

# Ensemble® QDe

## High-Performance, Networked, Desktop Piezo Drive

Networkable with any Ensemble drive to control up to ten axes of piezo and/or servo motor stages

Multi-axis Position Synchronized Output (PSO) for real-time triggering of events

High-precision 20-bit sensor resolution for capacitive sensor feedback

Configurable, 18-bit analog input for external feedback sensor integration or command generation

Advanced control features such as learning control, harmonic cancellation and command shaping improve tracking error and overall process throughput

Ethernet and USB 2.0 communication interfaces

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

Program in AeroBasic™ using Aerotech's IDE or create custom remote interfaces with Microsoft .NET including C#, VB.NET, Managed C++, LabVIEW®, EPICS, MATLAB®, and TANGO

The Ensemble QDe is a high-performance desktop nanopositioning piezo drive designed for seamless use with the Ensemble family of drives and controllers. The QDe connects to any Ensemble controller network enabling coordinated motion between piezo stages and servo axes at much higher rates than other controller or drive products. This power and versatility make the Ensemble QDe ideal for single or multi-axis applications ranging from fundamental scientific research to advanced OEM machine systems.

Featuring a dual-core 456 MHz, double-precision, floating-point DSP, the QDe provides extreme processing power



The Ensemble QDe provides multi-axis functionality in a discrete single-axis, desktop package.

over a wide variety of applications including point-to-point motion, linear and circular interpolation, multi-axis error correction, and autofocusing. High-speed interrupts and data logging capabilities provide a real-time link to external systems. The QDe also features high-speed positioning latching capability and multi-axis position synchronized output (PSO) for generation of pulses based on actual position feedback in applications ranging from laser firing to acquisition system triggering.

### High-Resolution and Ultra-Precise Feedback

Using the latest technology and high-resolution A/D and D/A converters, the QDe enables sub-nanometer positioning resolution at high bandwidths. The QDe capacitive sensor feedback circuitry results in exceptionally low noise levels over the full travel range. Using an Aerotech developed proprietary linearization scheme achieves linearity better than 0.01% over the full travel range in closed-loop mode.

### Precision I/O

In addition to the four optically-isolated digital inputs, two high-speed digital inputs and four optically-isolated digital outputs, the Ensemble QDe possesses two analog inputs and two analog outputs. One analog input, an 18-bit precision A/D, can be programmatically configured to accept an external feedback sensor or position command. This analog input also allows direct control of the high-voltage power amplifier by an external low-level analog input. Also, one 20-bit D/A analog output can be programmatically configured for position or voltage monitoring at very high resolutions.

### Advanced Software and Control Features

The Ensemble QDe uses PID servo loops with advanced feedforward and multiple integrators coupled with eight programmable filters to supply the user with all necessary tools needed to optimize motion performance. Additional

## QDe DESCRIPTION

software options such as the Dynamic Controls Toolbox and Motion Designer packages make available a host of advanced, yet easy-to-use, tools such as Learning Control, Harmonic Cancellation, Command Shaping, and Cross-Axis Feedforward to improve tracking errors and provide faster step-and-settle times.

### Powerful Programming and Software Drivers

Monitor and control all aspects of the positioning system, no matter how complex, through the Ensemble GUI Integrated Development Environment software. Advanced tuning utilities minimize 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, MATLAB® library, .NET tools

for C#, VB.NET and managed C++ or C make the Ensemble even easier to use. See the Ensemble Control home page for detailed information on software capabilities and ordering options.

### Automatic Parameter Configuration

Aerotech's piezo stages include our time-saving "FlashConfig" feature that stores all of the parametric information required to operate the stage. Upon plug-in, the QDe automatically identifies the connected stage. All operation parameters, including axis calibration data and software parameters, are uploaded into the Ensemble QDe. This ensures faster setup and avoids errors that can result in substandard performance. "FlashConfig" provides true "plug and play" operation of your Aerotech stage.

The screenshot displays the Ensemble IDE (0.09) interface. The main window shows a G-code program for a 10-axis system. The code includes commands for waiting in mode, dwelling, faulting, enabling, homing, and moving axes X, Y, and Z. The program is structured as follows:

```

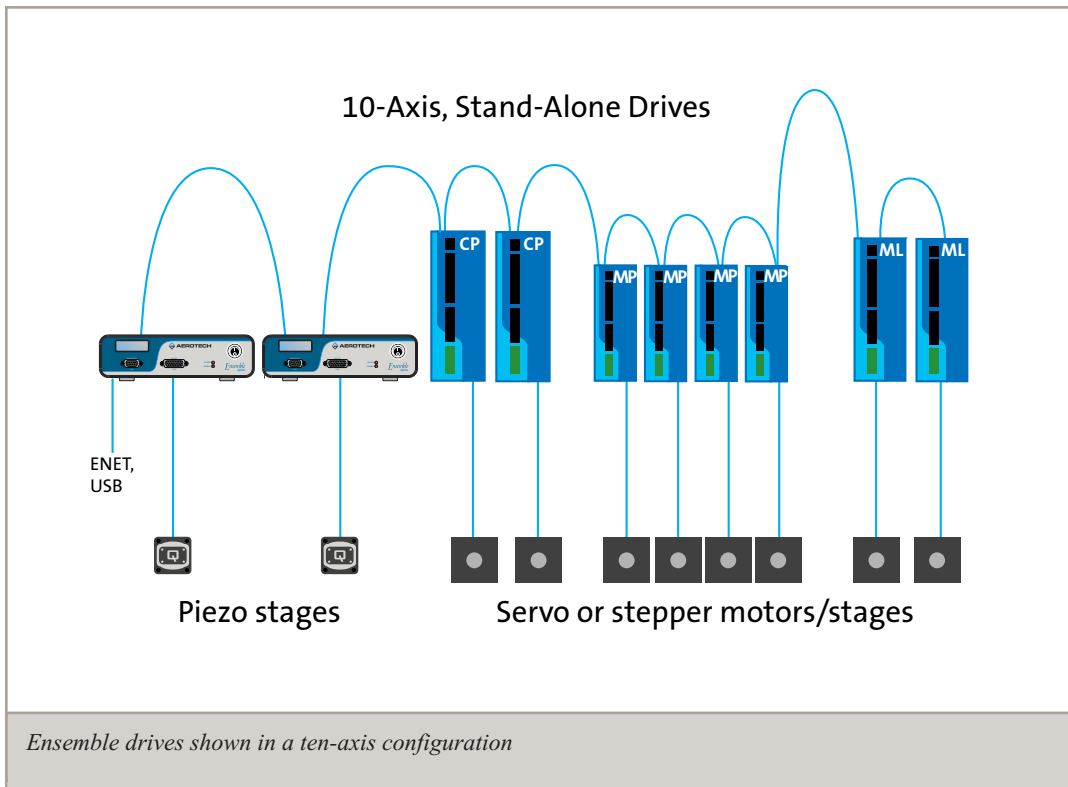
1  wait mode inpos
2
3
4
5  DWELL 5      ' auto-boot delay
6
7  faultack X Y
8  enable X Y
9  home X Y
10 DWELL 0.5    ' half second between all moves
11
12 while 1
13
14   moveinc X8000000 XF5000000
15   DWELL 0.5    ' half second between all moves
16
17   moveinc Y100000 YF40000
18   DWELL 0.5    ' half second between all moves
19
20   moveinc X-8000000
21   DWELL 0.5    ' half second between all moves
22
23   moveinc Y-100000
24   DWELL 0.5    ' half second between all moves
25
26   moveinc X8000000 Y100000 XF10000000 YF80000
27   DWELL 0.5    ' half second between all moves
28
29   moveinc X-8000000 Y-100000
30   DWELL 0.5    ' half second between all moves
31
32 wend
33
34
    
```

The right-hand side of the IDE features several diagnostic windows:

- Controller I/O:** Shows position, program, and velocity feedback for axes XX, YY, and ZZ.
- Axis I/O:** Shows various limit and input status for axes XX, YY, and ZZ.
- Axis Fault:** Shows fault status for axes XX, YY, and ZZ.
- Axis Status:** Shows the current status of axes XX, YY, and ZZ.

The status bar at the bottom indicates "System Online" and "EpaqMahogany" with "No Task Selected".

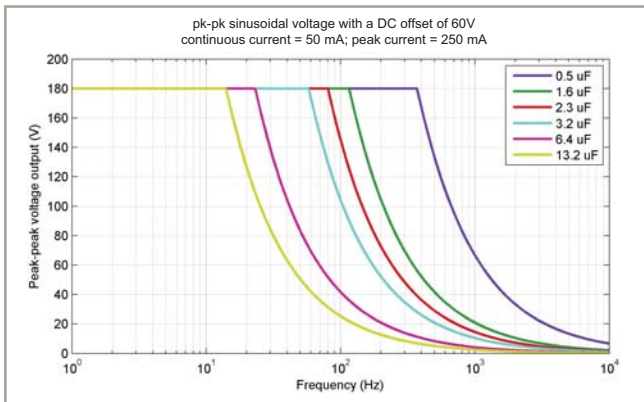
Ensemble IDE.



Ensemble drives shown in a ten-axis configuration

## Ensemble QDe SPECIFICATIONS

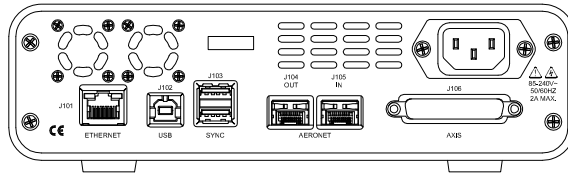
Feature	QDe250
Package Type	Desktop
Processor	Dual-Core 456 MHz, Double-Precision, Floating Point DSP
Power Supply	100-240 VAC; 50/60 Hz
Voltage Output	-30 to +150 V
Sensor Type	Capacitive Sensor
Sensor Resolution	20-bit
Voltage Resolution	20-bit
Continuous Power Output	10 Watts
Peak Current Output	250 mA
Continuous Current Output	50 mA
Digital Inputs	(4) Optically Isolated, (2) High Speed, and (1) ESTOP
Digital Outputs	(4) Optically Isolated
Analog Inputs	2 Total, $\pm 10$ V Differential (1) 16-bit General Purpose, (1) 18-bit High-Resolution Configurable for External Feedback or External Command Input
Analog Outputs	2 Total, $\pm 10$ V Single-Ended (1) 16-bit General Purpose, (1) 20-bit High-Resolution Configurable for Position or Voltage Monitoring
High-Speed Data Capture	Yes (50 ns latency)
Position Synchronized Output (PSO)	Three-Axis Standard
Cap Sensor Synchronization	Yes
Communication Interfaces	10/100 Base T Ethernet, USB 2.0
Servo Loop Update	20 kHz
Programming Environment	Multi-Tasking AeroBasic
Weight	1.4 kg (3.0 lbs)



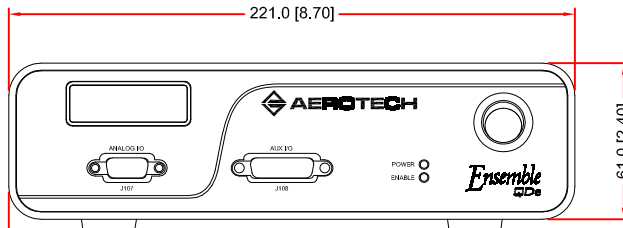
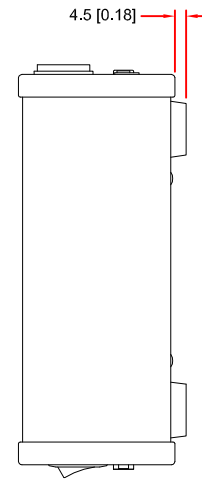
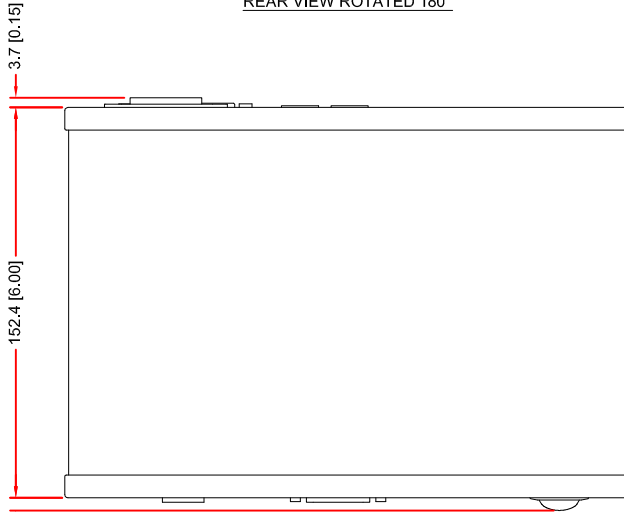
*QDe sinusoidal peak-peak voltage limits (with a 60 VDC offset) for various piezo stack capacitances.*

Ensemble QDe DIMENSIONS

Ensemble QDe250-C



REAR VIEW ROTATED 180°



29.0 [1.14]

ENSEMBLE QDe FRONT VIEW

## Ensemble QDe ORDERING INFORMATION

### Ensemble QDe High-Performance Panel-Mount Piezo Drive

Ensemble QDe250-C	High-performance networkable, standalone desktop piezo drive with capacitive sensor feedback, 250 mA peak current, 50 mA continuous current, -30 to +150 V output. Features include: <ul style="list-style-type: none"> <li>• High-precision 20-bit sensor resolution for cap sensor feedback in closed-loop.</li> <li>• Configurable input/outputs; 4 opto-isolated inputs, two high-speed digital inputs, 4 opto-isolated outputs, two analog inputs (1 18-bit, 1 16-bit), and two analog outputs (1 20-bit, 1 16-bit).</li> <li>• 3-axis Position Synchronized Output (PSO) standard</li> <li>• 10/100 base T Ethernet port; 1 USB 2.0 port</li> </ul>
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### Line Cord

-ENGLAND	UK compatible line cord
-GERMANY	German compatible line cord
-ISRAEL	Israel compatible line cord
-INDIA	India compatible line cord
-AUSTRALIA	Australia compatible line cord
-US115VAC	US 115 VAC line cord
-US230VAC	US 230 VAC line cord
-NOLINECORD	No line cord

### Ensemble Software Options

-DYNAMIC CONTROLS TOOLBOX	The Dynamic Controls Toolbox provides control algorithms that increase system performance such as settle time, accuracy, in-position stability and/or velocity stability.
-MOTION DESIGNER	Motion Designer is used to graphically generate and edit motion profiles that execute on the controller, providing the ability to import, run and evaluate motion profiles (trajectories). Included in the Motion Designer software is learning control that reduces tracking errors by as much as 1000 times.
-LABVIEW	LabVIEW® VI samples
-MATLAB	Includes MATLAB® library for motion, parameters, and data collection.