MDRIVE 23™ MOTOR+DRIVER Plus

MOTION CONTROL

STANDARD FEATURES

- Highly Integrated Microstepping Driver, Motion Controller and NEMA 23 High Torque Brushless Motor
- *Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness*
- *Single Supply: +12 to +75 VDC*
- Low Cost
- Extremely Compact
- Available Options:
  - Long Life Linear Actuator*
  - Internal Magnetic Encoder for Closed Loop Control
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
  - *Linear Slide*
- Three Rotary Motor Lengths Available
- *Auxiliary Logic Power Supply Input*
- *20* Microstep Resolutions up to 51,200 Steps Per Rev *Including: Degrees, Metric, Arc Minutes*
- Open or Optional Closed Loop Control
- Programmable Motor Run and Hold Currents
- Four +5 to +24 VDC I/O Lines *Accept Sourcing or Sinking Outputs*
- One 10 Bit Analog Input *Selectable: 0 to +10VDC,* 0 to +5VDC, 0-20mA, 4-20mA
- 0 to 5MHz Step Clock Rate Selectable in 0.59Hz Increments
- RS-422/485 *or Optional CANopen** Communications
- 62 Software Addresses for Multi-Drop Communications
- Simple 1 to 2 Character Instructions
- Interface Options:
  - Pluggable Terminal Strip
  - 12.0" (30.5cm) Flying Leads

EXPANDED PLUS^2 FEATURES

- *+24 VDC Tolerant I/O Lines Sourcing or Sinking, Inputs and Outputs:*
  - *8 I/O Lines with Electronic Gearing (or)*
  - *4 I/O Lines with External/Remote Encoder for Closed Loop Control*
- *High Speed Position Capture Input or Trip Output*
- *Pluggable Locking Wire Crimp Interface*
- *IP65 Sealed Configuration with M12/M23 Circular Connectors**

*Consult Factory for Availability.

NOTE: Red italic text denotes new product enhancements.

DESCRIPTION

The MDrive23Plus Motion Control offers system designers a low cost, intelligent motion controller integrated with a NEMA 23 high torque brushless motor and a *+12 to +75* volt microstepping driver.

The unsurpassed smoothness and performance delivered by the MDrive23Plus Motion Control are achieved through IMS's advanced 2nd generation current control. By applying innovative techniques to control current flow through the motor, resonance is significantly dampened over the entire speed range and audible noise is reduced.

The MDrive23Plus accepts a broad input voltage range from +12 to +75 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.

Standard features available in the MDrive23Plus Motion Control include four +5 to +24 volt general purpose I/O lines, one 10 bit analog input, 0 to 5MHz step clock rate, *20 microstep resolutions* up to 51,200 steps per revolution, and full featured easy-to-program instruction set.

Expanded features in the MDrive23Plus^2 version include up to eight +5 to +24 volt general purpose I/O lines and the capability of electronic gearing by following a rotary or linear axis at an electronically controlled ratio, or an output clock can be generated fixed to the internal step clock.

*For use in environments where exposure to chemical, dust and liquids may occur, a sealed assembly MDrive23Plus^2-65 version is designed to meet IP65 specifications. **

All MDrive23Plus Motion Control are available with optional closed loop control. This increases functionality by adding stall detection, position maintenance and find index mark.

The closed loop configuration is added via a 512 line (2048 edge) magnetic encoder with index mark, internal to the unit so there is no increase in length. *Or, for an expanded choice of line counts and resolutions with MDrive23Plus^2 versions only, closed loop control is available with an interface to a remotely mounted user-supplied external encoder.*

The MDrive communicates over RS-422/485 which allows for point-to-point or multiple unit configurations utilizing one communication port. Addressing and hardware support up to 62 uniquely addressed units communicating over a single line. Baud rate is selectable from 4.8 to 115.2kbps.

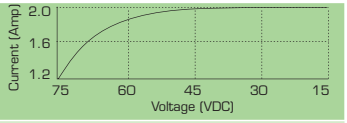
*Optional communication protocols include CANopen. The CAN bus is 2.0B active (11 and/or 29 bit) and is capable of all standard frequencies from 10kHz to 1MHz. CANopen features include node guarding, heartbeat, SDOs and PDOs. Highlights include variable PDO mapping and extended node indentifier. **

Available motor configurations include a single shaft rotary motor and a linear actuator with long life Acme screw*. Rotary versions are available in three motor lengths. Interface connections are accomplished using 12.0" (30.5cm) flying leads or a 7 position terminal strip. *Plus^2 versions come with pluggable locking wire crimp connectors. Plus^2-65 sealed versions* come *with M12/M23 circular connectors.*

The MDrive23Plus is a compact, powerful and inexpensive solution that will reduce system cost, design and assembly time for a large range of brushless motor applications.

MDrive23*Plus* MOTION CONTROL

STANDARD SPECIFICATIONS (Plus Versions)

INPUT VOLTAGE (+V)	Range		*+12 to +75 VDC* *Power supply current requirements = 2A (maximum) per MDrive23Plus. 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	
	Voltage Range		0 to +5 VDC, *0 to +10 VDC*, 0-20 mA, 4-20 mA	
GENERAL PURPOSE I/O	Number/Type		*4 Sinking Outputs/4 Sourcing or Sinking Inputs*	
	Logic Range		*Inputs and Outputs Tolerant to +24VDC, Inputs TTL Level Compatible*	
	Output Sink Current		*Up to* 600 mA *per Channel*	
	Protection		Over Temp, Short Circuit, Transient Over Voltage, Over Voltage, Inductive Clamp	
COMMUNICATION	Type *(Standard)*		RS-422/485	
	Baud Rate		4.8 to 115.2kbps	
	Type (Optional)		*CANopen DSP-402 (V2.0), DS-301 (V3.0), 2.0B Active*	
	ID		*11 and/or 29 Bit*	
	Isolation		*Galvanic*	
	Features		*Node Guarding, Heartbeat, SDOs, PDOs (Variable Mapping)*	
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 (Optional)	Internal Encoder	Type	Internal, Magnetic
			Steps Per Revolution	51200
			Resolution	512 Lines/2048 Edges Per Rev
	Counters		Type	Position, Encoder/32 Bit
			Edge Rate (Max)	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
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, Analog In, General Purpose
			Outputs	Moving, Fault, Stall, Velocity Change, General Purpose
	Trip Functions		Trip on Input, Trip on Position, *Trip on Time, Trip Capture*	
	Party Mode Addresses		62	
	Encoder Functions		Stall Detection, Position Maintenance, Find Index	
THERMAL	*Operating Temperature*		*–40° to +85°C*	

EXPANDED SPECIFICATIONS (Plus^2 & Plus^2-65 Versions)

GENERAL PURPOSE I/O	*Number/Type*		*8 Sourcing or Sinking Outputs/Inputs (or 4 when Remote Encoder Option is Selected)*		
	Logic Range		*Sourcing Outputs +12 to +24 VDC, Inputs and Sinking Outputs Tolerant to +24 VDC, Inputs TTL Level Compatible*		
	Output Sink/Source Current		*Up to 600 mA per Channel*		
MOTION	*Electronic Gearing*		*Range‡/Resolution/Threshold (External Clock In)*		*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)		*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 (Optional)	*Remote Encoder*	*Type*		*User-Supplied Differential Encoder*
			Steps Per Revolution		*See "Standard Specs Open Loop Steps/Rev" Above*
			Resolution		*User-Defined* *Note: µstep/rev 2X the encoder count/rev minimum*

‡ Adjusting the microstep resolution can increase the range.

MOTOR SPECIFICATIONS

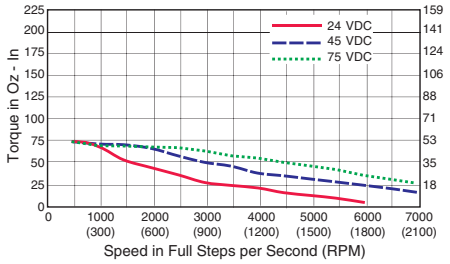
	Holding Torque	Detent Torque	Rotor Inertia	Weight (Motor+Driver)
SINGLE LENGTH	90 oz-in / 64 N-cm	3.9 oz-in / 2.7 N-cm	0.0025 oz-in-sec^2 / 0.18 kg-cm^2	21.6 oz / 612.3 g
DOUBLE LENGTH	144 oz-in / 102 N-cm	5.6 oz-in / 3.92 N-cm	0.0037 oz-in-sec^2 / 0.26 kg-cm^2	26.4 oz / 748.4 g
TRIPLE LENGTH	239 oz-in / 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

	Maximum Thrust	Backlash	Maximum Screw Deflection	Weight (without screw)
LINEAR ACTUATOR	200 lbs / 890 N	0.005 in / 0.127 mm	± 1°	22.0 oz / 623.7 g

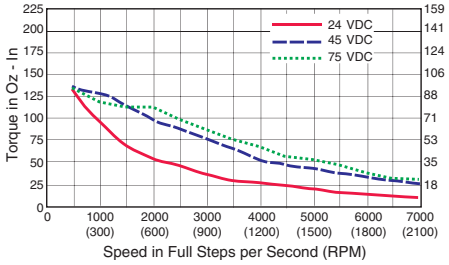
MOTOR PERFORMANCE

Speed-Torque

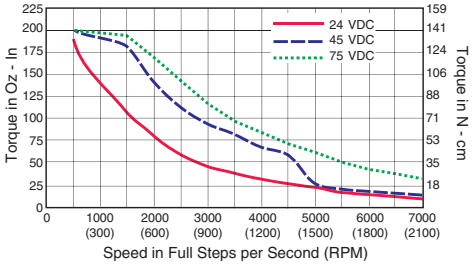
Single Length Rotary Motor



Double Length Rotary Motor

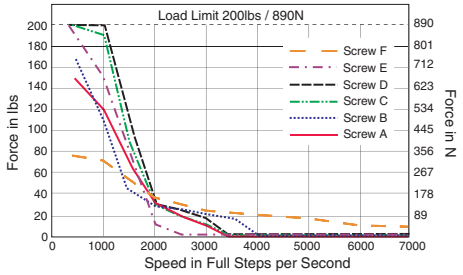


Triple Length Rotary Motor

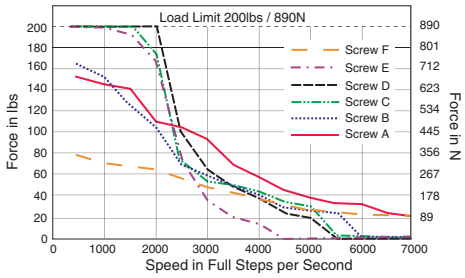


Speed-Force

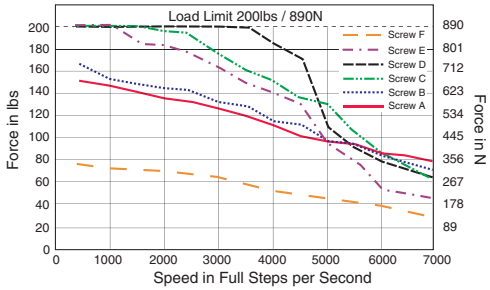
Linear Actuator – 24 VDC



Linear Actuator – 45 VDC



Linear Actuator – 75 VDC



PIN/WIRE ASSIGNMENTS – MDrive23Plus Motion Control

Plus

P1: I/O & POWER CONNECTOR		
Pluggable Terminal Strip	Flying Leads Wire Colors	Function
Pin 1	White/Yellow	I/O 1
Pin 2	White/Orange	I/O 2
Pin 3	White/Violet	I/O 3
Pin 4	White/Blue	I/O 4
Pin 5	Green	Analog Input
Pin 6	Black	Power/Aux-Ground
Pin 7	Red	+V (+12 to +75 VDC)

P2: COMM CONNECTOR				
RS-422/485			CANopen	
10-Pin IDC	Wire Crimp	Function	DB9	Function
Pin 1	Pin 9	TX +	Pin 1	No Connect
Pin 2	Pin 10	TX –	Pin 2	CAN Low
Pin 3	Pin 7	RX +	Pin 3	CAN –V
Pin 4	Pin 8	RX –	Pin 4	No Connect
Pin 5	Pin 5	Aux-Logic (+12 to +24 VDC)	Pin 5	Shield
Pin 6	Pin 6	RX +	Pin 6	CAN –V
Pin 7	Pin 3	RX –	Pin 7	CAN High
Pin 8	Pin 4	TX –	Pin 8	No Connect
Pin 9	Pin 1	TX +	Pin 9	CAN +V
Pin 10	Pin 2	Comm Ground		

Plus^2

P1: I/O CONNECTOR		
Wire Crimp	Function	
	Expanded I/O	Remote Encoder Closed Loop Control
Pin 1	I/O Power	I/O Power
Pin 2	I/O Ground	I/O Ground
Pin 3	I/O 1	I/O 1
Pin 4	I/O 2	I/O 2
Pin 5	I/O 3	I/O 3
Pin 6	I/O 4	I/O 4
Pin 7	I/O 9	Channel A +
Pin 8	I/O 10	Channel A –
Pin 9	I/O 11	Channel B +
Pin 10	I/O 12	Channel B –
Pin 11	Capture/Trip I/O	Capture/Trip I/O
Pin 12	Analog In	Analog In
Pin 13	Step/Clock I/O	Index +
Pin 14	Direction/Clock I/O	Index –

P3: POWER CONNECTOR		
Wire Crimp	Function	
	Expanded I/O	Remote Encoder Closed Loop Control
Pin 1	+V (+12 to +75 VDC)	+V (+12 to +75 VDC)
Pin 2	Power/Aux-Ground	Power/Aux-Ground

P2: COMM CONNECTOR				
RS-422/485			CANopen	
10-Pin IDC	Wire Crimp	Function	DB9	Function
Pin 1	Pin 9	TX +	Pin 1	No Connect
Pin 2	Pin 10	TX –	Pin 2	CAN Low
Pin 3	Pin 7	RX +	Pin 3	CAN –V
Pin 4	Pin 8	RX –	Pin 4	No Connect
Pin 5	Pin 5	Aux-Logic (+12 to +24 VDC)	Pin 5	Shield
Pin 6	Pin 6	RX +	Pin 6	CAN –V
Pin 7	Pin 3	RX –	Pin 7	CAN High
Pin 8	Pin 4	TX –	Pin 8	No Connect
Pin 9	Pin 1	TX +	Pin 9	CAN +V
Pin 10	Pin 2	Comm Ground		

Plus^2-65 (sealed)

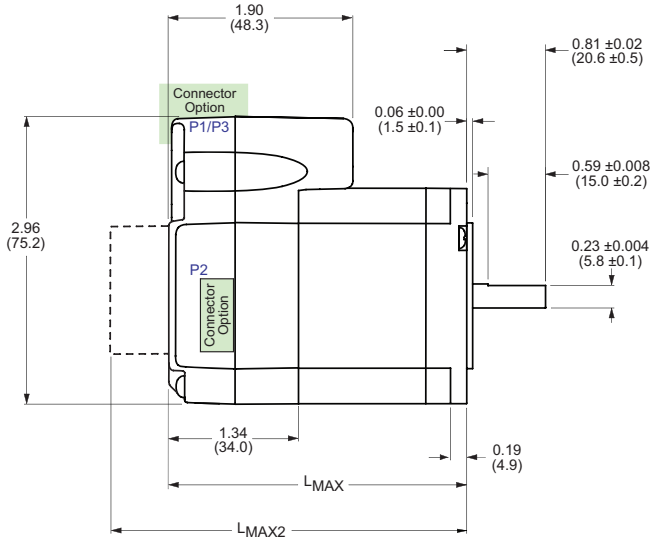
P1: I/O & POWER CONNECTOR		
M23 Circular (Male)	Function	
	Expanded I/O	Remote Encoder Closed Loop Control
Pin 1	I/O 9	Channel A +
Pin 2	I/O 11	Channel B +
Pin 3	Step/Clock I/O	Index +
Pin 4	I/O 1	I/O 1
Pin 5	Direction/Clock I/O	Index –
Pin 6	+V (+12 to +75 VDC)	+V (+12 to +75 VDC)
Pin 7	Aux-Logic (+12 to +24 VDC)	Aux-Logic (+12 to +24 VDC)
Pin 8	Comm Ground	Comm Ground
Pin 9	I/O 3	I/O 3
Pin 10	I/O Ground	I/O Ground
Pin 11	I/O Power	I/O Power
Pin 12	Earth Ground	Earth Ground
Pin 13	I/O 12	Channel B –
Pin 14	Capture/Trip I/O	Capture/Trip I/O
Pin 15	Analog In	Analog In
Pin 16	I/O 2	I/O 2
Pin 17	I/O 4	I/O 4
Pin 18	I/O 10	Channel A –
Pin 19	Power/Aux-Ground	Power/Aux-Ground

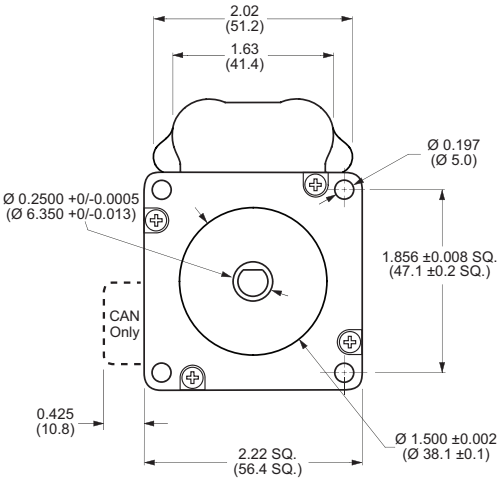
P2: COMM CONNECTOR			
RS-422/485		CANopen	
M12 Circular (Female)	Function	M12 Circular (Male)	Function
Pin 1	TX –	Pin 1	Shield
Pin 2	TX +	Pin 2	CAN +V
Pin 3	RX +	Pin 3	CAN –V
Pin 4	RX –	Pin 4	CAN High
Pin 5	Comm Ground	Pin 5	CAN Low

MECHANICAL SPECIFICATIONS

Dimensions in Inches (mm)

MDrive23Plus & Plus2 Motion Control

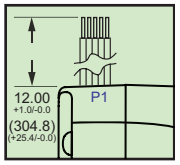




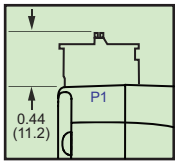
MDrive Lengths *Inches (mm)*

Motor Length	LMAX SINGLE SHAFT, ENCODER or LINEAR ACTUATOR VERSION	LMAX2 CONTROL KNOB VERSION
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)

P1 Connector Options *MDrivePlus*

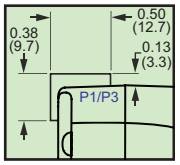


Flying Leads



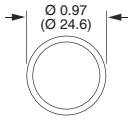
7-Pin Pluggable Clamp Type Terminal Strip

P1/P3 *MDrivePlus2*



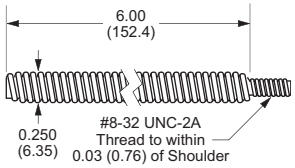
14- & 2-Pin Pluggable Locking Wire Crimps

LMAX2 Options



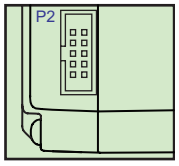
Control Knob

Linear Actuator

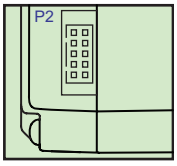


Standard Screw

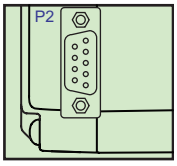
P2 Connector Options *MDrivePlus & Plus2*



10-Pin IDC

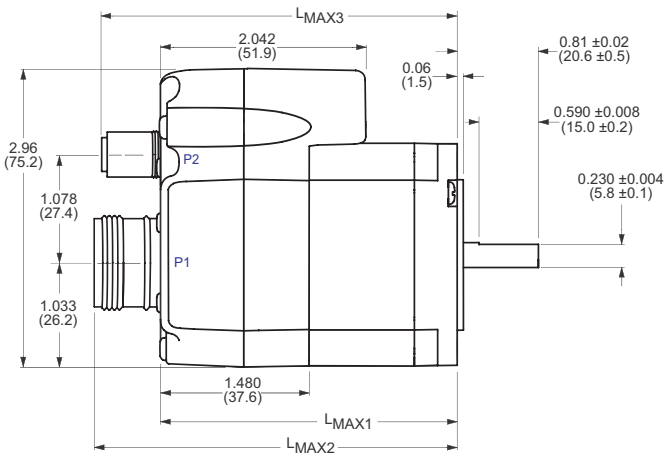


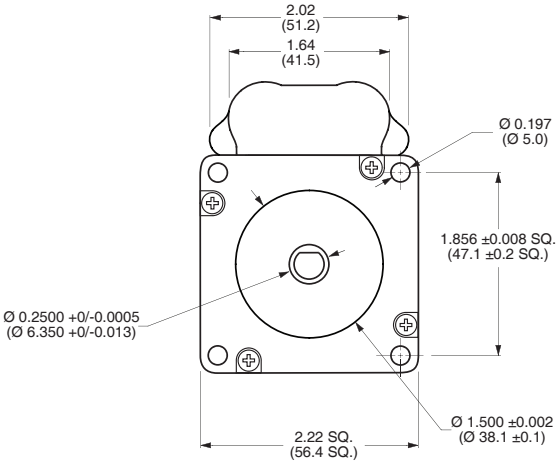
10-Pin Friction Lock Wire Crimp



DB9 (CANopen Only)

MDrive23Plus2-65 Motion Control (sealed)

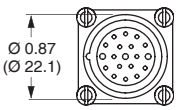




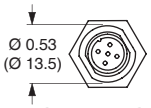
Sealed MDrive Lengths *Inches (mm)*

Motor 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)

Connectors



P1: 19-Pin M23 (Male)



P2: 5-Pin M12

OPTIONS

Linear Actuator‡ *

The MDrive23Plus with non-captive style linear actuator is available with the following long life Acme screws:

Screw F..... 0.002" (0.0508mm)/full step
Screw A ..... 0.001" (0.025mm)/full step
Screw B ..... 0.00083333" (0.021mm)/full step
Screw C ..... 0.0005" (0.0127mm)/full step
Screw D ..... 0.0004167" (0.0106mm)/full step
Screw E..... 0.0003125" (0.0079mm)/full step

Standard screw length is 6.0" (152.4mm) plus the mounting end thread. Custom lengths from 2.0" to 24.0" (50.8 to 609.6mm) are available without mounting end thread. Contact the factory regarding captive shaft or external style linear actuators.

NOTE: May not be combined with other options.

Internal Encoder

All MDrive23Plus Motion Control versions are available with an optional internal 512-line (2048 count) magnetic encoder with index mark.

***Remote Encoder** (Plus² versions only)*

MDrive23Plus² Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob‡

The MDrive23Plus Motion Control 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 MDrive23Plus. Refer to details and part numbers on the back cover.

Linear Slide

Integrated linear slides are available factory installed for precision linear movement. Screw pitches are 0.1", 0.2", 0.5" or 1.0" of travel per rev. Slides are 12.0" (30.5cm) to 36.0" (91.44cm) long. Contact factory for custom lengths. Refer to separate datasheet for complete details.

ACCESSORIES

Communications Converter Cables

These convenient accessory cables connect a PC's USB Port to the MDrive's P2 Connector. Total cable length is 12.0' (3.6m). An in-line RS-422 converter enables parameter setting to a single MDrive Motion Control. Purchase recommended with first orders.

USB to 10-Pin IDC MD-CC400-000
10-Pin to Wire Crimp Adapter ..... MD-ADP-H
USB to 5-Pin M12 (sealed version).... MD-CC401-000

Prototype Development Cables

To speed prototyping of Plus² versions, IMS recommends the following 10' (3m) interface cables with first orders:

14-Pin Wire Crimp Cable PD14-2334-FL3
2-Pin Wire Crimp Cable PD02-2300-FL3

***Cordsets** (sealed version only)*

19-pin M23 single-ended cordsets are offered to speed prototyping of sealed MDrivePlus units. Measuring 13.0' (4.0m) long, either straight or right angle termination is available. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination MD-CS100-000
Right Angle Termination MD-CS101-000

‡ Not Available with Sealed –65 Versions.
* Consult Factory for Availability.
NOTE: Red italic text denotes new product enhancements.

ORDER INFORMATION – MDrive23Plus Motion Control

MDI1☐☐☐23☐7 – OPTION

P1: I/O & Power
F = 12" Flying Leads
P = Pluggable Clamp Type Terminal Strip

P2: Communications
RD = RS-422/485 with 10-Pin IDC Connector
RL = RS-422/485 with 10-Pin Friction Lock Wire Crimp
CB = CANopen with DB9 Connector*

Motor Lengths
A = Single Length & Linear Actuator†*
B = Double Length
C = Triple Length

Example #1: Part Number **MDI1PRD23A7** is an MDrive23Plus Motion Control with pluggable I/O & power interface, RS-422/485 communications with 10-pin IDC connector, and NEMA 23 single length motor.

MDI3C☐☐23☐7 – OPTION

P1: I/O 14-Pin Locking Wire Crimp
P3: Power 2-Pin Locking Wire Crimp

P2: Communications
RD = RS-422/485 with 10-Pin IDC Connector
RL = RS-422/485 with 10-Pin Friction Lock Wire Crimp
CB = CANopen with DB9 Connector*

Motor Lengths
A = Single Length & Linear Actuator†*
B = Double Length
C = Triple Length

Example #2: Part Number **MDI3CRD23C7** is an MDrive23Plus² Motion Control with 14-pin I/O interface and 2-pin power interface, RS-422/485 communications with 10-pin IDC connector, and NEMA 23 triple length motor.

MDI4M☐☐23☐7 – OPTION

Motor Lengths
A = Single Length
B = Double Length
C = Triple Length

P2: Communications
RQ = RS-422/485 with 5-Pin M12 Circular Connector
CQ = CANopen with 5-Pin M12 Circular Connector*

P1: I/O & Power
19-Pin M23 Circular Connector

Example #3: Part Number **MDI4MRQ23B7** is an MDrive23Plus²-65 Motion Control sealed with IP65 rating, 19-pin M23 I/O & power interface, RS-422/485 communications with 5-pin M12 circular connector, and NEMA 23 double length motor.

†*Linear Actuator available ONLY with single length motor. Not available with sealed –65 versions.*
**Consult Factory for Availability.*

OPTIONS

Linear Actuator* –L☐☐☐☐

Acme Screw Type (Travel/Full Step)
F = 0.002" C = 0.0005"
A = 0.001" D = 0.0004167"
B = 0.0008333" E = 0.0003125"

Custom Screw Lengths
Range 2.0" to 24.0"
Example: 095 for 9.5" Screw
(6.0" Screw Length Standard)

Example: **MDI1PRD23A7–LA** adds standard 6" long, 0.00125" screw.

***NOTE:** MAY NOT be combined with any other option. Available ONLY with single length motor. Not available with sealed –65 versions.*

Internal Encoder –EQ

Example: **MDI4MRQ23B7–EQ** adds a 512-line internal magnetic encoder with index mark to example #3.

Remote Encoder –EE

Example: **MDI4MRQ23B7–EE** adds differential encoder inputs for use with remote encoder (not supplied). *Available with Plus² versions only. May not be combined with internal encoder option.*

Control Knob –N

Example: **MDI3CRD23C7–N a**dds a rear control knob for manual positioning to example #2. *Not available with sealed –65 versions.*

Planetary Gearbox –G☐☐☐ –F

Refer to gearbox page for complete table of ratios and part numbers.

Optional NEMA Flange

Example: **MDI3CRD23C7–G1A2** adds a 1-stage planetary gearbox with 5.18:1 ratio to example #2. Add –F for optional NEMA flange.

Linear Slide –R☐☐

Screw Lead (inches/rev)
A = 0.10" C = 0.50"
B = 0.20" D = 1.00"

Standard Screw Lengths
12", 18", 24" or 36"
For Custom Lengths, Consult Factory

Example: **MDI1PRD23A7–RA12** adds a Linear Slide with 0.10" screw lead, 12" long to example #1.

MDRIVE23PLUS WITH PLANETARY GEARBOX

The MDrive23Plus 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. Planetary Gearbox may be combined with other MDrive23Plus options, however are unavailable with Linear Actuators.

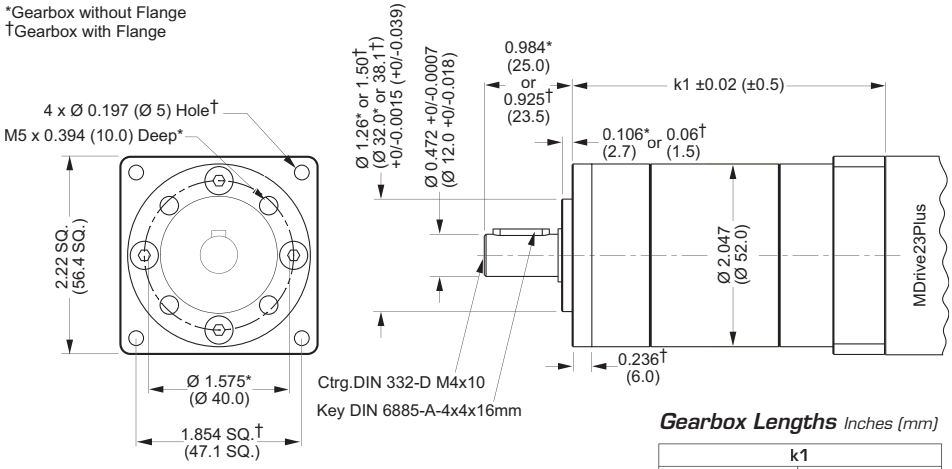
Planetary Gearbox Parameters

	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

Planetary Gearbox for MDrive23Plus

Dimensions in Inches (mm)

*Gearbox without Flange
†Gearbox with Flange



Gearbox Lengths *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 part number.

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