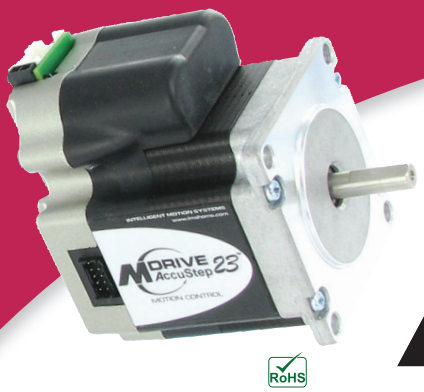


MDrive® AccuStep 23 MOTION CONTROL

MDrive® AccuStep™ motion systems, technology leading all-in-one brushless step motors with integrated electronics, feature revolutionary new control technology that prevents loss of synchronization due to transient or continued overload, extreme acceleration or deceleration, or excessive slew speed.

MDrive AccuStep motion systems react quickly to large changes in loads without loss of synchronization, delivering the performance of brush, brushless and servo motors in a lower cost solution. Additional benefits include:

- No tuning;
- Higher inertia mismatch allowed;
- High starting torque;
- Smooth motion, even at extremely slow speeds.

The product's enhanced performance is accomplished using a cost effective step motor, while eliminating associated disadvantages. AccuStep control technology benefits include:

- Eliminating loss of synchronization;
- Allowing full use of motor's torque;
- Allowing maximum acceleration, deceleration and move times;
- Maintaining constant motor torque *with torque mode*;
- Reduced motor heating *with variable current control*;
- Eliminates impact of system resonance.

MDrive AccuStep motion systems also allow the motor to handle large fluctuations in loads even at high rates of change.

The MDrive AccuStep Motion Control version is fully programmable. Users can quickly communicate and program via a PC using IMS Terminal, an integrated ASCII terminal emulator and program editor available for download at www.imshome.com.

Communication is over RS-422/485 or optional CANopen*. A USB to RS-422/485 Communications Converter is available for ease of connecting to a user's PC. Connectivity options range from all-inclusive QuickStart Kits to individual interfacing cables and mating connector kits to build your own cables.
See pg 5.

The extremely compact MDrive AccuStep 23 features a NEMA 23 1.8° brushless step motor with highly integrated microstepping driver, eliminating the need to run motor cabling through the machine and thereby reducing the potential for problems due to electrical noise.

The MDrive AccuStep 23 accepts a broad input voltage range from +12 to +60 VDC, delivering enhanced performance and speed. Oversized input capacitors are used to minimize power line surges, reducing problems that can occur with long runs and multiple drive systems. An extended operating range of –40° to +85°C provides long life, trouble free service in demanding environments.

A rugged 1000 line count (4000 edge) magnetic encoder with index mark is included for requisite closed loop configuration. Internal to the unit, the encoder does not increase product length.

An MDrive AccuStep Torque Mode is available to control rotary and linear applications with specific torque, or force, specifications. For use in applications such as web tension control, container capping, and clamping and holding.

The MDrive AccuStep 23 is available in 4 rotary motor lengths. Options include a control knob, planetary gearbox, linear actuator* or IP-65 rating*.

With AccuStep control technology, there is now a low cost alternative where brushless technology is required. When you combine its flexible operating environment and long list of features, the integrated motor technology of MDrive AccuStep offers clear advantages in a very cost effective package for a large range of motion control applications.

AccuStep™

AccuStep is a revolutionary control technology that, when applied to step motors, prevents the loss of synchronization due to transient or continued overload, extreme acceleration or deceleration, or excessive slew speed.

AccuStep control technology continually monitors the relationship between the rotor and stator at sub-microsecond intervals, and will not allow that relationship to exceed the point where synchronization is lost.

Variable current control can be enabled to allow only the required current necessary to perform the task, further enhancing performance and efficiency.

*Consult factory for availability.

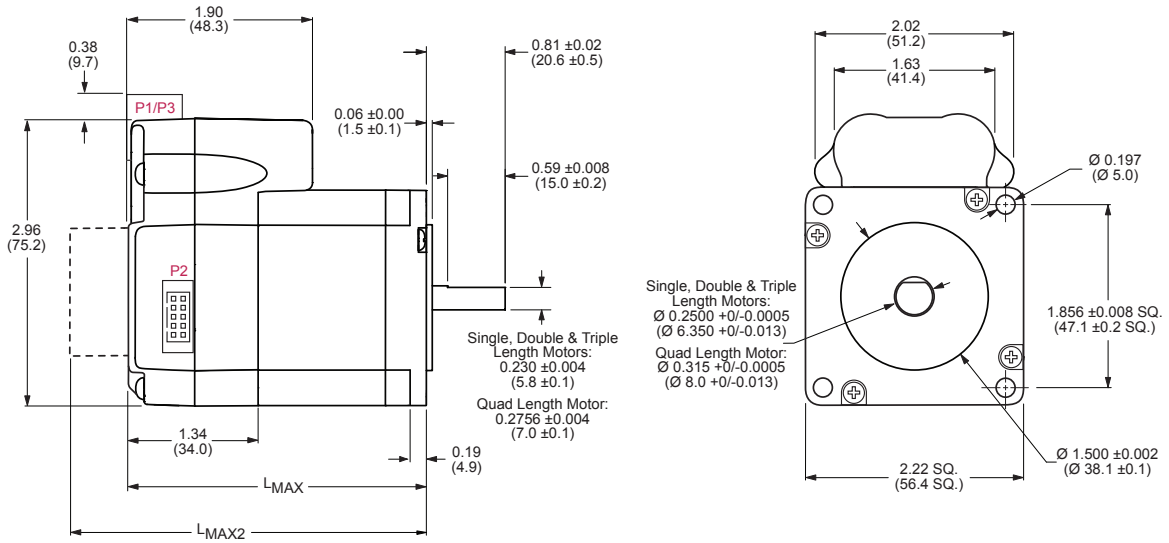
MDrive AccuStep 23 Motion Control

MDrive AccuStep motion systems offer clear advantages in a very cost effective package for a wide range of motion control applications such as:

- Point-to-point positioning
  - Reduce motor frame size requirement
- Conveyor control
  - No loss of synchronization
  - Adapts to sudden load changes
- Drilling
  - Variable torque
- Web handling
  - Tension control
- Hydraulic and pneumatics replacement
  - Low cost
  - Accurate and variable positioning
- Rotary and linear positioning to torque specification
  - Container capping
  - Clamping / holding
  - Screw tightening
- On-the-fly product marking (labeling)
  - High acceleration and deceleration rates

Mechanical specifications

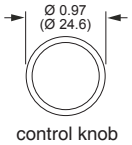
Dimensions in Inches (mm)



MDrive AccuStep lengths Inches (mm)

Motor length	L_{MAX} with single shaft or internal encoder	L_{MAX2} with control knob
Single	2.65 (67.31)	3.36 (85.34)
Double	3.02 (76.71)	3.73 (94.74)
Triple	3.88 (98.55)	4.59 (116.59)
Quad	5.28 (134.15)	5.99 (152.19)

L_{MAX2} option



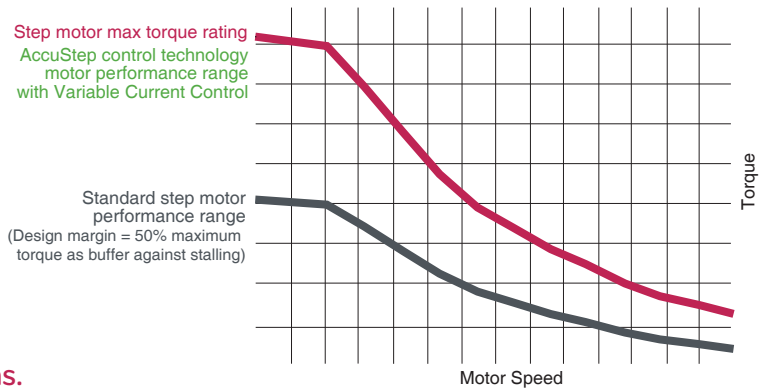
control knob

Speed-torque performance

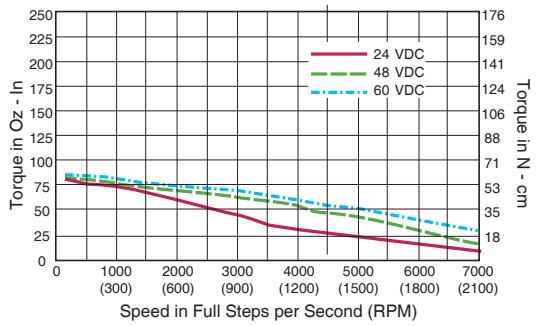
AccuStep revolutionary control technology allows full use of a step motor's maximum torque rating;

eliminates derating of up to 50%

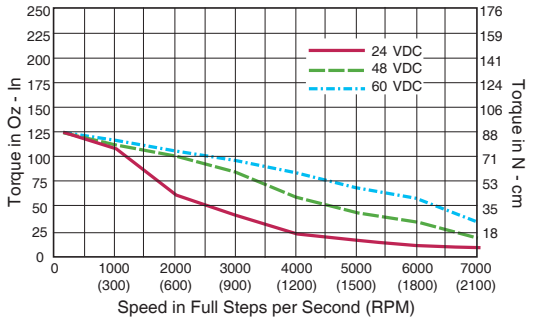
as buffer against stalling of standard step motor systems.



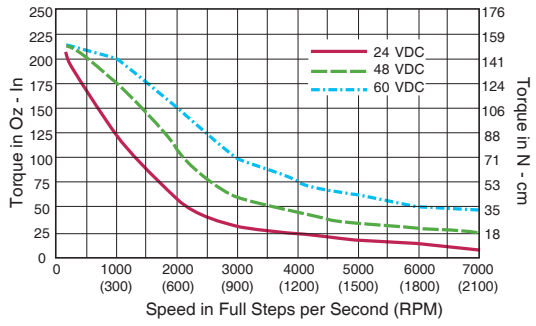
Single length motor speed-torque curves



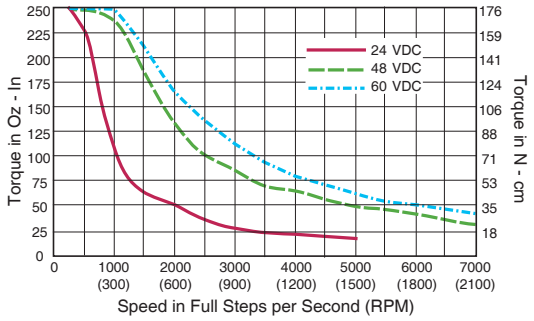
Double length motor speed-torque curves



Triple length motor speed-torque curves



Quad length motor speed-torque curves

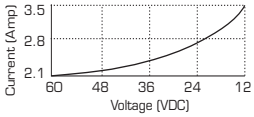


Motor specifications

	Holding torque	Detent torque	Rotor inertia	Weight (motor+driver)
Single length	90 oz-in / 64 N-cm	3.9 oz-in / 2.7 N-cm	0.0025 oz-in-sec^2 / 0.18 kg-cm^2	21.6 oz / 612.3 g
Double length	144 oz-in / 102 N-cm	5.6 oz-in / 3.92 N-cm	0.0037 oz-in-sec^2 / 0.26 kg-cm^2	26.4 oz / 748.4 g
Triple length	239 oz-in / 169 N-cm	9.7 oz-in / 6.86 N-cm	0.0065 oz-in-sec^2 / 0.46 kg-cm^2	39.2 oz / 1111.3 g
Quad length	283 oz-in / 200 N-cm	14.2 oz-in / 10.0 N-cm	0.0108 oz-in-sec^2 / 0.76 kg-cm^2	61.6 oz / 1746.3 g

MDrive AccuStep 23 Motion Control

Standard specifications

Input voltage (+V)	Range	+12 to +60 VDC *Power supply current requirements = 3A (maximum) per MDrive AccuStep 23. Refer to illustration. Actual power supply current will depend on voltage and load.* 		
Aux. logic input voltage	Range	+12 to +24 VDC *Maintains power to control and feedback circuits (only) when input voltage is removed.*		
Analog input	Resolution	10 Bit		
	Range	0 to +5 VDC, 0 to +10 VDC, 0-20 mA, 4-20 mA		
General purpose I/O	Number/type	8 sourcing or sinking outputs/inputs		
	Logic range	Sourcing outputs +12 to +24VDC, inputs and sinking outputs tolerant to +24VDC, inputs TTL level compatible		
	Output sink/source current	Up to 600 mA per channel		
	Protection	Over Temp, Short Circuit, Transient Over Voltage, Over Voltage, Inductive Clamp		
Communication	Type	RS-422/485		
	Baud rate	4.8 to 115.2kbps		
Motion	Closed loop configuration with encoder	Encoder type	Internal, magnetic	
		Steps per revolution	51200	
		Resolution	1000 lines / 4000 edges per rev	
	Counters	Type	Position, encoder	
		Resolution	32 bit	
		Edge rate (maximum)	5 MHz	
	Velocity	Range	+/- 5,000,000 steps per second	
		Resolution	0.5961 steps per second	
	Accel/Decel	Range	1.5 x 10^9 steps per second^2	
		Resolution	90.9 steps per second^2	
	High speed I/O	Position capture	Input filter range	50 nS to 12.9 µS (10 MHz to 38.8 kHz)
			Resolution	32 bit
		Trip output – speed / resolution / threshold		150 nS / 32 bit / TTL
Software	Program storage	Type / size	Flash / 6384 bytes	
	User registers	(4) 32 bit		
	User program labels and variables	192		
	Math functions	+, –, ×, ÷, >, <, =, <=, >=, AND, OR, XOR, NOT		
	Branch functions	Branch & call		
	General purpose I/O functions	Inputs	Home, Limit Plus, Limit Minus, Go, Stop, Pause, Jog Plus, Jog Minus, General Purpose	
		Outputs	Moving, Fault, Stall, Velocity Change, General Purpose	
	Trip functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture, Trip on Relative Position		
	Party mode addresses	62		
	Encoder functions	Stall Detection, Position Maintenance, Find Index		
Thermal	Operating temperature	Heat sink	–40° to +85°C (non-condensing)	
		Motor	–40° to +100°C (non-condensing)	

Interface pin assignments

P1
I/O connector

14-pin locking wire crimp	Function
Pin 1	I/O power
Pin 2	I/O ground
Pin 3	I/O 1
Pin 4	I/O 2
Pin 5	I/O 3
Pin 6	I/O 4
Pin 7	I/O 9
Pin 8	I/O 10
Pin 9	I/O 11
Pin 10	I/O 12
Pin 11	Capture/trip I/O
Pin 12	Analog in
Pin 13	Aux power
Pin 14	Aux ground

P2
Communication connector

10-pin friction lock wire crimp	Function
Pin 1	TX +
Pin 2	Communication ground
Pin 3	RX –
Pin 4	TX –
Pin 5	Communication ground
Pin 6	RX +
Pin 7	RX +
Pin 8	RX –
Pin 9	TX +
Pin 10	TX –

P3
Power connector

2-pin locking wire crimp	Function
Pin 1	+V (+12 to +60 VDC)
Pin 2	Power ground

Order information

Connectivity

QuickStart Kit
For rapid design verification, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive AccuStep initial functional setup and system testing.

Communication Converters
Electrically isolated, in-line converters pre-wired with mating connectors to conveniently set/program parameters for a single MDrive AccuStep via a PC's USB port. Length 12.0' (3.6m).
Mates to:
P2 connector MD-CC402-001

Prototype Development Cables
Speed test/development with pre-wired mating connectors that have flying leads opposite end. Length 10.0' (3.0m).
Mates to:
P1 connector PD14-2334-FL3
P2 connector PD10-1434-FL3
P3 connector. PD02-2300-FL3

Mating Connector Kits
Use to build your own cables. Kit contains 5 mating shells with pins. Cable not supplied. Manufacturer's crimp tool recommended.
Mates to:
P1 connector CK-09
P2 connector CK-02
P3 connector CK-04

Options

Linear Actuator
Integrated MDrive non-captive shaft and external shaft linear actuators are available with AccuStep control technology. Contact the factory for product specifications.

Control Knob
MDrive AccuStep is available with a factory-mounted rear control knob for manual shaft positioning.

Planetary Gearbox
Efficient, low maintenance planetary gearboxes are offered assembled with the MDrive AccuStep. Refer to details and part numbers on the back cover.

Encoder

Internal Magnetic Encoder
MDrive AccuStep products include a 1000 line internal magnetic encoder with index mark.

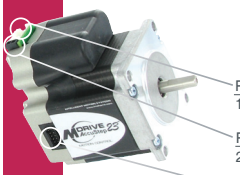
NOTE: AccuStep control performance is optimized at the higher resolution selections.

Part numbering

K MAI3CRL23 □ 6 – EJM – OPTION

K = QuickStart Kit details above

□ = Motor length
A = single
B = double
C = triple
D = quad



P1: I/O
14-pin locking wire crimp connector

P3: Power
2-pin locking wire crimp connector

P2: Communication
10-pin friction lock wire crimp connector

Example #1: **MAI3CRL23A6–EJM** is an MDrive AccuStep 23 Motion Control with locking wire crimp I/O and power interfaces, RS-422/485 communication via a friction lock crimp connector, NEMA 23 single length motor, 1000 line count internal magnetic encoder.

Options

Linear Actuator **–L**
Contact factory for availability.

Control Knob **–N**
Ex: **MAI3CRL23A6–EJM–N** adds a rear control knob for manual positioning to example #1.

Planetary Gearbox **–G □□□ – F**
Refer to gearbox page for complete table of ratios and part numbers.
F = Optional NEMA Flange
Ex: **MAI3CRL23A6–EJM–G1A2** adds 1-stage planetary gearbox with 5.18:1 ratio to example #1. Add –F for optional NEMA flange.

Planetary gearbox

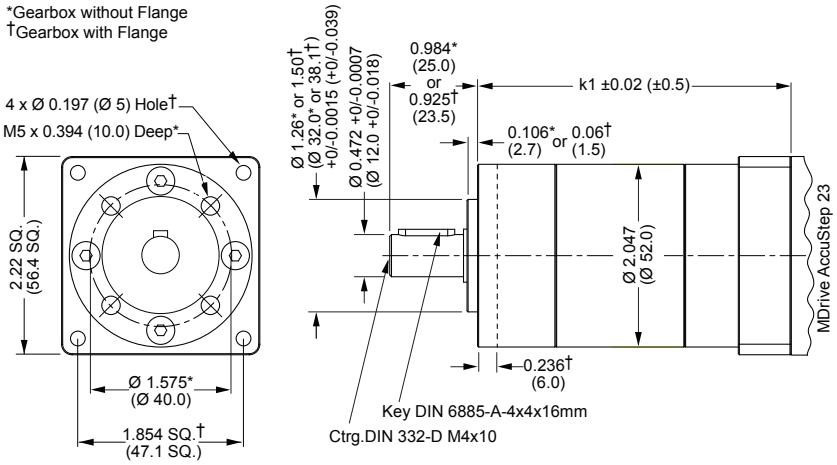
The MDrive AccuStep 23 is available with a Planetary Gearbox option developed to increase torque at lower speeds, enable better inertia matching and produce finer positional resolutions. These efficient, low maintenance Planetary Gearbox come fully assembled with the MDrive and are offered in a large number of reduction ratios in 1-, 2- and 3-stage configurations. An optional NEMA Output Flange allows mounting the Planetary Gearbox to the load using a standard NEMA bolt circle.

Parameters

	Permitted output torque (oz-in/Nm)	Gearbox efficiency	Maximum backlash	Output side with ball bearing			
				Maximum load (lb-force/N)		Weight (oz/g)	
				Radial	Axial	Gearbox	with Flange
1-stage	566/4.0	0.80	0.70°	45/200	13/60	25.0/711	25.9/735
2-stage	1699/12.0	0.75	0.75°	72/320	22/100	32.2/914	33.3/945
3-stage	3540/25.0	0.70	0.80°	101/450	34/150	39.4/1117	40.7/1155

Dimensions in inches (mm)

*Gearbox without Flange
†Gearbox with Flange



Gearbox lengths in inches (mm)

	k1	
	Gearbox*	with Flange†
1-Stage	2.976 (75.6)	3.035 (77.1)
2-Stage	3.537 (89.7)	3.59 (91.2)
3-Stage	4.087 (103.8)	4.146 (105.3)

Ratios and part numbers

Planetary gearbox	Ratio (rounded)	Part number**
1-Stage	3.71:1	G1A1
1-Stage	5.18:1	G1A2
1-Stage	6.75:1	G1A3
2-Stage	13.73:1	G1A4
2-Stage	15.88:1	G1A5
2-Stage	18.37:1	G1A6
2-Stage	19.20:1	G1A7
2-Stage	22.21:1	G1A8
2-Stage	25.01:1	G1A9
2-Stage	26.85:1	G1B1
2-Stage	28.93:1	G1B2
2-Stage	34.98:1	G1B3
2-Stage	45.56:1	G1B4
3-Stage	50.89:1	G1B5
3-Stage	58.86:1	G1B6
3-Stage	68.07:1	G1B7
3-Stage	71.16:1	G1B8
3-Stage	78.72:1	G1B9
3-Stage	92.70:1	G1C1
3-Stage	95.18:1	G1C2
3-Stage	99.51:1	G1C3
3-Stage	107.21:1	G1C4
3-Stage	115.08:1	G1C5
3-Stage	123.98:1	G1C6
3-Stage	129.62:1	G1C7
3-Stage	139.14:1	G1C8
3-Stage	149.90:1	G1C9
3-Stage	168.85:1	G1D1
3-Stage	181.25:1	G1D2
3-Stage	195.27:1	G1D3
3-Stage	236.10:1	G1D4
3-Stage	307.55:1	G1D5

**Include optional planetary gearbox by adding –G plus 3 characters to the end of an MDrive AccuStep part number.

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