



MDRIVE 23™

MOTOR+DRIVER

Plus

SPEED CONTROL

FEATURES

- Highly Integrated Microstepping Driver, Intelligent Variable Speed Controller 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
- 10-bit Analog Speed Control Input Accepts:
 - 0 to +5 VDC
 - 0 to +10 VDC
 - 4 to 20 mA
 - 0 to 20 mA
 - 15 to 25 kHz PWM
- Automatic Current Reduction
- Electronically Configurable:
 - Motor Run/Hold Current
 - Microstep Resolution
 - Acceleration/Deceleration
 - Initial and Max Velocity
 - Hold Current Delay Time/Motor Settling Delay Time
 - Programmable Filtering for the Start/Stop Input
- Available Options:
 - Long Life Linear Actuators**
 - External Optical Encoder
 - Integrated Planetary Gearbox
 - Control Knob for Manual Positioning
 - Linear Slide
- 4 Rotary Motor Lengths Available
- Setup Parameters May Be Switched On-The-Fly
- Interface Options:
 - 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.

DESCRIPTION

The **MDrive23Plus Speed Control** offers system designers cost effective, programmable velocity control integrated with a NEMA 23 high torque 1.8° brushless step motor and a +12 up to +75 VDC* microstepping driver.

The MDrive23Plus Speed Control features a digital oscillator for accurate velocity control with an output frequency of up to 5 Megahertz. Output frequency will vary with the signal applied to the speed control input and can be limited by the amount specified by the Maximum Velocity parameter.

Speed can be adjusted using three modes of operation: voltage, current and PWM. The ranges are 0 to +5 volts and 0 to +10 volts in voltage mode, 0 to 20 mA and 4 to 20 mA in current mode, and 15 to 25 kHz in PWM mode. This allows the MDrive23-Plus Speed Control to be driven by a wide variety of sensors and control devices.

There are two basic methods for controlling the velocity: bidirectional and unidirectional. By moving the center point, both speed and direction are controlled by a potentiometer or joystick. By setting the center point to zero or the lower end of the potentiometer, only velocity is controlled by the speed control input; direction is controlled by a separate digital input.

The MDrive23Plus Speed Control has 18 setup parameters, which may be configured using the supplied IMS Analog Speed Control GUI, or a user-developed front-end communicating over SPI. The setup parameters enable the user to configure all MDrive operational parameters which are stored in nonvolatile memory.

The versatile, compact MDrive23Plus Speed Control is available in multiple configurations to fit various system

needs. Rotary motor versions come in four lengths and may include an optical encoder, control knob, planetary gearbox or linear slide. Long life Acme screw linear actuators** are also available.

Connector style options give you choices for the best fit and features. Select from 12.0" (30.5cm) flying leads or pluggable terminal strip.

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 4.*

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 Analog Speed Control is a software GUI for quick and easy parameter setup of the MDrivePlus Speed Control from a computer's USB port. GUI access is via the IMS SPI Motor Interface available at www.imshome.com. The IMS interface is also used to upgrade MDrive-Plus Speed Control firmware.

IMS Analog Speed Control features:

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

STANDARD SPECIFICATIONS

INPUT VOLTAGE (+V)	Range	+12 to +75 VDC <i>applicable for motors:</i> - Single length - Double length - Triple length		+12 to +60 VDC <i>applicable for motor:</i> - Quad length	
		<p>Current (Amp) vs Voltage (VDC) Power supply current requirements = 2A (maximum)</p>		<p>Current (Amp) vs Voltage (VDC) Power supply current requirements = 3A (maximum)</p>	
SPEED CONTROL	Input	0 to +5 VDC*, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA or 15 to 25 kHz PWM			
	A/D Resolution	10 bit			
LOGIC INPUT	Start/Stop and Direction	Low Level	0 to +0.8 VDC		
		High Level	+2.0 to +5.0 VDC		
		Internal Pull-up Resistance (to +3.3 VDC)	20 kΩ		
MOTION	Oscillator Frequency (Max)	5 MHz			
	Microstep Resolution	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)		
THERMAL	Operating Temperature	Heat Sink	-40° to +85°C (non-condensing)		
		Motor	-40° to +100°C (non-condensing)		

*10 kΩ potentiometer resistance.

SETUP PARAMETERS

	Function	Range	Units	Default
A1	Analog Input Mode	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA, 15 to 25 kHz PWM	—	0 to +5 VDC
ACCL	Acceleration	91 to 1.5 X 10 ⁹	steps/second ²	1,000,000
C	Joystick Center	1 to 1022	counts	0
DB	Analog Deadband	0 to 255	counts	1
DECL	Deceleration	91 to 1.5 X 10 ⁹	steps/second ²	1,000,000
DIR	Motor Direction Override	Clockwise (CW) / Counterclockwise (CCW)	—	CW
FAULT	Fault/Checksum Error	Error Code	—	None
FS	Analog Full Scale	1 to 1023	counts	1023
HCDT	Hold Current Delay Time	HCDT + MSDT <= 65535	milliseconds	500
IF	Analog Input Filter	1 to 1000	counts	1
MHC	Motor Hold Current	0 to 100	percent	5
MRC	Motor Run Current	1 to 100	percent	25
MSDT	Motor Settling Delay Time	MSDT + HCDT <= 65535	milliseconds	0
MSEL	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
SSD	Stop/Start Debounce	0 to 255	milliseconds	0
VI	Initial Velocity	0 to <VM	steps/second	1000
VM	Maximum Velocity	VI to 5,000,000	steps/second	768,000
USER ID	User ID	Customizable	1-3 characters	IMS

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)
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

ENCODER SPECIFICATIONS

Pin Assignments

Encoder	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.

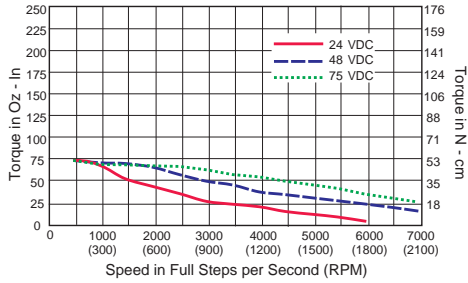
Line Counts and Part Numbers

Line Count	DIFFERENTIAL ENCODER <i>with locking connector feature</i>	SINGLE-END ENCODER
	Part Number	Part Number
100	EAL	E1
200	EBL	E2
250	ECL	E3
256	EWL	EP
400	EDL	E4
500	EHL	E5
512	EXL	EQ
1000	EJL	E6
1024	EYL	ER

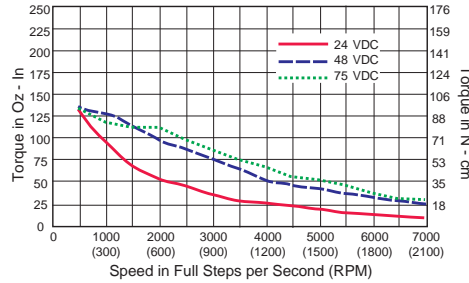
MOTOR PERFORMANCE — Speed-Torque

WIRE/PIN ASSIGNMENTS

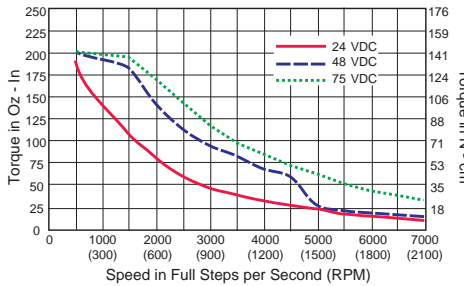
Single Length Rotary Motor



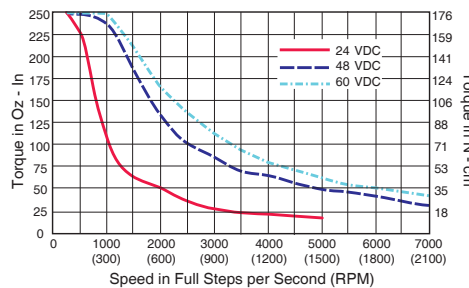
Double Length Rotary Motor



Triple Length Rotary Motor



Quad Length Rotary Motor

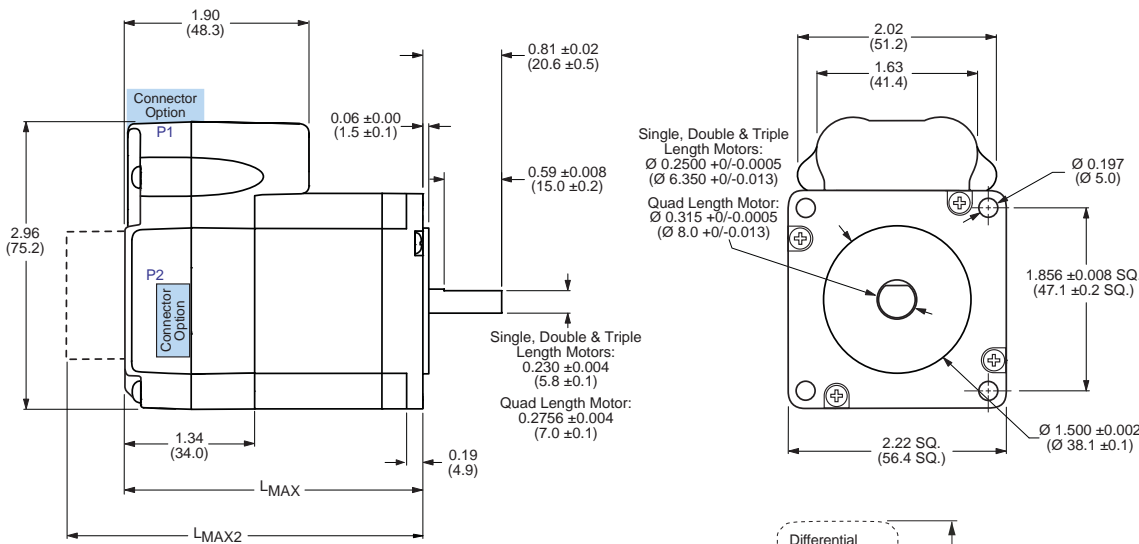


P1: I/O & POWER CONNECTOR		
Pluggable Terminal Strip	Flying Leads Wire Colors	Function
Pin 1	Violet	Start/Stop Input
Pin 2	Blue	CW/CCW Direction Input
Pin 3	Green	Speed Control Input
Pin 4	Yellow	+5 VDC Output
Pin 5	Gray	Logic Ground
Pin 6	Black	Power Ground
Pin 7	Red	Input Voltage: +12 to +75 VDC – Single, Double & Triple Motors +12 to +60 VDC – Quad Motor

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

MECHANICAL SPECIFICATIONS — MDrive23Plus Speed Control

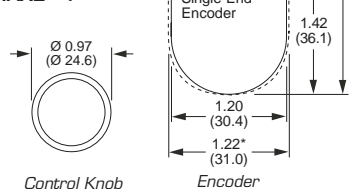
Dimensions in Inches (mm)



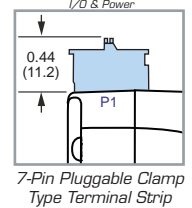
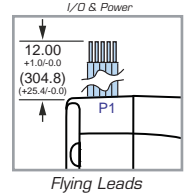
MDrive Lengths Inches (mm)

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

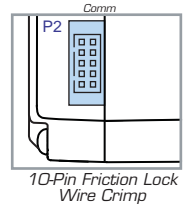
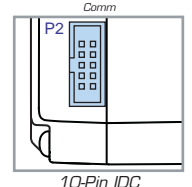
LMAX2 Options



P1 Connector Options



P2 Connector Options



ORDER INFORMATION — MDrive23Plus Speed Control

CONNECTIVITY

new 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.

new 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
- 10-Pin Wire Crimp MD-CC302-001

new 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:

- 10-Pin Wire Crimp CK-02

Kit contains 5 mating connectors that press fit onto ribbon cable. Cable not supplied.

- 10-Pin IDC CK-01

**Consult Factory for Availability.

Connectivity details: 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

External Encoder

External optical encoders, single-end or differential, are offered factory-mounted with the MDrive23Plus. Refer to the Encoder Specifications section for available line counts. All encoders come with an index mark.

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

Control Knob

The MDrive23Plus Speed 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 leads 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 or web site for complete details.

PART NUMBERING

Plus
base version

K MDO1 **S** 23 **OPTION**

QuickStart Kit details above

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

P2: Communications
D = SPI with 10-Pin IDC Connector
L = SPI with 10-Pin Friction Lock Wire Crimp Connector

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 **MDO1PSD23A7** is an MDrive23Plus Speed Control with pluggable I/O & power interface, SPI communications with 10-pin IDC connector, and NEMA 23 single length motor.

**Consult Factory for Availability.

OPTIONS

Linear Actuator** -L
For complete product specifications, see: www.imshome.com/mdriveplus_linear_actuator.html

External Encoder -E
Refer to encoder specifications section for line counts and part numbers.
Example: **MDO1PSD23A7-EHL** adds an external 500-line count differential optical encoder with index mark to example #1.

Control Knob -N
Example: **MDO1PSD23A7-N** adds a rear control knob for manual positioning to example #1.

Planetary Gearbox -G -F Optional NEMA Flange
Refer to gearbox page for complete table of ratios and part numbers.
Example: **MDO1PSD23A7-G1A2** adds a 1-stage planetary gearbox with 5.18:1 ratio to example #1. Add -F for optional NEMA flange.

Linear Slide -R
Screw Lead (inches/rev) | Standard Screw Lengths
A = 0.10" (2.54mm) | 12", 18", 24" or 36"
B = 0.20" (5.08mm) | For Custom Lengths, Consult Factory
C = 0.50" (12.7mm)
D = 1.00" (25.4mm)

Example: **MDO1PSD23A7-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

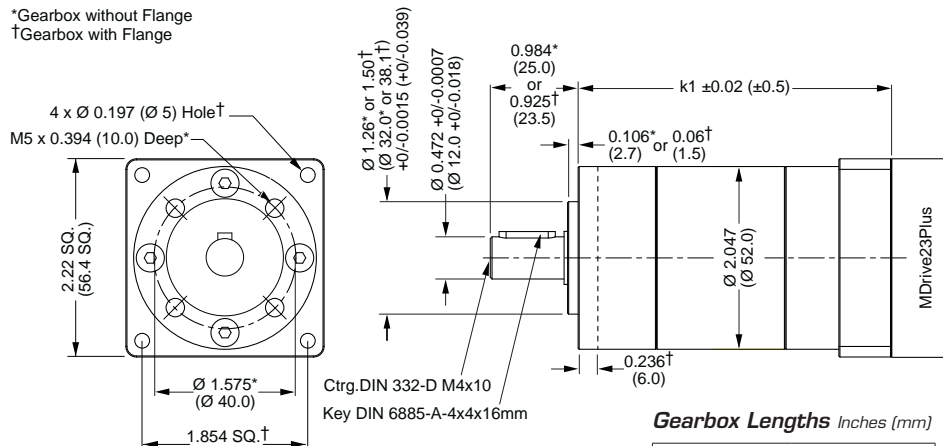
Ratios and Part Numbers

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)

*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)

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

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