MDrive® Motion Control

MDrive and
Linear Actuator Products

IMS
INTELLIGENT MOTION
SYSTEMS, INC.

Schneider Electric

MDrivePlus Motion Control Manual Change Log		
Date	Revision	Changes
07/15/2009	R082409	Integrated all NEMA sizes into a single document. Added Linear Actuators
08/24/2009	R082409	Removed details and specifications for the MDrive42AC Plus Motion Control, as it is discontinued.
11/16/2009	R031610	Added support for size 14 and 23 linear actuator.
02/26/2010	R031610	Updated Linear actuator sections with assembly instructions for the anti-backlash nut.

The information in IMS Schneider Electric Motion USA product manuals and on this web site has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.

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Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or un-braked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant documentation are authorized to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the operation of mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

Intended Use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment.

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In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual. To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

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Motion Control

Part 1: General Usage

1. Introduction
2. Safety
3. Interfacing DC power
4. Interfacing AC power
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1 Introduction

The MDrive Motion Control high torque integrated programmable motion controller 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 MDrivePlus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise

The MDrive Motion Control uses high torque brushless step motors integrated with a high performance programmable motion controller and a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes.

Programming is accomplished over RS-422/485 using the IMS Terminal software tool, which is provided.

The MDrive Motion Control 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.

1.1 MDrive versions

MDrive

The MDrive is available in the following power ranges and flange sizes:

+12 to +48 VDC

- NEMA 14
- NEMA 17

+12 to +75 VDC

- NEMA 23
- NEMA 34

120 and 240 VAC

- NEMA 34

MDrive Linear Actuator

MDrive Linear Actuators are available in the following power ranges and flange sizes:

+12 to +48 VDC

- NEMA 14
- NEMA 17

+12 to +75 VDC

- NEMA 23

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1.3 Documentation reference

The following user's manuals are available for the MDrive:

- Product hardware manual, describes the technical data and installation of the product.
- Product software manual, describes the configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the web site at: http://www.imshome.com/downloads/manuals.html.

1.4 Product software

1.4.1 Communications converter drivers

If using the IMS communications converter, drivers are required, these drivers are available for download from the IMS web site at: http://www.imshome.com/downloads/cable_drivers.html.

1.4.2 IMS Terminal

The MDrive motion control can be configured and programmed using any standard ANSI terminal emulator and ASCII text editor.

The recommended tool is the IMS Terminal integrated terminal and program editor. IMS Terminal features color-coded editor, multiple-function keys and is pre-configured to operate using the MDrive default settings

Installation and usages instructions are to be found in MCode software manual.

This software may be downloaded from: http://www.imshome.com/downloads/software_interfaces.html

2 Safety

2.1 Qualification of personnel

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The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

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The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

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The drive systems must not be operated in an environment subject to explosion hazard (ex area).

2.3 Hazard Categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions affixed to the product that warn of possible hazards and help to operate the product safely.

Depending on the seriousness of the hazard, the messages are divided into three hazard categories.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

2.4 General safety instructions

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe status during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

Failure to follow these instructions can result in death or serious injury.

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

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3 Interfacing DC power

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

MAXIMUM VOLTAGE INPUT

Do not exceed the maximum rated voltage of the device! Motor Back EMF, power supply ripple and high line must be taken into account when selecting a power supply voltage level.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

GENERAL POWER SUPPLY PRACTICE

Do not connect or disconnect the power supply while power is applied.

Disconnect the AC side to power down the DC supply.

For battery operated systems connect a “transient suppressor” across the switch to prevent arcs and high-voltage spikes.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect power, logic, or communications while the device is in a powered state without additional protection.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions may result in damage to system components!

Detailed specifications, voltage limits, current requirements and connectivity information are located in the product detail section corresponding to the MDrive model you purchased.

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3.1 Applicability

This section applies to all MDrive motion control products with a DC power input.

3.2 Selecting a power supply (+V)

Proper selection of a power supply to be used in a motion system is as important as selecting the drive itself. When choosing a power supply for a stepping motor driver, there are several performance issues that must be addressed. An undersized power supply can lead to poor performance and possibly even damage to your drive.

3.2.1 Power supply — motor relationship

Motor windings can basically be viewed as inductors. Winding resistance (R) and inductance (L) result in an L/R time constant that resists the change in current. To effectively manipulate the rate of charge, the voltage applied is increased. When traveling at high speeds, there is less time between steps to reach current. The point where the rate of commutation does not allow the driver to reach full current is referred to as voltage mode. Ideally you want to be in current mode, which is when the drive is achieving the desired current between steps. Simply stated, a higher voltage will decrease the time it takes to charge the coil and, therefore, will allow for higher torque at higher speeds.

Another characteristic of all motors is back EMF. Back EMF is a source of current that can push the output of a power supply beyond the maximum operating voltage of the driver. As a result, damage to the stepper driver could occur over a period of time. This is especially prevalent with overhauling loads.

3.2.2 Power supply — driver relationship

The MDrive is very current efficient as far as the power supply is concerned. Once the motor has charged one or both windings of the motor, all the power supply has to do is replace losses in the system. The charged winding acts as an energy storage in that the current will recirculate within the bridge and in and out of each phase reservoir. This results in a less than expected current draw on the power supply.

Stepping motor drivers are designed with the intent that a user's power supply output will ramp up to greater than or equal to the minimum operating voltage of the drive. The initial current surge is substantial and could damage the driver if the supply is undersized. The output of an undersized power supply could fall below the operating range of the driver upon a current surge. This could cause the power supply to start oscillating in and out of the voltage range of the driver and result in damage to either the supply, the driver, or both.

There are two types of supplies commonly used, regulated and unregulated, both of which can be switching or linear. Each have advantages and disadvantages.

3.2.3 Regulated vs unregulated

An unregulated linear supply is less expensive and more resilient to current surges, however, the voltage decreases with increasing current draw. This may cause problems if the voltage drops below the working range of the drive.

Fluctuations in line voltage are also a point of concern. These fluctuations may cause the unregulated linear supply to be above or below the anticipated or acceptable voltage.

A regulated supply maintains a stable output voltage, which is good for high speed performance. These supplies are also not affected by line fluctuations, however, they are more expensive. Depending on the current regulation, a regulated supply may crowbar or current clamp and lead to an oscillation that, as previously stated, can cause damage to the driver and/or supply. Back EMF can cause problems for regulated supplies as well. The current regeneration may be too large for the regulated supply to absorb. This could lead to an over voltage condition which could damage the output circuitry of the MDrive.

Switching power supplies and regulated linear supplies with over current protection are not recommended because of their inability to handle the surge currents inherit in stepping motor systems.

See the product detail section of this document for specific power supply voltage and current requirements and recommended power supplies.

3.3 Power supply cabling recommendations

⚠ CAUTION

EMI and RFI

These recommendations will provide optimal protection against EMI and RFI. The actual cable type, wire gauge, shield type and filtering devices used are dependent on the customer's application and system.

The length of the DC power supply cable to an MDrive should not exceed 50 feet (15.2 m).

Always use Shielded/Twisted Pairs for the MDrive DC Supply Cable and the AC Supply Cable.

Failure to follow these instructions may result in damage to system components!

Cable length, wire gauge and power conditioning devices play a major role in the performance of your MDrive.

Figure 3.1 illustrates the recommended cable configuration for DC power supply cabling under 50 feet (15.2 m) long. If cabling of 50 feet (15.2 m) or longer is required, the additional length may be gained by adding an AC power supply cable (see Figures 3.2 and 3.3).

Correct AWG wire size is determined by the current requirement plus cable length. Please see Table 3.1.

3.3.1 DC Cabling Under 50’ (15.24 m)

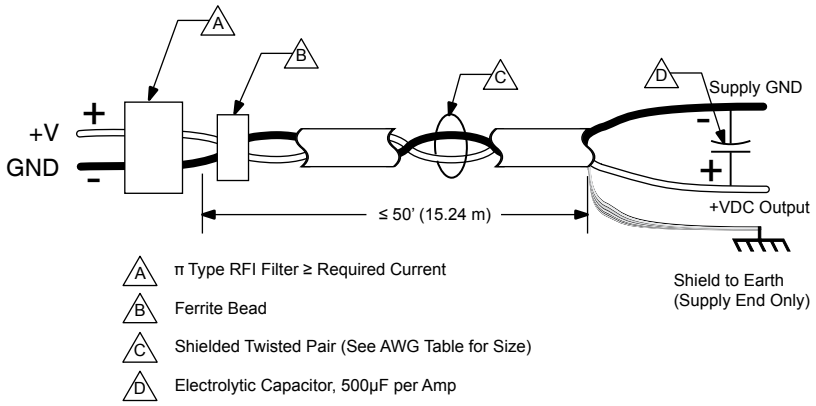


Figure 3.1 DC power supply cabling under 50’ (15.24 m)

3.3.2 AC power to full wave bridge

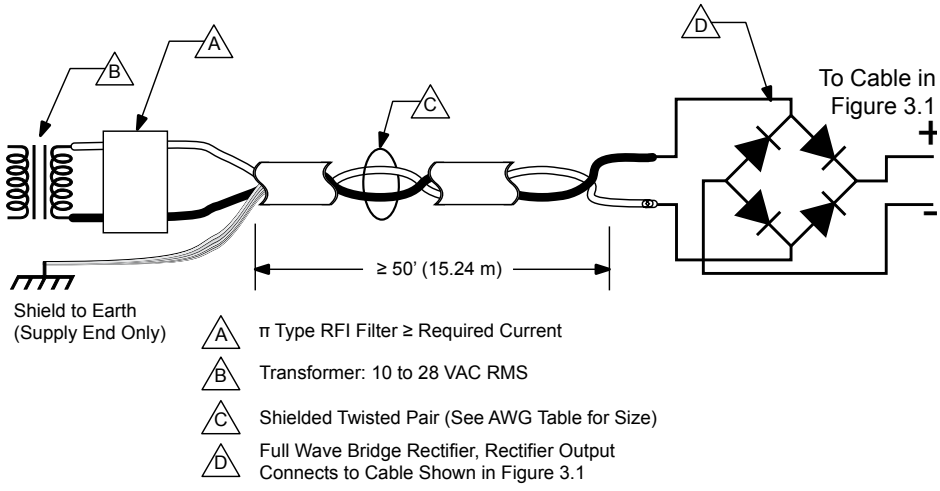


Figure 3.2 50’ (15.2 m) or greater, AC power to full wave bridge

3.3.3 AC power DC supply

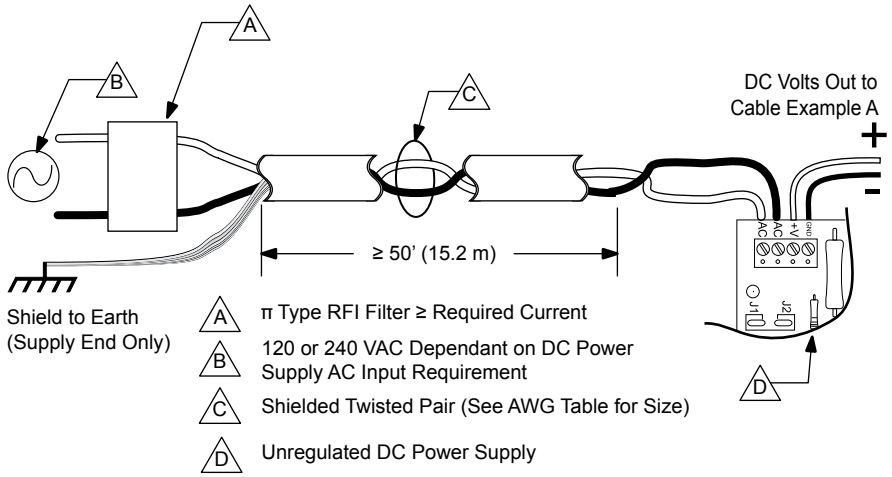


Figure 3.3 50' (15.2 m) or greater, AC power to DC supply

3.3.4 Recommended wire gauges

For cable lengths exceeding 50' (15.2 m), use the cable configurations shown in Figures 3.2 and 3.3.

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18
2 Amps Peak	20	18	16	14	14
3 Amps Peak	18	16	14	12	12
4 Amps Peak	18	16	14	12	12

Table 3.2 Power supply cable AWG recommendations

Detailed specifications, voltage limits and connectivity information are located in the product detail section corresponding to the MDrive model you purchased.

3.3 Switching DC power (DPM75 accessory)

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect power, logic, or communications while the device is in a powered state without additional protection.

Remove DC power by powering down at the AC side of the DC power supply.

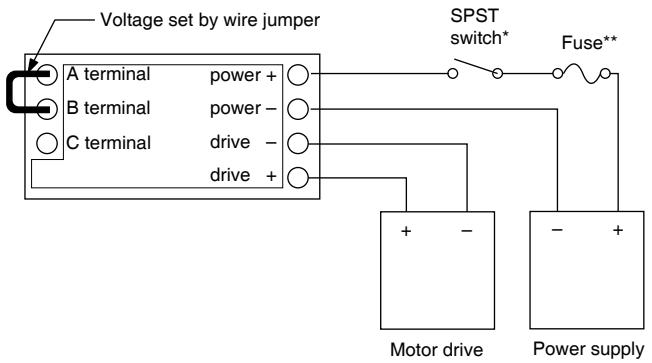
Failure to follow these instructions may result in damage to system components!

The function of the DPM75 Drive Protection Module is to limit the surge current and voltage to a safe level when DC input power is switched on and off to a motor drive. This provides the added protection necessary for reliable motor drive operation when switching the DC power, instead of the recommended AC power to the DC power supply. The device is designed to protect the motor drive when operating under all load conditions. This device does not protect the motor drive from wiring the power incorrectly.

The unit is capable of being used with 48, 60, and 75 volt rated motor drives. An external jumper selection is available so the user can match the circuit to their particular application. The DPM75 is capable of a steady state operating current of 4 amps.

The DPM75 can be used for any frame size motor drive, when properly configured. It can also be used for more than one unit provided the current and voltage do not exceed the DPM75's ratings. The maximum DPM75 ratings are 75 volts and 4 amps.

Power requirements and wiring details are available in the product detail section pertaining to the MDrive product purchased.



* Do not switch negative side of supply
**Fuse = 6.3 Amp slow blow (recommended: Bussman S505-6.3A or Littelfuse 215006.3). The fuse is optional.

Figure 3.4 DPM75 basic wiring and connection

4 Interfacing AC power

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if power or signal wiring is exposed.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

MAXIMUM VOLTAGE INPUT

Do not exceed the maximum rated voltage of the device!

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

Detailed specifications, voltage limits, current requirements and connectivity information are located in the product detail section corresponding to the MDrive model you purchased.

4.1 Applicability

This section is only applicable to those MDrives with a 120 or 240 VAC input voltage.

4.2 Interfacing AC voltage

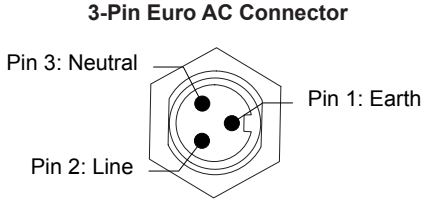


Figure 4.1 Euro AC connector (P3)

Signal	European (IEC) color code	US color code
Earth	Yellow/Green	Green
Line	Brown	Black
Neutral	Blue	White

Table 4.1 AC standard wire colors

4.3 MD-CS20x-000 cordset

The single-end three conductor cordsets are used with the MDrive AC. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. IEC color code, oil-resistant yellow PVC jacket, IP68 and NEMA 6P rated.

Straight Termination MD-CS200-000

Right Angle Termination MD-CS201-000

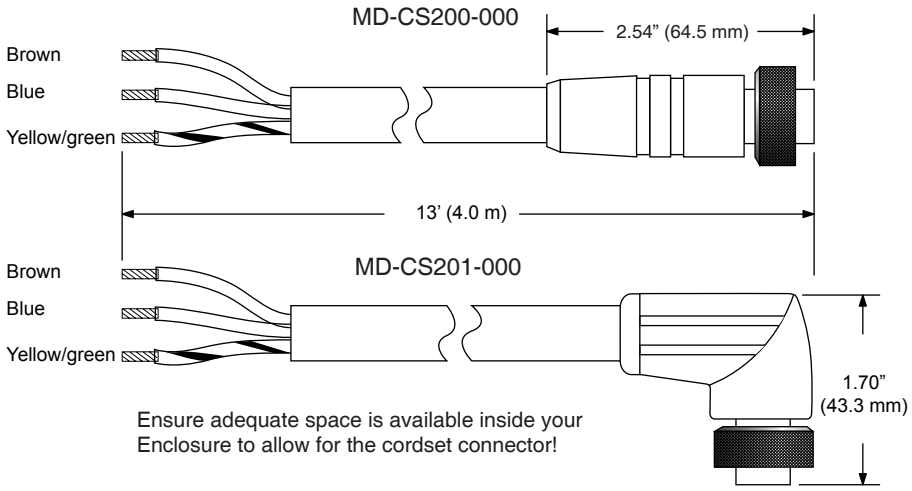


Figure 4.2 MD-CS20x-000

5 Interfacing serial communications

The MDrive communicates to the host using the RS-422/485 protocol. Communications may be configured as either half duplex (RS-485) or full duplex (RS-422) using the EM (Echo Mode) Instruction. RS-422/485 may be used in two ways: either to communicate to a single MDrive, or to address up to 62 individually named nodes in a multidrop system.

5.1 Applicability

This section applies to all MDrive Motion Control models with an RS-422/485 communications interface.

5.2 USB to RS-422/485 isolated communications converter cables

To simplify the wiring and connection process we offer an electrically isolated USB to RS-422/485 communications cables for the MDrive. These convenient 12.0' (3.6m) accessory cables connect a PC's USB port to the MDrive P2 connector. An in-line RS-422/485 converter enables parameter setting to a single MDrive. cable purchase recommended with first order.

There are two communications converter cables available depending on the connector type:

USB to 10-pin wire crimp.....Part No. MD-CC402-001

USB to 5-pin M-12 circular .....Part No. MD-CC401-001

5.2.2 Driver installation procedure

The installation of the MD-CC40x-000 requires the installation of two sets of drivers:

- Drivers for the USB to RS-422 converter hardware.
- Drivers for the Virtual Communications Port (VCP) used to communicate to your product.

Therefore the Hardware Update wizard will run twice during the installation process.

The full installation procedure will be a two-part process: Installing the cable/VCP drivers and Determining the Virtual COM Port used.

Installing the cable/VCP Drivers

1) Download the MD-CC40x-001 communications converter drivers from http://www.imshome.com/downloads/cable_drivers.html. Extract to a folder on your hard drive.
2) Plug the USB converter cable into the USB port of the MD-CC40x-001.
3) Plug the other end of the USB cable into an open USB port on your PC.
4) Your PC will recognize the new hardware and open the Hardware Update dialog.
5) Select “No, not this time” on the radio buttons in answer to the query “Can Windows Connect to Windows Update to search for software?” Click “Next”.
6) Select “Install from a list or specific location (Advanced)” on the radio buttons in answer to the query “What do you want the wizard to do?” Click “Next”.
   - Select “Search for the best driver in these locations.”
   - Check “Include this location in the search.”
   - Browse to the download location on your hard drive.
7) Click Next.
8) The drivers will begin to copy.
9) On the Dialog for Windows Logo Compatibility Testing, click “Continue Anyway”.
10) The driver installation will proceed. When completing the Found New Hardware Wizard dialog appears, Click “Finish”.
11) Upon finish, the Welcome to the Hardware Update Wizard will reappear to guide you through the second part of the install process. Repeat steps 1 through 9 above to complete the cable installation.
12) Your MD-CC40x-001 is now ready to use.

Determining the Virtual COM Port (VCP)

The MD-CC40x-000 uses a Virtual COM Port to communicate through the USB port to the MDrive. A VCP is a software driven serial port which emulates a hardware port in Windows.

The drivers for the MD-CC40x-000 will automatically assign a VCP to the device during installation. The VCP port number will be needed when IMS Terminal is set up in order that IMS Terminal will know where to find and communicate with your product.

To locate the Virtual COM Port.

1) Right-Click the “My Computer” Icon and select “Properties”.
2) Browse to the Hardware Tab, Click the Button labeled “Device Manager”.
3) Look in the heading “Ports (COM & LPT)” USB to RS-422 converter cable (COMx) will be listed). The COM # will be the Virtual COM Port connected. You will enter this number into your IMS Terminal configuration.

5.3 Interfacing single mode communications

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

5.3.1 Full duplex (RS-422)

To interface the MDrive using RS-422 protocol you will need one of the following:

- A PC equipped with RS-422 Interface.
- A PC RS-232 to RS-422/485 converter.
- MD-CC402-001 or equivalent communications converter.

Use the following diagram to connect RS-422 communications to the MDrive (not required if using our cables)

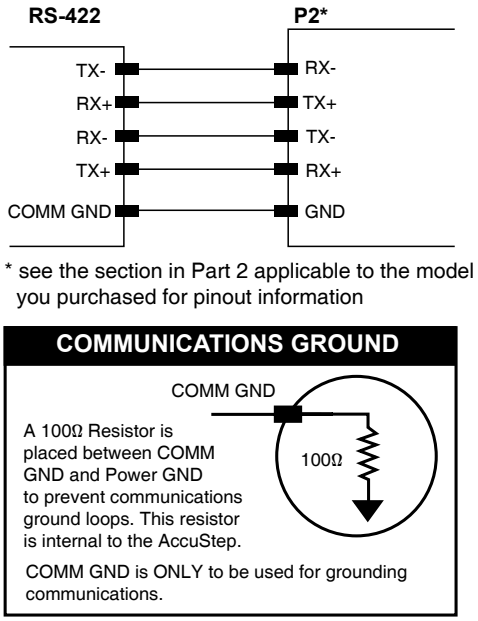


Figure 5.2 Full duplex RS-422 connection.

5.3.2 Half duplex (RS-485)

The MDrive can be operated in a two wire RS-485 communication bus. Before connecting the two wire RS-485, download your program and setup instructions using the standard four wire RS-422 Communications cable. If a program is not being used, download and save any setup parameters. To ensure the MDrive responds only to commands specifically meant for it, set the unit in party mode

The Echo Mode command (EM) must be set to the value of 1 (EM=1). This will set the MDrive communication into “half duplex” mode. Connect the driver in the two wire RS-485 configuration. The following diagram illustrates how to connect the four wire RS-485 to operate as a two wire system.

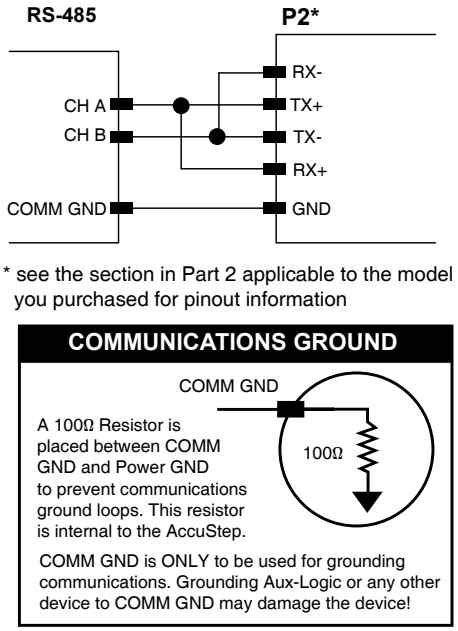


Figure 5.3 Half duplex RS-485 connection.

5.4 interfacing party mode communications

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

SHIELDED CABLES

Do not use the MD-CC400-001 communications converter cable for multi-drop systems. Ribbon cables are not recommended for use in multi-drop communications systems due to the lack of shielded cabling.

Failure to follow these instructions may result in damage to system components!

DEVICE NAME

Each unit in a party mode system must have a unique identifier, or device name. Each unit MUST be connected and communicated with in single mode communications and given a name using the DN command

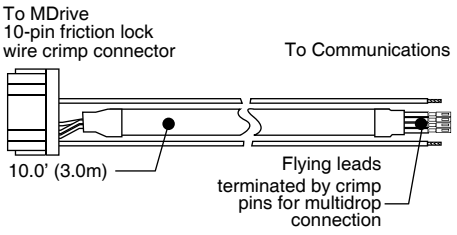
Please reference the MCode Programming and Software manua for more information.

5.4.1 Mutli-drop communications using MD-CC402-001

Required:

- MD-CC402-001 communications converter cable
- PD10-1434-FL3 prototype development cable(s)

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

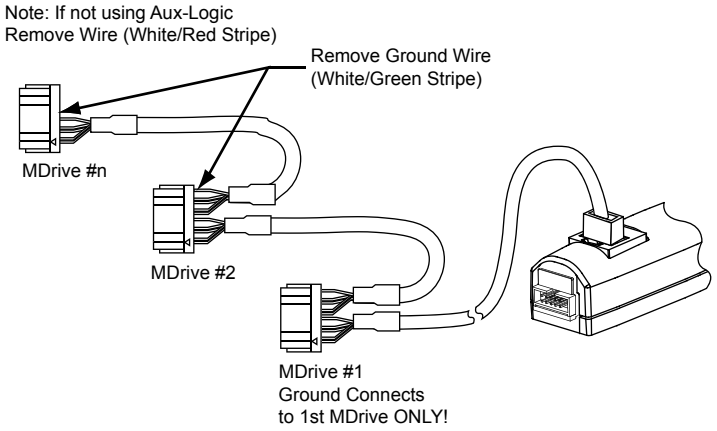


Figure 5.4 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

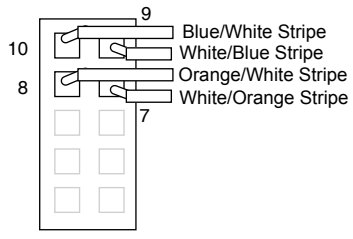


Figure 5.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

5.4.2 Mutli-drop communications connection

Figure 5.6 illustrates the connection schematic for a multi-drop communications system, note that communications ground only connects to the first system MDrive.

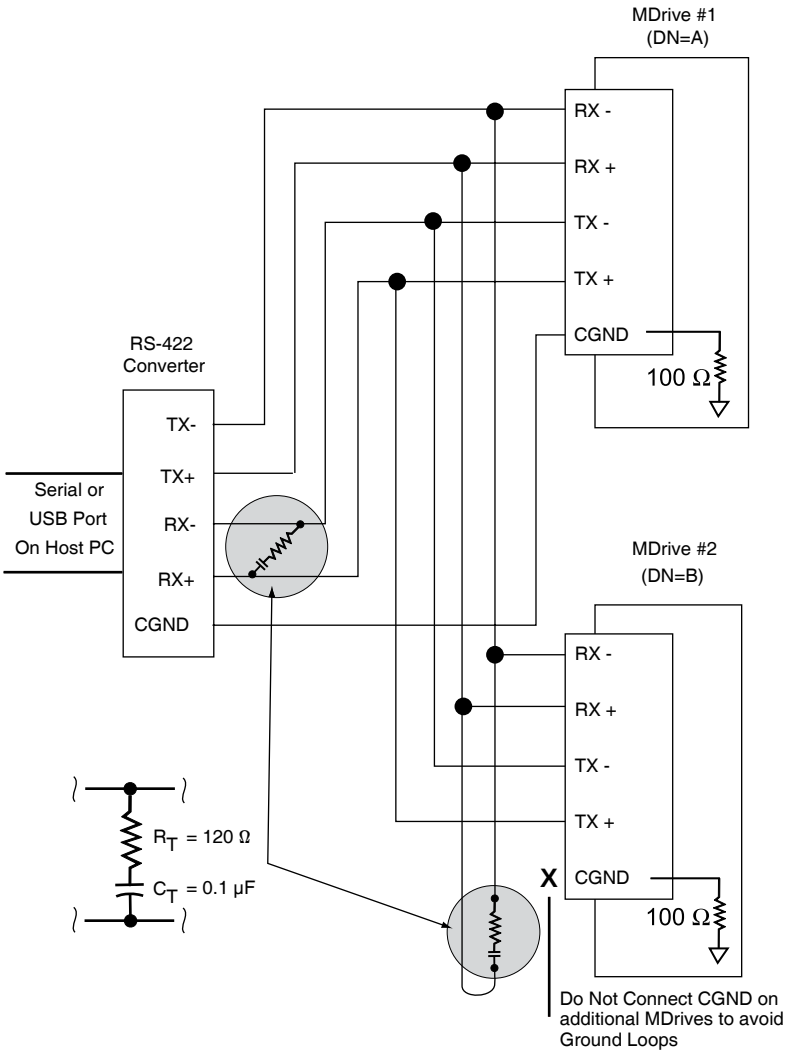


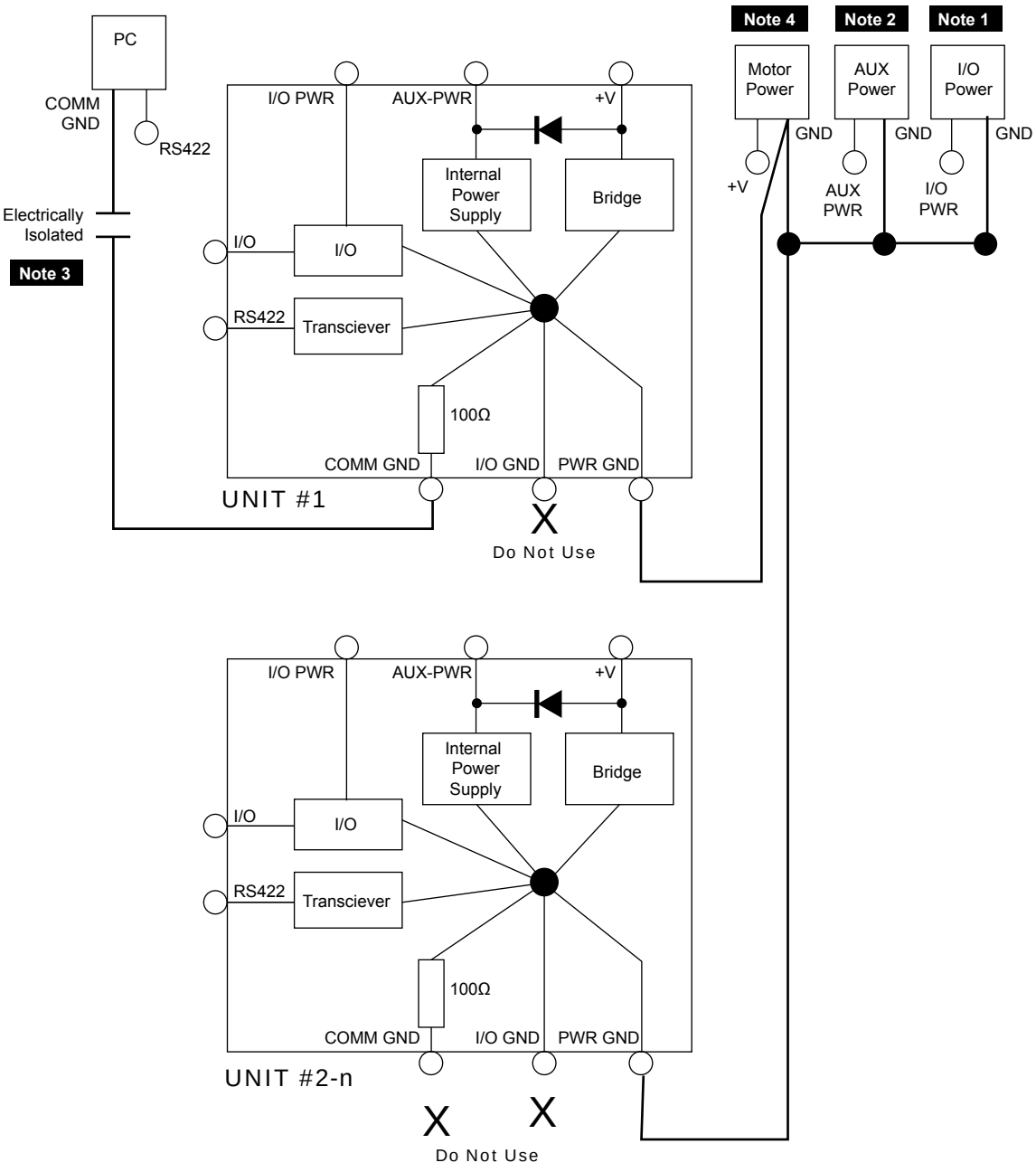
Figure 5.6 Interface for party-mode operation

Data cable Termination Resistors

Data cable lengths greater than 15 feet (4.5 meters) are susceptible to signal reflection and/or noise. We recommend 120 Ω termination resistors in series with 0.1µf capacitors at both ends of the receive lines of the communications cables. An example of resistor placement is shown in Figure 5.8. For systems with data cables 15 feet (4.5 meters) or less, the termination resistors are generally not required.

5.4.3 System power connection for a multi-drop system

The power connection schematic in Figure 5.7 represents the recommended power configuration for avoiding communications ground loops



Note 1 Use AUX-PWR only if position information is needed when motor power is lost AND the MDrive has an encoder

Note 2 Use I/O Power only if sourcing outputs are required. I/O Power is only available on MDrives with expanded I/O

Note 3 The isolated communication converter's common MUST be connected to ONLY one MDrive.

Note 4 If Multiple motor power supplies are used connect the commons together and refer to note three.

Figure 5.7 Power interface for eliminating communications ground loops

5.4.4 Software configuration

Party mode communications requires extensive software configuration and has a specific communications and response format.

This is documented in detail in the MCode software and programming manual.

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5 Interfacing CANopen communications

5.1 Features

- CANopen DS-301 and DS-402
- Galvanically isolated communications
- 3 Dynamically mappable process data objects (PDO)
- Layer Setting Services (LSS) to establish node id and baud
- Node guarding
- Heartbeat producer
- Emergency objects
- Upgradable software

5.2 Interfacing the can bus

The MDrive communicates using the CAN 2.0B Active Protocol and the CiA DS-301 Application Layer and Communications Profile. The full DS-301 V4.02 Specification may be downloaded free at http://www.can-cia.org. The default BAUD rate is 1 Mbit/Sec. The default Node ID is 41h.

5.2.1 CAN bus connections

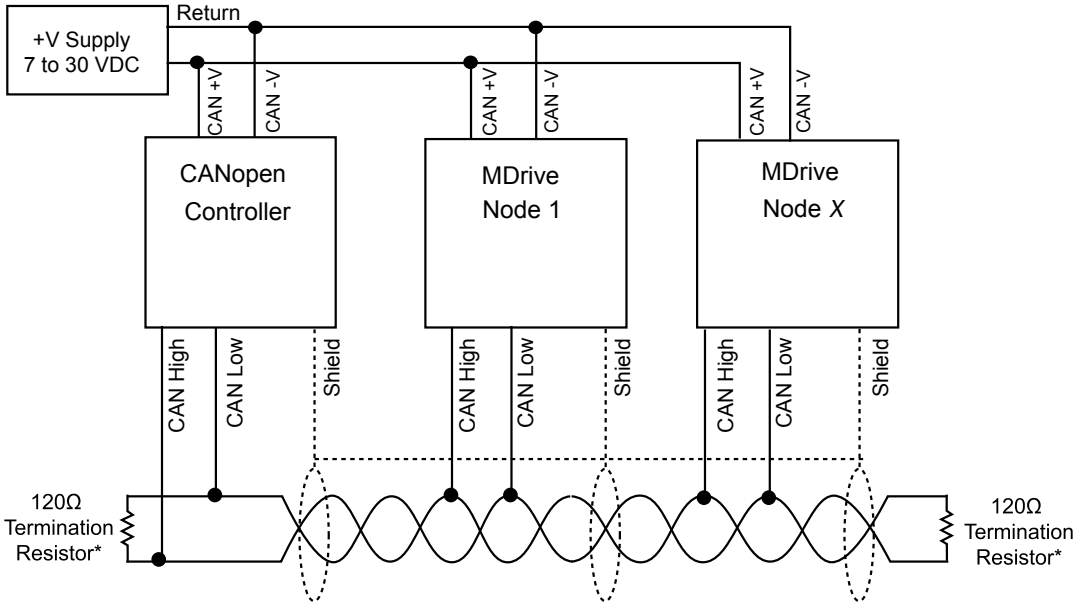

Figure 5.1 Interfacing the CAN bus

5.2.2 Recommended CANopen dongle

In order to use the CANopen Tester tool and upgrade utility for the MDrive you must purchase the MD-CC500-000 communications cable. When purchased from us, the user interface software for upgrading and prototyping is included. This is required to upgrade the firmware in the MDrive updates become available.

This device is also available from phytec at: http://www.phytec.com/can/hardware/pccaninterface/peakusb.htm, but does not include the CANopen Tester and upgrader software.

Interface cable construction

To connect the MD-CC500-000 dongle to the MDrive product an interface cable will need to be constructed. The figure below shows the parts required.

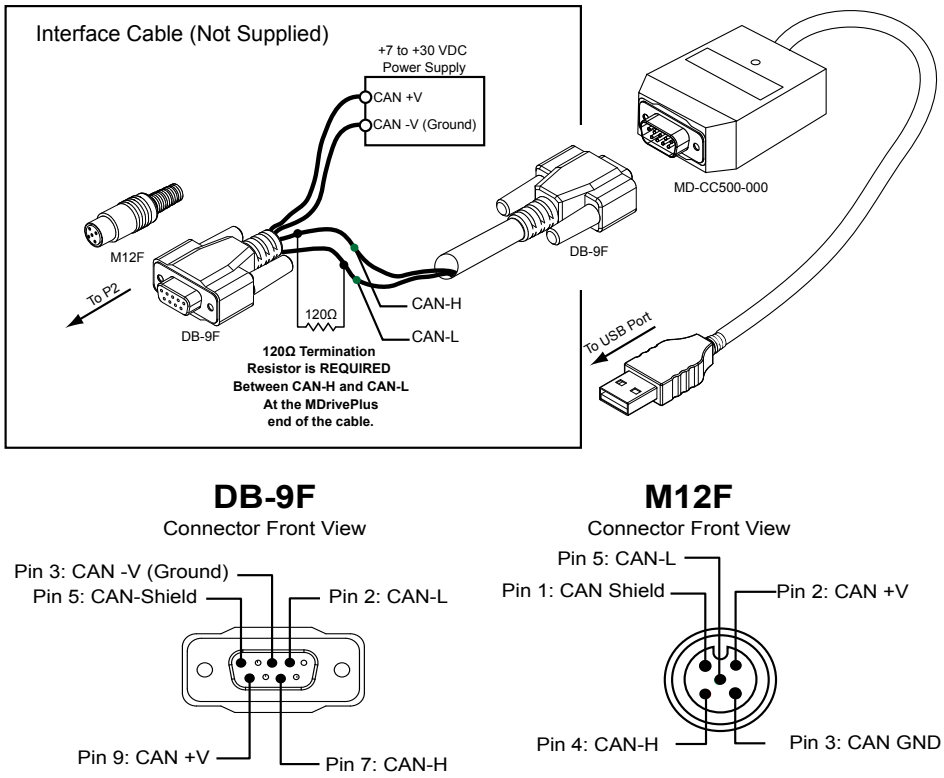

Figure 5.2 MD-CC500-000 USB to CANopen commissioning cable

Installation Instructions

1) Install the MD-CC500-000 adapter per the Phytec PCAN-USB Operating Instructions included on the PEAK CD included with the product.
2) Install the CANopen Tester software available online at http://www.imshome.com/
3) Using the interface cable (not supplied), connect the MDrive product to the MD-CC500-000.
4) Apply power to the MDrive product.

5.3 CANopen Tester quick start

5.3.1 Installation

1) Download the most recent version of the CANopen Tester from the web site at: http://www.imshome.com/downloads/software_interfaces.html.
2) Extract the files from the archive file.
3) Browse to the extracted folder.
4) Double-Click the Setup.exe file.
5) Follow the prompts to install the program.

5.3.2 Getting Started with CANopen Tester

⚠ CAUTION

CANopen Tester Software

Do not use this software unless you accept the responsibility of using the full tool.

Only technicians who are familiar with and understand the contents of the manual and the other relevant documentation are authorized to work with the full tool.

Damage and/or drive failure may be experienced without full knowledge of the device indexes and features.

The following brief tutorial will cover setting the MDrive in profile position. To place the software in advanced mode, select “advanced Mode” from the tools menu in the main interface. A warning dialog will launch with the caution text. If qualified, click “yes” on the dialog. This will launch the advanced features screen.

With the MDrive powered and the CANopen Tester software launched, select through the following sequence.

See figure 5.3 for button locations.

A. Click CAN Init

B. Check “Cycle Reading of indexes.

C. Click Msg Window Scripts – This will open another window to allow the user to see data being sent to MDrive in the following steps.

D. Click Operation_Toggle three times (this steps through Index 0x6040 Control Word ending with Operation Enabled). This enables the output bridge of the driver.

E.. Enter the number “1” in the Modes of Operations field, this places the MDrive into Profile Position mode.

F. Enter 512000 into the IDX67AH field, strike the return (Enter) key on your keyboard, the motor should move 10 revolutions.

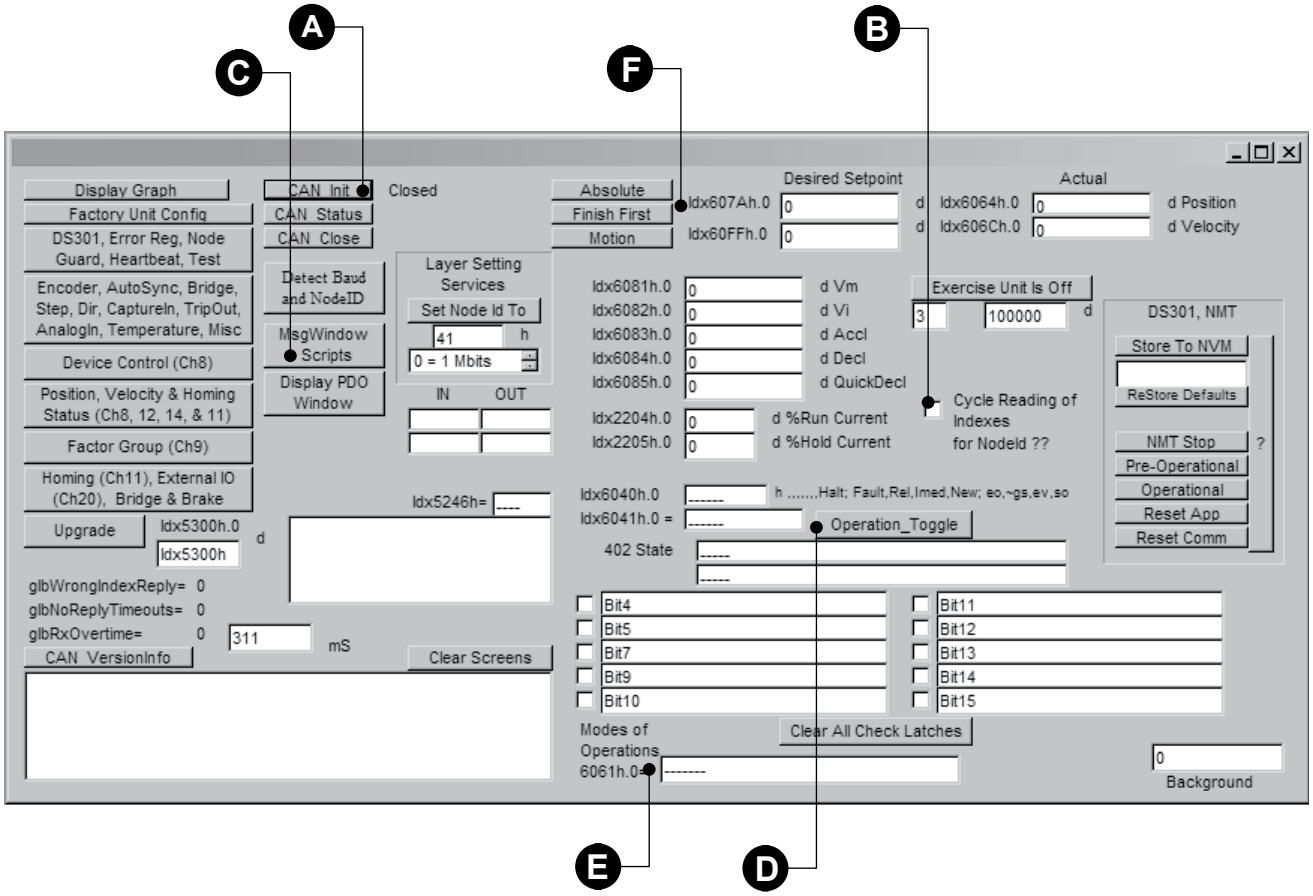

Figure 5.3 CANopen Tester

6 Interfacing I/O

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O points are TTL level and only tolerant to +5 VDC:

1) Step Clock
2) Direction
3) Capture/Trip
4) Remote encoder inputs

Do not exceed +5 VDC on these points.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions may result in damage to system components!

CONNECTOR OPTIONS

The MDrive motion control product family has an extensive set of connector options. The purpose of this section is to give a general overview of the I/O interface methods and practices.

Please see the section specific to the MDrive product you purchased in the second part of this document for connectors, pin configurations and connectivity options.

I/O FUNCTIONS AND PARAMETERS

The functions and operational parameters of the MDrive Motion Control I/O MUST be configured in software.

For detailed specifications and instruction please reference the MCode Software and Programming manual.

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6.1 I/O configurations

The MDrive Motion Control product line is available with the following I/O configuration.

I/O set	
General purpose	IO1, IO2, IO3, IO4, IO9, IO10, IO11, IO12 (Sinking or sourcing inputs or outputs
Dedicated	Capture input/trip output
Analog input	AIN1

Table 6.1 MDrive I/O configurations

6.1.1 I/O States

The digital I/O may be defined as either active HIGH or active LOW. When the I/O is configured as active HIGH, the level is +5 to +24 VDC and the state will be read/set as a “1”. If the level is 0 VDC, then the state will be read/set as “0”. Inversely, if configured as active LOW, then the state of the I/O will be read/set as a “1” when the level is LOW, and “0” when the level is HIGH.

The active HIGH/LOW state is configured by the third parameter of the I/O Setup (S1-4, S9-12) variable. The goal of this I/O configuration scheme is to maximize compatibility between the MDrive Motion Control and standard sensors and switches.

6.2 General purpose I/O

The general purpose +5 to +24 VDC I/O must be configured and programed to general or reserved functions in software. The I/O cannot be exercised without configuration parameters being set:

6.2.1 General purpose input functions

Function	*Description*
User defined	Input function used to control program branches, subroutine calls or BCD functions when the input bank is used as a group.
Home	Homing input
Limit +	Positive limit input
Limit -	Negative limit input
G0	Executes program at memory address 1 on activation
Soft stop	Stops motion with deceleration and halts program execution
Pause	Pause/resume program execution with motion
Jog +	Jog positive direction
Jog -	Jog negative direction
Reset	Reset program, equivalent to a ^C terminal input.

Table 6.2 General purpose input functions

6.2.2 General purpose output functions

Function	*Description*
User defined	Output function which can be set to trigger external events from within a program
Moving	Input will be in an active state when the motor is moving
Fault	Activates on an error.
Stall	Activates when a stall is detected (encoder required)
Velocity changing	Activates when accelerating or decelerating

Table 6.3 General purpose output functions

6.2.2 Interfacing sinking inputs

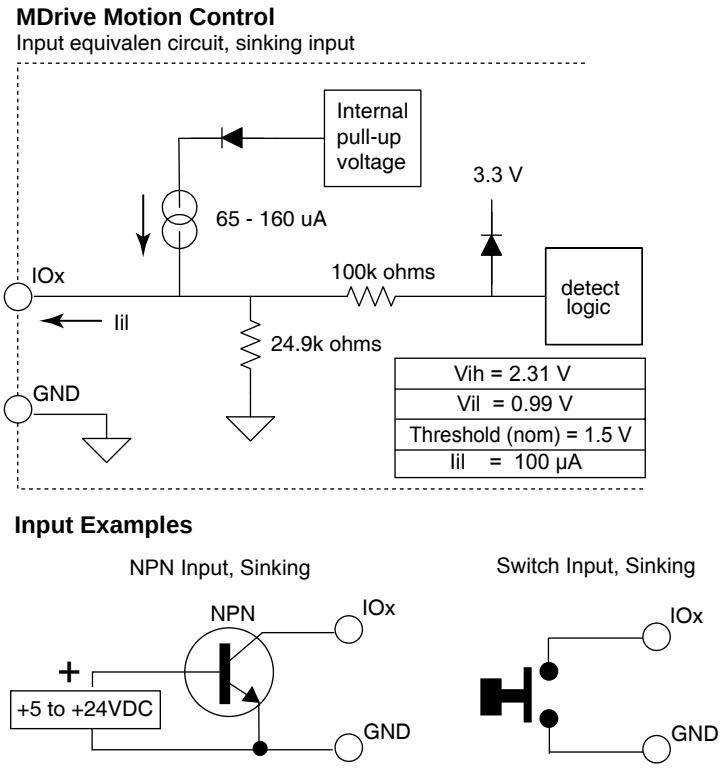

Figure 6.1 Sinking input equivalent circuit and interface examples

6.2.3 Interfacing sinking outputs

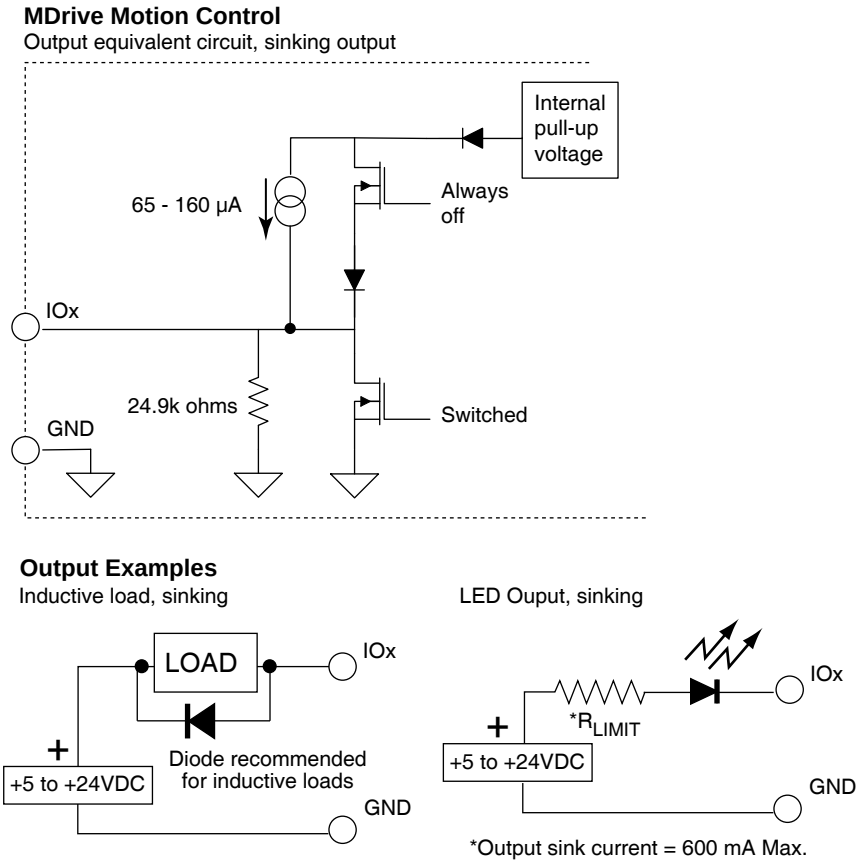

Figure 6.2 Sinking output equivalent circuit and interface examples

6.2.4 Interfacing sourcing inputs

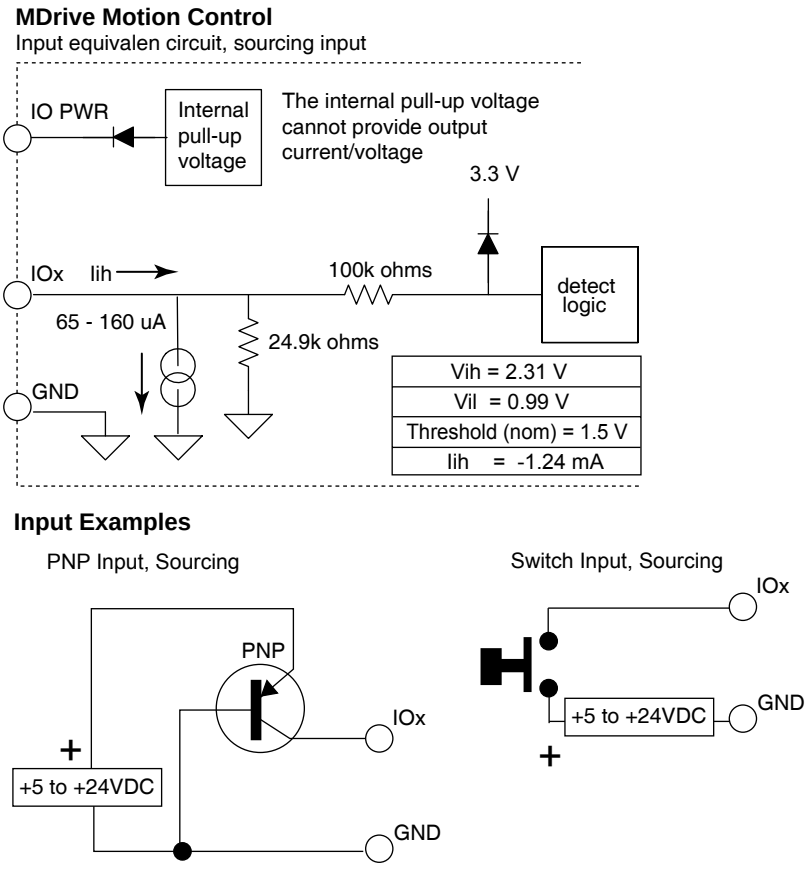

Figure 6.3 Sourcing input equivalent circuit and interface examples

6.2.5 Interfacing sourcing outputs

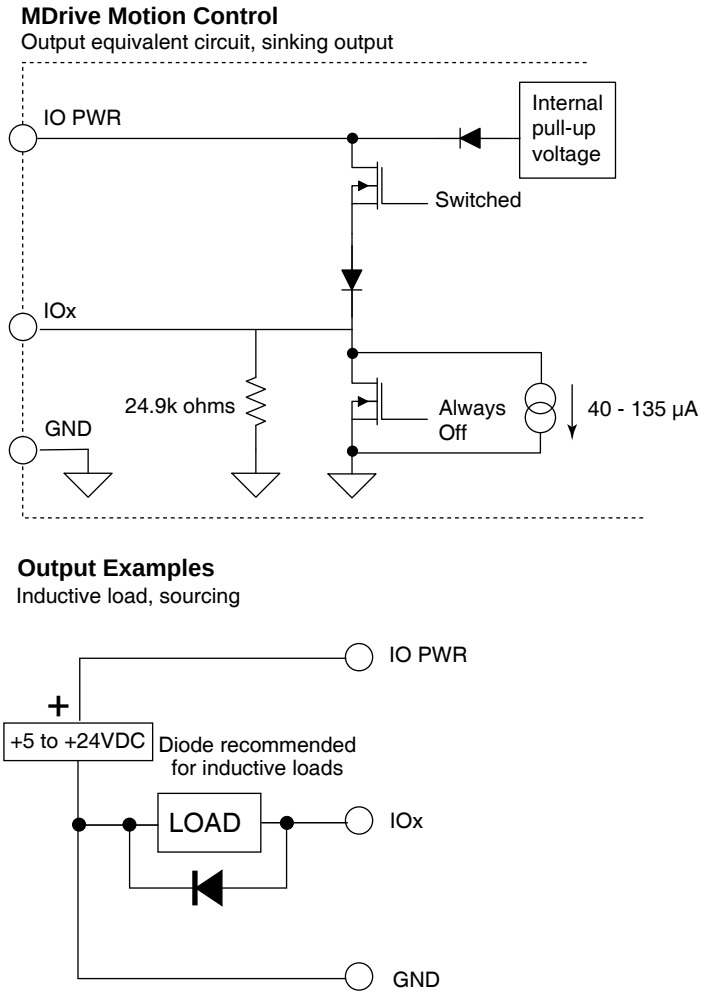

Figure 6.4 Sourcing output equivalent circuit and interface examples

6.2.5 Mixed I/O Example

The application illustrated in Figure 6.5 shows an example of the I/O points being used as mixed inputs and outputs on an MDrive with the standard I/O configuration.

IO3 and IO4 are configured as sinking limit inputs, IO2 is set up as a sourcing G0 input with IO1 as a sinking user output. This circuit would operate as automatic reset, where and event inside the program would trigger the user output and run a program located at address 1 in program storage.

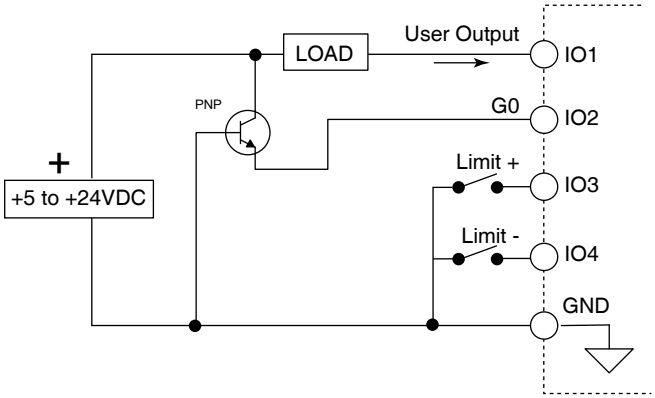

Figure 6.5 Mixed inputs and outputs, standard MDrive.

6.2.5 Mixed I/O Example (expanded)

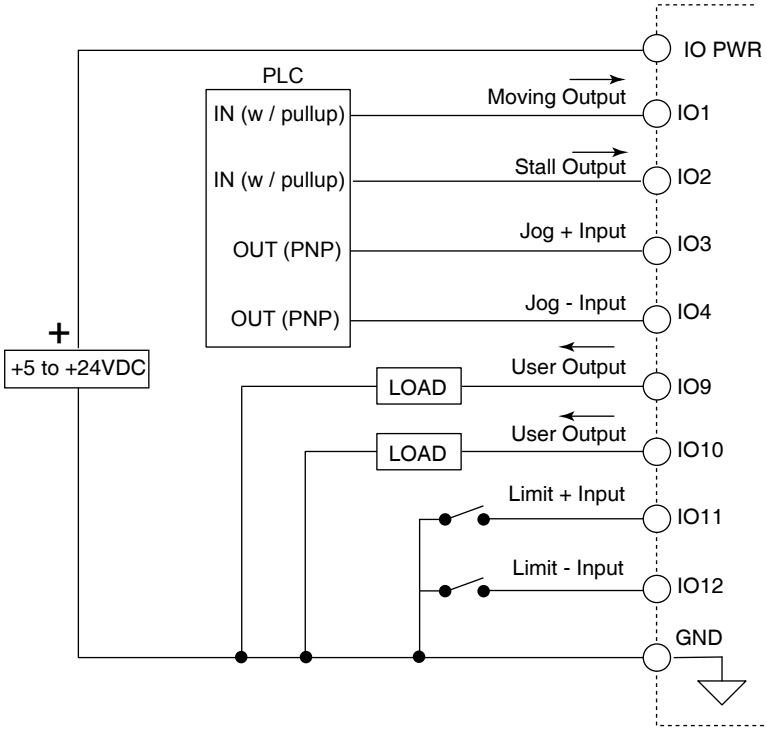

Figure 6.6 Mixed inputs and outputs, expanded MDrive.

6.2.6 Interfacing to a bank of I/O points

The I/O can be interfaced to as a bank of inputs or outputs. Available banks are:

Standard ..... Bank 1: IO1-O4

Expanded ..... Bank 1: IO1-IO4, Bank 2: IO9-IO12

Expanded + remote encoder ..... Bank 1: IO1-IO4

This feature gives the user to implement sophisticated process control applications by triggering events based upon the BCD state of the I/O.

Binary coded decimal inputs

Figure 6.7 illustrates a TTL interface to I/O banks 1 and 2 on an MDrive with the expanded I/O set. These are set to be user defined inputs and the state is read using the following software commands as a binary number. When reading the state of the bank to a terminal it will display as decimal:

- IL — will read the lower input group (IO1 - IO4) where IO1 is the LSB and IO4 is the MSB
- IH — will read the upper input group (IO9 - IO12) where IO9 is the LSB and IO12 is the MSB
- IT — will read both input groups (IO1 - IO12) where IO1 is the LSB and IO12 is the MSB

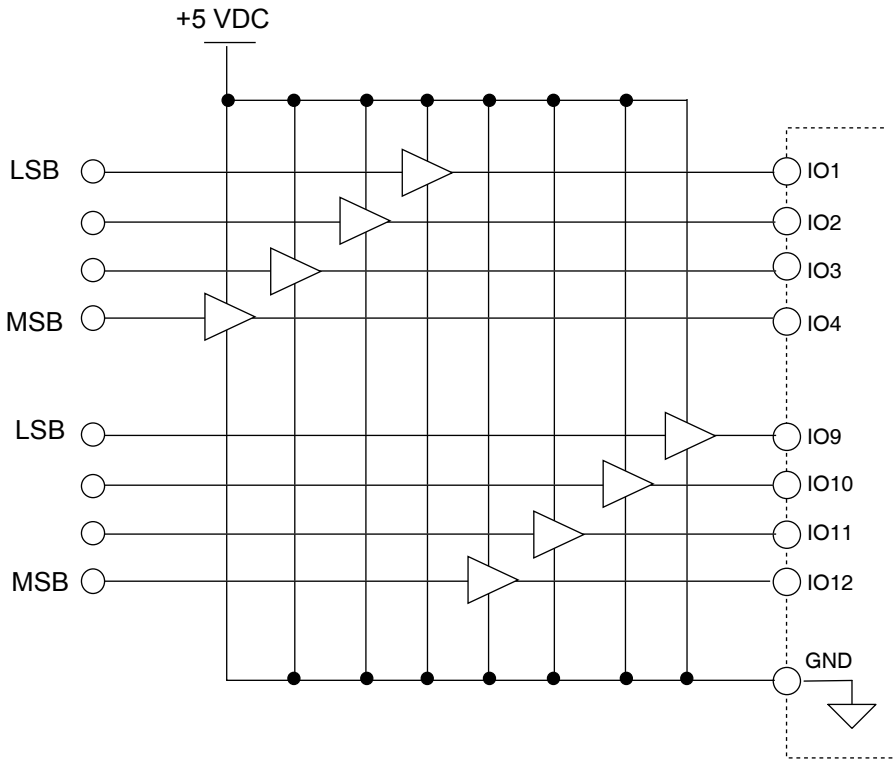

Figure 6.7 TTL interface to I/O banks as a group for BCD program control

Binary coded decimal outputs

Figure 6.8 illustrates an LED interface to I/O banks 1 and 2 on an MDrive with the expanded I/O set. This is one possible interface method for illustration purposes. A more practical application would be to interface the outputs to a PLC input module to control external processes from within an MDrive program. These are configured as user defined outputs and the state is set using the following software commands as a decimal number. When write the state of the outputs they will be set as a binary number.

- OL — will set the lower output group (IO1 - IO4) where IO1 is the LSB and IO4 is the MSB
- OH — will set the upper output group (IO9 - IO12) where IO9 is the LSB and IO12 is the MSB
- OT — will set both output groups (IO1 - IO12) where IO1 is the LSB and IO12 is the MSB

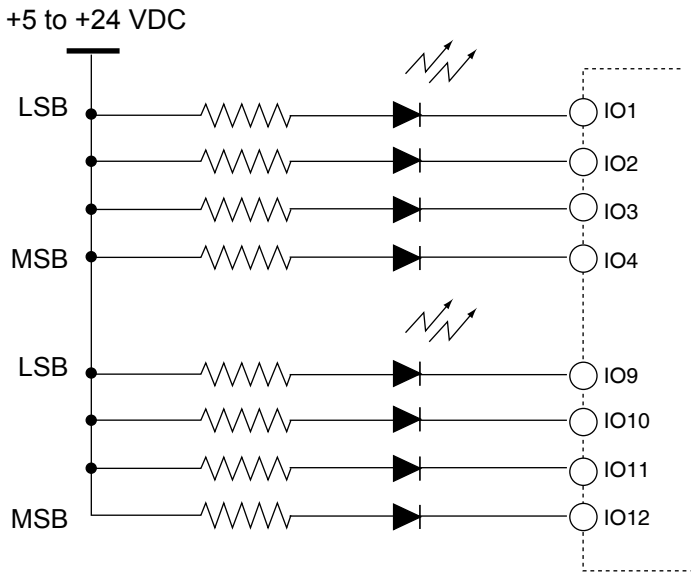

Figure 6.7 Output interface to I/O banks as a group for BCD process control

6.3 Dedicated I/O

> **⚠ CAUTION**
>
> **ELECTRICAL OVERSTRESS**
>
> The I/O points detailed in this subsection are TTL level and only tolerant to +5 VDC:
>
> 1) Capture/Trip
> 2) Remote encoder inputs
>
> Do not exceed +5 VDC on these points.
>
> **Failure to follow these instructions can result in equipment damage.**

6.3.1 Capture input/trip output

The Capture Input/Trip Output point is a high speed I/O point which can be used for time critical events in motion applications.

Capture Input When configured as a capture input I/O point 13 has programmable filtering with a range of 50nS to 12.9 µS and has a resolution of 32 bits. The capture input needs to be pulled up to TTL using a 10k ohm resistor.

Trip Output When configured as a trip output I/O 13 trip speed is 150 nS with 32 bit resolution.

MDrive Motion Control
Input equivalen circuit, capture/trip I/O

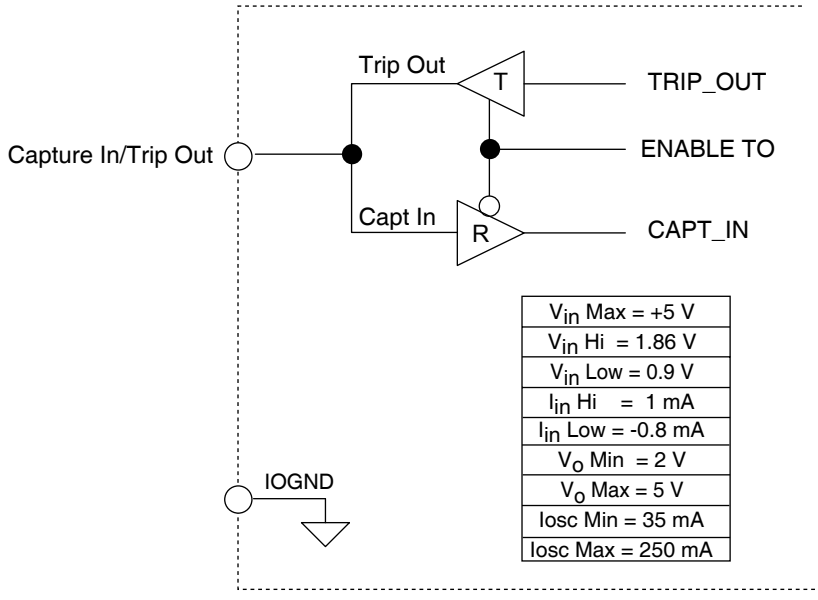

Figure 6.8 Input equivalent circuit, capture/trip I/O

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6.4 Analog input

The analog input of the MDrive is configured from the factory as a 0 to 5V, 10 bit resolution input). This offers the user the ability to receive input from temperature, pressure, or other forms of sensors, and then control events based upon the input.

The input can receive input from 0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA and 0 to 20 mA devices.

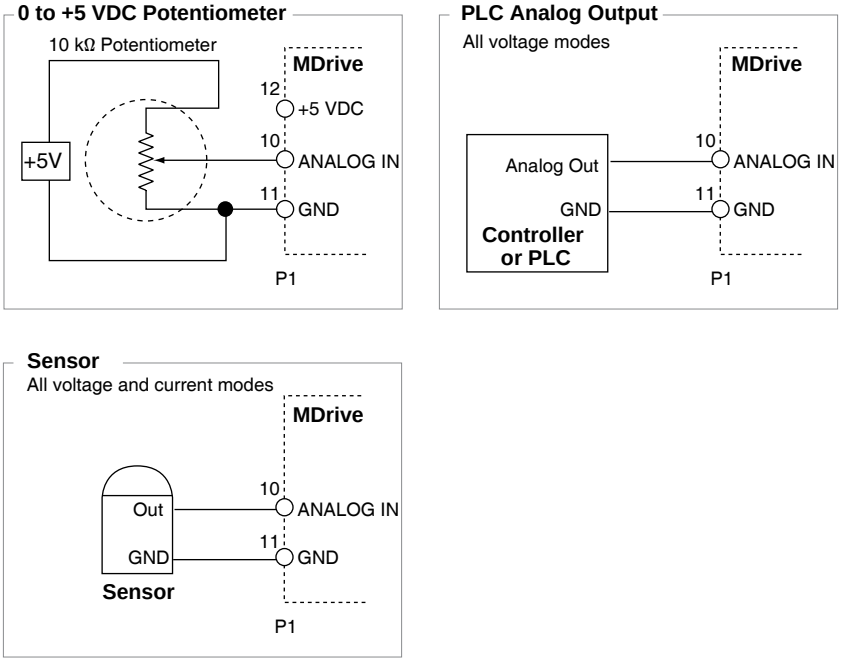

Figure 6.9 Analog input interface

MDrive®
Motion Control

Part 2: Detailed specifications and connectivity information

1. MDrive 14
2. MDrive 17
3. MDrive 23
4. MDrive 34
5. MDrive 34AC

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MDrive® 14
Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

The **MDrive® 14 Motion Control** offers system designers a cost effective, full featured programmable motion controller integrated with a NEMA 23 high torque 1.8° brushless step motor and a +12 up to +48 VDC* microstepping driver.

1.1 MDrive 14 unit overview

The unsurpassed smoothness and performance delivered by the MDrive 14 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 MDrive 14 accepts a broad input voltage range from +12 up 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 MDrive 14 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 MDrive 14 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.

All MDrive 14 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 MDrive 14 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 four lengths, and linear actuators with long life Acme screw**.

Revision R031610

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.

MDrive 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.

The MDrive 14 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.

1.2 Product identification

Plus

K MDI1CRZ14 ☐ 4 – OPTION

- K: QuickStart Kit details above
- ☐: Motor — A = Single Length & Linear Actuator** / C = Triple Length
- OPTION

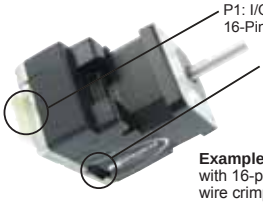
P1: I/O, Power & Communications
12-Pin Locking Wire Crimp

Example #1: Part Number **MDI1CRZ14A4** is an MDrive14Plus Motion Control with 12-pin pluggable locking wire crimp connector for I/O, power and communications interface and NEMA 14 single length motor.

Plus²

K MDI3C ☐☐ 14 ☐ 4 – OPTION

- K: QuickStart Kit details above
- ☐☐: P1: I/O & Power 16-Pin Locking Wire Crimp / P2: Communications — RL = RS-422/485 with 10-Pin Friction Lock Wire Crimp; CB = CANopen with DB9 Connector
- ☐: Motor — A = Single Length & Linear Actuator** / C = Triple Length
- OPTION



Example #2: Part Number **MDI3CRL14A4** is an MDrive14Plus² Motion Control with 16-pin I/O & power interface, RS-422/485 communications with 10-pin locking wire crimp connector, and NEMA 14 single length motor.

OPTIONS

Internal Encoder **–EQ**

Example: **MDI1CRZ14A4–EQ** adds a 512-line internal magnetic encoder with index mark to example #1.

Remote Encoder **–EE**

Example: **MDI3CRL14A4–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: **MDI3CRL14A4–N a**dds a rear control knob for manual positioning to example #2.

Planetary Gearbox **–G ☐☐☐ – F**

- ☐☐☐: Refer to gearbox page for complete table of ratios and part numbers.
- F: Optional NEMA Flange

Example: **MDI3CRL14A4–G1A2** adds a 1-stage planetary gearbox with 5.18:1 ratio to example #2. Add –F for optional NEMA flange.

Figure 1.1 Standard product options

1.3 Documentation reference

The following User's manuals are available for the MDrive 14:

- Product manuals, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for downloaded at http://www.imshome.com/downloads/literature_overview.html.

1.4 Product software

The MDrive 14 motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded at: http://www.imshome.com/downloads/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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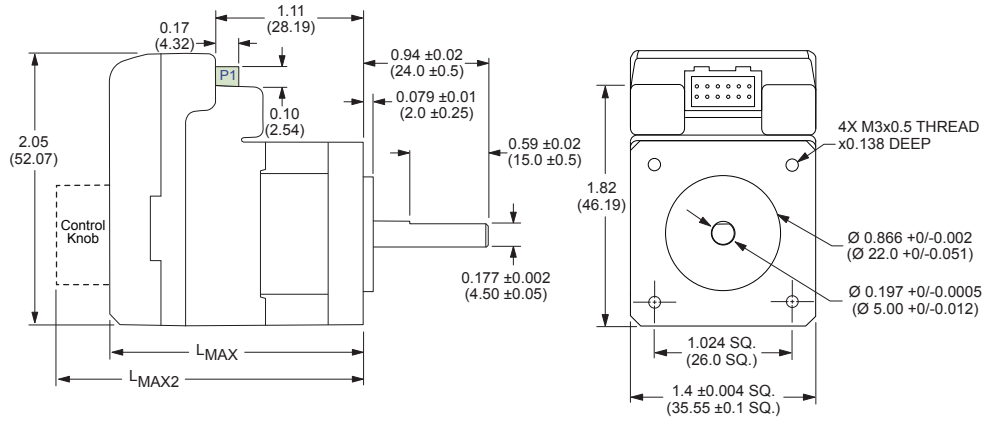
2 Specifications

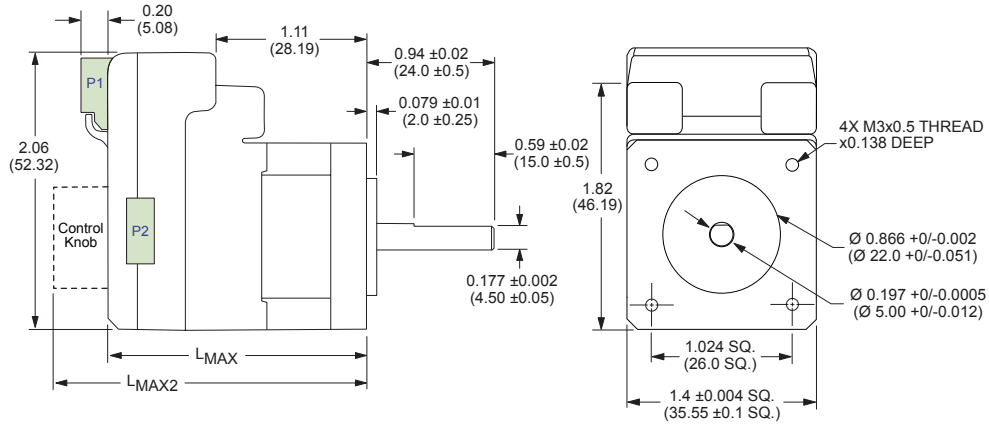
2.1 Mechanical specifications

2.1.1 Standard and expanded features version

MDrive 14



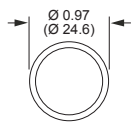
MDrive14 (Plus^2 expanded features)



MDrive Lengths *Inches (mm)*

Motor Length	L_{MAX} SINGLE SHAFT, INTERNAL ENCODER, or LINEAR ACTUATOR	L_{MAX2} CONTROL KNOB
Single	1.93 (49.02)	2.62 (66.55)
Triple	3.03 (76.96)	3.73 (94.74)

L_{MAX2} Option



Control Knob

Figure 2.1 Standard and Expanded features mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	—	+12	—	+48	VDC
Power supply current	—	—	—	1	A
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive 14, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
=I/O Points 1-4	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs	—	—	—	+24	VDC
Output Sink Current	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—		10		bits
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			

Table 2.2 I/O specifications

2.2.3 I/O specifications (Plus[2] expanded features))

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
I/O Points 1-8	—	8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs			
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current	One channel	—	—	600	mA
Clock I/O (Step & Direction I/O)					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Motion I/O					
Electronic gearing (uses Clock I/O)	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution		User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.			

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Motor specifications

Specification	Single length	Triple length
Holding torque oz-in (N-cm)	18.0 (12.71)	36.0 (25.0)
Detent torque oz-in (N-cm)	2.0 (1.4)	4.4 (3.1)
Rotor inertia oz-in-sec^2 (kg-cm^2)	0.00024 (0.017)	0.000801 (0.0566)
Weight motor and driver oz (g)	5.29 (150.0)	12.8 (380.0)

Table 2.8 Microstepping motor specifications

2.2.9 Speed-force performance curves

Single length motor

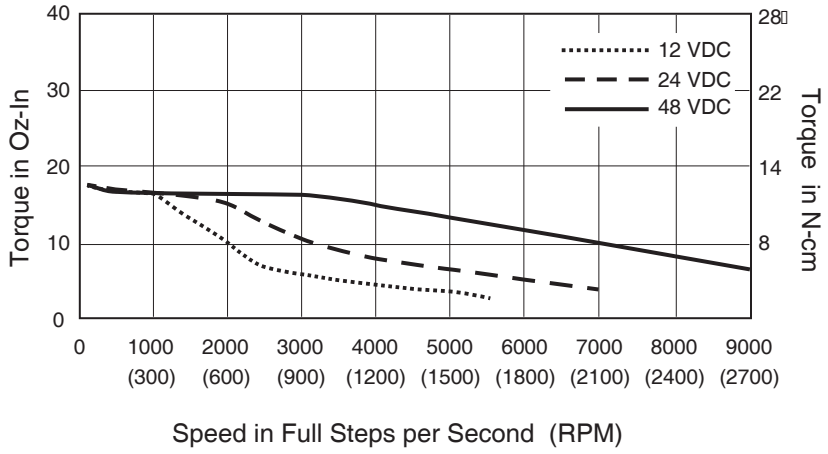


Figure 2.2 Performance curves - single length motor

Triple length motor

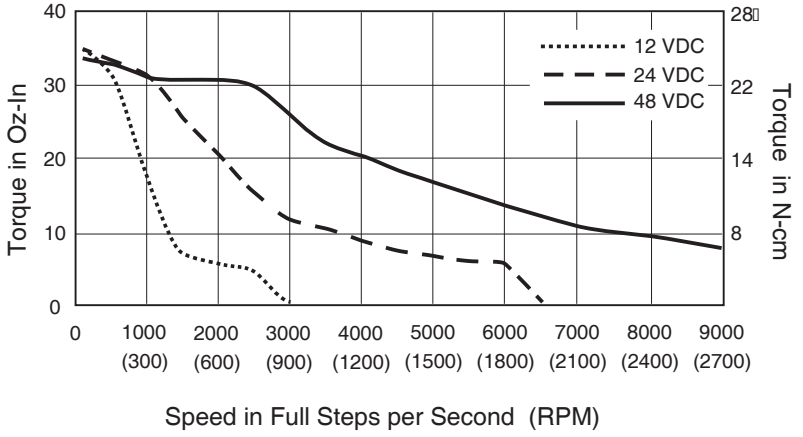
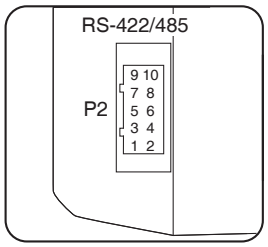


Figure 2.3 Performance curves - triple length motor

2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422 Converter:
MD-CC402-001

Mating connector kit:
CK-02

Mfg P/N:
Shell
Hirose DF11-2428SC

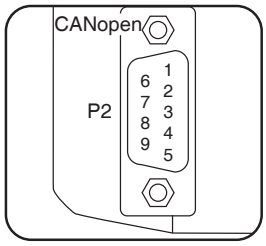
Pins
Hirose DF11-TA2428HC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

2.3.2 CANopen communications option (Plus² expanded feautures)

9-pin D-sub female (DB-9F)



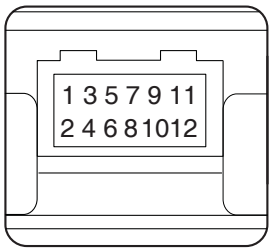
Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.10 CANopen communications, P2: 9-pin D-sub female (DB-9F)

2.4 Connectivity specifications/pin assignments - Comm, Power and I/O

2.4.1 Communications, Power and I/O - standard I/O (Plus only)



Connectivity Options
USB to RS-422 Converter:
MD-CC403-001

Mating connector kit:
CK-08

Mfg P/N:
Shell
JST PADP-12V-1-S

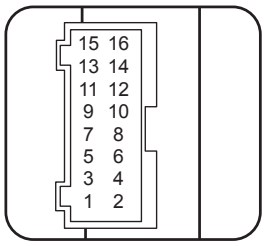
Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	GND	Power, Auxiliary and Communications ground.
2	+V	+12 to +48 VDC Power Supply
3	I/O 2	0 to +24 VDC Programmable I/O Point 2
4	I/O 3	0 to +24 VDC Programmable I/O Point 3
5	I/O 4	0 to +24 VDC Programmable I/O Point 4
6	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
7	I/O 1	0 to +24 VDC Programmable I/O Point 1
8	AUX	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
9	TX +	Transmit +: Connects to Receive + of the Communications Host.
10	TX -	Transmit –: Connects to Receive – of the Communications Host.
11	RX -	Receive –: Connects to Transmit – of the Communications Host.
12	RX +	Receive +: Connects to Transmit + of the Communications Host.

Table 2.11 P1 communications, power and I/O, 12-pin locking wire crimp

2.4.2 Power and I/O (Plus² expanded features)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

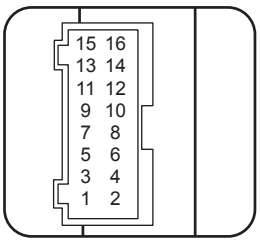
Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.12 P1 Expanded I/O, 14-pin locking wire crimp

2.4.3 Power and I/O (Plus² with remote encoder)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.13 I/O and remote encoder interface - 16-pin locking wire crimpl

2.5 Options

Drive Protection Module

The function of the DPM75 Drive Protection Module is to limit the surge current and voltage to a safe level when DC input power is switched on and off to a motor drive.

Internal encoder

Internal differential magnetic 512 line differential encoders with index mark are available.

Remote Encoder (Plus² versions only)

MDrive 14 Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob

The MDrive 14 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 MDrive 14.

2.6 Connectivity

QuickStart kit

For rapid design verification, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin wire crimp.....MD-CC402-001

P1 12-pin wire crimp.....MD-CC403-001

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:

P2 10-pin wire crimp..... PD10-1434-FL3

P1 12-pin wire crimp.....PD12B-1434-FL3

P1 16-pin wire crimp..... PD16-1417-FL3

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:

P2 10-pin wire crimp.....CK-02

P1 16-pin wire crimp.....CK-10

P1 12-pin wire crimp.....CK-08

3 Mounting and connection recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

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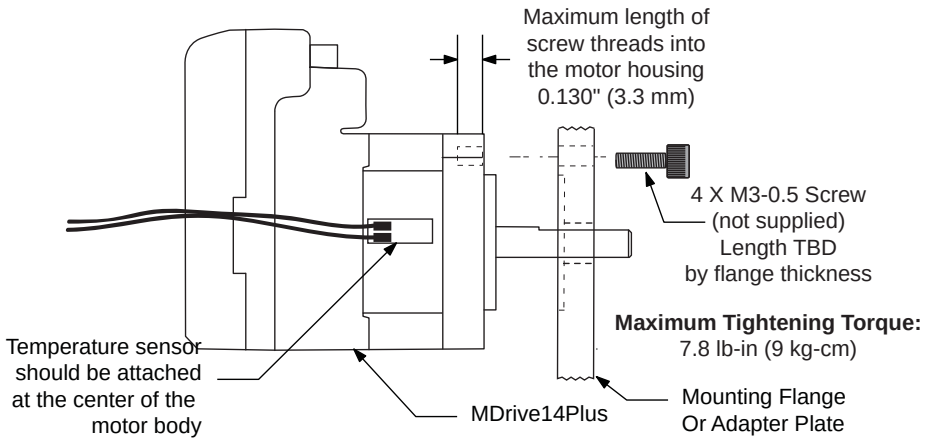
3.1 Mounting

Care must be observed when installing the mounting screws on ALL MDrive 14Plus versions. The mounting holes on the flange are not drilled through and have a maximum depth of 0.150” (3.81 mm).

The warning note and Figure below illustrate the maximum safe thread length and maximum torque for mounting all versions of the MDrive 14.



Drill Pattern for Mounting Flange or Adapter Plate

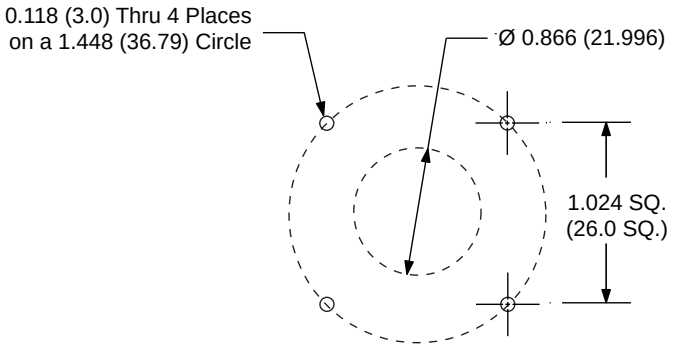


Figure 3.1 MDrive 14 mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

Revision R031610

3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive 14:

Logic Wiring..... 22 AWG

Wire Strip Length..... 0.25” (6.0 mm)

Power and Ground See Table 3.2 in Part 1, Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2) .....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG)DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

10-pin pressure-fit IDC .....Samtec TCSD-05-01-N

Ribbon cable.....Tyco 1-57051-9

Power and I/O

The following mating connectors are recommended for the MDrive142 Units ONLY! Please contact a JST distributor for ordering and pricing information.

16-pin Locking Wire Crimp Connector Shell JST PN PADP-16V-1-S

Crimp Pins..... JST PN SPH-001T-P0.5L

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

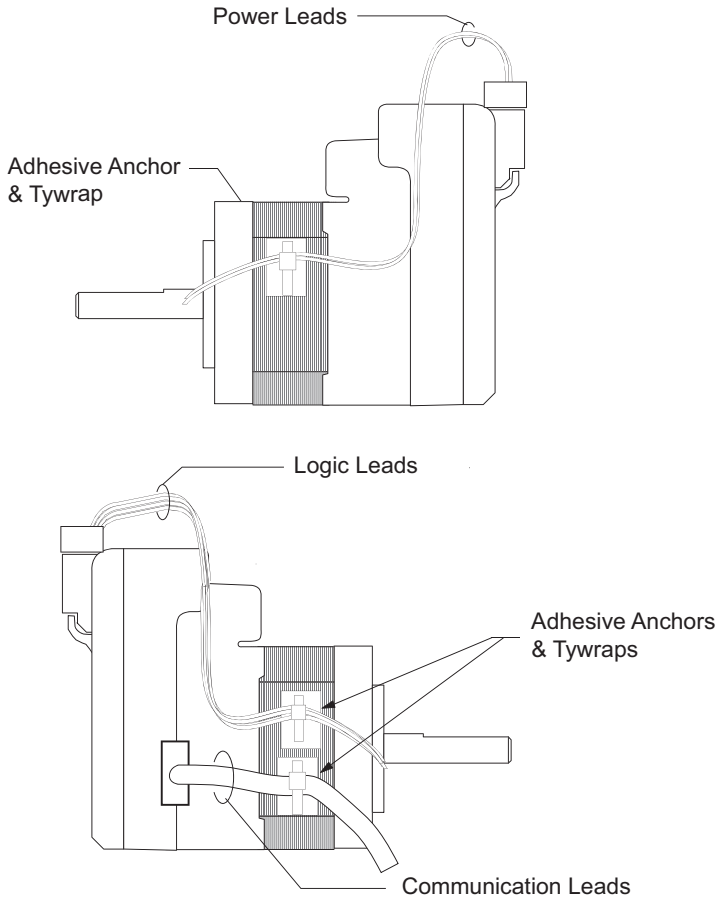


Figure 3.2 Securing leads

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

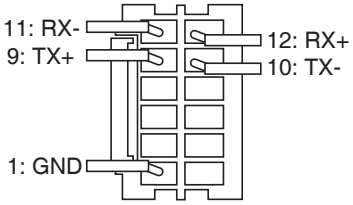
HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

Revision R031610

4.1.1 P1 — 12-pin locking wire crimp



Pin #	Function	Description
1	GND	Power/aux/communications ground
9	TX +	Transmit plus
10	TX -	Transmit minus
11	RX -	Receive minus
12	RX +	Receive plus

Table 4.1 Communications connections, P1 - 12-pin wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD12-1434-FL3

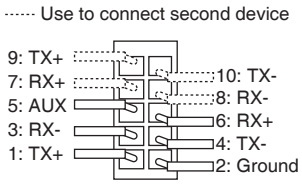
Communications converter cable (10'/3.0 m)..... MD-CC403-001

Manufacturer (JST) part numbers

Connector shell..... PADP-10V010S

Pins..... SPH-001T0.5L

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 4.2 P2 communications, 10-pin locking wire crimp

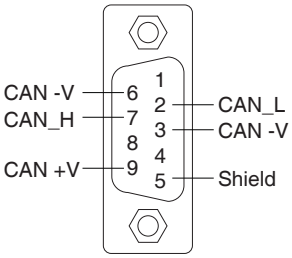
Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m)..... MD-CC402-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin D-sub connector (female)



Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.3 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

> **⚠ CAUTION**
>
> OVER VOLTAGE
>
> The DC voltage range for the MDrive 14 is +12 to +48 VDC. Ensure that motor back EMF is factored into your power supply size calculations.
>
> Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.
>
> **Failure to follow these instructions can result in equipment damage.**

4.3.1 Recommended power supply characteristics

Voltage range	+12 to +48 VDC
Type	Unregulated linear
Ripple	± 5%
Output current	1.0 A (per MDrive 1

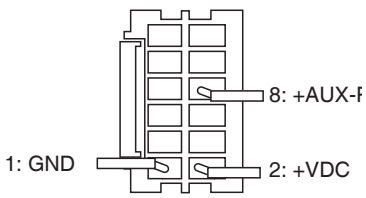
Table 4.4 Recommended power supply characteristics

4.3.2 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18

Table 4.5 Recommended power supply wire gauge

4.3.3 P1 — 12-pin locking wire crimp interface



Pin #	***Signal***	***IWire colors***	
		MD-CC305-001	PD12B-14340-FL3
1	Power ground	Black	See section 4.7.2 for wire colors.
2	+12 to + 48 VDC	Red	
8	Aux-power +2 to +24 VDC	Red/black	

Table 4.6 Power and ground connections, 12-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

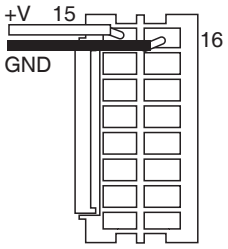
Prototype development cable (10'/3.0 m)..... PD12B-1434-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-12V-1-S

Pins..... SPH-001T0.5L

4.3.4 P1 — 16-pin locking wire crimp interface



Pin Numbers	*Signal*	*Prototype development cable wire colors*
15	+12 to + 48 VDC	Red
16	Power and auxiliary ground	Black

Table 4.7 Power and ground connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

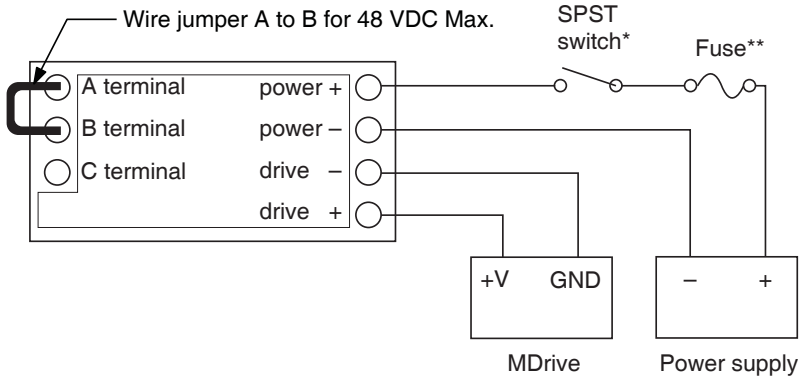
Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L04
(contains 5 connector shells, ribbon cable not included)

4.3.5 Power Interface using Drive Protection Module DPM75



* Do not switch negative side of supply
**Fuse = 6.3 Amp slow blow (recommended: Bussman S505-6.3A or Littelfuse 215006.3). The fuse is optional.

Figure 4.1 DPM75 Drive Protection Module

4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

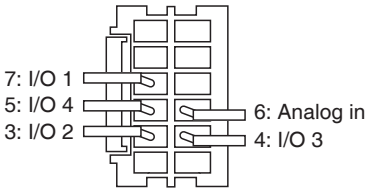
The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12-pin locking wire crimp



Pin #	*Signal*	*Wire colors*	
		MD-CC403-001	PD12B-1434-FL3
3	I/O 2	White	See section 4.7.2 for wire colors.
4	I/O 3	Green	
5	I/O 4	Orange	
6	Analog input	White/black	
7	I/O 1	Blue	

Table 4.8 Universal input connections, 12-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD12B-1434-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-12V-1-S

Pins..... SPH-001T0.5L

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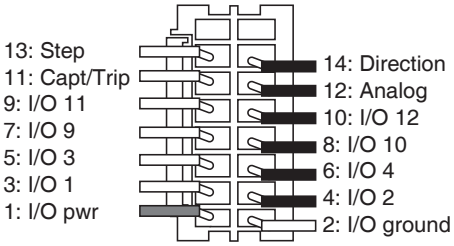
4.4.2 P1 — 16-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.9 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

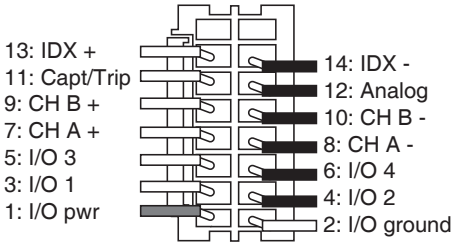
Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L

Revision R031610

4.4.3 P1 — 16-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.10 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-16V-1-S

Pins..... SPH-001T0.5L

4.5 Connectivity accessory details

4.5.1 RS-422/485 communications converter cables

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

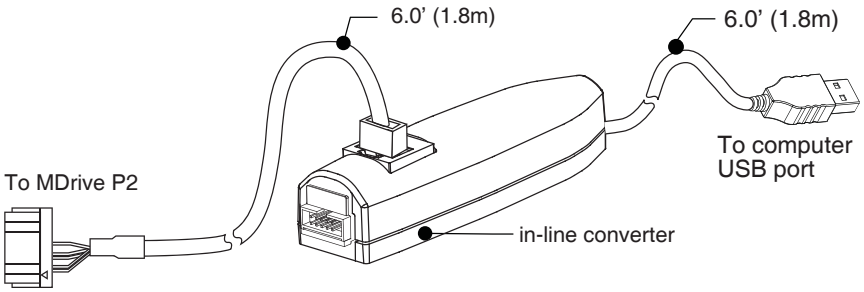
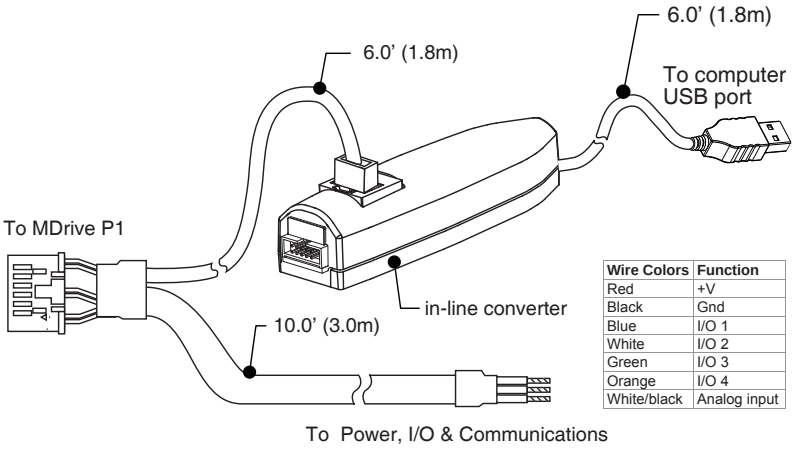


Figure 4.2 MD-CC402-001 communications converter cable

USB to 12-pin circular connector P1—
MD-CC403-000

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters.



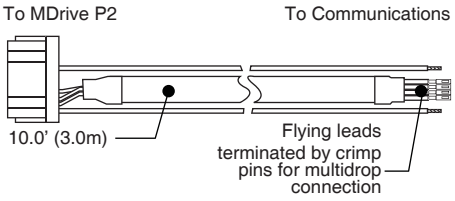
Wire Colors	Function
Red	+V
Black	Gnd
Blue	I/O 1
White	I/O 2
Green	I/O 3
Orange	I/O 4
White/black	Analog input

Figure 4.3 MD-CC403-001 communications converter

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

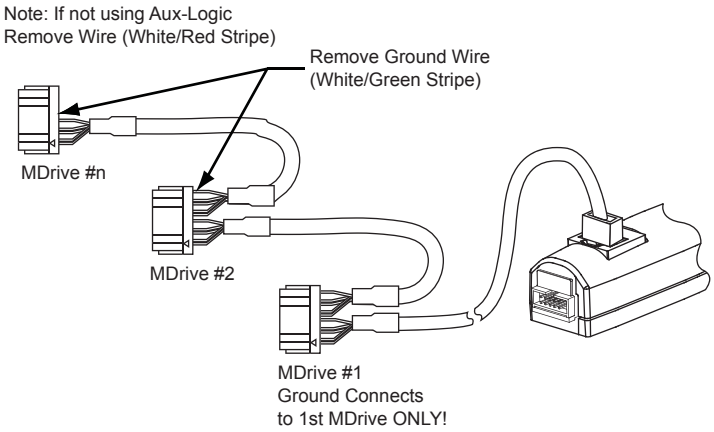


Figure 4.4 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

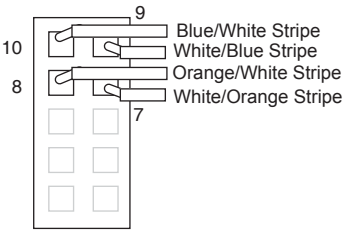


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

Flying leads to12-pin locking wire crimp connector P1 - PD12B-3400-FL3

Description: Pre-wired mating connector interfaces to an MDrive's 12-pin wire crimp connector, with flying leads other end, for quick test/ development.

Function: I/O, Power & Communications Interface.

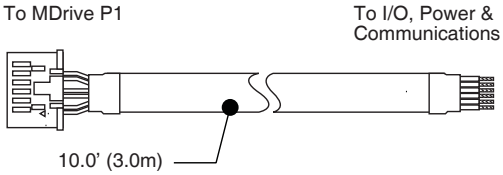
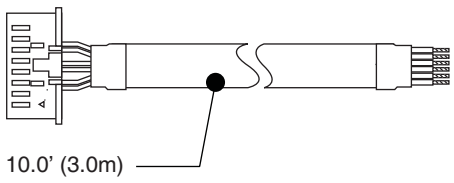


Figure 4.6 Prototype development cable PD12B-1434-FL3

Pair	Wire Colors	Function
1	Black	GND
	Red	+V
2	Black	TX-
	White	TX+
3	Black	RX-
	Green	RX+
4	Black	I/O 2
	Blue	I/O 1
5	Black	I/O 3
	Yellow	I/O 4
6	Black	Analog Input
	Brown	Aux-Logic

Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

The PD16-1417-FL3 prototype development cable is used to rapidly interface the MDrive 14 to the users controller. This 10' (3.0 m) cable consists of a 16-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to power, i/o and/or remote encoder.



Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	White	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power
8	Black	Power GND	Power GND
	Red	+V	+V

Figure 4.7 Prototype development cable PD16-1417-FL3

4.6 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 12-pin wire crimp CK-08

P1 16-pin wire crimp CK-10

Revision R031609

MDrive® 17
Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

The **MDrive® 17 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 up to +48 VDC* microstepping driver.

1.1 MDrive 17 unit overview

The unsurpassed smoothness and performance delivered by the MDrive 17 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 MDrive 17 accepts a broad input voltage range from +12 up 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 MDrive 17 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 MDrive 17 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, MDrive 17 sealed versions are designed to meet IP65 specifications.

All MDrive 17 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 MDrive 17 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.

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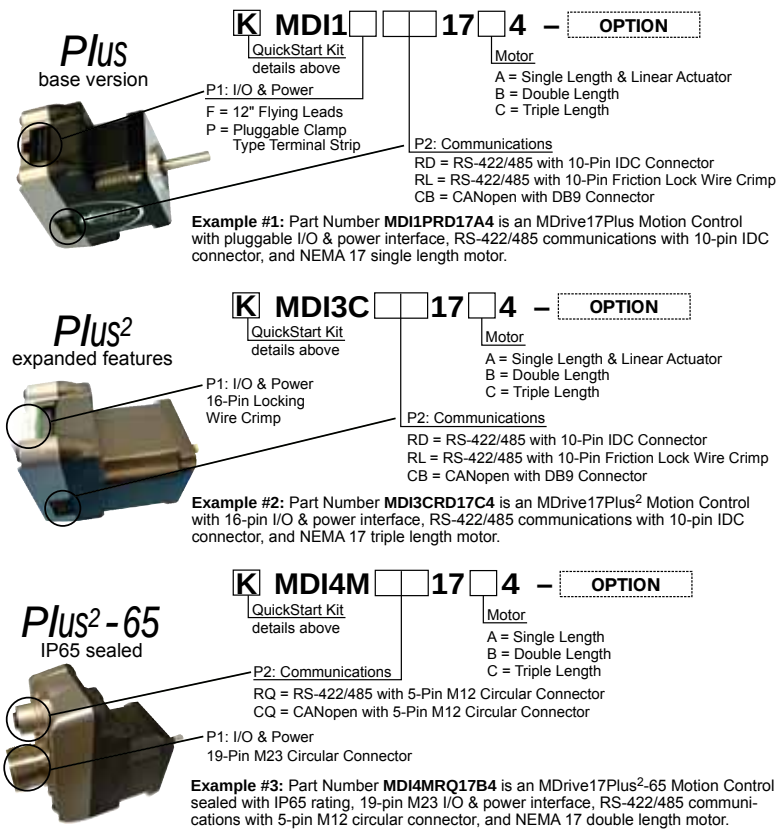
Motor configurations include a single shaft rotary in four lengths, and linear actuators with long life Acme screw**.

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.

MDrive 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.

The MDrive 17 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.

1.2 Product identification



OPTIONS

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.

Figure 1.1 Standard product options

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1.3 Documentation reference

The following User's manuals are available for the MDrive 17:

- Product manuals, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download at:
http://www.imshome.com/downloads/literature_overview.html.

1.4 Product software

The MDrive 17 motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded at:
http://www.imshome.com/downloads/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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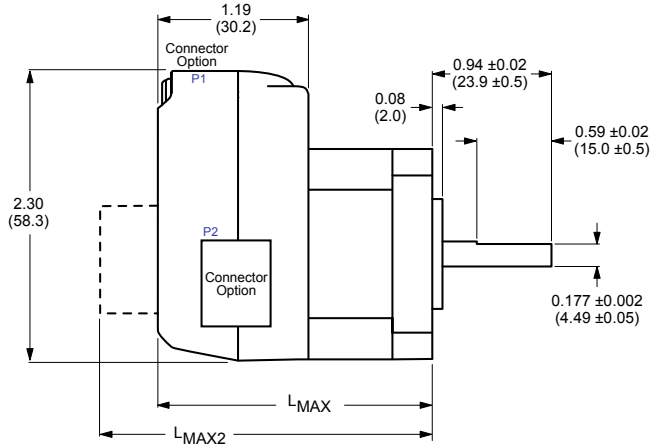
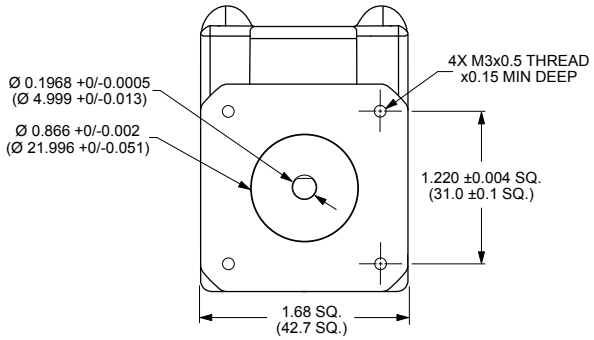
2 Specifications

2.1 Mechanical specifications

2.1.1 Dimensional information

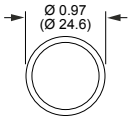




MDrive Lengths *Inches (mm)*

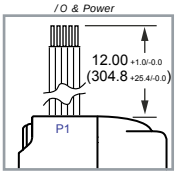
Motor Length	L_{MAX} SINGLE SHAFT, INTERNAL ENCODER or LINEAR ACTUATOR	L_{MAX2} CONTROL KNOB
Single	2.20 (55.9)	2.79 (70.9)
Double	2.43 (61.7)	3.02 (76.7)
Triple	2.77 (70.4)	3.37 (85.6)

L_{MAX2} Option

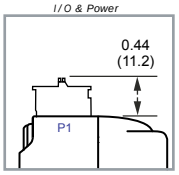


Control Knob

P1 Connector Options *MDrive*

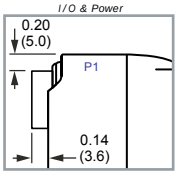


Flying Leads



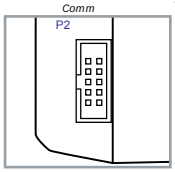
7-Pin Pluggable Clamp Type Terminal Strip

MDrive (Plus² expanded features)

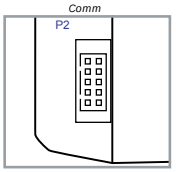


16-Pin Pluggable Locking Wire Crimp

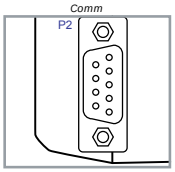
P2 Connector Options *MDrive & Plus² expanded features*



10-Pin IDC



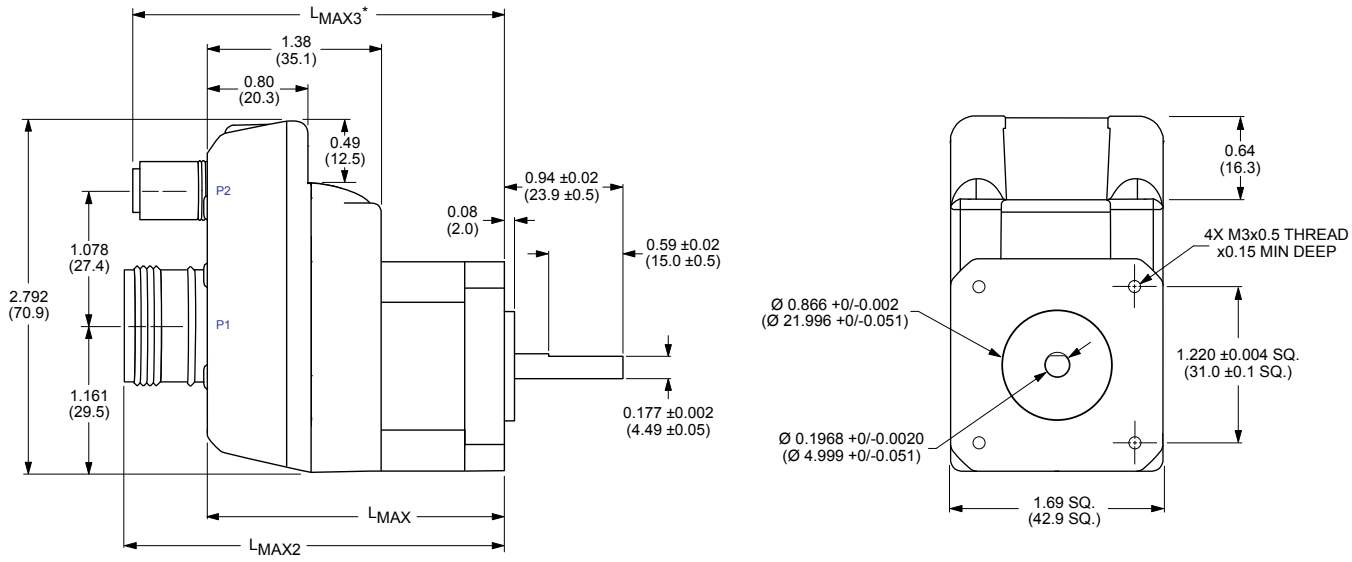
10-Pin Friction Lock Wire Crimp



DB9 (Male) for CANopen Only

Figure 2.1 Standard and Expanded features mechanical specifications

2.1.2 Dimensional information - sealed version

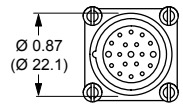


Sealed MDrive Lengths *Inches (mm)*

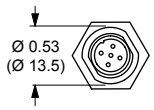
Motor Length	LMAX	LMAX2	LMAX3*
Single	2.39 (60.71)	3.06 (77.72)	2.99 (75.95)
Double	2.62 (66.55)	3.29 (83.57)	3.22 (81.79)
Triple	2.96 (75.18)	3.63 (92.20)	3.56 (90.42)

*CANopen increases measurement by 0.09"/2.0mm

Connectors



P1: 19-Pin M23 (Male)



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

Figure 2.2 Sealed mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	—	+12	—	+48	VDC
Power supply current	—	—	—	2	A
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive 17, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 I/O specifications

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
I/O Points 1-4	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs	—	—	—	+24	VDC
Output Sink Current	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			

Table 2.2 I/O specifications

2.2.3 I/O specifications (Plus² expanded features)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
I/O Points 1-8	—	8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs			
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current	One channel	—	—	600	mA
Clock I/O (Step & Direction I/O)					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type		User supplied differential encoder			
Steps per revolution		See motion specifications table			
Resolution		User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.			

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Motor specifications

Specification	Single length	Double length	Triple length
Holding torque oz-in (N-cm)	32 (22.6)	60 (42.4)	74.9 (52.9)
Detent torque oz-in (N-cm)	1.66 (1.17)	2.08 (1.47)	3.47 (2.45)
Rotor inertia oz-in-sec^2 (kg-cm^2)	0.00053 (0.038)	0.00080 (0.057)	0.00116 (0.082)
Weight motor and driver oz (g)	10.4 (294.8)	12.0 (340.2)	15.2 (430.9)

Table 2.6 Microstepping motor specifications

2.2.9 Speed-force performance curves

Single length motor

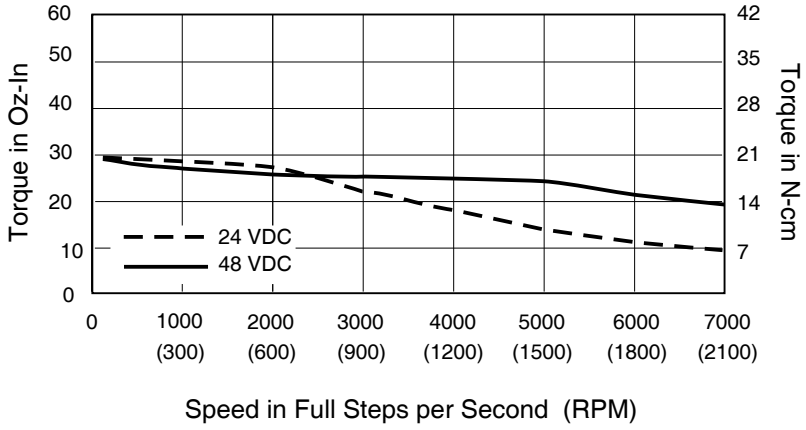


Figure 2.3 Single length motor

Double length motor

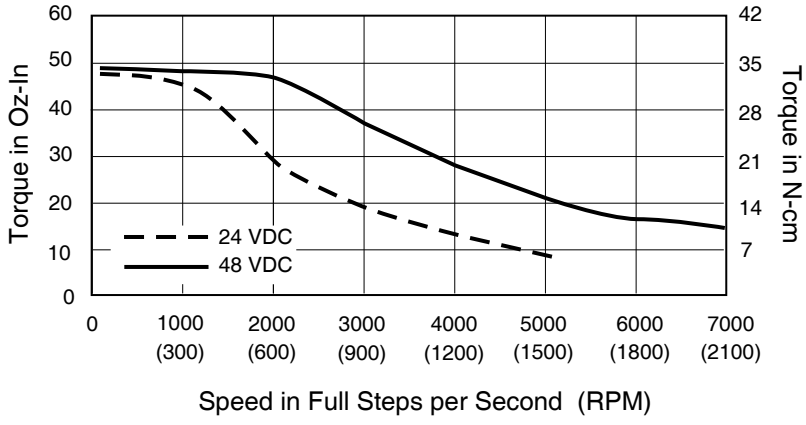


Figure 2.4 Double length motor

Triple length motor

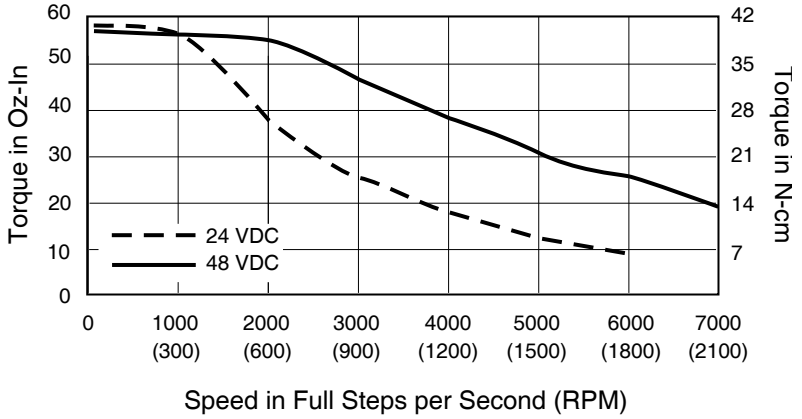
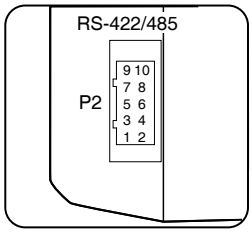


Figure 2.5 Triple length motor

2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422/485 Converter:
MD-CC402-001

Mating connector kit:
CK-02

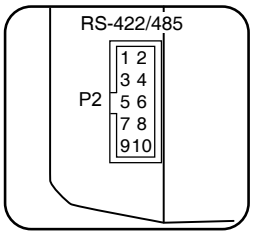
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

10-pin press-fit (IDC style)



Connectivity Options
USB to RS-422/485 Converter:
MD-CC400-001

Mating connector kit:
CK-01

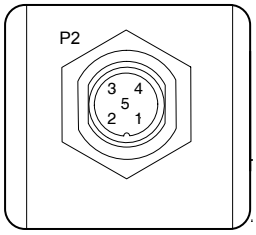
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

Ribbon cable
Tyco: 1-57051-9

Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communications, 10-pin pressure fit IDC/SAMTEC

5-pin M12 circular



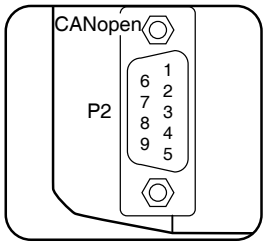
Connectivity Options
USB to RS-422/485 Converter:
MD-CC401-001

Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communications ground

Table 2.11 P2 communications, 10-pin pressure fit IDC/SAMTEC

2.3.2 CANopen communications option

9-pin D-sub female (DB-9F)

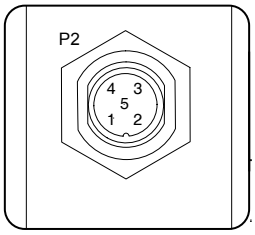


Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.12 CANopen communications, P2: 9-pin D-sub female (DB-9F)

5-pin M12 circular



Connectivity Options
USB to CANopen converter:
MD-CC500-000

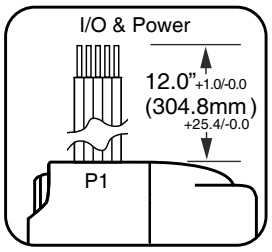
Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	CAN communications ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 2.13 CANopen communications, P2: 5-pin D-sub female

2.4 Connectivity specifications/pin assignments - Power and I/O

2.4.1 Power and I/O - standard I/O (Plus)

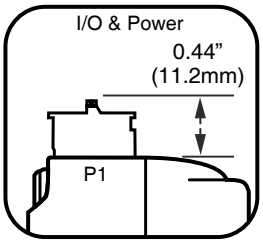
12” (304.8 mm) flying leads

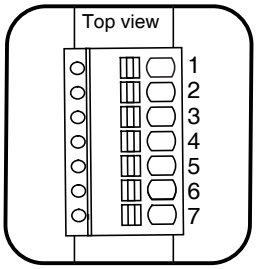


Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power and auxiliary ground
Red	+V	Motor power

Table 2.14 Power and I/O interface - 12” (308.8.mm) flying leads

7-pin pluggable terminal



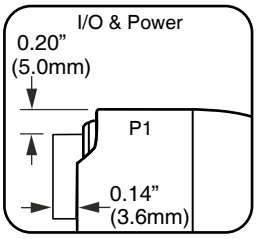


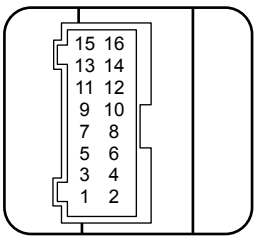
Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power

Table 2.15 Power and I/O interface - 7-pin pluggable terminal

2.4.2 Power and I/O - expanded I/O (Plus²)

16-pin locking wire crimp





Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

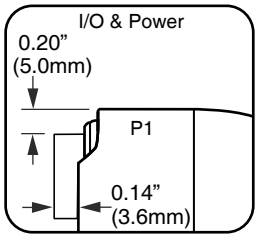
Pins
JST SPH-001T0.5L

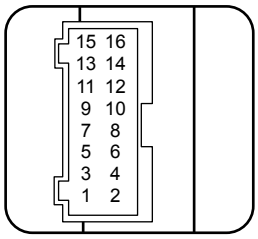
Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.16 P1 Expanded I/O, 14-pin locking wire crimp

2.4.3 Power and I/O - remote encoder (Plus²)

16-pin locking wire crimp





Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

Pins
JST SPH-001T0.5L

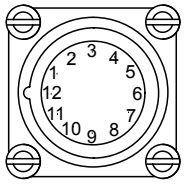
Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.17 I/O and remote encoder interface - 16-pin locking wire crimpl

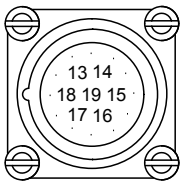
2.4.4 DC power and I/O - expanded I/O (Plus²-65)

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options

Prototype development cable:
MD-CS100-000 (straight)
MD-CS101-000 (right-angle)

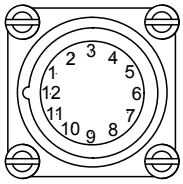
Pin #	Function	Description
1	I/O 9	0 to +24 VDC Programmable I/O Point 9.
2	I/O 11	0 to +24 VDC Programmable I/O Point 11.
3	Step/Clock I/O	0 to +5 VDC Step Clock I/O. Can also be configured as Quadrature or Clock Up/Down.
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	Direction/clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
6	+V	Motor power input
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O ground. Common with power ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs. See Section 2.3 for more details.
12	Shell	Shell connect
13	I/O 12	0 to +24 VDC Programmable I/O Point 12.
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	I/O 10	0 to +24 VDC Programmable I/O Point 10.
19	GND	Power ground

Table 2.18 P1 I/O and aux power, 19-pin lM23 circular connector

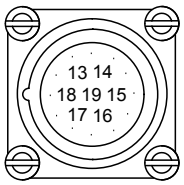
2.4.5 DC power and I/O - remote encoder (Plus²-65)

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options

Prototype development cable:
MD-CS100-000 (straight)
MD-CS101-000 (right-angle)

Pin #	Function	Description
1	CH A+	Channel A+ encoder input. +5 VDC logic level
2	CH B+	Channel B+ encoder input. +5 VDC logic level
3	IDX+	Index mark + encoder input. +5 VDC logic level
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	IDX-	Index mark - encoder input. +5 VDC logic level
6	+V	Motor power input
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O ground. Common with power ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs. See Section 2.3 for more details.
12	Shell	Shell connect
13	CH B-	Channel B- encoder input. +5 VDC logic level
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	CH A-	Channel A- encoder input. +5 VDC logic level
19	GND	Power ground

Table 2.19 P1 I/O and aux power, 19-pin IM23 circular connector

2.5 Options

Drive Protection Module

The function of the DPM75 Drive Protection Module is to limit the surge current and voltage to a safe level when DC input power is switched on and off to the MDrive.

Internal encoder

Internal differential magnetic 512 line differential encoders with index mark are available:

Remote Encoder (Plus² versions only)

MDrive 17 Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob

The MDrive 17 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 MDrive 17.

2.6 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin pressure-fit IDC MD-CC400-001

P2 5-pin M12 circular MD-CC401-001

P2 10-pin wire crimp MD-CC402-001

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:

P2 10-pin wire crimp PD10-1434-FL3

P1 16-pin wire crimp PD16-1417-FL3

P1 19-pin M23 circular (straight) MD-CS100-000

P1 19-pin M23 circular (right-angle) 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 16-pin wire crimp CK-10

Revision R031610

3 Mounting and connection recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

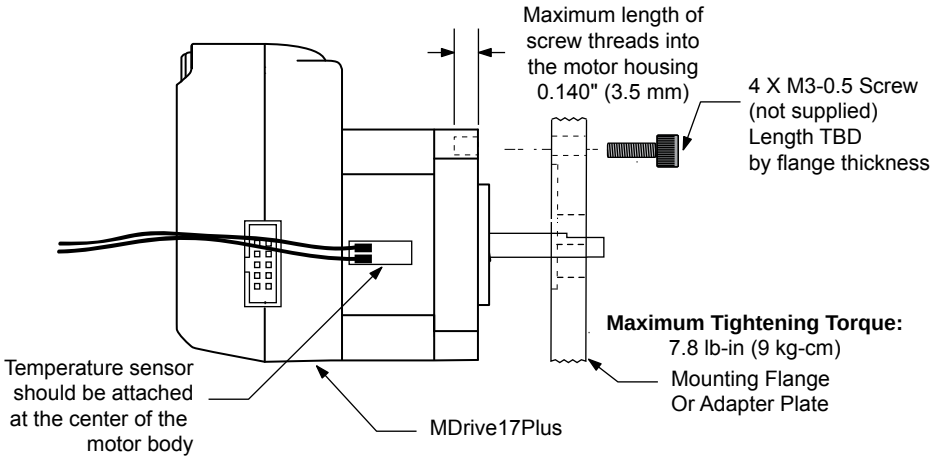
Failure to follow these instructions can result in equipment damage.

Revision R031610

3.1 Mounting

Care must be observed when installing the mounting screws on ALL MDrive 17 versions. The mounting holes on the flange are not drilled through and have a maximum depth of 0.150” (3.81 mm).

The warning note and Figure below illustrate the maximum safe thread length and maximum torque for mounting all versions of the MDrive 17.



Drill Pattern for Mounting Flange or Adapter Plate

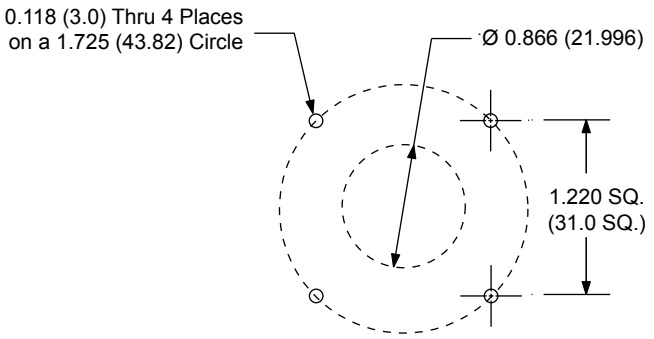


Figure 3.1 MDrive 17 mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

Revision R031610

3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive17:

Logic Wiring..... 22 AWG

Wire Strip Length..... 0.25” (6.0 mm)

Power and Ground See Table 3.2 in Part 1, Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2) .....Hirose DF11-10DS-2C

Crimp pin for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp pin for 10-pin Friction Lock (24 - 28 AWG) DF11-2428SC

Crimp pin for 10-pin Friction Lock (30 AWG)..... DF11-30SC

10-pin pressure-fit IDC .....Samtec TCSD-05-01-N

Ribbon cable.....Tyco 1-57051-9

Power and I/O

The following mating connectors are recommended for the MDrive172 Units ONLY! Please contact a JST distributor for ordering and pricing information.

16-pin Locking Wire Crimp Shell ..... JST PN PADP-16V-1-S

Crimp Pins..... JST PN SPH-001T-P0.5L

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

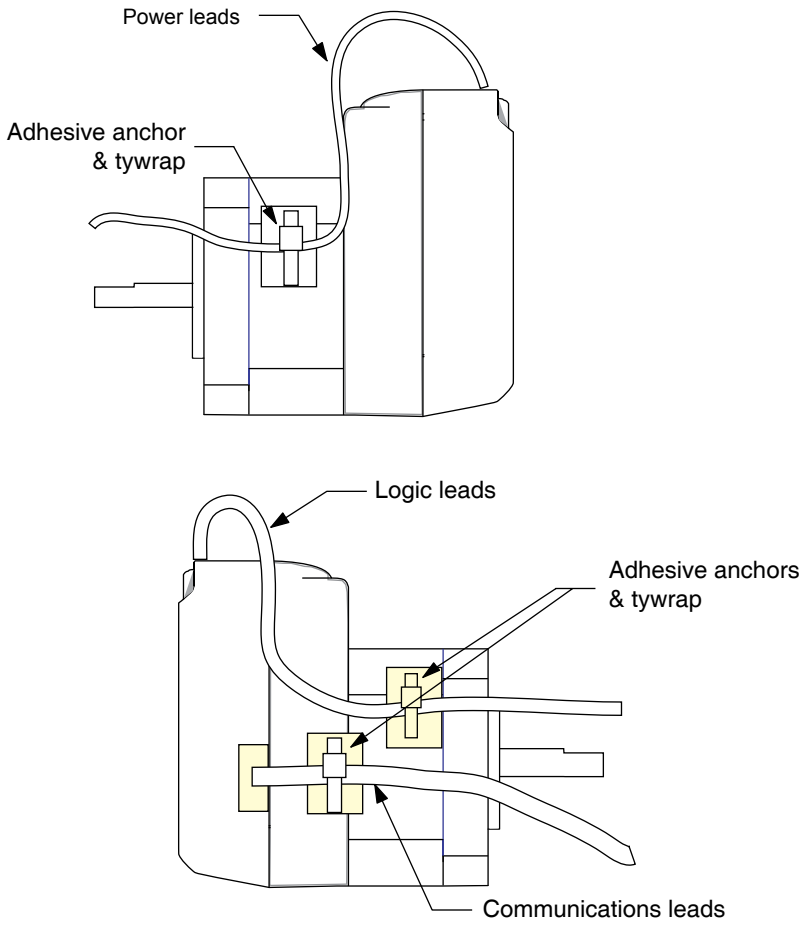


Figure 3.2 Securing leads

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

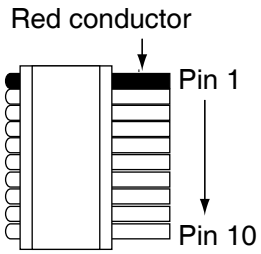
HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

Revision R031610

4.1.1 P2 — 10-pin pressure-fit IDC style connector



Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

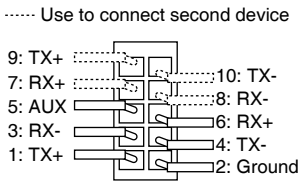
Table 4.1 Communications connections, P2 - 10-pin IDC

Connectivity accessories

Mating connector kit CK-01
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC400-001

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

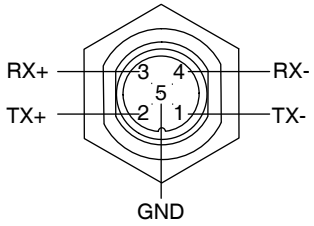
Table 4.2 P2 communications, 10-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC402-001

4.1.3 P2 — 5-pin M12 circular connector



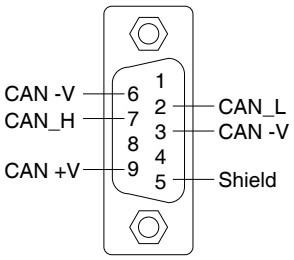
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 4.3 P2 communications, 5-pin M12F circular connector

Connectivity accessories Communications converter cable (10'/3.0 m).....MD-CC401-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin d-sub connector (female)

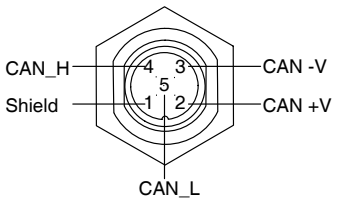


Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.4 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.2.2 P2 — 5-pin M12 circular connector (female)



Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	Optional ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 4.5 CANopen communications, P2: 5-pin M12 female

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

⚠ CAUTION

OVER VOLTAGE

The DC voltage range for the MDrive 17 is +12 to +48 VDC. Ensure that motor back EMF is factored into your power supply size calculations.

Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.

Failure to follow these instructions can result in equipment damage.

4.3.1 Recommended power supply characteristics

Voltage range	+12 to +48 VDC
Type	Unregulated linear
Ripple	± 5%
Output current	2.0 A (per MDrive 17

Table 4.6 Recommended power supply characteristics

4.3.2 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18
2 Amps Peak	20	18	16	14	14

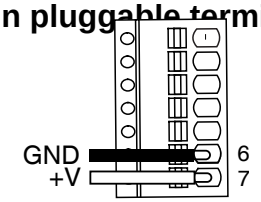
Table 4.7 Recommended power supply wire gauge

4.3.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.8 Power and ground connections, flying leads

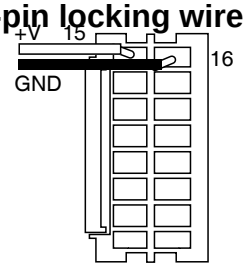
4.3.4 P1 — 7-pin pluggable terminal interface



Pin #	
6	Power ground
7	Motor power supply

Table 4.9 Power and ground connections, 7-pin terminal

4.3.5 P1 — 16-pin locking wire crimp interface



Pin Numbers	*Signal*	*Prototype development cable wire colors*
15	+12 to + 48 VDC	Red
16	Power and auxiliary ground	Black

Table 4.4 Power and ground connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10’/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

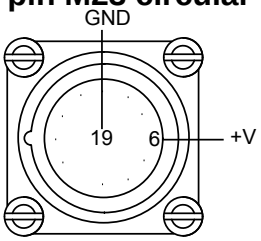
Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L04

Revision R031610

(contains 5 connector shells, ribbon cable not included)

4.3.6 P1 — 19-pin M23 circular interface



Pin #	*Signal*	*Cable wire colors*
		MD-CS10x-000
6	Motor power supply	Blue
19	Power ground	Brown

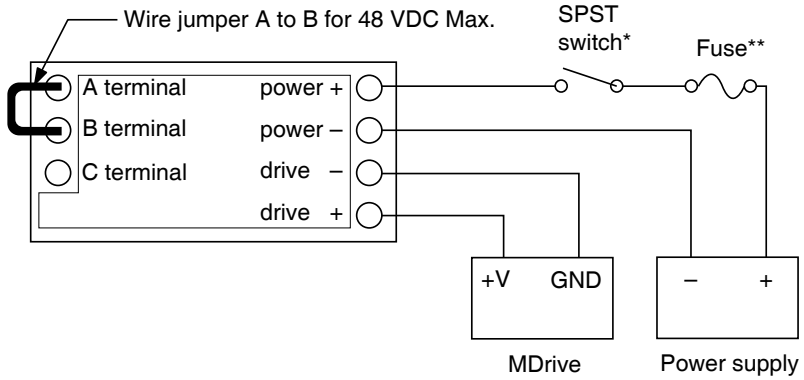
Table 4.10 Power and ground connections, 12-pin locking wire crimp

A mating connector kit is not available for this connector. Shop for compatible connectors at:

- Lumberg
- Phoenix
- Turck
- RDE Connectors
-

4.3.7 Power Interface using Drive Protection Module DPM75

The DPM75 Drive Protection Module will limit surge currents for up to three (3) MDrive 17 units at up to 48 VDC to allow switching DC Power.



* Do not switch negative side of supply
**Fuse = 6.3 Amp slow blow (recommended: Bussman S505-6.3A or Littelfuse 215006.3). The fuse is optional.

Figure 4.1 DPM75 Drive Protection Module

4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

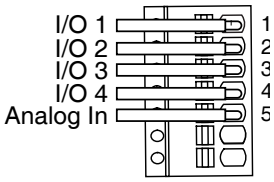
Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	*Signal*
White/yellow	General purpose I/O 1
White/orange	General purpose I/O 2
White/violet	General purpose I/O 3
White/blue	General purpose I/O 4
Green	Analog input

Table 4.11 I/O connections, flying leads

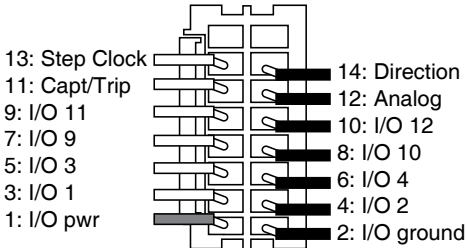
4.4.2 P1 — 7-pin pluggable terminal interface



Pin number	*Signal*
1	General purpose I/O 1
2	General purpose I/O 2
3	General purpose I/O 3
4	General purpose I/O 4
5	Analog input

Table 4.12 I/O connections, 7-pin terminal

4.4.3 P1 — 16-pin locking wire crimp interface (Plus² expanded features)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.13 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

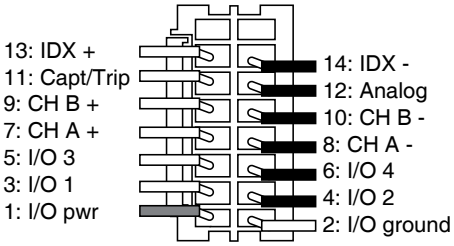
Manufacturer (JST) part numbers

Connector shell.....PADP-16V-1-S

Pins..... SPH-001T0.5L

Revision R031610

4.4.4 P1 — 16-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.14 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

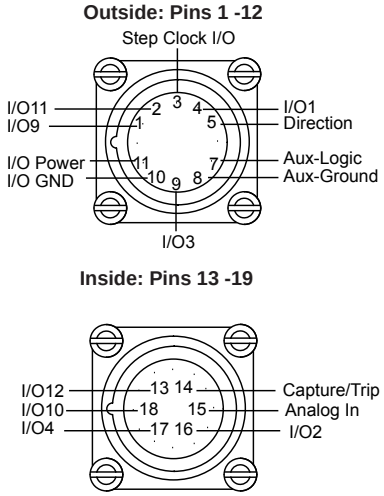
Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L

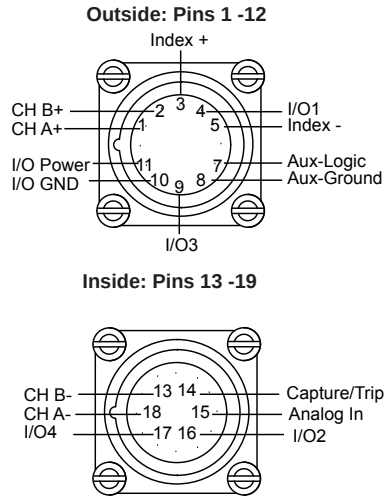
4.4.5 P1 — 19-pin M23 circular connector (Plus² expanded features)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	I/O 9	Violet
2	I/O 11	Red
3	Step/Clock I/O	Grey
4	I/O 1	Red/Blue
5	Direction I/O	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	I/O 12	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	I/O 10	Gray/Brown

Table 4.15 I/O connections, 19-pin M23 circular

4.4.5 P1 — 19-pin M23 circular connector (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	Channel A+	Violet
2	Channel B+	Red
3	Index +	Grey
4	I/O 1	Red/Blue
5	Index -	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	Channel B-	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	Channel A -	Gray/Brown

Table 4.161 I/O connections, 19-pin M23 circular

4.5 Connectivity accessory details

4.5.1 RS-422/485 communications converter cables

USB to 10-pin IDC connector P2
P/N: MD-CC400-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

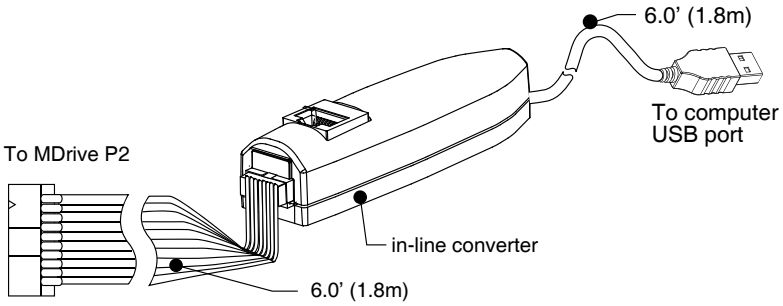


Figure 4.2 MD-CC400-000 communications converter cable

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

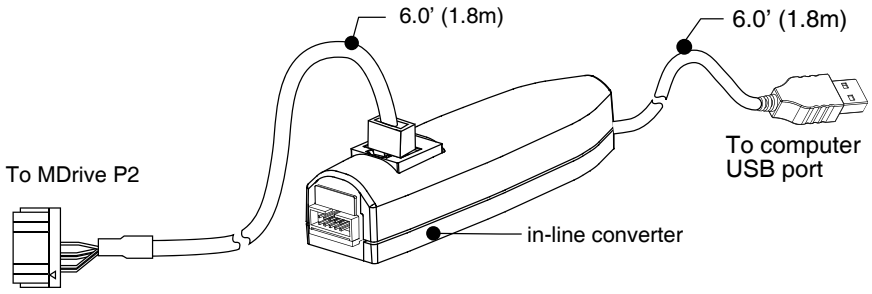


Figure 4.3 MD-CC402-001 communications converter cable

USB to 5-pin circular connector P2— MD-CC401-000

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters.

No mating connector kit is available for this connector style. Compatible mating connectors may be purchased from the following suppliers:

- Phoenix
- Turck
- RDE Connectors

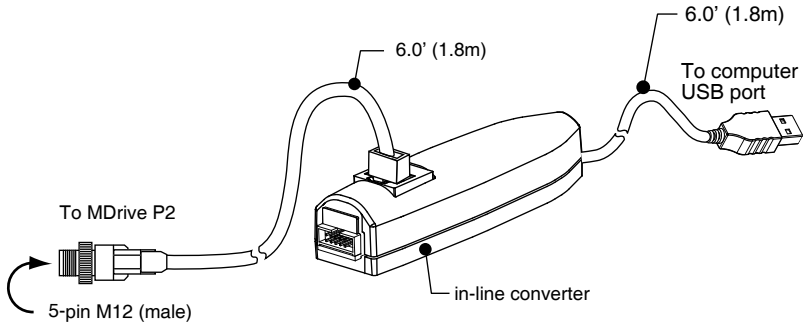
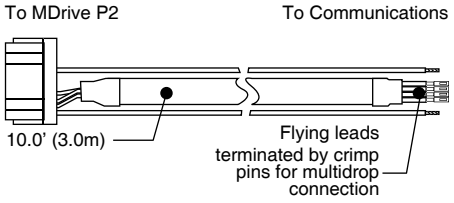


Figure 4.4 MD-CC401-001 communications converter

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

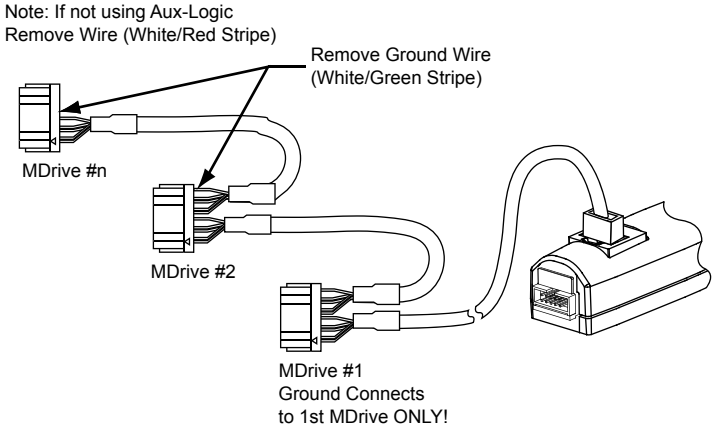


Figure 4.5 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

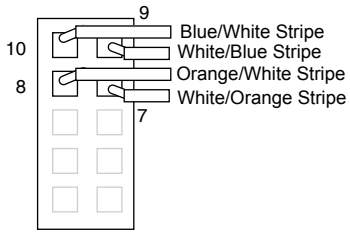
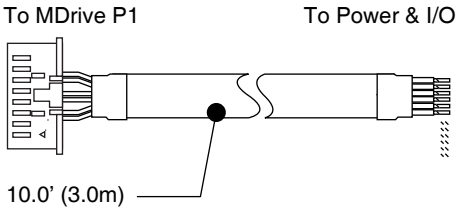


Figure 4.6 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

The PD16-1417-FL3 prototype development cable is used to rapidly interface the MDrive17 to the users controller. This 10' (3.0 m) cable consists of a 16-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to power, i/o and/or remote encoder.



Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	White	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power
8	Black	Power GND	Power GND
	Red	+V	+V

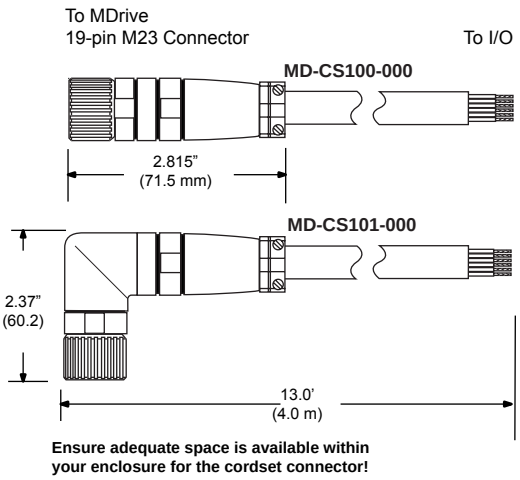
Figure 4.7 Prototype development cable PD16-1417-FL3

4.5.3 Connectivity option — 19 conductor cordset

19-pin M23 single-ended cordsets are offered to speed prototyping of the MDrive Accustep 34ac Motion Control. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination..... MD-CS100-000

Right Angle..... MD-CS101-000



Wire Colors	Function	Encoder Function
Violet	I/O9	Channel A+
Red	I/O11	Channel B+
Gray	Step Clock	Index+
Red/Blue	I/O1	I/O1
Green	Direction	Index-
Blue	+V*	+V*
Gray/Pink	Aux-Logic	Aux-Logic
White/Green	Comm GND	Comm GND
White/Yellow	I/O3	I/O3
White/Gray	I/O GND	I/O GND
Black	I/O Power	I/O Power
Green/Yellow	Shell Connect	Shell Connect
Yellow/Brown	I/O12	Channel B-
Brown/Green	Capture/Trip	Capture/Trip
White	Analog In	Analog In
Yellow	I/O2	I/O2
Pink	I/O1	I/O1
Gray/Brown	I/O10	I/O10
Brown	GND*	GND*

Figure 4.8 MD-CS10x-000 cordset

4.6 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 16-pin wire crimp CK-10

P3 2-pin wire crimp CK-04

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MDrive® 23
Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

The **MDrive® 23 Motion Control** offers system designers a cost effective, full featured programmable motion controller integrated with a NEMA 23 high torque 1.8° brushless step motor and a +12 up to +75 VDC* microstepping driver.

1.1 MDrive 23 unit overview

The unsurpassed smoothness and performance delivered by the MDrive 23 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 MDrive 23 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 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 MDrive 23 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 MDrive 23 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, MDrive 23-65 sealed assembly versions are designed to meet IP65 specifications.

All MDrive 23 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 MDrive 23 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

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mapping and extended node identifier.

Motor configurations include a single shaft rotary in four 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.

MDrive 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.

The MDrive 23 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.

1.2 Product identification

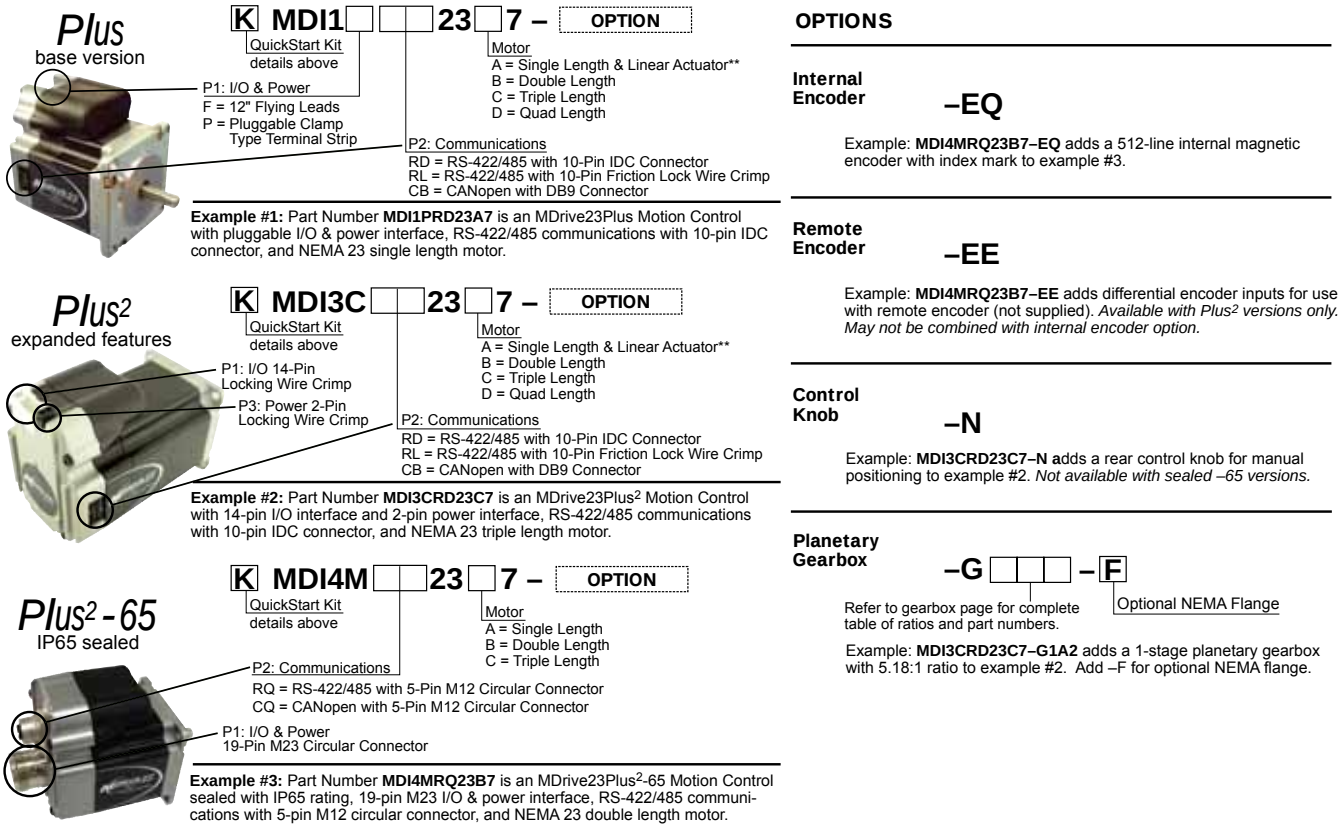

Figure 1.1 Standard product options

1.3 Documentation reference

The following User's manuals are available for the MDrive 23:

- Product manual, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.4 Product software

The MDrive 23 motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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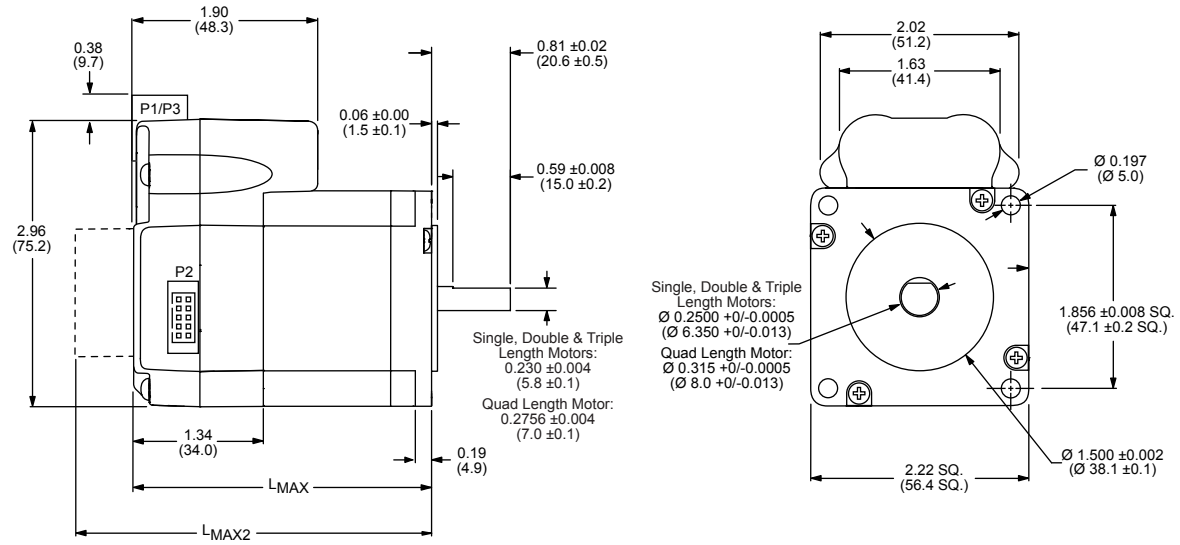
2 Specifications

2.1 Mechanical specifications

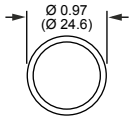
2.1.1 Standard and expanded features version



MDrive AccuStep lengths Inches (mm)

Motor length	LMAX with single shaft or internal encoder	LMAX2 with control knob
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)

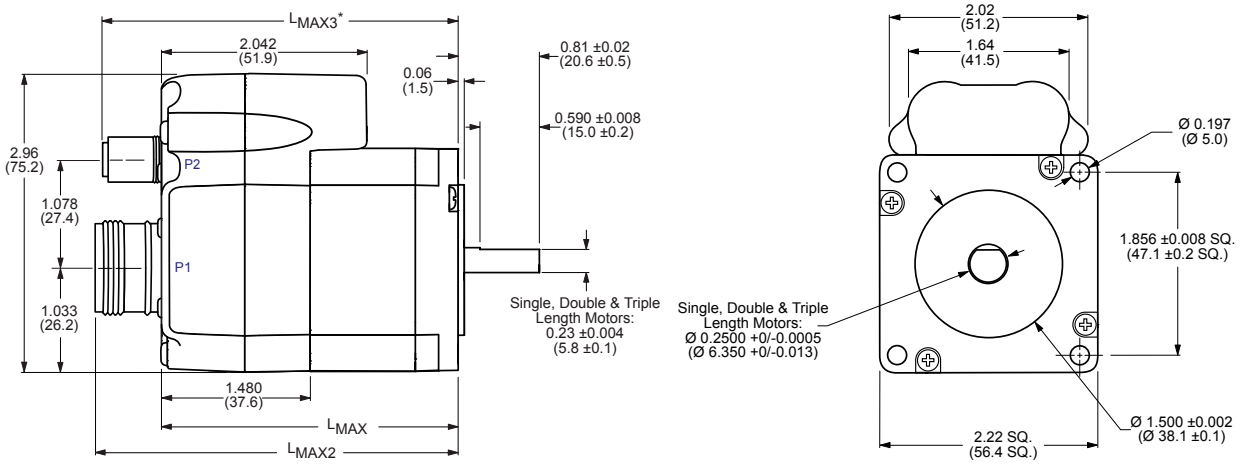
L_{MAX2} option



control knob

Figure 2.1 Standard and Expanded features mechanical specifications

2.1.2 Sealed version



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)

*CANopen increases measurement by 0.09"/2.0mm

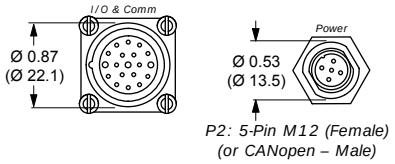
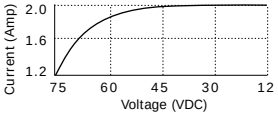
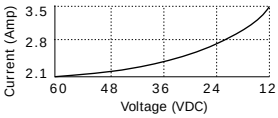


Figure 2.2 Sealed mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	Single, double and triple lengthe motors	+12	—	+75	VDC
	Quad length motor	+12		+60	
Max power supply current*	Single, double and triple length motors				
	Quad length ,motor				
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive 23, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications (plus)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-4)	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs (All)	—	—	—	+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			
Clock I/O					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			

Table 2.2 I/O specifications

2.2.3 Expanded I/O specifications (Plus²)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-8)	—			8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs	
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution	User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.				

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Motor specifications

Specification	Single length	Double length	Triple length	Quad length
Holding torque oz-in (N-cm)	90.0 (64)	144 (102)	239 (169)	283 (200)
Detent torque oz-in (N-cm)	3.9 (2.7)	5.6 (3.92)	9.7 (6.86)	14.2 (10.0)
Rotor inertia oz-in-sec^2 (kg-cm^2)	0.0025 (0.18)	0.0037 (0.26)	0.0065 (0.46)	0.0108 (0.76)
Weight motor and driver oz (g)	21.6 (612.3)	26.4 (784.4)	39.2 (1111.3)	61.6 (1746.3)

Table 2.8 MDrive 23 motor specifications

2.2.9 Speed-force performance curves

Single length motor

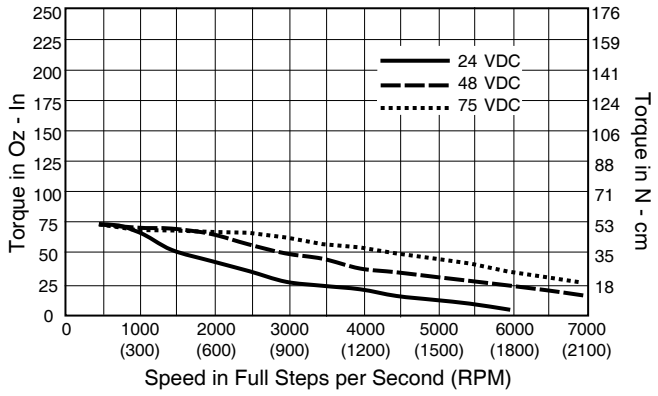


Figure 2.3 Motor performance curve — single length motor

Double length motor

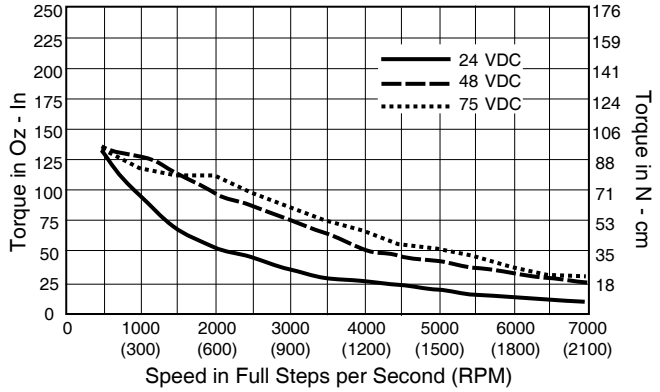


Figure 2.4 Motor performance curve — double length motor

Triple length motor

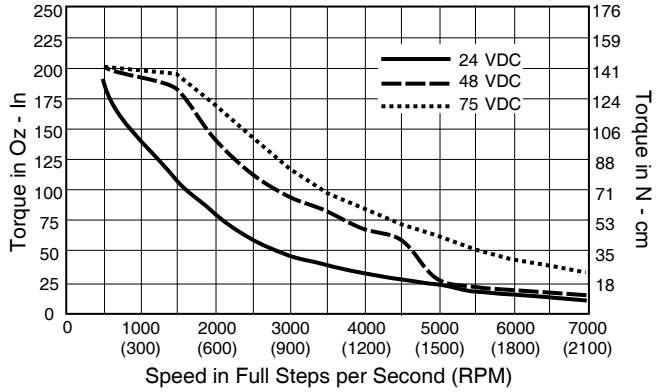


Figure 2.5 Motor performance curve — triple length motor

Quad length motor

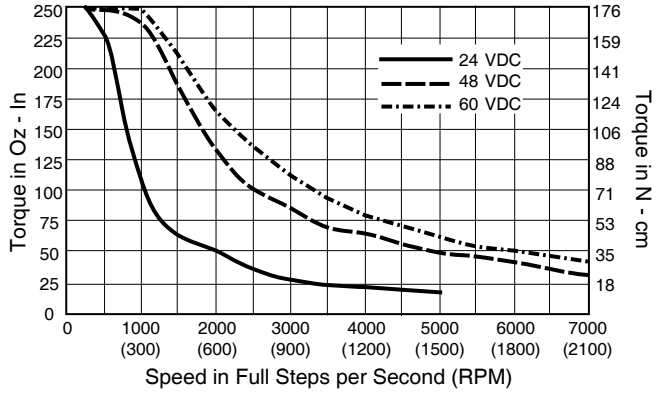
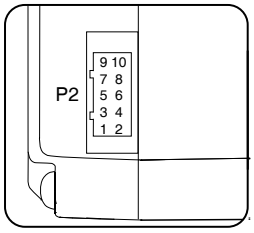


Figure 2.6 Motor performance curve — quad length motor

2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422/485 Converter:
MD-CC402-001

Mating connector kit:
CK-02

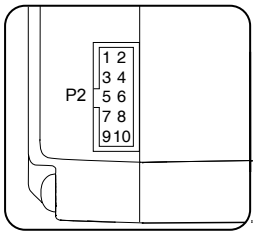
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

10-pin press-fit (IDC style)



Connectivity Options
USB to RS-422/485 Converter:
MD-CC400-001

Mating connector kit:
CK-01

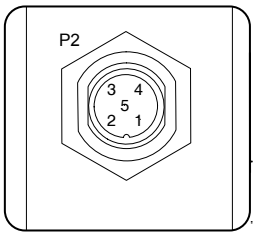
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

Ribbon cable
Tyco: 1-57051-9

Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communications, 10-pin pressure fit IDC/SAMTEC

5-pin M12 circular



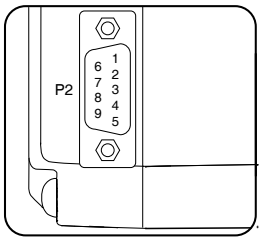
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communications ground

Table 2.11 P2 communications, 10-pin pressure fit IDC/SAMTEC

Connectivity Options
USB to RS-422/485 Converter:
MD-CC401-001

2.3.2 CANopen communications option

9-pin D-sub female (DB-9F)

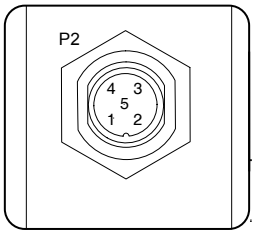


Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.12 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity Options
USB to CANopen converter:
MD-CC500-000

5-pin M12 circular



Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	CAN communications ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

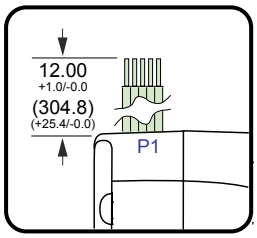
Table 2.13 CANopen communications, P2: 5-pin D-sub female

Connectivity Options
USB to CANopen converter:
MD-CC500-000

2.4 Connectivity specifications/pin assignments - Power and I/O

2.4.1 Power and I/O - standard I/O (Plus)

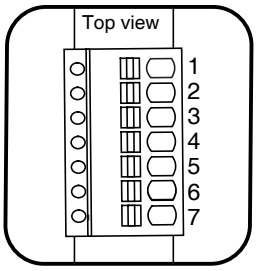
12” (304.8 mm) flying leads



Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power and auxiliary ground
Red	+V	Motor power

Table 2.14 Power and I/O interface - 12” (308.8.mm) flying leads

7-pin pluggable terminal

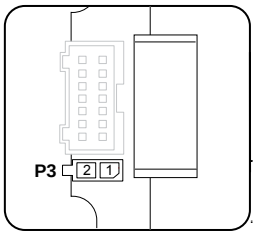


Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power

Table 2.15 Power and I/O interface - 7-pin pluggable terminal

2.4.2 DC motor power

2-pin friction lock wire crimp



Pin #	Function	Description
1	+V	+12 to +60 VDC motor power
2	Ground	Power supply return (ground)

Table 2.16 P3 DC power, 2-pin locking wire crimp

Connectivity Options
Prototype development cable *PD-02-2300-FL3*

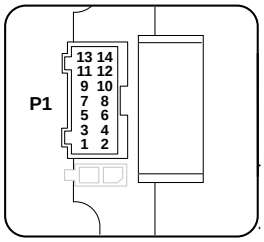
Mating connector kit:
CK-04

Mfg P/N:
Shell
Tyco 794617-2

Pins
Tyco 794610-1

2.4.3 I/O - expanded I/O (Plus²)

14-pin locking wire crimp



Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.

Table 2.17 P1 Expanded I/O, 14-pin locking wire crimp

Connectivity Options
Prototype development cable:: *PD14-2334-FL3*

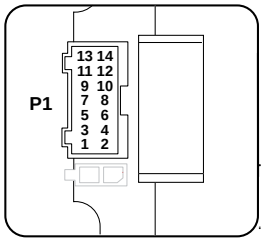
Mating connector kit:
CK-09

Mfg P/N:
Shell
JST PADP-14V-1-S

Pins
JST SPH-001T0.5L

2.4.4 I/O - remote encoder (Plus²)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD14-2334-FL3

Mating connector kit:
CK-09

Mfg P/N:
Shell
JST PADP-14V-1-S

Pins
JST SPH-001T0.5L

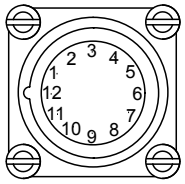
Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level

Table 2.18 I/O and remote encoder interface - 16-pin locking wire crimpl

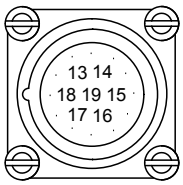
2.4.5 DC power and I/O - expanded I/O (Plus²-65)

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options

Prototype development cable:
MD-CS100-000 (straight)
MD-CS101-000 (right-angle)

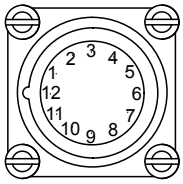
Pin #	Function	Description
1	I/O 9	0 to +24 VDC Programmable I/O Point 9.
2	I/O 11	0 to +24 VDC Programmable I/O Point 11.
3	Step/Clock I/O	0 to +5 VDC Step Clock I/O. Can also be configured as Quadrature or Clock Up/Down.
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	Direction/clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
6	+V	Motor power input
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O ground. Common with power ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs. See Section 2.3 for more details.
12	Shell	Shell connect
13	I/O 12	0 to +24 VDC Programmable I/O Point 12.
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	I/O 10	0 to +24 VDC Programmable I/O Point 10.
19	GND	Power ground

Table 2.19 P1 I/O and aux power, 19-pin lM23 circular connector

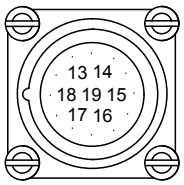
2.4.6 DC power and I/O - remote encoder (Plus²-65)

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options

Prototype development cable:
MD-CS100-000 (straight)
MD-CS101-000 (right-angle)

Pin #	Function	Description
1	CH A+	Channel A+ encoder input. +5 VDC logic level
2	CH B+	Channel B+ encoder input. +5 VDC logic level
3	IDX+	Index mark + encoder input. +5 VDC logic level
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	IDX-	Index mark - encoder input. +5 VDC logic level
6	+V	Motor power input
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O ground. Common with power ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs. See Section 2.3 for more details.
12	Shell	Shell connect
13	CH B-	Channel B- encoder input. +5 VDC logic level
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	CH A-	Channel A- encoder input. +5 VDC logic level
19	GND	Power ground

Table 2.20 P1 I/O and aux power, 19-pin M23 circular connector

2.5 Options

Internal encoder

Internal differential magnetic 512 line differential encoders with index mark are available:

Remote Encoder (Plus2 versions only)

MDrive 23 Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob

The MDrive 23 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 MDrive 23.

2.6 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin pressure-fit IDC MD-CC400-001

P2 5-pin M12 circular MD-CC401-001

P2 10-pin wire crimp MD-CC402-001

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:

P2 10-pin wire crimp PD10-1434-FL3

P1 14-pin wire crimp PD14-2334-FL3

P1 19-pin M23 circular (straight) MD-CS100-000

P1 19-pin M23 circular (right-angle) MD-CS101-000

P3 2-pin wire crimp PD02-2300-FL3

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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 14-pin wire crimp CK-09

P3 2-pin wire crimp CK-04

Revision R031610

3 Mounting and connection recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

Revision R031610

3.1 Mounting

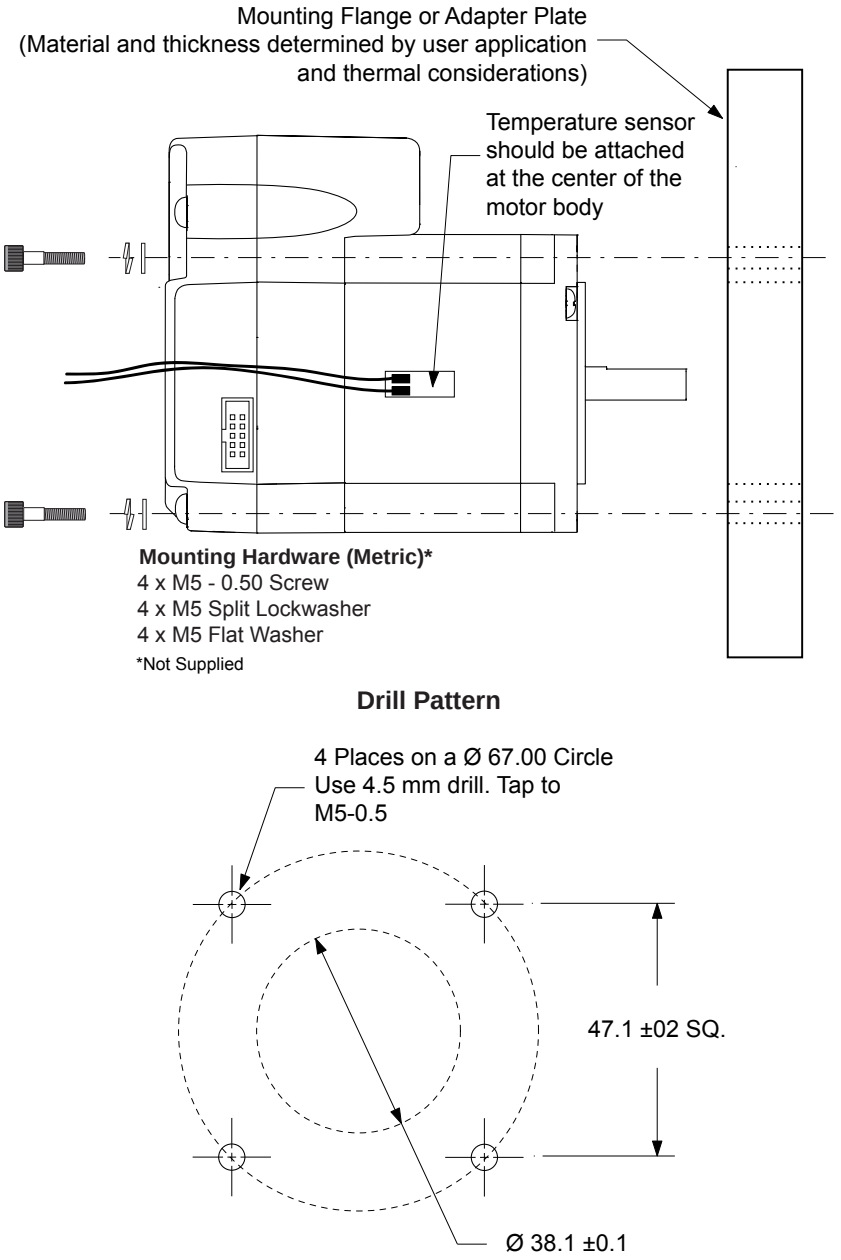


Figure 3.1 MDrive 23 mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

Revision R031610

3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive17:

Logic Wiring.....22 AWG

Wire Strip Length.....0.25” (6.0 mm)

Power and Ground .....See Table 3.2 in Part 1, Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2).....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG) DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

I/O

The following mating connectors are recommended for the MDrive172 Units ONLY! Please contact a JST distributor for ordering and pricing information.

14-pin Locking Wire Crimp Connector Shell.....JST PN PADP-14V-1-S

Crimp Pins.....JST PN SPH-001T-P0.5L

Power

2-pin Locking Wire Crimp Connector Shell.....Tyco 794617-2

Crimp Pins.....Tyco 794610-1

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

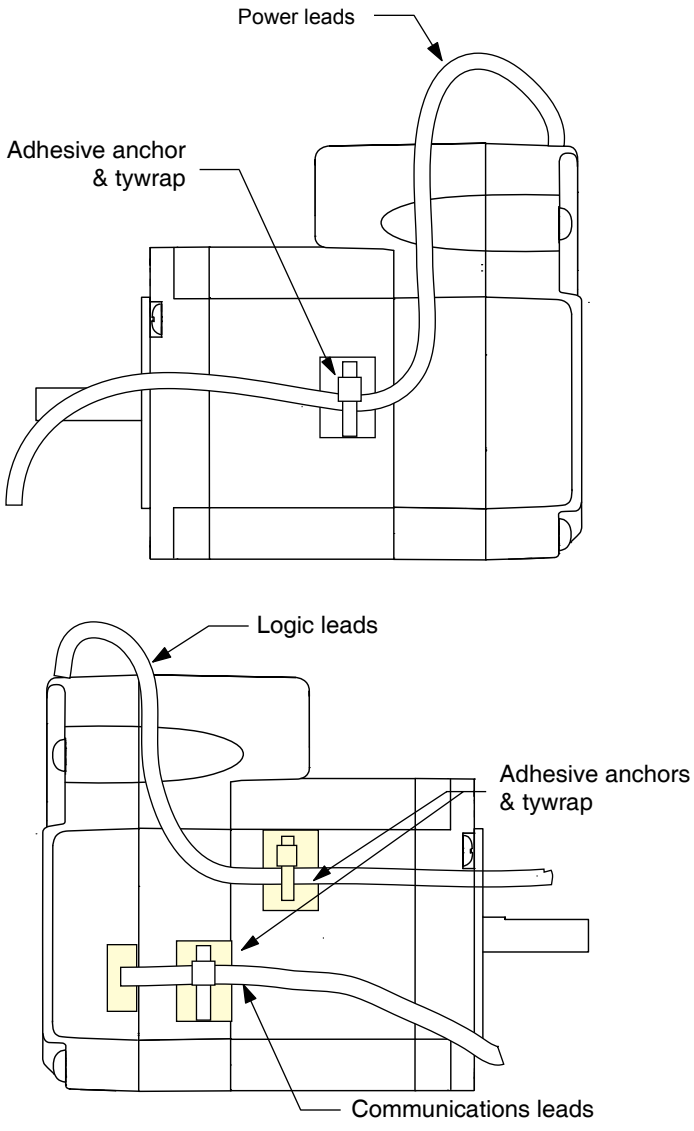


Figure 3.2 Securing leads

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

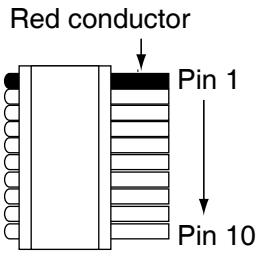
HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

Revision R031610

4.1.1 P2 — 10-pin pressure-fit IDCstyle connector



Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

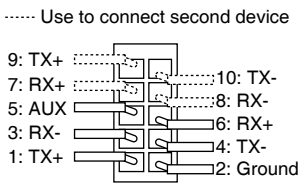
Table 4.1 Communications connections, P2 - 10-pin IDC

Connectivity accessories

Mating connector kit CK-01
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC400-001

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

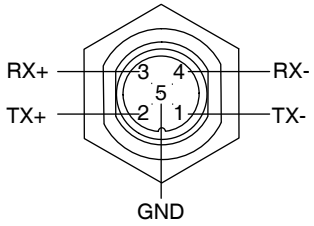
Table 4.2 P2 communications, 10-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC402-001

4.1.3 P2 — 5-pin M12 circular connector (male)



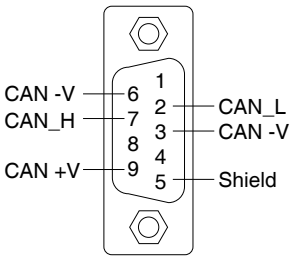
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 4.3 P2 communications, 5-pin M12F circular connector

Connectivity accessories Communications converter cable (10'/3.0 m).....MD-CC401-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin d-sub connector (female)

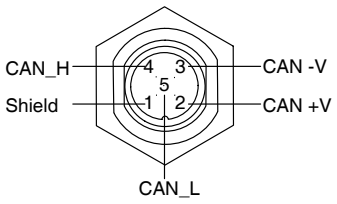


Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.4 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.2.2 P2 — 5-pin M12 circular connector (female)



Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	Optional ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 4.5 CANopen communications, P2: 5-pin M12 female

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

⚠ CAUTION

OVER VOLTAGE

The DC voltage range for the MDrive 23 is +12 to +60 VDC. Ensure that motor back EMF is factored into your power supply size calculations.

Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.

Failure to follow these instructions can result in equipment damage.

4.3.1 Recommended power supply characteristics

Voltage range	+12 to +75 VDC
Type	Unregulated linear
Ripple	± 5%
Output current	3.0 A (per MDrive 23

Table 4.6 Recommended power supply characteristics

4.3.2 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18
2 Amps Peak	20	18	16	14	14
3 Amps Peak	18	16	14	12	12

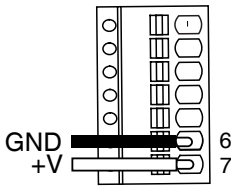
Table 4.7 Recommended power supply wire gauge

4.3.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.8 Power and ground connections, flying leads

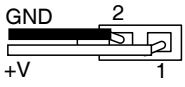
4.3.4 P1 — 7-pin pluggable terminal interface



Pin #	
6	Power ground
7	Motor power supply

Table 4.9 Power and ground connections, 7-pin terminal

4.3.5 P1 — 2-pin wire crimp interface



Pin #		*PD02-2300-FL3 wire colors*
6	Power ground	Black
7	Motor power supply	Red

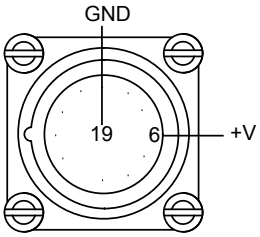
Table 4.10 Power and ground connections, 7-pin terminal

Connectivity accessories

Prototype development cable PD02-2300-FL3

Mating connector kit CK-04
(contains 5 connector shells, ribbon cable not included)

4.3.6 P1 — 19-pin M23 circular interface



Pin #	*Signal*	*Cable wire colors*
		MD-CS10x-000
6	Motor power supply	Blue
19	Power ground	Brown

Table 4.11 Power and ground connections, 12-pin locking wire crimp

A mating connector kit is not available for this connector. Shop for compatible connectors at:

- Lumberg
- Phoenix
- Turck
- RDE Connectors

4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

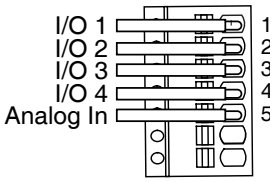
Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	*Signal*
White/yellow	General purpose I/O 1
White/orange	General purpose I/O 2
White/violet	General purpose I/O 3
White/blue	General purpose I/O 4
Green	Analog input

Table 4.12 I/O connections, flying leads

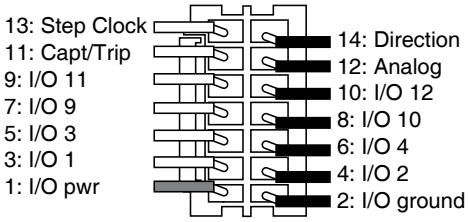
4.4.2 P1 — 7-pin pluggable terminal interface



Pin number	*Signal*
1	General purpose I/O 1
2	General purpose I/O 2
3	General purpose I/O 3
4	General purpose I/O 4
5	Analog input

Table 4.13 I/O connections, 7-pin terminal

4.4.3 P1 — 14-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	Black	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.14 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-09
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

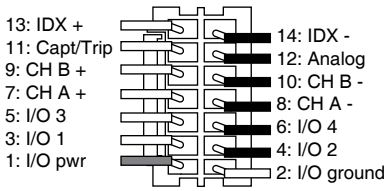
Prototype development cable (10'/3.0 m)..... PD14-2334-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-14V-1-S

Pins..... SPH-001T0.5L

4.4.4 P1 — 14-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.15 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-09
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

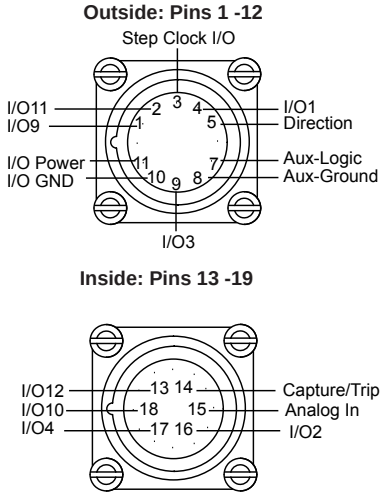
Prototype development cable (10'/3.0 m)..... PD14-2334-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-14V-1-S

Pins..... SPH-001T0.5L

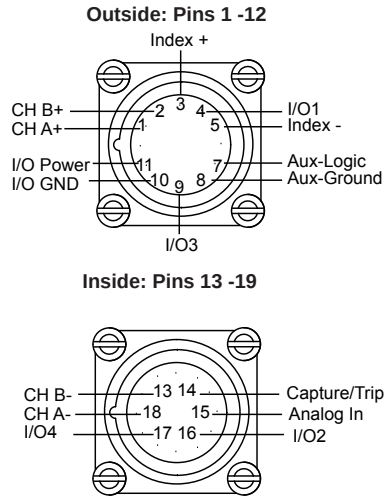
4.4.5 P1 — 19-pin M23 circular connector (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	I/O 9	Violet
2	I/O 11	Red
3	Step/Clock I/O	Grey
4	I/O 1	Red/Blue
5	Direction I/O	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	I/O 12	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	I/O 10	Gray/Brown

Table 4.16 I/O connections, 19-pin M23 circular

4.4.5 P1 — 19-pin M23 circular connector (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	Channel A+	Violet
2	Channel B+	Red
3	Index +	Grey
4	I/O 1	Red/Blue
5	Index -	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	Channel B-	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	Channel A -	Gray/Brown

Table 4.17 I/O connections, 19-pin M23 circular

4.5 Connectivity accessory details

4.5.1 RS-422/485 communications converter cables

USB to 10-pin IDC connector P2
P/N: MD-CC400-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

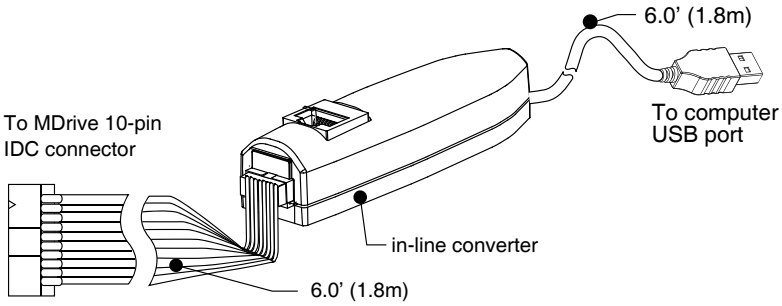


Figure 4.1 MD-CC400-000 communications converter cable

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

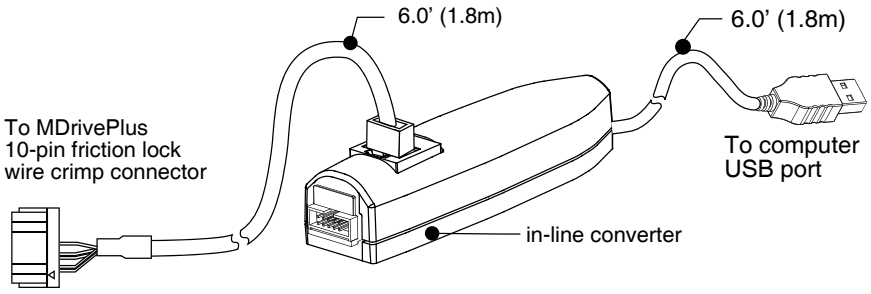


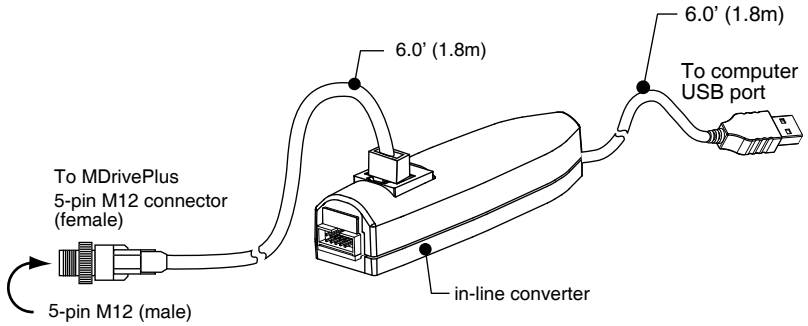
Figure 4.2 MD-CC402-001 communications converter cable

USB to 5-pin circular connector P2— MD-CC401-000

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters.

No mating connector kit is available for this connector style. Compatible mating connectors may be purchased from the following suppliers:

- Phoenix
- Turck
- RDE Connectors

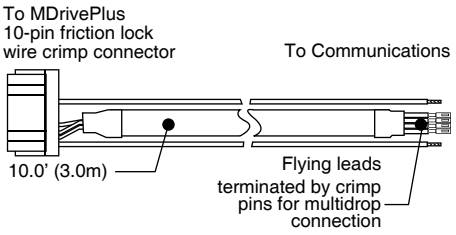


Figur e 4.3 MD-CC401-001 communications converter

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

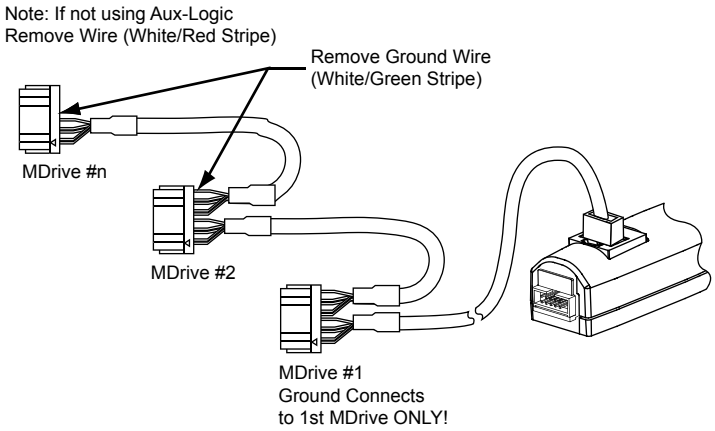


Figure 4.4 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

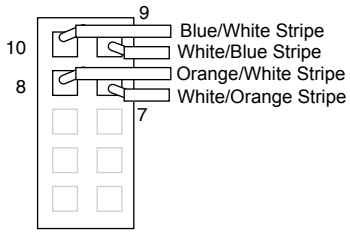


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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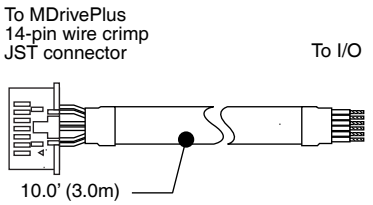
Flying leads to14-pin locking wire crimp connector P2 -P/N: PD14-2334-FL3

The PD14-2334-FL3 prototype development cable is used to rapidly interface the MDrive 23 to the users controller. This 10' (3.0 m) cable consists of a 14-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to I/O devices.

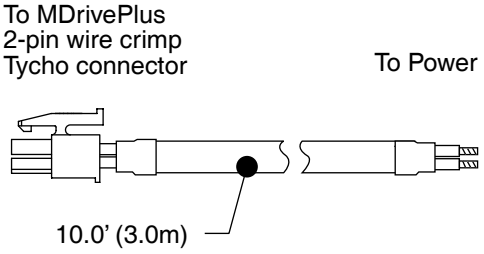


Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	Black	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power

Figure 4.6 Prototype development cable PD14-2334-FL3

Flying leads to 2-pin locking wire crimp connector P2 -P/N: PD02-2300-FL3

The PD02-2300-FL3 prototype development cable is used to rapidly interface the MDrive 23 to the users DC power supply. This 10' (3.0 m) cable consists of a 2-pin locking wire crimp connector to plug directly into the MDrive P3 connector with flying leads on the opposite end to interface to DC power.



Wire Colors	Function
Black	Power Ground
Red	+V

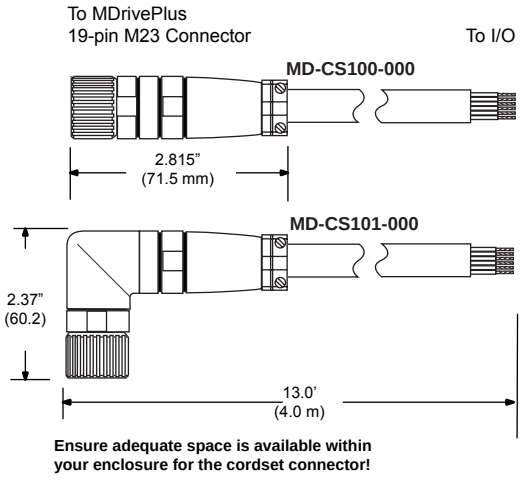
Figure 4.7 Prototype development cable PD02-2300-FL3

4.5.3 Connectivity option — 19 conductor cordset

19-pin M23 single-ended cordsets are offered to speed prototyping of the MDrive Accustep 34ac Motion Control. Measuring 13.0’ (4.0m) long, they are available in either straight or right angle termination. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination..... MD-CS100-000

Right Angle..... MD-CS101-000



Wire Colors	Function	Encoder Function
Violet	I/O9	Channel A+
Red	I/O11	Channel B+
Gray	Step Clock	Index+
Red/Blue	I/O1	I/O1
Green	Direction	Index-
Blue	+V*	+V*
Gray/Pink	Aux-Logic	Aux-Logic
White/Green	Comm GND	Comm GND
White/Yellow	I/O3	I/O3
White/Gray	I/O GND	I/O GND
Black	I/O Power	I/O Power
Green/Yellow	Shell Connect	Shell Connect
Yellow/Brown	I/O12	Channel B-
Brown/Green	Capture/Trip	Capture/Trip
White	Analog In	Analog In
Yellow	I/O2	I/O2
Pink	I/O1	I/O1
Gray/Brown	I/O10	I/O10
Brown	GND*	GND*

Figure 4.8 MD-CS10x-000 cordset

4.6 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 14-pin wire crimp CK-09

P3 2-pin wire crimp CK-04

Revision R031610

MDrive® 34
Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

The **MDrive® 34 Motion Control** offers system designers a cost effective, full featured programmable motion controller integrated with a NEMA 34 high torque 1.8° brushless step motor and a +12 up to +75 VDC* microstepping driver.

1.1 MDrive 34 unit overview

The unsurpassed smoothness and performance delivered by the MDrive 34 Motion Control are achieved through 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 MDrive 34 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 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 MDrive 34 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 MDrive 34 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, MDrive 34-65 sealed assembly versions are designed to meet IP65 specifications.

All MDrive 34 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 MDrive 34 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.

Revision R031610

Motor configurations include a single shaft rotary in four 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.

MDrive 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.

The MDrive 34 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.

1.2 Product identification

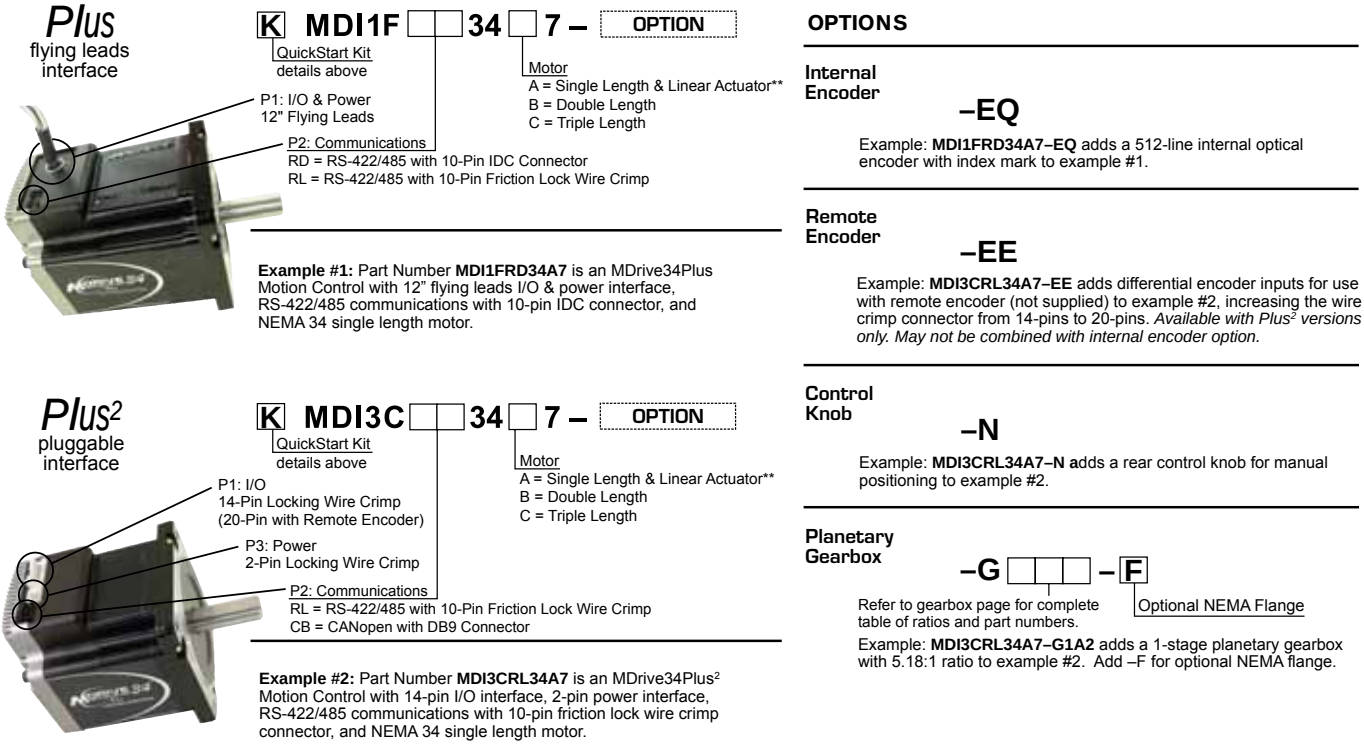

Figure 1.1 Standard product options

1.3 Documentation reference

The following User's manuals are available for the MDrive 34:

- Product manual, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.4 Product software

The MDrive 34 motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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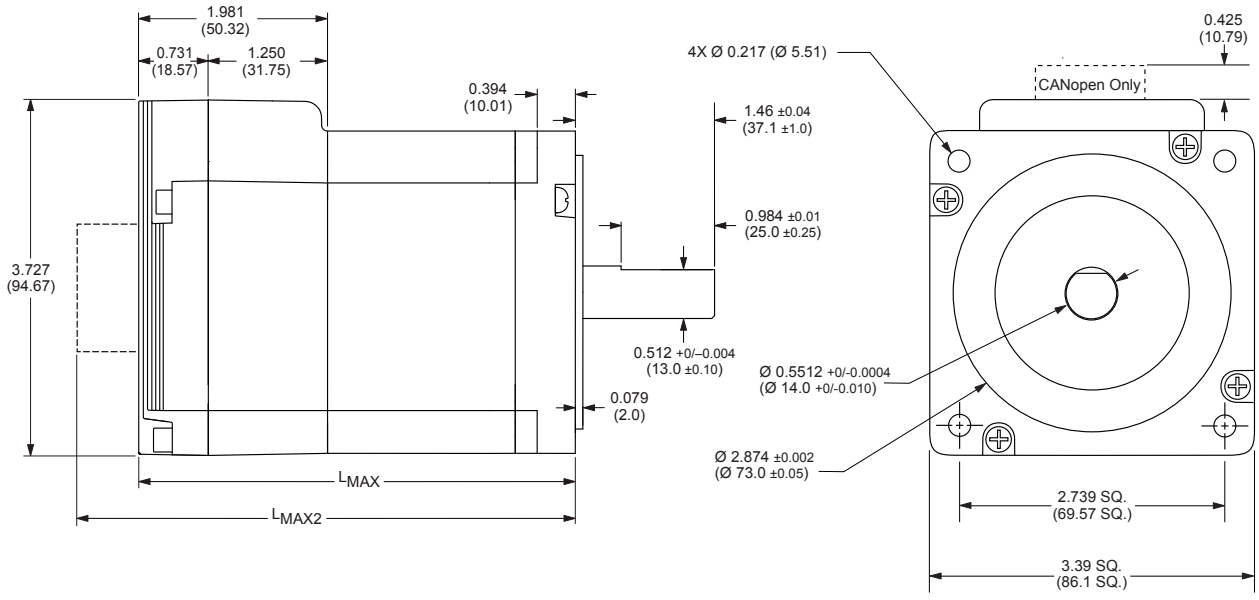
2 Specifications

2.1 Mechanical specifications

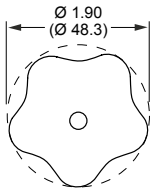
2.1.1 Standard and expanded features version



MDrive Lengths *Inches (mm)*

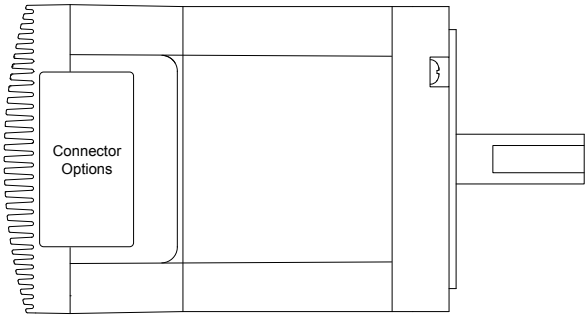
Motor Length	LMAX SINGLE SHAFT, INTERNAL ENCODER	LMAX2 CONTROL KNOB VERSION
Single	3.81 (96.77)	4.52 (114.81)
Double	4.60 (116.84)	5.31 (134.87)
Triple	6.17 (156.72)	6.88 (174.75)

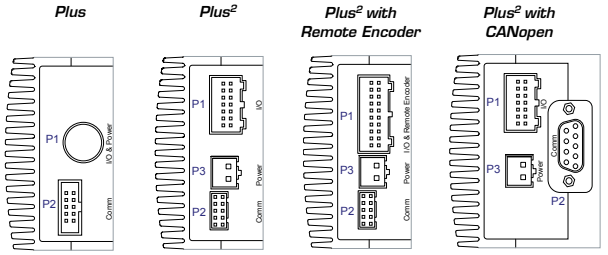
LMAX2 Option



Control Knob

Connector Options





Flying Leads | *Pluggable Locking Wire Crimp* | *Pluggable Locking Wire Crimp with Remote Encoder* | *Pluggable Locking Wire Crimp with CANopen DB9 (Male)*

Figure 2.1 Standard and Expanded features mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	—	+12	—	+75	VDC
Max power supply current*	—	—	—	3	A
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive 34, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications (plus)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-4)	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs (All)	—	—	—	+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			
Clock I/O					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			

Table 2.2 I/O specifications

2.2.3 Expanded I/O specifications (Plus²)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-8)	—			8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs	
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution	User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.				

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Motor specifications

Spcification	Single length	Double length	Triple length
Holding torque oz-in (N-cm)	381 (269)	575 (406)	1061(749)
Detent torque oz-in (N-cm)	10.9 (7.7)	14.16 (10.0)	19.83 (14.0)
Rotor inertia oz-in-sec^2 (kg-cm^2)	0.01416 (1.0)	0.02266 (1.6)	0.04815 (3.4)
Weight motor and driver lb (kg)	4.1 (1.90)	5.5 (2.5)	8.8 (4.0)

Table 2.8 Motor specifications

2.2.9 Performance curves

Single length motor

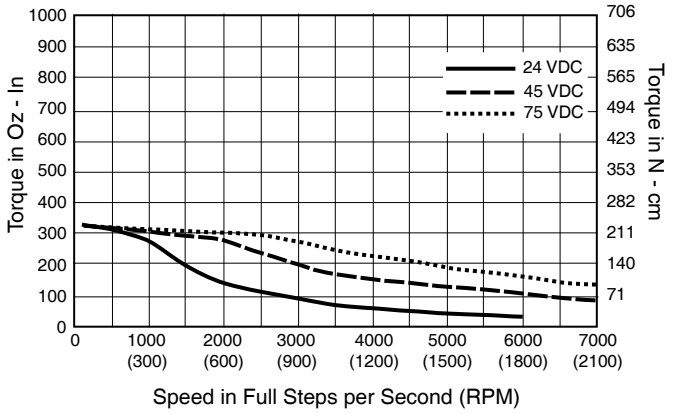


Figure 2.2 Performance curves - single length motor

Double length motor

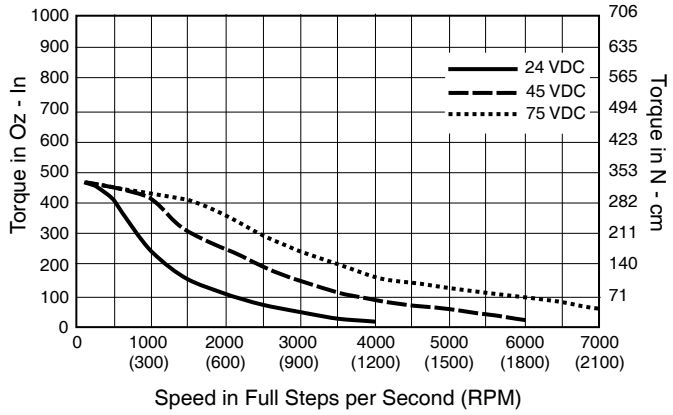


Figure 2.3 Performance curves -double length motor

Triple length motor

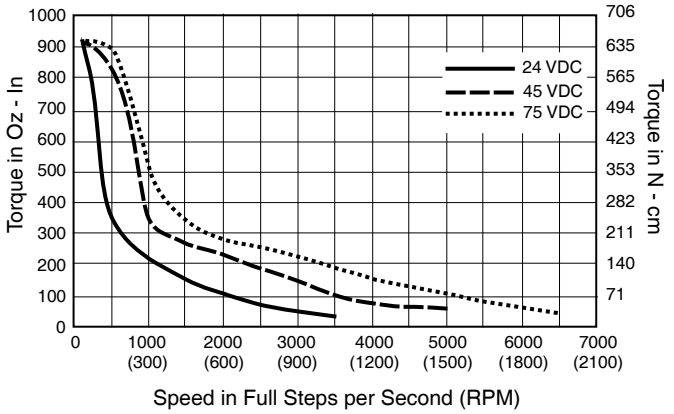
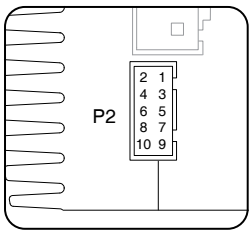


Figure 2.4 Performance curves -triple length motor

2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp (onlu available on pluggable connector versions)



Connectivity Options
USB to RS-422/485 Converter:
MD-CC402-001

Mating connector kit:
CK-02

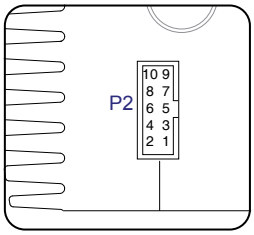
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

10-pin press-fit (IDC style) Only available on flying leads versions



Connectivity Options
USB to RS-422/485 Converter:
MD-CC400-001

Mating connector kit:
CK-01

Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

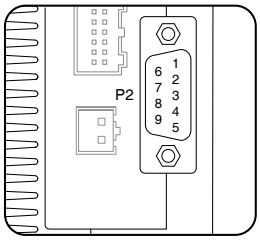
Ribbon cable
Tyco: 1-57051-9

Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communications, 10-pin pressure fit IDC/SAMTEC

2.3.2 CANopen communications option

9-pin D-sub female (DB-9F)



Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.11 CANopen communications, P2: 9-pin D-sub female (DB-9F)

2.4 Connectivity specifications/pin assignments - Power and I/O

2.4.1 Power and I/O - standard I/O (Plus)

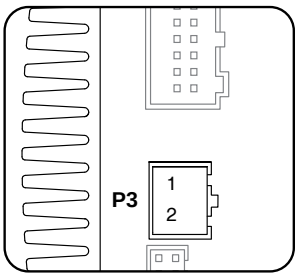
12” (304.8 mm) flying leads

Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power and auxiliary ground
Red	+V	Motor power

Table 2.12 Power and I/O interface - 12” (308.8.mm) flying leads

2.4.2 DC motor power

2-pin friction lock wire crimp



Pin #	Function	Description
1	+V	+12 to +60 VDC motor power
2	Ground	Power supply return (ground)

Table 2.13 P3 DC power, 2-pin locking wire crimp

Connectivity Options
Prototype development cable *PD-02-3400-FL3*

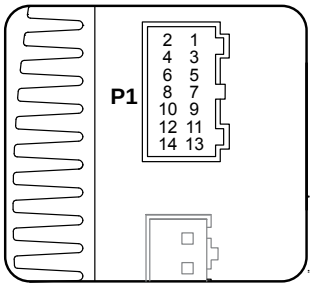
Mating connector kit:
CK-05

Mfg P/N:
Shell
Molex 751067-0200

Pins
Molex 750217-9101

2.4.3 I/O - expanded I/O (Plus²)

14-pin locking wire crimp



Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.

Table 2.147 P1 Expanded I/O, 14-pin locking wire crimp

Connectivity Options
Prototype development cable:
PD14-2334-FL3

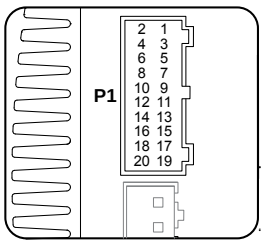
Mating connector kit:
CK-09

Mfg P/N:
Shell
JST PADP-14V-1-S

Pins
JST SPH-001T0.5L

2.4.4 I/O - remote encoder (Plus²)

20-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD20-3400-FL3

Mating connector kit:
CK-11

Mfg P/N:
Shell
JST PADP-20V-1-S

Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
15	CH A+	Channel A+ encoder input. +5 VDC logic level
16	CH A-	Channel A- encoder input. +5 VDC logic level
17	CH B+	Channel B+ encoder input. +5 VDC logic level
18	CH B-	Channel B- encoder input. +5 VDC logic level
19	IDX+	Index mark + encoder input. +5 VDC logic level
20	IDX-	Index mark - encoder input. +5 VDC logic level

Table 2.15 I/O and remote encoder interface - 20-pin locking wire crimpl

2.5 Options

Internal encoder Internal differential magnetic 512 line differential encoders with index mark are available:

Remote Encoder (Plus2 versions only) MDrive 34 Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob The MDrive 34 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 MDrive 34.

2.6 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin pressure-fit IDC MD-CC400-001

P2 5-pin M12 circular MD-CC401-001

P2 10-pin wire crimp MD-CC402-001

P2 9-pin DSub (CANopen) MD-CC500-000

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:

P2 10-pin wire crimp PD10-1434-FL3

P1 14-pin wire crimp PD14-2334-FL3

P1 19-pin M23 circular (straight) MD-CS100-000

P1 19-pin M23 circular (right-angle) MD-CS101-000

P3 2-pin wire crimp PD02-2300-FL3

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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 14-pin wire crimp CK-09

P3 2-pin wire crimp CK-04

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3 Mounting and connection recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

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3.1 Mounting

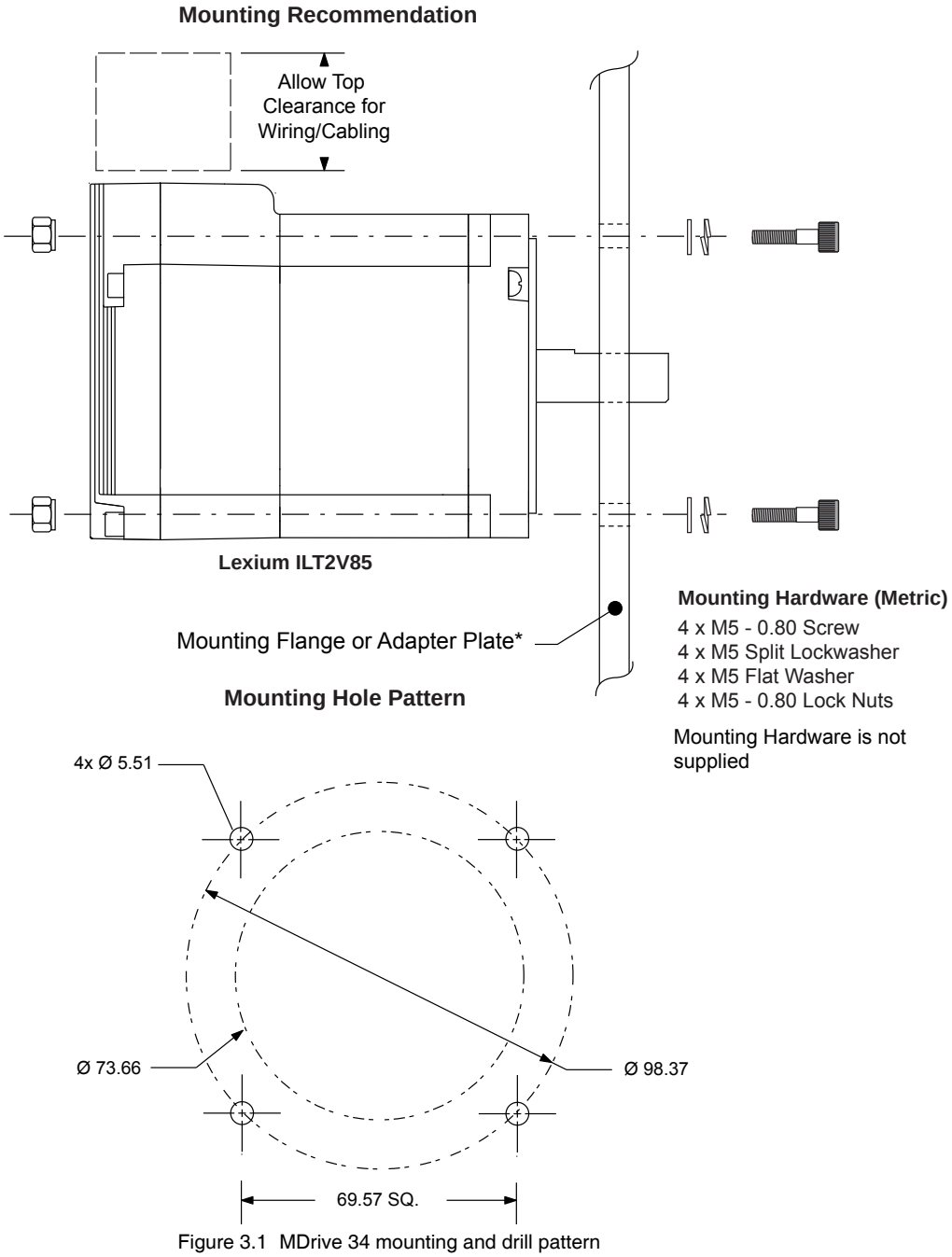

Figure 3.1 MDrive 34 mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

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3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive 34:

Logic Wiring..... 22 AWG

Wire Strip Length..... 0.25” (6.0 mm)

Power, Ground .....See Part 1 Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

Press-Fit IDC - P2 (MDrive 34 Only)

10-Pin IDC .....Samtec: TCSD-05-01-N

Ribbon Cable .....Tyco: 1-57051-9

Friction Lock Wire Crimp - P2

10-pin Friction Lock (MDI34Plus2) .....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG)DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

I/O, Power and Encoder

The following mating connectors are recommended for the MDrive 34 Units ONLY! Please contact a JST distributor for ordering and pricing information.

Manufacturer PNs

14-pin Locking Wire Crimp Connector Shell JST PN PADP-14V-1-S

Crimp Pins..... JST PN SPH-001T-P0.5L

20-pin Locking Wire Crimp Shell..... JST PN PADP-20V-1-S

Crimp Pins..... JST PN SPH-001T-P0.5L

2-pin Locking Wire Crimp Connector Shell..... Molex 51067-0200

Crimp Pins.....Molex 50217-9101 Brass

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

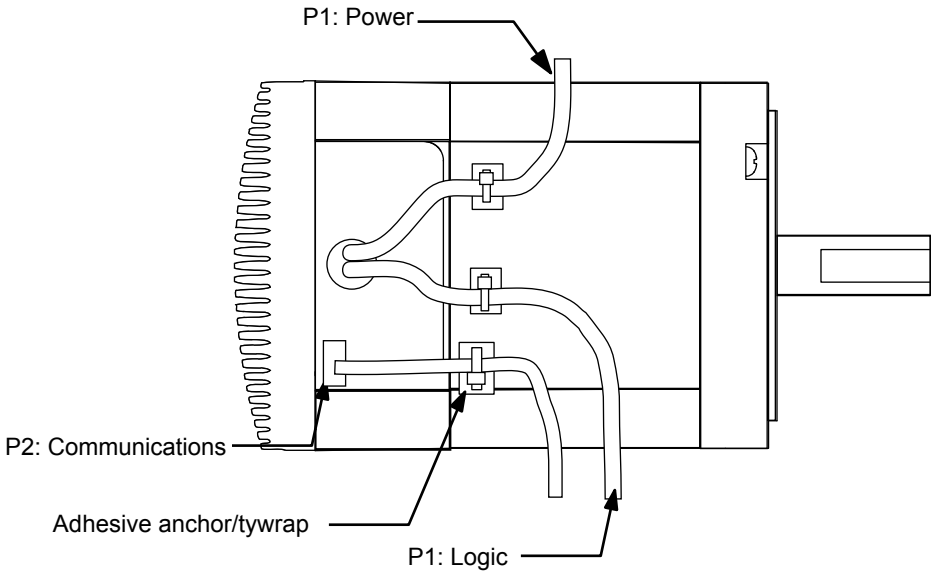

Figure 3.2 Securing leads

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

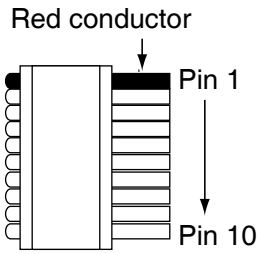
⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

4.1.1 P2 — 10-pin pressure-fit IDCstyle connector



Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

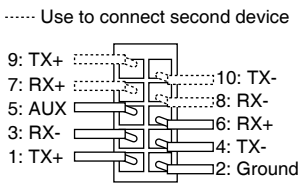
Table 4.1 Communications connections, P2 - 10-pin IDC

Connectivity accessories

Mating connector kit CK-01
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC400-001

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 4.2 P2 communications, 10-pin locking wire crimp

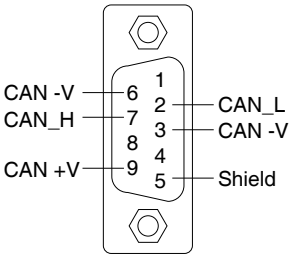
Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC402-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin d-sub connector (female)



Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.4 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

> **⚠ CAUTION**
>
> OVER VOLTAGE
>
> The DC voltage range for the MDrive23Plus is +12 to +60 VDC. Ensure that motor back EMF is factored into your power supply size calculations.
>
> Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.
>
> **Failure to follow these instructions can result in equipment damage.**

4.3.1 Recommended power supply characteristics

Voltage range	+12 to +75 VDC
Type	Unregulated linear
Ripple	± 5%
Output current	4.0 A (per MDrive 34

4.3.2 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18
2 Amps Peak	20	18	16	14	14
3 Amps Peak	18	16	14	12	12
4 Amps Peak	16	14	12	12	12

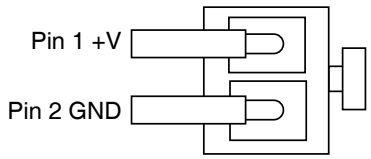
Table 4.61 Recommended power supply wire gauge

4.3.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.7 Power and ground connections, flying leads

4.3.4 P3 — 2-pin locking wire crimp interface



Pin #	*Signal*	*IMS cable wire colors*
		PD02-3400-FL3
1	+12 to +75 VDC supply	Red
2	Power ground	Black

Table 4.3 Power and ground connections, 12-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-05
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10’/3.0 m)..... PD02-3400-FL3

Manufacturer (Molex) part numbers

Connector shell..... 51067-0200

Pins..... 50217-9101

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4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

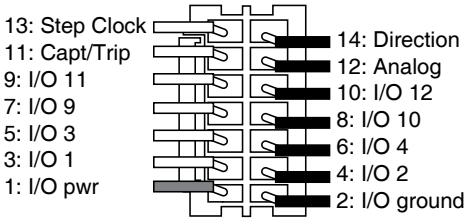
Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	*Signal*
White/yellow	General purpose I/O 1
White/orange	General purpose I/O 2
White/violet	General purpose I/O 3
White/blue	General purpose I/O 4
Green	Analog input

Table 4.11 I/O connections, flying leads

4.4.2 P1 — 14-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	Black	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.13 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-09
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD14-2334-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-14V-1-S

Pins..... SPH-001T0.5L

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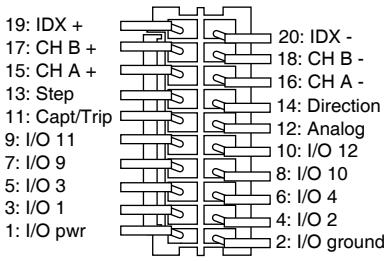
4.4.3 P1 — 20-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
		Cable 1	
1	I/O power	Red	Pair
2	I/O ground	Black	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	
		Cable 2	
15	Channel A +	White/blue	Pair
16	Channel A -	Blue/White	
17	Channel B +	White/orange	Pair
18	Channel B -	Orange/White	
19	Index +	White/green	Pair
20	Index -	Green/white	

Table 4.14 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK11
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD20-3400-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-20V-1-S

Pins..... SPH-001T0.5L

4.5 Connectivity accessory details

4.5.1 Communications converter cables

USB to 10-pin IDC connector P2
P/N: MD-CC400-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

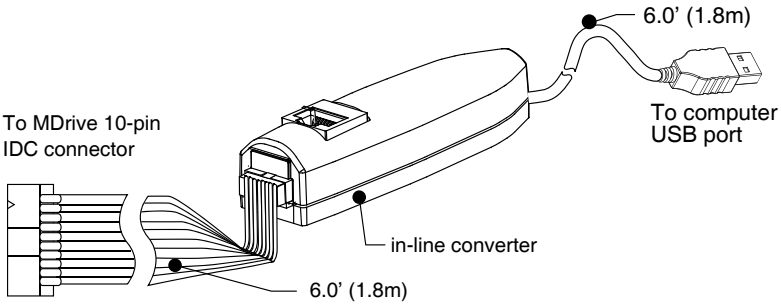


Figure 4.1 MD-CC400-000 communications converter cable

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

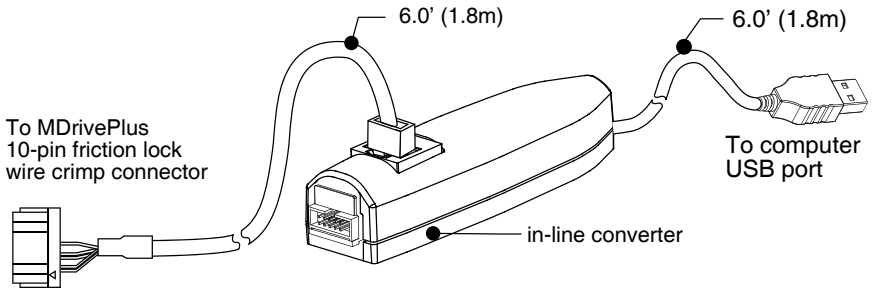


Figure 4.2 MD-CC402-001 communications converter cable

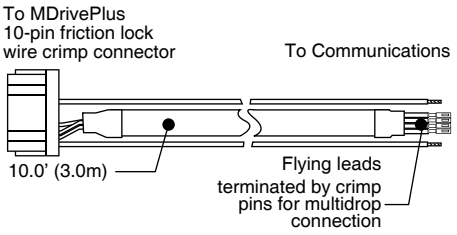
CANopen communications converter cable
MD-CC500-000

See Part 1, Section 6 of this document for CANopen connectivity instructions and MD-CC500-000 details.

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

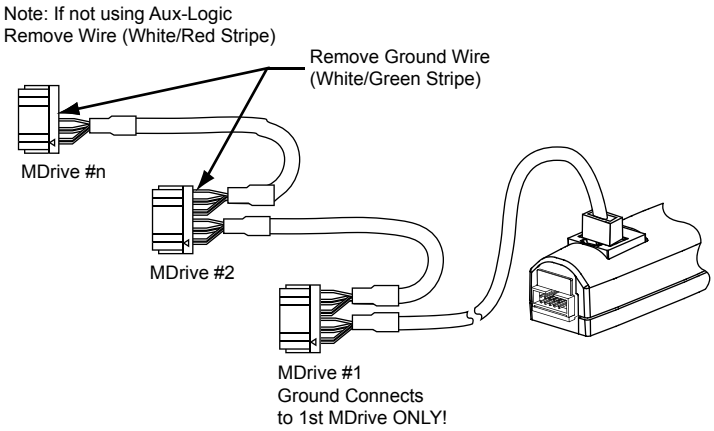


Figure 4.3 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

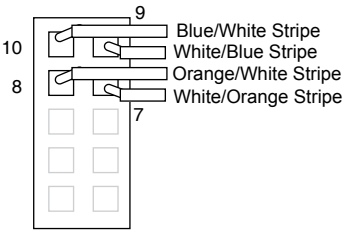
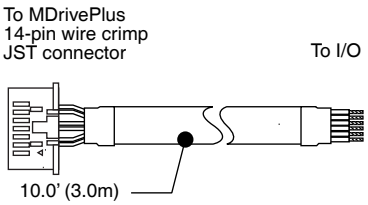


Figure 4.4 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

Flying leads to 14-pin locking wire crimp connector P1 -P/N: PD14-2334-FL3

The PD14-2334-FL3 prototype development cable is used to rapidly interface the MDrive 34 to the users controller. This 10' (3.0 m) cable consists of a 14-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to I/O devices.

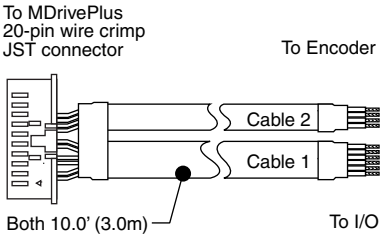


Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	Black	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power

Figure 4.5 Prototype development cable PD14-2334-FL3

Flying leads to 20-pin locking wire crimp connector P1 -P/N: PD20-3400-FL3

The PD20-3400-FL3 prototype development cable is used to rapidly interface the MDrive 34 to the users controller. This 10' (3.0 m) cable consists of a 20-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to I/O devices.



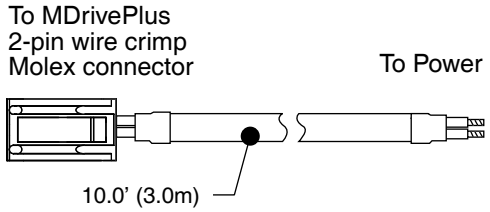
Pair	Wire Colors	Function
Cable 1		
1	Black	Direction
	White	Step Clock
2	Black	Analog In
	Green	Capt/Trip
3	Black	I/O12
	Blue	I/O11
4	Black	I/O10
	Yellow	I/O9
5	Black	I/O4
	Brown	I/O3
6	Black	I/O2
	Orange	I/O1
7	Black	I/O Ground
	Red	I/O Power

Cable 2		
1	White w/Blue Stripe	CH A+
	Blue w/White Stripe	CH A-
2	White w/Orange Stripe	CH B+
	Orange w/White Stripe	CH B-
3	White w/Green Stripe	IDX+
	Green w/White Stripe	IDX-

Figure 4.6 Prototype development cable PD20-3400-FL3

Flying leads to 2-pin locking wire crimp connector P2 -P/N: PD02-3400-FL3

The PD02-3400-FL3 prototype development cable is used to rapidly interface the MDrive 34 to the users DC power supply. This 10' (3.0 m) cable consists of a 2-pin locking wire crimp connector to plug directly into the MDrive P3 connector with flying leads on the opposite end to interface to DC power.



Wire Colors	Function
Black	Power Ground
Red	+V

Figure 4.7 Prototype development cable PD02-3400-FL3

4.6 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:

P2 10-pin pressure-fit IDC.....CK-01

P2 10-pin wire crimp.....CK-02

P1 14-pin wire crimp.....CK-09

P3 2-pin wire crimp.....CK-05

MDrive® 34AC

Motion Control

1. Introduction
2. Specifications
3. Interface and Connectivity

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1 Introduction

The **MDrive 34AC Motion Control** system offers designers a cost effective, full featured programmable motion controller integrated with a NEMA 34 high torque 1.8° brushless step motor and a microstepping driver operating at 120 or 240 VAC.

1.1 MDrive 34AC Motion Control overview

Unsurpassed smoothness and performance delivered by the MDrive 34AC are achieved through 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 MDrive 34AC accepts a broad input voltage range from 95 to 264 VAC, 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 +75°C provides long life, trouble free service in demanding environments.

The MDrive 34AC Motion Control system adds a versatile array of functions by combining a full featured programmable motion controller with our compact and cost effective MDrive 34AC Microstepping products, adding little cost and no increase in size. Standard offerings include up to 8 general purpose I/O lines (sourcing or sinking) that operate to +24 VDC, one 10 bit analog input, electronic gearing, high speed position capture input/trip output, microstep resolutions up to 51,200 steps per revolution, 0 to 5 MHz step clock rate, and a full featured easy-to-program instruction set.

The MDrive 34AC Motion Control system communicates over RS-422/485 which allows for point-to-point or multiple unit configurations utilizing one communication port. Addressing and hardware support multiple uniquely addressed units communicating over a single line.

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 10 kHz to 1 MHz. CANopen features include node guarding, heartbeat producer, SDOs and PDOs. Highlights include variable PDO mapping and extended node identifier.

The MDrive 34AC Motion Control is 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) optical encoder with index mark, internal to the MDrive 34AC so there is no increase in length. Or, for an expanded choice of line counts and resolutions, closed loop control is available with an interface to a remotely mounted user-supplied external encoder.

In addition to encoder options, the MDrive 34AC Motion Control has 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.

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A sealed version designed to meet IP65 specifications is also available. The sealed assembly allows the MDrive 34AC to be used in environments where exposure to chemical, dust and liquids may occur.

Interface connections are accomplished using standard industrial circular connectors. And connectivity has never been easier with options ranging from all-inclusive QuickStart Kits to individual interfacing cables.

1.2 Product identification

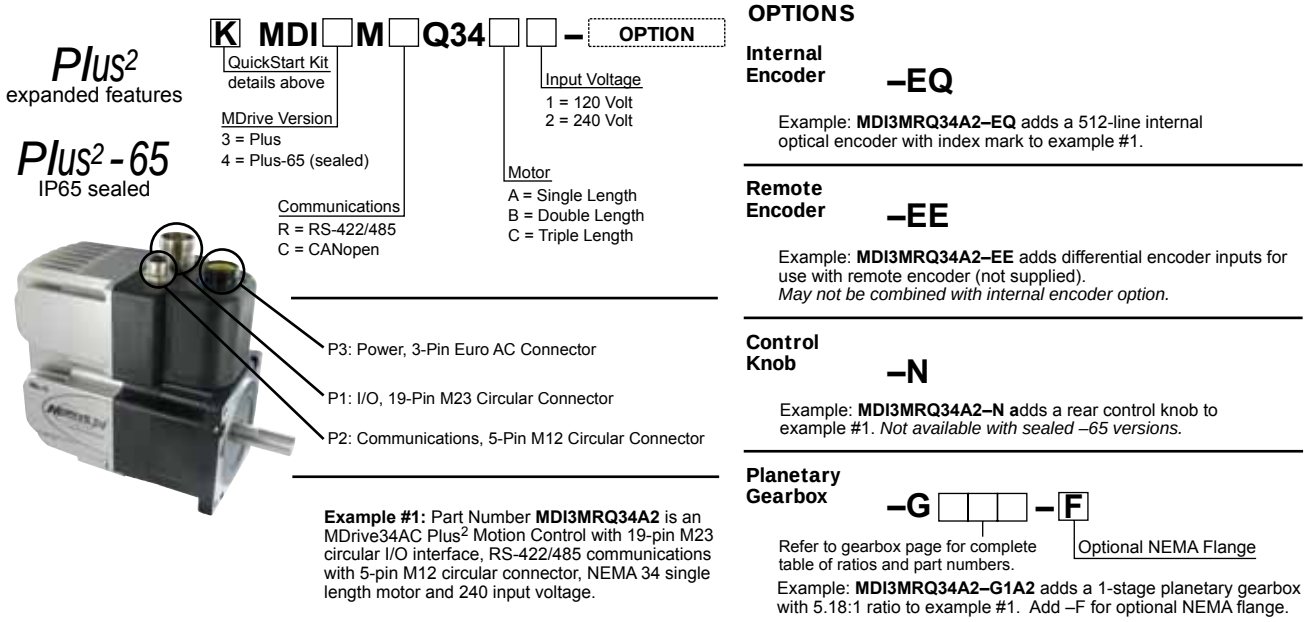

Figure 1.1 Standard product options

1.3 Documentation reference

The following User's manuals are available for the MDrive23 :

- Product hardware manual, describes the technical data and installation,of the product.
- MCode Programming and Reference manual which details the programming and configuration of the device.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.4 Product software

The MDrive 34AC Motion Control motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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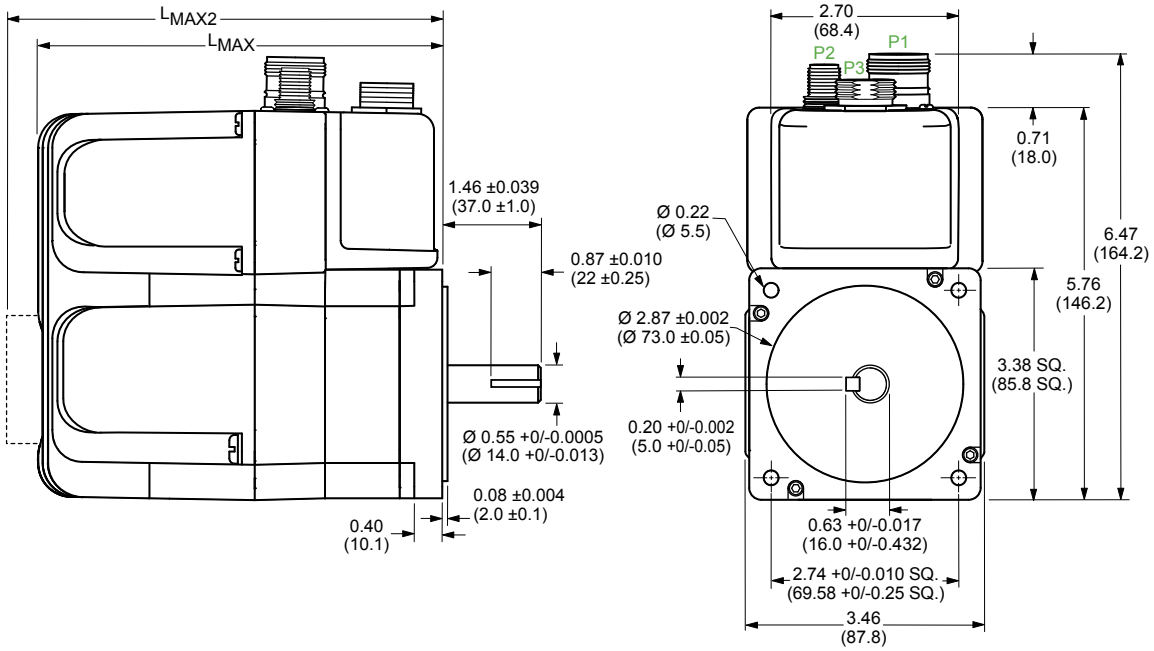
2 Specifications

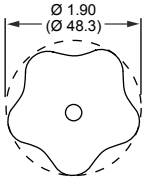
2.1 Mechanical specifications



MDrive AccuStep lengths Inches (mm)

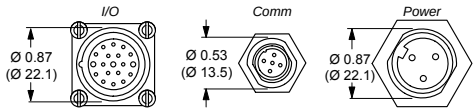
Motor length	LMAX with single shaft or internal encoder	LMAX2 with control knob
Single	6.1 (155.0)	7.1 (180.4)
Double	6.9 (174.3)	7.9 (199.7)
Triple	8.4 (214.3)	9.4 (239.7)

L_{MAX2} option



control knob

connectors



P1: 19-pin M23 P2: 5-pin M12 P3: 3-pin Euro AC

Figure 2.1 MDrive 34AC mechanical dimensions

2.2 General specifications

2.2.1 Electrical specifications

		Condition	Min	Typ	Max	Unit
Input voltage range	120 VAC	—	95	—	132	VAC
	240 VAC	—	95		264	VAC
Aux-Logic Input Voltage*		—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**		—	—	—	194	mA

** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.3 I/O specifications

		Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type						
I/O Points 1-8		—	8 I/O points configurable as sinking or sourcing inputs or outputs			
General Purpose I/O - Electrical						
Inputs	Sinking or Sourcing		TTL	—	+24	VDC
Outputs	Sinking		—	—	+24	VDC
	Sourcing		+12		+24	VDC
Output Sink Current (Plus)	One channel		—	—	600	mA
Motion I/O						
High speed position capture	Filter range				50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution		—	—	32	bit
High speed trip output	Speed		—	—	150	nS
	Resolution		—	—	32	bit
	Threshold		—	—	TTL	VDC
Analog input						
Resolution			—	—	10	bit
Range	Voltage		0	—	5	VDC
			0	—	10	VDC
	Current		0	—	20	mA
			4	—	20	mA

Table 2.2 I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.3 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+75	ºC
Motor temperature	non-condensing humidity	-40	—	+90	ºC

Table 2.4 Thermal specifications

2.2.6 Motion specifications

Microstep resolution (closed loop)	
Steps Per Revolution	51200
Position Resolution	2048
Encoder type	Internal, Differential magnetic
Resolution (Lines)	1000
Resolution (Edges)	4000
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.5 Motion specifications

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2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.6 Software specifications

2.2.8 Motor specifications

Specification	Single length	Double length	Triple length
Holding torque oz-in (N-cm)	330 oz-in (233)	500 (353)	700 (529)
Detent torque oz-in (N-cm)	10.9 (7.7)	14.16 (10.0)	19.83 (14.0)
Rotor inertia oz-in-sec^2 (kg-cm^2)	0.0142 (1.0)	0.0227 (1.6)	0.0482 (3.4)
Weight motor and driver lb (kg)	6.4 (2.9)	7.7 (3.5)	11.0 (5.0)

Table 2.7 MDrive 34AC Motion Control motor specifications

2.2.9 Speed-force performance curves

S120 VAC motor performance

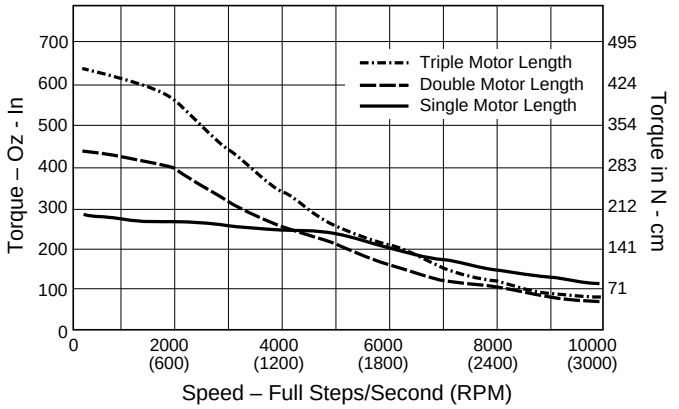


Figure 2.3 Motor performance curve — 120 VAC

240 VAC motor performance

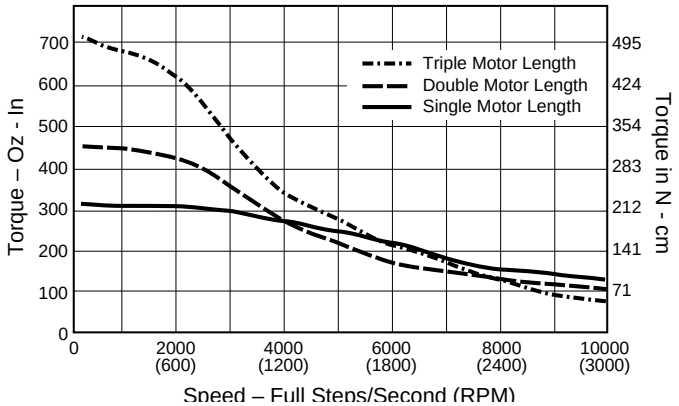
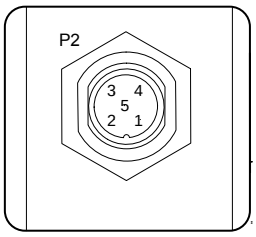


Figure 2.4 Motor performance curve — 240 VAC

2.3 Connectivity specifications/pin assignments

2.3.1 RS-422/485 communications

5-pin M12 circular connector (female)



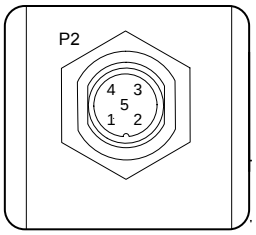
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communications ground

Table 2.8 P2 communications, 5-pin M12F circular connector

Connectivity Options
USB to RS-422/485 Converter:
MD-CC401-001

2.3.2 CANopen communications option

5-pin M12 circular



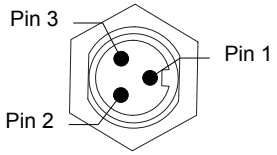
Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	CAN communications ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 2.9 CANopen communications, P2: 5-pin D-sub female

Connectivity Options
USB to CANopen converter:
MD-CC500-000

2.3.3 AC power

3-pin Euro AC



Pin #	Function	Description
1	Earth	Chassis (earth) ground
2	Line	AC line
3	Neutral	AC neutral

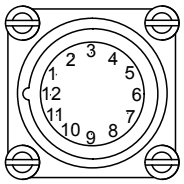
Table 2.10 P3 DC power, 2-pin locking wire crimp

Connectivity Options
Cordset
Straight MD-CS200-000
Right-angle: MD-CS201-000

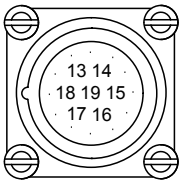
2.3.4 Expanded I/O

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options
Cordset
Straight MD-CS100-000
Right-angle: MD-CS101-000

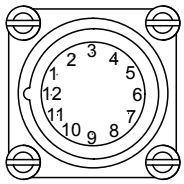
Pin #	Function	Description
1	I/O 9	0 to +24 VDC Programmable I/O Point 9.
2	I/O 11	0 to +24 VDC Programmable I/O Point 11.
3	Step/Clock I/O	0 to +5 VDC Step Clock I/O. Can also be configured as Quadrature or Clock Up/Down.
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	No Connect	No Connect.
6	No Connect	No Connect.
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs.
12	Shell	Shell connect
13	I/O 12	0 to +24 VDC Programmable I/O Point 12.
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	I/O 10	0 to +24 VDC Programmable I/O Point 10.
19	No Connect	No Connect.

Table 2.11 P1 I/O and aux power, 19-pin lM23 circular connector

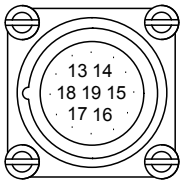
2.3.5 I/O and remote encoder

19-pin M23 circular

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options
Cordset
Straight MD-CS100-000
Right-angle: MD-CS101-000

Pin #	Function	Description
1	CH A+	Channel A+ encoder input. +5 VDC logic level
2	CH B+	Channel B+ encoder input. +5 VDC logic level
3	IDX+	Index mark + encoder input. +5 VDC logic level
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	IDX-	Index mark - encoder input. +5 VDC logic level
6	N/C	Not connected
7	Aux-Logic	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
8	Aux-Ground	Auxiliary Ground.
9	I/O 3	0 to +24 VDC Programmable I/O Point 3.
10	I/O GND	Non-isolated I/O ground. Common with power ground.
11	I/O PWR	I/O Power, used with sourcing inputs or outputs.
12	Shell	Shell connect
13	CH B-	Channel B- encoder input. +5 VDC logic level
14	Capture/Trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
15	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
16	I/O 2	0 to +24 VDC Programmable I/O Point 2.
17	I/O 4	0 to +24 VDC Programmable I/O Point 4.
18	CH A-	Channel A- encoder input. +5 VDC logic level
19	N/C	Not connected

Table 2.12 P1 I/O and aux power, 19-pin lM23 circular connector

2.4 Encoder

Internal encoder

MDrive 34ACl products include a 1000 line internal magnetic encoder with index mark.

2.5 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 34ACl 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 5-pinM12 circular..... MD-CC401-001

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:

P1 19-pin M23 (straight)..... MD-CS100-000

P1 19-pin M23 (right-angle)..... MD-CS101-000

P3 Euro AC (straight) MD-CS200-000

P3 Euro AC (right-angle) MD-CS201-000

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3 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

3.1 Interfacing I/O

See part 1 of this document, section 6, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/direction I/O
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

Failure to follow these instructions can result in equipment damage.

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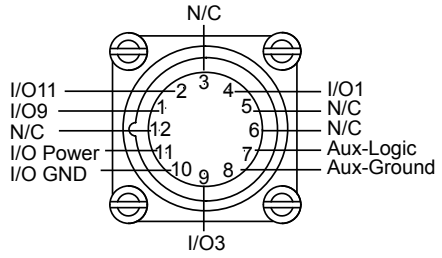
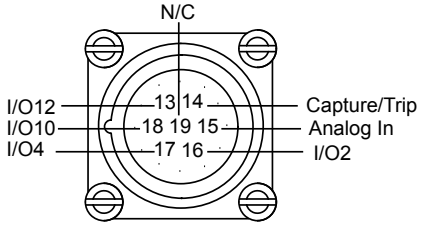
3.1.1 P1 — 19-pin M23 circular connector (expanded I/O)

Outside: Pins 1 -12



Inside: Pins 13 -19

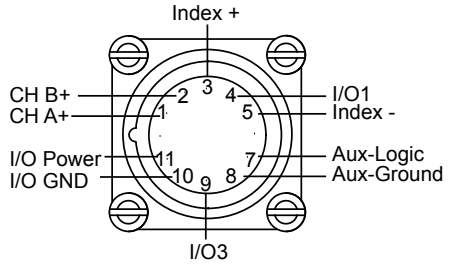


Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	I/O 9	Violet
2	I/O 11	Red
3	Step/Clock I/O	Grey
4	I/O 1	Red/Blue
5	No Connect	Green
6	No Connect	Blue
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
12	No Connect	Green/Yellow*
13	I/O 12	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	I/O 10	Gray/Brown
19	No Connect	Brown

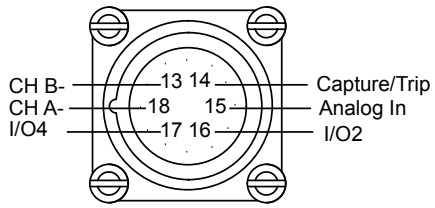
Table 3.1 I/O connections, 19-pin M23 circular

3.1.1 P1 — 19-pin M23 circular connector (remote encoder)

Outside: Pins 1 -12



Inside: Pins 13 -19



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	Channel A+	Violet
2	Channel B+	Red
3	Index +	Grey
4	I/O 1	Red/Blue
5	Index -	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	Channel B-	Yellow/Brown
14	Capture/Trip I/O	Brown/Green
15	AIN	White
16	I/O 2	Yellow
17	I/O 4	Pink
18	Channel A -	Gray/Brown

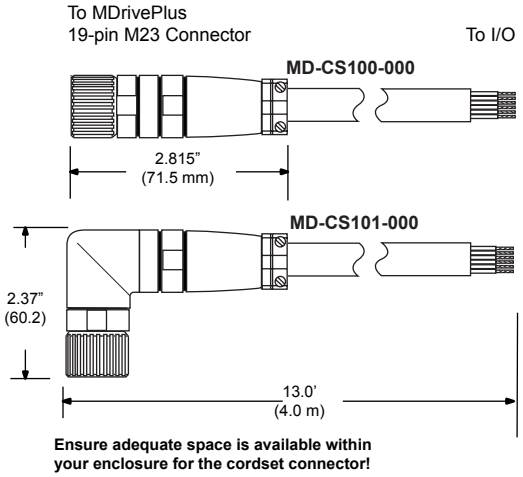
Table 3.2 I/O connections, 19-pin M23 circular

3.1.3 Connectivity option — 19 conductor cordset

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

Straight Termination..... MD-CS100-000

Right Angle..... MD-CS101-000

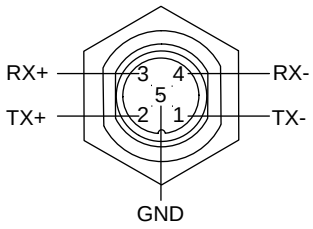


Wire Colors	Function	Encoder Function
Violet	I/O9	Channel A+
Red	I/O11	Channel B+
Gray	Step Clock	Index+
Red/Blue	I/O1	I/O1
Green	Direction	Index-
Blue	+V*	+V*
Gray/Pink	Aux-Logic	Aux-Logic
White/Green	Comm GND	Comm GND
White/Yellow	I/O3	I/O3
White/Gray	I/O GND	I/O GND
Black	I/O Power	I/O Power
Green/Yellow	Shell Connect	Shell Connect
Yellow/Brown	I/O12	Channel B-
Brown/Green	Capture/Trip	Capture/Trip
White	Analog In	Analog In
Yellow	I/O2	I/O2
Pink	I/O1	I/O1
Gray/Brown	I/O10	I/O10
Brown	GND*	GND*

Figure 3.1 MD-CS10x-000 cordset

3.2 Interfacing RS-422/485 communications

3.2.1 P2 — 5-pin M12 circular connector (male)



Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 3.3 P2 communications, 5-pin M12F circular connector

3.2.2 Communications converter — MD-CC401-000

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters.

No mating connector kit is available for this connector style. Compatible mating connectors may be purchased from the following suppliers:

- Phoenix
- Turck
- RDE Connectors

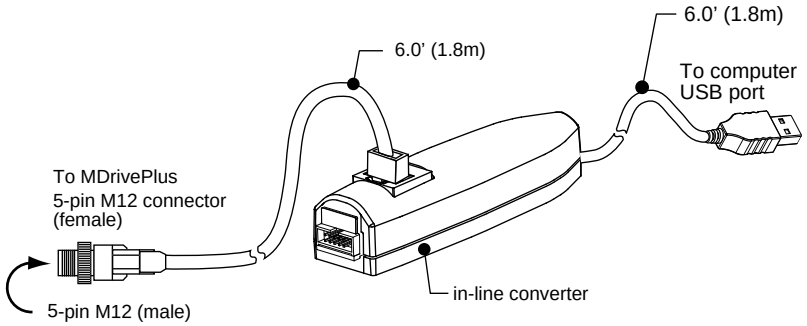
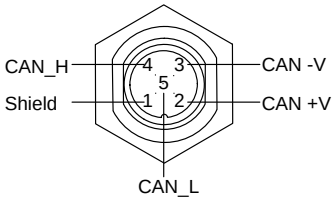


Figure 3.2 MD-CC401-001 communications converter

3.3 Interfacing CANopen communications

3.3.1 P2 — 5-pin M12 circular connector (female)



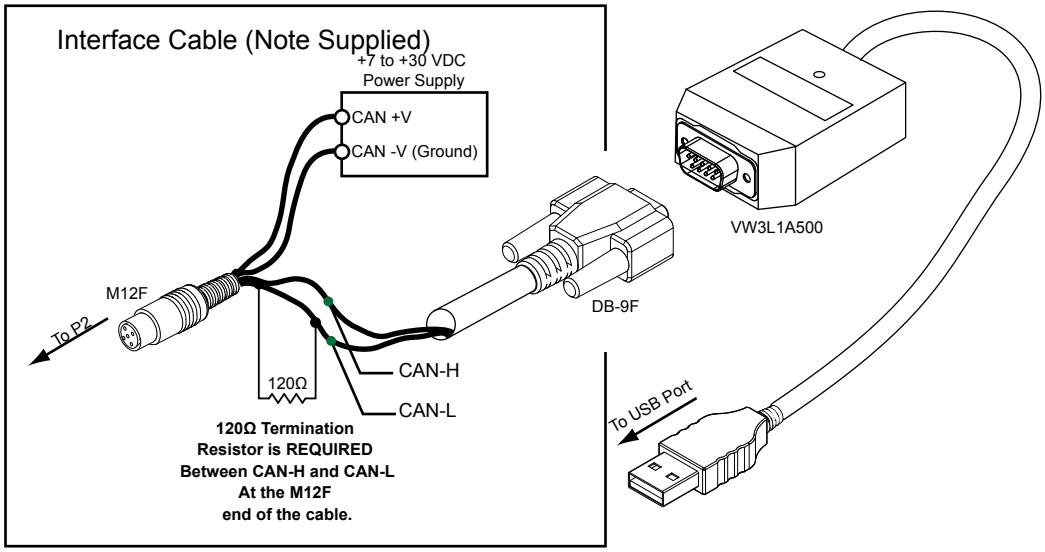
Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	Optional ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 3.4 CANopen communications, P2: 5-pin M12 female

Connectivity accessories Communications converter cable MD-CC500-000

3.3.2 MD-CC500-000 USB to CANopen converter

The MD-CC500-000 will not natively interface to the P2 connector of the device. An interface cable must be constructed as illustrated below.



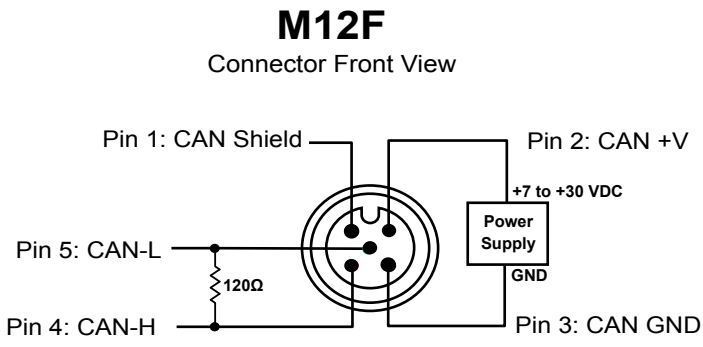
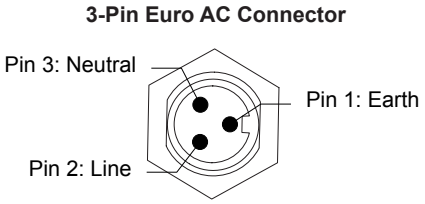


Figure 3.3 MD-CC500-000 and interface cable

3.4 Interfacing AC power

3.4.1 P3 — 3-pin Euro AC



Pin number	Signal	European (IEC) color code
1	Earth	Yellow/Green
2	Line	Brown
3	Neutral	Blue

Table 3.5 AC standard wire colors

3.4.2 MD-CS20x-000 cordset

The single-end three conductor cordsets are used with the MDrive AC. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. IEC color code, oil-resistant yellow PVC jacket, IP68 and NEMA 6P rated.

Straight Termination MD-CS200-000

Right Angle Termination MD-CS201-000

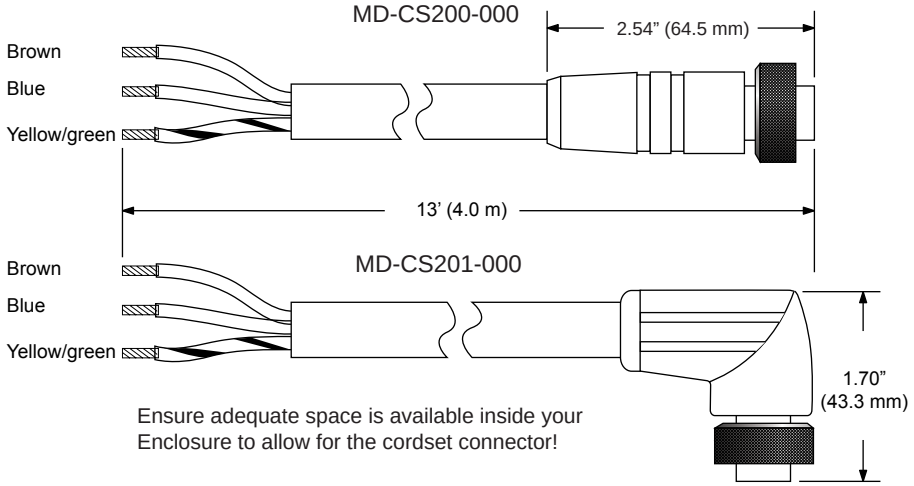


Figure 3.4 MD-CS20x-000

MDrive® Linear Actuator
Motion Control

Part 2: Detailed specifications and connectivity information

1. MDrive 14 Linear Actuator
2. MDrive 17 Linear Actuator
3. MDrive 23 Linear Actuator

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MDrive® 14 Linear Actuator

Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

MDrive® linear actuators combine leading all-in-one integrated motion technology with linear motion to deliver high accuracy, unsurpassed repeatability and long life, all in a package that is extremely compact and affordable.

1.1 MDrive 14 linear actuator unit overview

1.1.1 Linear actuator styles

Two (2) linear actuator styles of MDrive 14 integrated motor + driver solutions are available:

- **Non-captive shaft** — a screw runs through the MDrive and moves axially as the motor rotates
- **External shaft** — a rotating screw, integral to the motor shaft, moves a screw-mounted nut axially

Precision rolled lead screws used with MDrive linear actuators are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel and available with optional coating.

1.1.2 MDrive 14 linear versions

Three (2) MDrive14 integrated versions provide a choice of features and capabilities:

- **Microstepping** — motor + driver
- **Motion Control** — motor + driver + controller

MDrive14 linear actuators feature high torque 1.8° brushless NEMA 14 single length step motors with integrated electronics, providing the leading technology solution for all-in-one linear motion applications.

Unsurpassed smoothness and performance delivered by MDrive 14 products 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 MDrive 14 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.mapping and extended node identifier.

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

Revision R031610

1.2 Product identification

P1

I/O, power & communication connector:

C = locking wire crimp
(separate Comm connector on Plus² versions)

P2

Communication connectors Plus² versions only:

L = 10-pin locking wire crimp
B = DB9, only with CANopen Comm

Optional encoder

For NO encoder, omit any –E specification from part number

P1

MLI1 C RZ14A4 – EQ – L linear actuator

RS-422/485 comm

Internal magnetic encoder with 512-line count and index mark.

P1 P2

Plus² **MLI3 C R L 14A4 – EQ** (see above) or **– EE – L** linear actuator

RS-422/485 comm

Plus² **MLI3 C C B 14A4 – L** linear actuator

CANopen comm

Plus² version only: optional inputs for differential remote encoder (not supplied). May not be combined with internal encoder.

See details at bottom of page for complete linear actuator part numbers.

Non-captive shaft

– L□1□ □□□ Z□

Screw lead travel per rev
A = 0.250" (6.35mm)
B = 0.125" (3.175mm)
C = 0.063" (1.588mm)
D = 0.031" (0.794mm)

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 18.0" in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Coating
T = teflon*
Z = none

Screw length calculation = desired stroke length + 1.40" (35.56mm) + mounting surface plate thickness

*Contact factory for availability.

External shaft

– L□3□ □□□ □ □

Screw lead travel per rev
A = 0.250" (6.35mm)
B = 0.125" (3.175mm)
C = 0.063" (1.588mm)
D = 0.031" (0.794mm)

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 18.0" in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Nut
G = general purpose (dynamic load limit to 25lbs/11kg)
A = anti-backlash (dynamic load limit to 5lbs/2kg)

Coating
T = teflon*
Z = none

Screw length calculation = desired stroke length + nut length + mounting surface plate thickness

Figure 1.1 Standard product options

Revision R031610

1.3 Documentation reference

The following User's manuals are available for the MDrive14Plus:

- Product manual, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.4 Product software

The MDrive 14 Linear Actuator motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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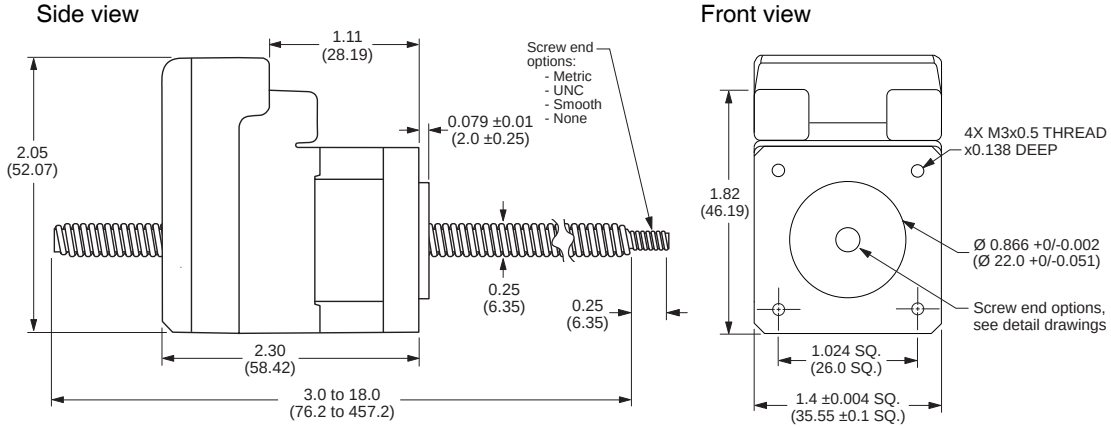
2 Specifications

2.1 Mechanical specifications

2.1.1 Non-captive shaft



Load limit

Nominal load limit: 50 lbs (22 kg)*

*Screw D: 10 lbs (4.5 kg). Heavier loads will degrade screw life. Consult factory for alternatives.

Screw specifications

Screw material

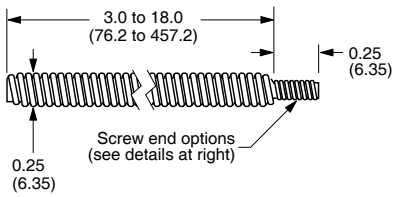
MDrive Linear Actuator precision rolled lead screws are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel.

Screw coating

An optional teflon screw coating is available for smooth operation and extended life.

Standard screw

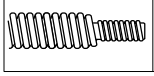
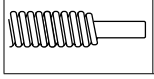
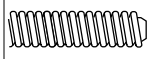
Dimensions in inches (mm)



Lead options

inches (mm)	travel per revolution	travel per full step
Screw A	0.250 (6.350)	0.00125 (0.0317)
Screw B	0.125 (3.175)	0.00063 (0.0158)
Screw C	0.063 (1.588)	0.00031 (0.0079)
Screw D	0.031 (0.794)	0.00016 (0.0040)

Screw end options

Threaded end 	Metric end: M4 x 0.7mm thread to within 0.03" (0.76mm) of shoulder	UNC end: #8-32 UNC-2A thread to within 0.03" (0.76mm) of shoulder
Smooth end 	Ø 0.1967" ±0.001 (Ø 5mm ±0.003)	
None 	—	

Cantilevered loads

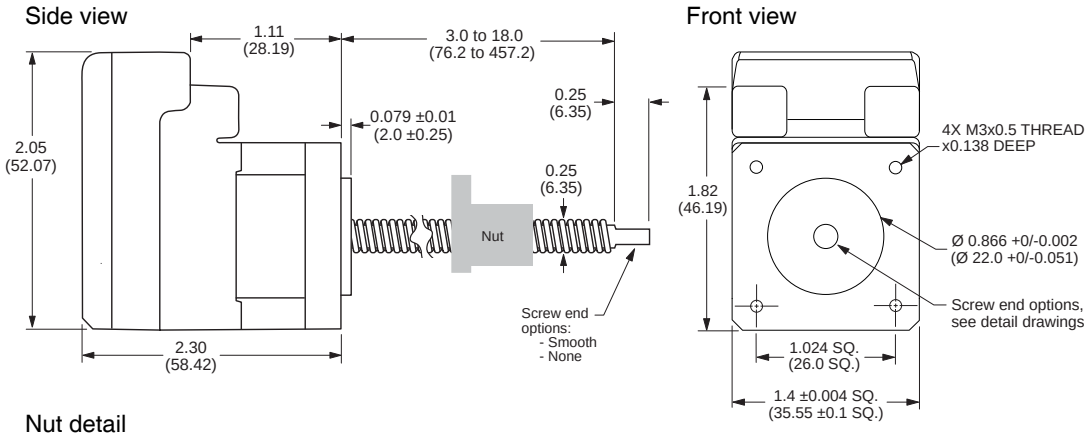
Unsupported loads and side loading are not recommended for non-captive shaft MDrive® linear actuator products.

Calculating screw length

Screw length = [mounting surface plate thickness] + [1.40" (35.56mm)] + [desired stroke length]

Figure 2.1 Non-captive shaft mechanical specifications

2.1.2 External shaft



General purpose nut
Flange shape: round
Load limit: 25 lbs (11 kg)
Purpose: for applications not requiring anti-backlash and wear compensation.

Anti-backlash nut
Flange shape: triangle
Load limit: 5 lbs (2 kg)
Purpose: backlash free operation for high accuracy and low drag torque.

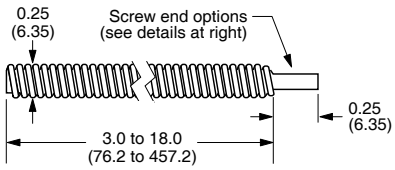
inches (mm)	A	B	D	E	F	BCD	*load limit*	*drag torque*
General purpose	0.50 (12.7)	0.75 (19.1)	1.0 (25.4)	0.14 (3.6)	0.15 (3.81)	0.75 (19.1)	25lbs/ 11 kg	free wheeling
Anti-backlash	0.50 (12.7)	0.9max (22.86)	1.0 (25.4)	0.143 (3.63)	0.18 (4.57)	0.75 (19.1)	5lbs/ 2 kg	< 1.0 oz-in < 0.7 N-cm

Screw specifications

Screw material
MDrive Linear Actuator precision rolled lead screws are corrosion resistant and non-magnetic, manufactured from premium grade stainless steel.

Screw coating
An optional teflon screw coating is available for smooth operation and extended life.

Standard screw
Dimensions in inches (mm)



Lead options

inches (mm)	travel per revolution	travel per full step
Screw A	0.250 (6.350)	0.00125 (0.0317)
Screw B	0.125 (3.175)	0.00063 (0.0158)
Screw C	0.063 (1.588)	0.00031 (0.0079)
Screw D	0.031 (0.794)	0.00016 (0.0040)

Screw end options

Threaded end	Metric end: M4 x 0.7mm thread to within 0.03" (0.76mm) of shoulder	UNC end: #8-32 UNC-2A thread to within 0.03" (0.76mm) of shoulder
Smooth end	Ø 0.1967" ±0.001 (Ø 5mm ±0.003)	
None	—	

Cantilevered loads
Loads for external shaft MDrive® linear actuator products MUST BE supported. Side loading is not recommended.

Calculating stroke length
Available stroke length = [screw length] – [nut length] – [mounting surface plate thickness]

Figure 2.2 External shaft mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	—	+12	—	+48	VDC
Power supply current	—	—	—	1	A
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive14Plus, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications (plus)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-4)	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs (All)	—	—	—	+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			
Clock I/O					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			

Table 2.2 I/O specifications

2.2.3 Expanded I/O specifications (Plus²)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-8)	—			8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs	
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution	User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.				

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

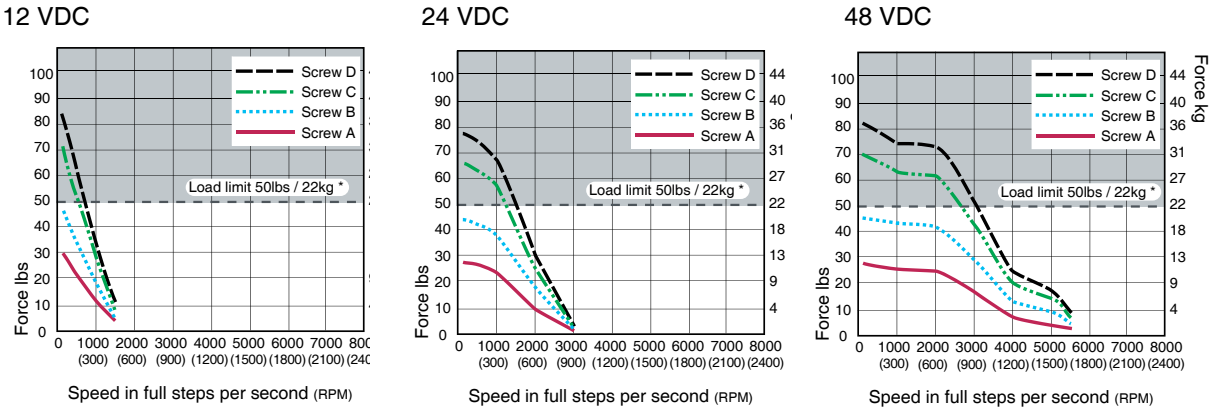
Table 2.7 Software specifications

2.2.8 Motor specifications

Holding torque		18 oz-in (13 N-cm)
Rotor inertia		0.0003 oz-in-sec^2 (0.021 kg-cm2)
Maximum thrust (Non-captive)	General purpose	50 lbs (22 kg)
	With anti-backlash nut	—
Maximum thrust (External)	General purpose	25 lbs (11 kg)
	With anti-backlash nut	5 lbs (2 kg)
Maximum repeatability (Non-captive)	General purpose	0.005” (0.127 mm)
	With anti-backlash nut	—
Maximum repeatability (External)	General purpose	0.005” (0.127mm)
	With anti-backlash nut	0.0005” (0.0127 mm)
Maximum screw misalignment		± 1°
Wieght without screw		8.0 oz (230.0 g)

Table 2.8 Actuator specifications

2.2.9 Speed-force performance curves



*For non-captive shaft linear actuators. Load limit for external shaft linear actuators is determined by selected nut.

Figure 2.3 Performance curves

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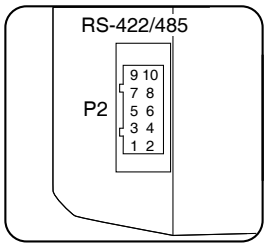
2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422 Converter:
MD-CC402-001

Mating connector kit:
CK-02

Mfg P/N:
Shell
Hirose DF11-2428SC

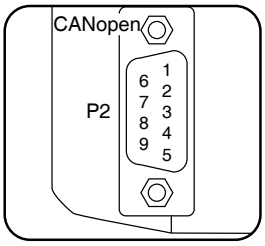
Pins
Hirose DF11-TA2428HC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

2.3.2 CANopen communications option (Plus² only)

9-pin D-sub female (DB-9F)



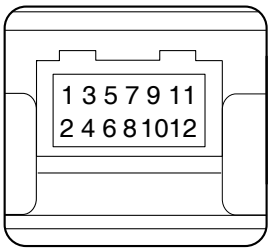
Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.10 CANopen communications, P2: 9-pin D-sub female (DB-9F)

2.4 Connectivity specifications/pin assignments - Comm, Power and I/O

2.4.1 Communications, Power and I/O - standard I/O (Plus only)



Connectivity Options
USB to RS-422 Converter:
MD-CC403-001

Mating connector kit:
CK-08

Mfg P/N:
Shell
JST PADP-12V-1-S

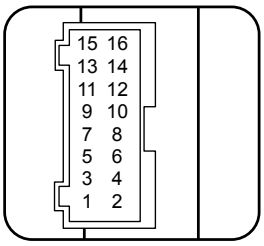
Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	GND	Power, Auxiliary and Communications ground.
2	+V	+12 to +48 VDC Power Supply
3	I/O 2	0 to +24 VDC Programmable I/O Point 2
4	I/O 3	0 to +24 VDC Programmable I/O Point 3
5	I/O 4	0 to +24 VDC Programmable I/O Point 4
6	AIN	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
7	I/O 1	0 to +24 VDC Programmable I/O Point 1
8	AUX	+12 to +24 VDC Auxiliary Logic Supply Input. This provides power to control and logic circuits if main power is removed.
9	TX +	Transmit +: Connects to Receive + of the Communications Host.
10	TX -	Transmit –: Connects to Receive – of the Communications Host.
11	RX -	Receive –: Connects to Transmit – of the Communications Host.
12	RX +	Receive +: Connects to Transmit + of the Communications Host.

Table 2.11 P1 communications, power and I/O, 12-pin locking wire crimp

2.4.2 Power and I/O - expanded I/O (Plus²)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

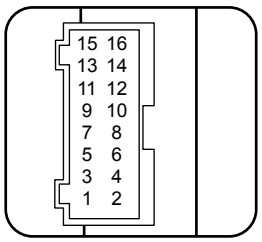
Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.12 P1 Expanded I/O, 14-pin locking wire crimp

2.4.3 Power and I/O - remote encoder (Plus²)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.13 I/O and remote encoder interface - 16-pin locking wire crimpl

2.5 Options

Internal encoder

Internal differential magnetic 512 line differential encoders with index mark are available:

Remote Encoder (Plus2 versions only)

MDrive14Plus^2 Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

Control Knob

The MDrive14Plus 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 MDriv14Plus.

2.6 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin wire crimp.....MD-CC402-001

P1 12-pin wire crimp.....MD-CC403-001

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:

P2 10-pin wire crimp..... PD10-1434-FL3

P1 12-pin wire crimp.....PD12B-1434-FL3

P1 16-pin wire crimp..... PD16-1417-FL3

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:

P2 10-pin wire crimp.....CK-02

P1 16-pin wire crimp.....CK-10

P1 12-pin wire crimp.....CK-08

3 Mounting, connection and assembly recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

SCREW MISALIGNMENT

Ensure that support for the screw is in place as to not exceed the maximum misalignment of ±1°.

Failure to follow these instructions can result in equipment damage.

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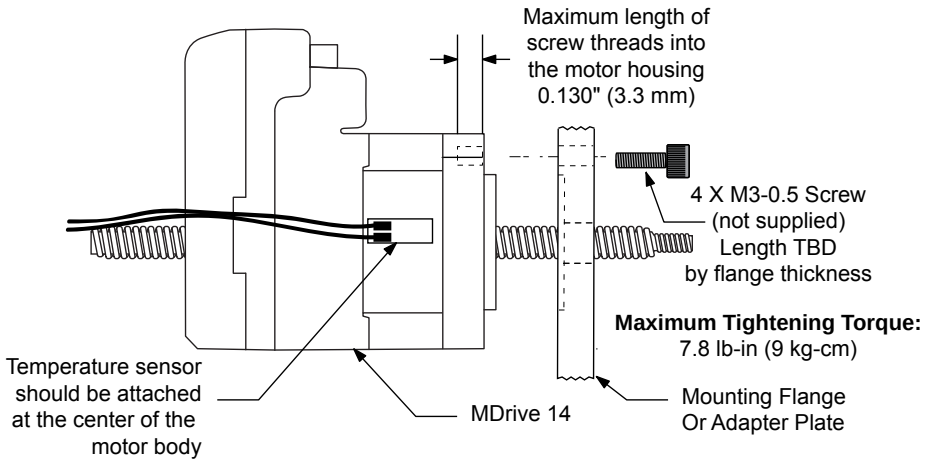
> **⚠ CAUTION**
>
> CANTILEVER LOADS
>
> Loads for external shaft MDrive linear actuator products MUST BE supported. Side loading is not recommended.
>
> **Failure to follow these instructions can result in equipment damage.**

3.1 Mounting

Care must be observed when installing the mounting screws on ALL MDrive 14Plus versions. The mounting holes on the flange are not drilled through and have a maximum depth of 0.150” (3.81 mm).

The warning note and Figure below illustrate the maximum safe thread length and maximum torque for mounting all versions of the MDrive14Plus.



Drill Pattern for Mounting Flange or Adapter Plate

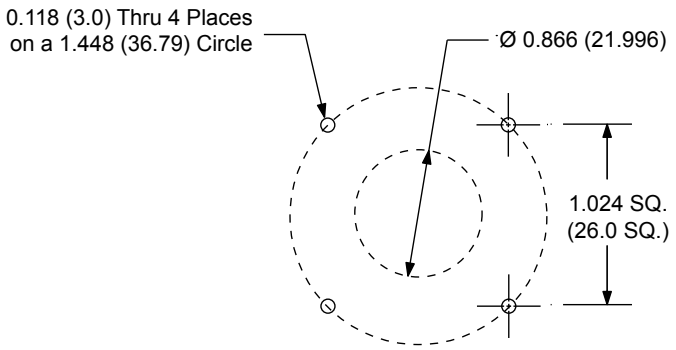


Figure 3.1 MDrive 14 linear actuator mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

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3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive14:

Logic Wiring.....22 AWG

Wire Strip Length.....0.25” (6.0 mm)

Power and Ground .....See Table 3.2 in Part 1, Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2).....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG) DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

10-pin pressure-fit IDC..... Samtec TCSD-05-01-N

Ribbon cable .....Tyco 1-57051-9

Power and I/O

The following mating connectors are recommended for the MDrive142 Units ONLY! Please contact a JST distributor for ordering and pricing information.

16-pin Locking Wire Crimp Connector Shell.....JST PN PADP-16V-1-S

Crimp Pins.....JST PN SPH-001T-P0.5L

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

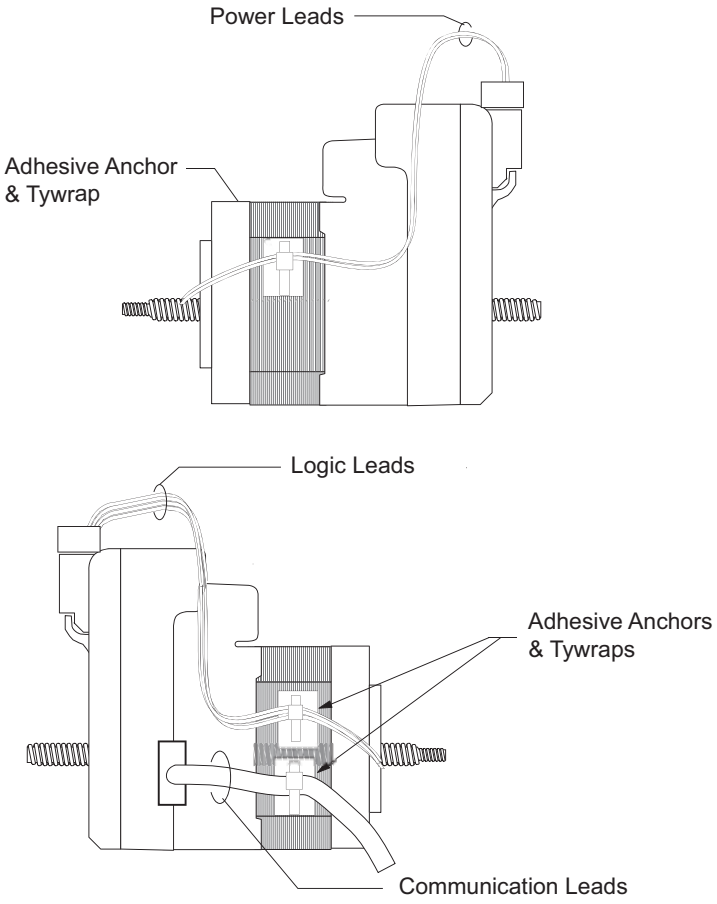

Figure 3.2 Securing leads

3.5 Anti-Backlash nut assembly and installation

3.5.1 Notes and warnings

- Do not use a wrench on the stainless steel cam of the nut.
- Do not oil the mechanism of the nut.
- Do not install the note into an interference fit bore (mechanism will not work).

3.5.2 Installation

To install threaded model nuts, simply hand tighten until shoulder is flush with mounting surface. A small amount of Loctite thread compound such as #277 can be used to prevent loosening. Alternatively, a pin can be installed to mechanically lock the threads.

Flanged models can be mounted to either the front or rear face of the flange.

Before use, it is recommended that the stainless steel preload mechanism be turned so that the caming surfaces move down the ramps. Once play is felt, allow the mechanism to slowly unwind again to establish the proper preload. (It is possible in assembly to inadvertently twist the cam creating excessive drag torque. This procedure will correct this.)

Using lubricant on the lead screw threads is recommended. This extends the life of the nut and reduces heat generation, noise and vibration. TriGEL-300S or TriGEL-1200SC is recommended.

3.5.3 Removal from screw

If it is necessary to remove the nut from your screw, you may lock the mechanism so that it can be immediately reinstalled without re-setting the preload. This can be done by wrapping tape around the junction between the stainless steel cam and the plastic nut halves. This will prevent the cam from turning when the nut is removed from screw. Remember to remove tape after installation.

For immediate transfer from one screw to another, hold the nut together between your thumb and forefinger so that it cannot expand axially. Remove the nut and install it on the second screw. It may be helpful to prevent the cam from turning with your remaining fingers as you transfer. If the nut becomes disassembled or looses its preload for any reason, follow the steps listed in the assembly procedure below.

3.5.4 Assembly procedure

1) Insert spring tang into cam slot.

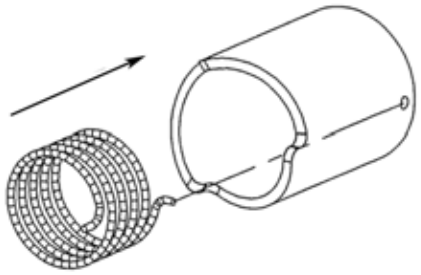

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

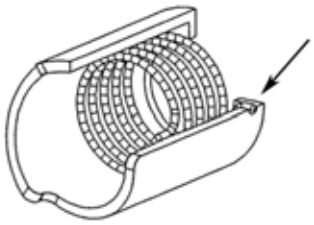

Figure 3.4 Spring engaged

3) Insert opposite tang into front nut slot or hole (dependant on size). Use the slot or hole that will allow the the cam to be positioned closest to the bottom of the ramp.

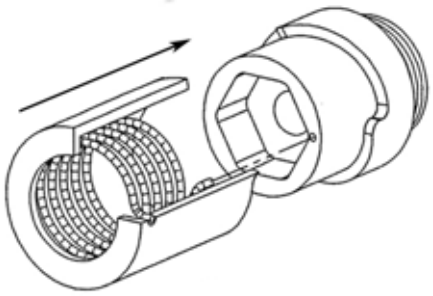

Figure 3.5 Insert opposite tang

4) With washer installed, insert the back nut into the front nut.

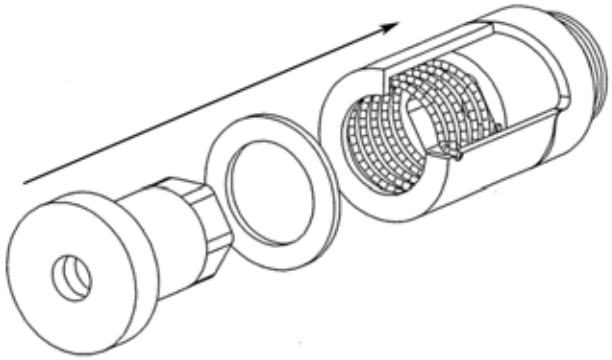

Figure 3.6 Inserting the back nut

5) With the cam held at the bottom of the ramp, thread the entire nut onto the screw starting with the front nut. After the entire nut is threaded onto the screw, release the cam to observe the gap distance (X on the drawing). The gap distance (X) should be about one-third of the full ramp distance, but no more than half.

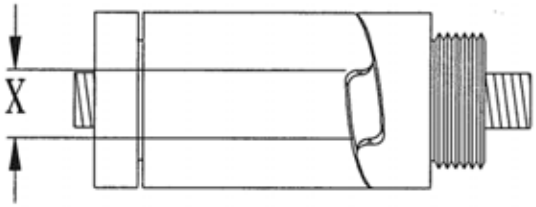

Figure 3.7 Measuring the gap distance

6) If the gap distance is incorrect, unthread the nut just enough to allow the back nut to disengage from the screw. Pull the back nut off and rotate to the next index position and reinsert back into the front nut. With the cam held at the bottom of the ramp, thread the entire nut back onto the screw. Release the cam and verify the correct gap distance. If still not correct repeat this step.

7) Once the back nut has been properly clocked to yield the correct gap distance, unthread the nut again just enough to disengage the back nut from the screw, but do not remove from the nut. Pull the cam away from the ramp and rotate in the clockwise direction for two ramp settings, then hold the cam at the bottom of the second ramp. Be careful not to allow the back nut to rotate with respect to the front nut while completing this task. With the cam held at the bottom of the second ramp, push the back nut into the front nut and thread the entire nut onto the screw.

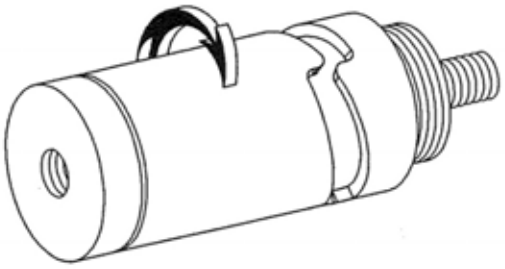

Figure 3.8 Pre-loading the nut

8) The anti-backlash nut is now pre-loaded and fully assembled.

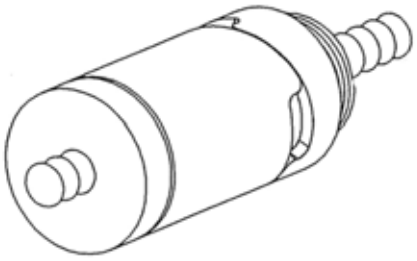

Figure 3.9 Nut pre-loaded and fully assembled

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

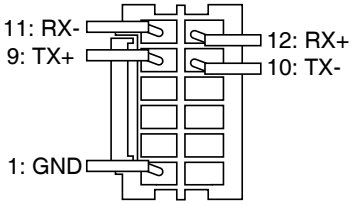
⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

4.1.1 P1 — 12-pin locking wire crimp



Pin #	Function	Description
1	GND	Power/aux/communications ground
9	TX +	Transmit plus
10	TX -	Transmit minus
11	RX -	Receive minus
12	RX +	Receive plus

Table 4.1 Communications connections, P1 - 12-pin wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD12-1434-FL3

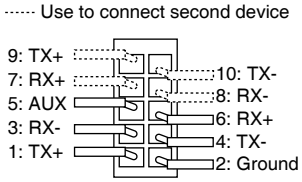
Communications converter cable (10'/3.0 m)..... MD-CC403-001

Manufacturer (JST) part numbers

Connector shell..... PADP-10V010S

Pins..... SPH-001T0.5L

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 4.2 P2 communications, 10-pin locking wire crimp

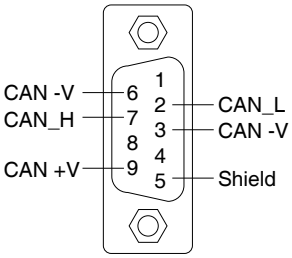
Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m)..... MD-CC402-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin d-sub connector (female)



Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.3 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

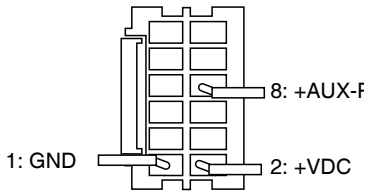
> **⚠ CAUTION**
>
> OVER VOLTAGE
>
> The DC voltage range for the MDrive14Plus is +12 to +48 VDC. Ensure that motor back EMF is factored into your power supply size calculations.
>
> Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.
>
> **Failure to follow these instructions can result in equipment damage.**

4.3.1 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18

Table 4.4 Recommended power supply wire gauge

4.3.2 P1 — 12-pin locking wire crimp interface



Pin #	***Signal***	***IMS cable wire colors***	
		MD-CC305-001	PD12B-14340-FL3
1	Power ground	Black	See section 4.7.2 for wire colors.
2	+12 to + 48 VDC	Red	
8	Aux-power +2 to +24 VDC	Red/black	

Table 4.5 Power and ground connections, 12-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD12B-1434-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-12V-1-S

Pins..... SPH-001T0.5L

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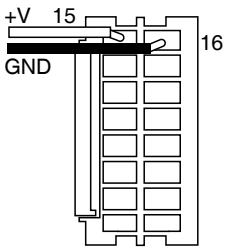
4.3.3 P1 — 16-pin locking wire crimp interface



Pin Numbers	*Signal*	*Prototype development cable wire colors*
15	+12 to + 48 VDC	Red
16	Power and auxiliary ground	Black

Table 4.6 Power and ground connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-16V-1-S

Pins..... SPH-001T0.5L04
(contains 5 connector shells, ribbon cable not included)

4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

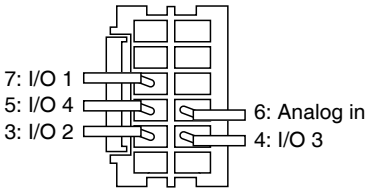
The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12-pin locking wire crimp



Pin #	*Signal*	*IMS cable wire colors*	
		MD-CC403-001	PD12B-1434-FL3
3	I/O 2	White	See section 4.7.2 for wire colors.
4	I/O 3	Green	
5	I/O 4	Orange	
6	Analog input	White/black	
7	I/O 1	Blue	

Table 4.7 Universal input connections, 12-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-08
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD12B-1434-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-12V-1-S

Pins..... SPH-001T0.5L

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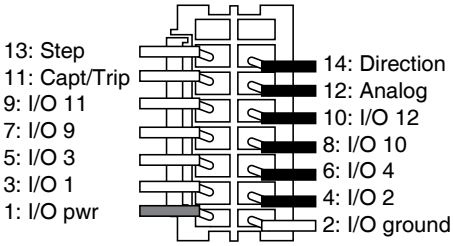
4.4.2 P1 — 16-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.8 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L

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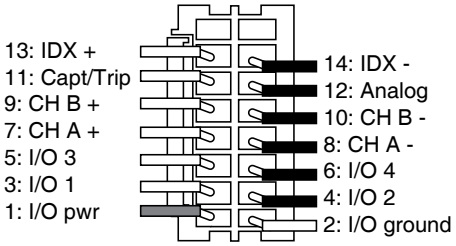
4.4.3 P1 — 16-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.9 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-16V-1-S

Pins..... SPH-001T0.5L

4.5 Connectivity accessory details

4.5.1 RS-422/485 communications converter cables

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

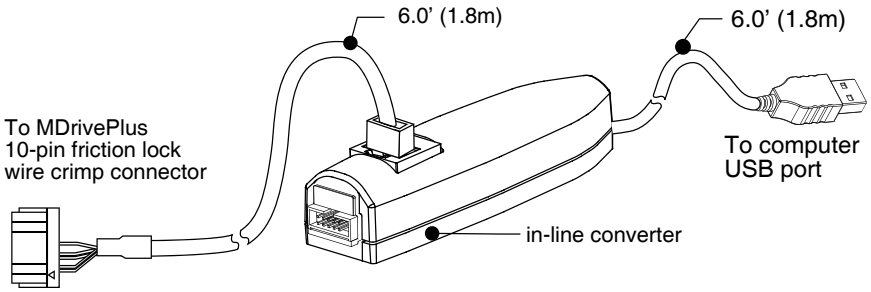


Figure 4.1 MD-CC402-001 communications converter cable

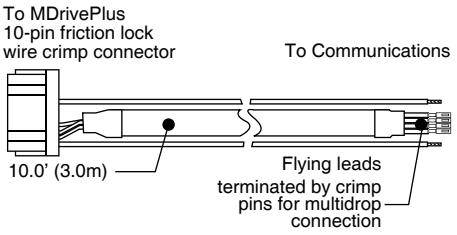
USB to 12-pin circular connector P1—
MD-CC403-000

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters.

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

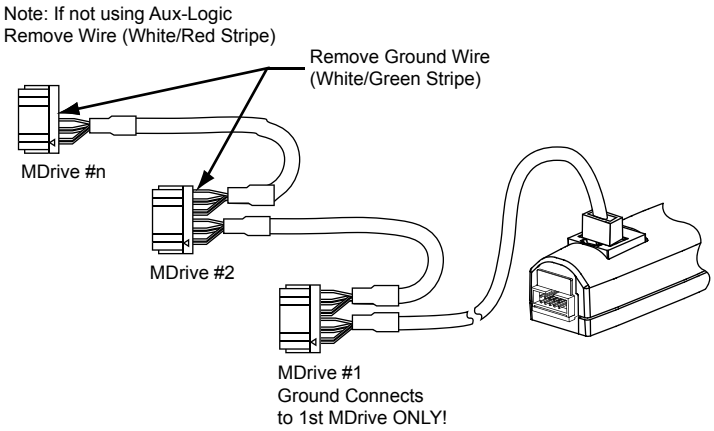


Figure 4.3 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

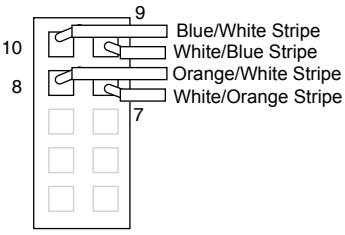
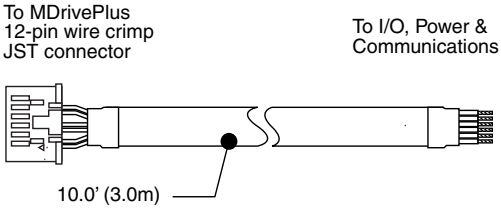


Figure 4.4 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

Flying leads to12-pin locking wire crimp connector P1 - PD12B-3400-FL3

Description: Pre-wired mating connector interfaces to an MDrive's 12-pin wire crimp connector, with flying leads other end, for quick test/ development.

Function: I/O, Power & Communications Interface.

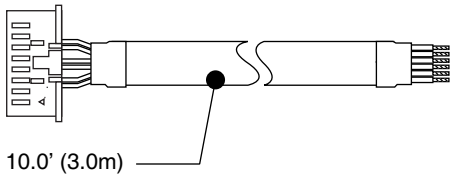


Pair	Wire Colors	Function
1	Black	GND
	Red	+V
2	Black	TX-
	White	TX+
3	Black	RX-
	Green	RX+
4	Black	I/O 2
	Blue	I/O 1
5	Black	I/O 3
	Yellow	I/O 4
6	Black	Analog Input
	Brown	Aux-Logic

Figure 4.5 Prototype development cable PD12B-1434-FL3

Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

The PD16-1417-FL3 prototype development cable is used to rapidly interface the MDrive14 to the users controller. This 10' (3.0 m) cable consists of a 16-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to power, i/o and/or remote encoder.



Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	White	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power
8	Black	Power GND	Power GND
	Red	+V	+V

Figure 4.6 Prototype development cable PD16-1417-FL3

4.6 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 12-pin wire crimp CK-08

P1 16-pin wire crimp CK-10

MDrive® 17 Linear Actuator
Motion Control

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

MDrive® linear actuators combine leading all-in-one integrated motion technology with linear motion to deliver high accuracy, unsurpassed repeatability and long life, all in a package that is extremely compact and affordable.

1.1 MDrive17 linear actuator unit overview

1.1.1 Linear actuator styles

Two (2) linear actuator styles of MDrive17 integrated motor + driver solutions are available:

- **Non-captive shaft** — a screw runs through the MDrive and moves axially as the motor rotates
- **External shaft** — a rotating screw, integral to the motor shaft, moves a screw-mounted nut axially

Precision rolled lead screws used with MDrive linear actuators are designed specifically for motion
control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic,
screws are manufactured from premium grade stainless steel and available with optional coating.

1.1.2 MDrive17 versions

Three (3) MDrive17 integrated versions provide a choice of features and capabilities:

- **Microstepping** — motor + driver
- **Motion Control** — motor + driver + controller

MDrive17 linear actuators feature high torque 1.8° brushless NEMA 17 (1.7”/43mm sq.) single length step motors with integrated electronics, providing the leading technology solution for all-in-one linear motion applications.

Unsurpassed smoothness and performance delivered by MDrive17 products 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 MDrive17 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.

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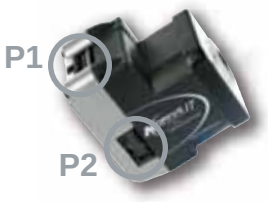
1.3 Product identification



P1
I/O & power connectors:
F = flying leads
P = pluggable terminal
C = locking wire crimp (includes Comm on Microstepping version)

P2
Communication connectors:
D = 10-pin IDC
L = 10-pin friction lock wire crimp
B = DB9, only with CANopen Comm
Z = None (when C used at P1 on Microstepping version)

P1 P2

MLI1 [F,P] **R** [D,L] **17A4** – **L** linear actuator
RS-422/485 comm

MLI1 [F,P] **C** [B] **17A4** – **L** linear actuator
CANopen comm

Plus² **MLI3** [C] **R** [D,L] **17A4** – **L** linear actuator
RS-422/485 comm

Plus² **MLI3** [C] **C** [B] **17A4** – **L** linear actuator
CANopen comm

– **EQ**
Internal magnetic encoder with 512-line count and index mark.

– **EQ** (see above)
or
– **EE**
Plus² version only: optional inputs for differential remote encoder (not supplied). May not be combined with internal encoder.

See details at bottom of page for complete linear actuator part numbers.

1.3.1 Linear actuator options

Non-captive shaft

– L□1□ □□□ Z□

Screw lead
travel per rev
A = 0.250" (6.35mm)
B = 0.125" (3.175mm)
C = 0.063" (1.588mm)
D = 0.031" (0.794mm)

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 18.0"
in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Coating
T = teflon*
Z = none

Screw length calculation = mounting surface plate thickness + 1.40" (35.56mm) + desired stroke length

*Contact factory for availability.

External shaft

– L□3□ □□□ □ □

Screw lead
travel per rev
A = 0.250"/6.35mm
B = 0.125"/3.175mm
C = 0.063"/1.588mm
D = 0.031"/0.794mm

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 18.0"
in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Nut
G = general purpose (dynamic load limit to 25lbs/111N)
A = anti-backlash (dynamic load limit to 5lbs/22N)

Coating
T = teflon*
Z = none

Stroke length calculation =
screw length – nut length – mounting surface plate thickness

Figure 1.1 Standard product options

1.4 Documentation reference

The following User's manuals are available for the MDrive17 linear actuator:

- Product manual, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.5 Product software

The MDrive17 linear actuator motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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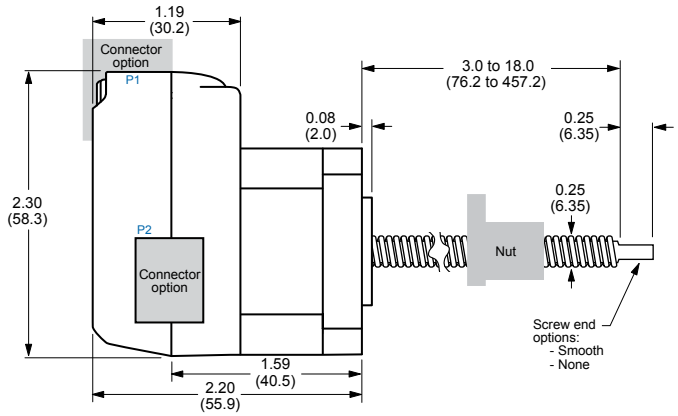
2 Specifications

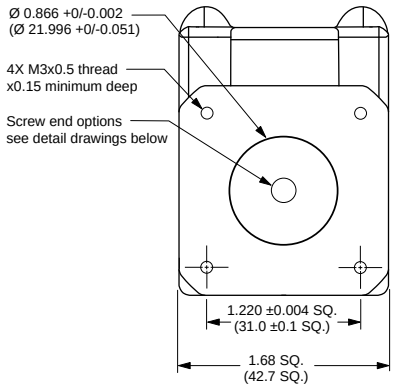
2.1 Mechanical specifications

2.1.1 External shaft

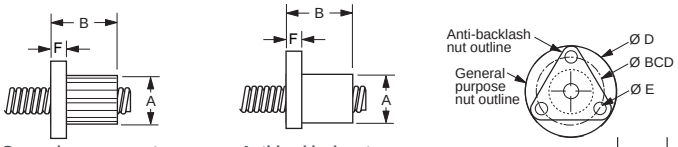
Side view



Front view



Nut detail



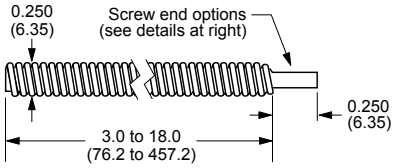
General purpose nut
Flange shape: round
Load limit: 25 lbs (11.3 kg)
Purpose: for applications not requiring anti-backlash and wear compensation.

Anti-backlash nut
Flange shape: triangle
Load limit: 5 lbs (2.3 kg)
Purpose: backlash free operation for high accuracy and low drag torque.

inches (mm)	A	B	D	E	F	BCD	*load limit*	*drag torque*
General purpose	0.50 (12.7)	0.75 (19.1)	1.0 (25.4)	0.14 (2.6)	0.15 (2.81)	0.75 (19.1)	25lbs/ 11.3kg	free wheeling
Anti-backlash	0.50 (12.7)	0.9max (22.86)	1.0 (25.4)	0.143 (2.63)	0.18 (4.57)	0.75 (19.1)	5lbs/ 2.3kg	< 1.0 oz-in < 0.7 N-cm

Screw Specifications

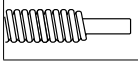
Standard Acme style rolled screw



Lead options

inches (mm)	Travel/revolution	Travel/full step
Screw A	0.250 (6.35)	0.00125 (0.0317)
Screw B	0.125 (2.175)	0.00063 (0.0158)
Screw C	0.063 (1.588)	0.00031 (0.0079)
Screw D	0.031 (0.794)	0.00016 (0.004)

Screw end options

Smooth 	Dimensions Ø 0.1967" ±0.001 (Ø 5mm ±0.003)
None	—

Screw coating

An optional teflon screw coating is available for smooth operation and extended life. *Contact factory for availability.*

Figure 2.1 External shaft mechanical specifications - dimensions in inches (mm)

Cantilevered loads

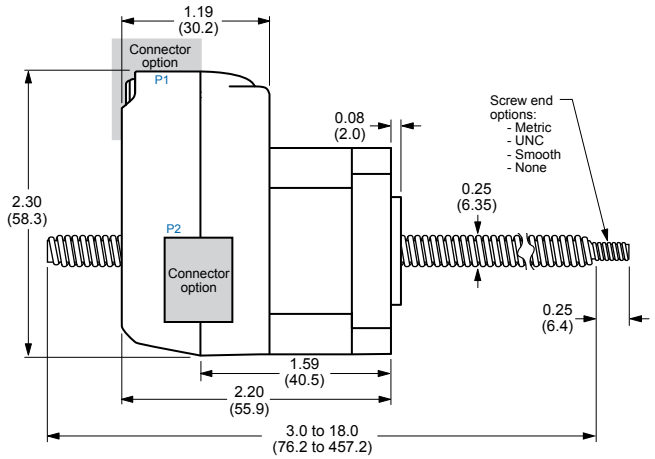
Loads for external shaft MDrive® linear actuator products MUST BE supported. Side loading is not recommended.

Calculating screw/stroke length

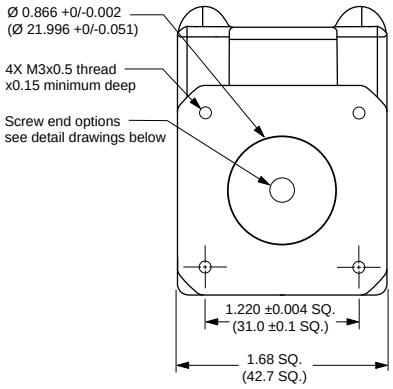
Available stroke length = [6.0" screw] – [nut length] – [mounting surface plate thickness]

2.1.1 Non-captive shaft

Side view

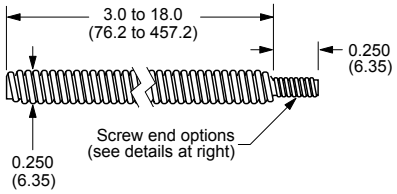


Front view



Screw Specifications

Standard Acme style rolled screw



Lead options

inches (mm)	Travel/revolution	Travel/full step
Screw A	0.250 (6.35)	0.00125 (0.0317)
Screw B	0.125 (2.175)	0.00063 (0.0158)
Screw C	0.063 (1.588)	0.00031 (0.0079)
Screw D	0.031 (0.794)	0.00016 (0.004)

Screw end options

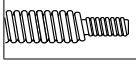
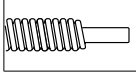
	Dimensions
Metric	M4 x 0.7mm thread to within 0.03" (0.76mm) of shoulder
UNC 	#8-32 UNC-2A thread to within 0.03" (0.76mm) of shoulder
Smooth 	Ø 0.1967" ±0.001 (Ø 5mm ±0.003)
None	—

Figure 2.2 Non-captive shaft mechanical specifications - dimensions in inches (mm)

Cantilevered loads

Unsupported loads and side loading are not recommended for non-captive shaft MDrive® linear actuator products.

Calculating screw/stroke length

Screw length = [mounting surface plate thickness] + [1.40" (35.56mm)] + [desired stroke length]]

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	—	+12	—	+48	VDC
Max power supply current	—	—	—	2.0*	A
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive17)**	—	—	—	161	mA

**per MDrive17, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications (Plus)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-4)	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs (All)	—	—	—	+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			
Clock I/O					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			

Table 2.2 Standard I/O specifications

2.2.3 Expanded I/O specifications (Plus²)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-8)	—	8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs			
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution	User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.				

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Actuator motor specifications

Holding torque		29.16 oz-in (20.6 N-cm)
Rotor inertia		0.0005 oz-in-sec^2 (0.035 kg-cm^2)
Maximum thrust	General purpose	50 lbs (222 N)
	With anti-backlash nut	25 lbs (111 N)
Maximum repeatability	General purpose	0.005” (0.127 mm)
	With anti-backlash nut	0.0005” (0.0127 mm)
Maximum screw misalignment		± 1°
Wieght without screw		9.6 oz (272.2 g)

Table 2.8 Linear actuator motor specifications

2.2.9 Speed-force performance curves

12 VDC Curves

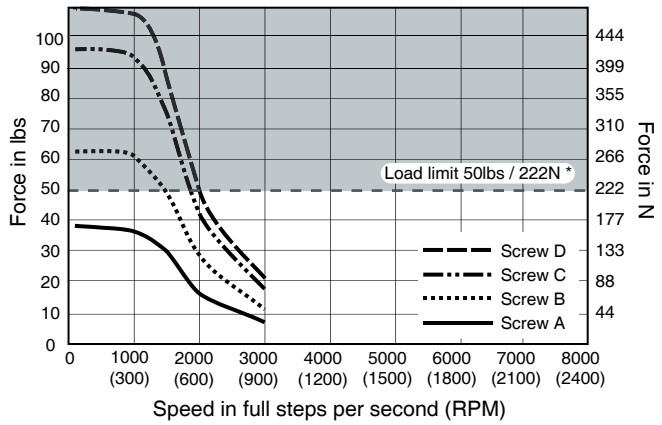


Figure 2.3 12 VDC speed-force curves

24 VDC Curves

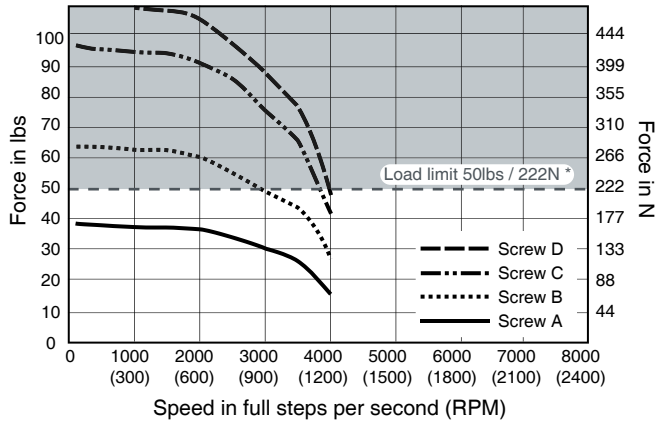


Figure 2.4 24 VDC speed-force curves

48VDC Curves

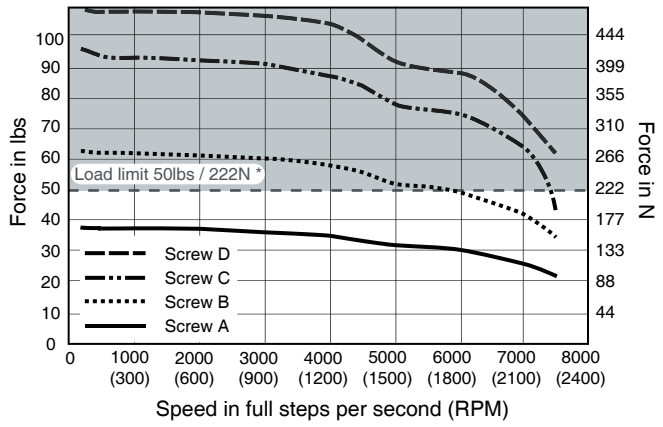
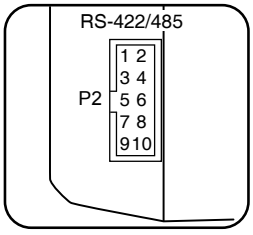


Figure 2.5 48 VDC speed-force curves

2.3 Connectivity specifications/pin assignments - Communications

2.3.1 RS-422/RS-485 communications

10-pin pressure fit IDC



Connectivity Options
USB to RS-422/485 Converter:
MD-CC400-001

Mating connector kit:
CK-01

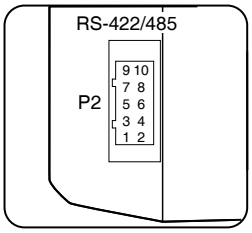
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

Ribbon cable
Tyco: 1-57051-9

Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 2.9 P2 communications, 10-pin pressure fit IDC/SAMTEC

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422/485 Converter:
MD-CC402-001

Mating connector kit:
CK-02

Mfg P/N:
Shell
Hirose DF11-10DS-2C

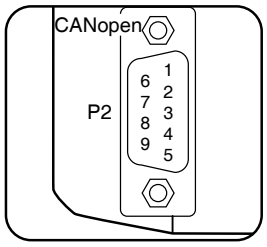
Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.10 P2 communications, 10-pin locking wire crimp

2.3.2 CANopen communications option (connector P2)

9-pin D-sub female (DB-9F)



Connectivity Options
USB to CANopen converter:
MD-CC500-000

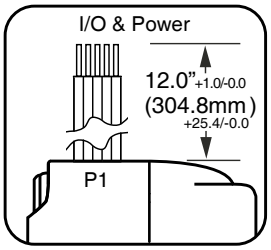
Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	VAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.11 CANopen communications, P2: 9-pin D-sub female (DB-9F)

2.4 Connectivity specifications/pin assignments - Power and I/O

2.4.1 Power and I/O - standard I/O (Plus)

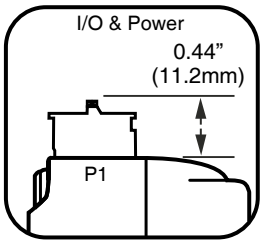
12” (304.8 mm) flying leads

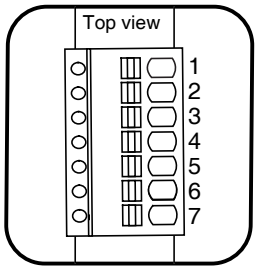


Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power and auxiliary ground
Red	+V	Motor power (+12 to +48VDC

Table 2.12 Power and I/O interface - 12” (308.8.mm) flying leads

7-pin pluggable terminal



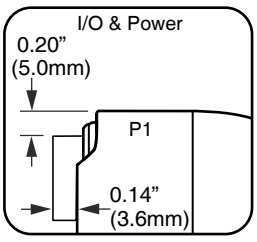


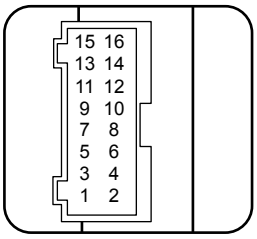
Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power (+12 to +48VDC

Table 2.13 Power and I/O interface - 7-pin pluggable terminal

2.4.2 Power and I/O - expanded I/O (Plus²)

16-pin locking wire crimp





Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

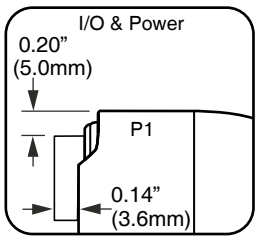
Pins
JST SPH-001T0.5L

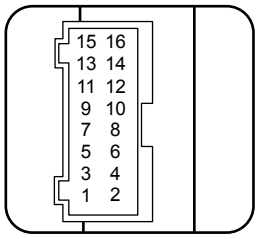
Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.14 Power and I/O interface - 16-pin locking wire crimp

.4.2 Power and I/O - remote encoder (Plus²)

16-pin locking wire crimp





Connectivity Options
Prototype development cable::
PD16-1417-FL3

Mating connector kit:
CK-10

Mfg P/N:
Shell
JST PADP-16V-1-S

Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level
15	+V	+12 to +48 VDC motor power supply input.
16	Power/aux ground	Power and auxiliary ground

Table 2.15 Power, I/O and remote encoder interface - 16-pin locking wire crimpl

3.6 Options

Internal encoder

Internal differential magnetic encoders with index mark are available with the MDrive14Plus Microstepping.

Line counts available: 100, 200, 250, 256, 400, 500, 512, 800,1000

3.7 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive linear actuator 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin IDC MD-CC400-001

P2 10-pin wire crimp MD-CC402-001

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:

P2 10-pin wire crimp PD10-1434-FL3

P1 16-pin wire crimp PD16-1417-FL3

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:

P2 10-pin wire crimp CK-02

P1 16-pin wire crimp CK-10

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

P2 10-pin IDC CK-01

3 Mounting and connection recommendations

⚠ CAUTION

LEAD RESTRAINT

Some linear actuator mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly restrained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

SCREW MISALIGNMENT

Ensure that support for the screw is in place as to not exceed the maximum misalignment of ±1°.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

CANTILEVER LOADS

Loads for external shaft MDrive linear actuator products MUST BE supported. Side loading is not recommended.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

MOUNTING SCREW TORQUE

When mounting the MDrive, do not exceed the maximum recommended tightening torque of 7.8 lb-in (9 kg-cm).

Failure to follow these instructions can result in equipment damage.

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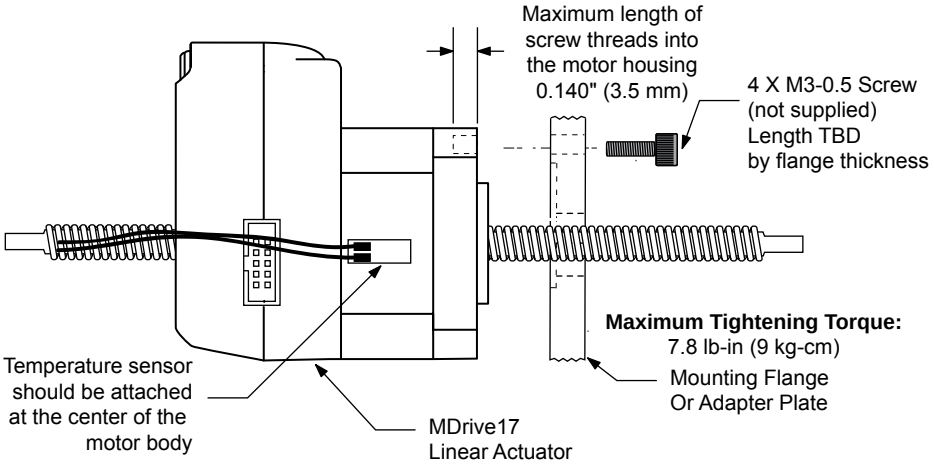
3.1 Mounting

Care must be observed when installing the mounting screws on ALL MDrive17 linear actuator versions. The mounting holes on the flange are not drilled through and have a maximum depth of 0.150” (3.81 mm).

The warning note and Figure below illustrate the maximum safe thread length and maximum torque for mounting all versions of the MDrive17 linear actuator.



Drill Pattern for Mounting Flange or Adapter Plate

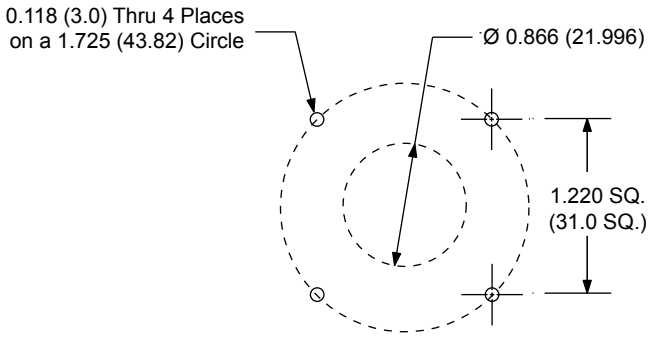


Figure 3.1 Mdrive linear actuator mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive17 need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power Supply and Motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

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3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive17:

Logic Wiring..... 22 AWG

Wire Strip Length..... 0.25” (6.0 mm)

Power and Ground .....

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2) .....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG)DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

Logic and Power

The following mating connectors are recommended for the MDrive172 Units ONLY! Please contact a JST distributor for ordering and pricing information.

16-pin Locking Wire Crimp Connector Shell JST PN PADP-16V-1-S

Crimp Pins..... JST PN SPH-001T-P0.5L

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

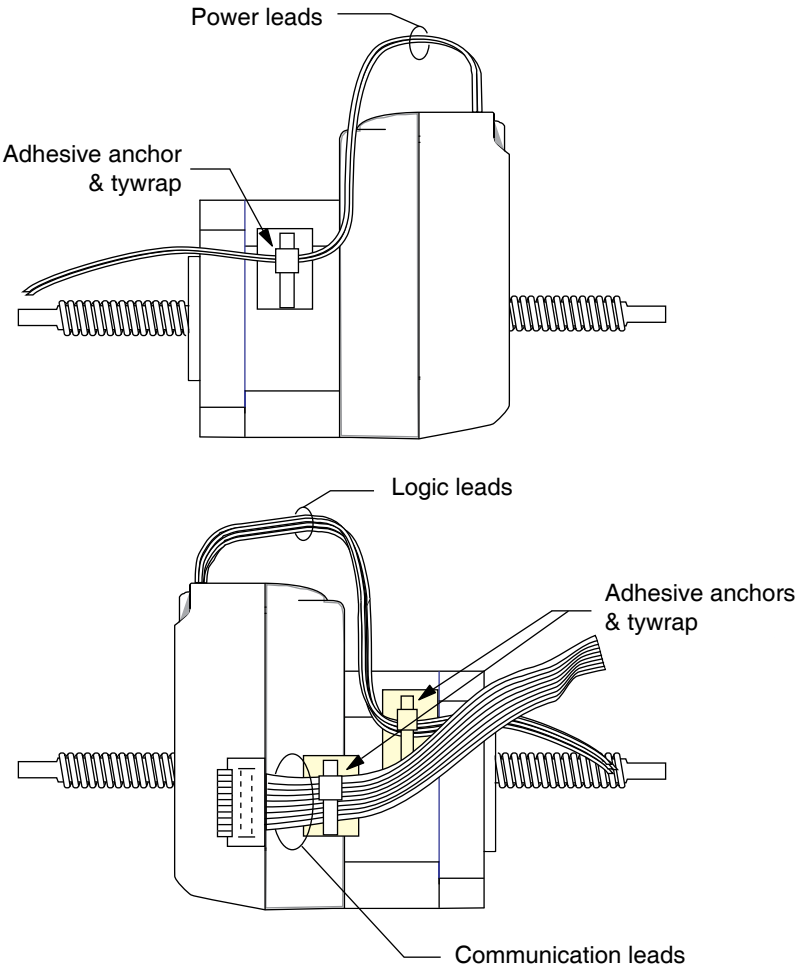

Figure 3.2 Securing leads

3.5 Anti-Backlash nut assembly and installation

3.5.1 Notes and warnings

- Do not use a wrench on the stainless steel cam of the nut.
- Do not oil the mechanism of the nut.
- Do not install the note into an interference fit bore (mechanism will not work).

3.5.2 Installation

To install threaded model nuts, simply hand tighten until shoulder is flush with mounting surface. A small amount of Loctite thread compound such as #277 can be used to prevent loosening. Alternatively, a pin can be installed to mechanically lock the threads.

Flanged models can be mounted to either the front or rear face of the flange.

Before use, it is recommended that the stainless steel preload mechanism be turned so that the caming surfaces move down the ramps. Once play is felt, allow the mechanism to slowly unwind again to establish the proper preload. (It is possible in assembly to inadvertently twist the cam creating excessive drag torque. This procedure will correct this.)

Using lubricant on the lead screw threads is recommended. This extends the life of the nut and reduces heat generation, noise and vibration. TriGEL-300S or TriGEL-1200SC is recommended.

3.5.3 Removal from screw

If it is necessary to remove the nut from your screw, you may lock the mechanism so that it can be immediately reinstalled without re-setting the preload. This can be done by wrapping tape around the junction between the stainless steel cam and the plastic nut halves. This will prevent the cam from turning when the nut is removed from screw. Remember to remove tape after installation.

For immediate transfer from one screw to another, hold the nut together between your thumb and forefinger so that it cannot expand axially. Remove the nut and install it on the second screw. It may be helpful to prevent the cam from turning with your remaining fingers as you transfer. If the nut becomes disassembled or looses its preload for any reason, follow the steps listed in the assembly procedure below.

.5.4 Assembly procedure

1) Insert spring tang into cam slot.

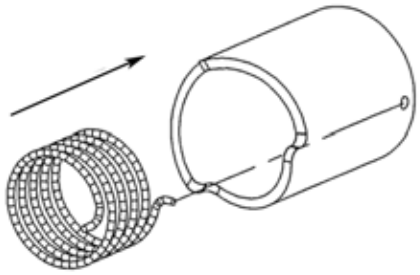

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

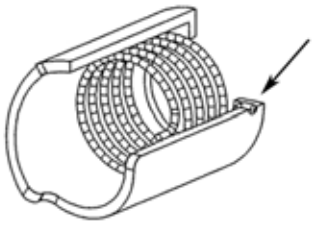

Figure 3.4 Spring engaged

3) Insert opposite tang into front nut slot or hole (dependant on size). Use the slot or hole that will allow the the cam to be positioned closest to the bottom of the ramp.

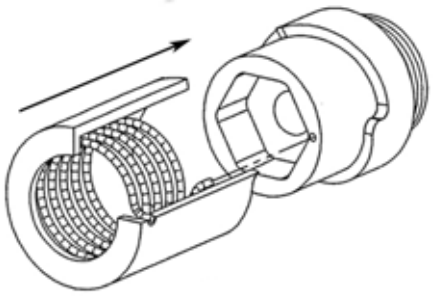

Figure 3.5 Insert opposite tang

4) With washer installed, insert the back nut into the front nut.

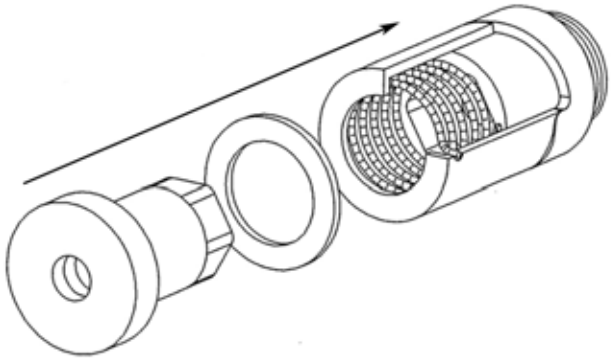

Figure 3.6 Inserting the back nut

5) With the cam held at the bottom of the ramp, thread the entire nut onto the screw starting with the front nut. After the entire nut is threaded onto the screw, release the cam to observe the gap distance (X on the drawing). The gap distance (X) should be about one-third of the full ramp distance, but no more than half.

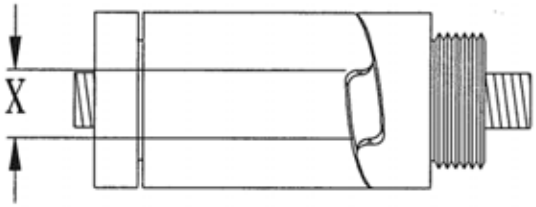

Figure 3.7 Measuring the gap distance

6) If the gap distance is incorrect, unthread the nut just enough to allow the back nut to disengage from the screw. Pull the back nut off and rotate to the next index position and reinsert back into the front nut. With the cam held at the bottom of the ramp, thread the entire nut back onto the screw. Release the cam and verify the correct gap distance. If still not correct repeat this step.

7) Once the back nut has been properly clocked to yield the correct gap distance, unthread the nut again just enough to disengage the back nut from the screw, but do not remove from the nut. Pull the cam away from the ramp and rotate in the clockwise direction for two ramp settings, then hold the cam at the bottom of the second ramp. Be careful not to allow the back nut to rotate with respect to the front nut while completing this task. With the cam held at the bottom of the second ramp, push the back nut into the front nut and thread the entire nut onto the screw.

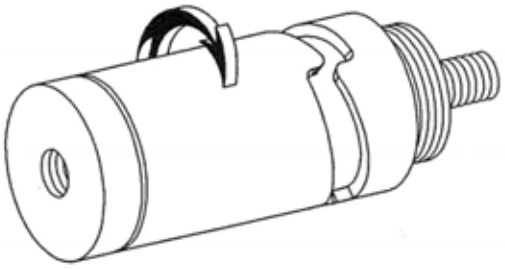

Figure 3.8 Pre-loading the nut

8) The anti-backlash nut is now pre-loaded and fully assembled.

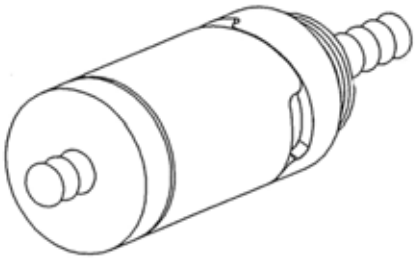

Figure 3.9 Nut pre-loaded and fully assembled

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing communications

Communications interface, connector pin configuration and specifications are common to all NEMA sizes of the MDrive linear actuator. Connectivity information is located in Part 1 of this document, Section 1.4

4.2 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

⚠ CAUTION

OVER VOLTAGE

The DC voltage range for the MDrive17 linear actuator is +12 to +48 VDC. Ensure that motor back EMF is factored into your power supply size calculations.

Allow 2.0 A maximum power supply output current per MDrive17 in the system. Actual power supply current will depend on voltage and load.

Failure to follow these instructions can result in equipment damage.

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4.2.1 Recommended IMS power supplies

IP402 Unregulated Linear Supply

Input Range

120 VAC Versions ..... 102-132 VAC

240 VAC Versions ..... 204-264 VAC

Output (All Measurements were taken at 25˚C, 120 VAC, 60 Hz)

No Load Output Voltage .....39 VDC @ 0 Amps

Continuous Output Rating .....30 VDC @ 1.0 Amps

Peak Output Rating .....25 VDC @ 2.0 Amps

IP404 Unregulated Linear Supply

Input Range

120 VAC Versions ..... 102-132 VAC

240 VAC Versions ..... 204-264 VAC

Output (All Measurements were taken at 25˚C, 120 VAC, 60 Hz)

No Load Output Voltage .....43 VDC @ 0 Amps

Continuous Output Rating .....32 VDC @ 1.5 Amps

Peak Output Rating .....26 VDC @ 3 Amps

ISP200-4 Unregulated Switching Supply

Input Range

120 VAC Versions ..... 102-132 VAC

240 VAC Versions ..... 204-264 VAC

Output (All Measurements were taken at 25˚C, 120 VAC, 60 Hz)

No Load Output Voltage .....41 VDC @ 0 Amps

Continuous Output Rating .....38 VDC @ 1.5 Amps

Peak Output Rating ..... 35 VDC @ 3 Amp

4.2.2 Recommended wire gauge

1 Ampere (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	20	18	18	16
2 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	18	16	14	14

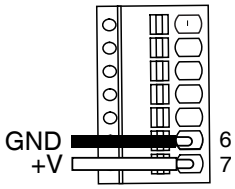
Table 4.1 Recommended power supply wire gauge

4.2.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	+12 to + 48 VDC
Black	Power and auxiliary ground

Table 4.2 Power and ground connections, flying leads

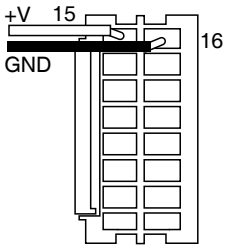
4.2.4 P1 — 7-pin pluggable terminal interface



Pin Numbers	
6	Power and auxiliary ground
7	+12 to + 48 VDC

Table 4.3 Power and ground connections, 7-pin terminal

4.2.5 P1 — 16-pin locking wire crimp interface



Pin Numbers	*Signal*	*Prototype development cable wire colors*
15	+12 to + 48 VDC	Red
16	Power and auxiliary ground	Black

Table 4.4 Power and ground connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10’/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L

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4.3 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O points are TTL level and only tolerant to +5 VDC:

1) Step Clock
2) Direction
3) Capture/Trip
4) Remote encoder inputs

Do not exceed +5 VDC on these points.

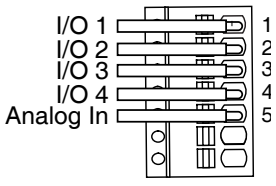
Failure to follow these instructions can result in equipment damage.

4.3.1 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	*Signal*
White/yellow	General purpose I/O 1
White/orange	General purpose I/O 2
White/violet	General purpose I/O 3
White/blue	General purpose I/O 4
Green	Analog input

Table 4.5 I/O connections, flying leads

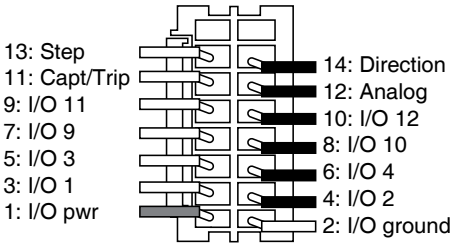
4.3.2 P1 — 7-pin pluggable terminal interface



Pin number	*Signal*
1	General purpose I/O 1
2	General purpose I/O 2
3	General purpose I/O 3
4	General purpose I/O 4
5	Analog input

Table 4.6 I/O connections, 7-pin terminal

4.3.3 P1 — 16-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.7 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-16V-1-S

Pins..... SPH-001T0.5L

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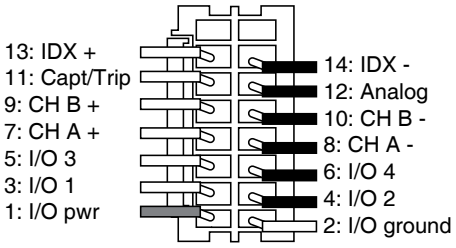
4.3.4 P1 — 16-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.7 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-10
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD16-1417-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-16V-1-S

Pins..... SPH-001T0.5L

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4.4 Connectivity accessory details

4.4.1 RS-422/485 communications converter cables

USB to 10-pin IDC connector P2
P/N: MD-CC400-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

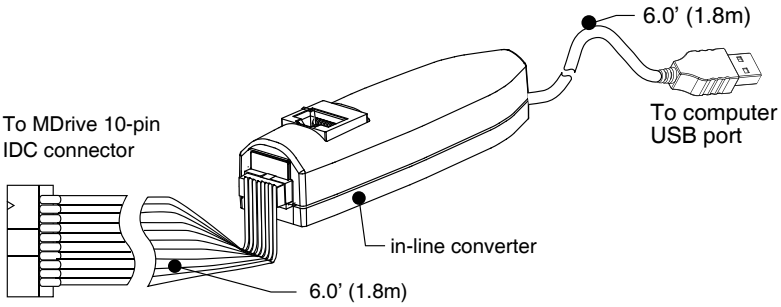


Figure 4.1 MD-CC400-000 communications converter cable

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

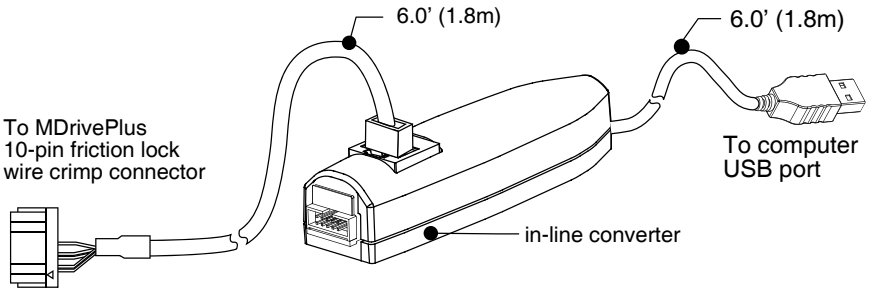
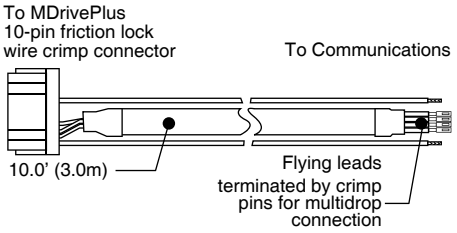


Figure 4.2 MD-CC402-001 communications converter cable

4.4.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

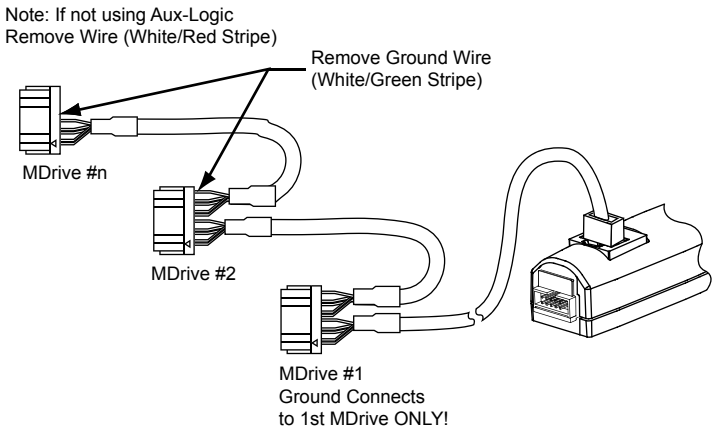
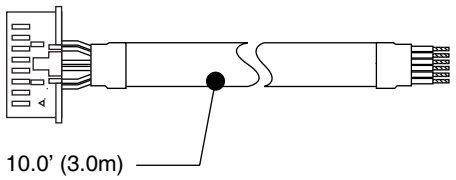


Figure 4.3 Multi-drop communications using the PD10-1434-FL3

Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

The PD16-1417-FL3 prototype development cable is used to rapidly interface the MDrive17 to the users controller. This 10’ (3.0 m) cable consists of a 16-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to power, i/o and/or remote encoder.



Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	White	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power
8	Black	Power GND	Power GND
	Red	+V	+V

Figure 4.4 Prototype development cable PD16-1417-FL3

4.4.3 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:

P2 10-pin wire crimp.....CK-02

P1 16-pin wire crimp.....CK-10

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

P2 10-pin IDC.....CK-01

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MDrive® 23 Linear Actuator

Motion Control

CE RoHS

1. Introduction
2. Specifications
3. Mounting Recommendations
4. Interface and Connectivity

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1 Introduction

MDrive® linear actuators combine leading all-in-one integrated motion technology with linear motion to deliver high accuracy, unsurpassed repeatability and long life, all in a package that is extremely compact and affordable.

1.1 MDrive 23 linear actuator unit overview

1.1.1 Linear actuator styles

Two (2) linear actuator styles of MDrive 23 integrated motor + driver solutions are available:

- **Non-captive shaft** — a screw runs through the MDrive and moves axially as the motor rotates
- **External shaft** — a rotating screw, integral to the motor shaft, moves a screw-mounted nut axially

Precision rolled lead screws used with MDrive linear actuators are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel and available with optional coating.

1.1.2 MDrive 23 linear versions

Three (2) MDrive 23 integrated versions provide a choice of features and capabilities:

- **Microstepping** — motor + driver
- **Motion Control** — motor + driver + controller

MDrive14 linear actuators feature high torque 1.8° brushless NEMA 23 single length step motors with integrated electronics, providing the leading technology solution for all-in-one linear motion applications.

Unsurpassed smoothness and performance delivered by MDrive 23 products 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 MDrive 23 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 cable runs and multiple drive systems. An extended operating range of –40° to +85°C provides long life, trouble free service in demanding environments.mapping and extended node identifier.

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

Revision R031610

1.2 Product identification

P1

I/O & power connectors:
F = flying leads
P = pluggable terminal
C = locking wire crimp

P2

Communication connectors:
D = 10-pin IDC
L = 10-pin friction lock wire crimp
B = DB9, only with CANopen Comm

Optional encoder
For NO encoder, omit any –E specification from part number

P1 P2

MLI1 [F,P] **R** [D,L] **23A7** – **EQ** – **L** [linear actuator]
RS-422/485 comm

MLI1 [F,P] **C** [B] **23A7** – **L** [linear actuator]
CANopen comm

Internal magnetic encoder with 512-line count and index mark.

Plus² **MLI3** [C] **R** [D,L] **23A7** – **EQ** (see above) or – **EE** – **L** [linear actuator]
RS-422/485 comm

Plus² **MLI3** [C] **C** [B] **23A7** – **L** [linear actuator]
CANopen comm

Plus² version only: optional inputs for differential remote encoder (not supplied). May not be combined with internal encoder.

See details at bottom of page for complete linear actuator part numbers.

Non-captive shaft

– L□1□ □□□ Z□

Screw lead
travel per rev
G = 0.375" (9.525mm)
A = 0.200" (5.08mm)
B = 0.167" (4.233mm)
D = 0.083" (2.116mm)

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 24.0"
in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Coating
T = teflon*
Z = none

Screw length calculation = desired stroke length + 1.8" (45.7mm) + mounting surface plate thickness

External shaft

– L□3□ □□□□ □

Screw lead
travel per rev
G = 0.375" (9.525mm)
A = 0.200" (5.08mm)
B = 0.167" (4.233mm)
D = 0.083" (2.116mm)

Screw end
M = metric
U = UNC
S = smooth
Z = none

Screw length
3.0 to 24.0"
in 0.1 increments
ex. 12.5" = 125
10.0" = 100

Nut
G = general purpose (dynamic load limit to 60lbs/22kg)
A = anti-backlash (dynamic load limit to 25lbs/11kg)

Coating
T = teflon*
Z = none

Screw length calculation = desired stroke length + nut length + mounting surface plate thickness

Figure 1.1 Standard product options

1.3 Documentation reference

The following User's manuals are available:

- Product manual, describes the technical data, installation, configuration and programming of the product.
- Quick Reference, describes the basic wiring, connection and use of this product. The quick reference is shipped in printed form with the product.

This documentation is also available for download from the IMS web site at http://www.imshome.com

1.4 Product software

The MDrive 23 Linear Actuator motion control integrated motor and driver may be programmed using any standard ASCII txt editor and ANSI terminal emulated. The recommended environment is the IMS Terminal Interface, which is a combined terminal/program editor tailored for use with IMS motion control products. This free software may be downloaded from http://www.imshome.com/software_interfaces.html.

Installation and usages instructions are to be found in the MCode Programming Manual, which is correlated to this document.

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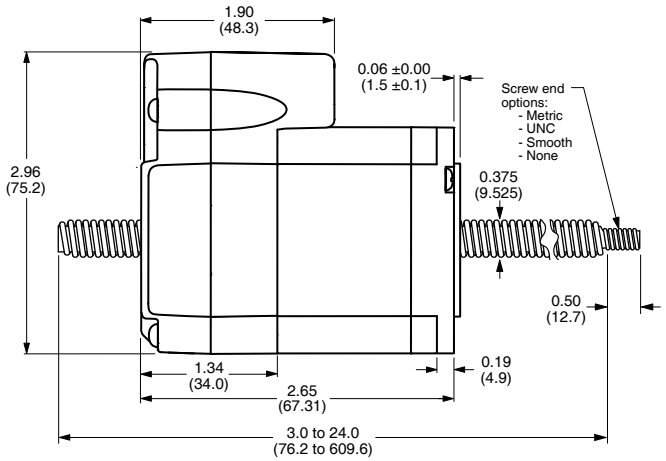
2 Specifications

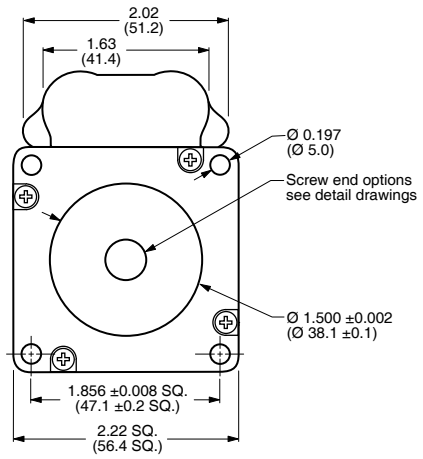
2.1 Mechanical specifications

2.1.1 Non-Captive Shaft

Side view



Front view



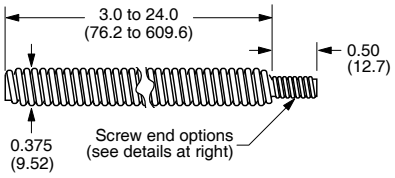
Load limit
Nominal load limit: 200 lbs (91 kg)

Screw specifications

Screw material
MDrive Linear Actuator precision rolled lead screws are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel.

Screw coating
An optional teflon screw coating is available for smooth operation and extended life.

Standard screw
Dimensions in inches (mm)



Lead options

inches (mm)	Travel/revolution		Travel/full step	
Screw G	0.3750	(9.525)	0.001875	(0.0476)
Screw A	0.200	(5.08)	0.001	(0.0254)
Screw B	0.1670	(4.233)	0.000835	(0.0212)
Screw D	0.0833	(2.116)	0.0004165	(0.0106)

Screw end options

Threaded end	Metric end: M6 x 1.0mm thread to within 0.03" (0.76mm) of shoulder	UNC end: 1/4-20 UNC-2A thread to within 0.05" (1.3mm) of shoulder
Smooth end	Ø 0.2362" ±0.001 (Ø 6mm ±0.003)	
None	—	

Cantilevered loads

Unsupported loads and side loading are not recommended for non-captive shaft MDrive® linear actuator products.

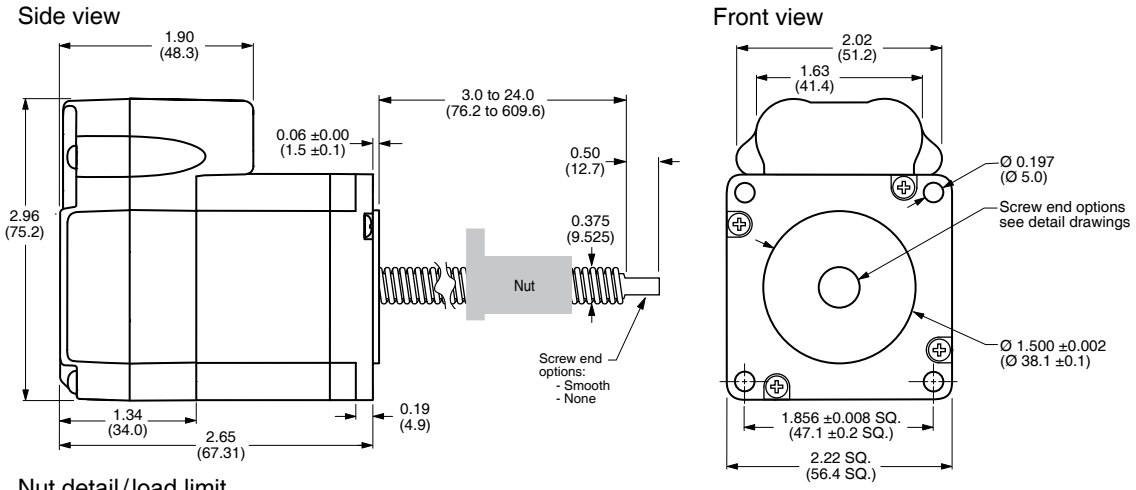
Calculating screw length

Screw length = [mounting surface plate thickness] + [1.8" (45.7mm)] + [desired stroke length]

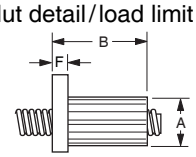
Figure 2.1 Non-captive shsft mechanical specifications

2.1.2 External Shaft

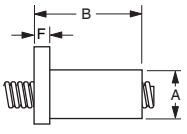
2.1.2 External Shaft



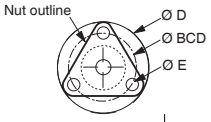
Nut detail / load limit



General purpose nut
Flange shape: round
Load limit: 60 lbs (27 kg)
Purpose: for applications not requiring anti-backlash and wear compensation.



Anti-backlash nut
Flange shape: triangle
Load limit: 25 lbs (11 kg)
Purpose: backlash free operation for high accuracy and low drag torque.



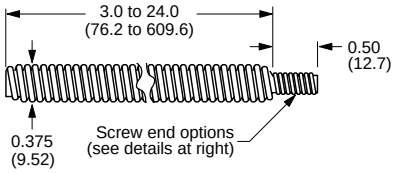
inches (mm)	A	B	D	E	F	BCD	*load limit*	*drag torque*
General purpose	0.71 (18.0)	1.50 (38.1)	1.5 (38.1)	0.20 (5.08)	0.20 (5.08)	1.125 (28.6)	60lbs/ 27kg	free wheeling
Anti-backlash	0.82 (20.8)	1.875 (47.63) max	1.5 (38.1)	0.20 (5.08)	0.20 (5.08)	1.125 (28.6)	25lbs/ 11kg	1–3

Screw specifications

Screw material
MDrive Linear Actuator precision rolled lead screws are corrosion resistant and non-magnetic, manufactured from premium grade stainless steel.

Screw coating
An optional teflon screw coating is available for smooth operation and extended life.

Standard screw
Dimensions in inches (mm)



Lead options

inches (mm)	Travel/revolution		Travel/full step	
Screw G	0.3750	(9.525)	0.001875	(0.0476)
Screw A	0.200	(5.08)	0.001	(0.0254)
Screw B	0.1670	(4.233)	0.000835	(0.0212)
Screw D	0.0833	(2.116)	0.0004165	(0.0106)

Screw end options

Threaded end	Metric end: M6 x 1.0mm thread to within 0.03" (0.76mm) of shoulder	UNC end: 1/4-20 UNC-2A thread to within 0.05" (1.3mm) of shoulder
Smooth end	Ø 0.2362" ±0.001 (Ø 6mm ±0.003)	
None	—	

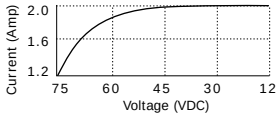
Cantilevered loads
Loads for external shaft MDrive® linear actuator products MUST BE supported. Side loading is not recommended.

Calculating stroke length
Available stroke length = [screw length] – [nut length] – [mounting surface plate thickness]

Figure 2.2 Sealed mechanical specifications

2.2 General specifications

2.2.1 Electrical specifications

	Condition	Min	Typ	Max	Unit
Input voltage range	Single, double and triple lengthe motors	+12	—	+75	VDC
Max power supply current*	Single length motors				
Aux-Logic Input Voltage	—	+12	—	+24	VDC
Max Aux-Logic Supply Current (Per MDrive)**	—	—	—	194	mA

**per MDrive 23, Actual current depends on voltage and load.*
*** Maintains power to control and feedback circuits [only] when input voltage is removed*

Table 2.1 Electrical specifications

2.2.2 Standard I/O specifications (plus)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-4)	—	4 I/O points configurable as sinking or sourcing inputs or sinking outputs			
General Purpose I/O - Electrical					
Inputs	—	TTL	—	+24	VDC
Sinking Outputs (All)	—	—	—	+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Logic Threshold	Logic 0	—	—	< 0.8	VDC
	Logic 1	—	—	> 2.2	VDC
Protection	Sinking	Over temp, short circuit			
	Sourcing	Transient Over Voltage, Inductive Clamp			
Analog Input					
Resolution	—				
Range	Voltage Mode	0 to +5 VDC, 0 to +10 VDC			
	Current Mode	4 to 20 mA, 0 to 20mA			
Clock I/O					
Types	—	Step/Direction, Up/Down, Quadrature			
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			
Trip Output/Capture Input					
Logic Threshold	—	+5 VDC TTL Input, TTL Output (with 2 kΩ Load to Ground			

Table 2.2 I/O specifications

2.2.3 Expanded I/O specifications (Plus²)

	Condition	Min	Typ	Max	Unit
General Purpose I/O - Number and Type					
Plus (I/O Points 1-8)	—	8 I/O points (4 if configured for remote encoder) configurable as sinking or sourcing inputs or outputs			
General Purpose I/O - Electrical					
Inputs	Sinking or Sourcing	TTL	—	+24	VDC
Outputs	Sinking	—	—	+24	VDC
	Sourcing	+12		+24	VDC
Output Sink Current (Plus)	One channel	—	—	600	mA
Motion I/O					
Electronic gearing	Range	0.001	—	2.000	
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Secondary clock out ratio				1:1
High speed position capture	Filter range			50 nS to 12.9 µS (10 MHz to 38.8 kHz	
	Resolution	—	—	32	bit
High speed trip output	Speed	—	—	150	nS
	Resolution	—	—	32	bit
	Threshold	—	—	TTL	VDC
Optional remote encoder (closed loop)*					
Type				User supplied differential encoder	
Steps per revolution				See motion specifications table	
Resolution	User defined . Note: microsteps/rev = 2X the encoder counts/rev minimum.				

**Remote encoder inputs replace I/O points 4-8 and step and direction I/O*

Table 2.3 Expanded I/O specifications

2.2.4 Communications specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
CANopen (optional)					
Type					2.0B active
BAUD rate	—	10 kHz	—	1 MHz	—
Application layer	Version 3.0				DS-301
Device profile	Version 2.0				DSP-402
ID	—				11 or 29 bit
Isolation	—				Galvanic

Table 2.4 Communications specifications

2.2.5 Thermal specifications

		Min	Typ	Max	Unit
Heat sink temperature	non-condensing humidity	-40	—	+85	ºC
Motor temperature	non-condensing humidity	-40	—	+100	ºC

Table 2.5 Thermal specifications

2.2.6 Motion specifications

Microstep Resolution - Open Loop	
Number of microstep resolutions	20

Available microsteps per revolution

200	400	800	1000	1600	2000	3200	5000	6400	10000
12800	20000	25000	25600	40000	50000	51200	36000[1]	21600[2]	25400[3]

1=0.01 deg/µstep 2=1 arc minute/µstep *3=0.001 mm/µstep
** 1" per revolution lead screw*

Microstep resolution (closed loop configuration - (optional)	
Steps Per Revolution (Fixed)	51200
Position Resolution	2048
Optional differential encoder (internally mounted)	
Type	Internal, Magnetic
Resolution (Lines)	512
Resolution (Edges)	2048
Counters	
Counter 1 (C1) Type	Position
Counter 2 (C2) Type	Encoder
Resolution	32 bit
Maximum Edge Rate	5 MHz
Velocity	
Range	±5,000,000 Steps/Sec.
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specifications

2.2.7 Software specifications

Program Storage Type/Size	Flash/6384 Bytes
User Registers	(4) 32 Bit
User Program Labels and Variables	192
Math, Logic and Conditional Functions	+, -, x, ÷, <, >, =, ≤, ≥, AND, OR, XOR, NOT
Branch Functions	Branch and Call (Conditional)
Party Mode Addresses	62
Encoder Functions	Stall Detect, Position Maintenance, Find Index
Predefined I/O Functions	
Input Functions	Home, Limit+, Limit -, Go, Stop, Pause, Jog+, Jog-, Analog Input
Output Functions	Moving, Fault, Stall, Velocity Changing
Trip Functions	Trip on Input, Trip on Position, Trip on Time, Trip Capture

Table 2.7 Software specifications

2.2.8 Motor specifications

Holding torque		90 oz-in (64 N-cm)
Rotor inertia		0.0025 oz-in-sec^2 (0.18 kg-cm^2)
Maximum thrust (Non-captive)	General purpose	200 lbs (91 kg)
	With anti-backlash nut	—
Maximum thrust (External)	General purpose	60 lbs (27 kg)
	With anti-backlash nut	25 lbs (11 kg)
Maximum repeatability (Non-captive)	General purpose	0.005” (0.127 mm)
	With anti-backlash nut	—
Maximum repeatability (External)	General purpose	0.005” (0.127mm)
	With anti-backlash nut	0.0005” (0.0127 mm)
Maximum screw misalignment		± 1°
Wieght without screw		22.0 oz (625.0 g)

Table 2.8 MDrive 23 linear actuator specifications

2.2.9 Speed-force performance curves

+24 VDC

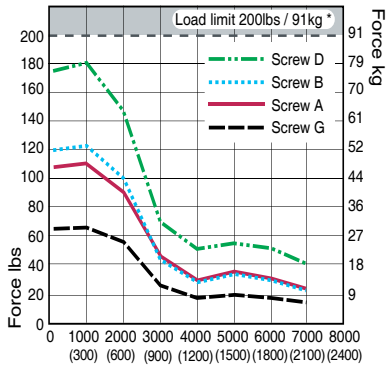


Figure 2.3 Motor performance curve — +24 VDC

+48 VDC

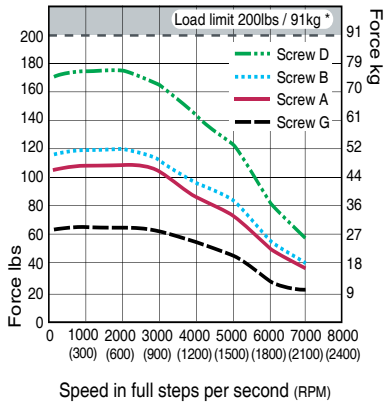


Figure 2.4 Motor performance curve — +48 VDC

+75 VDC

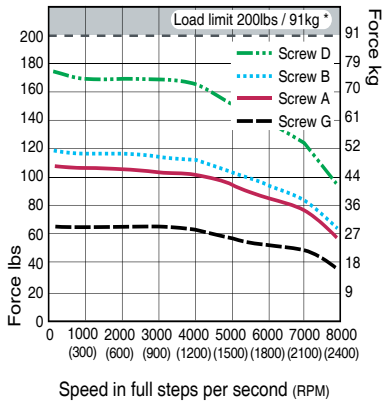
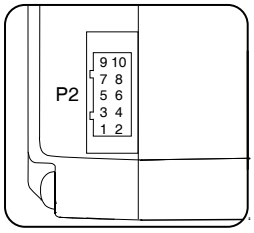


Figure 2.5 Motor performance curve — +75 VDCr

2.3 Connectivity specifications/pin assignments — Communications

2.3.1 RS-422/485 communications

10-pin friction lock wire crimp



Connectivity Options
USB to RS-422/485 Converter:
MD-CC402-001

Mating connector kit:
CK-02

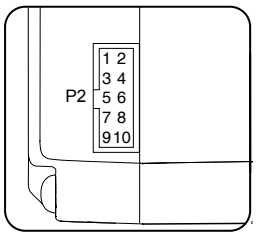
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 2.9 P2 communications, 10-pin locking wire crimp

10-pin press-fit (IDC style)



Connectivity Options
USB to RS-422/485 Converter:
MD-CC400-001

Mating connector kit:
CK-01

Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

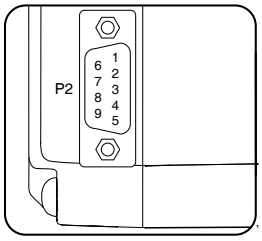
Ribbon cable
Tyco: 1-57051-9

Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communications, 10-pin pressure fit IDC/SAMTEC

2.3.2 CANopen communications option

9-pin D-sub female (DB-9F)



Connectivity Options
USB to CANopen converter:
MD-CC500-000

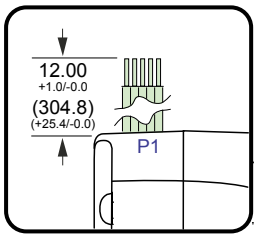
Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.11 CANopen communications, P2: 9-pin D-sub female (DB-9F)

2.4 Connectivity specifications/pin assignments - Power and I/O

2.4.1 Power and I/O - standard I/O (Plus)

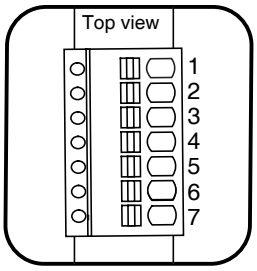
12” (304.8 mm) flying leads



Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power and auxiliary ground
Red	+V	Motor power

Table 2.12 Power and I/O interface - 12” (308.8.mm) flying leads

7-pin pluggable terminal

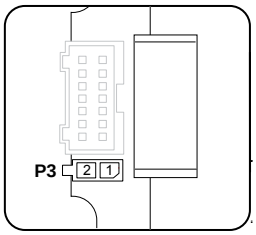


Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power

Table 2.13 Power and I/O interface - 7-pin pluggable terminal

2.4.2 DC motor power

2-pin friction lock wire crimp



Pin #	Function	Description
1	+V	+12 to +60 VDC motor power
2	Ground	Power supply return (ground)

Table 2.14 P3 DC power, 2-pin locking wire crimp

Connectivity Options
Prototype development cable *PD-02-2300-FL3*

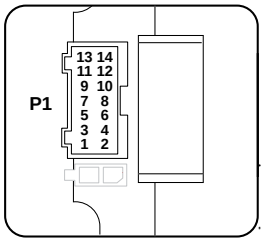
Mating connector kit:
CK-04

Mfg P/N:
Shell
Tyco 794617-2

Pins
Tyco 794610-1

2.4.3 I/O - expanded I/O (Plus²)

14-pin locking wire crimp



Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	I/O 9	0 to +24 VDC Programmable I/O Point 9
8	I/O 10	0 to +24 VDC Programmable I/O Point 10
9	I/O 11	0 to +24 VDC Programmable I/O Point 11
10	I/O 12	0 to +24 VDC Programmable I/O Point 12
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input
13	Step/clock I/O	Step clock i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.
14	Direction/ clock I/O	Direction i/o. Can also be configured as quadrature or clock up/down. +5 VDC logic level.

Table 2.15 P1 Expanded I/O, 14-pin locking wire crimp

Connectivity Options
Prototype development cable:: *PD14-2334-FL3*

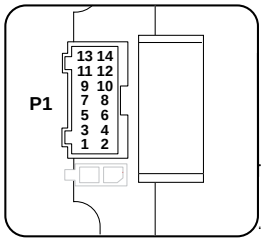
Mating connector kit:
CK-09

Mfg P/N:
Shell
JST PADP-14V-1-S

Pins
JST SPH-001T0.5L

2.4.4 I/O - remote encoder (Plus²)

16-pin locking wire crimp



Connectivity Options
Prototype development cable::
PD14-2334-FL3

Mating connector kit:
CK-09

Mfg P/N:
Shell
JST PADP-14V-1-S

Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 VDC Programmable I/O Point 4
7	CH A+	Channel A+ encoder input. +5 VDC logic level
8	CH A-	Channel A- encoder input. +5 VDC logic level
9	CH B+	Channel B+ encoder input. +5 VDC logic level
10	CH B-	Channel B- encoder input. +5 VDC logic level
11	Capture/trip I/O	High Speed Capture Input or Trip Output. +5 VDC Logic Level.
12	Analog in	0 to 10 V / 4 to 20 mA / 0 to 20 mA Analog Input.
13	IDX+	Index mark + encoder input. +5 VDC logic level
14	IDX-	Index mark - encoder input. +5 VDC logic level

Table 2.16 I/O and remote encoder interface - 16-pin locking wire crimpl

2.5 Options

Internal encoder

Internal differential magnetic 512 line differential encoders with index mark are available:

Remote Encoder (Plus2 versions only)

MDrive 23 Linear Actuator Motion Control versions are available with differential encoder inputs for use with a remote encoder (not supplied).

2.6 Connectivity

QuickStart kit

For rapid design verifi cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 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 MDrive product via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

P2 10-pin pressure-fit IDC MD-CC400-001

P2 10-pin wire crimp MD-CC402-001

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:

P2 10-pin wire crimp PD10-1434-FL3

P1 14-pin wire crimp PD14-2334-FL3

P3 2-pin wire crimp PD02-2300-FL3

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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 14-pin wire crimp CK-09

P3 2-pin wire crimp CK-04

Revision R031610

3 Mounting and connection recommendations

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

LEAD RESTRAINT

Some MDrive mounting configurations require that the MDrive move along the screw. Ensure that all cabling is properly re-strained to provide strain relief on connection points..

Failure to follow these instructions can result in equipment damage.

⚠ CAUTION

THERMAL MANAGEMENT

The mounting plate material should offer sufficient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

Revision R031610

3.1 Mounting

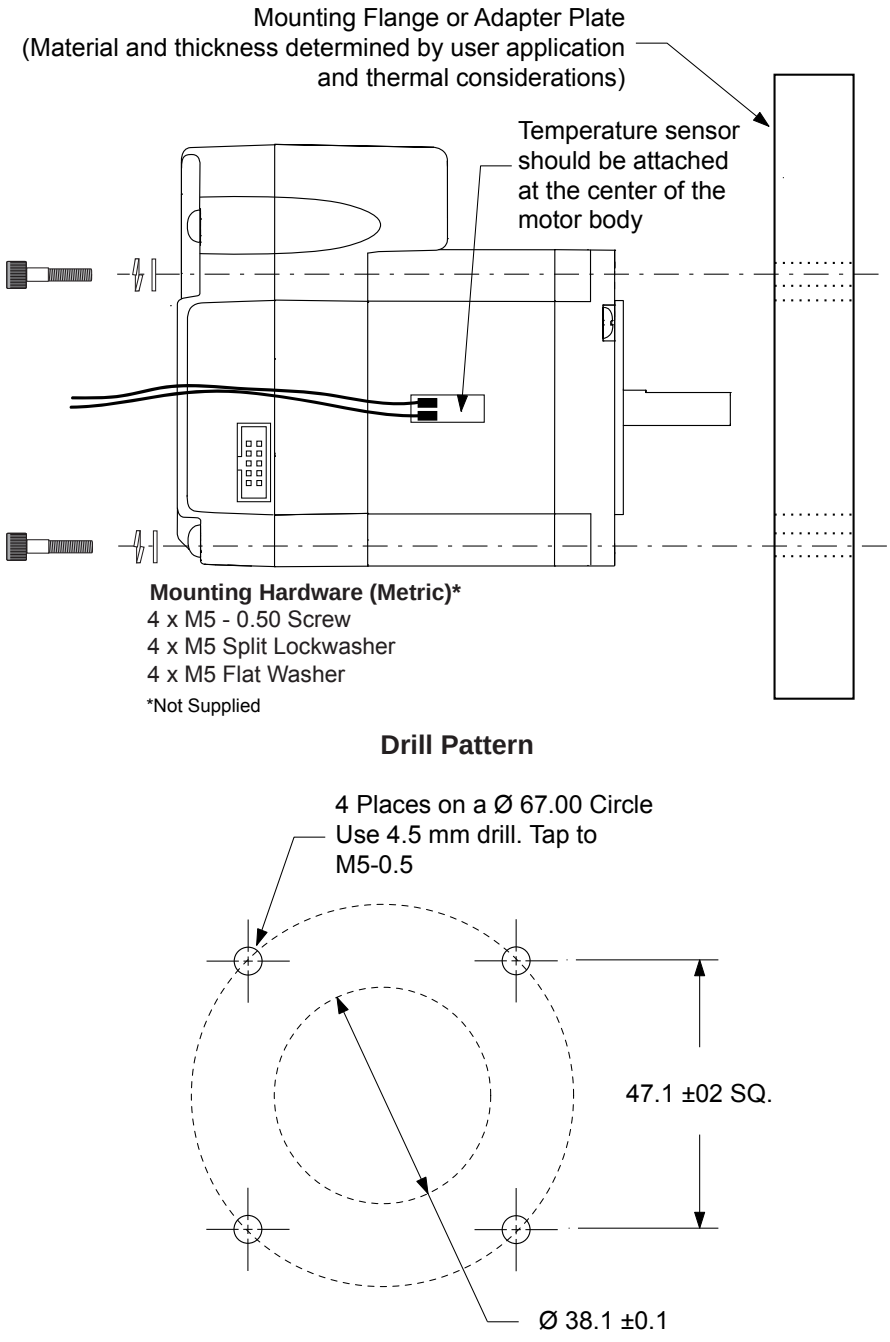


Figure 3.1 MDrive 23 mounting and drill pattern

3.2 Layout and interface guidelines

Logic level cables must not run parallel to power cables. Power cables will introduce noise into the logic level cables and make your system unreliable.

Logic level cables must be shielded to reduce the chance of EMI induced noise. The shield needs to be grounded at the signal source to earth. The other end of the shield must not be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the MDrive need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

3.2.1 Rules of wiring

- Power supply and motor wiring should be shielded twisted pairs, and run separately from signal-carrying wires.
- A minimum of one twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20 gauge, or for distances of more than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs of 18 gauge for less than 4 amps DC and 16 gauge for more than 4 amps DC.

3.2.2 Rules of shielding

- The shield must be tied to zero-signal reference potential. It is necessary that the signal be earthed or grounded, for the shield to become earthed or grounded. Earthing or grounding the shield is not effective if the signal is not earthed or grounded.
- Do not assume that Earth ground is a true Earth ground. Depending on the distance from the main power cabinet, it may be necessary to sink a ground rod at the critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield; however, the second shield is tied to ground at both ends.

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3.3 Recommended wiring

The following wiring/cabling is recommended for use with the MDrive 23:

Logic Wiring.....22 AWG

Wire Strip Length.....0.25” (6.0 mm)

Power and Ground .....See Table 3.2 in Part 1, Section 3 of this document

3.3.1 Recommended mating connectors and pins

Communications

10-pin Friction Lock (P2).....Hirose DF11-10DS-2C

Crimp Contact for 10-pin Friction Lock (22 AWG)..... DF11-22SC

Crimp Contact for 10-pin Friction Lock (24 - 28 AWG) DF11-2428SC

Crimp Contact for 10-pin Friction Lock (30 AWG)..... DF11-30SC

I/O

The following mating connectors are recommended for the MDrive 23 Units ONLY! Please contact a JST distributor for ordering and pricing information.

14-pin Locking Wire Crimp Connector Shell.....JST PN PADP-14V-1-S

Crimp Pins.....JST PN SPH-001T-P0.5L

Power

2-pin Locking Wire Crimp Connector Shell.....Tyco 794617-2

Crimp Pins.....Tyco 794610-1

3.4 Securing power leads and logic leads

Some applications may require that the MDrive move with the axis motion. If this is a requirement of your application, the motor leads (flying, pluggable or threaded) must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrive.

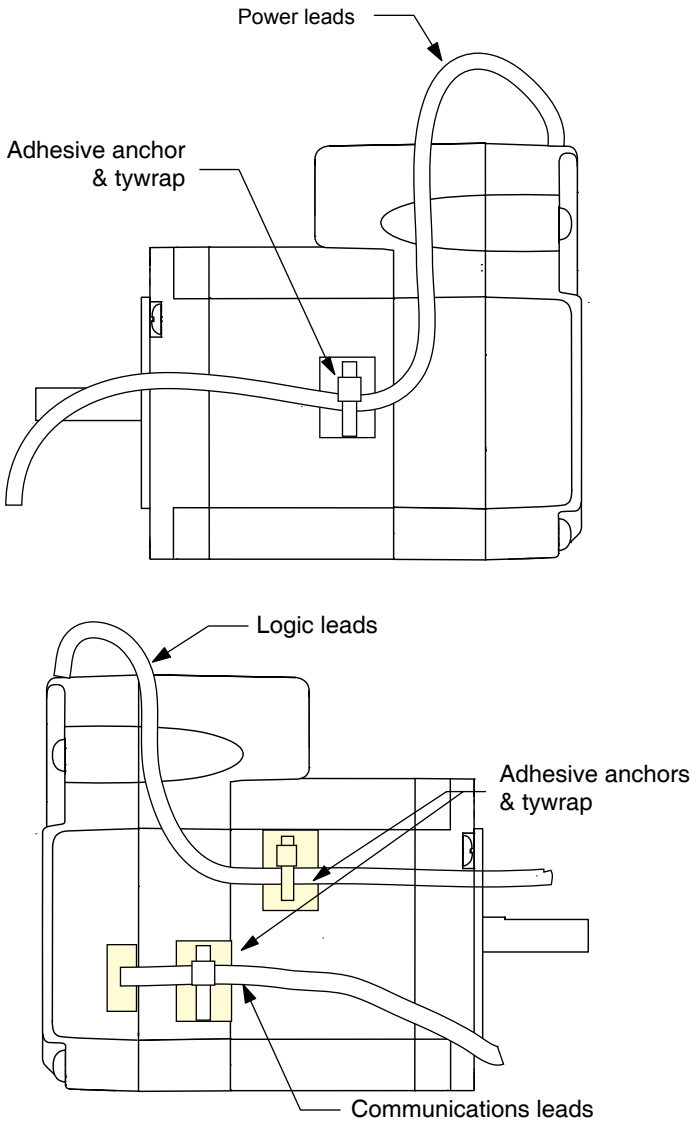

Figure 3.2 Securing leads

3.5 Anti-Backlash nut assembly and installation

3.5.1 Notes and warnings

- Do not use a wrench on the stainless steel cam of the nut.
- Do not oil the mechanism of the nut.
- Do not install the note into an interference fit bore (mechanism will not work).

3.5.2 Installation

To install threaded model nuts, simply hand tighten until shoulder is flush with mounting surface. A small amount of Loctite thread compound such as #277 can be used to prevent loosening. Alternatively, a pin can be installed to mechanically lock the threads.

Flanged models can be mounted to either the front or rear face of the flange.

Before use, it is recommended that the stainless steel preload mechanism be turned so that the caming surfaces move down the ramps. Once play is felt, allow the mechanism to slowly unwind again to establish the proper preload. (It is possible in assembly to inadvertently twist the cam creating excessive drag torque. This procedure will correct this.)

Using lubricant on the lead screw threads is recommended. This extends the life of the nut and reduces heat generation, noise and vibration. TriGEL-300S or TriGEL-1200SC is recommended.

3.5.3 Removal from screw

If it is necessary to remove the nut from your screw, you may lock the mechanism so that it can be immediately reinstalled without re-setting the preload. This can be done by wrapping tape around the junction between the stainless steel cam and the plastic nut halves. This will prevent the cam from turning when the nut is removed from screw. Remember to remove tape after installation.

For immediate transfer from one screw to another, hold the nut together between your thumb and forefinger so that it cannot expand axially. Remove the nut and install it on the second screw. It may be helpful to prevent the cam from turning with your remaining fingers as you transfer. If the nut becomes disassembled or looses its preload for any reason, follow the steps listed in the assembly procedure below.

.5.4 Assembly procedure

1) Insert spring tang into cam slot.

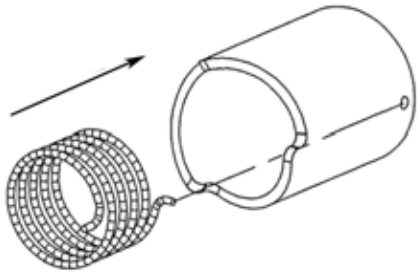

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

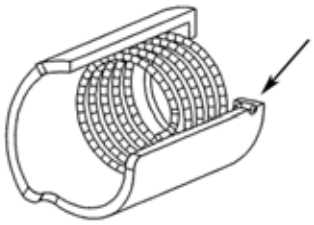

Figure 3.4 Spring engaged

3) Insert opposite tang into front nut slot or hole (dependant on size). Use the slot or hole that will allow the the cam to be positioned closest to the bottom of the ramp.

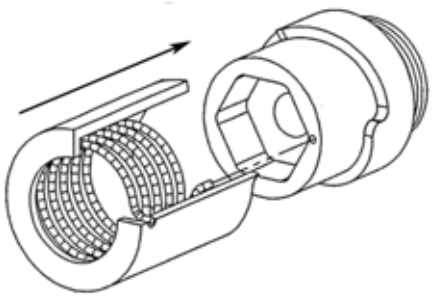

Figure 3.5 Insert opposite tang

1) With washer installed, insert the back nut into the front nut.

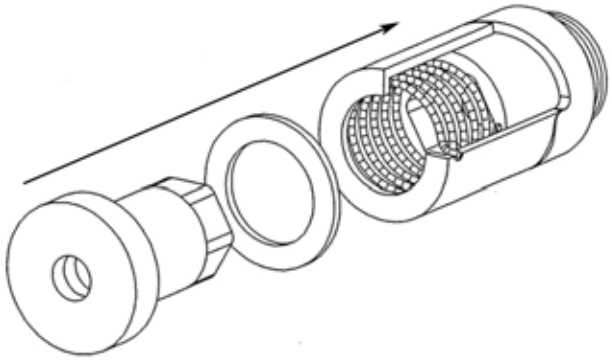

Figure 3.6 Inserting the back nut

2) With the cam held at the bottom of the ramp, thread the entire nut onto the screw starting with the front nut. After the entire nut is threaded onto the screw, release the cam to observe the gap distance (X on the drawing). The gap distance (X) should be about one-third of the full ramp distance, but no more than half.

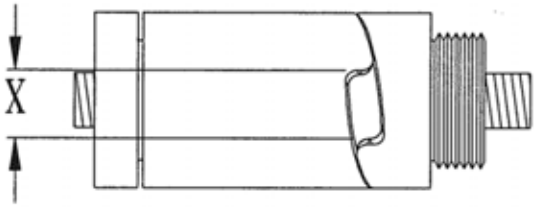

Figure 3.7 Measuring the gap distance

3) If the gap distance is incorrect, unthread the nut just enough to allow the back nut to disengage from the screw. Pull the back nut off and rotate to the next index position and reinsert back into the front nut. With the cam held at the bottom of the ramp, thread the entire nut back onto the screw. Release the cam and verify the correct gap distance. If still not correct repeat this step.

4) Once the back nut has been properly clocked to yield the correct gap distance, unthread the nut again just enough to disengage the back nut from the screw, but do not remove from the nut. Pull the cam away from the ramp and rotate in the clockwise direction for two ramp settings, then hold the cam at the bottom of the second ramp. Be careful not to allow the back nut to rotate with respect to the front nut while completing this task. With the cam held at the bottom of the second ramp, push the back nut into the front nut and thread the entire nut onto the screw.

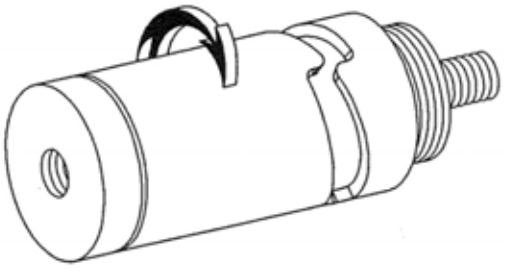

Figure 3.8 Pre-loading the nut

5) The anti-backlash nut is now pre-loaded and fully assembled.

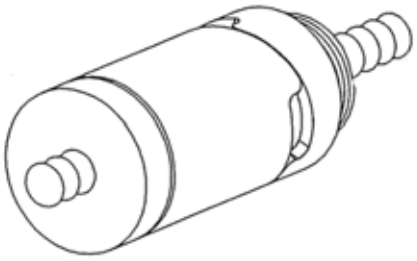

Figure 3.9 Nut pre-loaded and fully assembled

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4 Connection and interface

⚠ DANGER

EXPOSED SIGNALS

Hazardous voltage levels may be present if using an open frame power supply to power the product.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

SWITCHING DC POWER/HOT PLUGGING

Do not connect or disconnect power, logic, or communications while the device is in a powered state.

Remove DC power by powering down at the AC side of the DC power supply.

Failure to follow these instructions can result in equipment damage.

4.1 Interfacing RS422-485 communications

For general RS422/485 single and party mode communications practices please see Part 1 Section 5 of this document.

⚠ CAUTION

COMMUNICATIONS GROUND LOOPS

To avoid ground loops in the system only connect communications ground to the first MDrive in the system. Do not connect communications ground on subsequent MDrives.

Failure to follow these instructions may result in damage to system components!

⚠ CAUTION

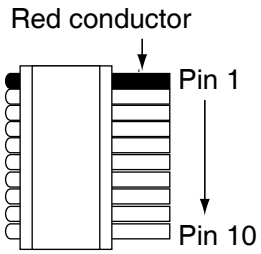
HOT PLUGGING!

Do not connect or disconnect communications while the device is in a powered state.

Failure to follow these instructions may result in damage to system components!

Revision R031610

4.1.1 P2 — 10-pin pressure-fit IDCstyle connector



Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	RX -	Receive minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX -	Receive minus
8	TX -	Transmit minus
9	TX +	Transmit plus
10	Comm GND	Communications ground only. Do not ground aux-logic to this pin.

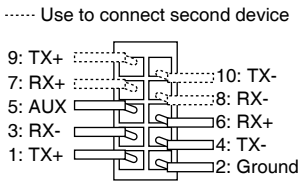
Table 4.1 Communications connections, P2 - 10-pin IDC

Connectivity accessories

Mating connector kit CK-01
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC400-001

4.1.2 P2 — 10-pin friction lock wire crimp



Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communications ground only. Do not ground aux-logic to this pin.
3	RX -	Receive minus
4	TX -	Transmit minus
5	Aux-Logic	Auxiliary logic maintains power to the logic circuitry in the absence of motor power. +12 to +24 VDC input
6	RX +	Receive plus
7	RX +	Receive plus
8	RX -	Receive minus
9	TX +	Transmit plus
10	TX -	Transmit minus

Table 4.2 P2 communications, 10-pin locking wire crimp

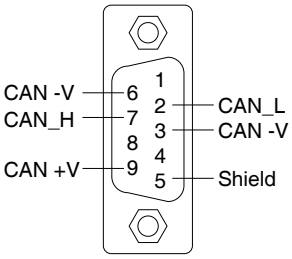
Connectivity accessories

Mating connector kit CK-02
(contains 5 connector shells, ribbon cable not included)

Communications converter cable (10'/3.0 m).....MD-CC402-001

4.2 Interfacing CANopen communications

4.2.1 P2 — 9-pin d-sub connector (female)



Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communications ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.4 CANopen communications, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communications converter cable MD-CC500-000

4.3 Interfacing DC power

See part 1 of this document, section 3, for recommended power cable configurations.

> **⚠ CAUTION**
>
> OVER VOLTAGE
>
> The DC voltage range for the MDrive 23 is +12 to +60 VDC. Ensure that motor back EMF is factored into your power supply size calculations.
>
> Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage and load.
>
> **Failure to follow these instructions can result in equipment damage.**

4.3.1 Recommended IMS power supplies

IP404 Unregulated Linear Supply

Input Range

120 VAC Versions ..... 102-132 VAC

240 VAC Versions ..... 204-264 VAC

Output (All Measurements were taken at 25˚C, 120 VAC, 60 Hz)

No Load Output Voltage .....43 VDC @ 0 Amps

Continuous Output Rating .....32 VDC @ 1.5 Amps

Peak Output Rating .....26 VDC @ 3 Amps

ISP300-4 Unregulated Switching Supply

Input Range

120 VAC Versions ..... 102-132 VAC

240 VAC Versions ..... 204-264 VAC

Output (All Measurements were taken at 25˚C, 120 VAC, 60 Hz)

No Load Output Voltage .....42 VDC @ 0 Amps

Continuous Output Rating .....39 VDC @ 3.0 Amps

Peak Output Rating ..... 37 VDC @6.0 Amp

Revision R031610

4.3.2 Recommended wire gauge

Cable Length: Feet (meters)	10 (3.0)	25 (7.6)	50 (15.2)	75 (22.9)	100 (30.5)
Amps Peak	**Minimum AWG**				
1 Amp Peak	20	20	18	18	18
2 Amps Peak	20	18	16	14	14
3 Amps Peak	18	16	14	12	12

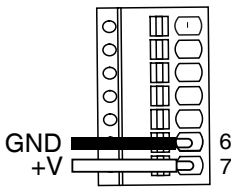
Table 4.61 Recommended power supply wire gauge

4.3.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.7 Power and ground connections, flying leads

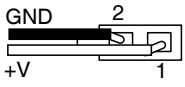
4.3.4 P1 — 7-pin pluggable terminal interface



Pin #	
6	Power ground
7	Motor power supply

Table 4.8 Power and ground connections, 7-pin terminal

4.3.5 P1 — 2-pin wire crimp interface



Pin #		*PD02-2300-FL3 wire colors*
6	Power ground	Black
7	Motor power supply	Red

Table 4.9 Power and ground connections, 7-pin terminal

Connectivity accessories

Prototype development cable PD02-2300-FL3

Mating connector kit CK-04
(contains 5 connector shells, ribbon cable not included)

4.4 Interfacing I/O

See part 1 of this document, section 4, for I/O interface configurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

1) Capture/Trip
2) Step/Direction
3) Remote encoder inputs

Do not exceed +5 VDC on these points.

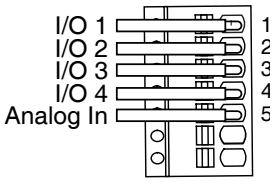
Failure to follow these instructions can result in equipment damage.

4.4.1 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	*Signal*
White/yellow	General purpose I/O 1
White/orange	General purpose I/O 2
White/violet	General purpose I/O 3
White/blue	General purpose I/O 4
Green	Analog input

Table 4.11 I/O connections, flying leads

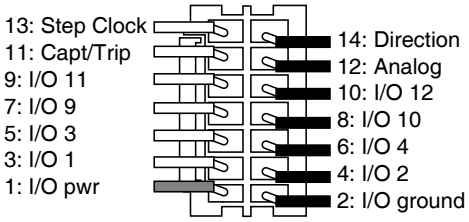
4.4.2 P1 — 7-pin pluggable terminal interface



Pin number	*Signal*
1	General purpose I/O 1
2	General purpose I/O 2
3	General purpose I/O 3
4	General purpose I/O 4
5	Analog input

Table 4.12 I/O connections, 7-pin terminal

4.4.3 P1 — 14-pin locking wire crimp interface (expanded I/O)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	Black	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	General purpose I/O 9	Yellow	Pair
8	General purpose I/O 10	Black	
9	General purpose I/O 11	Blue	Pair
10	General purpose I/O 12	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Step clock I/O	White	Pair
14	Direction clock I/O	Black	

Table 4.13 I/O connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-09
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

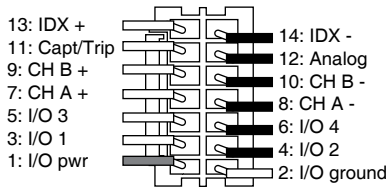
Prototype development cable (10'/3.0 m)..... PD14-2334-FL3

Manufacturer (JST) part numbers

Connector shell.....PADP-14V-1-S

Pins..... SPH-001T0.5L

4.4.4 P1 — 14-pin locking wire crimp interface (remote encoder)



Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*	
1	I/O power	Red	Pair
2	I/O ground	White	
3	General purpose I/O 1	Orange	Pair
4	General purpose I/O 2	Black	
5	General purpose I/O 3	Brown	Pair
6	General purpose I/O 4	Black	
7	Channel A +	Yellow	Pair
8	Channel A -	Black	
9	Channel B +	Blue	Pair
10	Channel B -	Black	
11	Capture output/trip input	Green	Pair
12	Analog input	Black	
13	Index +	White	Pair
14	Index -	Black	

Table 4.14 I/O and remote encoder connections, 16-pin locking wire crimp

Connectivity accessories

Mating connector kit CK-09
(contains 5 connector shells and the appropriate quantity of pins to make 5 cables)

Prototype development cable (10'/3.0 m)..... PD14-2334-FL3

Manufacturer (JST) part numbers

Connector shell..... PADP-14V-1-S

Pins..... SPH-001T0.5L

4.5 Connectivity accessory details

4.5.1 RS-422/485 communications converter cables

USB to 10-pin IDC connector P2
P/N: MD-CC400-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

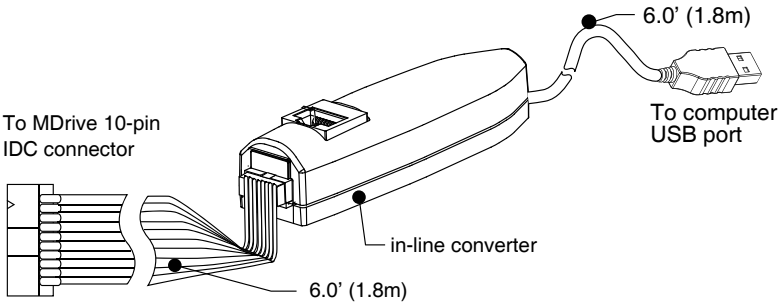


Figure 4.1 MD-CC400-000 communications converter cable

USB to 10-pin wire crimp connector P2
P/N: MD-CC402-001

Electrically isolated in-line USB to RS-422/485 converter pre-wired with mating connector to conveniently program and set configuration parameters

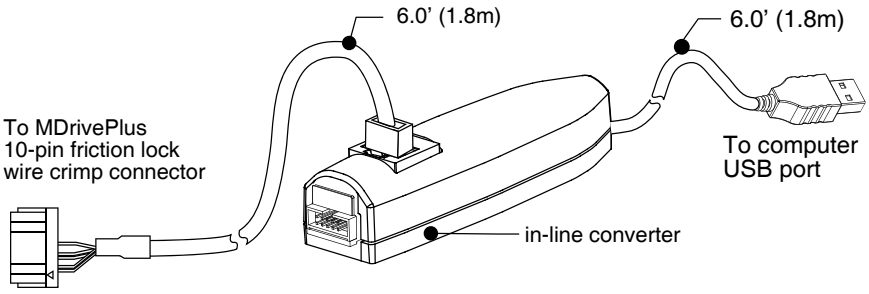
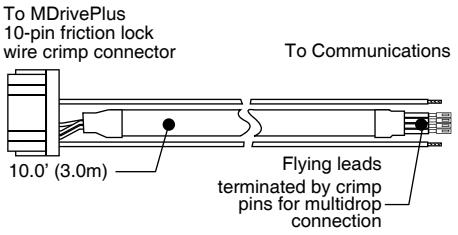


Figure 4.2 MD-CC402-001 communications converter cable

4.5.2 Prototype development cables

Flying leads to10-pin wire crimp connector P2 -P/N: PD10-1434-FL3

Used in conjunction with the MD-CC402-001 communications converter cable to facilitate multi-drop RS-422/485 communications.



Wire Colors	Function
White/Red Stripe	Aux-Logic
White/Blue Stripe	TX+
Blue/White Stripe	TX-
White/Orange Stripe	RX+
Orange/White Stripe	RX-
Green/White Stripe	GND

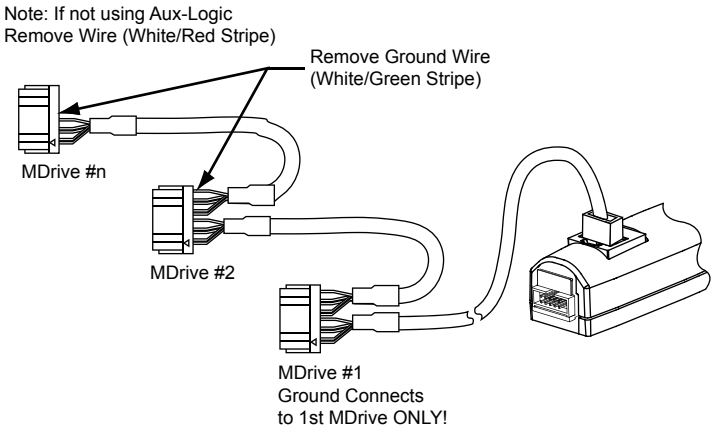


Figure 4.4 Multi-drop communications using the PD10-1434-FL3

Procedure

1) Remove ground wire (unless this is the first system MDrive, green/white stripe)
2) Remove aux-logic (if not used, red/white stripe)
3) Connect pre-crimped flying leads as shown in Figure 5.7 below

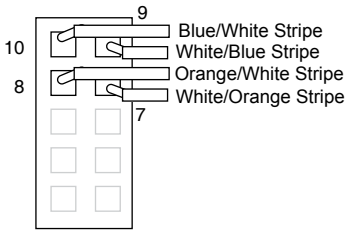
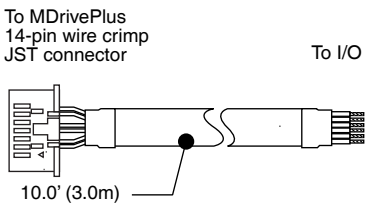


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

Flying leads to14-pin locking wire crimp connector P2 -P/N: PD14-2334-FL3

The PD14-2334-FL3 prototype development cable is used to rapidly interface the MDrive 23 to the users controller. This 10' (3.0 m) cable consists of a 14-pin locking wire crimp connector to plug directly into the MDrive P1 connector with flying leads on the opposite end to interface to I/O devices.

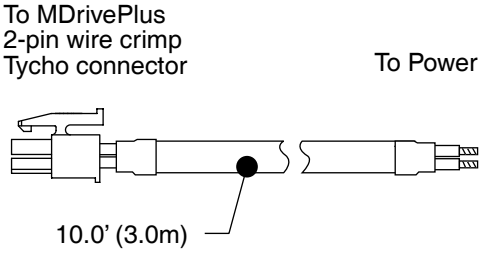


Pair	Wire Colors	Function	Encoder Function
1	Black	Direction	IDX+
	White	Step Clock	IDX-
2	Black	Analog In	Analog In
	Green	Capt/Trip	Capt/Trip
3	Black	I/O12	CH B-
	Blue	I/O11	CH B+
4	Black	I/O10	CH A-
	Yellow	I/O9	CH A +
5	Black	I/O4	I/O4
	Brown	I/O3	I/O3
6	Black	I/O2	I/O2
	Orange	I/O1	I/O1
7	Black	I/O Ground	I/O Ground
	Red	I/O Power	I/O Power

Figure 4.6 Prototype development cable PD14-2334-FL3

Flying leads to 2-pin locking wire crimp connector P2 -P/N: PD02-2300-FL3

The PD02-2300-FL3 prototype development cable is used to rapidly interface the MDrive 23 to the users DC power supply. This 10' (3.0 m) cable consists of a 2-pin locking wire crimp connector to plug directly into the MDrive P3 connector with flying leads on the opposite end to interface to DC power.



Wire Colors	Function
Black	Power Ground
Red	+V

Figure 4.7 Prototype development cable PD02-2300-FL3

4.6 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:

P2 10-pin pressure-fit IDC CK-01

P2 10-pin wire crimp CK-02

P1 14-pin wire crimp CK-09

P3 2-pin wire crimp CK-04

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WARRANTY

TWENTY-FOUR (24) MONTH LIMITED WARRANTY

IMS Schneider Electric Motion USA warrants only to the purchaser of the Product from IMS Schneider Electric Motion USA (the "Customer") that the product purchased from IMS Schneider Electric Motion USA (the "Product") will be free from defects in materials and workmanship under the normal use and service for which the Product was designed for a period of 24 months from the date of purchase of the Product by the Customer. Customer's exclusive remedy under this Limited Warranty shall be the repair or replacement, at Company's sole option, of the Product, or any part of the Product, determined by IMS Schneider Electric Motion USA to be defective. In order to exercise its warranty rights, Customer must notify Company in accordance with the instructions described under the heading "Obtaining Warranty Service."

> *NOTE: MDrive Motion Control electronics are not removable from the motor in the field. The entire unit must be returned to the factory for repair.*

This Limited Warranty does not extend to any Product damaged by reason of alteration, accident, abuse, neglect or misuse or improper or inadequate handling; improper or inadequate wiring utilized or installed in connection with the Product; installation, operation or use of the Product not made in strict accordance with the specifications and written instructions provided by IMS; use of the Product for any purpose other than those for which it was designed; ordinary wear and tear; disasters or Acts of God; unauthorized attachments, alterations or modifications to the Product; the misuse or failure of any item or equipment connected to the Product not supplied by IMS Schneider Electric Motion USA; improper maintenance or repair of the Product; or any other reason or event not caused by IMS Schneider Electric Motion USA.

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This Limited Warranty shall be void if the Customer fails to comply with all of the terms set forth in this Limited Warranty. This Limited Warranty is the sole warranty offered by IMS Schneider Electric Motion USA with respect to the Product. IMS Schneider Electric Motion USA does not assume any other liability in connection with the sale of the Product. No representative of IMS Schneider Electric Motion USA is authorized to extend this Limited Warranty or to change it in any manner whatsoever. No warranty applies to any party other than the original Customer.

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OBTAINING WARRANTY SERVICE

Warranty service may obtained by a distributor, if the Product was purchased from IMS Schneider Electric Motion USA by a distributor, or by the Customer directly from IMS Schneider Electric Motion USA, if the Product was purchased directly from IMS Schneider Electric Motion USA. Prior to returning the Product for service, a Returned Material Authorization (RMA) number must be obtained. Complete the form at http://www.imshome.com/rma.html after which an RMA Authorization Form with RMA number will then be faxed to you. Any questions, contact Customer Service (860) 295-6102.

Include a copy of the RMA Authorization Form, contact name and address, and any additional notes regarding the Product failure with shipment. Return Product in its original packaging, or packaged so it is protected against electrostatic discharge or physical damage in transit. The RMA number MUST appear on the box or packing slip. Send Product to: IMS Schneider Electric Motion USA, 370 N. Main Street, Marlborough, CT 06447.

Customer shall prepay shipping charges for Products returned to IMS Schneider Electric Motion USA for warranty service and IMS Schneider Electric Motion USA shall pay for return of Products to Customer by ground transportation. However, Customer shall pay all shipping charges, duties and taxes for Products returned to IMS Schneider Electric Motion USA from outside the United States.

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