

Microstepping systems - the next generation....

The new ZETA series drives from Parker represent a true revolution in microstep drive design. Incorporating breakthrough techniques known as Electronic Viscosity and Active Damping (patents pending), they offer a level of performance hitherto unattainable from a production stepper drive. By achieving a dramatic reduction in settling time both at the end of a move and following a speed change, the ZETA drive allows higher throughput rates to be realised at the same time as reduced mechanical vibration.

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.

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.

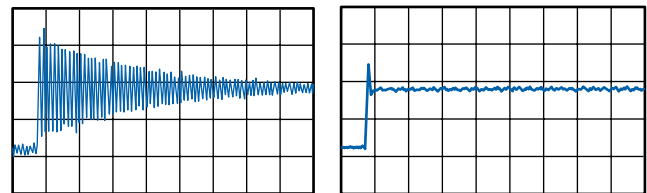
More useable torque at all speeds

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 below 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.

Settling time following a speed change



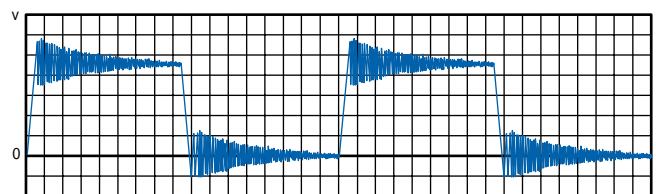
Traditional stepper - 1860 mS ZETA drive - 20 mS

Improved end-of-move settling

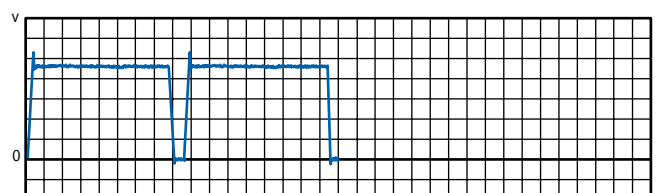
With conventional stepper systems, the motor shaft oscillates around its commanded final position before settling at the end of a move. In many applications this settling period represents wasted time since the next operation must be delayed until the motor has settled.

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.

Comparative throughput - two machine cycles



Traditional stepper drive



ZETA drive

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

A major advance in microstepping technology

ZETA Series microstep drives form the basis of a revolutionary system that delivers exceptional performance and reliability. They incorporate Parker's Active Damping and Electronic Viscosity, a combination of innovative features which makes the ZETA Series the highest performing and most cost-effective microstepping drives currently available. In addition, the products incorporate the latest developments in ASIC (Application Specific Integrated Circuit) and FPGA (Field Programmable Gate Array) technology.

The ZETA4-240 has been developed from the acclaimed ZETA4 and permits direct operation from AC supplies up to 240V. It is CE marked for LVD compliance and meets EMC requirements with the addition of an EMC installation kit. The ZETA4's output current rating of 4A/phase has been retained, doubling the power capability - peak torque is up to 14Nm and maximum available shaft power is now 800 watts. The drive is ideal in both single and multi-axis applications and allows control by any standard step and direction or clockwise/counter clockwise indexer.

A new range of CE-marked motors has been introduced for use with the ZETA4-240. Designated the R-series, these motors have high-voltage windings specifically for use at bus voltages up to 340VDC. They are available in 34 and 42 frame sizes and have a distinctive yellow finish to distinguish them from standard versions.



ZETA4-240 features

Performance

- Torques up to 14 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 low-speed smoothness
 - Less audible noise
- Anti-resonance eliminates mid-range instability and provides damping ratios of up to 0.2
- Damping adjustable for optimised performance

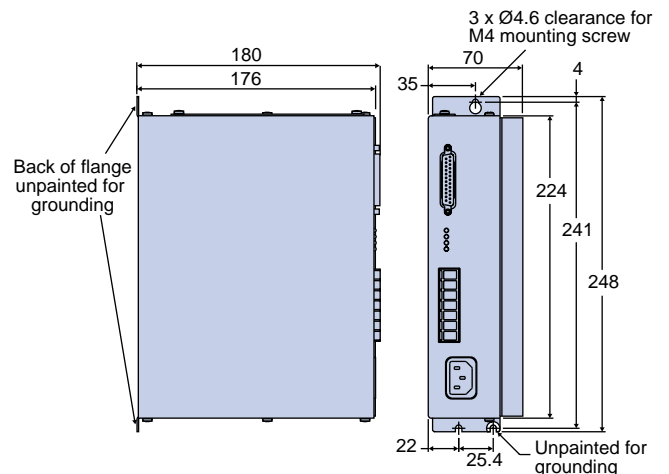
Protection circuits

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

Additional features

- Drive status indicators: power, step input, over/under voltage, overtemperature and motor fault
- 230/240VAC nominal input (340VDC bus voltage)
- Removable connectors for easy installation

ZETA4-240 drive dimensions (mm)



<i>Parameter</i>	<i>Value</i>
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 (0.0334°) unloaded, bidirectional.
Resolution	16 selectable choices: 200, 400, 1000, 2000, 5000, 10000, 12800, 18000, 20000, 21600, 25000, 25400, 25600, 36000, 50000, 50800
Waveform	Selectable. Allows microstepping shaping for optimum smoothness or relative accuracy. Pure sine, -2%, -4%, -6%, -10% third harmonic.
Motors	
Type	2-phase hybrid permanent magnet, 1.8 degree.
Breakdown voltage (HIPOT)	1900V DC
Number of leads	4, 6 or 8
Accuracy Grade	3%
Inductance	0.5 mH minimum; 5 to 50 mH recommended range; 80 mH max
Amplifier	
Type	20 kHz fixed frequency, variable duty cycle PWM (pulse width modulated). Current controlled, bipolar type. MOSFET construction.
Number of phases	2
Protection:*	
Short Circuit	Phase-to-phase, phase-to-ground.
Under voltage	If AC supply drops below 85VAC.
Overtemperature	If internal air temperature exceeds 55°C.
Auto standby	If selected, motor current ramps to 50% of preset value if no step pulses are received for 1 second. Rated current levels are resumed upon receipt of next step pulse.
Automatic test function	This feature (used primarily for testing and verification of correct wiring) rotates the motor at approximately 1 rps in the CCW direction.
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. Direction input change may coincide with first step pulse.
CW/CCW Input	Dip switch selectable. High-going pulse, 200nsec min. width, max pulse rate 2MHz.
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. Open collector and open emitter.
Power Input	95 - 264VAC, 50/60 Hz
Weight	2.7kg
Environmental	
Operating	0°C to 50°C
Drive	Maximum allowable ambient temperature is 50°C. Fan cooling may be required if airflow restricted.
Motor	100°C maximum motor case temperature. Actual temperature rise duty cycle dependent.
Storage	-40°C to 85°C
Humidity	0-95%, non-condensing

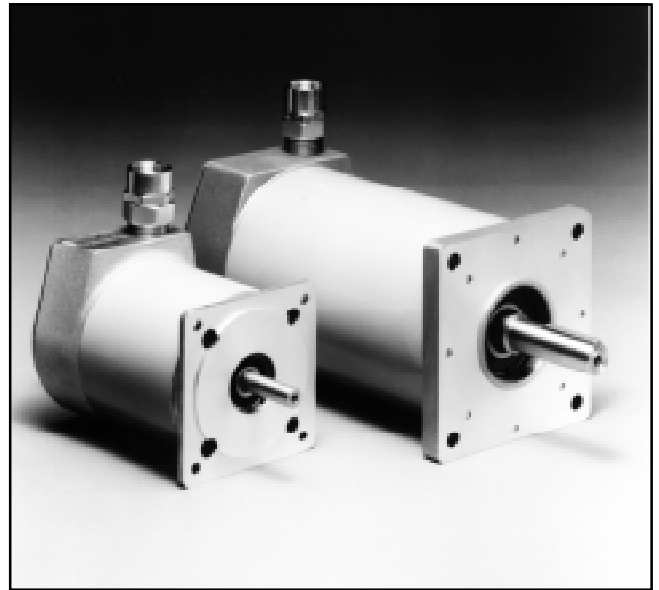
* Drive shuts down in conditions listed. Power must be cycled to resume operation.

A range of high-performance motors compatible with ZETA

To take advantage of the higher bus voltage in the ZETA4-240, a range of compatible motors has been specially developed. The R-series motors have a high-voltage winding specifically for use at voltages up to 340V DC (please note that standard stepper motors are unsuitable for use at this voltage and may be severely damaged if used with the ZETA4-240).

Available in 34 and 42 frame sizes, the R-series motors produce torques in the range 1Nm to 14Nm. The 34-size motors in particular offer exceptional performance - the high operating voltage results in virtually constant torque output up to 3000 rpm. There is an enhanced version of the 42-size double stack motor (RE series) which delivers approximately 50% more torque than the standard type, and over 800 watts of shaft power at 2000 rpm.

All motors may be fitted with a 1000-ppr differential encoder, and a special cable kit (type C10) can be supplied to meet the requirements of the EMC Directive.

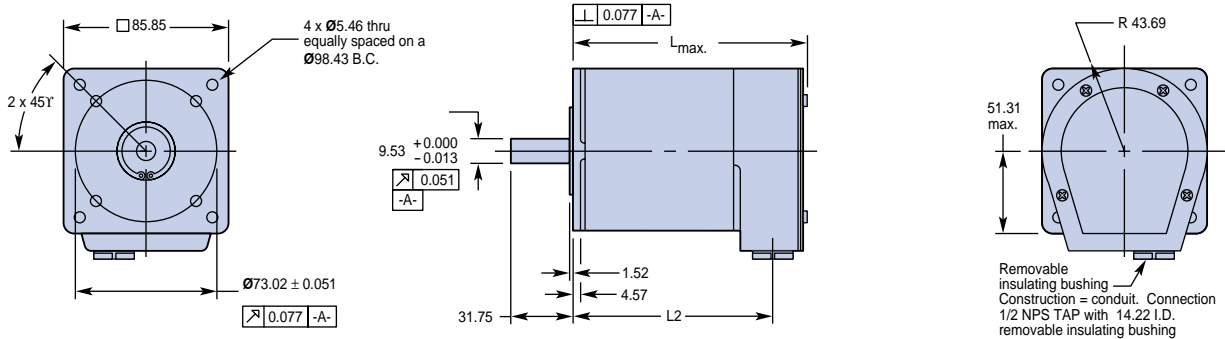


R Series Motor Specifications

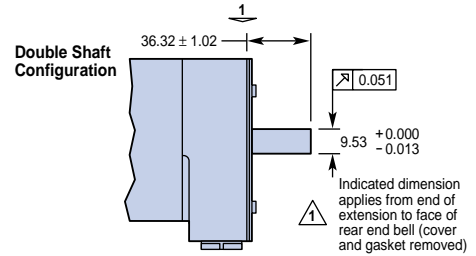
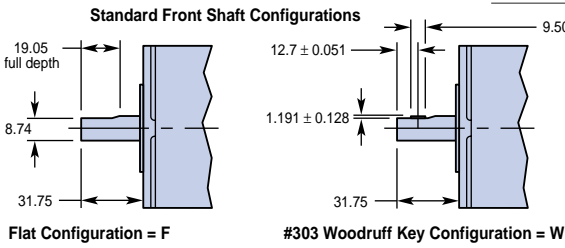
	Size 34			Size 42		
	RS31C	RS32C	RS33C	RS42C	RE42C	RS43C
Static torque Nm	1.21	2.06	3.76	8.94	13.8	11.8
Rotor inertia kg-cm ²	0.59	1.2	1.8	11.29	11.29	16.94
Drive Current A pk (RMS)						
Series	2.3 (1.6)	2.9 (2.0)	3.5 (2.5)	3.3 (2.3)	3.4 (2.4)	4.0 (2.8)
Parallel	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)	4.0 (2.8)
Phase Inductance mH						
Series	17.4	26.2	23.3	65.4	55.6	42.9
Parallel	4.3	6.5	5.8	16.4	13.9	10.7
Detent Torque kg-cm ²	0.062	0.13	0.19	0.35	0.57	0.5
Bearings – Thrust load rating N	800	800	800	1800	1800	1800
Bearings – Radial load rating N	150	150	150	600	600	600
Bearings – End play mm (5N reversing load)	0.025	0.025	0.025	0.025	0.025	0.025
Bearings – Radial play mm per 2N load	0.02	0.02	0.02	0.02	0.02	0.02
Motor Weight kg	1.45	2.41	3.45	8.26	8.26	11.66
Certifications						
UL recognised	yes	yes	yes	yes	yes	yes
CE - LVD	yes	yes	yes	yes	yes	yes
CE - EMC & LVD	*	*	*	*	*	*

* EMC compliance is achievable with C10 Cable Kit and EMC Kit

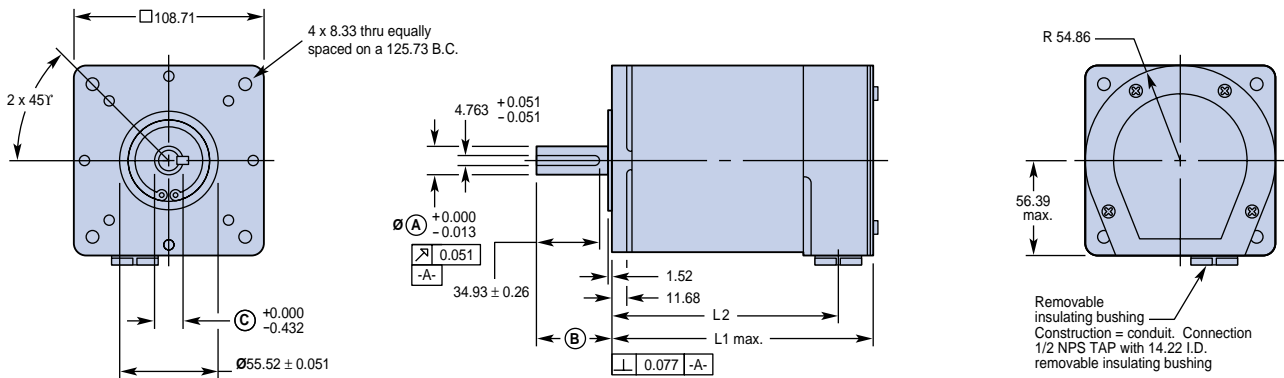
R-motors frame size 34



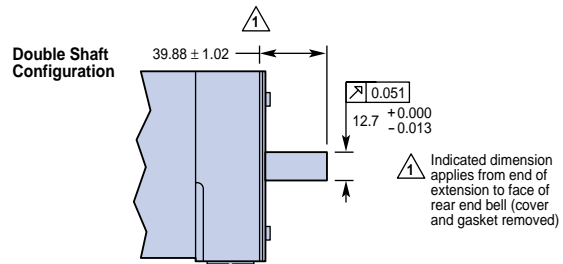
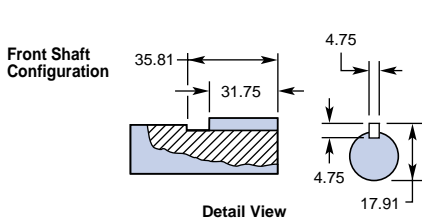
Model	Lmax	L2
RS31C-nnNPS	91.95	72.9
RS32C-nnNPS	121.16	102.11
RS33C-nnNPS	153.67	134.62



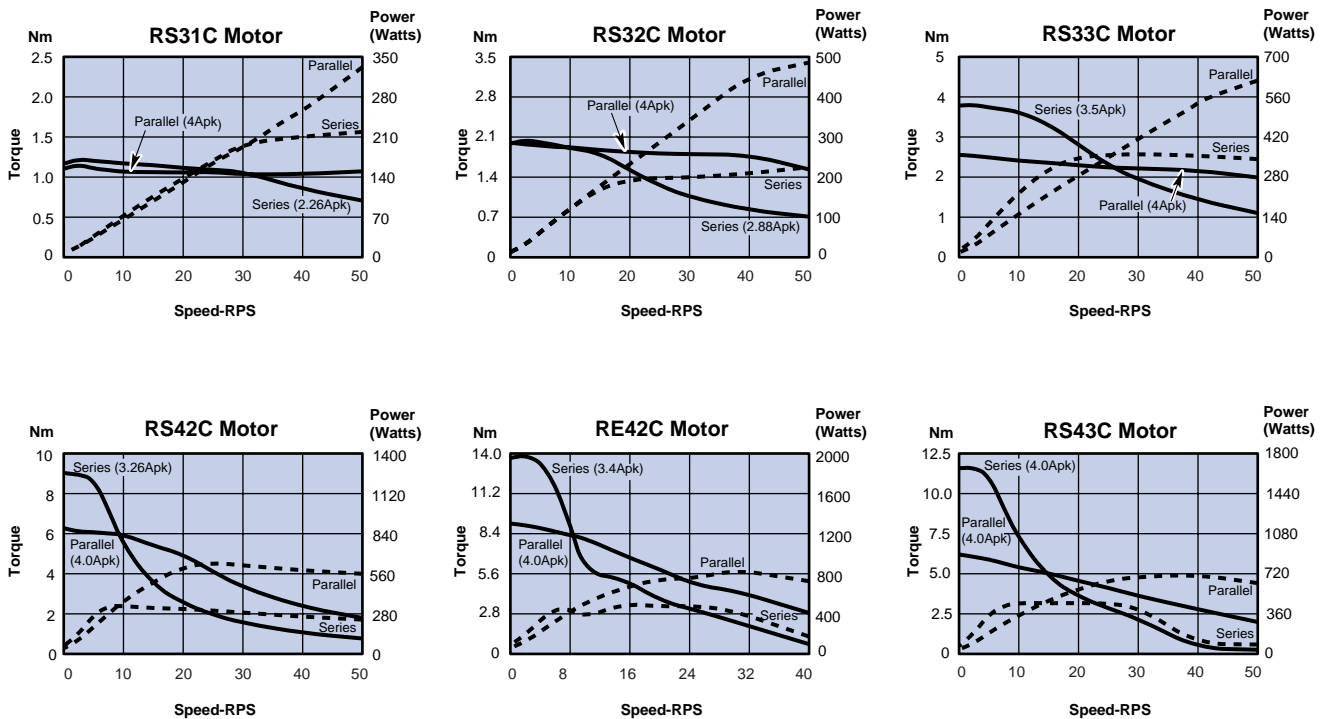
R-motors frame size 42



Model	L1max	L2	A	B	C
RS42C-nnNPS	204.22	185.17	15.57	55.63	17.91
RE42C-nnNPS	204.22	185.17	15.87	55.63	17.91
RS43C-nnNPS	268.23	249.18	19.05	55.63	21.09



Speed/torque curves: ZETA4-240 on 240v AC input



Solid lines indicate torque, broken lines indicate shaft power.

Drive & accessory order codes

Model	Description
ZETA4-240	High-power ZETA drive for 240V AC operation
ZETA240 EMC Kit	LVD/EMC Drive Kit (includes the AC power filter and EMC drive/indexer cable)
C10	LVD/EMC Step-motor cable kit (includes 3 mtr LVD/EMC cable, gland (360° shielded connector), R-clamp, screws and assembly instructions.
EC*	1000 ppr differential encoder with line driver & 3mtr cable.
3NPS*	Encoder mounting plate for size 34 NPS motors.
4NPS*	Encoder mounting plate for size 42 NPS motors.

* The encoder option requires the EC encoder and appropriate NPS mounting plate to be ordered separately

Motor order codes

Series	Type	Frame	No. of stacks	Winding	Shaft	Standard shaft	Construction	Encoder option
R (round)	S-standard E-enhanced (42 only)	3-size 34 4-size 42	1-1 stack† 2-2 stack 3-3 stack	C-340V (yellow body)	S-single D-double	N-smooth (34 size) K-key (42 size)	NPS-end bell & terminal board via 1/2" NPS thread	Blank-none EC-1000ppr encoder with 3m cable

Example: RS42C-DKNPS is a standard 42-frame 2-stack motor with double shaft and keyway, no encoder.

† Single stack version available in size 34 frame only