MDRIVE 17™ MOTOR+DRIVER Plus

MOTION CONTROL
(with optional CANopen)

STANDARD FEATURES

- Highly Integrated Microstepping Driver, Intelligent Motion Controller and NEMA 17 High Torque 1.8° Brushless Step Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: +12 to +48 VDC
- Cost Effective
- Extremely Compact
- Available Options:
  - Long Life Linear Actuators**
  - 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 +10 VDC, 0 to +5 VDC, 0-20 mA, 4-20 mA
- 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.

DESCRIPTION

The **MDrive17Plus Motion Control** offers system designers a cost effective, full featured programmable motion controller integrated with a NEMA 17 high torque 1.8° brushless step motor and a +12 to +48 volt microstepping driver.

The unsurpassed smoothness and performance delivered by the MDrive17Plus 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 MDrive17Plus accepts a broad input voltage range from +12 to +48 VDC, delivering enhanced performance and speed. Oversized input capacitors are used to minimize power line surges, reducing problems that can occur with long cable 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 of all MDrive17Plus 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 of MDrive17Plus^2 versions 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, MDrive17Plus^2-65 sealed assembly versions are designed to meet IP65 specifications.

All MDrive17Plus 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 MDrive17Plus^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 producer, SDOs and PDOs. Highlights include variable PDO mapping and extended node identifier.

Motor configurations include a single shaft rotary in three lengths, and linear actuators with long life Acme screw**.

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 M12/M23 circular connectors on IP65 sealed versions.

new

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 MDrive17Plus 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.

MDrive17*Plus* MOTION CONTROL

STANDARD SPECIFICATIONS (Plus Versions)

INPUT VOLTAGE (+V)	Range		+12 to +48 VDC *Power supply current requirements = 2A (maximum) per MDrive17Plus.* *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 10^3 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		+, –, x, ÷, >, <, =, <=, >=, 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)

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

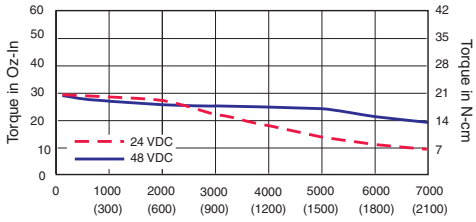
‡ Adjusting the microstep resolution can increase the range.

MOTOR SPECIFICATIONS

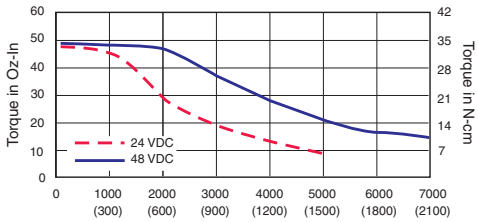
	Holding Torque	Detent Torque	Rotor Inertia	Weight (Motor+Driver)
SINGLE LENGTH	32 oz-in / 22.6 N-cm	1.66 oz-in / 1.17 N-cm	0.00053 oz-in-sec^2 / 0.038 kg-cm^2	10.4 oz / 294.8 g
DOUBLE LENGTH	60.0 oz-in / 42.4 N-cm	2.08 oz-in / 1.47 N-cm	0.00080 oz-in-sec^2 / 0.057 kg-cm^2	12.0 oz / 340.2 g
TRIPLE LENGTH	74.9 oz-in / 52.9 N-cm	3.47 oz-in / 2.45 N-cm	0.00116 oz-in-sec^2 / 0.082 kg-cm^2	15.2 oz / 430.9 g

MOTOR PERFORMANCE — Speed-Torque

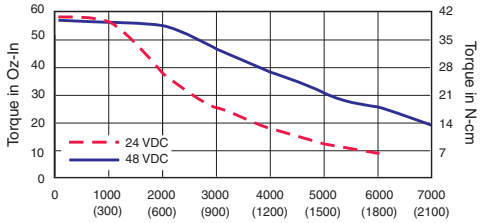
Single Length Rotary Motor



Double Length Rotary Motor



Triple Length Rotary Motor



PIN/WIRE ASSIGNMENTS — MDrive17Plus 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 +48 VDC)

P2: COMM CONNECTOR				
RS-422/485			CANopen	
10-Pin IDC	Wire Crimp	Function	DB9 (male)	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	Aux Power
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 & POWER 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 –
Pin 15	+V (+12 to +48 VDC)	+V (+12 to +48 VDC)
Pin 16	Power/Aux Ground	Power/Aux Ground

P2: COMM CONNECTOR				
RS-422/485			CANopen	
10-Pin IDC	Wire Crimp	Function	DB9 (male)	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	Aux Power
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)

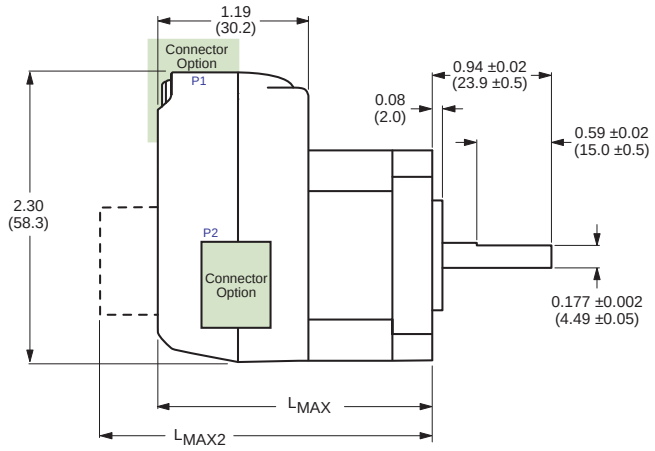
P1: I/O & POWER CONNECTOR		
M23 Circular (Male)	Function	
	Expanded I/O	Remote Encoder Closed Loop Control
Pin 1	I/O 9	Channel A +
Pin 2	I/O 11	Channel B +
Pin 3	Step/Clock I/O	Index +
Pin 4	I/O 1	I/O 1
Pin 5	Direction/Clock I/O	Index –
Pin 6	+V (+12 to +48 VDC)	+V (+12 to +48 VDC)
Pin 7	Aux-Logic (+12 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	Shell Connect	Shell Connect
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

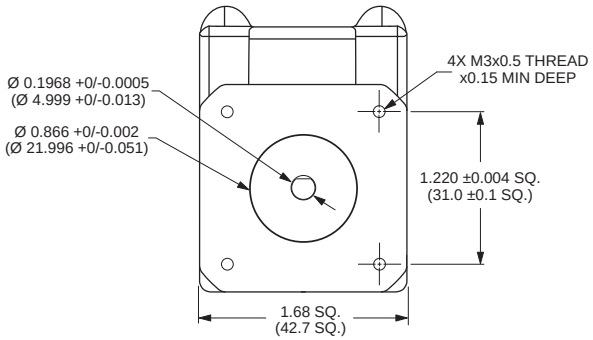
P2: COMM CONNECTOR			
RS-422/485		CANopen	
M12 Circular (Female)	Function	M12 Circular (Male)	Function
Pin 1	TX –	Pin 1	Shield
Pin 2	TX +	Pin 2	CAN +V
Pin 3	RX +	Pin 3	CAN –V
Pin 4	RX –	Pin 4	CAN High
Pin 5	Comm Ground	Pin 5	CAN Low

MECHANICAL SPECIFICATIONS

Dimensions in Inches (mm)

MDrive17Plus & Plus2 Motion Control

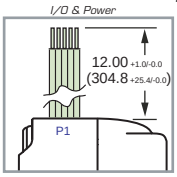




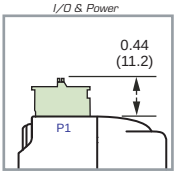
MDrivePlus Lengths Inches (mm)

Motor Length	LMAX SINGLE SHAFT, INTERNAL ENCODER or LINEAR ACTUATOR	LMAX2 CONTROL KNOB
Single	2.20 (55.9)	2.79 (70.9)
Double	2.43 (61.7)	3.02 (76.7)
Triple	2.77 (70.4)	3.37 (85.6)

P1 Connector Options MDrivePlus

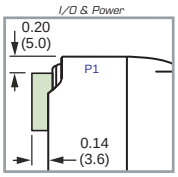


Flying Leads



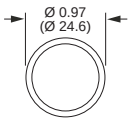
7-Pin Pluggable Clamp Type Terminal Strip

MDrivePlus2 (Only)



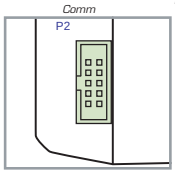
16-Pin Pluggable Locking Wire Crimp

LMAX2 Options

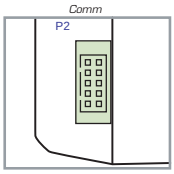


Control Knob

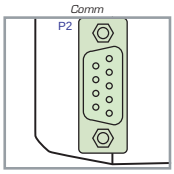
P2 Connector Options MDrivePlus & Plus2



10-Pin IDC

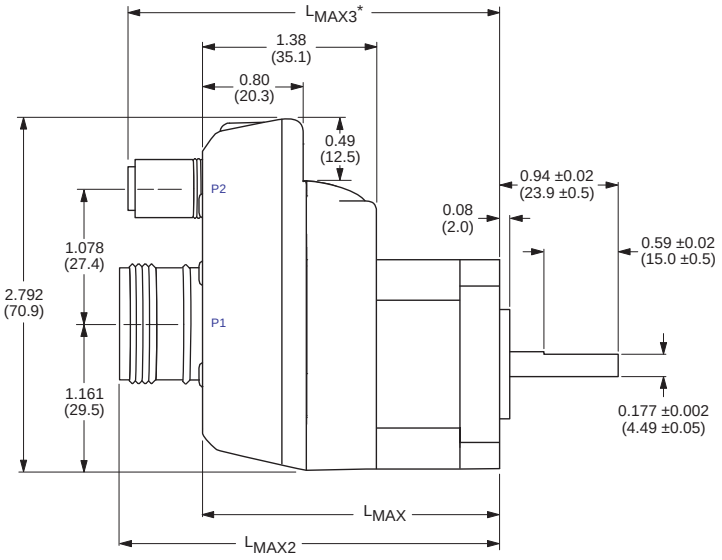


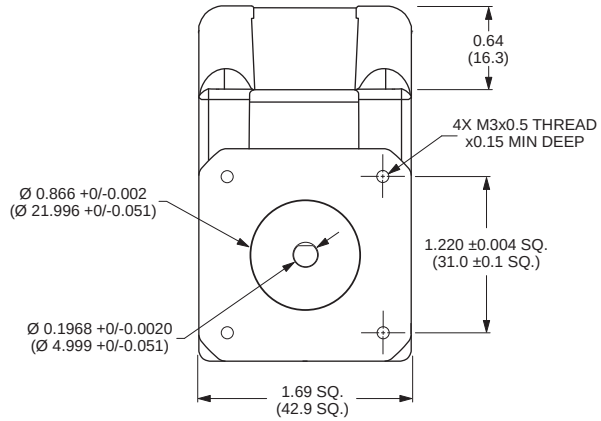
10-Pin Friction Lock Wire Crimp



DB9 (Male) for CANopen Only

MDrive17Plus2-65 Motion Control (sealed)



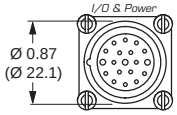


Sealed MDrivePlus Lengths Inches (mm)

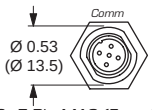
Motor Length	LMAX	LMAX2	LMAX3*
Single	2.39 (60.71)	3.06 (77.72)	2.99 (75.95)
Double	2.62 (66.55)	3.29 (83.57)	3.22 (81.79)
Triple	2.96 (75.18)	3.63 (92.20)	3.56 (90.42)

*CANopen increases measurement by 0.09"/2.0mm

Connectors



P1: 19-Pin M23 (Male)



P2: 5-Pin M12 (Female) (or CANopen – Male)

Connectivity details: www.imshome.com/cables_cordsets.html

ORDER INFORMATION — MDrive17Plus Motion Control

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-CC400-001
10-Pin Wire Crimp MD-CC402-001
DB9 CANopen MD-CC500-000*
5-Pin M12 CANopen (sealed version) MD-CC500-000*
5-Pin M12 RS-422/485 (sealed version) MD-CC401-001
*Requires mating connector adapter and power supply, not supplied.

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:

10-Pin Wire Crimp PD10-1434-FL3
16-Pin Wire Crimp PD16-1417-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:

10-Pin Wire Crimp CK-02
16-Pin Wire Crimp CK-10

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

10-Pin IDC CK-01

OPTIONS

Linear Actuator**
The MDrive17Plus 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

Internal Encoder
All MDrive17Plus Motion Control versions are available with an optional internal 512-line (2048 count) magnetic encoder with index mark.

Remote Encoder (Plus² versions only)
MDrive17Plus² Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob‡
The MDrive17Plus is available with a factory-mounted rear control knob for manual shaft positioning.

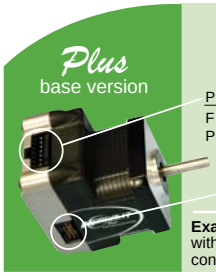
Planetary Gearbox
Efficient, low maintenance planetary gearboxes are offered assembled with the MDrive17Plus. Refer to details and part numbers on the back cover.

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.

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

Connectivity details: www.imshome.com/cables_cordsets.html

PART NUMBERING



K **MDI1☐☐☐17☐4 – OPTION**

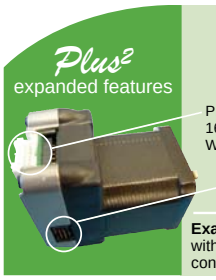
QuickStart Kit details above

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

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

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

Example #1: Part Number **MDI1PRD17A4** is an MDrive17Plus Motion Control with pluggable I/O & power interface, RS-422/485 communications with 10-pin IDC connector, and NEMA 17 single length motor.



K **MDI3C☐☐17☐4 – OPTION**

QuickStart Kit details above

P1: I/O & Power
16-Pin Locking Wire Crimp

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

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

Example #2: Part Number **MDI3CRD17C4** is an MDrive17Plus² Motion Control with 16-pin I/O & power interface, RS-422/485 communications with 10-pin IDC connector, and NEMA 17 triple length motor.

K **MDI4M☐☐17☐4 – OPTION**

QuickStart Kit details above

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

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

Example #3: Part Number **MDI4MRQ17B4** is an MDrive17Plus²-65 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 17 double length motor.

***Consult Factory for Availability.*

OPTIONS

Linear Actuator –L**

For complete product specifications, see: www.imshome.com/mdriveplus_linear_actuator.html

Internal Encoder –EQ

Example: **MDI4MRQ17B4–EQ** adds a 512-line internal magnetic encoder with index mark to example #3.

Remote Encoder –EE

Example: **MDI4MRQ17B4–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: **MDI3CRD17C4–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: **MDI3CRD17C4–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" (2.54mm)
B = 0.20" (5.08mm)
C = 0.50" (12.7mm)
D = 1.00" (25.4mm)

Standard Screw Lengths
10", 12", 15", 18", 24" or 36"
For Custom Lengths, Consult Factory

NOTE: 10" lengths only with A or B leads.
15" lengths only with A, B or C leads.
36" lengths only with D leads.

Example: **MDI1PRD17A4–RA10** adds a Linear Slide with 0.10" screw lead, 10" long to example #1.

MDRIVE17PLUS WITH PLANETARY GEARBOX

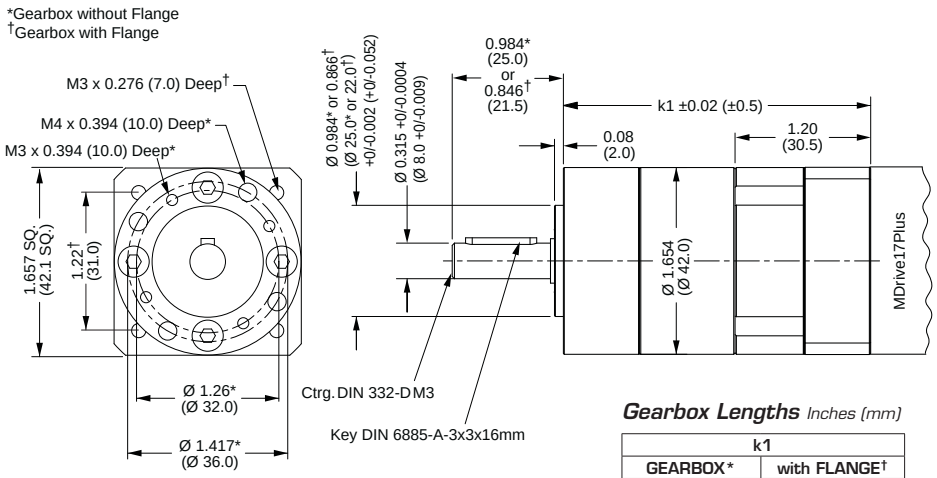
The MDrive17Plus is available with a Planetary Gearbox option developed to increase torque at lower speeds, enable better inertia matching and produce finer positional resolutions. These efficient, low maintenance Planetary Gearbox come fully assembled with the MDrive and are offered in a large number 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 MDrive17Plus 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	425/3.0	0.80	0.80°	36/160	11/50	14.3/406	14.8/420
2-STAGE	1062/7.5	0.75	0.85°	52/230	18/80	17.9/508	18.5/525
3-STAGE	2124/15.0	0.70	0.90°	67.5/300	25/110	18.5/525	22.2/630

Planetary Gearbox for MDrive17Plus

Dimensions in Inches (mm)



Gearbox Lengths *Inches (mm)*

	k1	
	GEARBOX*	with FLANGE†
1-Stage	2.736 (69.5)	2.858 (72.6)
2-Stage	3.248 (82.5)	3.37 (85.6)
3-Stage	3.76 (95.5)	3.882 (98.6)

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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