



## MDRIVE<sup>®</sup> 23 MOTOR+DRIVER *Plus* MICROSTEPPING

### FEATURES

- Highly Integrated Microstepping Driver and NEMA 23 High Torque 1.8° Brushless Step Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: +12 up to +75 VDC\*
- Cost Effective
- Extremely Compact
- 20 Microstep Resolutions up to 51,200 Steps Per Rev Including: Degrees, Metric, Arc Minutes
- Optically Isolated Input Options:
  - Universal +5 to +24 VDC Signals, Sourcing or Sinking
  - Differential +5 VDC Signals
- Automatic Current Reduction
- Configurable:
  - Motor Run/Hold Current
  - Motor Direction vs. Direction Input
  - Microstep Resolution
  - Clock Type: Step and Direction, Quadrature, Step Up and Step Down, Clockwise and Counterclockwise
  - Programmable Digital Filtering for Clock and Direction Inputs
- Available Options:
  - Long Life Linear Actuators\*\*
  - Encoder: External Optical or Internal Magnetic
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
  - IP65 Sealed Configuration with M23 Circular Connector<sup>1</sup>
- 4 Rotary Motor Lengths Available
- Setup Parameters May Be Switched On-The-Fly
- Interface Options:
  - Pluggable Locking Wire Crimp
  - Pluggable Terminal Strip
  - 12.0" (30.5cm) Flying Leads
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

\* 12-75 VDC single, double & triple length motors; 12-60 VDC quad length motor.

\*\* Consult Factory for Availability.

<sup>1</sup>Not available with Differential Input option.

### DESCRIPTION

The **MDrive<sup>®</sup>23Plus Microstepping** high torque integrated motor and step and direction driver is ideal for designers who want the simplicity of a motor with on-board electronics. The integrated electronics of the MDrive23Plus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise.

The unsurpassed smoothness and performance delivered by the MDrive23-Plus Microstepping 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 up 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.

The MDrive23Plus uses a NEMA 23 frame size high torque brushless step motor integrated with a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes. These settings may be changed on-the-fly or downloaded and stored in nonvolatile memory with the use of a simple GUI which is provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

For use in environments where exposure to chemical, dust and liquids may occur, a sealed MDrive23Plus-65 Microstepping

unit with 19-pin M23 circular connector meets IP65 specifications.<sup>1</sup>

The versatile MDrive23Plus Microstepping is available in multiple configurations to fit various system needs. Rotary motor versions come in four lengths and may include an encoder, control knob or planetary gearbox. Long life Acme screw linear actuators\*\* are also available.

Numerous connector styles give you choices for the best fit and features. Select from 12.0" (30.5cm) flying leads, pluggable terminal strip, locking wire crimp connectors, and M23 circular connectors on IP65 sealed versions<sup>1</sup>.

MDrivePlus connectivity has never been easier with options ranging from **all-inclusive QuickStart Kits** to **individual interfacing cables** and **mating connector kits** to build your own cables. See pg 5.

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

### CONFIGURING

The IMS Motor Interface software is an easy to install and use GUI for configuring the MDrive23Plus from a computer's USB port. GUI access is via the IMS SPI Motor Interface available at [www.imshome.com](http://www.imshome.com).

The IMS SPI Motor Interface features:

- Easy installation.
- Automatic detection of MDrive version and communication configuration.
- Will not set out-of-range values.
- Tool-tips display valid range setting for each option.
- Simple screen interfaces.

# MDrive23Plus MICROSTEPPING

## STANDARD SPECIFICATIONS

<b>INPUT VOLTAGE (+V)</b>	Range	<b>+12 to +75 VDC</b> <i>applicable for motors:</i> - Single length - Double length - Triple length		<b>+12 to +60 VDC</b> <i>applicable for motor:</i> - Quad length	
		Power supply current requirements = 2A (maximum)		Power supply current requirements = 3.5A (maximum)	
		Actual power supply current will depend on voltage and load.			
<b>ISOLATED INPUT</b>	Universal	Voltage Range: +5 to +24 VDC Sourcing or Sinking Step Clock, Direction and Enable			
	Differential	Voltage Range: +5 VDC Clockwise and Counterclockwise			
<b>MOTION</b>	Digital Filter Range	50 nS to 12.9 μS (10 MHz to 38.8 kHz)			
	Clock Types	Step/Direction, Quadrature, Step Up/Step Down, Clockwise/Counterclockwise			
	Step Frequency	2 MHz Default / 5 MHz Max			
	Resolution	Number of Settings	20		
<b>THERMAL</b>	Operating Temperature	Heat Sink	-40° to +85°C (non-condensing)		
		Motor	-40° to +100°C (non-condensing)		

## SETUP PARAMETERS

	Function	Range	Units	Default
<b>MHC</b>	Motor Hold Current	0 to 100	percent	5
<b>MRC</b>	Motor Run Current	1 to 100	percent	25
<b>MSEL</b>	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100, 108, 125, 127, 128, 180, 200, 250, 256	μsteps per full step	256
<b>DIR</b>	Motor Direction Override	0/1	—	CW
<b>HCDT</b>	Hold Current Delay Time	0 or 2-65535	mSec	500
<b>CLK TYPE</b>	Clock Type	Step/Dir, Quadrature, Up/Down, CW/CCW	—	Step/Dir
<b>CLK IOF</b>	Clock and Direction Filter	50 nS to 12.9 μS (10 MHz to 38.8 kHz)	nS (MHz)	200 nS (2.5 MHz)
<b>USER ID</b>	User ID	Customizable	1-3 characters	IMS
<b>EN ACT</b>	Enable Active	High/Low	—	High

All parameters are set using the supplied IMS SPI Motor Interface GUI and may be changed on-the-fly.  
An optional Communication Converter is recommended with first orders.

## MOTOR SPECIFICATIONS

	Holding Torque	Detent Torque	Rotor Inertia	Weight (Motor+Driver)
<b>SINGLE LENGTH</b>	90 oz-in / 64 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
<b>DOUBLE LENGTH</b>	144 oz-in / 102 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
<b>TRIPLE LENGTH</b>	239 oz-in / 169 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
<b>QUAD LENGTH</b>	283 oz-in / 200 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

## ENCODER PIN ASSIGNMENTS

### External Encoder

Pluggable Interface	DIFFERENTIAL ENCODER <i>with locking connector feature</i>	SINGLE-END ENCODER
	Function	Function
Pin 1	No Connect	Ground
Pin 2	+5 VDC Input	Index
Pin 3	Ground	Channel A
Pin 4	No Connect	+5 VDC Input
Pin 5	Channel A -	Channel B
Pin 6	Channel A +	
Pin 7	Channel B -	
Pin 8	Channel B +	
Pin 9	Index -	
Pin 10	Index +	

Optional encoder cables are available.

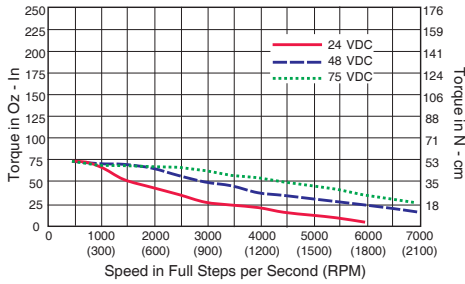
### Internal Encoder

An internal differential encoder option is available on MDrive23Plus Microstepping regular and IP65 sealed versions.

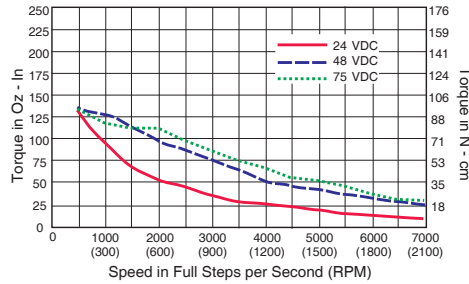
See Wire/Pin Assignments on the following page for connection details.

## MOTOR PERFORMANCE — Speed-Torque

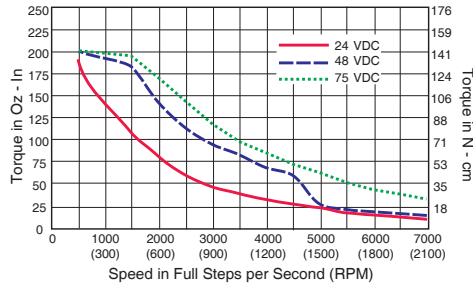
### Single Length Rotary Motor



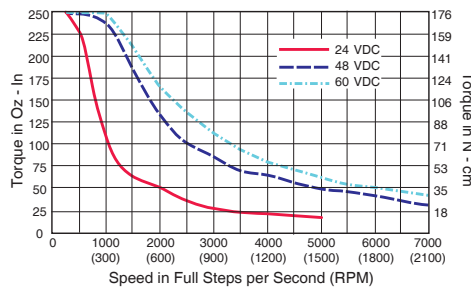
### Double Length Rotary Motor



### Triple Length Rotary Motor



### Quad Length Rotary Motor



## WIRE/PIN ASSIGNMENTS — MDrive23Plus Microstepping

### Plus

P1: I/O & POWER CONNECTOR				
Pluggable Terminal Strip	Flying Leads Wire Colors	Pluggable Locking Wire Crimp**	Function	
			Universal Input	Differential Input <i>Clockwise/Counterclockwise</i>
Pin 1	White	Pin 3	Optocoupler Reference	CW +
Pin 2	—	—	No Connect	No Connect
Pin 3	Orange	Pin 4	Step Clock Input	CW -
Pin 4	Blue	Pin 6	CW/CCW Direction Input	CCW -
Pin 5	Brown	Pin 5	Enable Input	CCW +
Pin 6	Black	Pin 1	Power Ground	Power Ground
Pin 7	Red	Pin 2	Input Voltage*	Input Voltage*
		Pin 7	+5 VDC Output	+5 VDC Output
		Pin 8	SPI Clock	SPI Clock
		Pin 9	Communications Ground	Communications Ground
		Pin 10	SPI Master Out - Slave In	SPI Master Out - Slave In
		Pin 11	SPI Chip Select	SPI Chip Select
		Pin 12	SPI Master In - Slave Out	SPI Master In - Slave Out

P2: COMM CONNECTOR (SPI)**	
10-Pin IDC	Function
Pin 1	No Connect
Pin 2	No Connect
Pin 3	No Connect
Pin 4	SPI Chip Select
Pin 5	Communications Ground
Pin 6	+5 VDC Output
Pin 7	SPI Master Out - Slave In
Pin 8	SPI Clock
Pin 9	No Connect
Pin 10	SPI Master In - Slave Out

\*\*The 12-Pin Pluggable Locking Wire Crimp connector at P1 eliminates the P2 connector.

P4: OPTIONAL INTERNAL DIFFERENTIAL ENCODER	
10-Pin Wire Crimp	Function
Pin 1	Ground
Pin 2	Channel A +
Pin 3	Channel A -
Pin 4	Channel B +
Pin 5	Channel B -
Pin 6	Index +
Pin 7	Index -
Pin 8	No Connect
Pin 9	No Connect
Pin 10	No Connect

An optional encoder cable is available.

### Plus-65 (sealed)

P1: I/O, POWER & COMM CONNECTOR	
M23 Circular (Male)	Function
Pin 1	Optocoupler Reference
Pin 2	Enable Input
Pin 6	+V (+12 to +75 VDC)
Pin 8	SPI Master Out - Slave In
Pin 9	SPI Chip Select
Pin 10	+5 VDC Output
Pin 11	Communications Ground
Pin 12	Shell Connect
Pin 13	CW/CCW Direction Input
Pin 16	SPI Clock
Pin 17	SPI Master In - Slave Out
Pin 18	Step Clock Input
Pin 19	Power Ground

Pins below are No Connect unless populated for encoder option.

Optional Internal Differential Encoder	
Pin 3	Index +
Pin 4	Channel B +
Pin 5	Channel B -
Pin 7	Channel A +
Pin 14	Index -
Pin 15	Channel A -

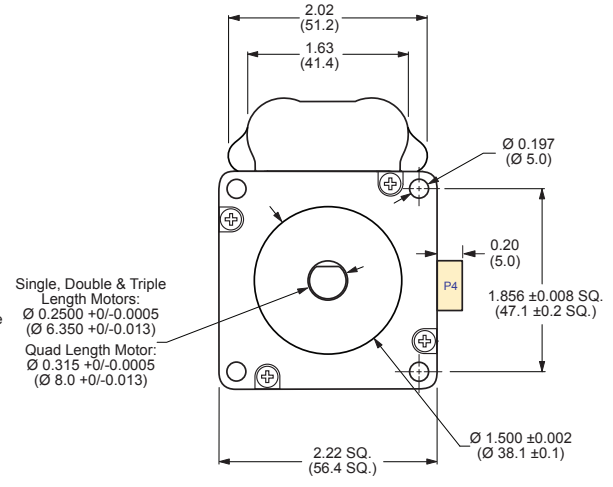
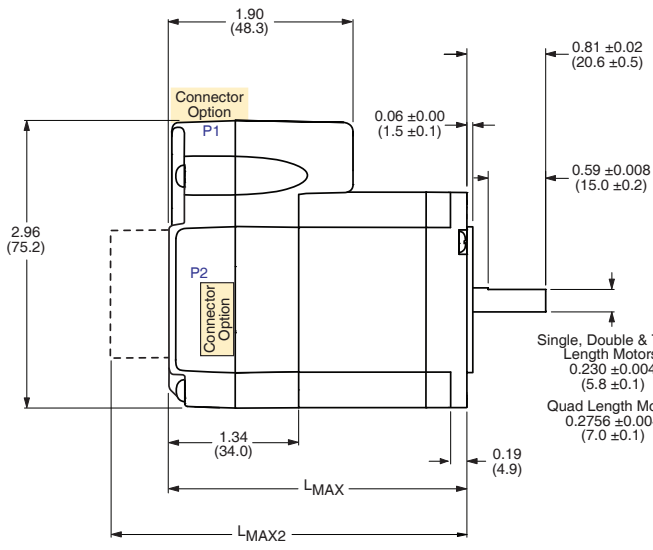
#### \*Input Voltage

+12 to +75 VDC - Single, Double & Triple Length Motors  
+12 to +60 VDC - Quad Length Motor

# MECHANICAL SPECIFICATIONS

Dimensions in Inches (mm)

## MDrive23Plus Microstepping



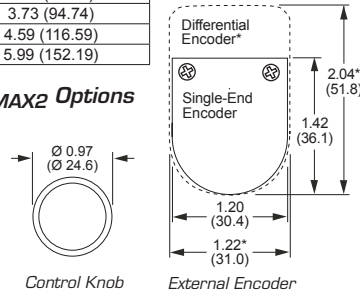
Single, Double & Triple Length Motors:  
 Ø 0.2500 +0/-0.0005  
 (Ø 6.350 +0/-0.013)

Quad Length Motor:  
 Ø 0.315 +0/-0.0005  
 (Ø 8.0 +0/-0.013)

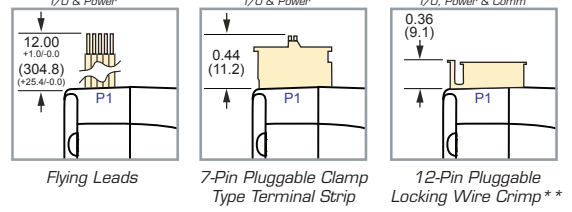
### MDrive Lengths Inches (mm)

Motor Length	LMAX	LMAX2
	SINGLE SHAFT or LINEAR ACTUATOR VERSION	CONTROL KNOB or ENCODER 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)
Quad	5.28 (134.15)	5.99 (152.19)

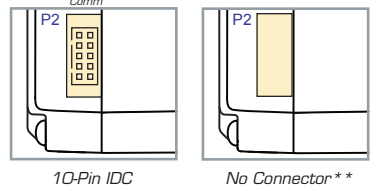
### LMAX2 Options



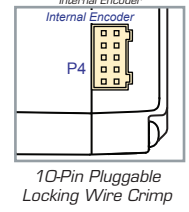
### P1 Connector Options



### P2 Connector Options

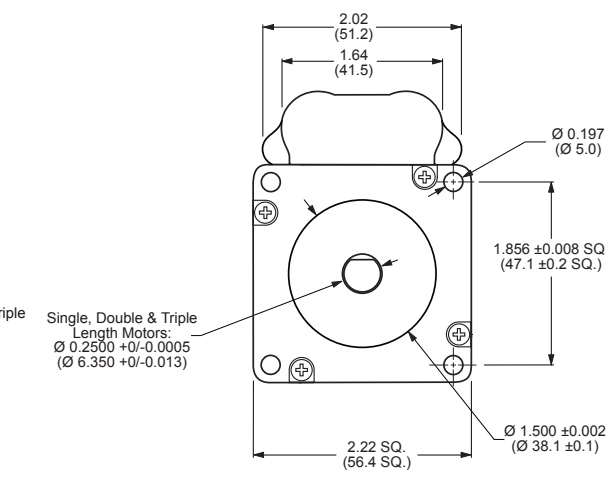
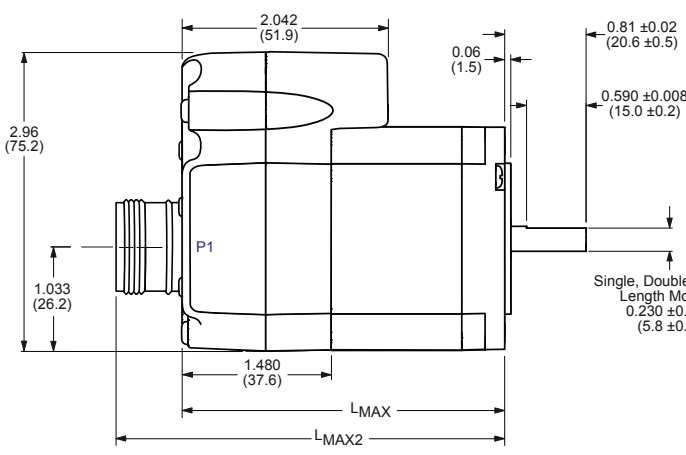


### P4 Option



\*\*12-Pin Pluggable Locking Wire Crimp connector at P1 eliminates the P2 connector.

## MDrive23Plus-65 Microstepping (sealed)

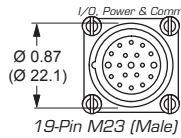


Single, Double & Triple Length Motors:  
 Ø 0.2500 +0/-0.0005  
 (Ø 6.350 +0/-0.013)

### Sealed MDrive Lengths Inches (mm)

Motor Length	LMAX	LMAX2
	Single	2.82 (71.63)
Double	3.16 (80.26)	3.82 (97.03)
Triple	4.02 (102.11)	4.67 (118.62)

### Connector



# ORDER INFORMATION — MDrive23Plus Microstepping

## CONNECTIVITY

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

**Communication Converters**  
Electrically isolated, in-line converters pre-wired with mating connectors to conveniently set/program communication parameters for a single MDrivePlus via a PC's USB port. Length 12.0" (3.6m).  
*Mates to connector:*  
10-Pin IDC ..... MD-CC300-001  
12-Pin Wire Crimp ..... MD-CC303-001  
19-Pin M23 (sealed version) ..... MD-CC301-001

**Prototype Development Cables**  
Speed test/development with pre-wired mating connectors that have flying leads other end. Length 10.0' (3.0m).  
*Mates to connector:*  
12-Pin Wire Crimp ..... PD12-1434-FL3  
For IP65 sealed versions, single-ended cordsets are PVC jacketed with foil shield and unconnected drain wire. Length 13.0' (4.0m).  
19-Pin M23  
Straight Termination ..... MD-CS100-000  
Right Angle Termination ..... MD-CS101-000

**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 connector:*  
12-Pin Wire Crimp ..... CK-03  
Kit contains 5 mating connectors that press fit onto ribbon cable. Cable not supplied.  
10-Pin IDC ..... CK-01

\*\* Consult Factory for Availability.  
‡ Not Available with Sealed -65 Versions.

Connectivity details: [www.imshome.com/cables\\_cordsets.html](http://www.imshome.com/cables_cordsets.html)

## OPTIONS

**Linear Actuator\*\***  
The MDrive23Plus is offered with numerous linear actuator styles and options to satisfy a broad range of linear motion applications. Contact the factory for details or see: [www.imshome.com/mdriveplus\\_linear\\_actuator.html](http://www.imshome.com/mdriveplus_linear_actuator.html)

**External Encoder‡**  
External optical encoders, single-end or differential, are offered factory-mounted with the MDrive23Plus. All encoders come with an index mark. Refer to the table below.

Line Count	100	200	250	256	400	500	512	1000	1024
Single-End part#	E1	E2	E3	EP	E4	E5	EQ	E6	ER
Differential part#	EAL	EBL	ECL	EWL	EDL	EHL	EXL	EJL	EYL

Optional encoder cables are available. Order separately.  
Single-end Cable (12.0"/30.5cm) ..... ES-CABLE-2  
Differential Locking Cable (6.0'/1.8m) ..... ED-CABLE-6

**Internal Encoder**  
Internal differential magnetic encoders with index mark are options with regular and IP65 sealed versions.

Line Count	100	200	250	256	400	500	512	800	1000
Differential part#	EAM	EBM	ECM	EWL	EDM	EHL	EXM	EFM	EJM

An optional encoder cable, mating to the regular version's 10-pin wire crimp connector, is available. Order separately.  
Internal Encoder Cable (6.0'/1.8m) ..... ED-CABLE-JST10  
A mating connector kit is available to build your own cable.  
10-pin Wire Crimp ..... CK-13

**Control Knob‡**  
The MDrive23Plus 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.

## PART NUMBERING

**Plus base version**

**K MDM [ ] [ ] S [ ] 23 [ ] [ ] - OPTION**

**QuickStart Kit** details above

**Input Version**  
1 = Universal  
5 = Differential

**P1: I/O & Power**  
F = 12" Flying Leads  
P = Pluggable Clamp Type Terminal Strip  
C = 12-Pin Locking Wire Crimp (Includes I/O, Power & Comm)

**P2: Communications**  
D = SPI with 10-Pin IDC Connector  
Z = None. Used with 12-Pin Locking Wire Crimp in Position P1, which includes Communications.

**Motor**  
A7 = Single Length (12-75 VDC) & Linear Actuator\*\*  
B7 = Double Length (12-75 VDC)  
C7 = Triple Length (12-75 VDC)  
D6 = Quad Length (12-60 VDC)

**Example #1:** Part Number **MDM1PSD23A7** is an MDrive23Plus Microstepping with pluggable I/O & power interface, SPI communications with 10-pin IDC connector, and NEMA 23 single length motor.

**Plus-65 IP65 sealed**

**K MDM2MSZ23 [ ] [ ] - OPTION**

**QuickStart Kit** details above

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

**Motor**  
A7 = Single Length (12-75 VDC)  
B7 = Double Length (12-75 VDC)  
C7 = Triple Length (12-75 VDC)

**Example #2:** Part Number **MDM2MSZ23B7** is an MDrive23Plus-65 Microstepping sealed with IP65 rating, 19-pin M23 I/O, power and communications circular connector, and NEMA 23 double length motor.

\*\*Consult Factory for Availability.

**OPTIONS**

**Linear Actuator\*\*** -L  
For complete product specifications, see: [www.imshome.com/mdriveplus\\_linear\\_actuator.html](http://www.imshome.com/mdriveplus_linear_actuator.html)

**External Encoder** -E [ ]  
Refer to external encoder table for line counts and part numbers.  
Example: **MDM1PSD23A7-EHL** adds an external 500-line count differential optical encoder with index mark to example #1.  
*Not available with sealed -65 versions.*

**Internal Encoder** -E [ ]  
Refer to internal encoder table for line counts and part numbers.  
Example: **MDM1PSD23A7-ECM** adds an internal 250-line count differential magnetic encoder with index mark to example #1.

**Control Knob** -N  
Example: **MDM1PSD23A7-N** adds a rear control knob for manual positioning to example #1. *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: **MDM1PSD23A7-G1A2** adds a 1-stage planetary gearbox with 5.18:1 ratio to example #1. Add -F for optional NEMA flange.

## 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

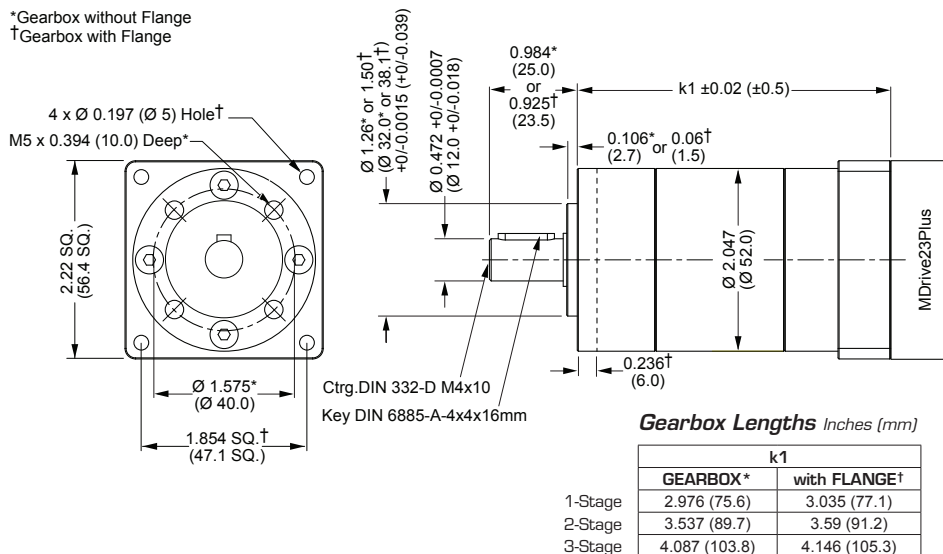
	Permitted Output Torque (oz-in/Nm)	Gearbox Efficiency	Maximum Backlash	Output Side with Ball Bearing			
				Maximum Load (lb-force/N)		Weight (oz/g)	
				Radial	Axial	Gearbox	with Flange
<b>1-STAGE</b>	566/4.0	0.80	0.70°	45/200	13/60	25.0/711	25.9/735
<b>2-STAGE</b>	1699/12.0	0.75	0.75°	72/320	22/100	32.2/914	33.3/945
<b>3-STAGE</b>	3540/25.0	0.70	0.80°	101/450	34/150	39.4/1117	40.7/1155

### 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

### Planetary Gearbox for MDrive23Plus

Dimensions in Inches (mm)



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

#### U.S.A. SALES OFFICES

**Eastern Region**  
Tel. 862 208-9742 - Fax 973 661-1275  
e-mail: jroake@imshome.com

**Central Region**  
Tel. 260 402-6016 - Fax 419 858-0375  
e-mail: dwaksman@imshome.com

**Western Region**  
Tel. 602 578-7201  
e-mail: dweisenberger@imshome.com

#### IMS ASIA PACIFIC OFFICE

30 Raffles Pl., 23-00 Chevron House, Singapore 048622  
Tel. +65/6233/6846 - Fax +65/6233/5044  
e-mail: wlee@imshome.com

#### IMS EUROPEAN SALES MANAGEMENT

4 Quai Des Etroits  
69005 Lyon, France  
Tel. +33/4 7256 5113 - Fax +33/4 7838 1537  
e-mail: bmartinez@imshome.com

#### IMS UK Sales

Machine Technology Centre, Blackhill Drive  
Wolverton, Milton Keynes MK12 5TS  
Tel. +44/0 1908 628000 - Fax +44/0 1908 628001  
e-mail: mcheckley@imshome.com

#### TECHNICAL SUPPORT

Tel. +00 (1) 860 295-6102 - Fax +00 (1) 860 295-6107  
e-mail: etech@imshome.com

#### Intelligent Motion Systems, Inc.

370 North Main Street, P.O. Box 457  
Marlborough, CT 06447 - U.S.A.  
Tel. +00 (1) 860 295-6102 - Fax +00 (1) 860 295-6107  
e-mail: info@imshome.com  
http: //www.imshome.com