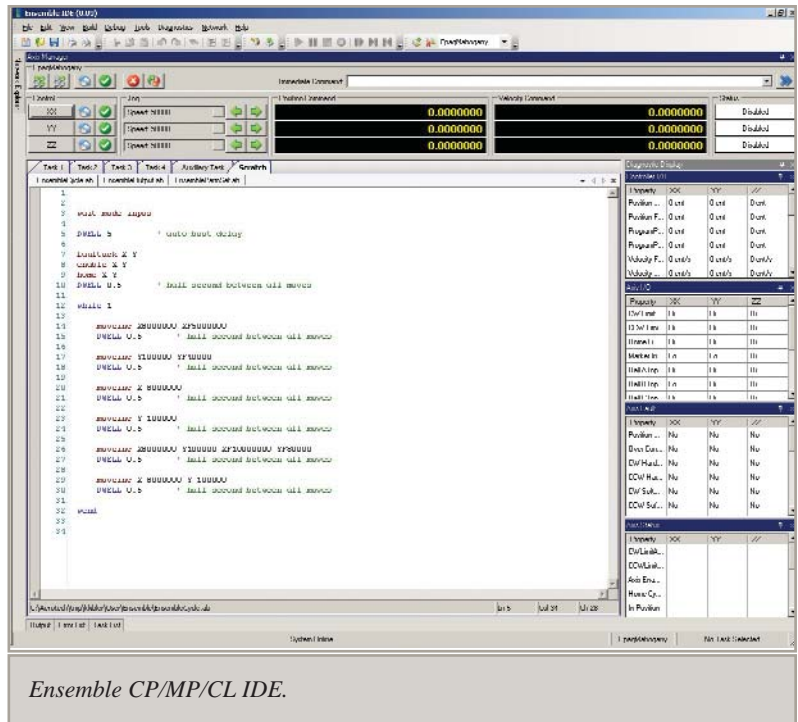
The processing power of a 225 MHz double precision, floating-point DSP supplies exceptional performance in a

## Ensemble CP/MP/CL DESCRIPTION

variety of applications, including point-to-point motion, linear and circular interpolation, multi-axis error correction, 2D error mapping, direct commutation of linear and rotary brushless servomotors, and on-board servo autotuning. High-speed interrupts and data logging capabilities provide a real-time link to external systems. The Ensemble drives also offer high-speed position latching capability and optional single-axis PSO (Position Synchronized Output). Whether the requirement is simple point-to-point motion or complex velocity-profiled contours with output on the fly, Ensemble ensures peak performance for critical operations.

### Enhancing a Legacy of Success

Ensemble carries a legacy of success founded in Aerotech's A3200 and Soloist™ controllers. Enhanced capabilities make it an obvious choice for aggressive motion control applications. The Ensemble motion control architecture builds upon the Soloist™ intuitive graphical user interface, while improving multi-axis control through advanced features.



Ensemble CP/MP/CL IDE.

## Ensemble CP/MP/CL SPECIFICATIONS

CP Electrical Specifications		
Logic Input Voltage	VAC	85 to 240
Bus Input Voltage	VAC	14 to 240
Output Voltage	VDC	20 to 320
Peak Output Current	A <sub>pk</sub>	10 to 30
Continuous Output Current	A	5 to 15
PWM Switching Frequency	kHz	20
Power Amplifier Bandwidth	kHz	Software Selectable
Minimum Load Inductance	mH	0.1 @ 160 VDC (1 mH @ 320 VDC)
Digital Inputs and Outputs	Standard	4 opto inputs; 2 high-speed opto inputs; 4 opto outputs
	Optional	16 additional opto inputs; 16 additional opto outputs
Analog Inputs and Outputs	Standard	1 (±10 VDC, 16-bit) input; 1 (±10 VDC, 16-bit) output
	Optional	1 additional (±10 VDC, 12-bit) input; 1 additional (±10 VDC, 16-bit) output
Encoder Inputs		TTL RS-422 standard, and auxiliary encoder input; optional amplified sine encoder input on primary encoder channel; programmable resolution up to 1024 times the analog encoder resolution; 250 kHz amplified sine primary
Operating Temperature	°C	0 to 50
Storage Temperature	°C	-30 to 85
Weight	kg (lb)	1.6 (3.6)

MP Electrical Specifications		
Logic Input Voltage	VDC	24 to 80
Bus Input Voltage	VDC	10 to 80
Output Voltage	VDC	10 to 80
Peak Output Current	A <sub>pk</sub>	10
Continuous Output Current	A	5
PWM Switching Frequency	kHz	20
Power Amplifier Bandwidth	kHz	Software Selectable
Minimum Load Inductance	mH	0.1 @ 80 VDC
Digital Inputs and Outputs	Standard	None
	Optional	8 opto inputs; 8 opto outputs
Analog Inputs and Outputs	Standard	1 (±10 VDC, 16-bit) input
	Optional	1 additional (±10 VDC, 12-bit) input; 1 (additional ±10 VDC, 16-bit) output
Encoder Inputs		TTL RS-422 standard, and auxiliary encoder input; optional amplified sine encoder input on primary encoder channel; programmable resolution up to 1024 times the analog encoder resolution; 250 kHz amplified sine primary
Operating Temperature	°C	0 to 50
Storage Temperature	°C	-30 to 85
Weight	kg (lb)	0.45 (1.0)

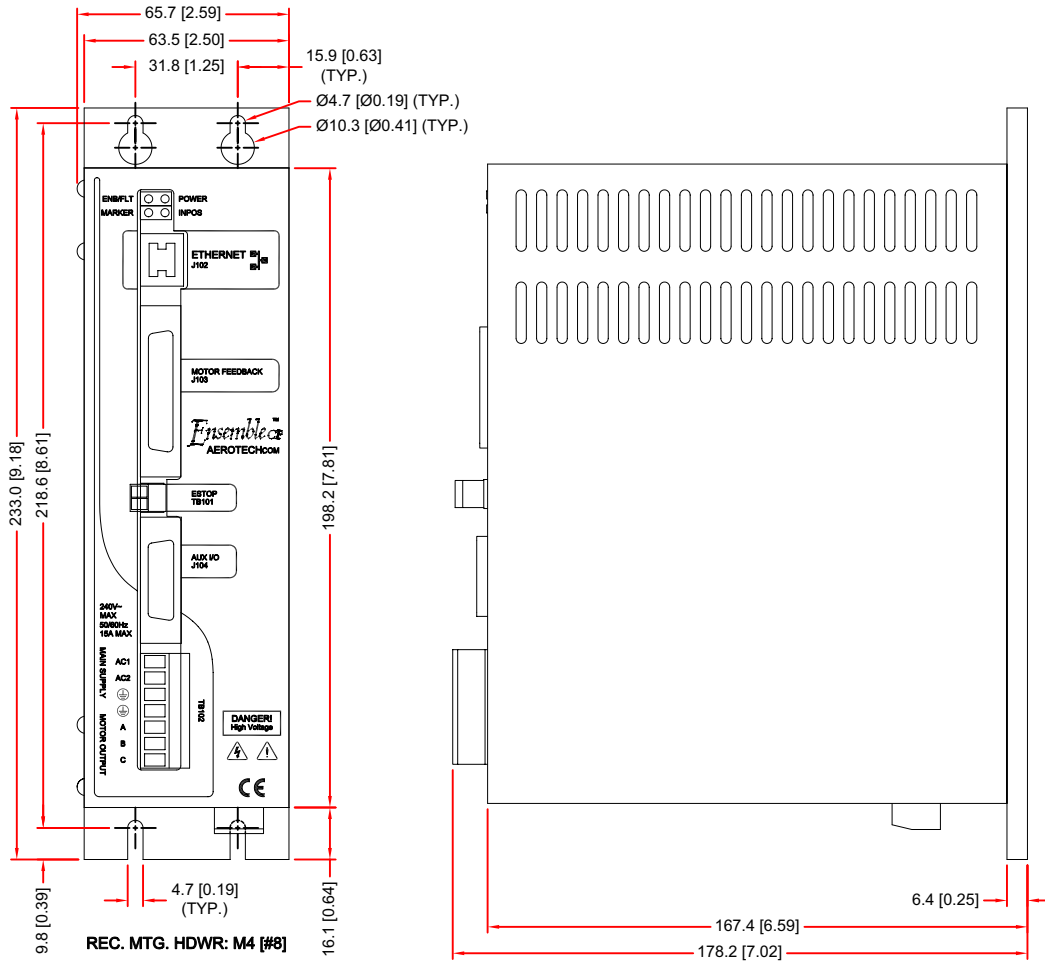
CL Electrical Specifications		
Logic Input Voltage	VAC	85-240
Bus Input Voltage	VAC	56 VAC (center tapped transformer; two 28 VAC windings)
Output Voltage	VDC	±40
Peak Output Current	A <sub>pk</sub>	10 (load dependent)
Continuous Output Current	A	5 (load dependent)
Power Amplifier Bandwidth	kHz	Software Selectable
Minimum Load Inductance	mH	0
Digital Inputs and Outputs	Standard	4 opto inputs; 2 high-speed opto inputs; 4 opto outputs
	Optional	16 additional opto inputs; 16 additional opto outputs
Analog Inputs and Outputs	Standard	1 (±10 VDC, 16-bit) input; 1 (±10 VDC, 16-bit) output
	Optional	1 additional (±10 VDC, 12-bit) input; 1 additional (±10 VDC, 16-bit) output
Encoder Inputs		TTL RS-422 standard, and auxiliary encoder input; optional amplified sine encoder input on primary encoder channel; programmable resolution up to 1024 times the analog encoder resolution; 250 kHz amplified sine primary
Operating Temperature	°C	0 to 50
Storage Temperature	°C	-30 to 85
Weight	kg (lb)	3.8 (8.4)

## Ensemble CP/MP/CL FEATURES

Feature	Details	
<b>Axes</b>	Up to 10 axes of coordinated motion	
<b>Axis Loop Type/Update Rate</b>	PID loop with up to 20 kHz servo update rate with feedforward; four user-configurable digital filters (e.g., notch, low pass)	
<b>On-Board Memory</b>	Program Storage	2 MB flash memory for user programs, parameters, miscellaneous storage
	Program Execution	8 MB RAM
<b>Driver Type Compatibility</b>	Brushless (linear or rotary) servo with on-board commutation DC brush servo Stepper/microstepper (on-board commutation)	
<b>Position Feedback</b>	Encoder interface, differential RS-422 signal, sine, cosine, and marker; 32 MHz input data rate; optional onboard analog encoder interpolation (of up to 1024-times encoder multiplication)	
<b>Position Modes</b>	Absolute, incremental, dynamic trajectory correction	
<b>Motion Types</b>	Independent Motions	Point-to-point incremental; target position or velocity; velocity profiles; time based; free run
	Coordinated Motions	Advanced queuing and deferred execution features for simultaneous command execution
	Interpolated Motions	Up to 10-axis linear and circular interpolation
	Digitally Geared Motions	Gearing with optional auxiliary encoder input
	Advanced Features	Automatic PID loop gain computation (autotuning)
	Contouring	Cubic spline curve-fitting; velocity profiling
	Error Mapping	2D error mapping, backlash compensation
<b>Acceleration Profiles</b>	Linear and jerk limiting parabolic; independent acceleration and deceleration profiles possible	
<b>Acceleration Ramp</b>	Rate, time, or distance based; independent acceleration and deceleration capability	
<b>Programmable Multitasking</b>	Up to 5 independent tasks	
<b>Programming</b>	Command Set	AeroBASIC™, LabVIEW®, VB.Net, C#
<b>Command Execution Modes</b>	AUTO	Program runs complete upon startup
	SINGLE	Full debug capability to step, step over, step into individual program lines
	IMMEDIATE	Commands are executed upon entry
	REMOTE	Command execution controlled by remote host through Ethernet, RS-232, or IEEE-488 communications port via ASCII strings
<b>Process Time</b>	Command execution up to 1000 lines of code per 1 ms (from command sent to motion start); read request @ 1 ms; average is 7 μs per program line (e.g., c = a + b)	
<b>Additional Interfaces</b>	Serial	10/100 Base-T Ethernet communication interface for system setup, application networking, embedded programming, immediate commands, and Modbus over TCP; USB communication interface for system setup, application networking, Windows® PC control interface
	Machine Control	Estop discrete input to stop all axes

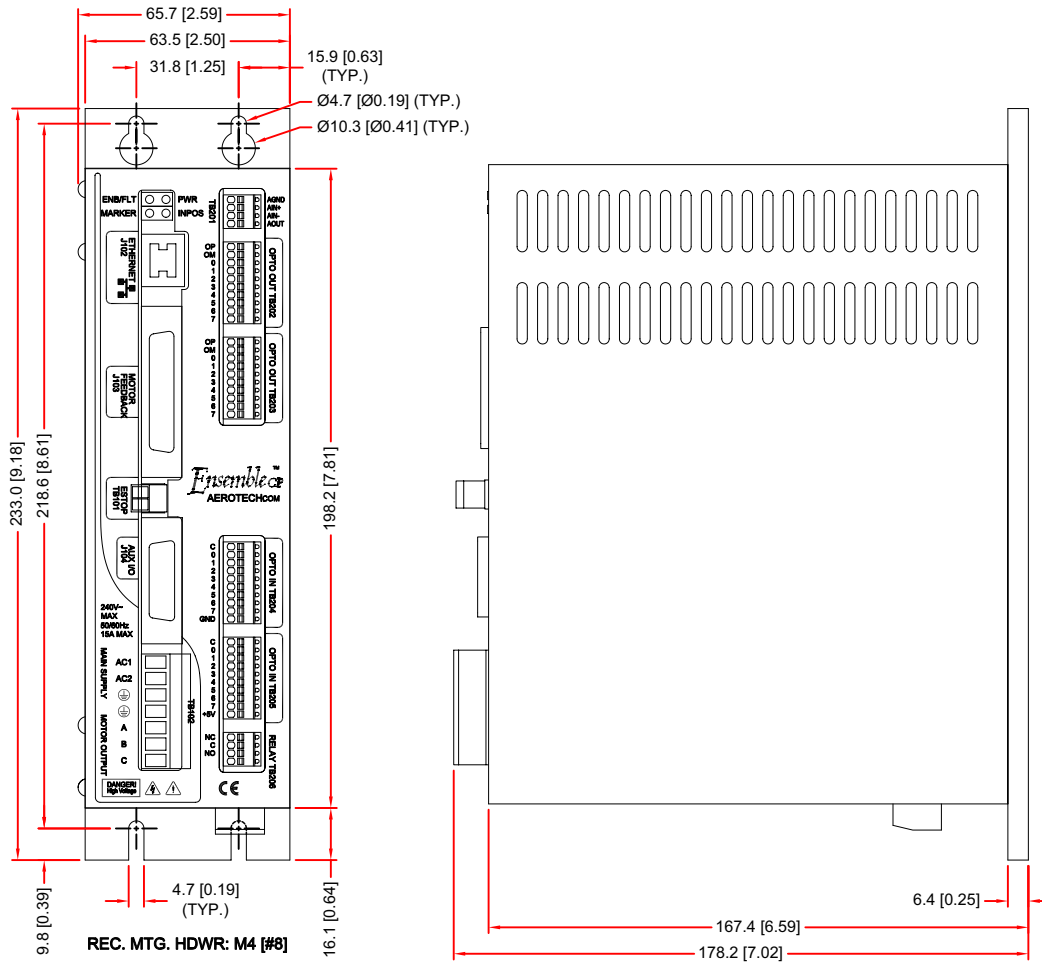
# Ensemble CP/MP/CL DIMENSIONS

## Ensemble CP

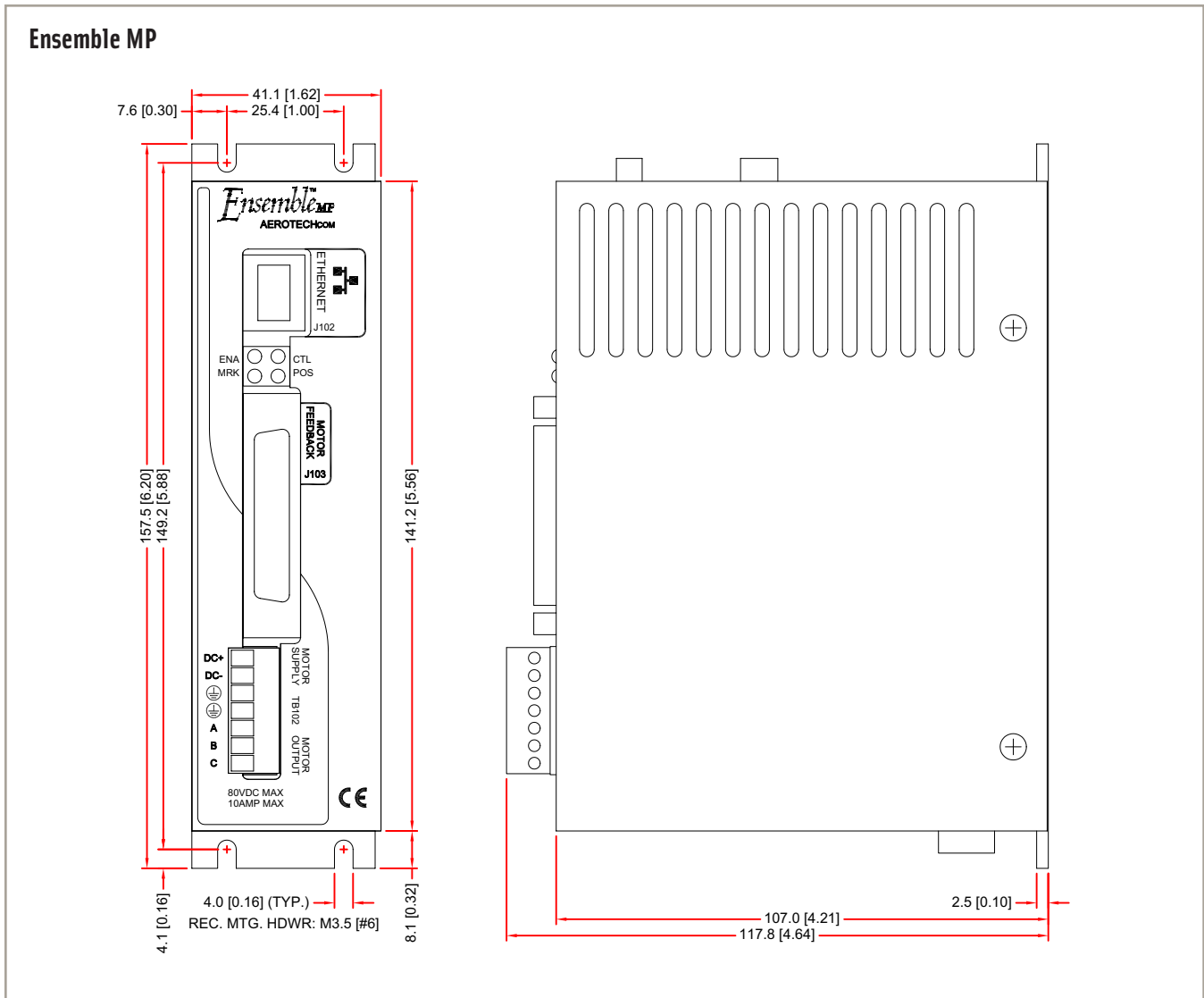


## Ensemble CP/MP/CL DIMENSIONS

### Ensemble CP with additional IO

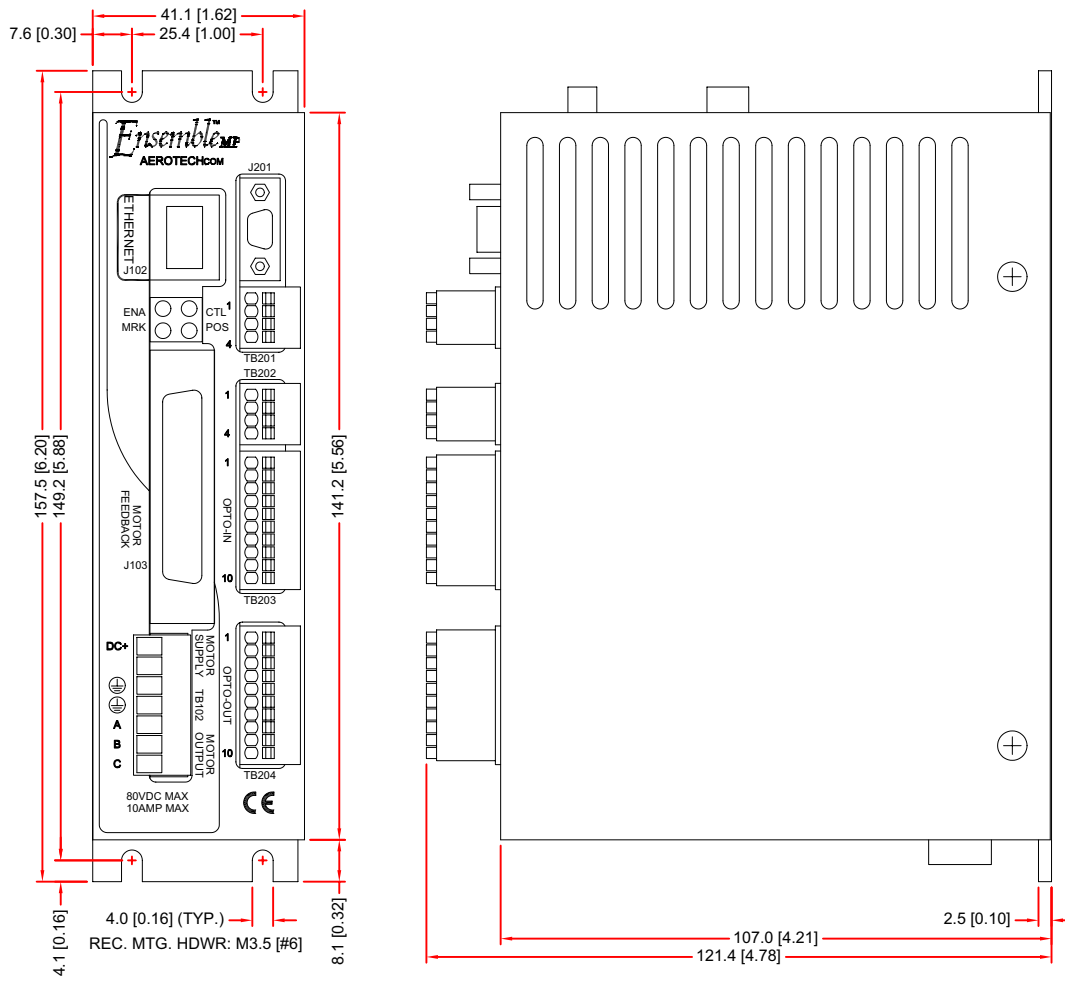


# Ensemble CP/MP/CL DIMENSIONS



## Ensemble CP/MP/CL DIMENSIONS

### Ensemble MP with additional IO







## Ensemble CP/MP/CL ORDERING INFORMATION

### Ordering Example

Ensemble CP	-10	-IO
Hardware Package	Peak Output Current	Options
Ensemble CP	-10*	-IO
Ensemble MP	-20	-MXU
Ensemble CL	-30	-S
		-AUXPWR

\*Ensemble MP10 is the only MP configuration available.

### Ensemble CP/MP/CL Discrete Drives

ENSEMBLE CP10	10 A peak, 5 A continuous, 115 VAC input digital drive with Ethernet interface; includes 4 digital outputs, 6 digital inputs, one analog output, one analog input, one 24 VDC 1-amp solid-state brake relay; includes axis calibration, PSO, camming, absolute encoder support
ENSEMBLE CP20	20 A peak, 10 A continuous, 115 VAC input digital drive with Ethernet interface; includes 4 digital outputs, 6 digital inputs, one analog output, one analog input, one 24 VDC 1-amp solid-state brake relay; includes axis calibration, PSO, camming, absolute encoder support
ENSEMBLE CP30-S	30 A peak, 15 A continuous, 115 VAC input digital drive with Ethernet interface; includes 4 digital outputs, 6 digital inputs, one analog output, one analog input, one 24 VDC 1-amp solid-state brake relay, integral shunt resistor network; includes axis calibration, PSO, camming, absolute encoder support
ENSEMBLE MP10	10 A peak, 5 A continuous, 10-80 VDC input, PWM digital amplifier with Ethernet interface; supports brush and brushless motors; 2 quadrature encoder input channels, Estop sense input, and 24-80 VDC logic power input; includes axis calibration and camming
ENSEMBLE CL10-40	10 A peak, 5 A continuous, 115 VAC logic input power; 56 VAC bus power; includes 4 digital outputs, 6 digital inputs, one analog output, one analog input, one 24 VDC 1-amp solid-state brake relay; includes axis calibration, PSO, camming, absolute encoder support

### Options: Ensemble CP

-IO	Expansion board with 16 opto-isolated inputs (sinking or sourcing) and 16 outputs (sinking), one 16-bit analog output, one 16-bit analog input, one 24 VDC 1-amp mechanical relay
-MXU	x1024 software multiplication after quadrature; no real-time PSO output
-S	Integral shunt resistor network for Ensemble CP10 and Ensemble CP20
-AUXPWR	Auxiliary 85-240 VAC input to power logic circuitry – required for "keep alive" or 20-120 VDC bus operation; 20-120 VDC operation requires external transformer to generate 15-85 VAC bus power input
-EXTSHUNT	Connection for external shunt resistor network

### Options (Ensemble CP/MP/CL)

BRAKE24-2	24 volt power supply for brake; 2 A
ENET-CAT6-10	1.0 m (3.2 ft) Ethernet cable
ENET-CAT6-20	2.0 m (6.6 ft) Ethernet cable
ENET-CAT6-30	3 m (9.8 ft) Ethernet cable
ENET-CAT6-45	4.5 m (14.7 ft) Ethernet cable

### Options (Ensemble MP)

-IO	Expansion board with 8 opto-isolated inputs (sinking or sourcing), 8 outputs (sinking or sourcing), one 12-bit analog input, one 16-bit analog output, and one 24 VDC 1-amp mechanical relay (must add this option for PSO on the MP)
-MXU	Programmable encoder multiplier up to x1024; no real-time PSO output
-AUXENC	IO auxiliary encoder input

## Ensemble CP/MP/CL ORDERING INFORMATION

### Ordering Example (continued)

<b>Ensemble</b>
<b>Software</b>
Ensemble

### Options (Ensemble CL)

-IO	Expansion board with 16 opto-isolated inputs (sinking or sourcing), 16 outputs (sinking or sourcing ), one 12-bit analog input, one 16-bit analog output, and one 24 VDC 1-amp mechanical relay
-MXU	Programmable encoder multiplier up to x1024; no real-time output
-AUXPWR	Auxiliary 85-240 VAC input to power logic circuitry (Note: Required option for Ensemble CL)

### Ensemble Software

ENSEMBLE-SOFTWARE-IDE	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; includes C# and .NET samples
ENSEMBLE-SOFTWARE-IDE-LAB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; includes C#, .NET, and LABVIEW 8.2 samples
ENSEMBLE-SOFTWARE-IDE-APPLIB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; includes C#, .NET samples and source code.
ENSEMBLE-SOFTWARE-IDE-APPLIB-LAB	ENSEMBLE Integrated Development Environment for software programming, debugging in AeroBASIC; includes C#, .NET samples and source code, and LABVIEW 8.2 samples
ENSEMBLE-SOFTWARE-SUB	One Year subscription to software for new downloads