

# MDrive<sup>®</sup> Plus

Stepper motors with integrated electronics



**MDrive 23 Plus Motion Control**  
fully programmable



MDrive® Plus Motion Control, fully programmable

### Presentation

The MDrive® Plus Motion Control is a 1.8° 2-phase stepper motor with on-board fully programmable motion controller, drive electronics and optional encoder. This means MDrive Plus Motion Control products are stand-alone motion control solutions that can be used without any external controller.

MDrive products come standard with RS-422/485 serial interface. Programming is with MCode, simple 1 to 2 character instructions, using the IMS Terminal software tool.

Size 23 MDrive products are also available for Modbus/TCP protocol. Programming is with the same MCode instruction set used for the RS-422/485 products. Modbus/TCP products support the application protocol per specification Version 1.1b, with operation in immediate mode, not as programmable products.

MDrive Plus Motion Control products may be equipped with encoders for stall detection, position maintenance and find index mark.

### Application areas

The MDrive Plus Motion Control is ideal for machine builders who want an optimized motor with on-board electronics. The integrated electronics of the fully programmable MDrive Plus Motion Control reduces the potential for problems due to electrical noise by eliminating the cable between motor and drive.

These compact, powerful and cost effective motion control solutions deliver unsurpassed smoothness and performance that will reduce system cost, design and assembly time for a large range of 2-phase stepper motor applications.

### Features

#### Standard Plus

- Highly integrated microstepping drive and high torque 1.8° 2-phase stepper motor
- Advanced current control for exceptional performance and smoothness
- Single supply: from +12 up to +75 VDC or 120 and 240 VAC
- Cost effective
- Extremely compact
- 20 microstep resolutions to 51,200 steps/rev including: Degrees, Metric, Arc Minutes
- Auxiliary logic power supply input
- Open or optional closed loop control
- Programmable motor run and hold currents
- Four +5 to +24 VDC I/O lines accept sinking outputs, or sourcing and sinking inputs
- One 10 bit analog input selectable: 0 to +10 VDC, 0 to +5 VDC, 0-20 mA, 4-20 mA
- 0 to 5 MHz step clock rate selectable in 0.59 Hz increments
- RS-422/485 or Modbus/TCP communication protocols (1)
- 62 software addresses for multi-drop communications (2)
- Simple 1 to 2 character instructions
- Available options:
  - Long life linear actuators (3)
  - Hybrid Motion Technology™ (3)
  - Encoders
  - Control knob for manual positioning
  - Industrial connectors with IP54 rating (4)
- Several motor stack lengths available
- Graphical user interface provided for quick and easy configuration and programming

#### Expanded Plus<sup>2</sup>

- +24 VDC tolerant I/O sourcing or sinking, inputs and outputs with up to 8 I/O lines and electronic gearing
- Closed loop control available with external / remote encoder option
- High speed position capture input or trip output

(1) Modbus/TCP only available for MDrive23 products.

(2) Only with RS-422/485 products.

(3) See separate documentation.

(4) Industrial connectors are unavailable for MDrive14 or MDrive34 products.

### Standard Plus specifications

		MDrive 14	MDrive 17	MDrive 23 (1)	MDrive 23 (1)	MDrive 34	MDrive 34ac (2)	
Input power	Voltage	VDC	12 to 48	12 to 48	12 to 75	12 to 60	12 to 75	
		VAC	—	—	—	—	—	120
	Current maximum (3)		1A	2A	2A	3.5A	4A	95 to 132 VAC @ 50/60 Hz
Thermal	Operating temp non-condensing	Heat sink	-40° to +85°C				-40° to +75°C	
		Motor	-40° to +100°C				-40° to +90°C	
Protection	Type	not applicable					- Thermal - Over voltage/current	

Aux. logic input voltage	Range	+12 to +24 VDC <i>When input voltage is removed, maintains power only to control and feedback circuits. (4)</i>						
Analog input	Resolution	10 bit						
	Voltage range	0 to +5 VDC, 0 to +10 VDC, 0-20 mA, 4-20 mA						
General purpose I/O	Number	4						
	Type	sourcing or sinking inputs, or sinking outputs						
	Logic range	Inputs and outputs tolerant to +24 VDC, inputs TTL level compatible						
	Output sink current	Up to 600 mA						
	Protection	Over temp, short circuit, transient over voltage, inductive clamp						
Communication	Type	RS-422/485						
	Baud rate	4.8 to 115.2 kbps						
Motion	Open loop configuration	Number of settings	20					
		Steps per revolution	200, 400, 800, 1000, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 20000, 25000, 25600, 40000, 50000, 51200, 36000 (0.01 deg/μstep), 21600 (1 arc minute/μstep), 25400 (0.001mm/μstep)					
	Closed loop configuration (requires encoder option)	Encoder resolution	512 lines/2048 edges per rev					
		Counters	Type	position, encoder/32 bit				
	Velocity	Edge rate maximum	5 MHz					
		Range	+/- 5,000,000 steps per second					
	Accel/Decel	Resolution	0.5961 steps per second					
		Range	1.5 x 10 <sup>9</sup> steps per second <sup>2</sup>					
	Software	Program storage	Type/size	flash/6384 bytes				
		User registers	Four 32 bit					
User program labels & variables		192						
Math functions		+, -, ×, ÷, >, <, =, <=, >=, AND, OR, XOR, NOT						
Branch functions		Branch and 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 (4)						
Encoder functions	Stall detection, position maintenance, find index							

### Expanded Plus<sup>2</sup> specifications

General purpose I/O	Number	8 (or 4 with either remote encoder option or Modbus/TCP protocol)					
	Type	sourcing or sinking outputs/inputs					
	Logic range	Sourcing outputs +12 to +24 VDC, inputs and sinking outputs tolerant to +24 VDC, inputs TTL level compatible					
	Output sinking current	Up to 600 mA					
Communication	Type	RS-422/485 or Modbus/TCP (5)					
Motion	Electronic gearing	Range/resolution/ threshold – external clock in (6)		0.001 to 2.000/32 bit/TTL			
		Input filter range		50 nS to 12.9 μS (10 MHz to 38.8 kHz)			
		Range – secondary clock out (6)		1 to 1			
	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				
	Closed loop configuration (requires remote encoder)	Steps per revolution		Same as Standard Plus specification shown in section above			
		Encoder type		User-supplied differential encoder			
		Encoder resolution		User-defined			

(1) Only quad stack NEMA 23 motors have +12 to +60 VDC drives, all other NEMA 23 motors have +12 to +75 VDC drives.

(2) Only available as Plus<sup>2</sup> products.

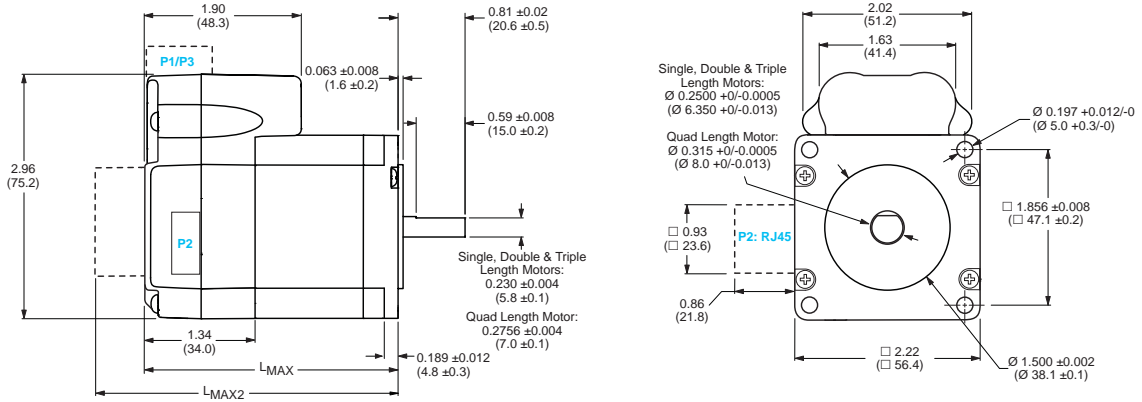
(3) Actual power supply current will depend on voltage and load.

(4) Not available with Modbus/TCP products.

(5) Modbus/TCP only available with MDrive23 Plus<sup>2</sup> products.

(6) Adjusting the microstep resolution can increase the range.

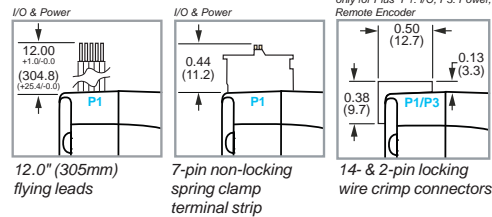
**– Plus & Plus<sup>2</sup> – mechanical specifications, dimensions in inches (mm)**



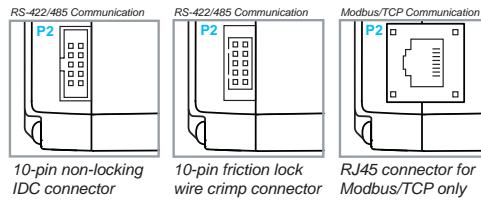
Motor stack length	Lmax (1)	Lmax2 (2)
Single	2.65 (67.31)	3.36 (85.34)
Double	3.02 (76.71)	3.73 (94.74)
Triple	3.88 (98.55)	4.59 (116.59)
Quad	5.28 (134.15)	5.99 (152.19)

(1) Single shaft or internal encoder.  
(2) Control knob (max. torque 20 lb-in / 2.3 N-m) or external encoder.

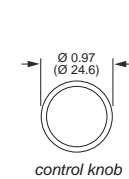
**P1 connector options**



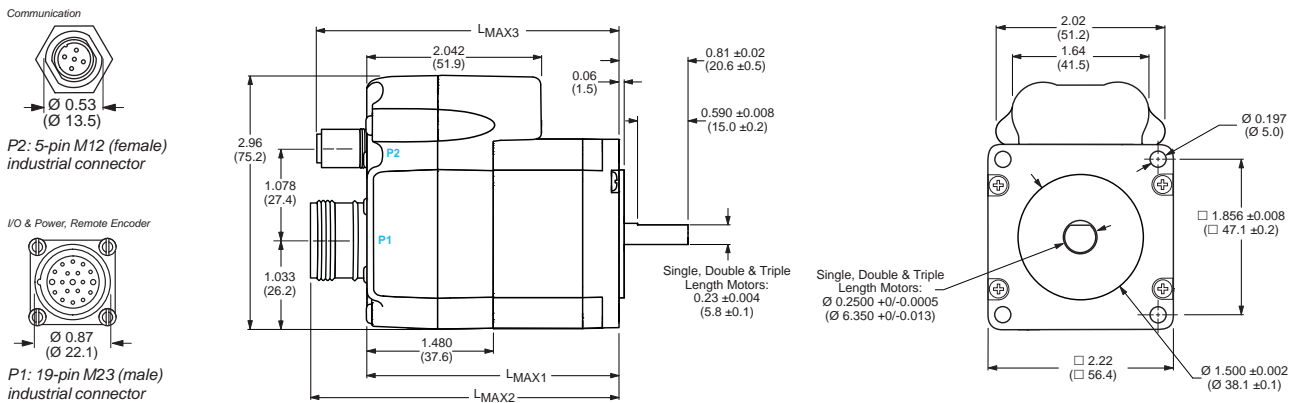
**P2 connector options**



**Lmax2 option**



**– Plus<sup>2</sup> with industrial connectors – mechanical specifications, dimensions in inches (mm)**

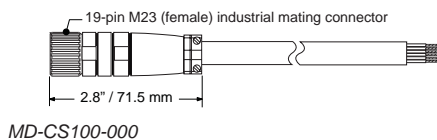
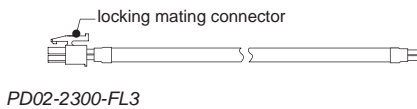
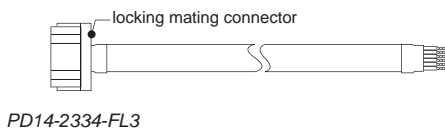
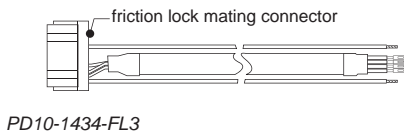
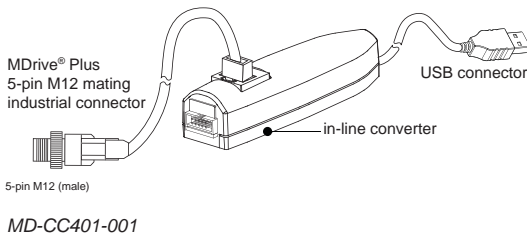
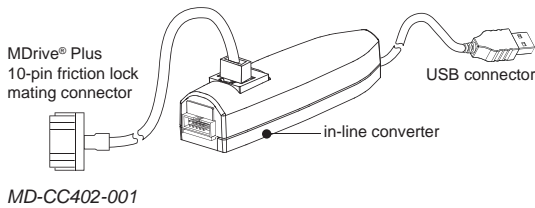
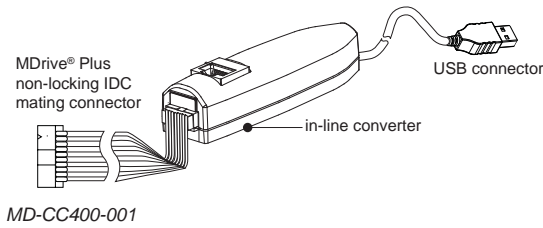


Motor stack length	Lmax	Lmax2	Lmax3
Single	2.82 (71.63)	3.48 (88.39)	3.42 (86.87)
Double	3.16 (80.26)	3.82 (97.03)	3.76 (95.5)
Triple	4.02 (102.11)	4.67 (118.62)	4.62 (117.35)

# MDrive<sup>®</sup> 23 Plus

## Motion Control

fully programmable



### Installation accessories

Description	Length feet (m)	Part number
-------------	-----------------	-------------

#### QuickStart Kit

For rapid design verification, all-inclusive QuickStart Kits includes prototype development cables and a communication converter for MDrive Plus initial functional setup and system testing.

- For MDrive23 Motion Control products — add "K" to part number (1)

#### Communication converter

Electrically isolated, in-line converter pre-wired with mating connector to conveniently set/program communication parameters for a single MDrive Plus via a PC's USB port.

- |  |            |              |
|--|------------|--------------|
| ■ Mates to 10-pin non-locking IDC connector          | 12.0 (3.6) | MD-CC400-001 |
| ■ Mates to 10-pin friction lock wire crimp connector | 12.0 (3.6) | MD-CC402-001 |
| ■ Mates to 5-pin female M12 industrial connector     | 12.0 (3.6) | MD-CC401-001 |

#### Prototype development cable

Speed test/development with pre-wired mating connector with other cable end open.

- |   |            |               |
|---|------------|---------------|
| ■ Mates to 10-pin friction lock wire crimp connector for communication  | 10.0 (3.0) | PD10-1434-FL3 |
| ■ Mates to 14-pin locking wire crimp connector for I/O and remote encoder option                                      | 10.0 (3.0) | PD14-2334-FL3 |
| ■ Mates to 2-pin locking wire crimp connector for power   | 10.0 (3.0) | PD02-2300-FL3 |
| ■ Mates to 19-pin male M23 industrial connector with straight termination for I/O, power and remote encoder option    | 13.0 (4.0) | MD-CS100-000  |
| ■ Mates to 19-pin male M23 industrial connector with right angle termination for I/O, power and remote encoder option | 13.0 (4.0) | MD-CS101-000  |

#### Mating connector kit

Connectors for assembly of cables, cable material not supplied. Sold in lots of 5. Manufacturer's crimp tool recommended for crimp connectors.

- |   |   |       |
|---|---|-------|
| ■ 10-pin friction lock wire crimp connector for communication           | — | CK-02 |
| ■ 10-pin non-locking IDC connector for communication                    | — | CK-01 |
| ■ 14-pin locking wire crimp connector for I/O and remote encoder option | — | CK-09 |
| ■ 2-pin locking wire crimp connector for power                          | — | CK-04 |

#### Drive protection module

Limits surge current and voltage to a safe level when DC input power is switched on-and-off to an MDrive Plus.

- For all MDrive23 Motion Control products — DPM75

(1) See next page.

# MDrive® 23 Plus

## Motion Control

fully programmable

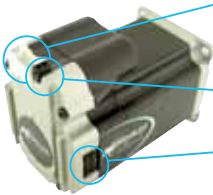
MDrive® 23 Plus



**P1: I/O & Power**  
 F = 12" flying leads  
 P = non-locking spring clamp terminal strip

**P2: Communication**  
 D = RS-422/485 with 10-pin IDC non-locking connector  
 L = RS-422/485 with 10-pin friction lock wire crimp connector

MDrive® 23 Plus<sup>2</sup>



**P1: I/O, and optional remote encoder**  
 C = 14-pin locking wire crimp connector

**P3: Power**  
 2-pin locking wire crimp connector

**P2: Communication**  
 D = RS-422/485 with 10-pin IDC non-locking connector  
 L = RS-422/485 with 10-pin friction lock wire crimp connector  
 R = ModbusTCP with RJ45 locking connector

MDrive® 23 Plus<sup>2</sup>  
 with industrial connectors



**P2: Communication**  
 Q = RS-422/485 with 5-pin M12 female industrial connector

**P1: I/O & Power, and optional remote encoder**  
 M = 19-pin M23 male industrial connector

### Part numbers

Example:	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>QuickStart Kit</b> K = kit option, or leave blank if not wanted	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>MDrive Plus version</b> MDI = Motion Control	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Input</b> 1 = Plus, standard features 3 = Plus <sup>2</sup> , expanded features 4 = Plus <sup>2</sup> , expanded features, with industrial connectors, IP54-rated (1)	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>P1 connector</b> F = flying leads P = pluggable C = wire crimp (2) M = M23 industrial connector (3)	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Communication</b> R = RS-422/485 E = Modbus/TCP (2)	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>P2 connector</b> D = IDC L = wire crimp R = RJ45 (4) Q = M12 industrial connector (3)	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Motor size</b> 23 = NEMA 23 (2.3" / 57 mm)	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Motor length (4)</b> A = single stack B = double stack C = triple stack D = quad stack	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Drive voltage (4)</b> 7 = +12 to +75 VDC 6 = +12 to +60 VDC	K	M	D	I	1	F	R	D	2	3	A	7	-EQ
<b>Options</b> Leave blank if not wanted Options may be combined, unless noted													-EQ
-EQ = internal encoder, 512-line internal magnetic encoder with index mark													
-EE = remote encoder interface, differential encoder to be provided by user (3) (5) <i>May not be combined with internal encoder option.</i>													
-N = rear control knob for manual positioning (5)													

(1) Not available with quad stack motor.

(2) Only available with Plus<sup>2</sup> products without industrial connectors.

(3) Only available with Plus<sup>2</sup> products.

(4) Only quad stack motors have +12 to +60 VDC drives, all other motors have +12 to +75 VDC drives.

(5) Not available with Modbus/TCP or products with industrial connectors.

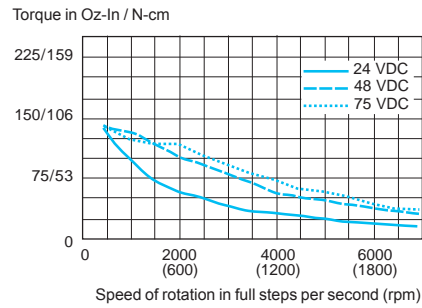
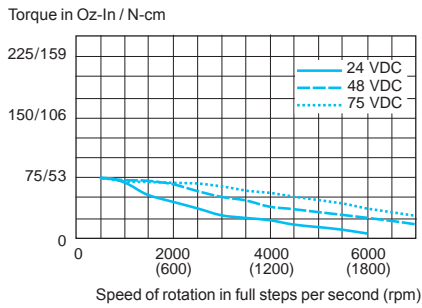
**Motor specifications MDrive23**

		Holding torque	Detent torque	Rotor inertia	Weight (motor + driver)
Motor stack length	Single	90.0 oz-in / 64.0 N-cm	3.9 oz-in / 2.7 N-cm	0.0025 oz-in-sec <sup>2</sup> / 0.18 kg-cm <sup>2</sup>	21.6 oz / 612.3 g
	Double	144.0 oz-in / 102.0 N-cm	5.6 oz-in / 3.92 N-cm	0.0037 oz-in-sec <sup>2</sup> / 0.26 kg-cm <sup>2</sup>	26.4 oz / 748.4 g
	Triple	239.0 oz-in / 169.0 N-cm	9.7 oz-in / 6.86 N-cm	0.0065 oz-in-sec <sup>2</sup> / 0.46 kg-cm <sup>2</sup>	39.2 oz / 1111.3 g
	Quad	283.0 oz-in / 200.0 N-cm	14.2 oz-in / 10.0 N-cm	0.0108 oz-in-sec <sup>2</sup> / 0.76 kg-cm <sup>2</sup>	61.6 oz / 1746.3 g

**Speed torque characteristics MDrive 23**

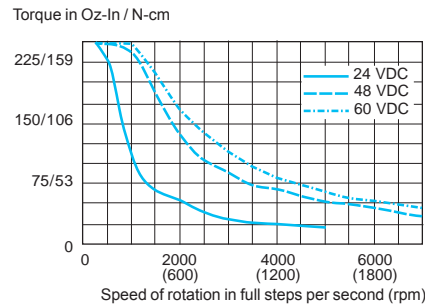
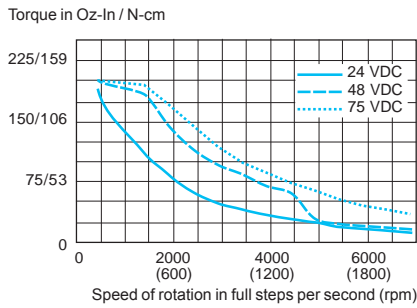
**Single stack length**

**Double stack length**



**Triple stack length**

**Quad stack length**



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