## Microstepping systems - the next generation

ZETA Series drives form the basis of a user-friendly system that delivers high performance and reliability with a choice of two packages—the ZETA4 drive and the ZETA6104 drive/indexer. Both models incorporate the breakthrough techniques known as Active Damping and Electronic Viscosity (patents pending). This combination of innovative features makes the ZETA Series the smallest, highest performing and most cost-effective microstepping system available today. Furthermore, the products incorporate the latest developments in ASIC (Application Specific Integrated Circuit) and FPGA (Field Programmable Gate Array) technology.

The ZETA4 drive is perfect for multi-axis applications and allows control by any standard step and direction or clockwise/counter clockwise indexer.

The ZETA6104 combines the power and reliability of Parker's ZETA drive with the flexibility of the 6000 Series indexers. This advanced design gives the ZETA6104 an unmatched performance and versatility.

Like all 6000 Series products, the ZETA6104 uses the 6000 Series command language—a powerful programming language that is flexible enough to implement complex motion control applications, yet simple enough for the novice programmer. The ZETA6104 is also compatible with Motion Toolbox, DDE6000 Server and Motion Builder for additional application ease-of-use and flexibility.

The ZETA6104 can operate stand-alone or can interface to PCs and PLCs.

## ZETA series features

### *Performance*

- Torques from 0.5 to 3.4 Nm
- Active Damping (patent pending) provides:
  - Damping ratios of up to 0.5
  - Higher acceleration than conventional stepper systems
  - Reduced motor vibration
  - Increased shaft power
  - Higher overall performance
- Electronic Viscosity (patent pending) provides:
  - Reduced settling time
  - Improved slow-speed smoothness (reduced velocity ripple)
  - Less audible noise
- Anti-resonance eliminates mid-range instability and provides damping ratios of up to 0.2
- Damping adjustable for optimised performance

### *Protection circuits*

- Motor short circuits (phase-to-phase and phase-to-ground)
- Overtemperature
- Overvoltage
- Power dump (dissipates excessive regenerated power during deceleration)

### *Physical*

- Drive status indicators: power, step input, over/under voltage, overtemperature and motor fault
- 120 VAC nominal input (170 VDC bus voltage)
- Removable connectors for easy installation

### Controlling step motor response

Step motors often require some form of damping to minimise the likelihood of stalling caused by oscillation at the resonant frequency. The higher the degree of damping, the quicker the oscillation will decay. A well-damped step motor system will be able to achieve the highest overall performance.

Previously, the usual way to increase the damping of a step motor system was by mechanical means. Mechanical dampers are mounted on the back of the motor and come in a variety of types. The most common and effective type of damper consists of a seismic mass suspended in a viscous fluid.

However, mechanical dampers do not always provide a perfect solution. They need to be sized according to the load. If the load changes or mechanical wear occurs, the damper is no longer as effective. Furthermore, mechanical dampers can add significant inertia to the system, reducing the acceleration rate that can be attained.

The ZETA Series Drives provide electronic damping with no additional devices to connect. The damping effect is configurable, so it can change if the application changes. In the case of the ZETA6104, the damping is programmable by software so it can be altered during the machine cycle if required.

ZETA's Active Damping (patent pending) offers the following benefits:

- The likelihood of stalling is minimised without the additional expense and inertia of a damper
- Useable torque is increased
- Higher acceleration rates can be attained

### Damping at no extra cost

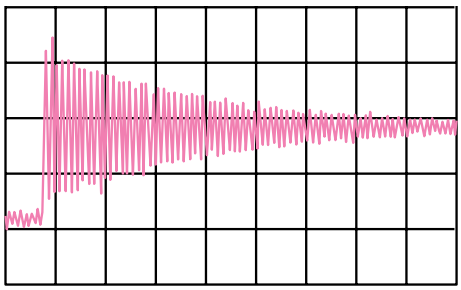
Mechanical dampers can be expensive; a good one may cost considerably more than the motor itself. The ZETA Series provides adjustable electronic damping at no additional cost.

### More useable torque at all speeds

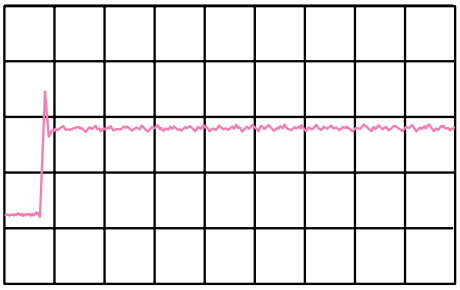
In conventional step motor systems, the speed-torque curve represents the maximum measurable torque rather than useable torque. A safety margin is always necessary to be able to control rotor oscillation as well as to allow for changing load and friction conditions. As a result of Active Damping, the ZETA system requires a smaller safety margin resulting in higher useable torque at all speeds.

### Quicker settling following a speed change

The diagram above shows an example of the ringing that can result when an undamped step motor is commanded to change velocity from 4rps to 7rps. The motor is driving a load inertia equal to six times the rotor inertia. In this undamped system, it takes almost two seconds for the motor to settle at the new speed. Using the ZETA Drive, the settling time is reduced to 20 milliseconds. Actual ringing and settling times are application-specific and will depend on move parameters as well as the inertia of the load.



Traditional Stepper–Settling Time = 1860 Milliseconds



ZETA Drive–Settling Time = 20 Milliseconds

### Improved end-of-move settling

With conventional stepper systems, the motor shaft oscillates around its commanded final position before settling at the end of a move. In many applications this settling period represents wasted time since the next operation must be delayed until the motor has settled.

ZETA's Electronic Viscosity feature (patent pending) takes over from Active Damping at speeds below 3rps and damps the ringing of the motor at the end of the move. This allows higher system throughput due to the reduction in settling time, and also gives a significant improvement in low-speed smoothness since velocity ripple is reduced.

The combination of Active Damping and Electronic Viscosity gives much tighter control of step motor response and a significant improvement in overall system performance.

## ZETA6104 Packaged Indexer/ Drive System

The ZETA6104 is a stand-alone, single-axis drive/indexer system. It packs all the power and reliability of the 6000 family of controllers and ZETA drives into one convenient package. All of the I/O points, RS-232C/RS422/RS485 control, operator interface options and following capabilities for single-axis applications are included. The following package can perform phase shifts, electronic gearbox and flying cutoff functionality with ease.

The ZETA6104 is designed to solve single-axis applications cleanly and completely. For multiple-axis applications, up to 99 ZETA6104s can be daisy chained together (up to 32 units can be multi-dropped using RS-422/RS-485).

In order to speed your application development, the ZETA6104 comes standard with Motion Architect, a Microsoft Windows-based development package. Motion Architect contains many tools which allow you to easily create and implement motion programs. The ZETA6104 is also compatible with Motion Toolbox™, DDE6000 Server, and Motion Builder software packages.

Using the 6000 Series command language, the ZETA6104 is powerful enough to implement complex motion control applications yet simple enough not to overwhelm the novice programmer.

### ZETA6104 features

#### *I/O*

- Encoder channels configurable as hardware up/ down counters
- Incremental encoder input
- All inputs and outputs are optically isolated
- Home and end-of-travel limit inputs
- Two fast (trigger) inputs for position capture, registration, etc.
- 16 programmable inputs (Opto-22 compatible)
- Nine programmable outputs (Opto-22 compatible)

#### *Language*

- 40,000 bytes of non-volatile memory for storing programs and paths (expandable to 150 Kbytes)
- Interrupts program execution on error conditions
- Encoder and motor position capture (using the trigger inputs)
- Registration (using the trigger inputs)
- Programmable damping to optimize performance for changing loads
- Variable storage, conditional branching and maths capability
- Program debug tools – single-step and trace modes, breakpoints, error messages and simulation of I/O

#### *Software provided*

- Motion Architect, Microsoft Windows-based application development software
- DOS®-based program editor and terminal emulator software
- Dynamic Link Library (DLL) provided for use with Microsoft Windows and Microsoft Windows NT software development kits

#### *Interface capabilities*

- Operates stand-alone or interfaces to PCs and PLCs
- Communication with PC or dumb terminal via 3-wire RS-232C interface
- One dedicated RS-232C port
- One configurable port for RS232C, RS422 or RS485

#### *Physical*

- Stand-alone indexer/drive package
- Four diagnostic LEDs
- Removable connectors for easy installation
- 120 VAC input (170 VDC bus voltage)

## ZETA4 & ZETA6104 common specifications

| Parameter | Value |
|---|---|
| Performance | |
| Accuracy | ±5 arc min (0.083°) typical, unloaded & bidirectional with Parker-supplied motors. In loaded condition, add 1 arc min (0.017°) for each increment of load equal to 1% of rated torque. |
| Repeatability | ±5 arc sec (0.0014°) typical, unloaded, one revolution returning to start point from same direction. |
| Hysteresis | Less than 2 arc min (0.033°) unloaded, bidirectional. |
| Resolution | Selectable, 200, 400, 1000, 2000, 5000, 10000, 12800, 18000, 20000, 21600, 25000, 25400, 25600, 36000, 50000 & 50800 steps/rev |
| Waveform | Selectable, allows profile shaping for optimum smoothness or relative accuracy. Options are pure sine, -4%, -6% & -10% third harmonic. |
| Motors | |
| Type | 2-phase hybrid; 4, 6 or 8 leads |
| Minimum Inductance | 0.5mH |
| Recommended Induct. Range | 5 to 50mH (80mH max) |
| Amplifier | |
| Type | 20 kHz fixed frequency, variable duty cycle PWM (pulse width modulated). Current controlled, bipolar type. MOSFET construction. |
| Number of phases | 2 |
| Output current | 4A peak |
| Protection* | |
| Short Circuit | Phase-to-phase, phase-to-ground. |
| Undervoltage | If AC supply drops below 85VAC. |
| Overtemperature | If internal air temperature exceeds 70°C. |
| Auto standby | If selected, motor current ramps to 50% of preset value if no step pulses received for 1 second. Rated current levels are resumed upon receipt of next step pulse. |
| Power input | 90 - 130V AC, 50/60Hz |
| Environmental | |
| Operating temp: | 0°C to 50°C (maximum allowable ambient temperature is 50°C; fan cooling may be required if airflow is restricted. |
| Storage temp: | -30°C to 85°C |
| Humidity | 0-95%, non-condensing |

* Drive shuts down under conditions listed. Power must be cycled to resume operation.

## ZETA4 specifications

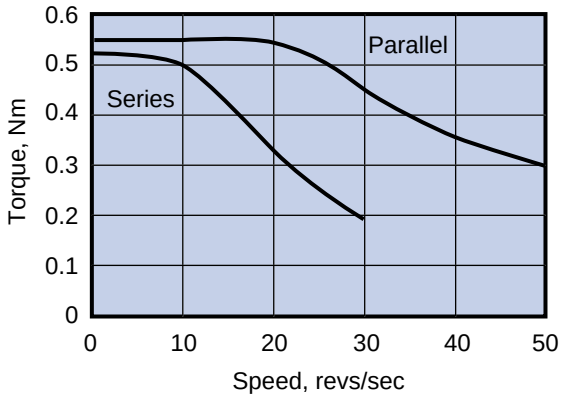
| Parameter | Value |
|---|---|
| Signal inputs | Opto-isolated differential inputs, TTL levels. Quoted logic levels refer to the + input |
| Step Input | High-going pulse, 200 nsec min. width; max. pulse rate is 2 MHz. |
| Direction Input | Logic High = positive (CW) rotation. Logic Low = negative (CCW) rotation. |
| CW/CCW step input | Switch-selectable. High-going pulse, 200 nsec min. width; max. pulse rate is 2 MHz. |
| Shutdown Input | Logic High = amplifier disable. Logic Low = normal operation. |
| Reset input | Logic High = drive held in reset. Logic Low = normal operation. |
| Fault Output | Conducting = normal operation. Not conducting = drive fault. |
| Auto test function | This feature (used primarily for testing and verification of correct wiring) rotates the motor at approximately 1 rps in the negative (CCW) direction if the motor is wired correctly. |

## ZETA6104 specifications

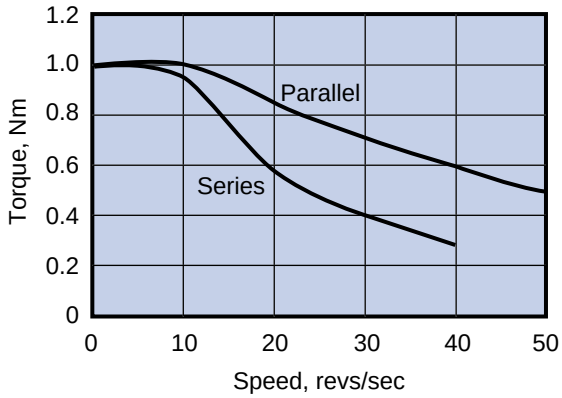
| *Parameter* | *Value* |
|---|---|
| Performance | |
| Position range | ±2,147,483,648 steps |
| Velocity range | 1 to 2,000,000 steps/sec |
| Acceleration range | 1 to 24,999,975 steps/sec$^2$ |
| Stepping Accuracy | ±0 steps from preset total |
| Velocity Accuracy | ±0.02% of maximum rate |
| Velocity Repeatability | ±0.02% of set rate |
| Motion Algorithm Update Rate | 2 ms |
| RS232C Interface | |
| Connections | 3-wire (Rx, Tx, and GND) connection to the COM1 and/or COM2 connectors. |
| Maximum number of ZETA6104s | 99 units in daisy-chain configuration |
| Communication parameters | 9,600 baud (auto-baud option); 8 data bits, 1 stop bit, no parity bit, full duplex. |
| RS485 Interface | |
| Connections | 4-wire (Rx+, Rx-, Tx+, Tx-) using COM2 connector (configured as RS-485 Interface). |
| Maximum number of ZETA6104s | 32 multi-dropped units |
| Communication parameters | 9,600 baud, 8 data bits, 1 stop bit, no parity bit, full duplex. |
| Inputs | All inputs are optically isolated. |
| Encoder | Accepts differential (recommended) or single-ended quadrature encoder outputs. Max voltage 5 VDC. TTL switching levels - Low ≤0.4V, High ≥ 2.4V. Maximum frequency 1.9 MHz. Minimum time between transitions 625 ns. |
| 16 Programmable | HCMOS* compatible with internal 6.8 KΩ pull-up/pull down (selectable). Voltage range 0–24V. 50-pin plug compatible with OPTO-22™ signal conditioning equipment. |
| Trigger Inputs | Two high-speed inputs for encoder capture and registration. HCMOS* compatible with internal 6.8KΩ pull-up/pull down (selectable). Voltage range 0–24V. |
| Home, Pos/Neg Limits | HCMOS*; internal 6.8KΩ pull-up/pull down (selectable). Voltage range 0–24V. |
| Outputs | |
| 9 Programmable | Optically isolated, HCMOS* compatible, open collector outputs with 4.7KΩ pull ups. Can be pulled up to +5V on auxiliary board, or to user-supplied voltage up to 24V. Max OFF voltage 24V, max ON current 30mA. 50-pin plug compatible with OPTO-22™ signal conditioning equipment. |
| Environmental | |
| Operating temperature | 0° to 50°C |
| Storage temperature | -30° to 85°C |
| Humidity | 0% to 95% non-condensing |
| Diagnostic LEDs | Power/drive on, step pulses, drive overtemperature, motor short circuit |

* HCMOS-compatible voltage levels: low ≤ 1.67V, high ≥ 3.3V. TTL-compatible voltage levels: low ≤ 0.4V; high ≥ 2.4V

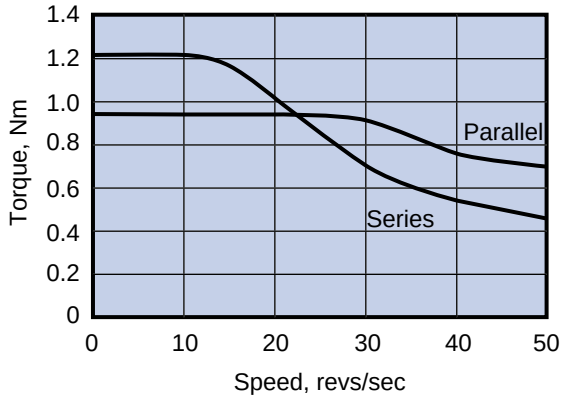
### ZETA4 with ST57-51M motor*



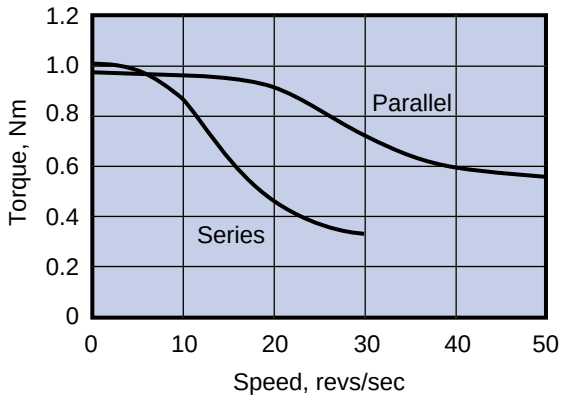

### ZETA4 with ST57-83M motor*



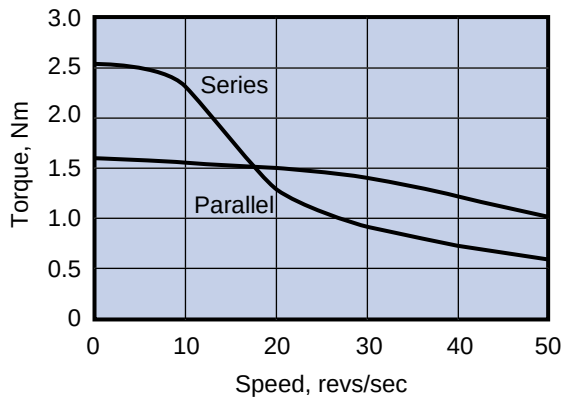

### ZETA4 with ST57-102M motor*



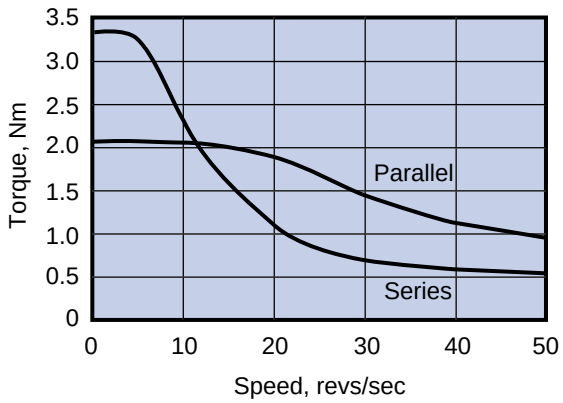

### ZETA4 with ST83-62M motor




### ZETA4 with ST83-93M motor

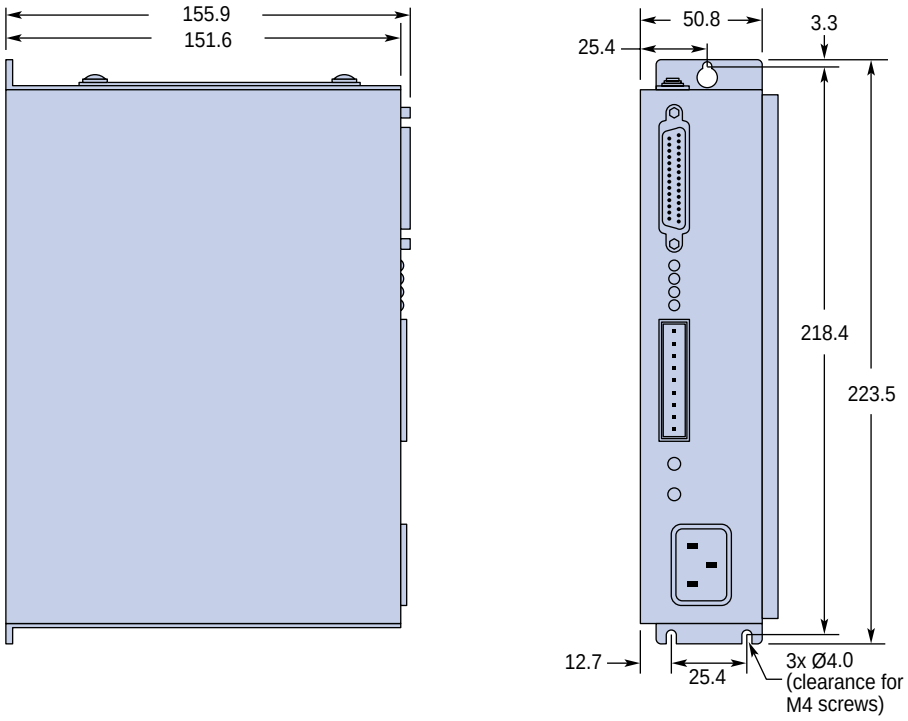



### ZETA4 with ST83-135M motor




* Series connection available only on flying lead version of this motor

## ZETA4 dimensions (mm)




## ZETA6104 dimensions (mm)