MDrive® Motion Control

MDrive and
Linear Actuator Products

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 specif cations for the MDrive42AC Plus Motion Control, as it is discontinued.
11/16/2009	R111609	Added support for size 14 and 23 linear actuator.
03/16/2010	R031610	Updated Linear actuator sections with assembly instructions for the anti-backlash nut.
07/02/2010	R070210	Minor corrections throughout
09/07/2010	R090710	Changed party mode connecting to ref ect termination capacitance equation.
11/02/2010	R110210	Added support for Ethernet communication interface.
02/07/2011	R020711	Modif ed dimensioned drawing for NEMA size 17 models with industrial connectors to ref ect a 0.07” (1.8 mm) increase in length. Added pin numbers to cable detail drawings.

The information in IMS Schneider Electric Motion USA product documentation 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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MDrivePlus Motion Control Manual Revision R020711

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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 specif cally 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 suff cient 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 specif cally 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 specif ed operating conditions, such as environmental conditions and specif ed 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 specif cations in this manual. To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modif cations 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 specif ed 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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MDrive®

Motion Control

Part 1: General Usage

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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 f ange 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 f ange 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 conf guration 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 Communication converter drivers

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

1.4.2 IMS Terminal

The MDrive motion control can be conf gured 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-conf gured 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

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 suff cient 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.

2.2 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 specif cally 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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Changes and modif cations of the drive systems are not permitted and if made no warranty and liability will be accepted.

The drive system must be operated only with the specif ed 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).

2.3 Hazard Categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions aff xed 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, f nal 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 communication 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 communication 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 specif cations, voltage limits, current requirements and connectivity information are located in the product detail section corresponding to the MDrive model you purchased.

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 eff cient 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 f uctuations 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 f uctuations, 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 specif c 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 f ltering 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 conf guration 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)

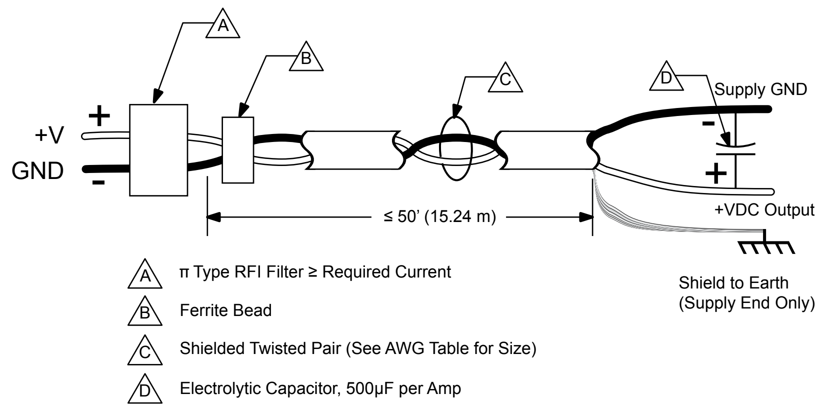

Figure 3.1 DC power supply cabling under 50’ (15.24 m)

3.3.2 AC power to full wave bridge

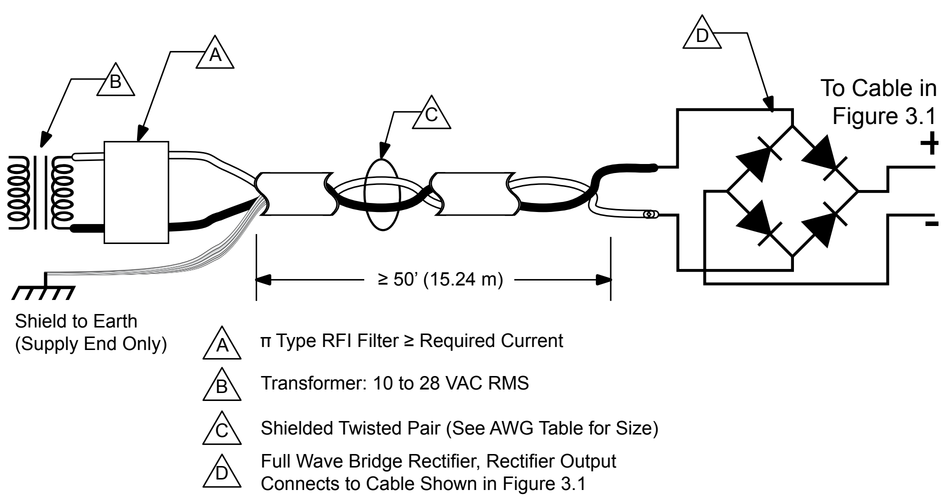

Figure 3.2 50’ (15.2 m) or greater, AC power to full wave bridge

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3.3.3 AC power DC supply

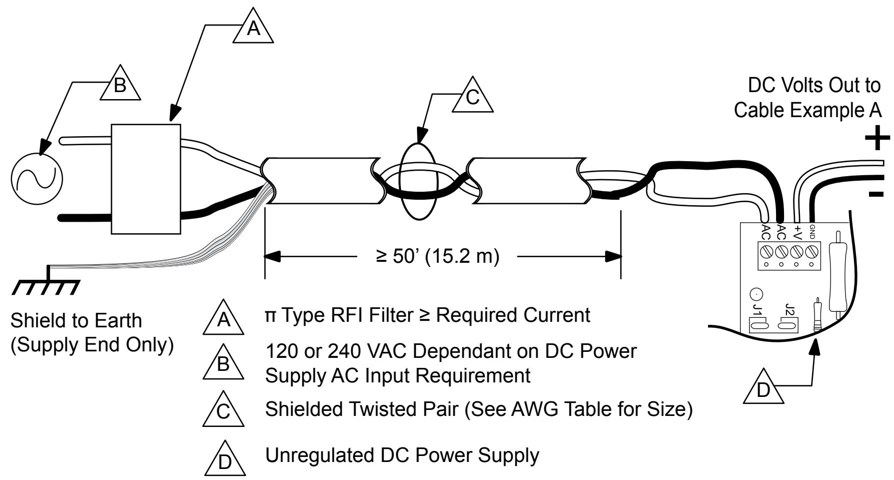

Figure 3.3 50' (15.2 m) or greater, AC power to DC supply

3.3.4 Recommended wire gauges

For cable lengths exceeding 50' (15.2 m), use the cable conf gurations 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 specif cations, voltage limits and connectivity information are located in the product detail section corresponding to the MDrive model you purchased.

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3.3 Switching DC power (DPM75 accessory)

⚠ **CAUTION**

HOT PLUGGING!

Do not connect or disconnect power, logic, or communication 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 conf gured. 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.

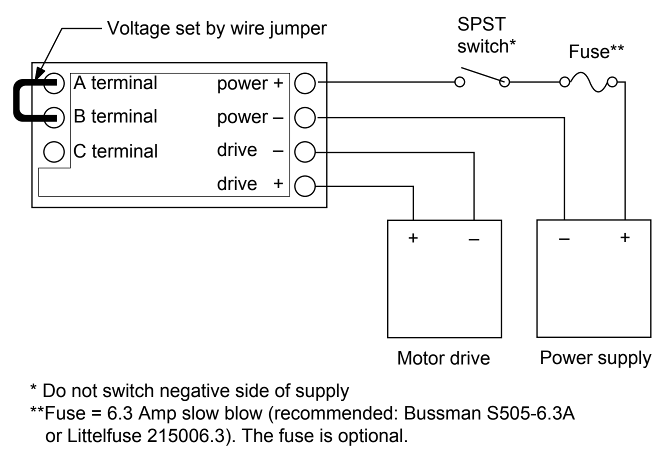

Figure 3.4 DPM75 basic wiring and connection

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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 communication while the device is in a powered state.

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

Detailed specif cations, 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

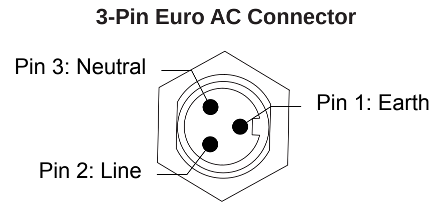

Figure 4.1 Euro AC connector (P3)

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

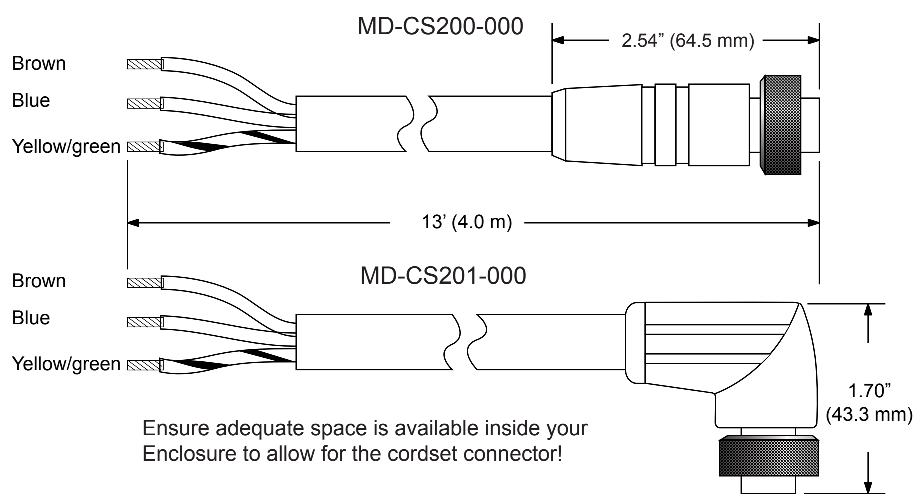

Figure 4.2 MD-CS20x-000

5 Interfacing serial communication

The MDrive communicates to the host using the RS-422/485 protocol. Communication may be conf gured 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 communication interface.

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

To simplify the wiring and connection process we offer an electrically isolated USB to RS-422/485 communication 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 f rst order.

There are two communication 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 Communication 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 communication 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 specif c 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 f nish, the Welcome to the Hardware Update Wizard will re-appear 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 f nd 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 conf guration.

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5.3 Interfacing single mode communication

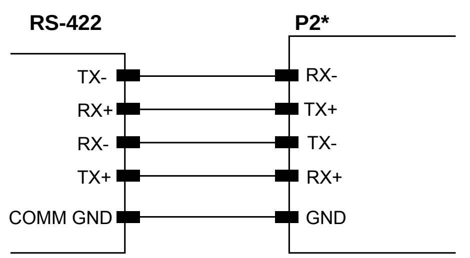
⚠ CAUTION
HOT PLUGGING!
Do not connect or disconnect communication while the device is in a powered state.
Failure to follow these instructions may result in damage to system components!

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 communication converter.

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



* see the section in Part 2 applicable to the model you purchased for pinout information

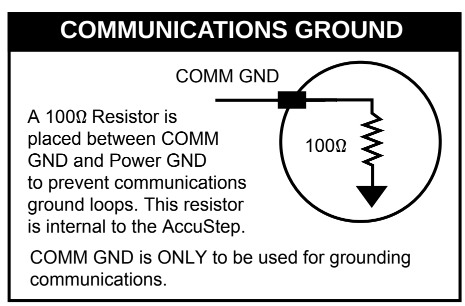


Figure 5.2 Full duplex RS-422 connection.

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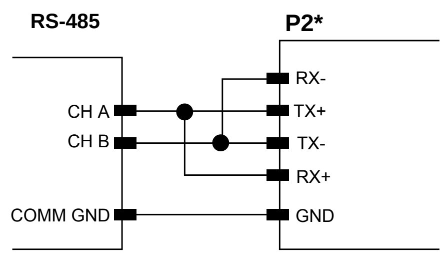
5.3.2 Half duplex (RS-485)

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 Communication cable. If a program is not being used, download and save any setup parameters. To ensure the MDrive responds only to commands specif cally 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 conf guration. The following diagram illustrates how to connect the four wire RS-485 to operate as a two wire system.



* see the section in Part 2 applicable to the model you purchased for pinout information

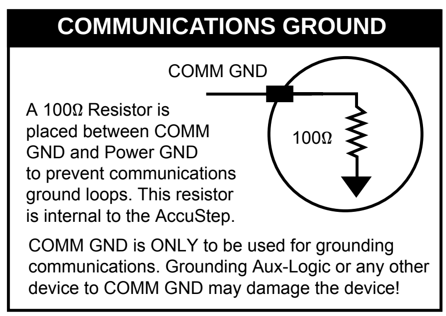


Figure 5.3 Half duplex RS-485 connection.

5.4 interfacing party mode communication

⚠ CAUTION

HOT PLUGGING!

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

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

⚠ CAUTION

Communication GROUND LOOPS

To avoid ground loops in the system only connect communication ground to the f rst MDrive in the system. Do not connect communication 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 communication converter cable for multi-drop systems. Ribbon cables are not recommended for use in multi-drop communication 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 identif er, or device name. Each unit MUST be connected and communicated with in single mode communication and given a name using the DN command

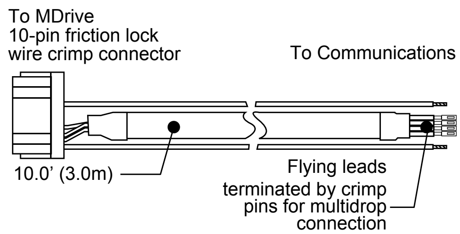
Please reference the MCode Programming and Software manual for more information.

5.4.1 Mutli-drop communication using MD-CC402-001

Required:

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

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



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

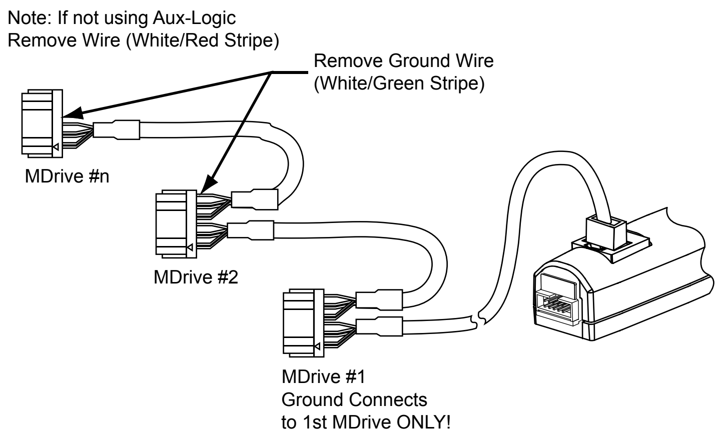


Figure 5.4 Multi-drop communication using the PD10-1434-FL3

Procedure

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

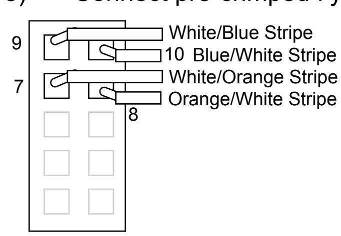


Figure 5.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

5.4.2 Multi-drop communication connection

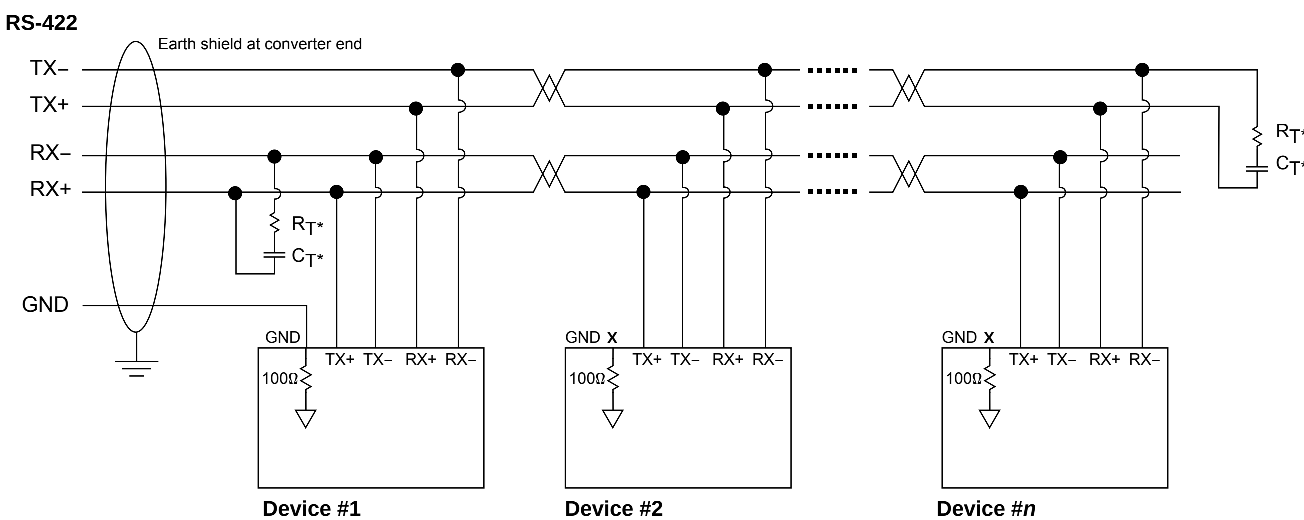
Connecting RS-422 in party mode can be fraught with issues. Following a few simple best practices can save a good deal of time troubleshooting.

Conf guring the MDrive

WIth a comm converter and the MDrive units you plan to use in Party Mode at hand, perform the following:

1) Connect in single mode RS-422 and initiate communication, download any programs if required.
2) Assign a device name (DN="<A-Z, a-z or 0-9>") i.e DN="A".
3) Set the party f ag to 1 (PY=1)
4) Press CTRL+J to activate party mode
5) Type in [Device Name]S and press CTRL+J (saves the DN and party conf guration) ie AS CTRL+J
6) Remove power and label the drive with the assigned DN.
7) Repeat for each system MDrive.

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



***Termination**

R_T = based on the impedence of the cable, generally 120Ω

C_T = (cable length in ft * 1.7nS/ft * 2) / Z_o*

*Z_o = characteristic impedence of the cable

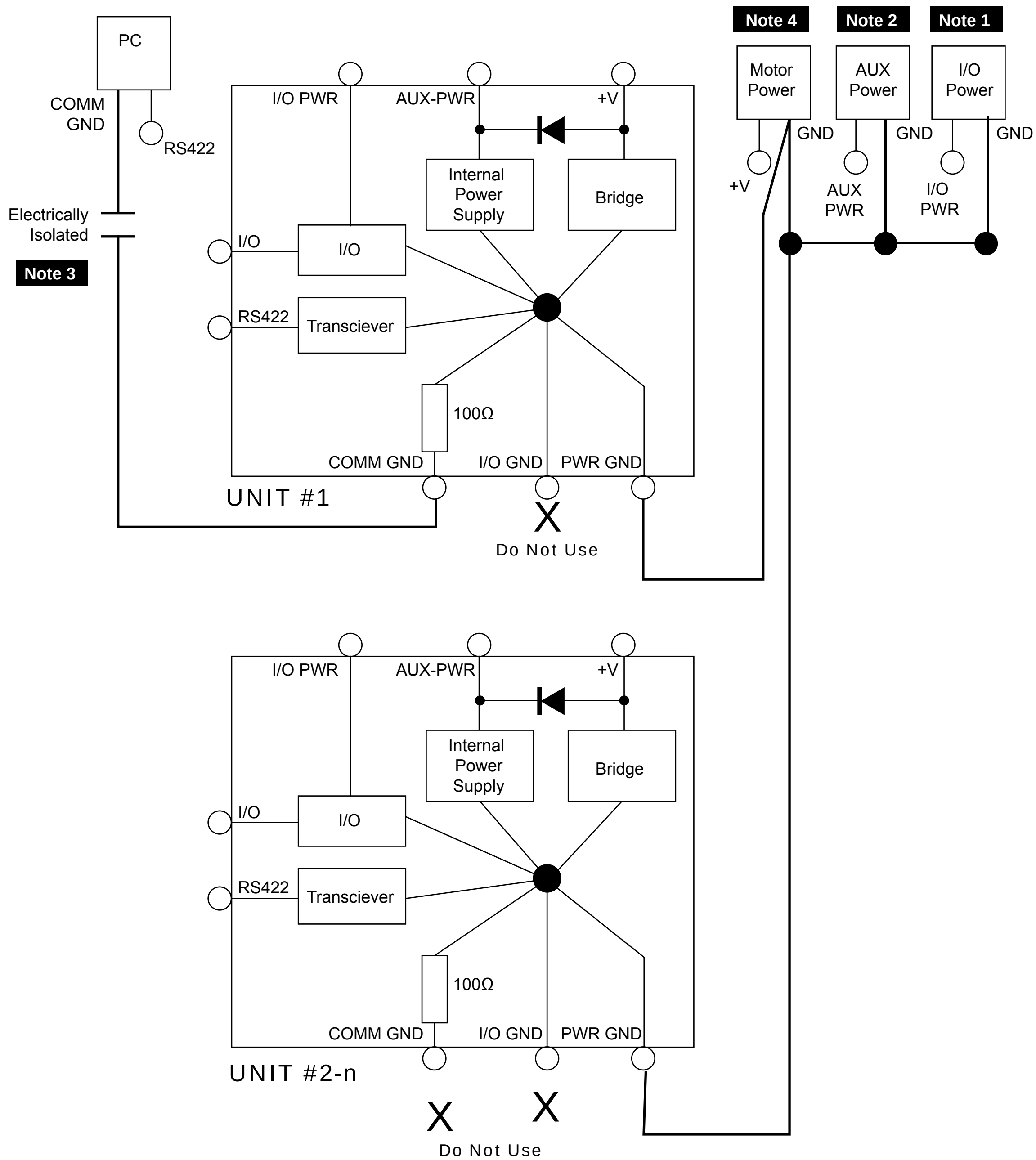
Figure 5.6 Interface for party-mode operation

Data cable Termination Resistors

Under15 ft we recommend that no termination is used. Over 15' (4.5 meters) The value of capacitance should be calculated using the formula above to f nd the cable round trip delay divided by the characteristic impedance of the cable (Zo).

5.4.3 System power connection for a multi-drop system

The power connection schematic in Figure 5.7 represents the recommended power conf guration for avoiding communication 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 communication ground loops

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5.4.4 Software configuration

Party mode communication requires extensive software conf guration and has a specif c communication and response format.

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

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6 Interfacing CANopen communication

6.1 Features

- CANopen DS-301 and DS-402
- Galvanically isolated communication
- 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

6.2 Interfacing the can bus

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

6.2.1 CAN bus connections

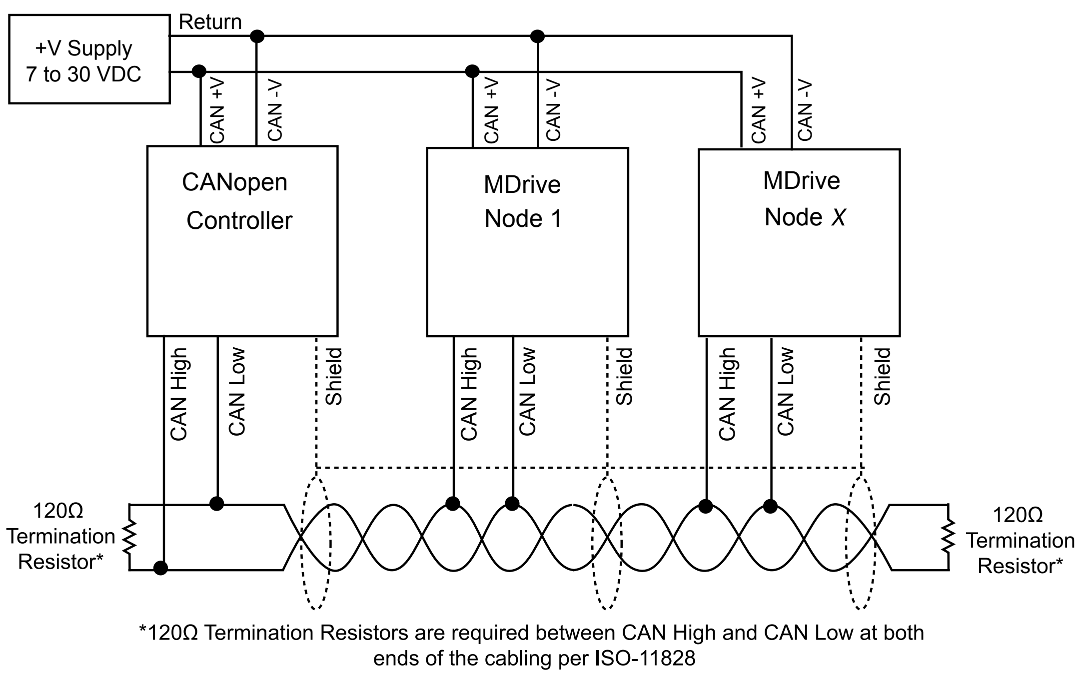

Figure 6.1 Interfacing the CAN bus

6.2.2 Recommended CANopen dongle

In order to use the CANopen Tester tool and upgrade utility for the MDrive you must purchase the MD-CC500-000 communication cable. When purchased from us, the user interface software for upgrading and prototyping is included. This is required to upgrade the f rmware 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 f gure below shows the parts required.

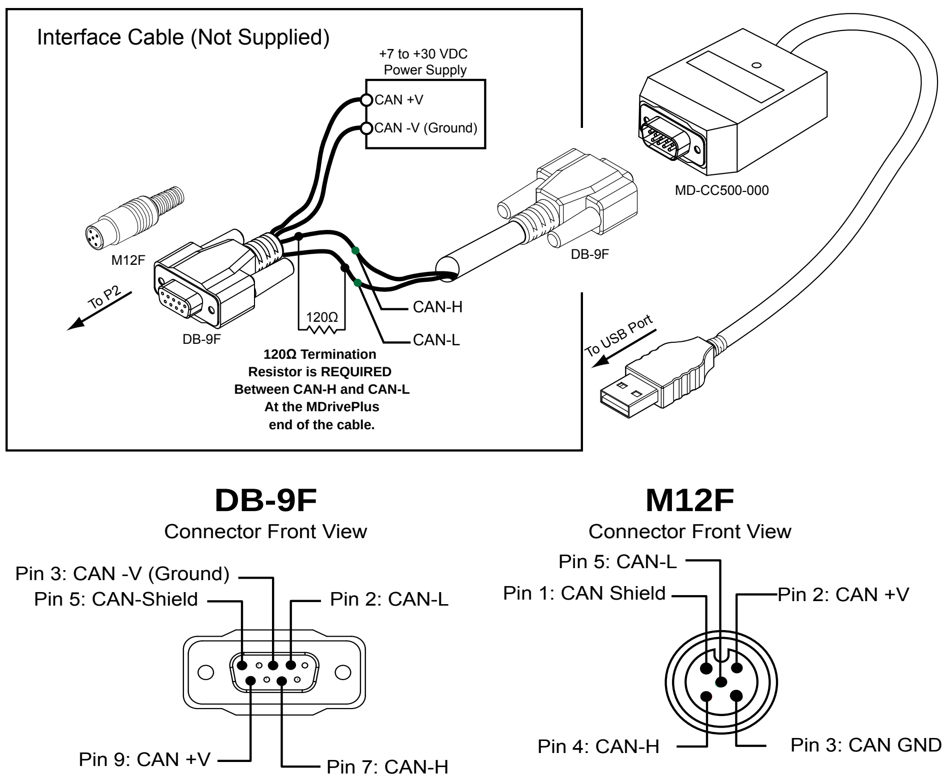

Figure 6.2 MD-CC500-000 USB to CANopen commissioning cable

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.

6.3 CANopen Tester quick start

6.3.1 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.

6.3.2 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.

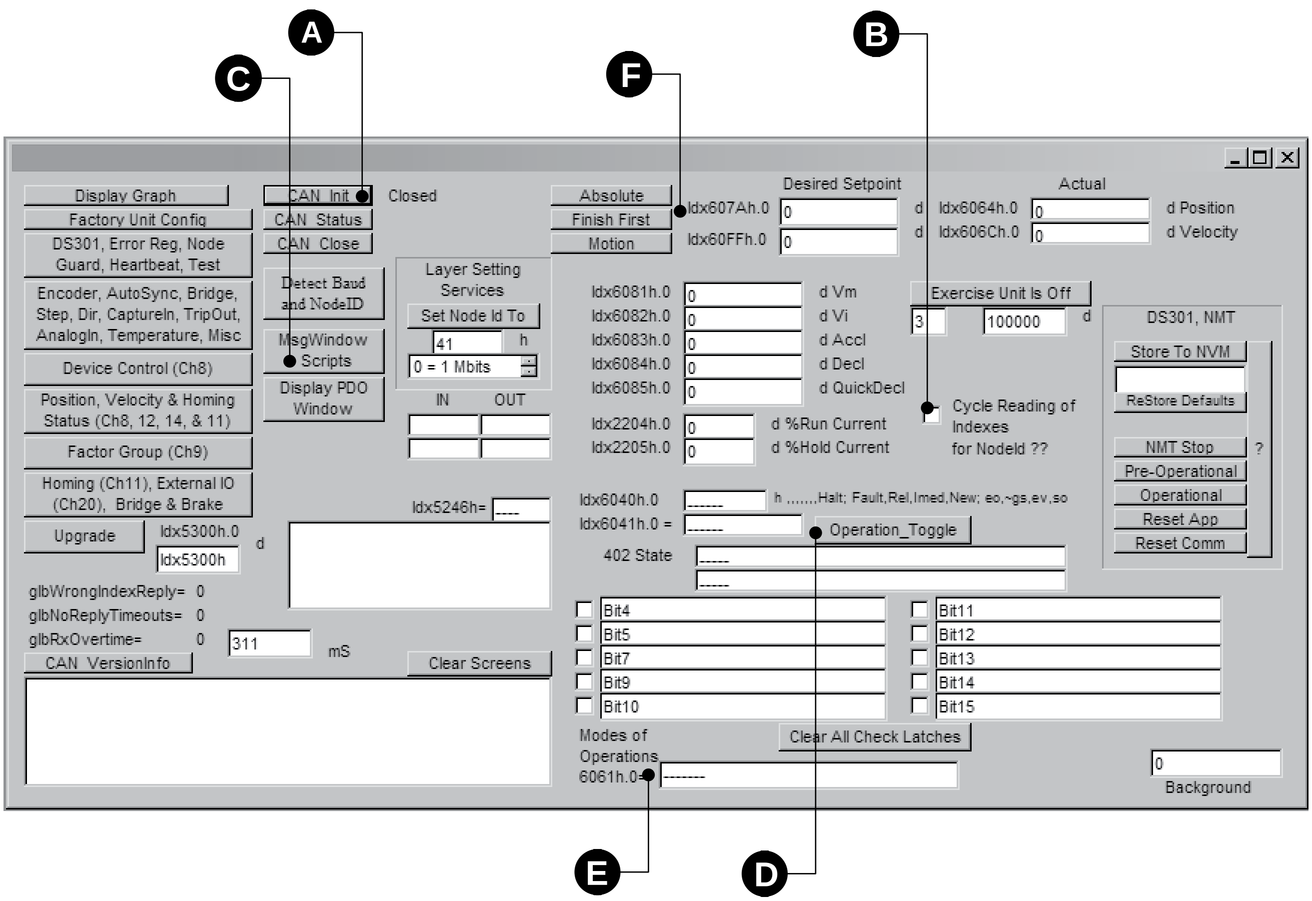

Figure 6.3 CANopen Tester

7 Interfacing Ethernet communication

Ethernet is a frame based, standardized networking system used for Local Area Networks. The ease of connectivity and use, reliability and minimal signal degradation over long distance has made it an ideal networking standard for a number of industrial protocols.

MDrive with Ethernet is not to be confused with the EtherNet/IP (Ethernet Industrial Protocol), developed by Rockwell Automation.

A major benef t of using Ethernet in motion control systems is the standardized IP addressing system, which allows for up to 255 devices on a network, while eliminating the complicated wiring and software conf guration of traditional multi-drop systems using RS-232, RS-422 or RS-485.

Ethernet is available as a communications interface on MDrive23Plus Motion Control units only

NOTE: While def ned as an MDrive23Plus2, please note that the Ethernet version DOES NOT have the upper I/O bank, I/O points 9 - 12. Only I/O points 1 - 4 are available, they may be programmed as sinkinh or sourcing inputs or outputs.

7.1 Features

- Standard RJ45 and CAT5/6 cabling
- Isolated communication
- Minimal signal degradation over long distance
- All error checking handled by the system (no check-summing)
- No complicated multidrop wiring and conf guration
- MODBUS/TCP or MCode/TCP protocols

7.2 Connecting to a network

The MDrivePlus Motion Control withe Ethernet uses standard RJ45 connectors with CAT5 or 6 cabling without crossover.

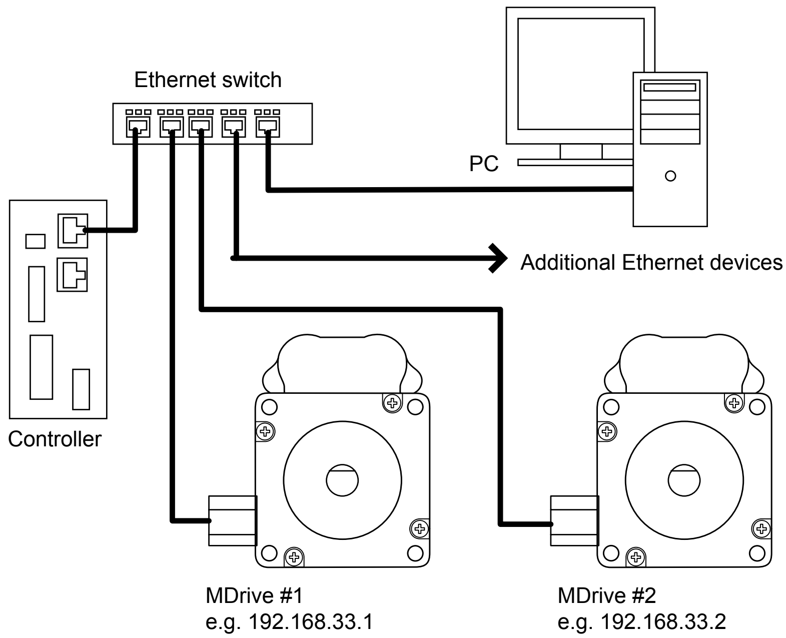

Figure 7.1 Example Ethernet network using MDrivePlus

7.2.1 Network setup preparation

To set up a network using MDrive Motion Control with Ethernet there are a few steps that must be followed to conf gure the MDrivePlus units for use on your network.

NOTE: You may need to contact the IT department at your location to obtain a block of viable IP addresses for your system.

Information needed to start:

- Default IP Address: **192.168.33.1**
- Default Subnet Mask: **255.255.0.0**

System/software requirements:

- PC running Windows XP SP2 or newer
- TCP/IP Conf guration Utility installed - *available at http://www. imshome.com*
- MDrive Motion Control with Ethernet connected to your network with power applied.

7.2.2 Network setup procedure

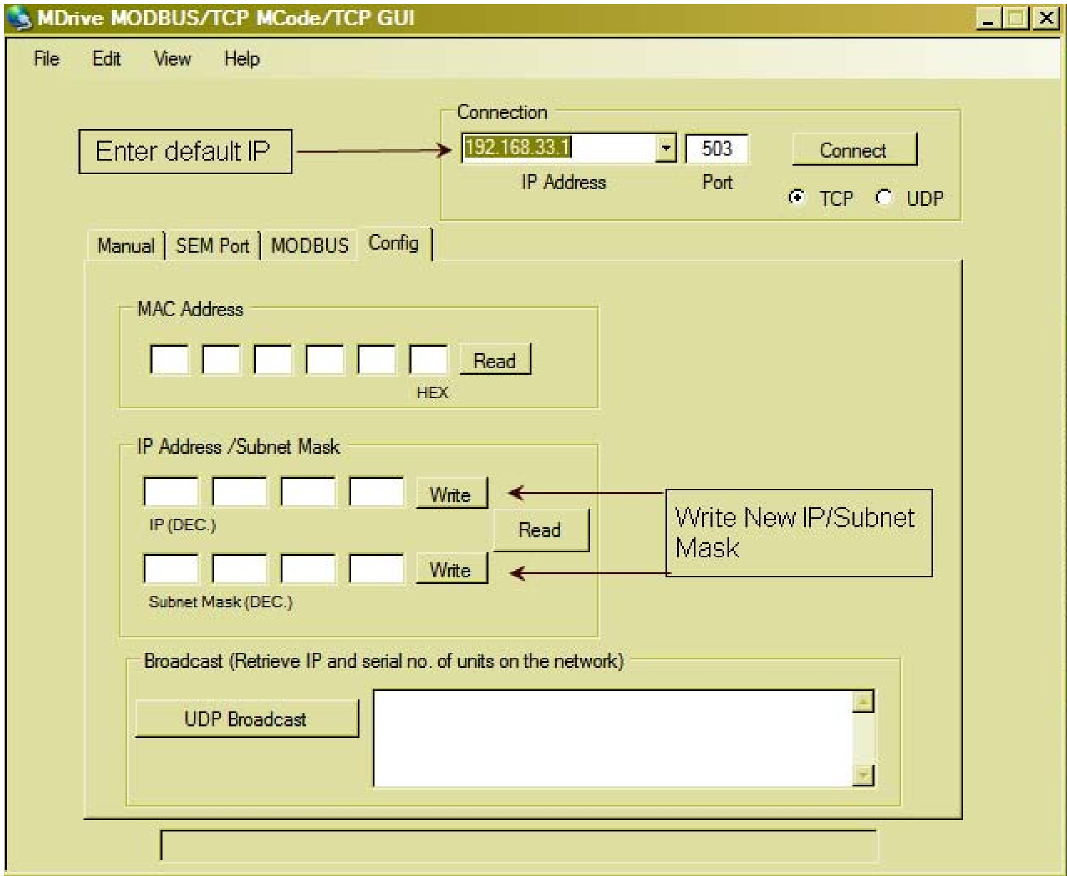

Figure 7.2 TCP/IP Conf guration Utility

1) Open the TCP/IP Conf guration utility.
2) In the IP Address dropdown enter the default IP: 192.168.33.1.
3) Click “Connect”.
4) Write the desired IP and Subnet mask to the device.
   WARNING: ensure the IP/Subnet is available on your network!
5) Cycle power on the MDrivePlus.
6) Reconnect to the new IP Address.
7) To verify communication, click the SEM Port tab on the TCP/IP Conf guration utility.
8) Click into the bottom text area, key in CTRL+C.
9) If communications are functioning the sign-on “Copyright ©2010 Schneider Electric Motion USA” should appear in the upper window.
10) Repeat steps 2 – 9 on each subsequent MDrive for your system.

7.3 Supported protocols

The new MDrive Motion Control Ethernet products support two protocols in a single package:

1) **MCode/TCP —** Schneider Electric Motion USA's proprietary programming language for MDrive Motion Control products,adapted to utilize TCP/IP message formatting.

   If using the device using MCode/TCP, please see the MCode Programming and Reference Manual located on the web site at http://www.imshome.com/downloads/manuals.html.

2) **MODBUS/TCP —** A standard open industrial protocol supported by a variety of machine components such as programmable controllers, drives and controls, I/O modules and switches.

   These protocols may be used separately or interchangeably, as is required by the constraints of the application by connecting to the port thatthe protocol is running on, 503 for MCode/TCP and 502 for MODBUS/TCP.

7.4 Ethernet status LED indicators

The MDrivePlus with Ethernet has two dual-color (red/green) LEDs visible from the back of the drive to give status and error indication of the Ethernet connection.

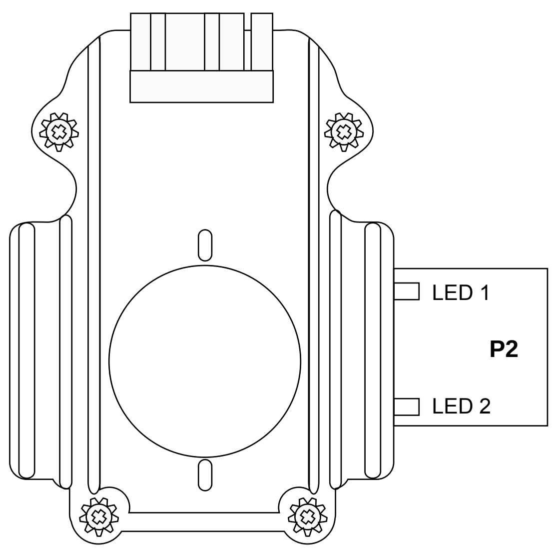

Figure 7.3 Ethernet status indicator LEDs

LED 1	LED 2	Description
Boot-up/Initialization faults		
Off	Off	Boot-up / TCP-IP stack ok. (Waiting for connection)
Green	Off	Drive initialization error, if persistent, contact applications support
MODBUS/TCP connection (Port 502)		
Off	Red (flashing)	MODBUS/TCP port 502 connected
Off	Green	Set socket option failure
Off	Red+Green	Socket receive error or Port 502 disconnect
Red+Green	Red+Green (1 sec. interval)	UART overrun, retry in progress
MCode/TCP connection (Port 503)		
Red (flashing)	Off	MCode/TCP port 503 connected
Green	Off	Set socket option failure
Red+Green	Off	Socket receive error or Port 503 disconnect

Table 7.1 Ethernet status indicator LEDs

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8 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 communication 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.

8.1 I/O configurations

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

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 8.1 MDrive I/O conf gurations

8.1.1 I/O States

The digital I/O may be def ned as either active HIGH or active LOW. When the I/O is conf gured 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 conf gured 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 conf gured by the third parameter of the I/O Setup (S1-4, S9-12) variable. The goal of this I/O conf guration scheme is to maximize compatibility between the MDrive Motion Control and standard sensors and switches.

8.2 General purpose I/O

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

8.2.1 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 8.2 General purpose input functions

8.2.2 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 8.3 General purpose output functions

8.2.3 Interfacing sinking inputs

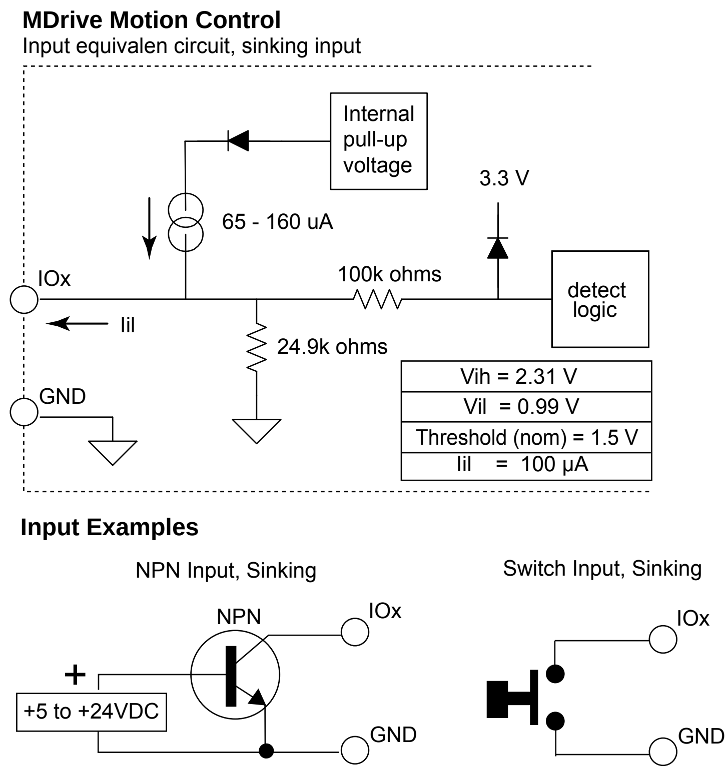

Figure 8.1 Sinking input equivalent circuit and interface examples

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8.2.4 Interfacing sinking outputs

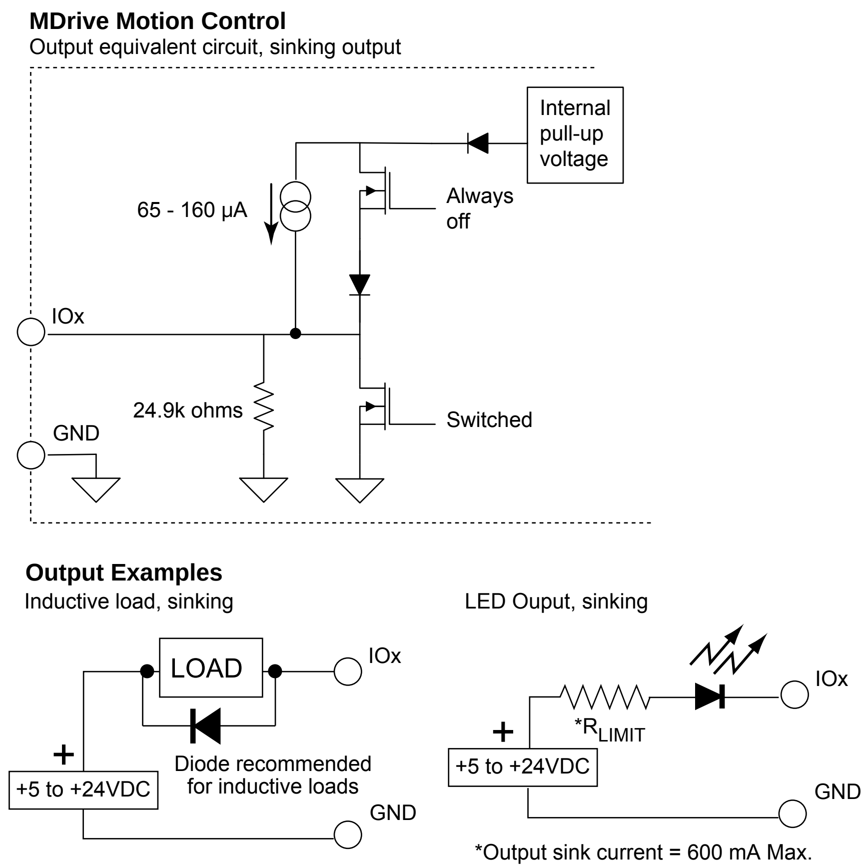

Figure 8.2 Sinking output equivalent circuit and interface examples

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8.2.5 Interfacing sourcing inputs

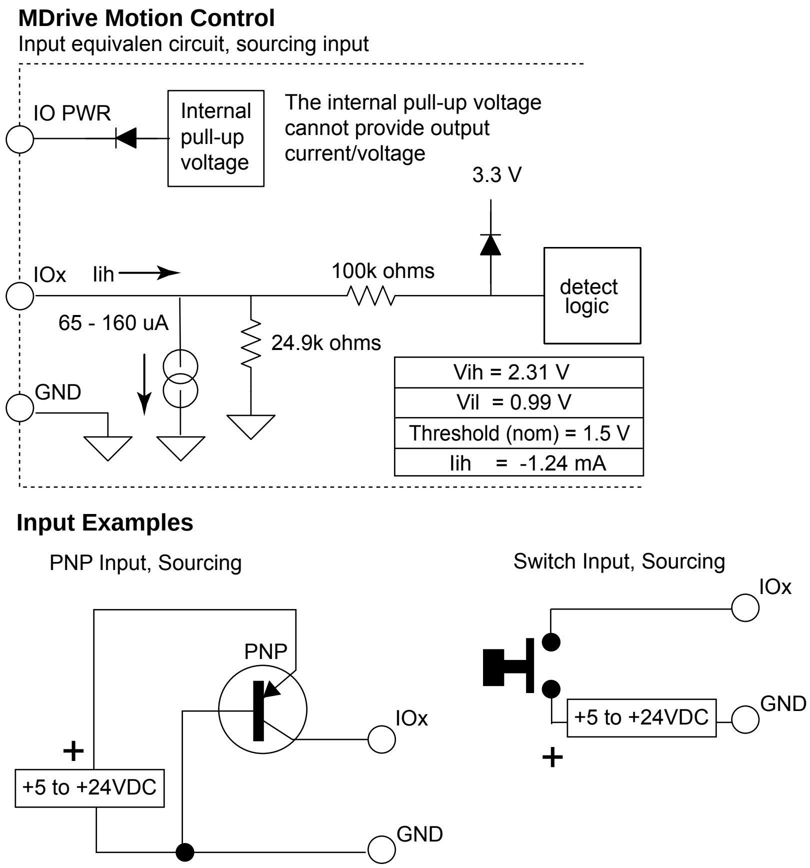

Figure 8.3 Sourcing input equivalent circuit and interface examples

8.2.6 Interfacing sourcing outputs

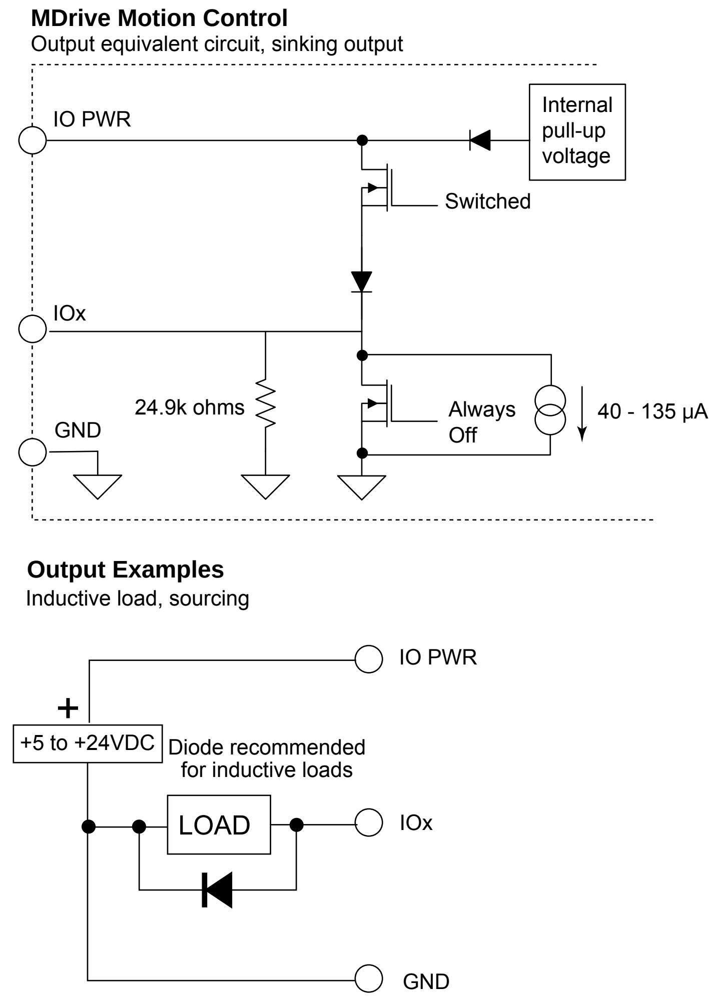

Figure 8.4 Sourcing output equivalent circuit and interface examples

8.2.7 Mixed I/O Example

The application illustrated in Figure 8.5 shows an example of the I/O points being used as mixed inputs and outputs on an MDrive with the standard I/O conf guration.

IO3 and IO4 are conf gured 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.

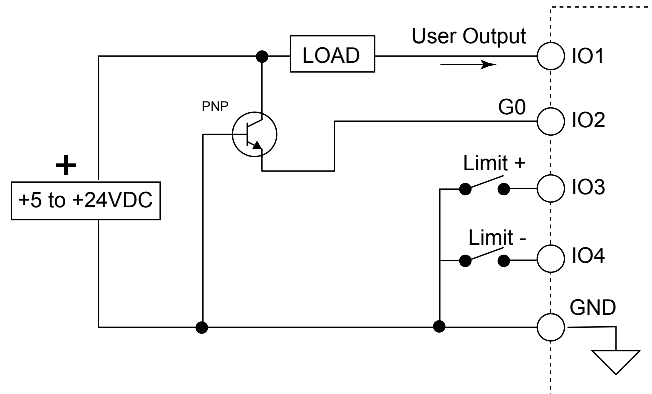

Figure 8.5 Mixed inputs and outputs, standard MDrive.

8.2.8 Mixed I/O Example (expanded)

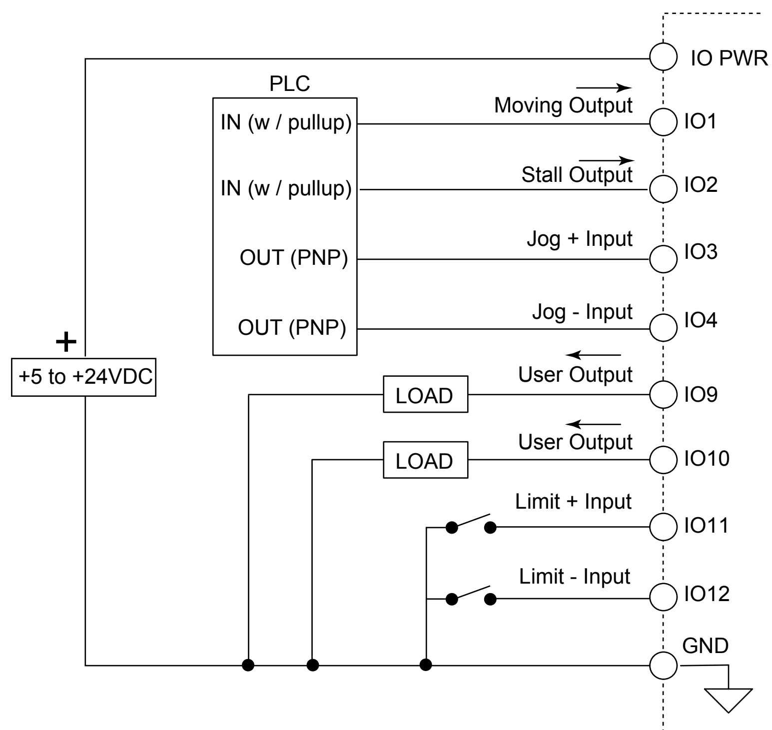

Figure 8.6 Mixed inputs and outputs, expanded MDrive.

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8.2.9 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 8.7 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 def ned 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

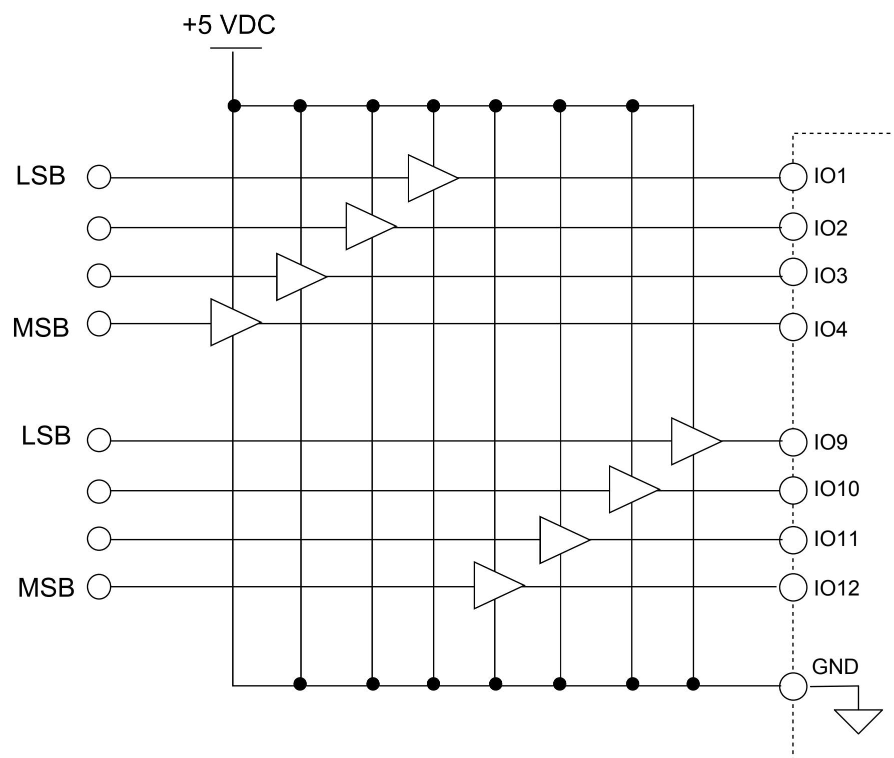

Figure 8.7 TTL interface to I/O banks as a group for BCD program control

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Binary coded decimal outputs

Figure 8.8 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 conf gured as user def ned 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

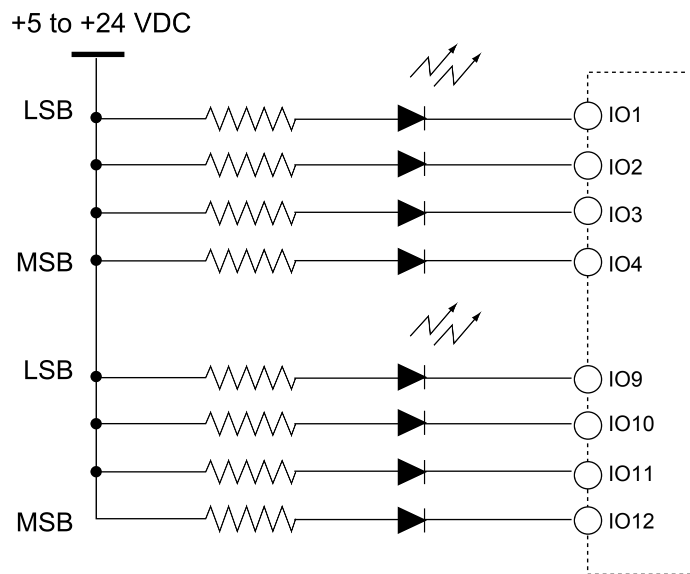

Figure 8.8 Output interface to I/O banks as a group for BCD process control

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8.3 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.**

8.3.1 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 conf gured as a capture input I/O point 13 has programmable f ltering 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 conf gured 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

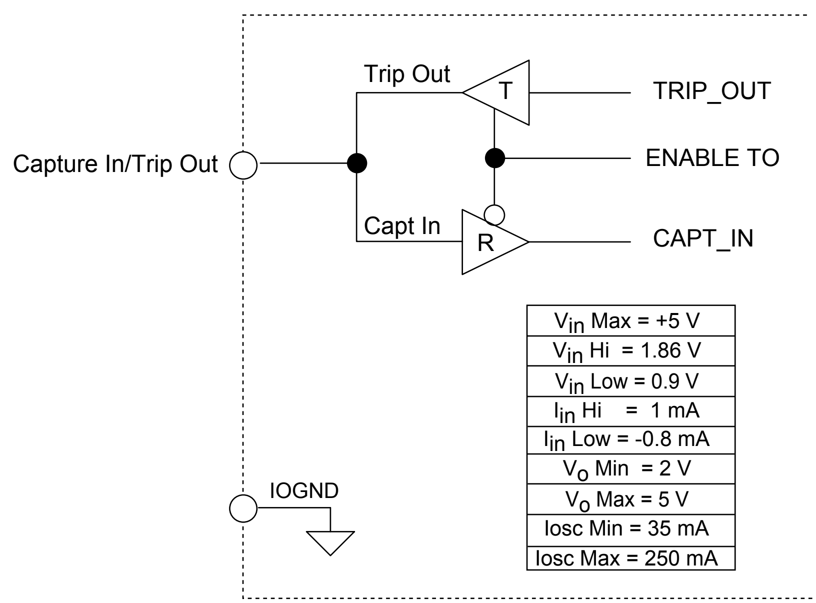

Figure 8.9 Input equivalent circuit, capture/trip I/O

8.4 Analog input

The analog input of the MDrive is conf gured 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.

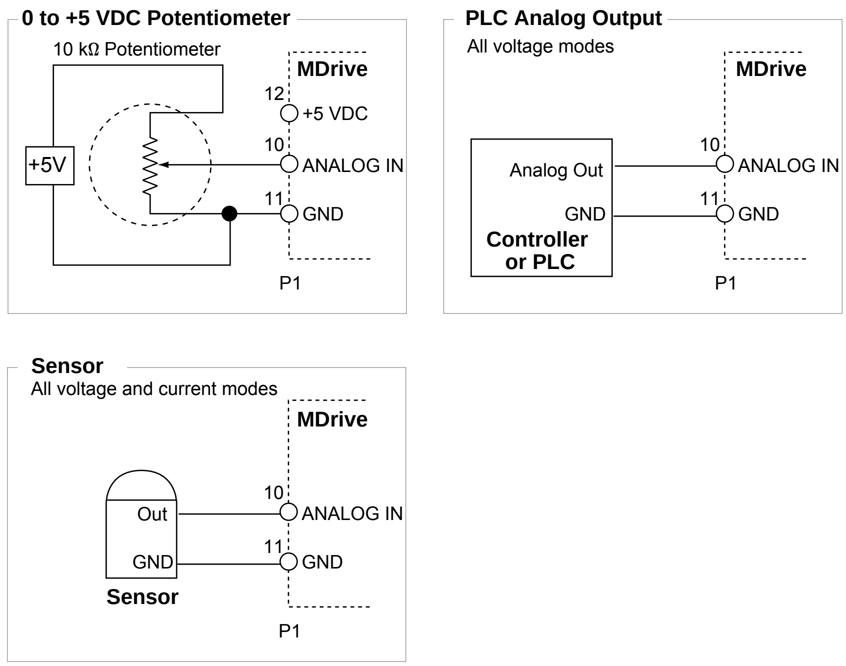

Figure 8.10 Analog input interface

MDrive®
Motion Control

Part 2: Detailed specif cations 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

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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 our advanced 2nd generation current control. By applying innovative techniques to control current f ow through the motor, resonance is signif cantly 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 f xed 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 f nd index mark.

The closed loop conf guration 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 conf gurations 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 identif er.

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

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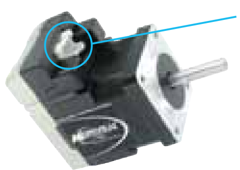
Numerous connector styles give you choices for the best f t and features. Select from 12.0” (30.5cm) f ying leads, pluggable terminal strip, locking wire crimp connectors.

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.

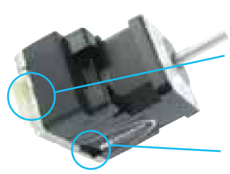
The MDrive 14 is a compact, powerful and cost effective motion control solution that will reduce system cost, design and assembly time for a large range of brushless step motor applications.

1.2 Product identification

MDrive® 14 Plus



MDrive® 14 Plus²



Part numbers													
Example:	**K**	**M**	**D**	**I**	**1**	**C**	**R**	**Z**	**1**	**4**	**A**	**4**	**–EQ**
QuickStart Kit **K** = kit option, or leave blank if not wanted	**K**	M	D	I	1	C	R	Z	1	4	A	4	–EQ
MDrive Plus version **MDI** = Motion Control	K	**M**	**D**	**I**	1	C	R	Z	1	4	A	4	–EQ
Input **1** = Plus, standard features **3** = Plus², expanded features	K	M	D	I	**1**	C	R	Z	1	4	A	4	–EQ
P1 connector **C** = wire crimp	K	M	D	I	1	**C**	R	Z	1	4	A	4	–EQ
Communication **R** = RS-422/485	K	M	D	I	1	C	**R**	Z	1	4	A	4	–EQ
P2 connector **Z** = none (only for Plus products) **L** = wire crimp (only for Plus² products)	K	M	D	I	1	C	R	**Z**	1	4	A	4	–EQ
Motor size **14** = NEMA 14 (1.4" / 36 mm)	K	M	D	I	1	C	R	Z	**1**	**4**	A	4	–EQ
Motor length **A** = single stack **C** = triple stack	K	M	D	I	1	C	R	Z	1	4	**A**	4	–EQ
Drive voltage **4** = +12 to +48 VDC	K	M	D	I	1	C	R	Z	1	4	A	**4**	–EQ
Options Leave blank if not wanted Options may be combined, unless noted **–EQ** = internal encoder, 512-line internal magnetic encoder with index mark **–EE** = remote encoder interface, differential encoder to be provided by user *Available with Plus² versions only. May not be combined with internal encoder option.* **–N** = rear control knob for manual positioning													**–EQ**

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, conf guration 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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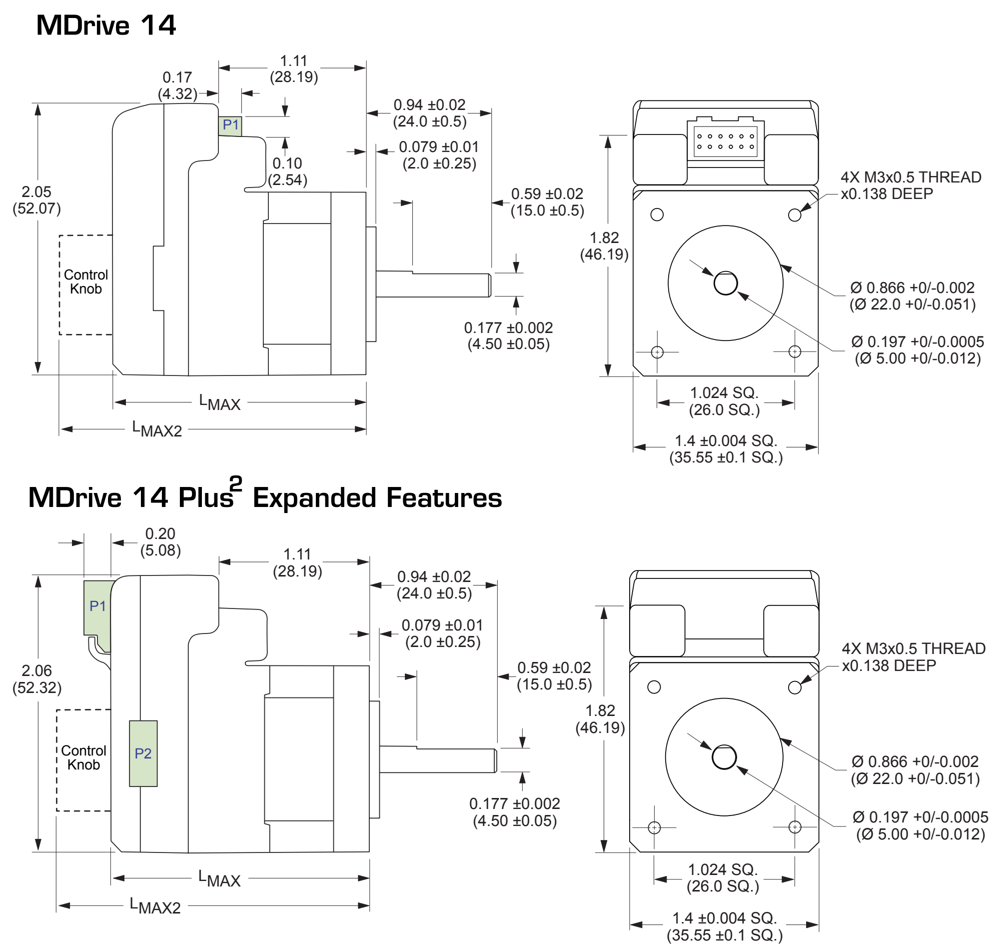
2 Specifications

2.1 Mechanical specifications

2.1.1 Standard and expanded features version



MDrive Lengths *Inches (mm)*

Motor Length	LMAX	LMAX2
	SINGLE SHAFT, INTERNAL ENCODER, or LINEAR ACTUATOR	CONTROL KNOB
Single	1.93 (49.02)	2.62 (66.55)
Triple	3.03 (76.96)	3.73 (94.74)

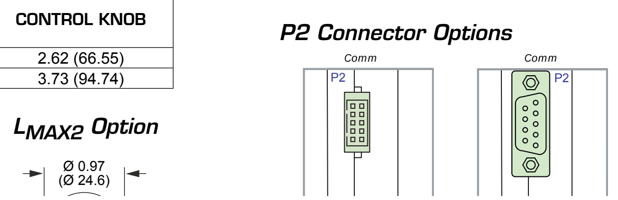


Figure 2.1 Standard and Expanded features mechanical specif cations

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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 specif cations

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 specif cations

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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 specif cations

2.2.4 Communication 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 Communication specif cations

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 specif cations

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 x 10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specif cations

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 specif cations

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-sec² (kg-cm²)	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 specif cations

2.2.9 Speed-force performance curves

Single length motor

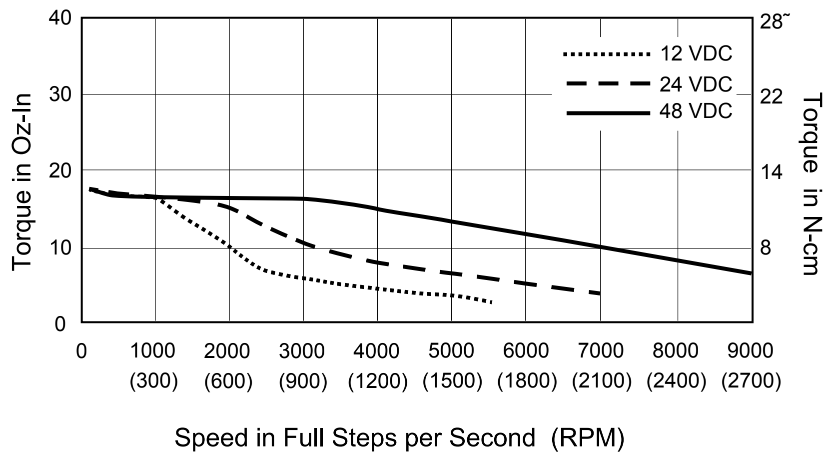

Figure 2.2 Performance curves - single length motor

Triple length motor

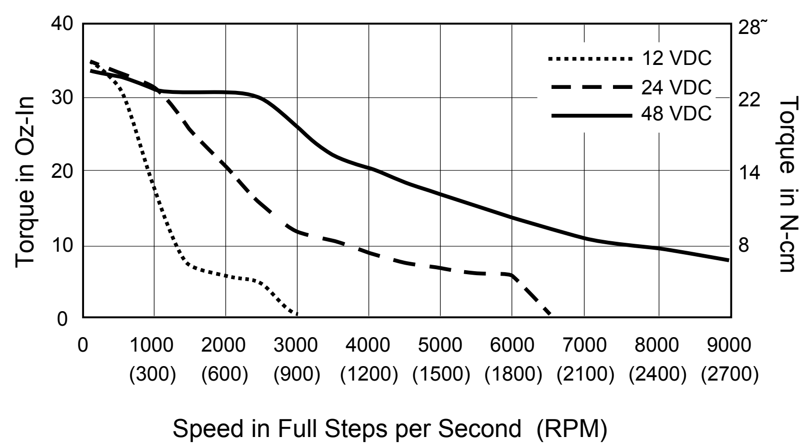

Figure 2.3 Performance curves - triple length motor

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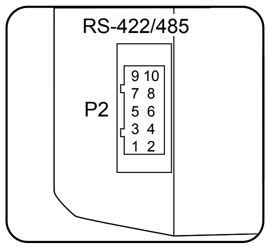
2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

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

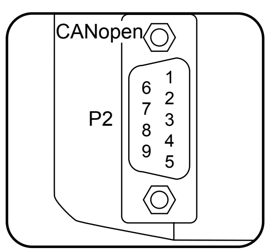
Pins
Hirose DF11-TA2428HC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

2.3.2 CANopen communication option (Plus^2 expanded feautures)

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



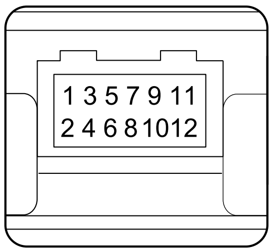
Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communication 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 communication, P2: 9-pin D-sub female (DB-9F)

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

2.4.1 Communication, 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 Communication 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 Communication Host.
10	TX -	Transmit –: Connects to Receive – of the Communication Host.
11	RX -	Receive –: Connects to Transmit – of the Communication Host.
12	RX +	Receive +: Connects to Transmit + of the Communication Host.

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

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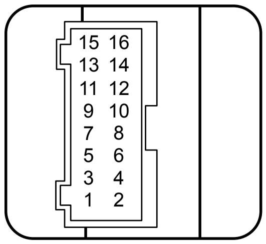
2.4.2 Power and I/O (Plus² expanded features)

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

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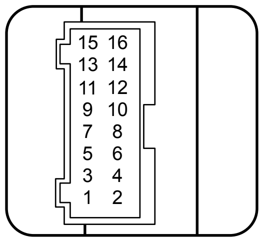
2.4.3 Power and I/O (Plus² with remote encoder)

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.

P2.6 Connectivity

QuickStart kit

For rapid design verif 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 f ying 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 communication 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 conf gurations 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 suff cient 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.

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.

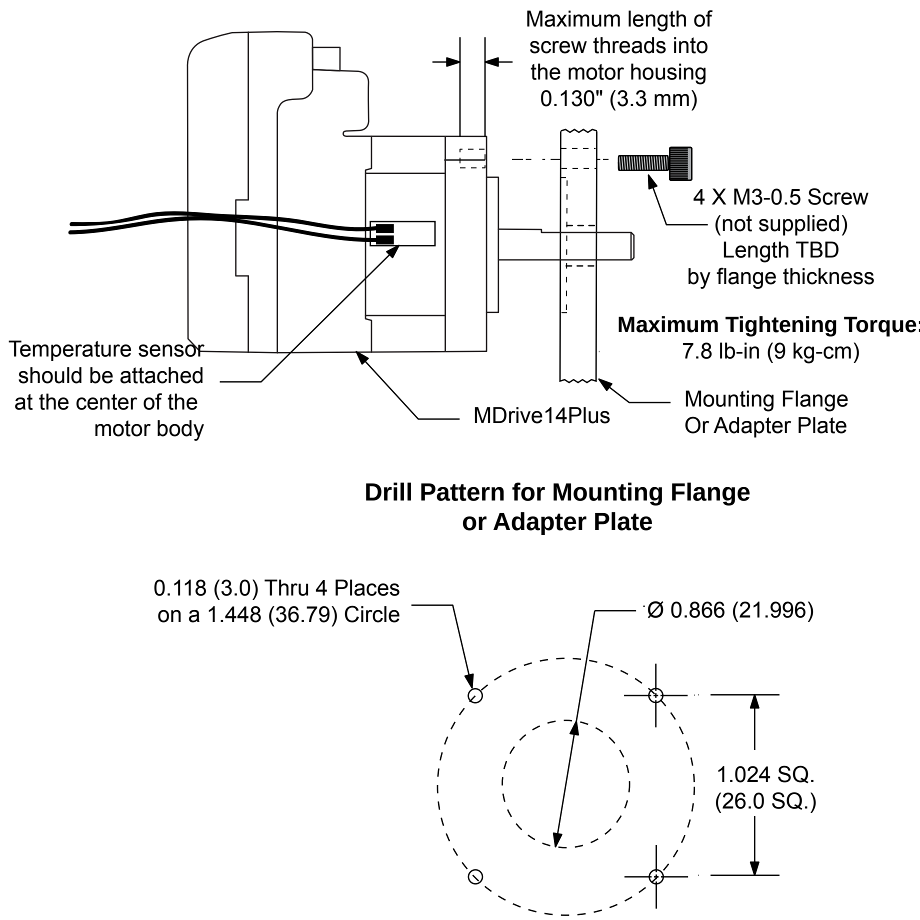


Figure 3.1 MDrive 14 mounting and drill pattern

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 f oat. 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.

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

Communication

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-f t 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

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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 (f ying, pluggable or threaded) must be properly anchored. This will prevent f exing and tugging which can cause damage at critical connection points within the MDrive.

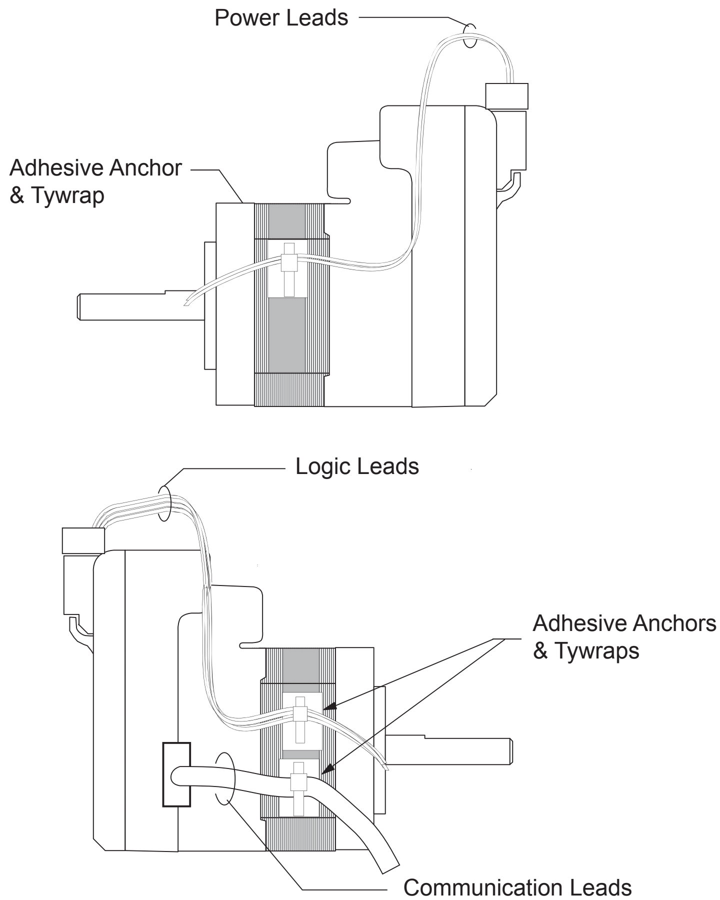

Figure 3.2 Securing leads

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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 communication 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 communication

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

⚠ CAUTION

Communication GROUND LOOPS

To avoid ground loops in the system only connect communication ground to the f rst MDrive in the system. Do not connect communication ground on subsequent MDrives.

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

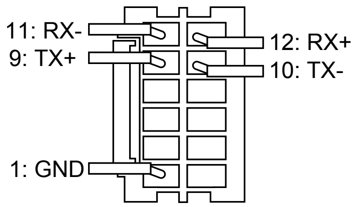
⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communication 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/communication ground
9	TX +	Transmit plus
10	TX -	Transmit minus
11	RX -	Receive minus
12	RX +	Receive plus

Table 4.1 Communication 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

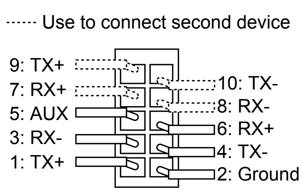
Communication converter cable (10’/3.0 m)............. MD-CC403-001

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	Communication 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 communication, 10-pin locking wire crimp

Connectivity accessories

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

Communication converter cable (10’/3.0 m)............. MD-CC402-001

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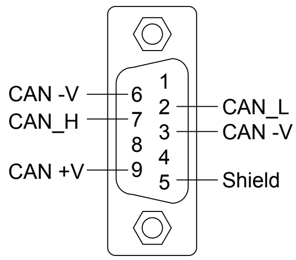
4.2 Interfacing CANopen communication

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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communication converter cable MD-CC500-000

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4.3 Interfacing DC power

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

⚠ 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

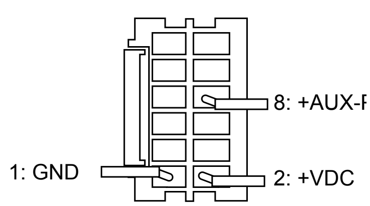
Table 4.4 Recommended power supply characteristics

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)

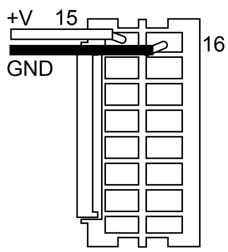
Prototype development cable (10'/3.0 m).............. PD12B-1434-FL3

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)

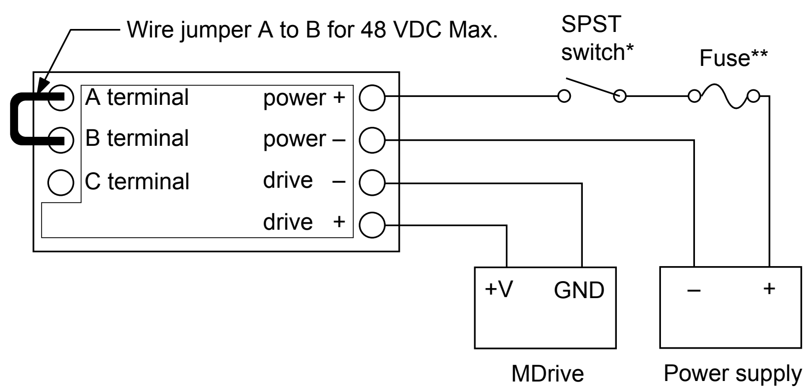
Prototype development cable (10'/3.0 m)................ PD16-1417-FL3

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

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4.4 Interfacing I/O

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

⚠ CAUTION

ELECTRICAL OVERSTRESS

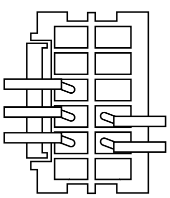
The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

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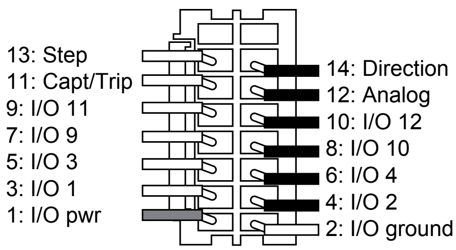
4.4.2 P1 — 16-pin locking wire crimp interface (expanded I/O)



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

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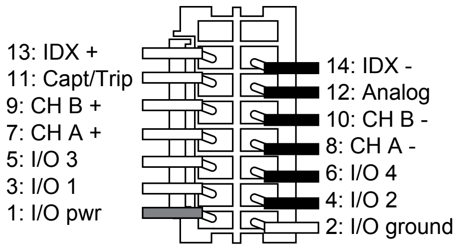
4.4.3 P1 — 16-pin locking wire crimp interface (remote encoder)



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 4.10 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 communication 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 conf guration parameters

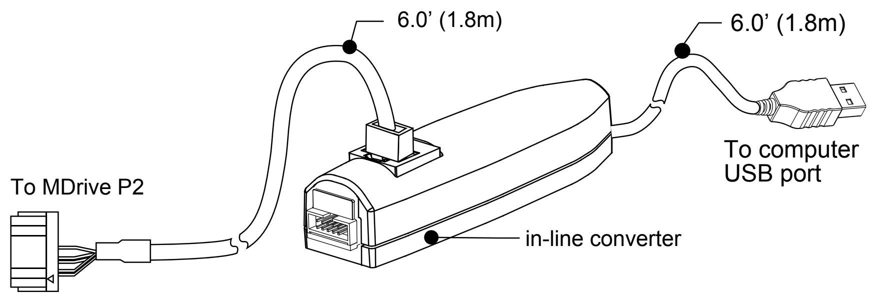
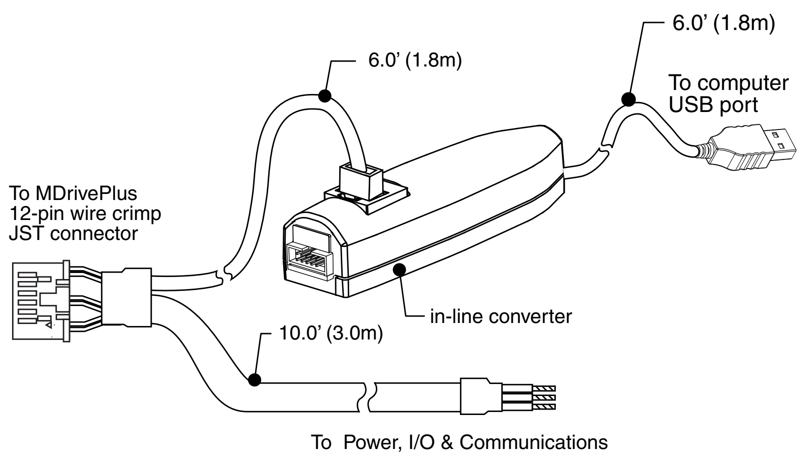


Figure 4.2 MD-CC402-001 communication converter cable

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 conf guration parameters.



Pin #	*Wire Colors*	*Signal*
1	Black	GND
2	Red	+V
3	White	I/O 2
7	Blue	I/O 1
5	Green	I/O 3
5	Orange	I/O 4
6	Brown	Analog Input

Figure 4.2 MD-CC403-001 communication converter

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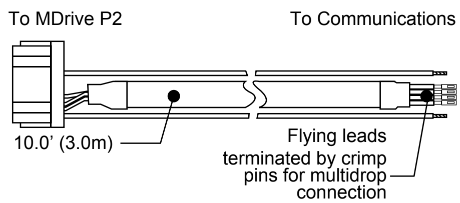
4.5.2 Prototype development cables

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

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



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

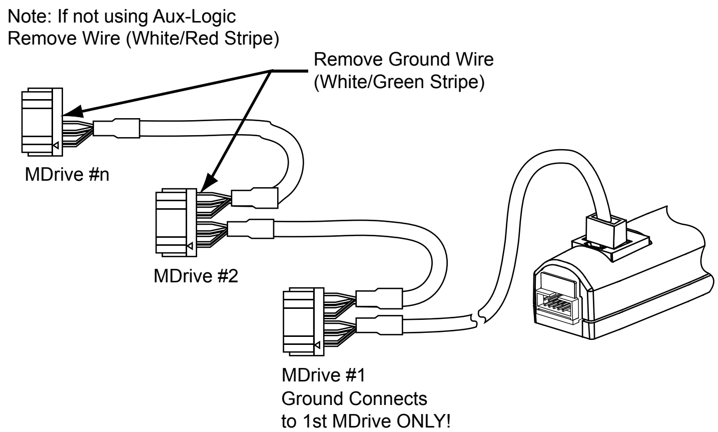


Figure 4.4 Multi-drop communication using the PD10-1434-FL3

Procedure

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

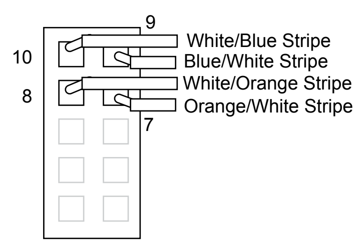


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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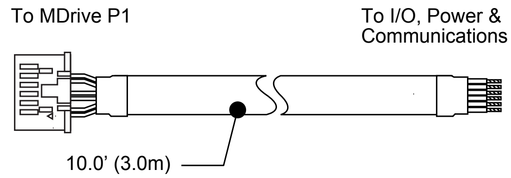
Flying leads to12-pin locking wire crimp connector P1 - PD12B-3400-FL3

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

Function: I/O, Power & Communication Interface.

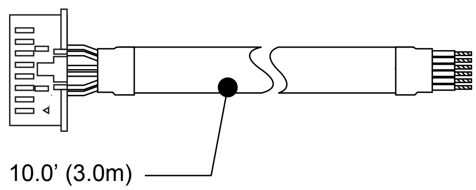


Pin #	*Wire Colors*	*Signal*	*Pairs*
1	Black	GND	X
2	Red	+V	
10	Black	TX-	X
9	White	TX+	
11	Black	RX-	X
12	Green	RX+	
3	Black	I/O 2	X
7	Blue	I/O 1	
5	Black	I/O 3	X
5	Yellow	I/O 4	
6	Black	Analog Input	X
8	Brown	Aux-Logic	

Figure 4.6 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 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 f ying leads on the opposite end to interface to power, i/o and/or remote encoder.



Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
16	Black	GND	GND	X
15	Red	+V	+V	
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	White	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

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-f t IDC..CK-01

P2 10-pin wire crimp..CK-02

P1 12-pin wire crimp..CK-08

P1 16-pin wire crimp..CK-10

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MDrive® 17
Motion Control

1. Introduction
2. Specif cations
3. Mounting Recommendations
4. Interface and Connectivity

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Table of Contents

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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.

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.

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

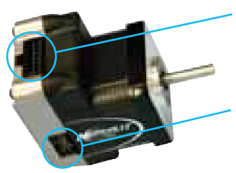
Numerous connector styles give you choices for the best f t and features. Select from 12.0” (30.5cm) f ying leads, pluggable terminal strip, locking wire crimp connectors, and M12/M23 industrial connectors.

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.

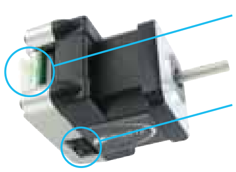
The MDrive 17 is a compact, powerful and cost effective motion control solution that will reduce system cost, design and assembly time for a large range of brushless step motor applications.

1.2 Product identification

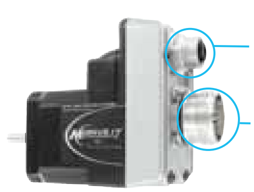
MDrive® 17 Plus



MDrive® 17 Plus²



MDrive® 17 Plus²
with industrial connectors



Part numbers	
Example:	**K M D I 1 F R D 1 7 A 4 –EQ**
QuickStart Kit **K** = kit option, or leave blank if not wanted	**K** M D I 1 F R D 1 7 A 4 –EQ
MDrive Plus version **MDI** = Motion Control	K **M D I** 1 F R D 1 7 A 4 –EQ
Input **1** = Plus, standard features **3** = Plus², expanded features **4** = Plus², expanded features, with industrial connectors, IP54-rated	K M D I **1** F R D 1 7 A 4 –EQ
P1 connector **F** = ˜ying leads **P** = pluggable **C** = wire crimp *(1)* **M** = M23 industrial connector *(2)*	K M D I 1 **F** R D 1 7 A 4 –EQ
Communication **R** = RS-422/485	K M D I 1 F **R** D 1 7 A 4 –EQ
P2 connector **D** = IDC **L** = wire crimp **Q** = M12 industrial connector *(2)*	K M D I 1 F R **D** 1 7 A 4 –EQ
Motor size **17** = NEMA 17 (1.7" / 42 mm)	K M D I 1 F R D **1 7** A 4 –EQ
Motor length **A** = single stack **B** = double stack **C** = triple stack	K M D I 1 F R D 1 7 **A** 4 –EQ
Drive voltage **4** = +12 to +48 VDC	K M D I 1 F R D 1 7 A **4** –EQ
Options Leave blank if not wanted Options may be combined, unless noted **–EQ** = internal encoder, 512-line internal magnetic encoder with index mark **–EE** = remote encoder interface, differential encoder to be provided by user *Available with Plus² versions only. May not be combined with internal encoder option.* **–N** = rear control knob for manual positioning *(3)*	**–EQ**

(1) Only available with Plus² products without industrial connectors.
(2) Only available with Plus² products with industrial connectors.
(3) Not available with industrial connector products.

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, conf guration 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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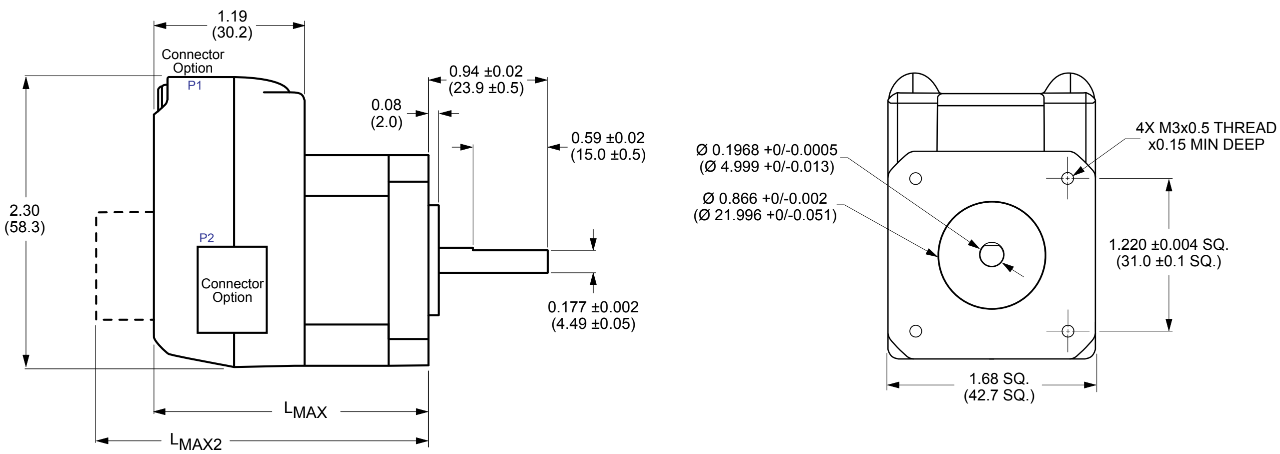
2 Specifications

2.1 Mechanical specifications

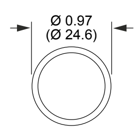
2.1.1 Dimensional information



MDrive Lengths *Inches (mm)*

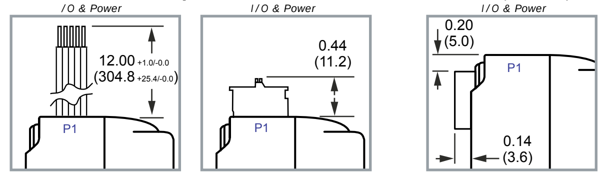
Motor Length	L_{MAX} SINGLE SHAFT, INTERNAL ENCODER or LINEAR ACTUATOR	L_{MAX2} CONTROL KNOB
Single	2.20 (55.9)	2.79 (70.9)
Double	2.43 (61.7)	3.02 (76.7)
Triple	2.77 (70.4)	3.37 (85.6)

L_{MAX2} Option



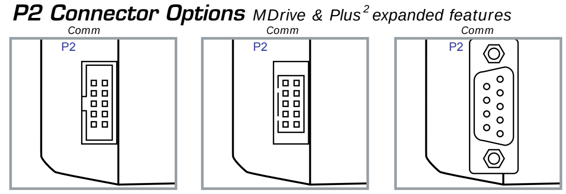
Control Knob

P1 Connector Options *MDrive*   *MDrive (Plus² expanded features)*



Flying Leads   *7-Pin Pluggable Clamp Type Terminal Strip*   *16-Pin Pluggable Locking Wire Crimp*

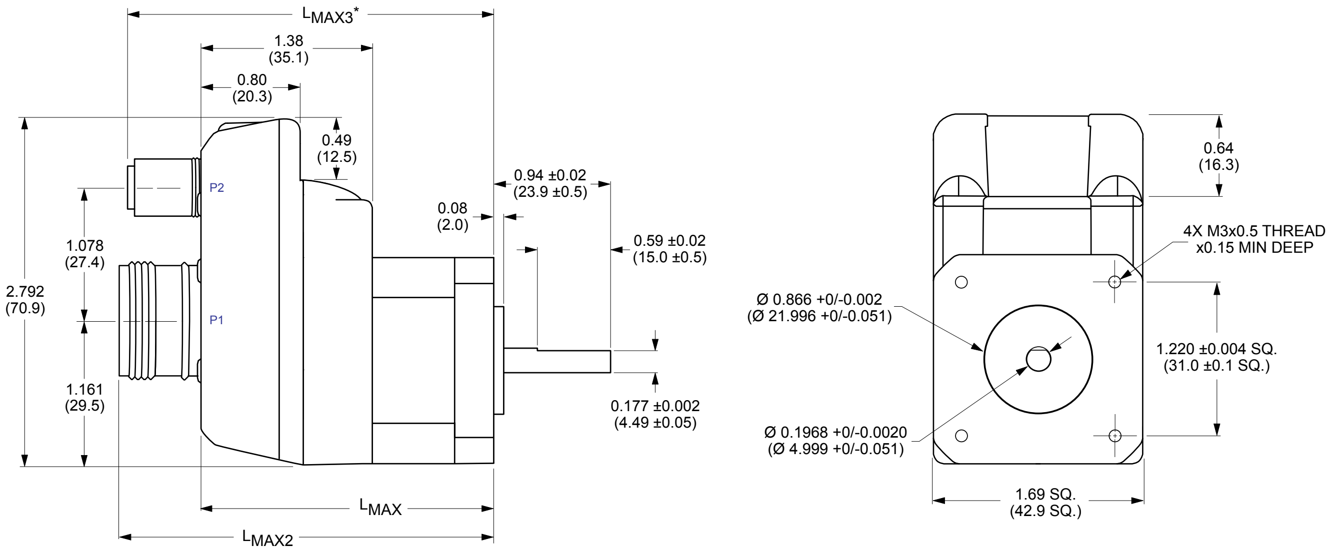
P2 Connector Options *MDrive & Plus² expanded features*



10-Pin IDC   *10-Pin Friction Lock Wire Crimp*   *DB9 (Male) for CANopen Only*

Figure 2.1 Standard and Expanded features mechanical specif cations

2.1.2 Dimensional information - sealed version



Sealed MDrive Lengths *Inches (mm)*

Motor Length	LMAX	LMAX2	LMAX3*
Single	2.48 (63.00)	3.15 (80.00)	3.08 (78.23)
Double	2.71 (68.83)	3.38 (85.85)	3.31 (85.10)
Triple	3.04 (77.22)	3.71 (94.23)	3.64 (92.46)

*CANopen increases measurement by 0.09"/2.0mm

Connectors

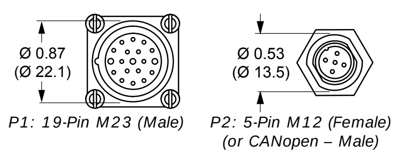


Figure 2.2 Sealed mechanical specif cations

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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 specif cations

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 specif cations

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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	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 specif cations

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2.2.4 Communication 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 Communication specif cations

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 specif cations

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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 x 10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specif cations

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 specif cations

Revision R020711

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 specif cations

2.2.9 Speed-force performance curves

Single length motor

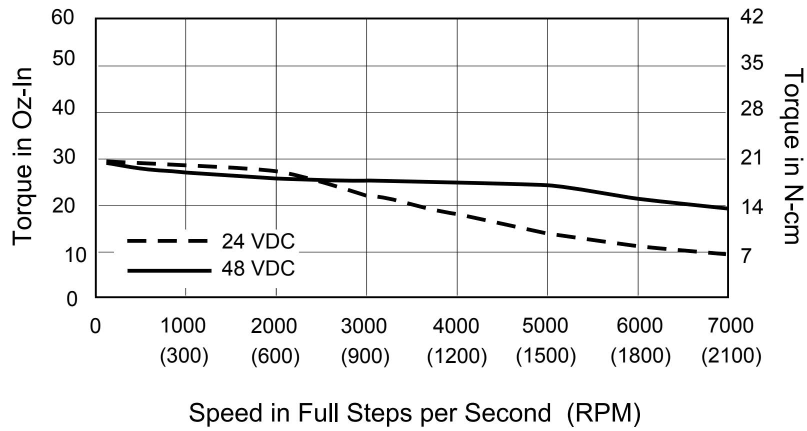

Figure 2.3 Single length motor

Double length motor

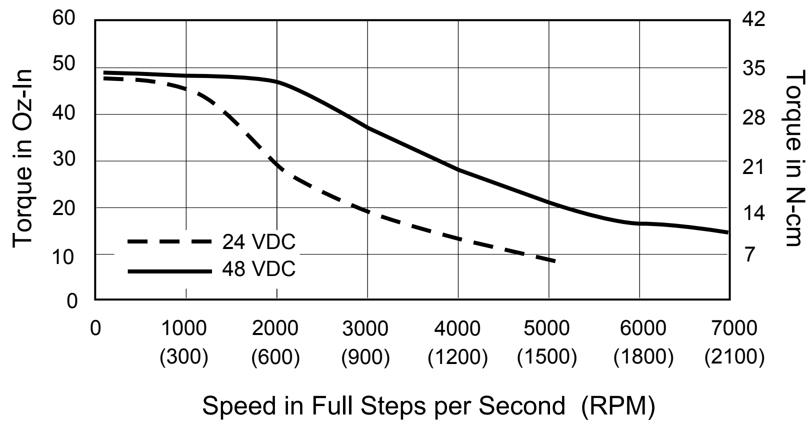

Figure 2.4 Double length motor

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Triple length motor

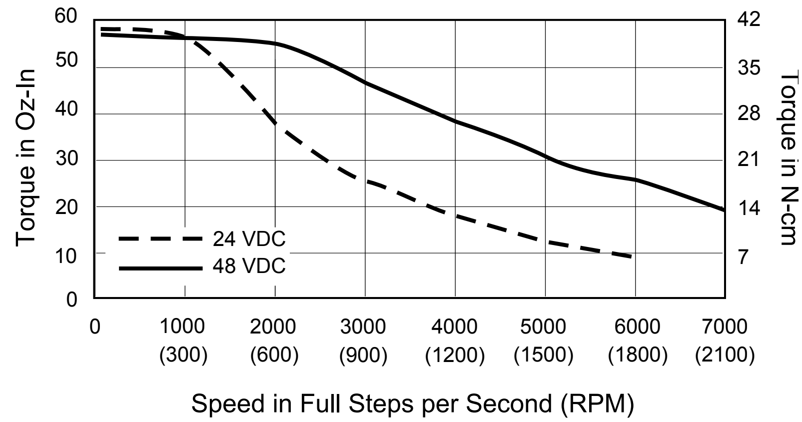
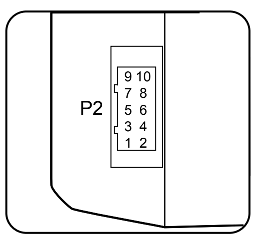


Figure 2.5 Triple length motor

2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

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

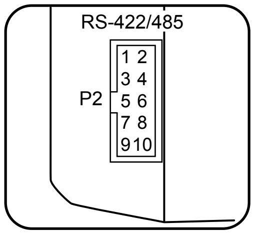
Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

Revision R020711

10-pin press-f t (IDC style)



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

Mating connector kit:
CK-01

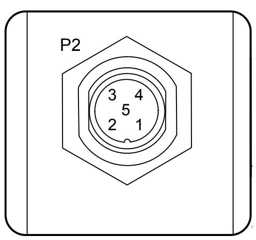
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

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	Communication ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communication, 10-pin pressure f t IDC/SAMTEC

5-pin M12 industrial



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

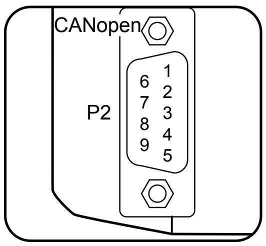
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communication ground

Table 2.11 P2 communication, 10-pin pressure f t IDC/SAMTEC

Revision R020711

2.3.2 CANopen communication option

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

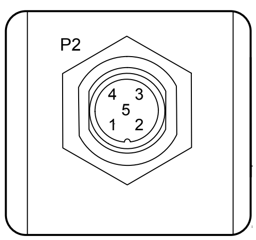


Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communication 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 communication, P2: 9-pin D-sub female (DB-9F)

5-pin M12 industrial



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

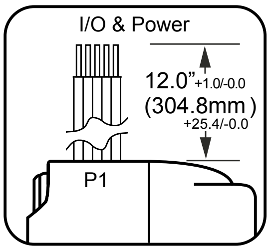
Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	CAN communication ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 2.13 CANopen communication, 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)

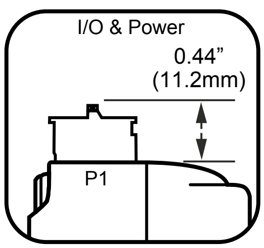
12” (304.8 mm) f ying leads

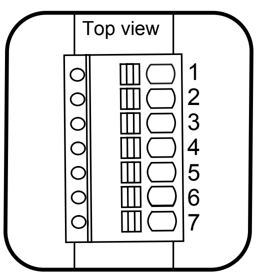


Wire Color	Function	Description
White/yellow	I/O 1	General purpose I/O point 1
White/orange	I/O 2	General purpose I/O point 2
White/violet	I/O 3	General purpose I/O point 3
White/blue	I/O 4	General purpose I/O point 4
Green	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
Black	GND	Power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

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

7-pin pluggable terminal



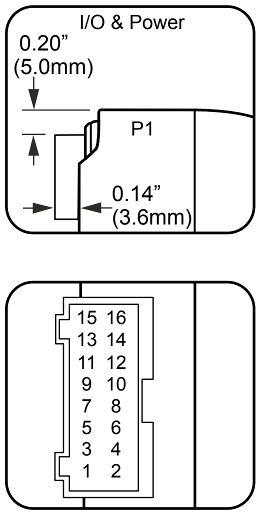


Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power

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



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

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

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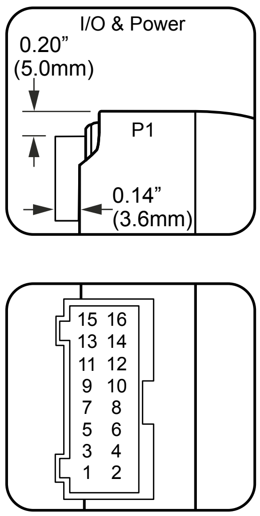
2.4.3 Power and I/O - remote encoder (Plus²)

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

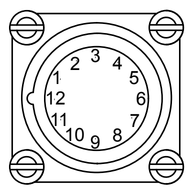
Pin #	Function	Description
1	I/O power	I/O Power, used with sourcing inputs or outputs.
2	I/O GND	Non-isolated I/O Ground. Common with Power Ground.
3	I/O 1	0 to +24 VDC Programmable I/O Point 1
4	I/O 2	0 to +24 VDC Programmable I/O Point 2
5	I/O 3	0 to +24 VDC Programmable I/O Point 3
6	I/O 4	0 to +24 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

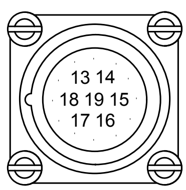
2.4.4 DC power and I/O - expanded I/O (Plus²-65)

19-pin M23 industrial

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 IM23 industrial connector

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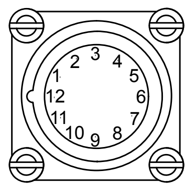
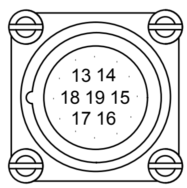
2.4.5 DC power and I/O - remote encoder (Plus²-65)

19-pin M23 industrial

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 industrial 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.

2.6 Connectivity

QuickStart kit

For rapid design verif 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-f t IDC....................................... MD-CC400-001

P2 5-pin M12 industrial.. MD-CC401-001

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

Prototype Development Cables

Speed test/development with pre-wired mating connectors that have f ying 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 industrial (straight)........................... MD-CS100-000

P1 19-pin M23 industrial (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-f t IDC... CK-01

P2 10-pin wire crimp.. CK-02

P1 16-pin wire crimp.. CK-10

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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 communication 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 conf gurations 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

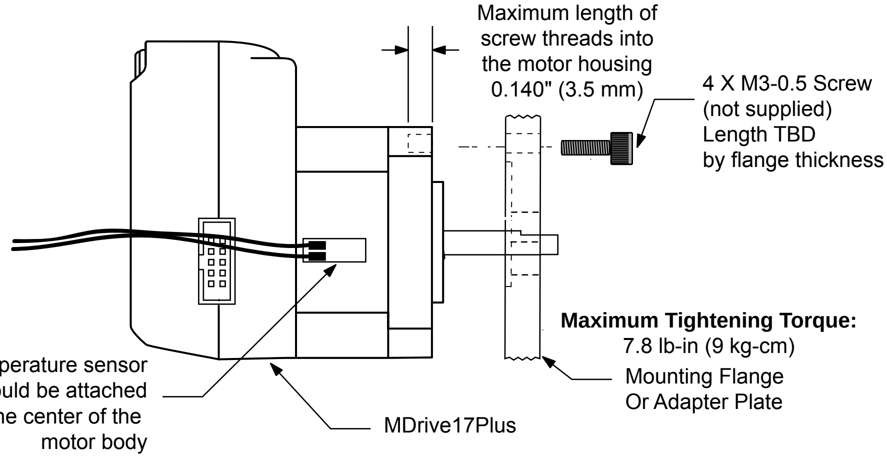
The mounting plate material should offer suff cient mass and thermal conductivity to ensure that the motor temperature does not eceed 100°C.

Failure to follow these instructions can result in equipment damage.

3.1 Mounting

Care must be observed when installing the mounting screws on ALL MDrive 17 versions. The mounting holes on the f ange 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

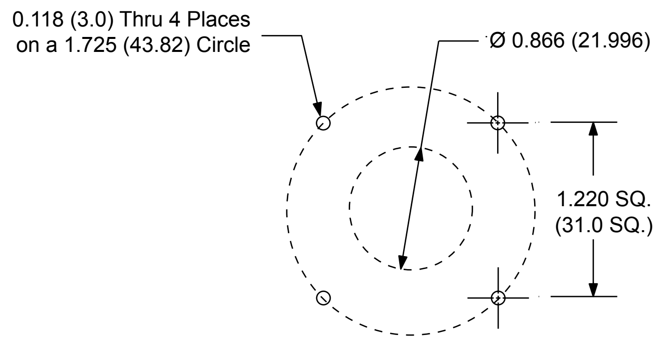


Figure 3.1 MDrive 17 mounting and drill pattern

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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 f oat. 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.

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

Communication

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-f t 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

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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 (f ying, pluggable or threaded) must be properly anchored. This will prevent f exing and tugging which can cause damage at critical connection points within the MDrive.

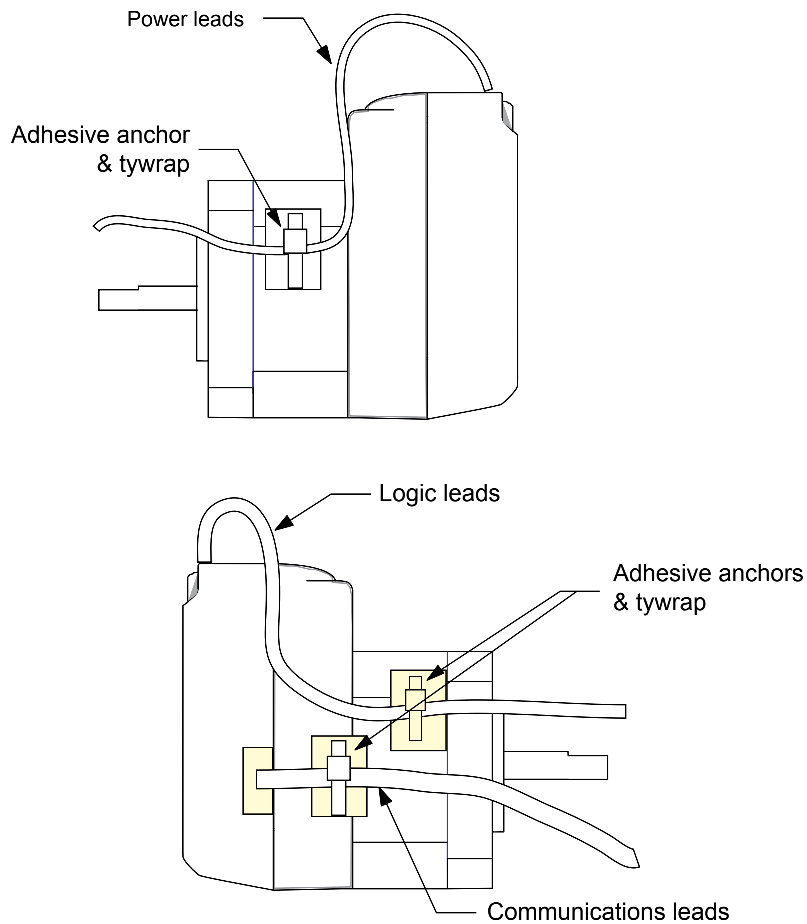

Figure 3.2 Securing leads

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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 communication 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 communication

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

⚠ CAUTION

Communication GROUND LOOPS

To avoid ground loops in the system only connect communication ground to the f rst MDrive in the system. Do not connect communication ground on subsequent MDrives.

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

⚠ CAUTION

HOT PLUGGING!

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

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

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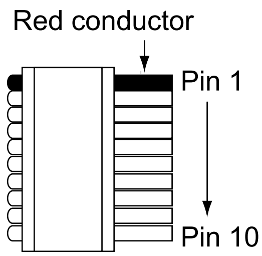
4.1.1 P2 — 10-pin pressure-fit IDC style connector



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	Communication ground only. Do not ground aux-logic to this pin.

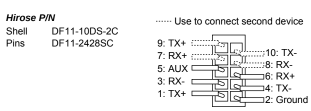
Table 4.1 Communication connections, P2 - 10-pin IDC

Connectivity accessories

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

Communication 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	Communication 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

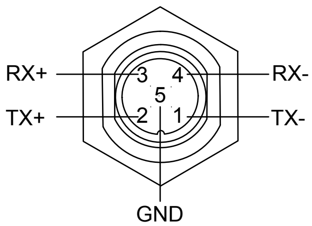
Table 4.2 P2 communication, 10-pin locking wire crimp

Connectivity accessories

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

Communication converter cable (10’/3.0 m)............. MD-CC402-001

4.1.3 P2 — 5-pin M12 industrial connector



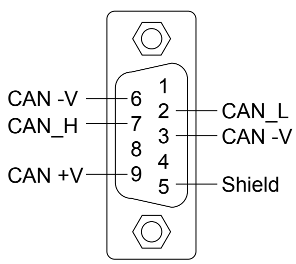
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm GND	Communication ground only. Do not ground aux-logic to this pin.

Table 4.3 P2 communication, 5-pin M12F industrial connector

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

4.2 Interfacing CANopen communication

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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communication converter cable...............................MD-CC500-000

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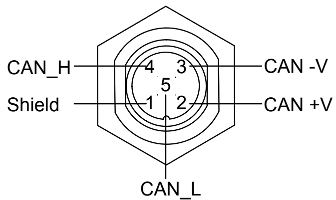
4.2.2 P2 — 5-pin M12 industrial connector (female)



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 communication, P2: 5-pin M12 female

Connectivity accessories

Communication converter cable MD-CC500-000

4.3 Interfacing DC power

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

⚠ **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

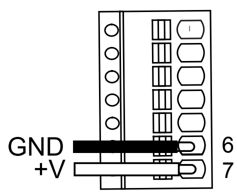
Table 4.7 Recommended power supply wire gauge

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, f ying leads

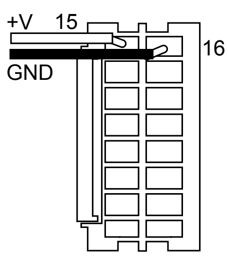
4.3.4 P1 — 7-pin pluggable terminal interface



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

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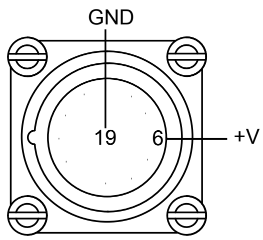
(contains 5 connector shells, ribbon cable not included)

4.3.6 P1 — 19-pin M23 industrial interface



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

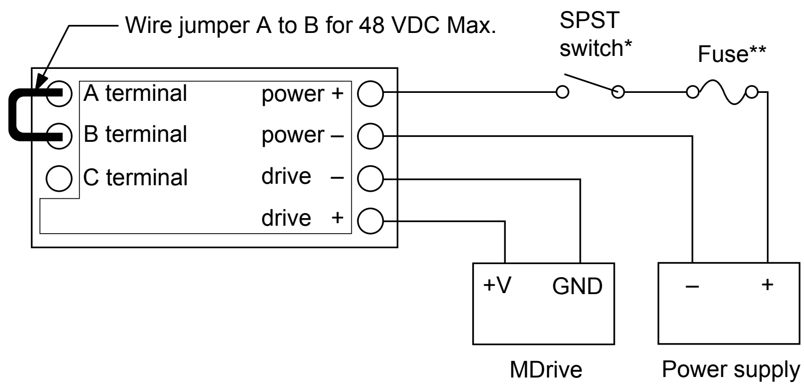
Table 4.10 Power and ground connections, 12-pin locking wire crimp

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

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4.4 Interfacing I/O

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

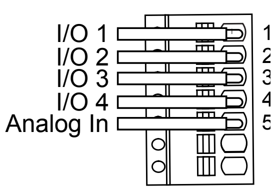
⚠ CAUTION
ELECTRICAL OVERSTRESS The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC: 1) Capture/Trip 2) Step/Direction 3) Remote encoder inputs Do not exceed +5 VDC on these points. **Failure to follow these instructions can result in 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, f ying 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

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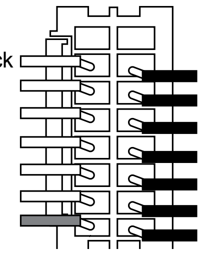
4.4.3 P1 — 16-pin locking wire crimp interface (Plus^2 expanded features)



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

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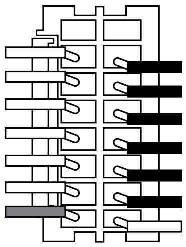
4.4.4 P1 — 16-pin locking wire crimp interface (remote encoder)



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

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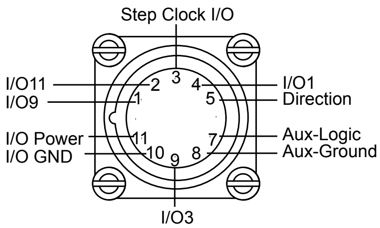
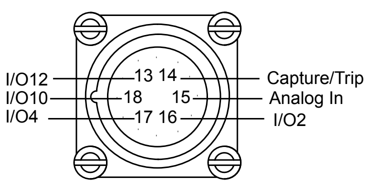
4.4.5 P1 — 19-pin M23 industrial connector (Plus² expanded features)

Outside: Pins 1 -12



Inside: Pins 13 -19

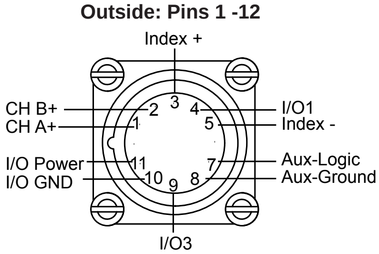


Pin Numbers	***Signal***	***Prototype development cable wire colors (twisted pairs)***
1	I/O 9	Violet
2	I/O 11	Red
3	Step/Clock I/O	Grey
4	I/O 1	Red/Blue
5	Direction I/O	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	I/O 12	Yellow/Brown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

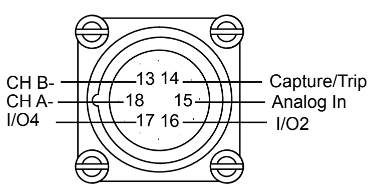
Table 4.15 I/O connections, 19-pin M23 industrial

4.4.5 P1 — 19-pin M23 industrial 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 4.161 I/O connections, 19-pin M23 industrial

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4.5 Connectivity accessory details

4.5.1 RS-422/485 communication 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 conf guration parameters

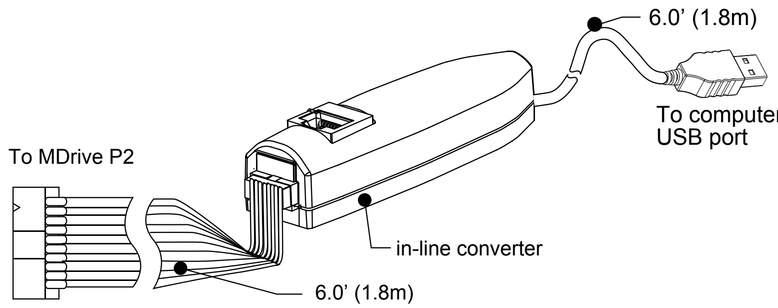

Figure 4.2 MD-CC400-000 communication converter cable

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 conf guration parameters

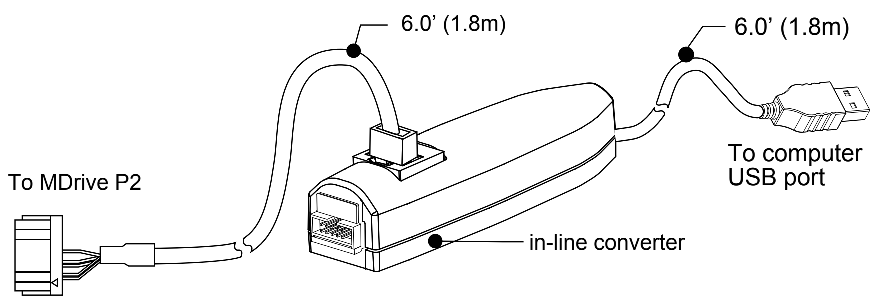

Figure 4.3 MD-CC402-001 communication converter cable

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USB to 5-pin industrial 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 conf guration 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

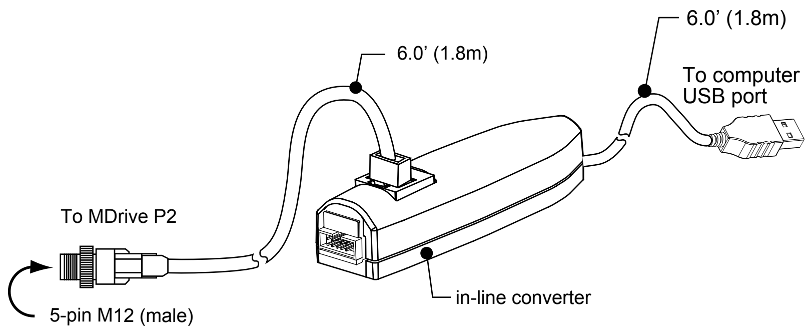
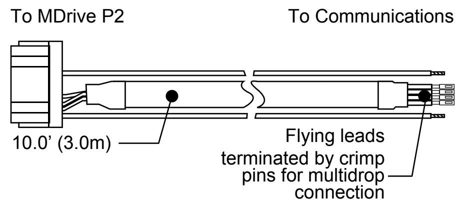


Figure 4.4 MD-CC401-001 communication converter

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 communication converter cable to facilitate multi-drop RS-422/485 communication.



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

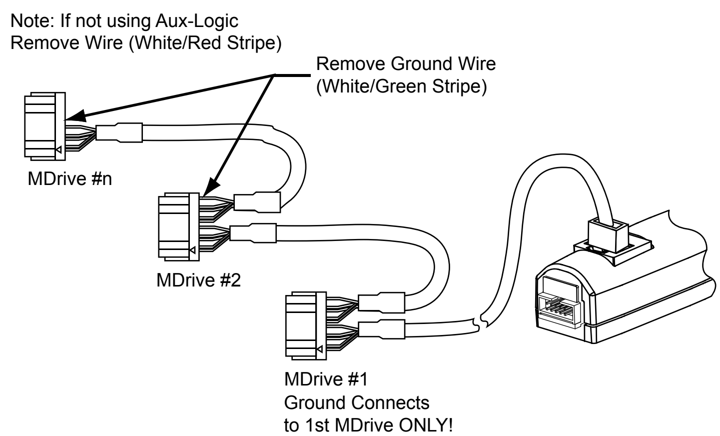


Figure 4.5 Multi-drop communication using the PD10-1434-FL3

Procedure

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

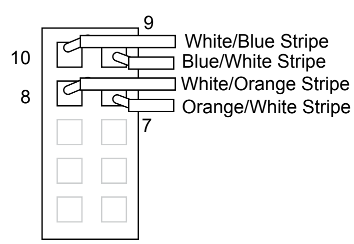


Figure 4.6 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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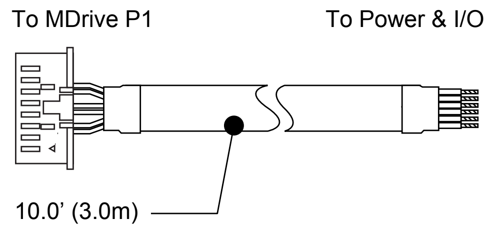
Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

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 f ying leads on the opposite end to interface

to p



Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
16	Black	GND	GND	X
15	Red	+V	+V	
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	White	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

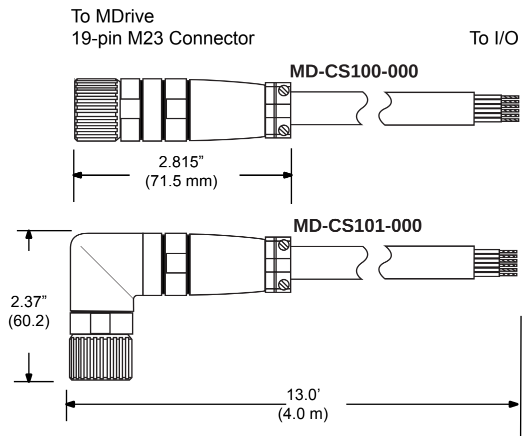
Figure 4.7 Prototype development cable PD16-1417-FL3

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



Ensure adequate space is available within your enclosure for the cordset connector!

Pin #	***Wire Colors***	***Signal (Expanded Features)***	***Signal (Remote encoder)***
1	Violet	I/O9	Channel A +
2	Red	I/O11	Channel B +
3	Gray	Step Clock	Index +
4	Red/Blue	I/O1	I/O1
5	Green	Direction	Index –
6	Blue	+V	+V
7	Gray/Pink	Aux-Logic	Aux-Logic
8	White/Green	Comm GND	Comm GND
9	White/Yellow	I/O3	I/O3
10	White/Gray	I/O GND	I/O GND
11	Black	I/O Power	I/O Power
12	Green/Yellow	Shell Connect	Shell Connect
13	Yellow/Brown	I/O12	Channel B –
14	Brown/Green	Capture/Trip	Capture/Trip
15	White	Analog In	Analog In
16	Yellow	I/O2	I/O2
17	Pink	I/O4	I/O4
18	Gray/Brown	I/O10	Channel A –
19	Brown	GND	GND

Figure 4.8 MD-CS10x-000 cordset

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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-f t IDC...CK-01

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

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

P3 2-pin wire crimp...CK-04

MDrive® 23
Motion Control

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

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Revision R020711

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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.

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 and Ethernet. 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. The Ethernet versions supports MODBUS/TCP and MCode/TCP.

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

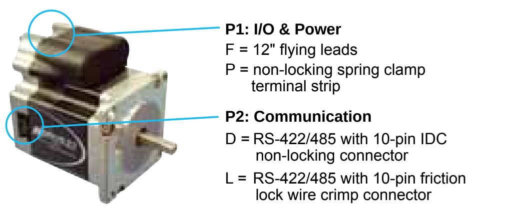
Numerous connector styles give you choices for the best fit and features. Select from 12.0” (30.5cm) flying leads, pluggable terminal strip, locking wire crimp connectors, and M12/M23 industrial connectors.

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.

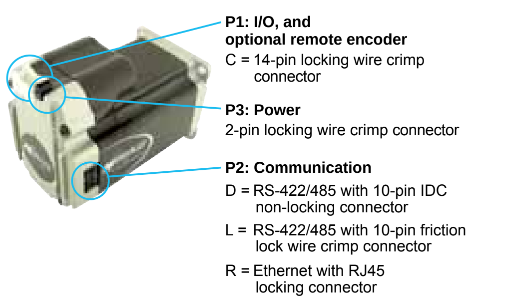
The MDrive 23 is a compact, powerful and cost effective motion control solution that will reduce system cost, design and assembly time for a large range of brushless step motor applications.

1.2 Product identification

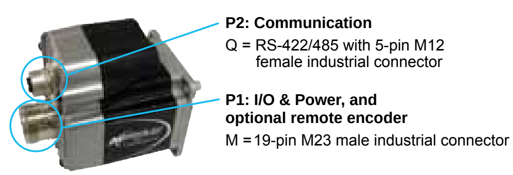
MDrive® 23 Plus



MDrive® 23 Plus²



MDrive® 23 Plus² with industrial connectors



Part numbers													
Example:	**K**	**M**	**D**	**I**	**1**	**F**	**R**	**D**	**2**	**3**	**A**	**7**	**–EQ**
QuickStart Kit **K** = kit option, or leave blank if not wanted	**K**	M	D	I	1	F	R	D	2	3	A	7	–EQ
MDrive Plus version **MDI** = Motion Control	K	**M**	**D**	**I**	1	F	R	D	2	3	A	7	–EQ
Input **1** = Plus, standard features **3** = Plus², expanded features **4** = Plus², expanded features, with industrial connectors, IP54-rated	K	M	D	I	**1**	F	R	D	2	3	A	7	–EQ
P1 connector **F** = flying leads **P** = pluggable **C** = wire crimp *(1)* **M** = M23 industrial connector *(2)*	K	M	D	I	1	**F**	R	D	2	3	A	7	–EQ
Communication **R** = RS-422/485 **E** = Ethernet *(3)*	K	M	D	I	1	F	**R**	D	2	3	A	7	–EQ
P2 connector **D** = IDC **L** = wire crimp **R** = RJ45 *(3)* **Q** = M12 industrial connector *(2)*	K	M	D	I	1	F	R	**D**	2	3	A	7	–EQ
Motor size **23** = NEMA 23 (2.3" / 57 mm)	K	M	D	I	1	F	R	D	**2**	**3**	A	7	–EQ
Motor length *(4)* **A** = single stack **B** = double stack **C** = triple stack **D** = quad stack	K	M	D	I	1	F	R	D	2	3	**A**	7	–EQ
Drive voltage *(4)* **7** = +12 to +75 VDC **6** = +12 to +60 VDC	K	M	D	I	1	F	R	D	2	3	A	**7**	–EQ
Options Leave blank if not wanted Options may be combined, unless noted **–EQ** = internal encoder, 512-line internal magnetic encoder with index mark **–EE** = remote encoder interface, differential encoder to be provided by user *Available with Plus² versions only. May not be combined with internal encoder option.(5)* **–N** = rear control knob for manual positioning *(6)*													**–EQ**

(1) Only available with Plus² products without industrial connectors.
(2) Only available with Plus² products with industrial connectors.
(3) Only available with Plus products with Ethernet protocol.
(4) Only quad stack motors have +12 to +60 VDC drives, all other motors have +12 to +75 VDC drives.
(5) Not available with Ethernet products.
(6) Not available with industrial connector products.

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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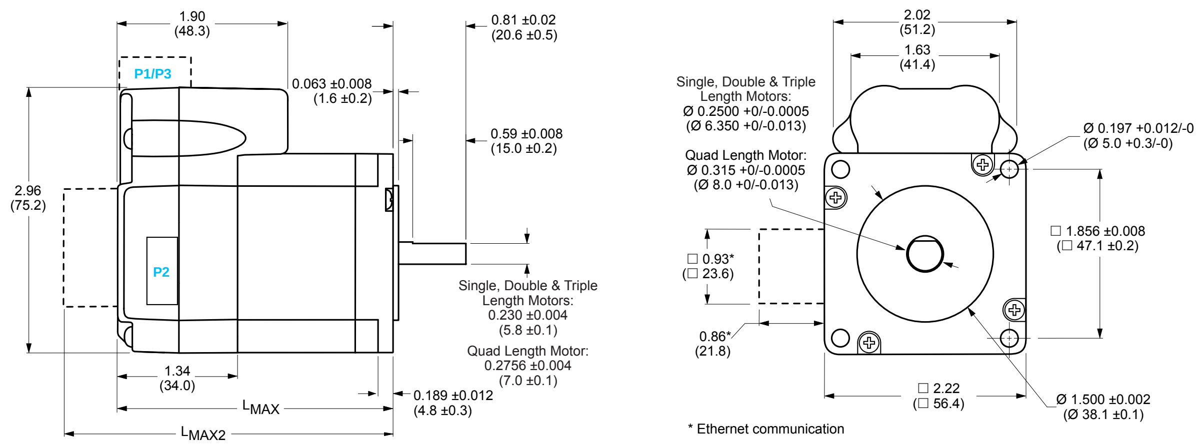
2 Specifications

2.1 Mechanical specifications

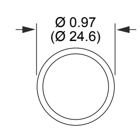
2.1.1 Standard and expanded features version



Motor stack length	Lmax *(1)*	Lmax2 *(2)*
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)

(1) Single shaft or internal encoder.
(2) Control knob or external encoder.

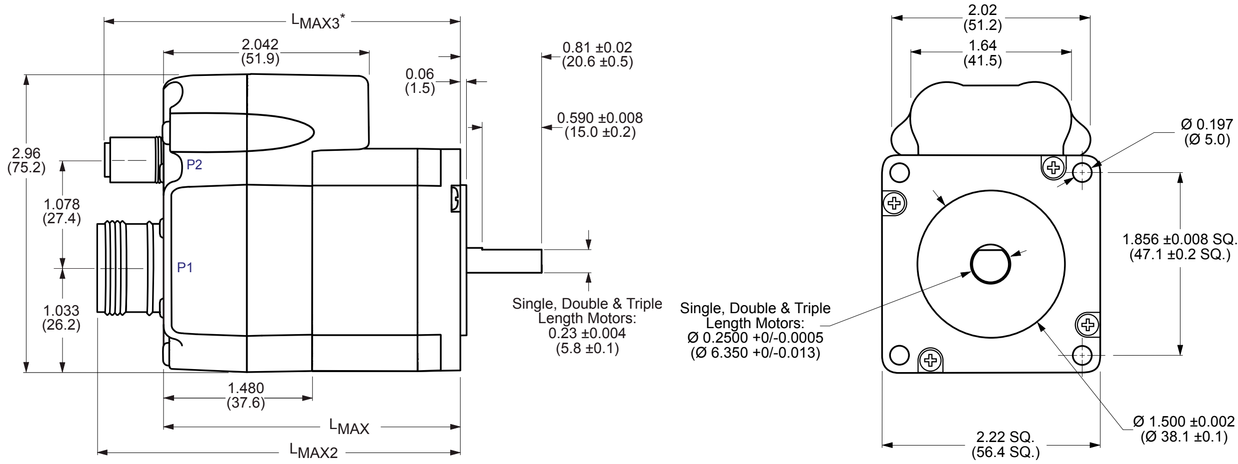
Lmax2 option



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

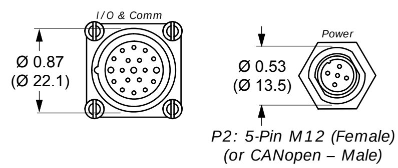
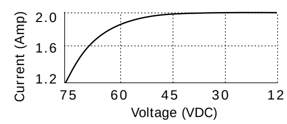
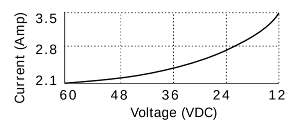


Figure 2.2 Sealed mechanical specifications

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

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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

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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					
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 Communication specifications

	Condition	Min	Typ	Max	Unit
RS-422/485 (standard)					
BAUD rate	—	4.8		115.2	kbps
Ethernet (optional)					
Protocols	MODBUS/TCP and MCode/TCP				
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 Communication specifications

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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 x 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

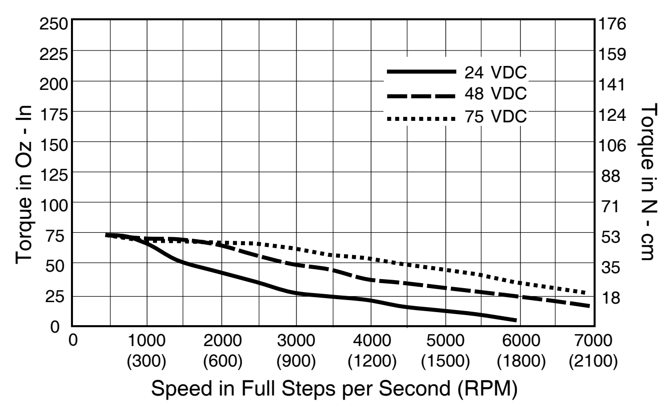

Figure 2.3 Motor performance curve — single length motor

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Double length motor

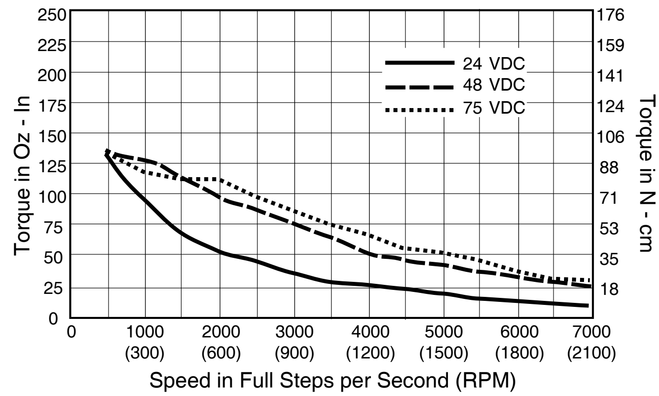

Figure 2.4 Motor performance curve — double length motor

Triple length motor

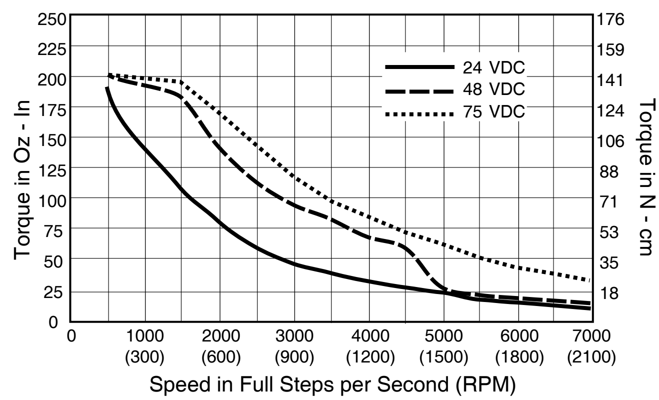

Figure 2.5 Motor performance curve — triple length motor

Quad length motor

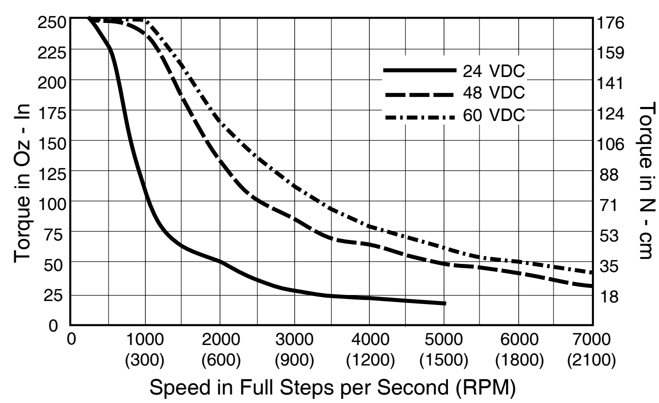

Figure 2.6 Motor performance curve — quad length motor

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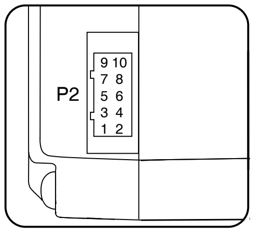
2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

10-pin friction lock wire crimp



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

Mating connector kit:
CK-02

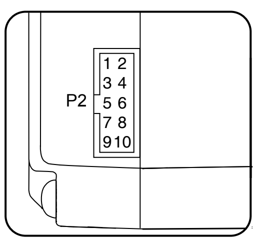
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

10-pin press-f t (IDC style)



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

Mating connector kit:
CK-01

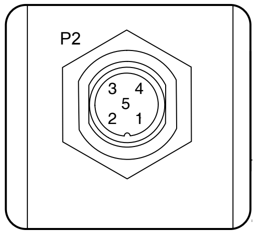
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

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	Communication ground only. Do not ground aux-logic to this pin.

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

5-pin M12 industrial



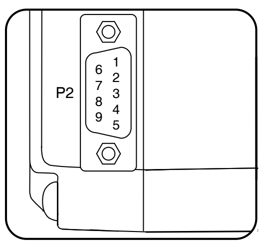
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communication ground

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

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

2.3.2 CANopen communication option

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

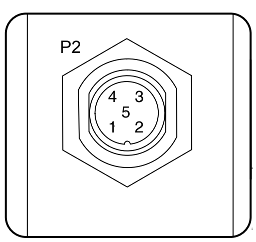


Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communication ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

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

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

5-pin M12 industrial



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

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

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

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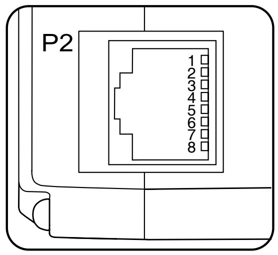
RJ45 (Ethernet versions only)



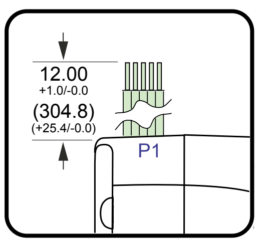
Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	N/C	Not connected
5	N/C	Not connected
6	RX -	Receive minus
7	N/C	Not connected
8	N/C	Not connected

Table 2.14 P2 communications, RJ45 (ethernet versions only)

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

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

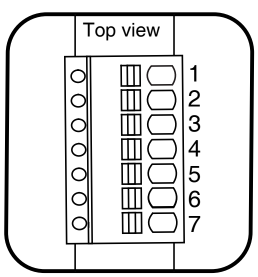
12” (304.8 mm) f ying leads



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 2.15 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 2.16 Power and I/O interface - 7-pin pluggable terminal

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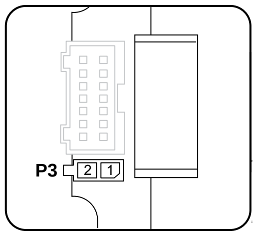
2.4.2 DC motor power

2-pin friction lock wire crimp



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

Mating connector kit:
CK-04

Mfg P/N:
Shell
Tyco 794617-2

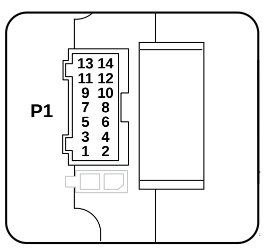
Pins
Tyco 794610-1

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

Table 2.17 P3 DC power, 2-pin locking wire crimp

2.4.3 I/O - expanded I/O (Plus[2])

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

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[1]	0 to +24 VDC Programmable I/O Point 9
8	I/O 10[1]	0 to +24 VDC Programmable I/O Point 10
9	I/O 11[1]	0 to +24 VDC Programmable I/O Point 11
10	I/O 12[1]	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 2.18 P1 Expanded I/O, 14-pin locking wire crimp

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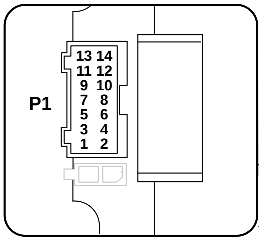
2.4.4 I/O - expanded I/O (Plus² – Ethernet version)

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

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 - 10	N/C	Not connected
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 2.19 P1 Expanded I/O (Ethernet Version), 14-pin locking wire crimp

2.4.5 I/O - remote encoder (Plus²)

Not available with Ethernet models

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	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 2.20 I/O and remote encoder interface - 16-pin locking wire crimp

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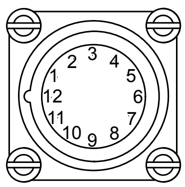
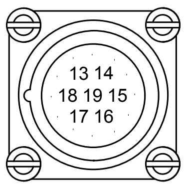
2.4.6 DC power and I/O - expanded I/O (Plus² with industrial connectors)

19-pin M23 industrial

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 2.21 P1 I/O and aux power, 19-pin lM23 industrial connector

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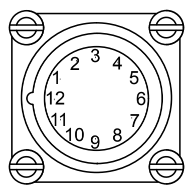
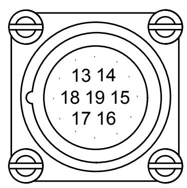
2.4.7 DC power and I/O - remote encoder (Plus² with industrial connectors)

19-pin M23 industrial

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 2.22 P1 I/O and aux power, 19-pin M23 industrial 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.

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 industrial...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 industrial (straight)............................ MD-CS100-000

P1 19-pin M23 industrial (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

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 communication 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 restrained 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.

3.1 Mounting

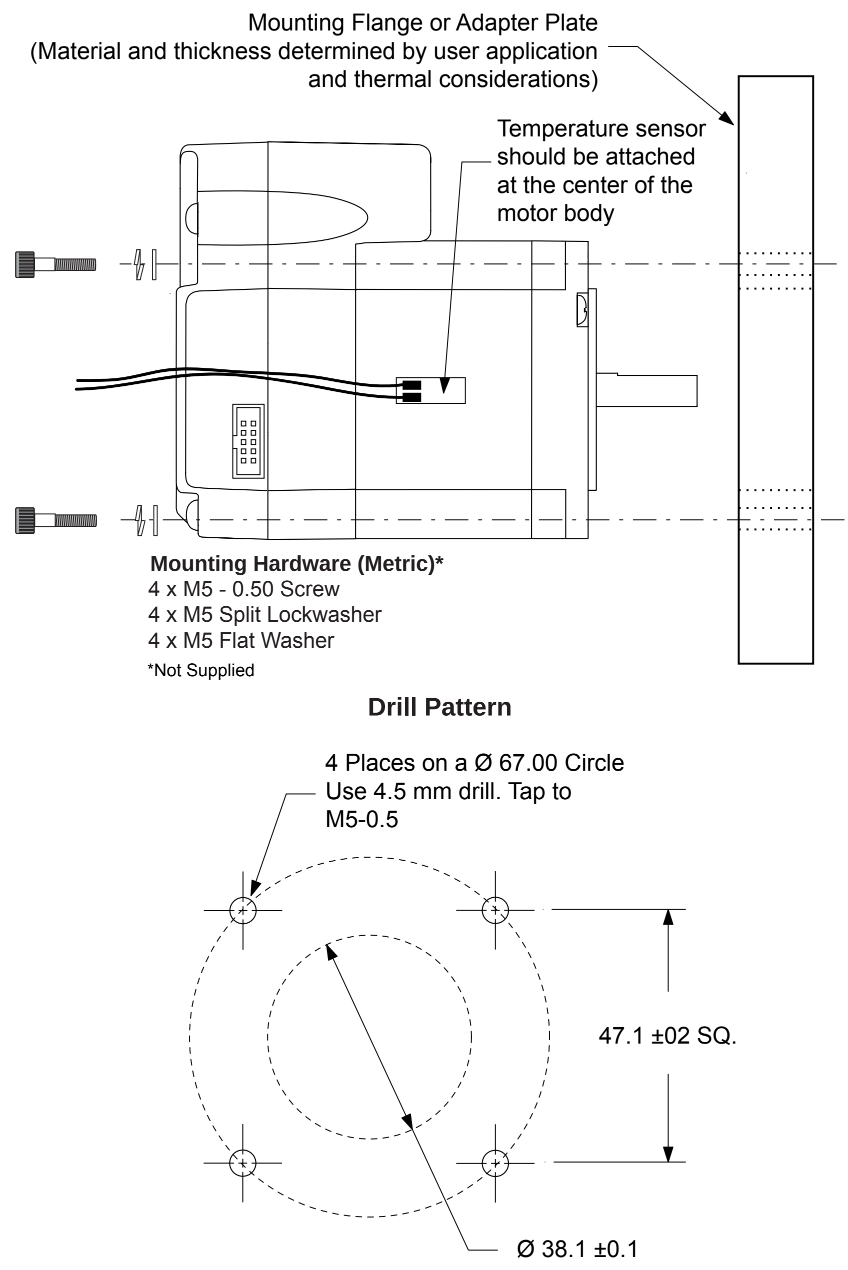


Figure 3.1 MDrive 23 mounting and drill pattern

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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.

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

Communication

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.

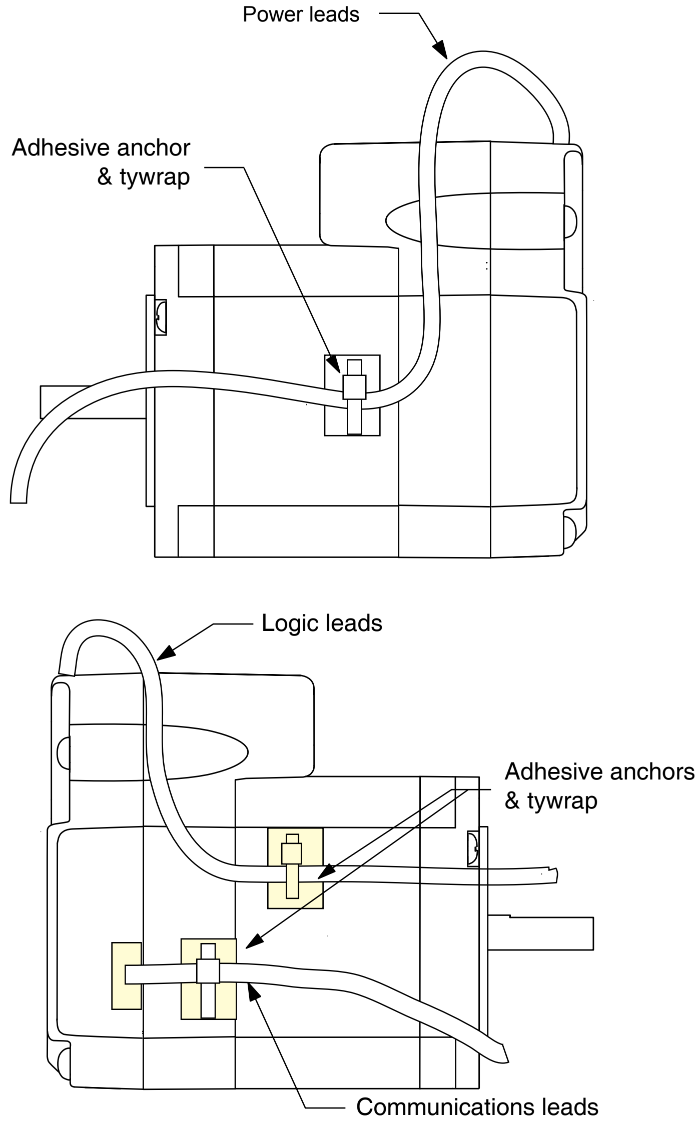

Figure 3.2 Securing leads

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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 communication 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 communication

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

⚠ CAUTION

Communication GROUND LOOPS

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

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

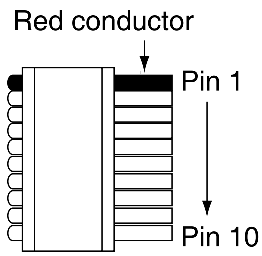
⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communication 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	Communication ground only. Do not ground aux-logic to this pin.

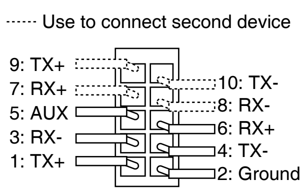
Table 4.1 Communication connections, P2 - 10-pin IDC

Connectivity accessories

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

Communication 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	Communication 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 communication, 10-pin locking wire crimp

Connectivity accessories

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

Communication converter cable (10’/3.0 m)............MD-CC402-001

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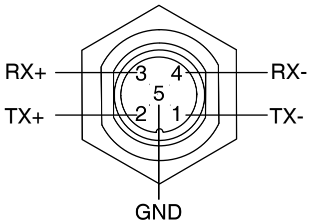
4.1.3 P2 — 5-pin M12 industrial connector (male)

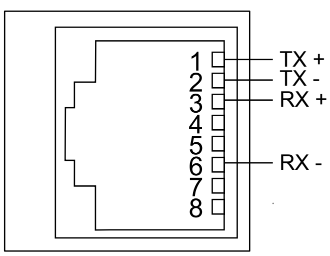


Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm GND	Communication ground only. Do not ground aux-logic to this pin.

Table 4.3 P2 communication, 5-pin M12F industrial connector

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

4.2 Interfacing Ethernet communication



Pin #	Function	Description
1	TX +	Transmit plus
2	TX -	Transmit minus
3	RX +	Receive plus
4	N/C	Not connected
5	N/C	Not connected
6	RX -	Receive minus
7	N/C	Not connected
8	N/C	Not connected

Table 4.4 P2 communication, Ethernet RJ45

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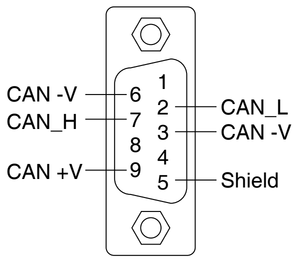
4.3 Interfacing CANopen communication

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

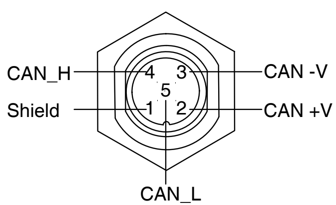


Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communication ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 4.5 CANopen communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories Communication converter cable MD-CC500-000

4.3.2 P2 — 5-pin M12 industrial 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 4.6 CANopen communication, P2: 5-pin M12 female

Connectivity accessories Communication converter cable MD-CC500-000

4.4 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.**

4.4.1 Recommended power supply characteristics

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

Table 4.7 Recommended power supply characteristics

4.4.2 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

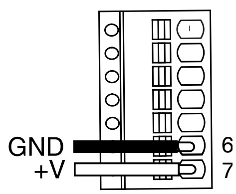
Table 4.8 Recommended power supply wire gauge

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

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.9 Power and ground connections, flying leads

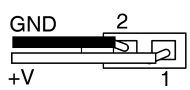
4.4.4 P1 — 7-pin pluggable terminal interface



Pin #	
6	Power ground
7	Motor power supply

Table 4.10 Power and ground connections, 7-pin terminal

4.4.5 P1 — 2-pin wire crimp interface



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

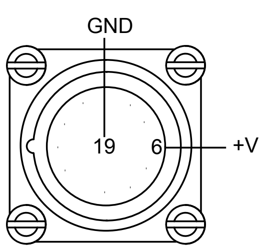
Table 4.11 Power and ground connections, 7-pin terminal

Connectivity accessories

Prototype development cable PD02-2300-FL3

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

4.4.6 P1 — 19-pin M23 industrial interface



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

Table 4.12 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

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4.5 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.

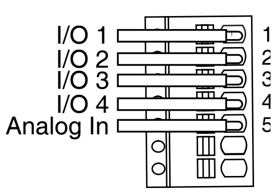
Failure to follow these instructions can result in equipment damage.

4.5.1 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 4.13 I/O connections, flying leads

4.5.2 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 4.14 I/O connections, 7-pin terminal

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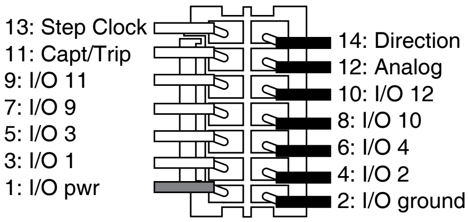
4.5.3 P1 — 14-pin locking wire crimp interface (expanded I/O)



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 4.15 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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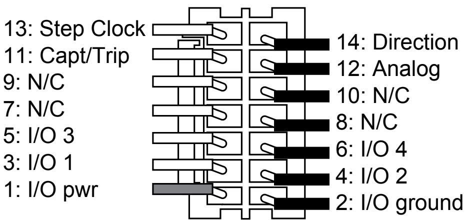
4.5.3 P1 — 14-pin locking wire crimp interface (Ethernet version)



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	Not connected	Yellow	Pair
8	Not connected	Black	
9	Not connected	Blue	Pair
10	Not connected	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 4.16 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)

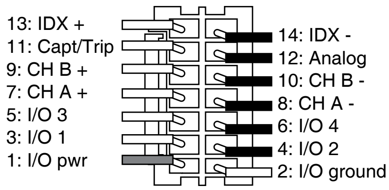
Prototype development cable (10’/3.0 m)................ PD14-2334-FL3

Manufacturer (JST) part numbers

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

Pins.. SPH-001T0.5L

4.5.4 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 4.17 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

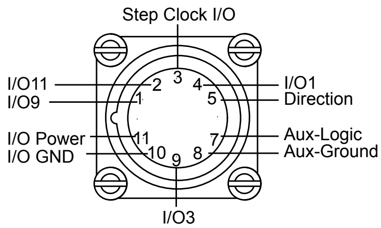
Manufacturer (JST) part numbers

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

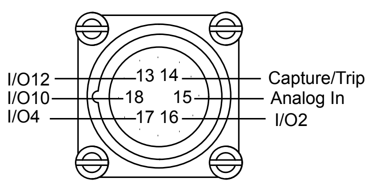
Pins... SPH-001T0.5L

4.5.5 P1 — 19-pin M23 industrial connector (expanded I/O)

Outside: Pins 1 -12



Inside: Pins 13 -19

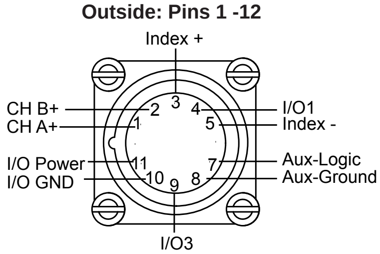


Pin Numbers	*Signal*	*Prototype development cable wire colors (twisted pairs)*
1	I/O 9	Violet
2	I/O 11	Red
3	Step/Clock I/O	Grey
4	I/O 1	Red/Blue
5	Direction I/O	Green
7	Aux-Logic	Gray/Pink
8	Aux-Ground	White/Green
9	I/O 3	White/Yellow
10	I/O GND	White/Gray
11	I/O PWR	Black
13	I/O 12	Yellow/Brown
14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

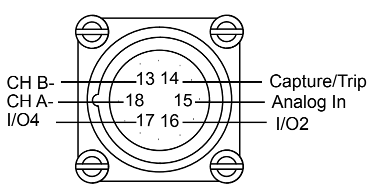
Table 4.18 I/O connections, 19-pin M23 industrial

4.5.5 P1 — 19-pin M23 industrial 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 4.18 I/O connections, 19-pin M23 industrial

4.6 Connectivity accessory details

4.6.1 RS-422/485 communication 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

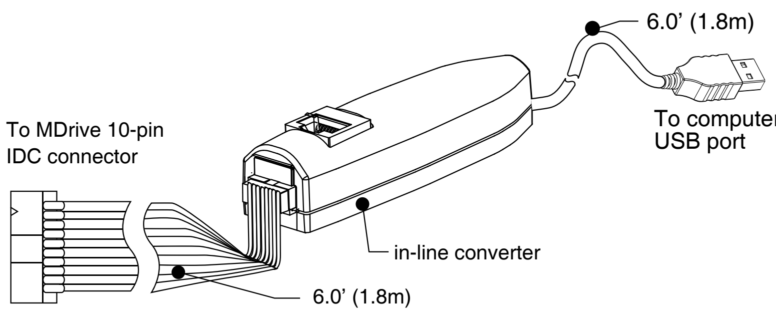


Figure 4.1 MD-CC400-000 communication converter cable

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

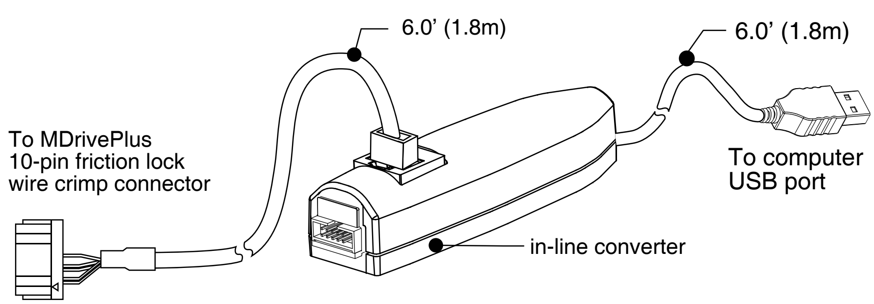


Figure 4.2 MD-CC402-001 communication converter cable

USB to 5-pin industrial 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

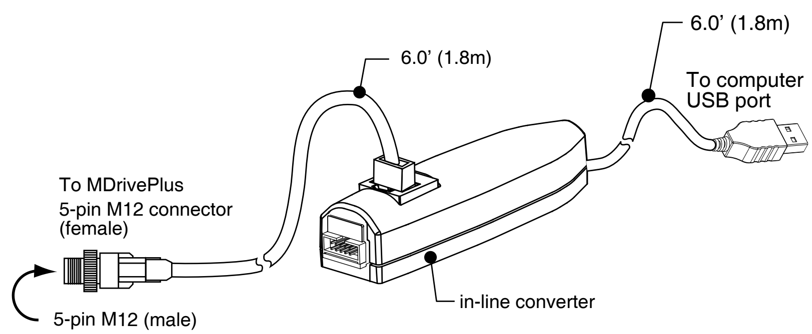


Figure 4.3 MD-CC401-001 communication converter

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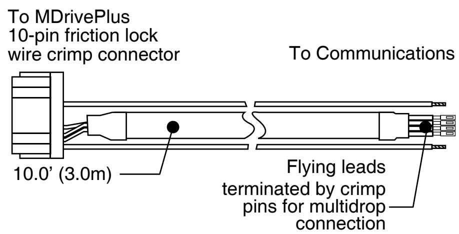
4.6.2 Prototype development cables

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

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



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

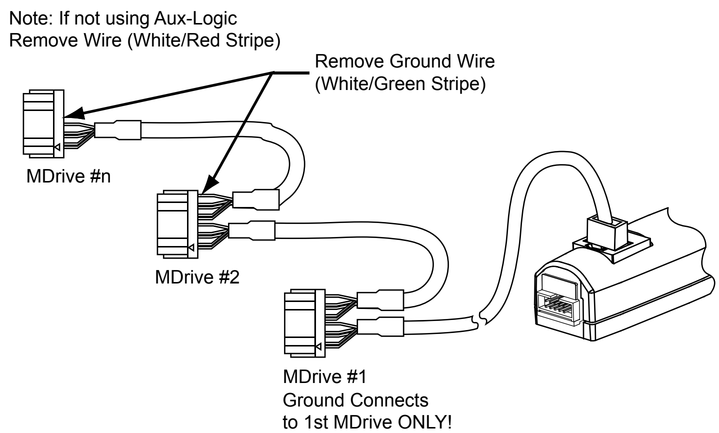


Figure 4.4 Multi-drop communication using the PD10-1434-FL3

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

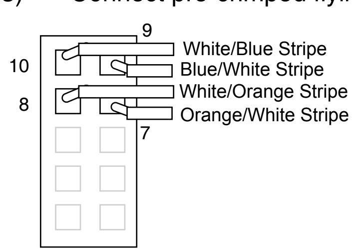
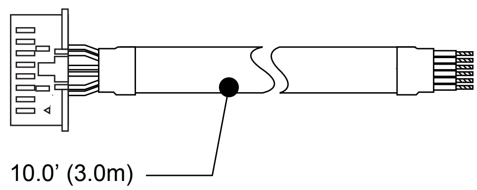


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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

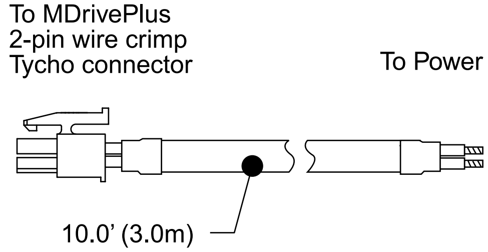


Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	Black	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

Figure 4.6 Prototype development cable PD14-2334-FL

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.



Pin #	***Wire Colors***	***Signal (Expanded features)***
2	Black	Ground
1	Red	+V

Figure 4.7 Prototype development cable PD02-2300-FL3

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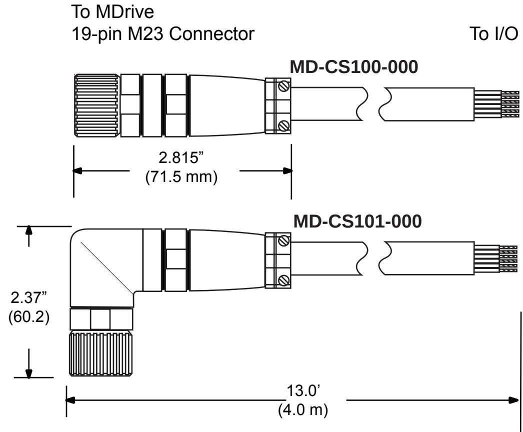
4.6.3 Connectivity option — 19 conductor cordset

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



Pin #	*Wire Colors*	*Signal (Expanded Features)*	*Signal (Remote encoder)*
1	Violet	I/O9	Channel A +
2	Red	I/O11	Channel B +
3	Gray	Step Clock	Index +
4	Red/Blue	I/O1	I/O1
5	Green	Direction	Index –
6	Blue	+V	+V
7	Gray/Pink	Aux-Logic	Aux-Logic
8	White/Green	Comm GND	Comm GND
9	White/Yellow	I/O3	I/O3
10	White/Gray	I/O GND	I/O GND
11	Black	I/O Power	I/O Power
12	Green/Yellow	Shell Connect	Shell Connect
13	Yellow/Brown	I/O12	Channel B –
14	Brown/Green	Capture/Trip	Capture/Trip
15	White	Analog In	Analog In
16	Yellow	I/O2	I/O2
17	Pink	I/O4	I/O4
18	Gray/Brown	I/O10	Channel A –
19	Brown	GND	GND

Figure 4.8 MD-CS10x-000 cordset

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4.7 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

MDrive® 34
Motion Control

1. Introduction
2. Specif cations
3. Mounting Recommendations
4. Interface and Connectivity

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List of Figures

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List of Tables

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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 f ow through the motor, resonance is signif cantly 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 f xed to the internal step clock.

All MDrive 34 Motion Control are available with optional closed loop control. This increases functionality by adding stall detection, position maintenance and f nd index mark.

The closed loop conf guration 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 conf gurations 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 identif er.

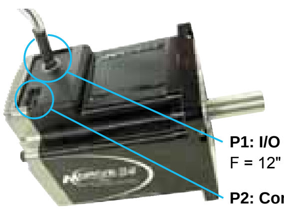
Numerous connector styles give you choices for the best f t and features. Select from 12.0” (30.5cm) f ying leads or locking wire crimp connectors.

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.

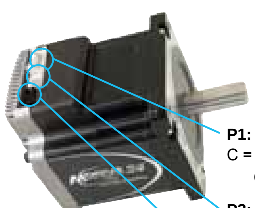
The MDrive 34 is a compact, powerful and cost effective motion control solution that will reduce system cost, design and assembly time for a large range of brushless step motor applications.

1.2 Product identification

MDrive® 34 Plus
flying leads interface



MDrive® 34 Plus²
pluggable interface



Part numbers													
Example:	**K**	**M**	**D**	**I**	**1**	**F**	**R**	**D**	**3**	**4**	**A**	**7**	**–EQ**
QuickStart Kit **K** = kit option, or leave blank if not wanted	**K**	M	D	I	1	F	R	D	3	4	A	7	–EQ
MDrive Plus version **MDI** = Motion Control	K	**M**	**D**	**I**	1	F	R	D	3	4	A	7	–EQ
Input **1** = Plus, standard features **3** = Plus², expanded features	K	M	D	I	**1**	F	R	D	3	4	A	7	–EQ
P1 connector **F** = ˜ying leads *(1)* **C** = pluggable *(2)*	K	M	D	I	1	**F**	R	D	3	4	A	7	–EQ
Communication **R** = RS-422/485	K	M	D	I	1	F	**R**	D	3	4	A	7	–EQ
P2 connector **D** = IDC *(1)* **L** = wire crimp	K	M	D	I	1	F	R	**D**	3	4	A	7	–EQ
Motor size **34** = NEMA 34 (3.4" / 86 mm)	K	M	D	I	1	F	R	D	**3**	**4**	A	7	–EQ
Motor length **A** = single stack **B** = double stack **C** = triple stack	K	M	D	I	1	F	R	D	3	4	**A**	7	–EQ
Drive voltage **7** = +12 to +75 VDC	K	M	D	I	1	F	R	D	3	4	A	**7**	–EQ
Options Leave blank if not wanted Options may be combined, unless noted **–EQ** = internal encoder, 512-line internal magnetic encoder with index mark **–EE** = remote encoder interface, differential encoder to be provided by user *Available with Plus² versions only. May not be combined with internal encoder option.* **–N** = rear control knob for manual positioning													**–EQ**

(1) Only available with Plus products.
(2) Only available with Plus² products.

Figure 1.1 Standard product options

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1.3 Documentation reference

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

- Product manual, describes the technical data, installation, conf guration 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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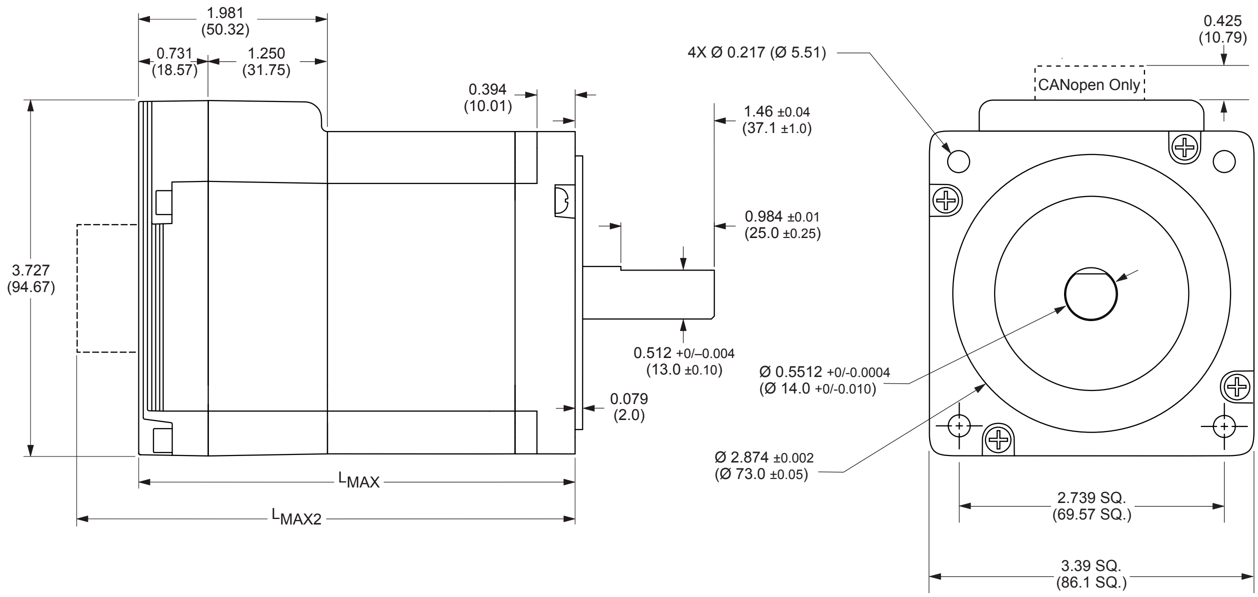
2 Specifications

2.1 Mechanical specifications

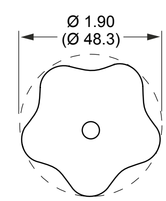
2.1.1 Standard and expanded features version



MDrive Lengths *Inches (mm)*

Motor Length	L_{MAX} SINGLE SHAFT, INTERNAL ENCODER	L_{MAX2} 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)

L_{MAX2} Option



Control Knob

Connector Options

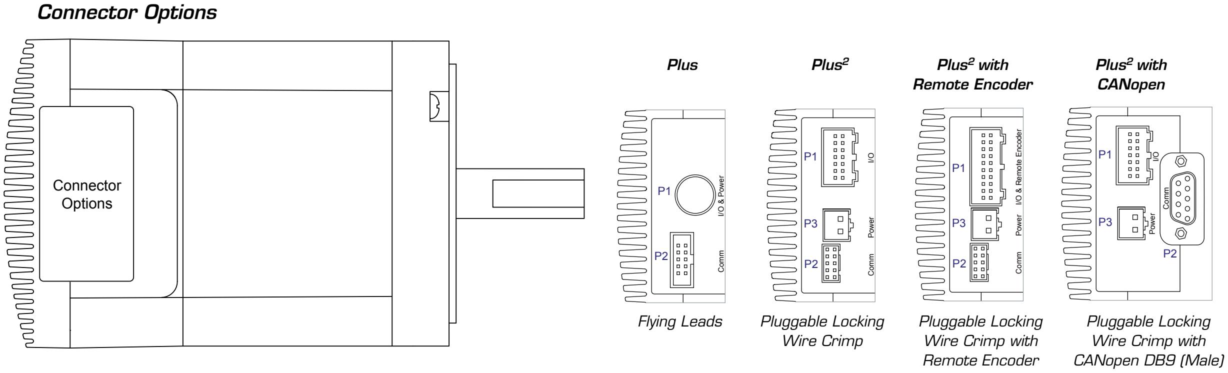


Figure 2.1 Standard and Expanded features mechanical specif cations

Revision R020711

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 specif cations

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 specif cations

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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 specif cations

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2.2.4 Communication 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 Communication specif cations

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 specif cations

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 specif cations

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 specif cations

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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-sec² (kg-cm²)	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 specif cations

2.2.9 Performance curves

Single length motor

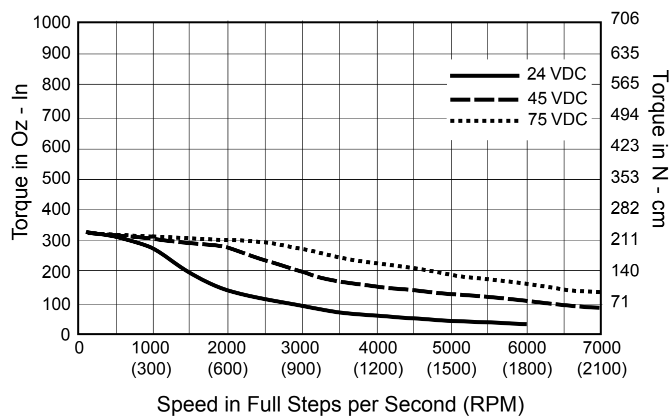

Figure 2.2 Performance curves - single length motor

Double length motor

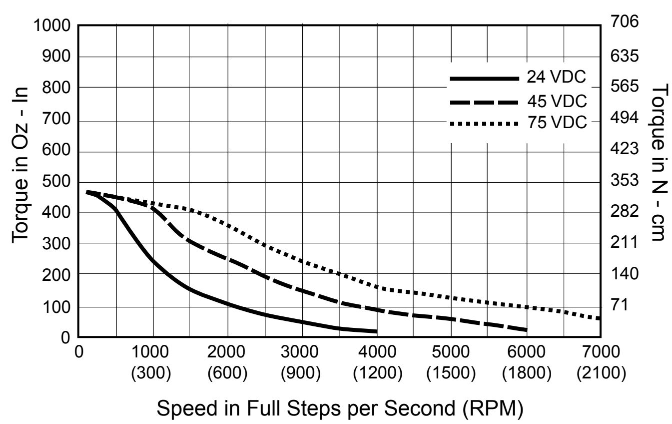

Figure 2.3 Performance curves -double length motor

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Triple length motor

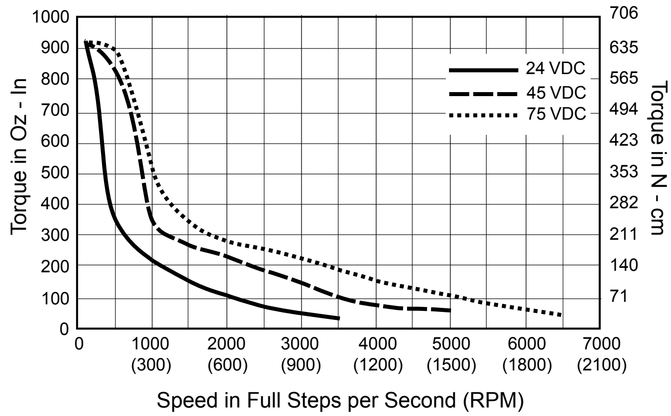
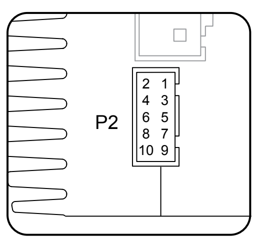


Figure 2.4 Performance curves -triple length motor

2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

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

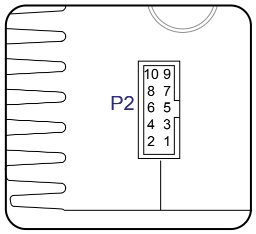
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

10-pin press-f t (IDC style) Only available on f ying 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

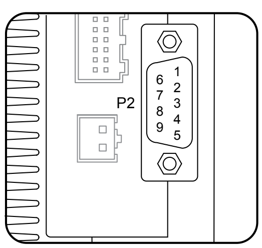
Ribbon cable
Tyco: 1-57051-9

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	Communication ground only. Do not ground aux-logic to this pin.

Table 2.10 P2 communication, 10-pin pressure f t IDC/SAMTEC

2.3.2 CANopen communication 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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

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

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

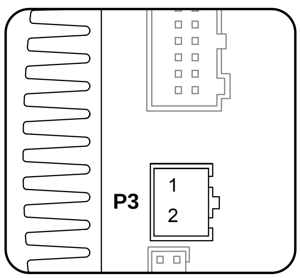
12” (304.8 mm) f ying leads

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) f ying leads

2.4.2 DC motor power

2-pin friction lock wire crimp



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

Mating connector kit:
CK-05

Mfg P/N:
Shell
Molex 751067-0200

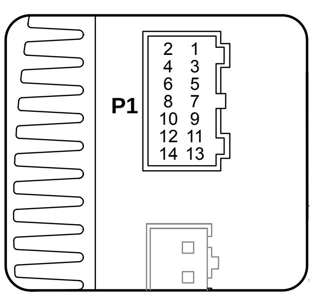
Pins
Molex 750217-9101

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

2.4.3 I/O - expanded I/O (Plus^2)

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

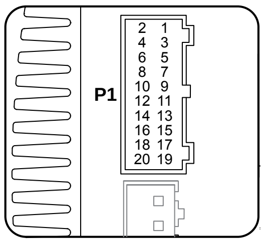
Pins
JST SPH-001T0.5L

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

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.

2.6 Connectivity

QuickStart kit

For rapid design verif 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-f t 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 f ying 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-f t 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 communication 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 conf gurations 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 suff cient 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

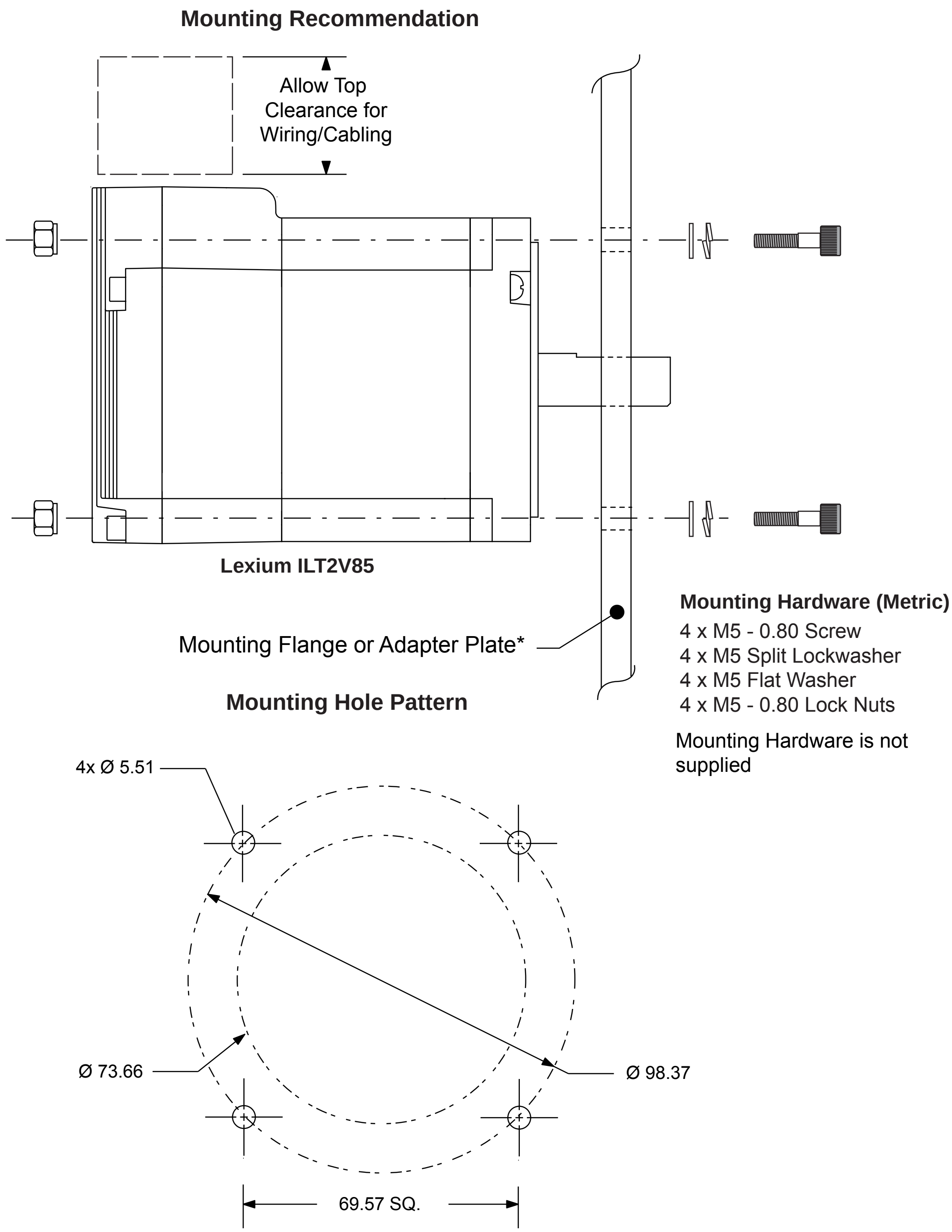

Figure 3.1 MDrive 34 mounting and drill pattern

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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 f oat. 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.

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

Communication

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 (f ying, pluggable or threaded) must be properly anchored. This will prevent f exing and tugging which can cause damage at critical connection points within the MDrive.

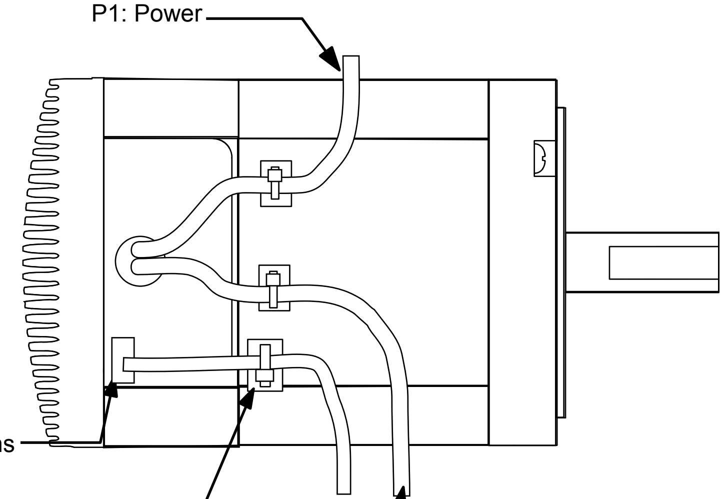

Figure 3.2 Securing leads

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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 communication 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 communication

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

⚠ CAUTION

Communication GROUND LOOPS

To avoid ground loops in the system only connect communication ground to the f rst MDrive in the system. Do not connect communication ground on subsequent MDrives.

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

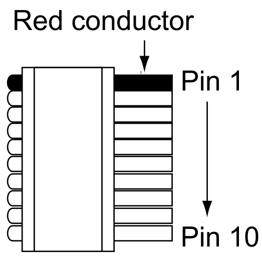
⚠ CAUTION

HOT PLUGGING!

Do not connect or disconnect communication 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	Communication ground only. Do not ground aux-logic to this pin.

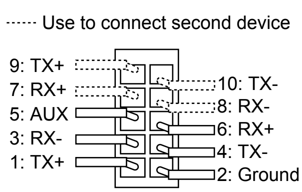
Table 4.1 Communication connections, P2 - 10-pin IDC

Connectivity accessories

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

Communication 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	Communication 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 communication, 10-pin locking wire crimp

Connectivity accessories

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

Communication converter cable (10’/3.0 m)............. MD-CC402-001

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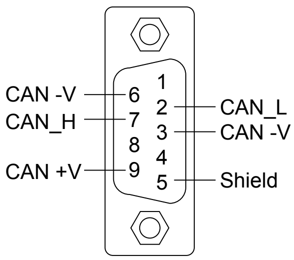
4.2 Interfacing CANopen communication

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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories

Communication converter cable MD-CC500-000

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4.3 Interfacing DC power

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

⚠ 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

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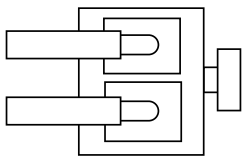
4.3.3 P1 — 12’ (30.5 cm) flying leads interface

Wire Color	
Red	Motor power supply
Black	Power ground

Table 4.7 Power and ground connections, f ying 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 conf gurations 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, f ying leads

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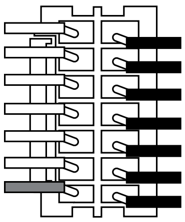
4.4.2 P1 — 14-pin locking wire crimp interface (expanded I/O)



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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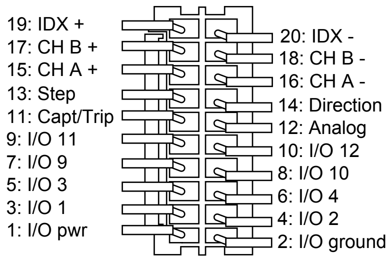
4.4.3 P1 — 20-pin locking wire crimp interface (remote encoder)



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 Communication 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 conf guration parameters

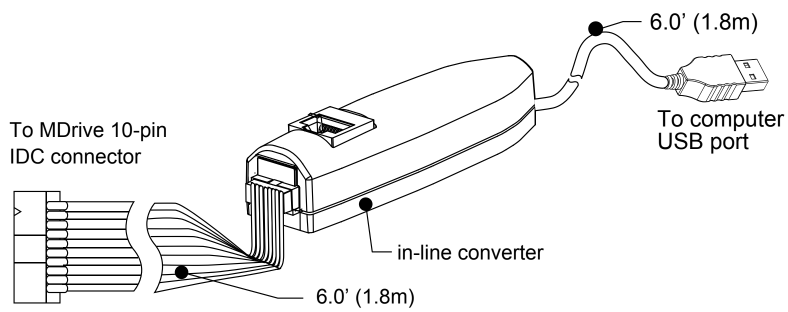


Figure 4.1 MD-CC400-000 communication converter cable

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 conf guration parameters

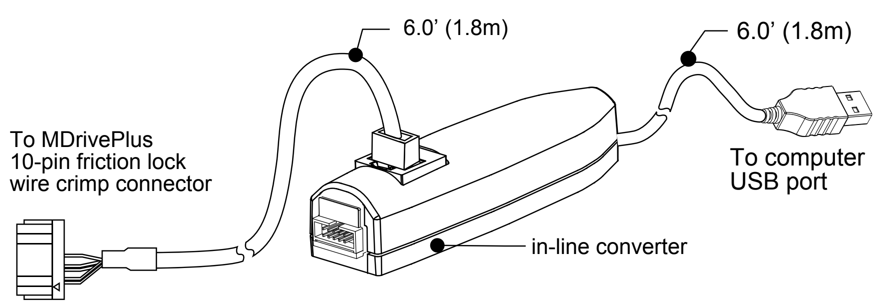


Figure 4.2 MD-CC402-001 communication converter cable

CANopen communication converter cable
MD-CC500-000

See Part 1, Section 6 of this document for CANopen connectivity instructions and MD-CC500-000 details.

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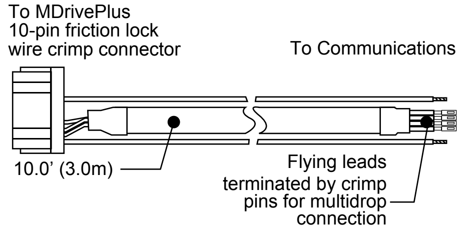
4.5.2 Prototype development cables

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

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



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

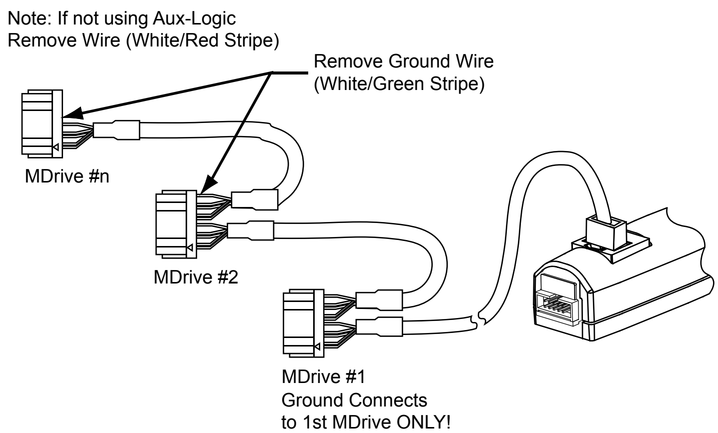


Figure 4.3 Multi-drop communication using the PD10-1434-FL3

Procedure

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

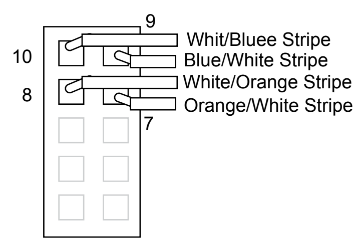


Figure 4.4 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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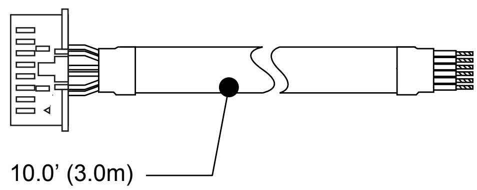
Flying leads to 14-pin locking wire crimp connector P1 -P/N: PD14-2334-FL3

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 f ying leads on the opposite end to interface

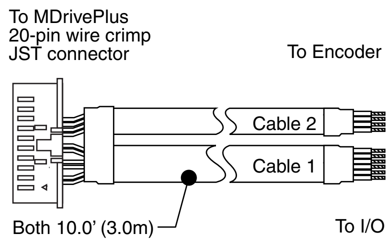


Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	Black	I/O Ground	I/O Ground	X
1	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 f ying leads on the opposite end to interface to I/O devices.



Pin #	***Wire Colors***	***Signal (Expanded features)***	***Pairs***
14	Black	Step Clock I/O	X
13	White	Direction I/O	
12	Black	Analog Input	X
11	Green	Capture/Trip I/O	
10	Black	I/O 12	X
9	Blue	I/O 11	
8	Black	I/O 10	X
7	Yellow	I/O 9	
6	Black	I/O 4	X
5	Brown	I/O 3	
4	Black	I/O 2	X
3	Orange	I/O 1	
2	Black	I/O Ground	X
1	Red	I/O Power	
Cable 2 - Encoder signals			
20	Green/White	Index –	X
19	White/Green	Index +	
18	Orange/White	Channel B –	X
17	White/Orange	Channel B +	
16	Blue/White	Channel A –	X
15	White/Blue	Channel A +	

Figure 4.6 Prototype development cable PD20-3400-FL3

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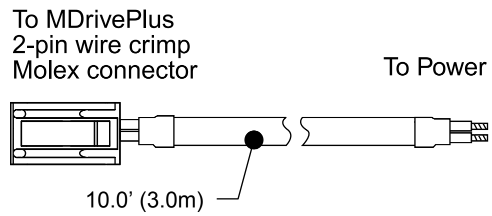
Flying leads to 2-pin locking wire crimp connector P2 -P/N: PD02-3400-FL3

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 f ying 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-f t IDC..CK-01

P2 10-pin wire crimp..CK-02

P1 14-pin wire crimp..CK-09

P3 2-pin wire crimp..CK-05

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MDrive® 34AC
Motion Control

1. Introduction
2. Specif cations
3. Interface and Connectivity

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Table of Contents

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List of Tables

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 f ow through the motor, resonance is signif cantly 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 conf gurations 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 identif er.

The MDrive 34AC Motion Control is available with optional closed loop control. This increases functionality by adding stall detection, position maintenance and f nd index mark.

The closed loop conf guration 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 f xed to the internal step clock.

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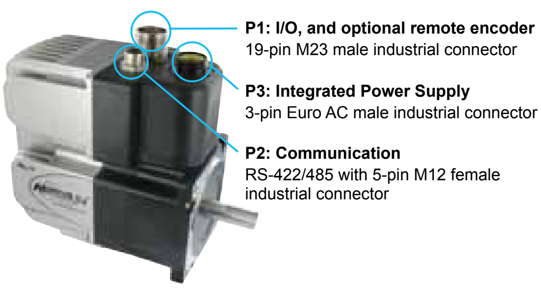
Interface connections are accomplished using standard industrial industrial connectors. And connectivity has never been easier with options ranging from all-inclusive QuickStart Kits to individual interfacing cables.

1.2 Product identification

MDrive® 34ac Plus[2]



Part numbers													
Example:	**K**	**M**	**D**	**I**	**4**	**M**	**R**	**Q**	**3**	**4**	**A**	**1**	**–EQ**
QuickStart Kit **K** = kit option, or leave blank if not wanted	**K**	M	D	I	4	M	R	Q	3	4	A	1	–EQ
MDrive Plus version **MDI** = Motion Control	K	**M**	**D**	**I**	4	M	R	Q	3	4	A	1	–EQ
Input **4** = Plus², expanded features, with industrial connectors, IP54-rated	K	M	D	I	**4**	M	R	Q	3	4	A	1	–EQ
P1 connector **M** = M23 industrial connector	K	M	D	I	4	**M**	R	Q	3	4	A	1	–EQ
Communication **R** = RS-422/485	K	M	D	I	4	M	**R**	Q	3	4	A	1	–EQ
P2 connector **Q** = M12 industrial connector	K	M	D	I	4	M	R	**Q**	3	4	A	1	–EQ
Motor size **34** = NEMA 34 (3.4" / 86 mm)	K	M	D	I	4	M	R	Q	**3**	**4**	A	1	–EQ
Motor length **A** = single stack **B** = double stack **C** = triple stack	K	M	D	I	4	M	R	Q	3	4	**A**	1	–EQ
Drive voltage **1** = 120 VAC **2** = 240 VAC	K	M	D	I	4	M	R	Q	3	4	A	**1**	–EQ
Options Leave blank if not wanted Options may be combined, unless noted **–EQ** = internal encoder, 512-line internal magnetic encoder with index mark **–EE** = remote encoder interface, differential encoder to be provided by user *May not be combined with internal encoder option.* **–N** = rear control knob for manual positioning *(1)*													**–EQ**

(1) Not IP54-rated.

Figure 1.1 Standard product options

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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 conf guration 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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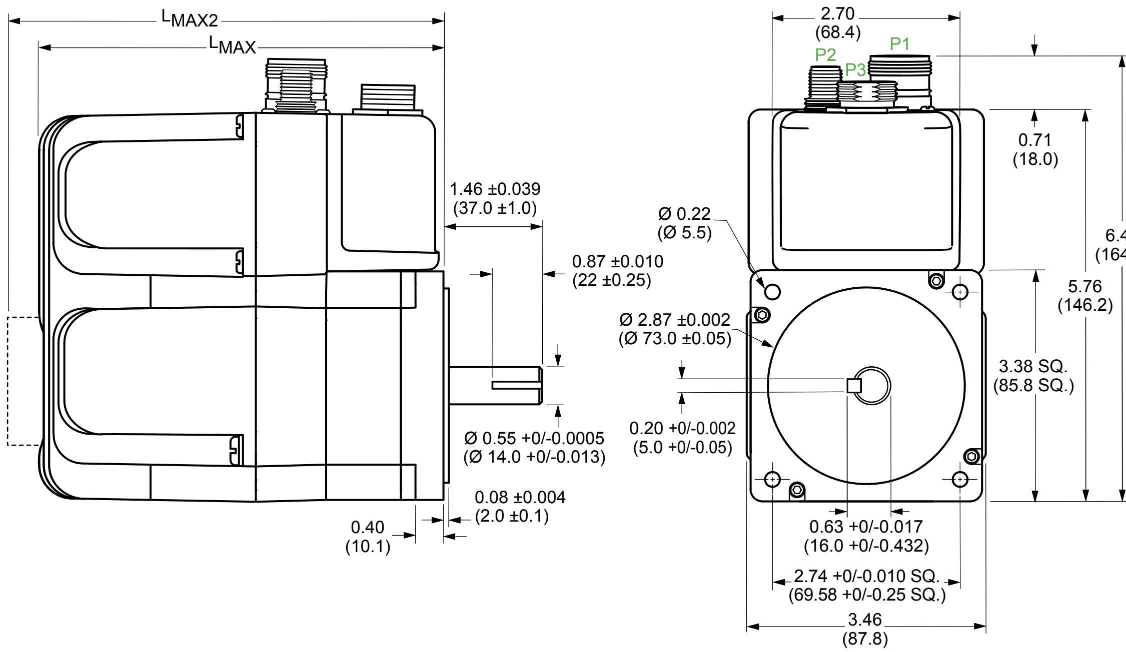
2 Specifications

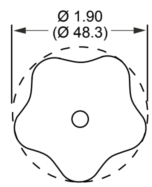
2.1 Mechanical specifications



MDrive AccuStep lengths Inches (mm)

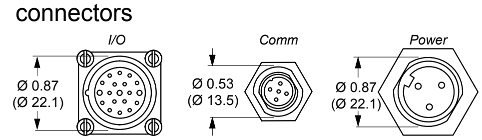
Motor length	L_{MAX} with single shaft or internal encoder	L_{MAX2} with control knob
Single	6.1 (155.0)	7.1 (180.4)
Double	6.9 (174.3)	7.9 (199.7)
Triple	8.4 (214.3)	9.4 (239.7)

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

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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 specif cations

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 specif cations

2.2.4 Communication 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 Communication specif cations

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 specif cations

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 specif cations

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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 specif cations

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 specif cations

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2.2.9 Speed-force performance curves

S120 VAC motor performance

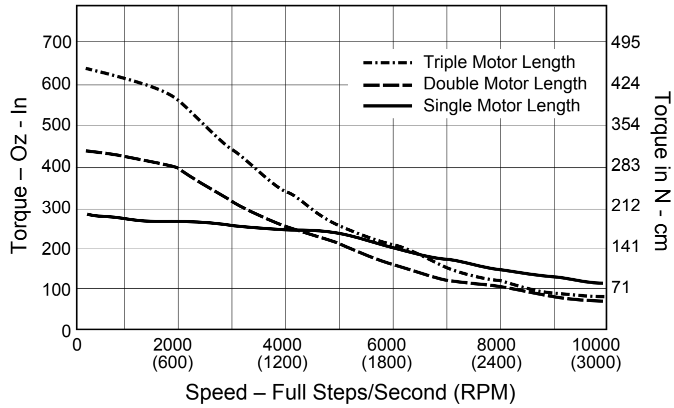


Figure 2.3 Motor performance curve — 120 VAC

240 VAC motor performance

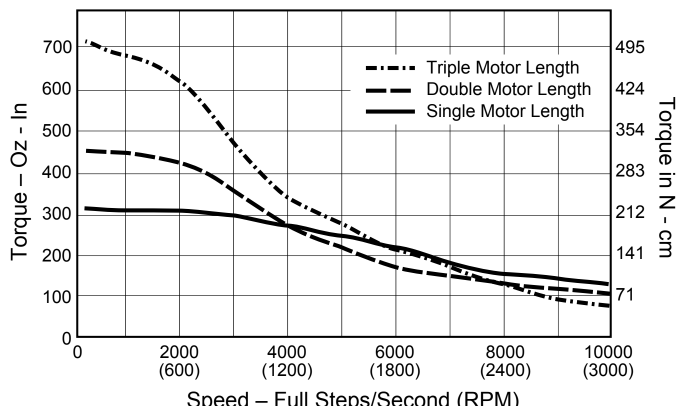
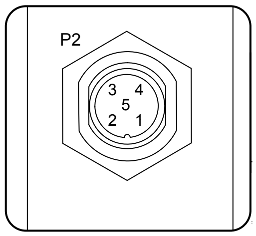


Figure 2.4 Motor performance curve — 240 VAC

2.3 Connectivity specifications/pin assignments

2.3.1 RS-422/485 communication

5-pin M12 industrial connector (female)



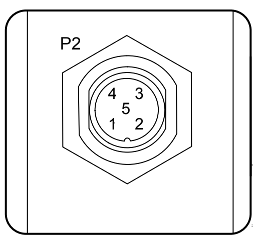
Pin #	Function	Description
1	TX -	Transmit minus
2	TX +	Transmit plus
3	RX +	Receive plus
4	RX -	Receive minus
5	Comm Gnd	Communication ground

Table 2.8 P2 communication, 5-pin M12F industrial connector

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

2.3.2 CANopen communication option

5-pin M12 industrial



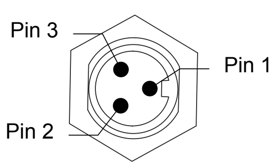
Pin #	Function	Description
1	Shield	Optional CAN shield
2	CAN +V	+7 to +30 VDC power supply
3	CAN -V	CAN communication ground
4	CAN high	CAN_H bus line (high dominant)
5	CAN low	CAN_L bus line (low dominant)

Table 2.9 CANopen communication, 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

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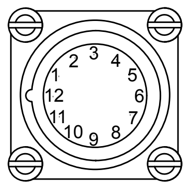
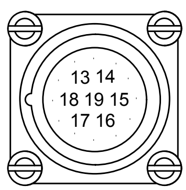
2.3.4 Expanded I/O

19-pin M23 industrial

Outside: Pins 1 -12



Inside: Pins 13 -19



Connectivity Options
Cordset
Straight MD-CS100-000
Right-angle: MD-CS101-000

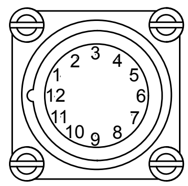
Pin #	Function	Description
1	I/O 9	0 to +24 VDC Programmable I/O Point 9.
2	I/O 11	0 to +24 VDC Programmable I/O Point 11.
3	Step/Clock I/O	0 to +5 VDC Step Clock I/O. Can also be configured as Quadrature or Clock Up/Down.
4	I/O 1	0 to +24 VDC Programmable I/O Point 1.
5	No Connect	No Connect.
6	No Connect	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 IM23 industrial connector

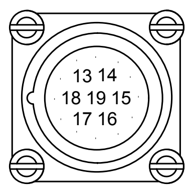
2.3.5 I/O and remote encoder

19-pin M23 industrial

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 IM23 industrial connector

2.4 Encoder

Internal encoder

MDrive 34ACI products include a 1000 line internal magnetic encoder with index mark.

2.5 Connectivity

QuickStart kit

For rapid design verif cation, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrive 34ACI 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 industrial..MD-CC401-001

Prototype Development Cables

Speed test/development with pre-wired mating connectors that have f ying 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 conf gurations and methods.

⚠ CAUTION

ELECTRICAL OVERSTRESS

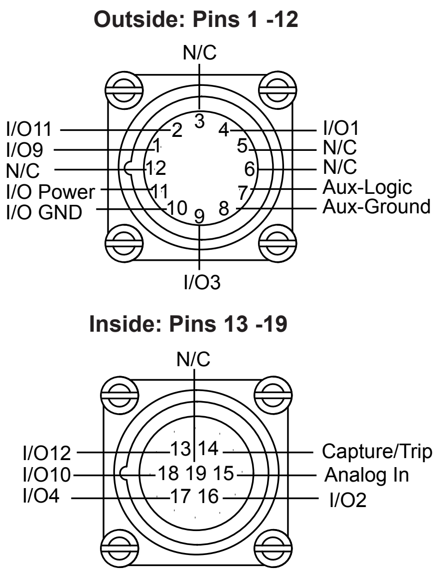
The general purpose I/O is tolerant to +24 VDC. The following listed I/O point is TTL level and only tolerant to +5 VDC:

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.

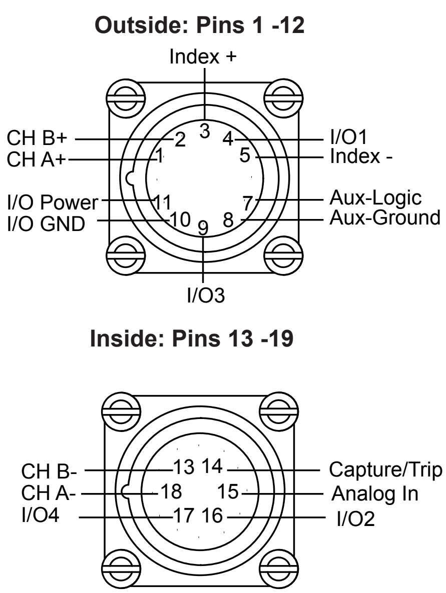
3.1.1 P1 — 19-pin M23 industrial connector (expanded I/O)



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	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 industrial

3.1.1 P1 — 19-pin M23 industrial 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

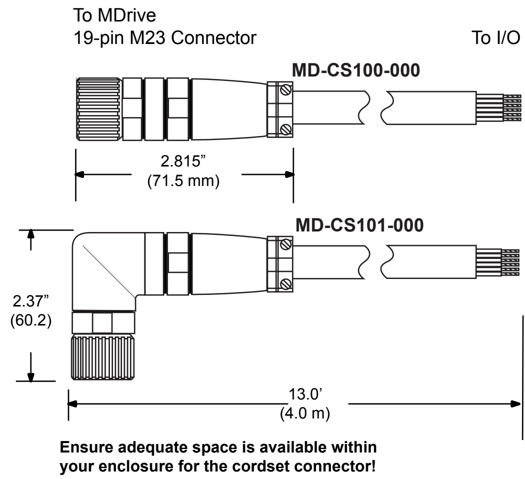
Table 3.2 I/O connections, 19-pin M23 industrial

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



Pin #	*Wire Colors*	*Signal (Expanded Features)*	*Signal (Remote encoder)*
1	Violet	I/O9	Channel A +
2	Red	I/O11	Channel B +
3	Gray	Step Clock	Index +
4	Red/Blue	I/O1	I/O1
5	Green	Direction	Index –
6	Blue	Not connected	Not connected
7	Gray/Pink	Aux-Logic	Aux-Logic
8	White/Green	Comm GND	Comm GND
9	White/Yellow	I/O3	I/O3
10	White/Gray	I/O GND	I/O GND
11	Black	I/O Power	I/O Power
12	Green/Yellow	Shell Connect	Shell Connect
13	Yellow/Brown	I/O12	Channel B –
14	Brown/Green	Capture/Trip	Capture/Trip
15	White	Analog In	Analog In
16	Yellow	I/O2	I/O2
17	Pink	I/O4	I/O4
18	Gray/Brown	I/O10	Channel A –
19	Brown	Not connected	Not connected

Figure 3.1 MD-CS10x-000 cordset

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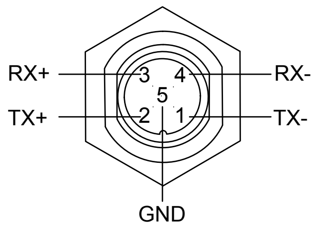
3.2 Interfacing RS-422/485 communication

3.2.1 P2 — 5-pin M12 industrial connector (male)



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

Table 3.3 P2 communication, 5-pin M12F industrial connector

3.2.2 Communication converter — MD-CC401-000

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

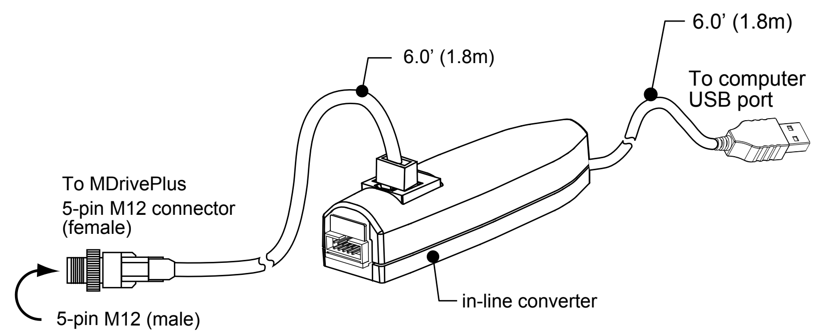


Figure 3.2 MD-CC401-001 communication converter

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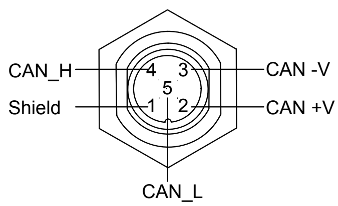
3.3 Interfacing CANopen communication

3.3.1 P2 — 5-pin M12 industrial 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 communication, P2: 5-pin M12 female

Connectivity accessories Communication 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.

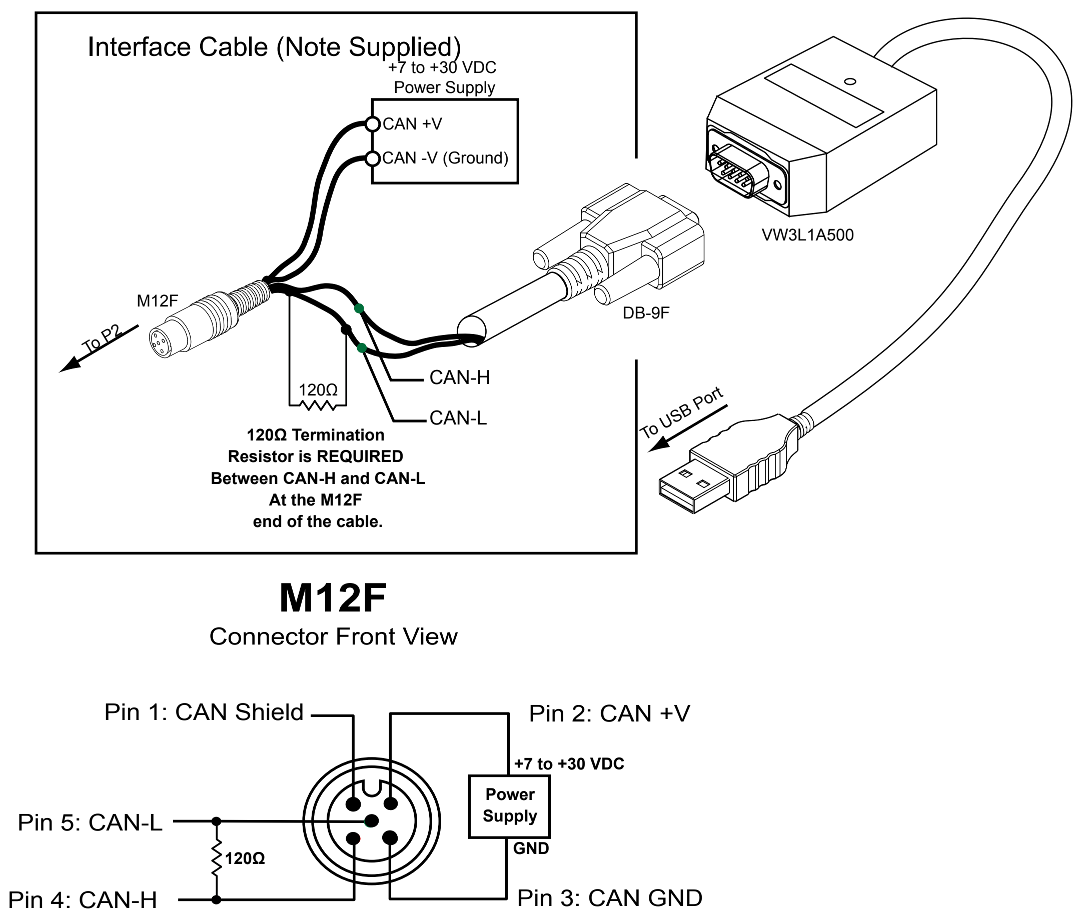


Figure 3.3 MD-CC500-000 and interface cable

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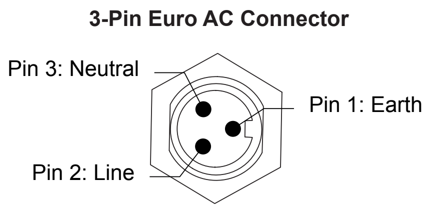
3.4 Interfacing AC power

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

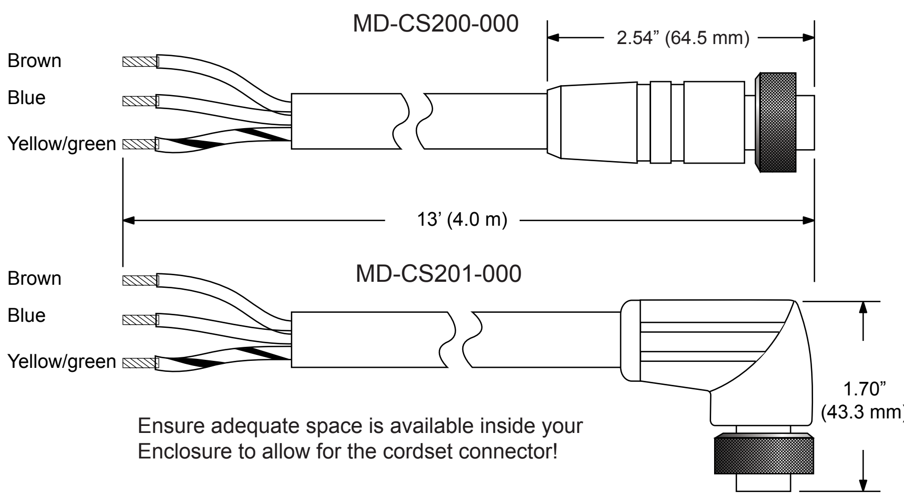


Figure 3.4 MD-CS20x-000

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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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Table of Contents

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List of Figures

List of Tables

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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**.

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

MLI1 [C] R Z14A4 –EQ –L [linear actuator]

- P1: C
- R: RS-422/485 comm
- –EQ: Internal magnetic encoder with 512-line count and index mark.

Plus² **MLI3 [C] R [L] 14A4 –EQ (see above) or –EE –L** [linear actuator]

- P1: C; P2: L
- R: RS-422/485 comm

Plus² **MLI3 [C] C [B] 14A4 –L** [linear actuator]

- C: CANopen comm

–EE: Plus² version only: optional inputs for differential remote encoder (not supplied). May not be combined with internal encoder.

–L: 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

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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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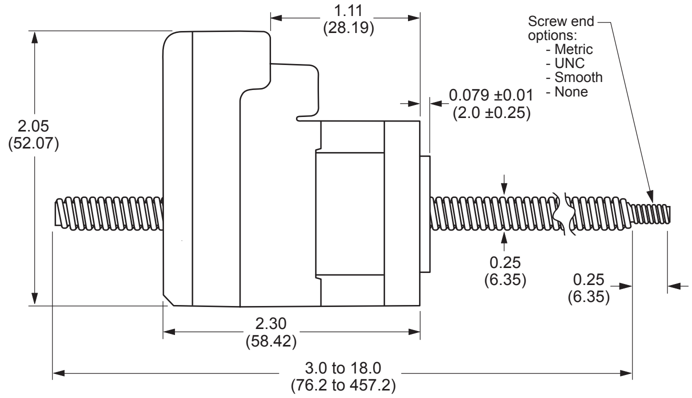
2 Specifications

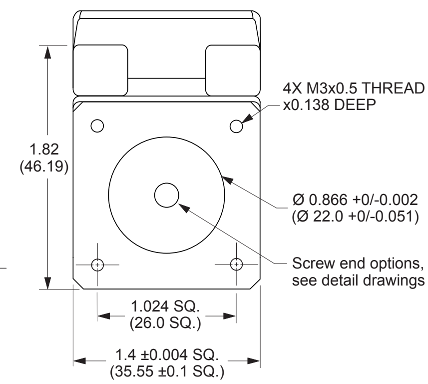
2.1 Mechanical specifications

2.1.1 Non-captive shaft

Side view



Front view



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

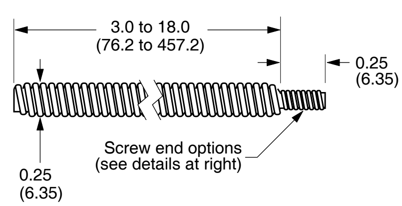
MDrive Linear Actuator precision rolled lead screws are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel.

Screw coating

An optional teflon screw coating is available for smooth operation and extended life.

Standard screw

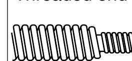
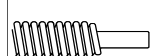
Dimensions in inches (mm)



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

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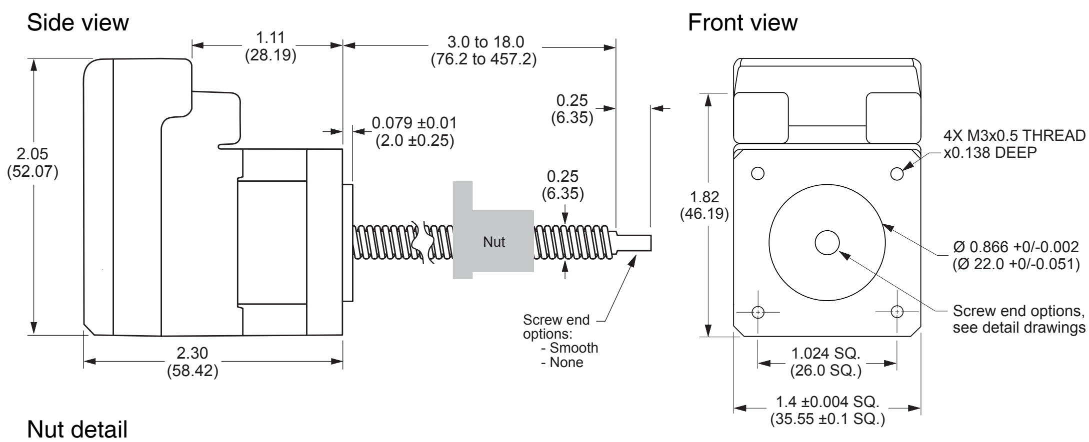
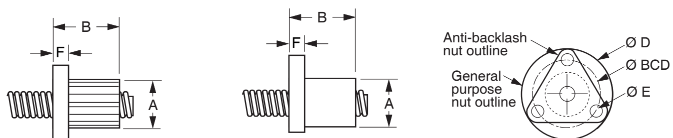
2.1.2 External shaft



Nut detail



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

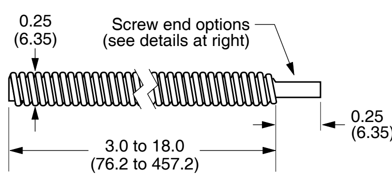
MDrive Linear Actuator precision rolled lead screws are corrosion resistant and non-magnetic, manufactured from premium grade stainless steel.

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

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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

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2.2.3 Expanded I/O specifications (Plus[2])

	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

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2.2.4 Communication 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 Communication 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 x 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

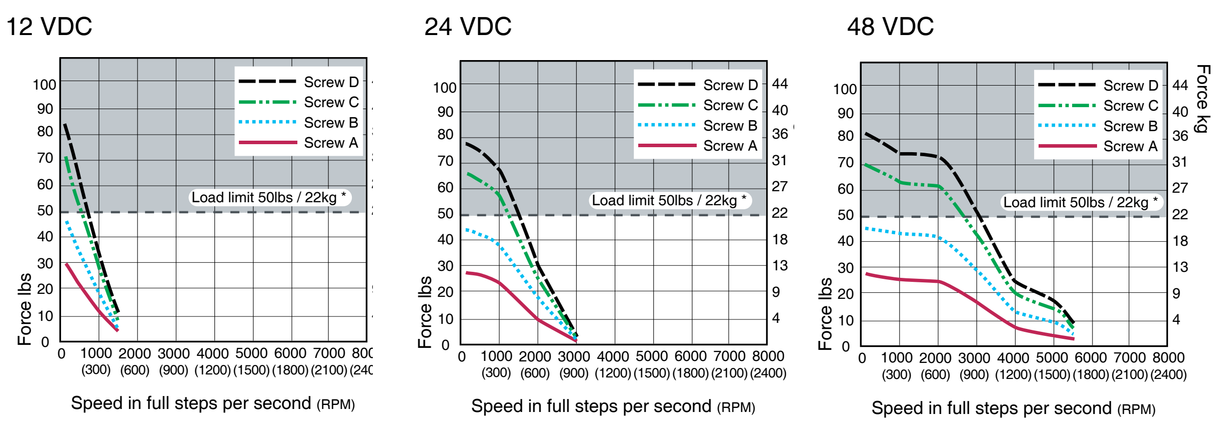
Table 2.7 Software specifications

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



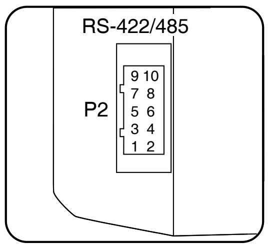
*For non-captive shaft linear actuators. Load limit for external shaft linear actuators is determined by selected nut.

Figure 2.3 Performance curves

2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

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

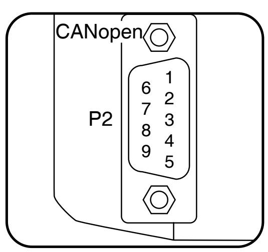
Pins
Hirose DF11-TA2428HC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

2.3.2 CANopen communication option (Plus² only)

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



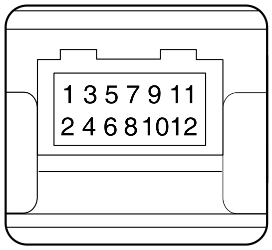
Connectivity Options
USB to CANopen converter:
MD-CC500-000

Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	CAN -V	CAN communication 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 communication, P2: 9-pin D-sub female (DB-9F)

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

2.4.1 Communication, 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

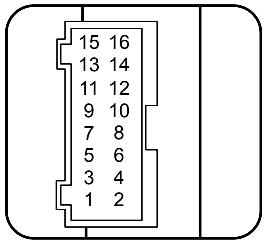
Pins
JST SPH-001T0.5L

Pin #	Function	Description
1	GND	Power, Auxiliary and Communication 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 Communication Host.
10	TX -	Transmit –: Connects to Receive – of the Communication Host.
11	RX -	Receive –: Connects to Transmit – of the Communication Host.
12	RX +	Receive +: Connects to Transmit + of the Communication Host.

Table 2.11 P1 communication, 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

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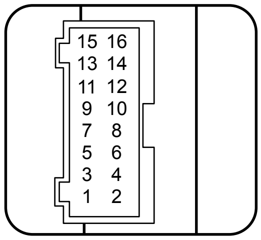
2.4.3 Power and I/O - remote encoder (Plus²)

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)

MDrive14Plus² 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 communication 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 restrained 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.

⚠ 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.

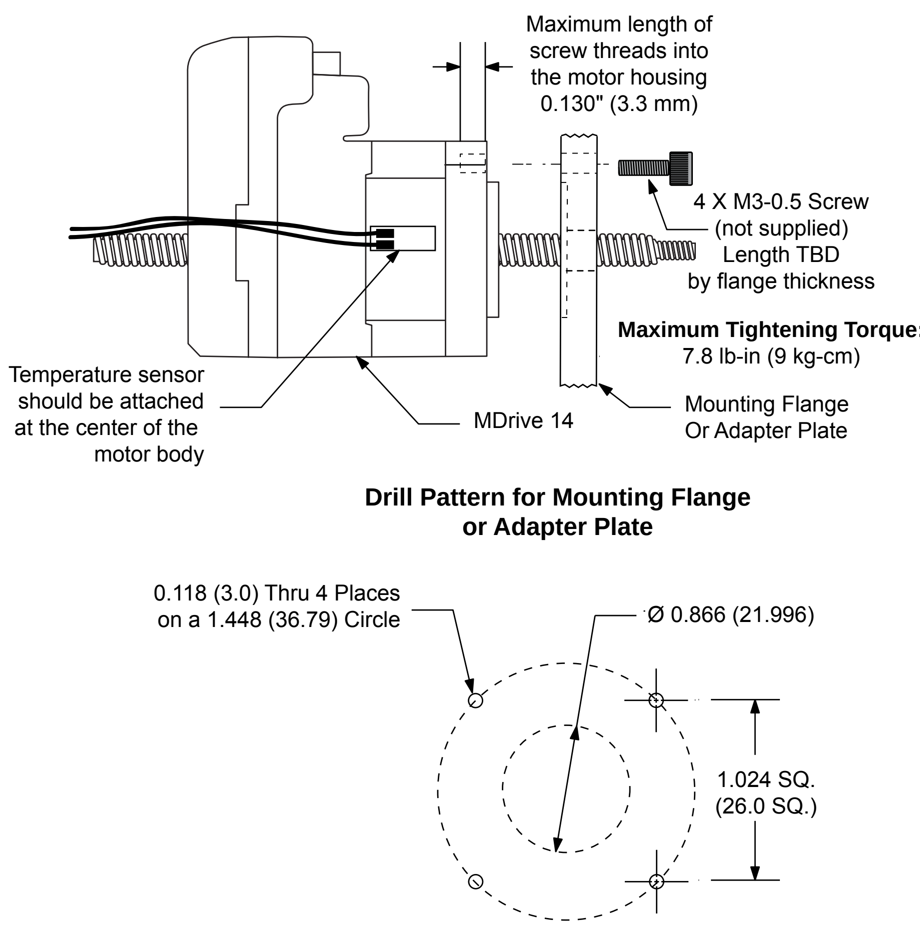


Figure 3.1 MDrive 14 linear actuator mounting and drill pattern

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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.

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

Communication

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

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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.

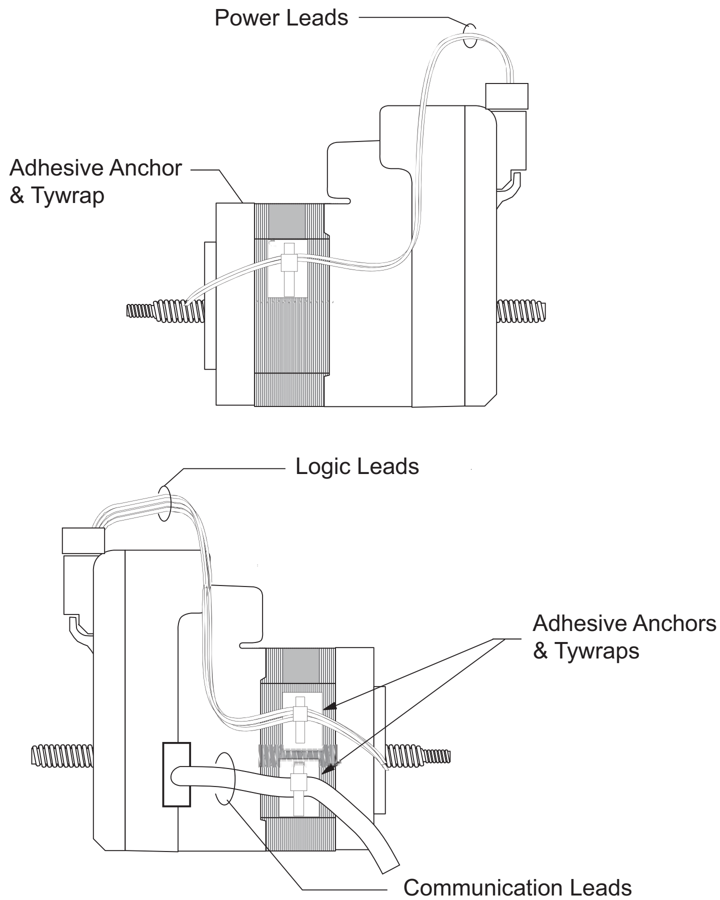

Figure 3.2 Securing leads

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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.

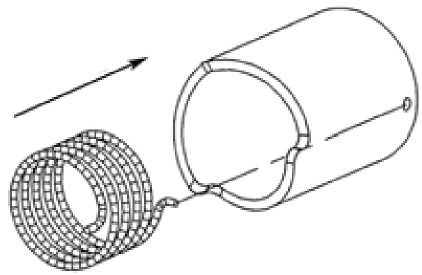

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

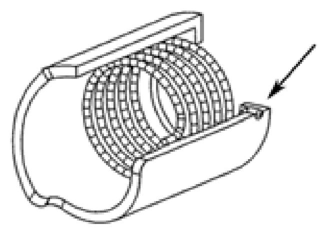

Figure 3.4 Spring engaged

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.

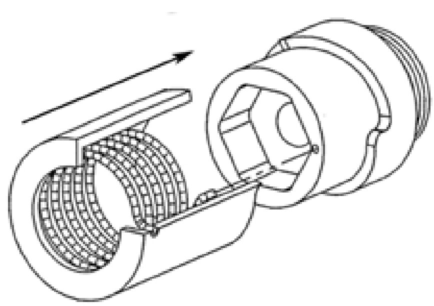

Figure 3.5 Insert opposite tang

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4) With washer installed, insert the back nut into the front nut.

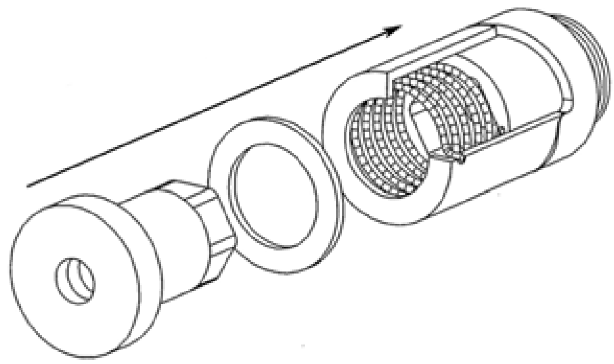

Figure 3.6 Inserting the back nut

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.

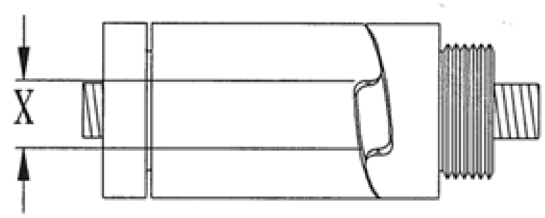

Figure 3.7 Measuring the gap distance

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.

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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.

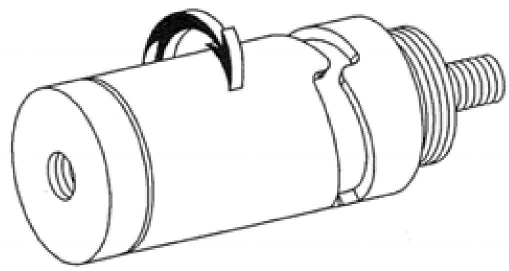

Figure 3.8 Pre-loading the nut

8) The anti-backlash nut is now pre-loaded and fully assembled.

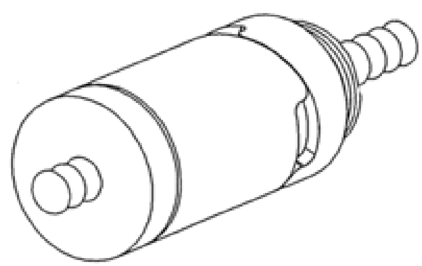

Figure 3.9 Nut pre-loaded and fully assembled

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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 communication 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 communication

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

⚠ CAUTION
Communication GROUND LOOPS
To avoid ground loops in the system only connect communication ground to the first MDrive in the system. Do not connect communication ground on subsequent MDrives.
Failure to follow these instructions may result in damage to system components!

⚠ CAUTION
HOT PLUGGING!
Do not connect or disconnect communication while the device is in a powered state.
Failure to follow these instructions may result in damage to system components!

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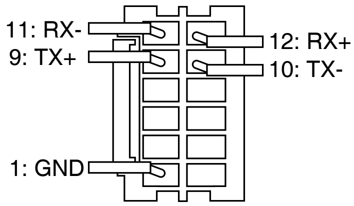
4.1.1 P1 — 12-pin locking wire crimp



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

Table 4.1 Communication 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

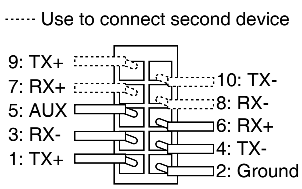
Communication converter cable (10’/3.0 m).............MD-CC403-001

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	Communication 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 communication, 10-pin locking wire crimp

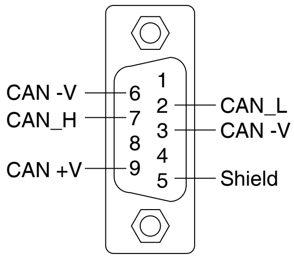
Connectivity accessories

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

Communication converter cable (10’/3.0 m).............MD-CC402-001

4.2 Interfacing CANopen communication

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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories

Communication converter cable MD-CC500-000

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4.3 Interfacing DC power

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

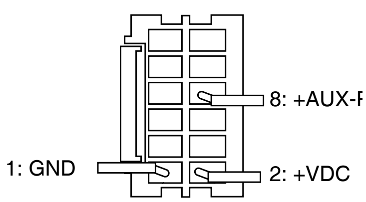
> ⚠ **CAUTION**
>
> OVER VOLTAGE
>
> The DC voltage range for the MDrive14Plus is +12 to +48 VDC. Ensure that motor back EMF is factored into your power supply size calculations.
>
> Allow 3.0 A maximum power supply output current per MDrive in the system. Actual power supply current will depend on voltage 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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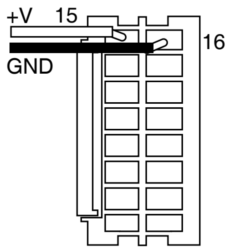
4.3.3 P1 — 16-pin locking wire crimp interface



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)

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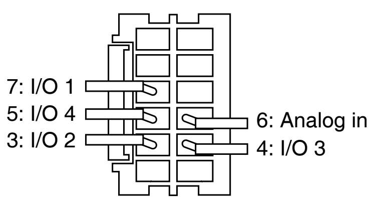
4.4 Interfacing I/O

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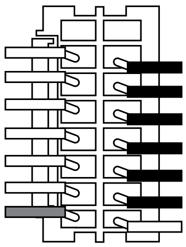
4.4.2 P1 — 16-pin locking wire crimp interface (expanded I/O)



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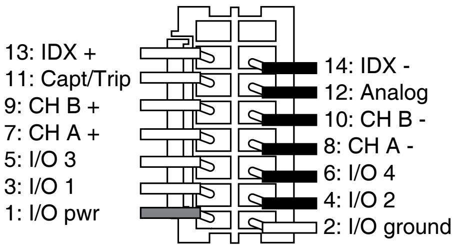
4.4.3 P1 — 16-pin locking wire crimp interface (remote encoder)



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 communication 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

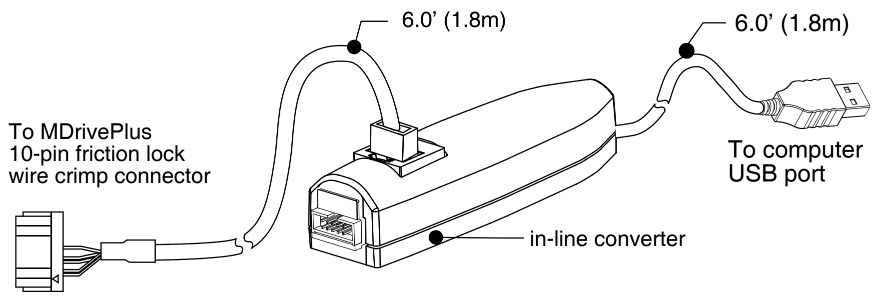
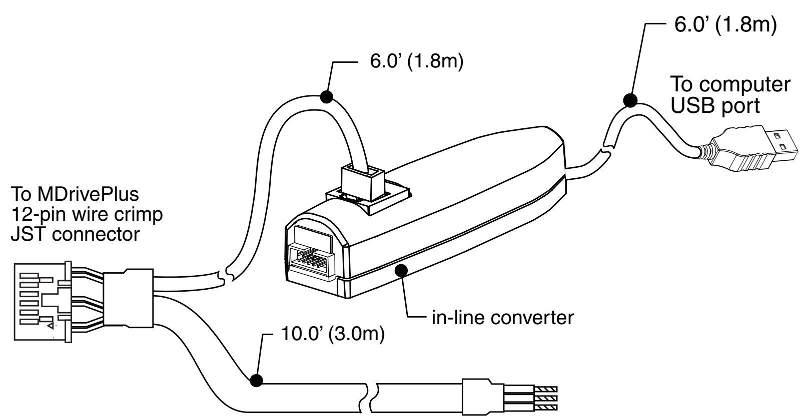


Figure 4.1 MD-CC402-001 communication converter cable

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.



To Power, I/O & Communications

Pin #	*Wire Colors*	*Signal*
1	Black	GND
2	Red	+V
3	White	I/O 2
7	Blue	I/O 1
5	Green	I/O 3
5	Orange	I/O 4
6	Brown	Analog Input

Figure 4.2 MD-CC403-001 communication converter

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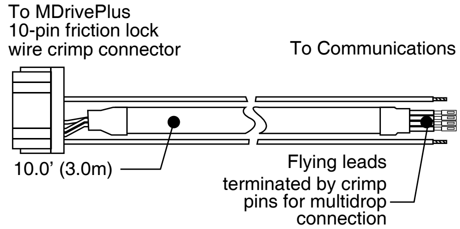
4.5.2 Prototype development cables

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

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



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

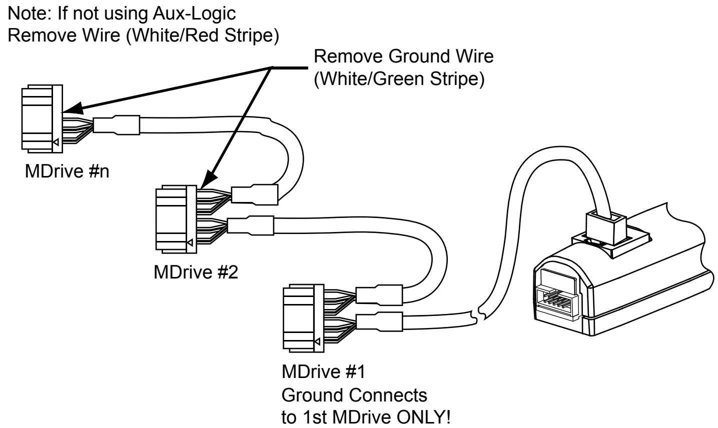


Figure 4.3 Multi-drop communication using the PD10-1434-FL3

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

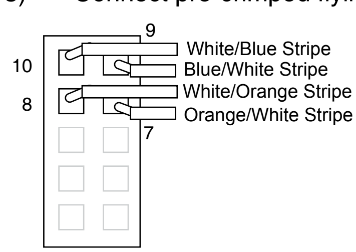


Figure 4.4 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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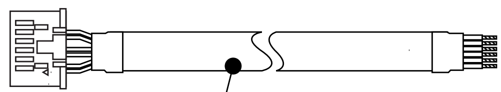
Flying leads to12-pin locking wire crimp connector P1 - PD12B-3400-FL3

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 & Communication Interface.



Pin #	*Wire Colors*	*Signal*	*Pairs*
1	Black	GND	X
2	Red	+V	
10	Black	TX-	X
9	White	TX+	
11	Black	RX-	X
12	Green	RX+	
3	Black	I/O 2	X
7	Blue	I/O 1	
5	Black	I/O 3	X
5	Yellow	I/O 4	
6	Black	Analog Input	X
8	Brown	Aux-Logic	

Figure 4.5 Prototype development cable PD12B-1434-FL3

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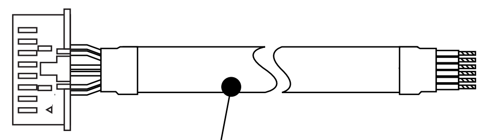
Flying leads to16-pin locking wire crimp connector P2 -P/N: PD16-1417-FL3

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.



Pin #	Wire Colors	Signal (Expanded features)	Signal (Remote encoder)	Pairs
16	Black	GND	GND	X
15	Red	+V	+V	
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	White	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

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

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MDrive® 17 Linear Actuator
Motion Control

1. Introduction
2. Specif cations
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 specif cally 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 f ow through the motor, resonance is signif cantly 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.

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]
R: RS-422/485 comm

MLI1 [F,P] **C** [B] **17A4** – L [linear actuator]
C: CANopen comm

– EQ: Internal magnetic encoder with 512-line count and index mark.

Plus² **MLI3** [C] **R** [D,L] **17A4** – L [linear actuator]
R: RS-422/485 comm

Plus² **MLI3** [C] **C** [B] **17A4** – L [linear actuator]
C: CANopen comm

– 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

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

*Contact factory for availability.

Figure 1.1 Standard product options

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1.4 Documentation reference

The following User's manuals are available for the MDrive17 linear actuator:

- Product manual, describes the technical data, installation, conf guration 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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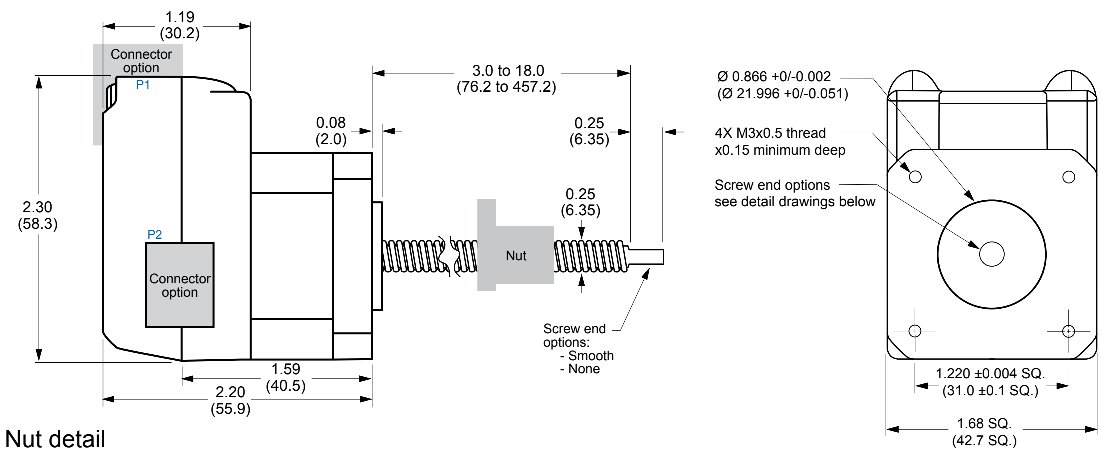
2 Specifications

2.1 Mechanical specifications

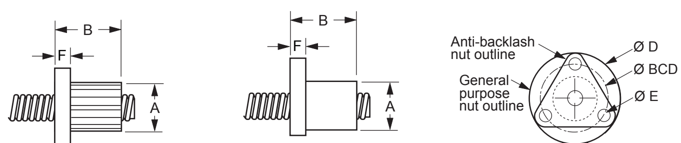
2.1.1 External shaft

Side view

Front view



Nut detail



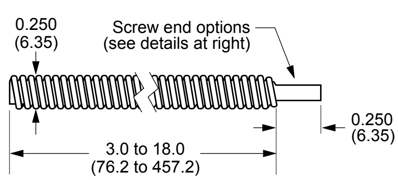
General purpose nut
Flange shape: round
Load limit: 25 lbs (11.3 kg)
Purpose: for applications not requiring anti-backlash and wear compensation.

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 Specif cations

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
Smooth 	Ø 0.1967" ±0.001 (Ø 5mm ±0.003)
None 	—

Screw coating

An optional tef on screw coating is available for smooth operation and extended life. *Contact factory for availability.*

Figure 2.1 External shaft mechanical specif cations - dimensions in inches (mm)

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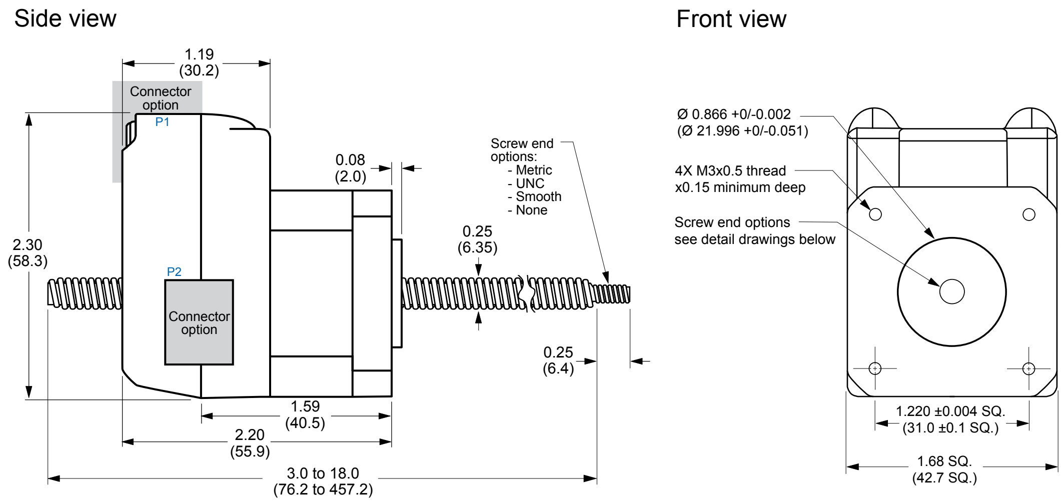
Cantilevered loads

Loads for external shaft MDrive® linear actuator products MUST BE supported. Side loading is not recommended.

Calculating screw/stroke length

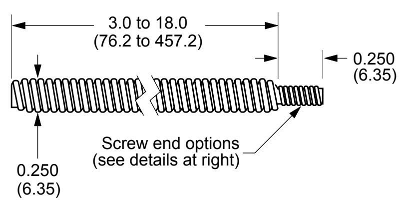
Available stroke length = [6.0" screw] – [nut length] – [mounting surface plate thickness]

2.1.1 Non-captive shaft



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]]

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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 specif cations

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 specif cations

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2.2.3 Expanded I/O specifications (Plus[2])

	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 specif cations

2.2.4 Communication 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 Communication specif cations

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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 specif cations

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 x 10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 Motion specif cations

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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 2.7 Software specif cations

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 specif cations

2.2.9 Speed-force performance curves

12 VDC Curves

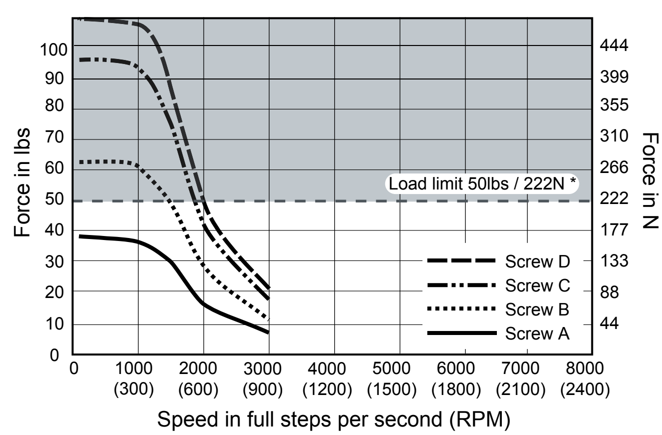

Figure 2.3 12 VDC speed-force curves

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24 VDC Curves

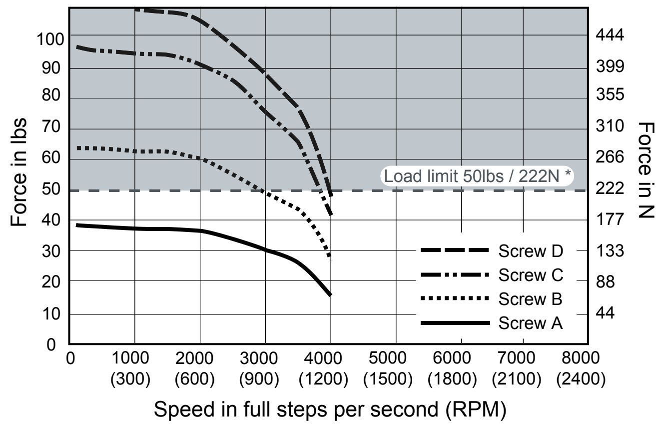


Figure 2.4 24 VDC speed-force curves

48VDC Curves

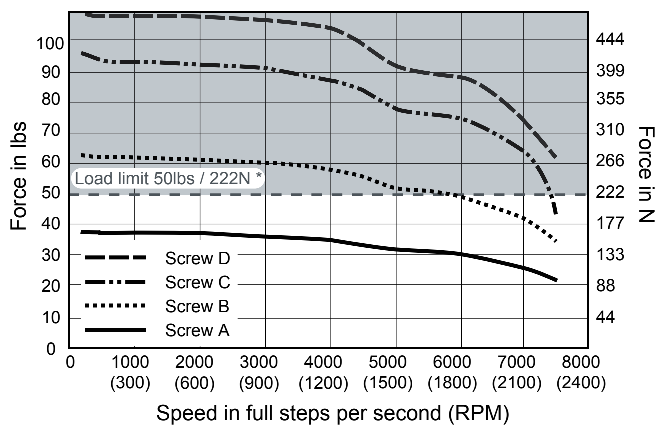
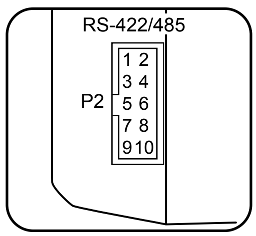


Figure 2.5 48 VDC speed-force curves

2.3 Connectivity specifications/pin assignments - Communication

2.3.1 RS-422/RS-485 communication

10-pin pressure f t IDC



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

Mating connector kit:
CK-01

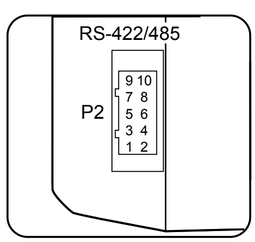
Mfg P/N:
Shell
SAMTEC: TCSD-05-01-N

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	Communication ground only. Do not ground aux-logic to this pin.

Table 2.9 P2 communication, 10-pin pressure f t 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

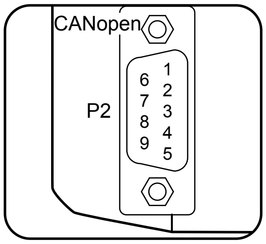
Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

2.3.2 CANopen communication option (connector P2)

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



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

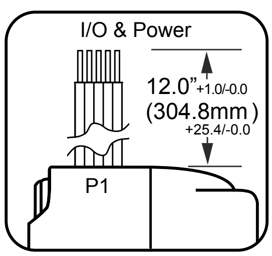
Pin #	Function	Description
1	N/C	Not connected
2	CAN low	CAN_L bus line (low dominant)
3	VAN -V	CAN communication ground
4	N/C	Not connected
5	Shield	Optional CAN shield
6	CAN -V	Optional ground
7	CAN high	CAN_H bus line (high dominant)
8	N/C	Not connected
9	CAN +V	+7 to +30 VDC power supply

Table 2.11 CANopen communication, 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) f ying 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) f ying leads

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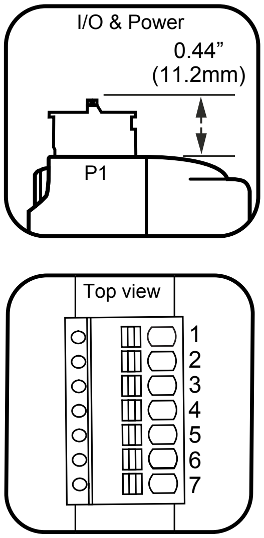
7-pin pluggable terminal

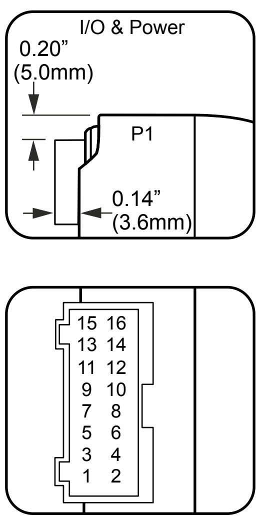


Pin #	Function	Description
1	I/O 1	General purpose I/O point 1
2	I/O 2	General purpose I/O point 2
3	I/O 3	General purpose I/O point 3
4	I/O 4	General purpose I/O point 4
5	Analog input	0 to +5 VDC, 0 to +10 VDC, 4 to 20 mA, 0 to 20 mA
6	GND	Power and auxiliary ground
7	+V	Motor power (+12 to +48VDC

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

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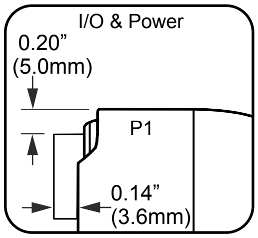
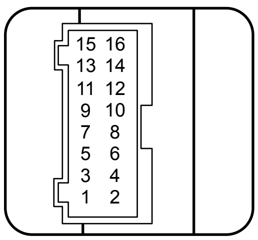
.4.2 Power and I/O - remote encoder (Plus²)

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

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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 verif 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 f ying 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 f t onto ribbon cable. Cable not supplied.

P2 10-pin IDC...CK-01

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3 Mounting and connection recommendations

⚠ CAUTION
LEAD RESTRAINT Some linear actuator mounting conf gurations 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.

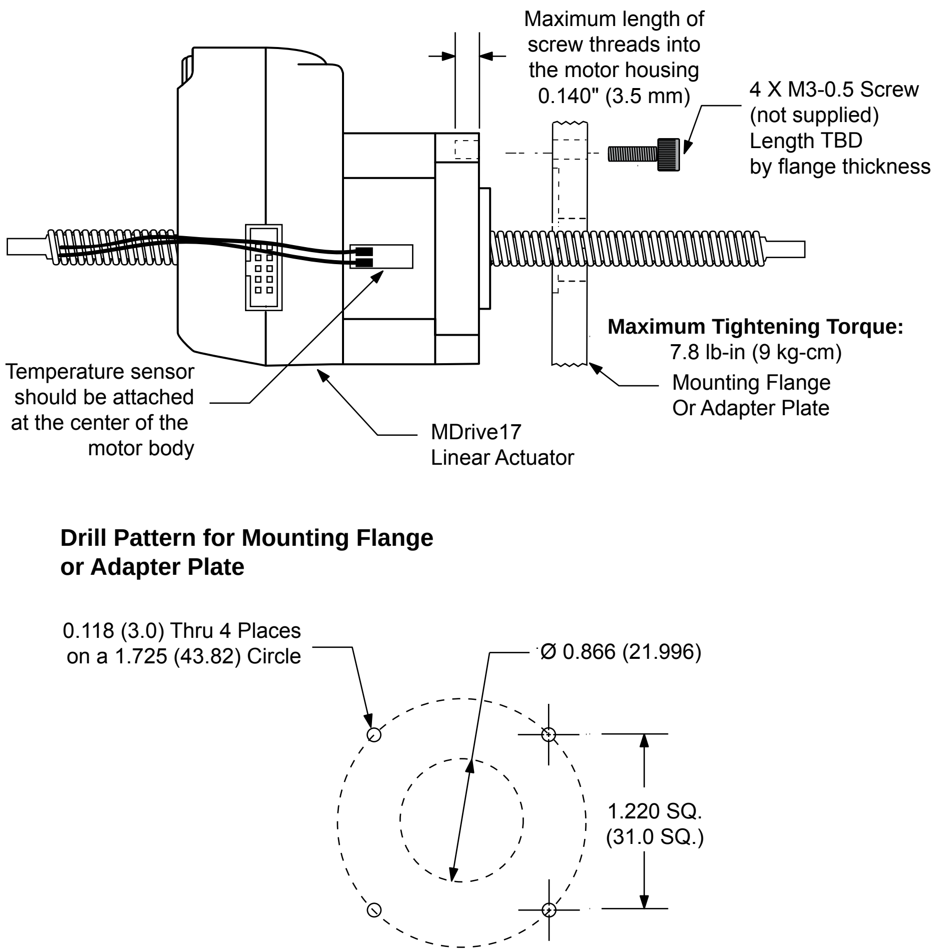

Figure 3.1 Mdrive linear actuator mounting and drill pattern

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 f oat. 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

Communication

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 (f ying, pluggable or threaded) must be properly anchored. This will prevent f exing and tugging which can cause damage at critical connection points within the MDrive.

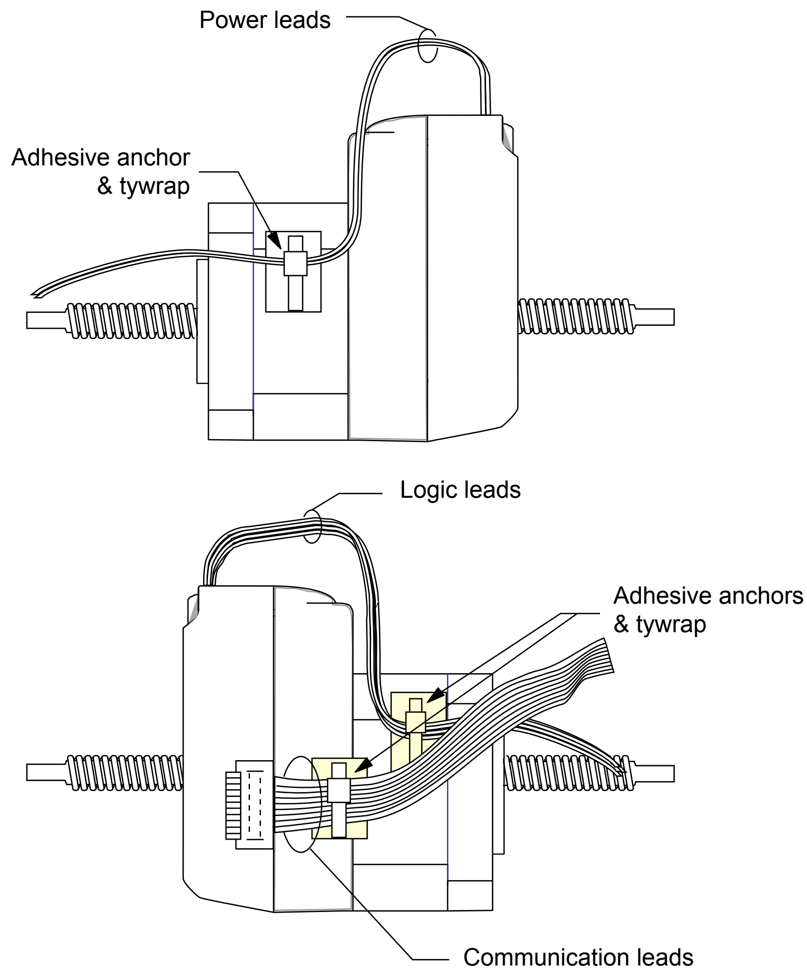

Figure 3.2 Securing leads

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 f t bore (mechanism will not work).

3.5.2 Installation

To install threaded model nuts, simply hand tighten until shoulder is f ush 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 f ange.

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 foref nger 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 f ngers 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.

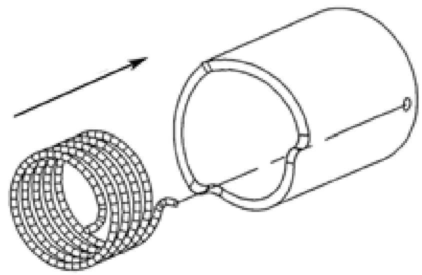

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

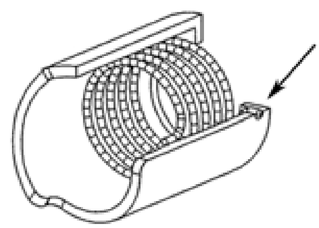

Figure 3.4 Spring engaged

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.

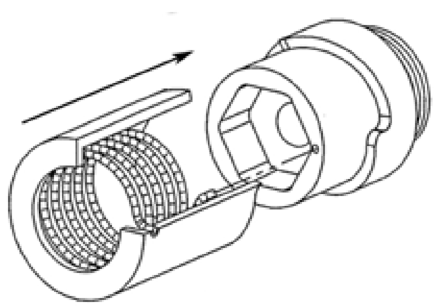

Figure 3.5 Insert opposite tang

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4) With washer installed, insert the back nut into the front nut.

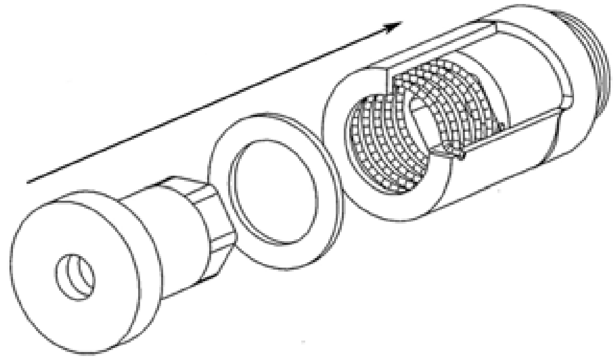

Figure 3.6 Inserting the back nut

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.

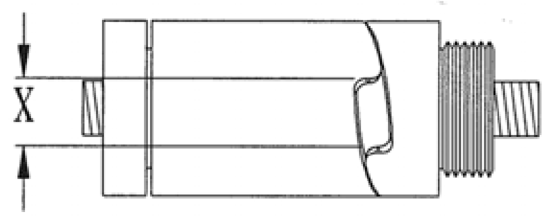

Figure 3.7 Measuring the gap distance

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.

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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.

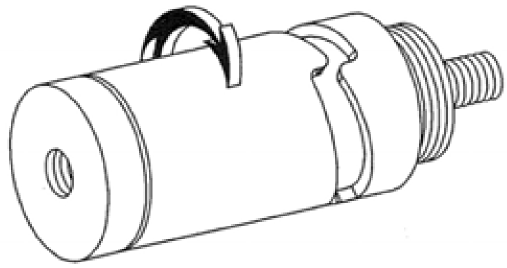

Figure 3.8 Pre-loading the nut

8) The anti-backlash nut is now pre-loaded and fully assembled.

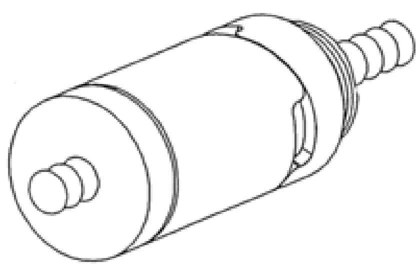

Figure 3.9 Nut pre-loaded and fully assembled

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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 communication 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 communication

Communication interface, connector pin conf guration and specif cations 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 conf gurations.

⚠ 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.

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

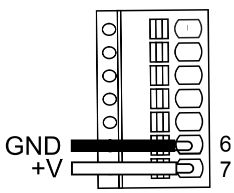
Table 4.1 Recommended power supply wire gauge

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, f ying leads

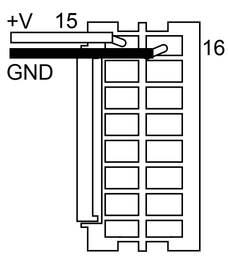
4.2.4 P1 — 7-pin pluggable terminal interface



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

4.3 Interfacing I/O

See part 1 of this document, section 4, for I/O interface conf gurations 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.

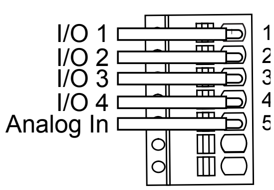
Failure to follow these instructions can result in equipment damage.

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, f ying 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

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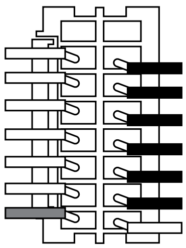
4.3.3 P1 — 16-pin locking wire crimp interface (expanded I/O)



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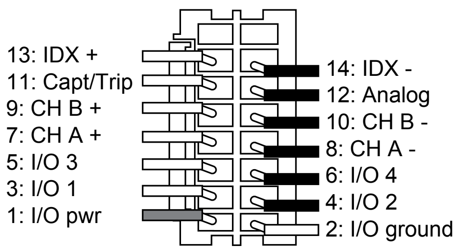
4.3.4 P1 — 16-pin locking wire crimp interface (remote encoder)



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

4.4 Connectivity accessory details

4.4.1 RS-422/485 communication 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 conf guration parameters

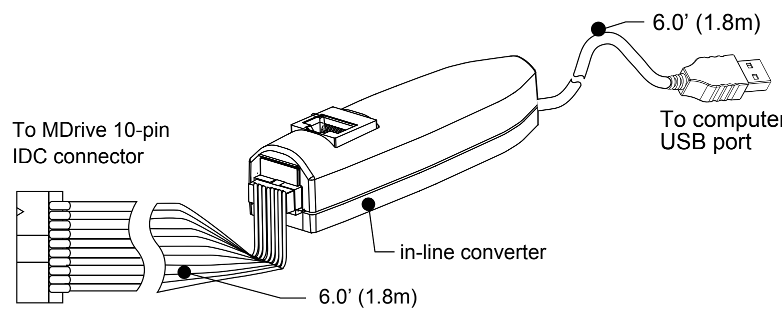


Figure 4.1 MD-CC400-000 communication converter cable

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 conf guration parameters

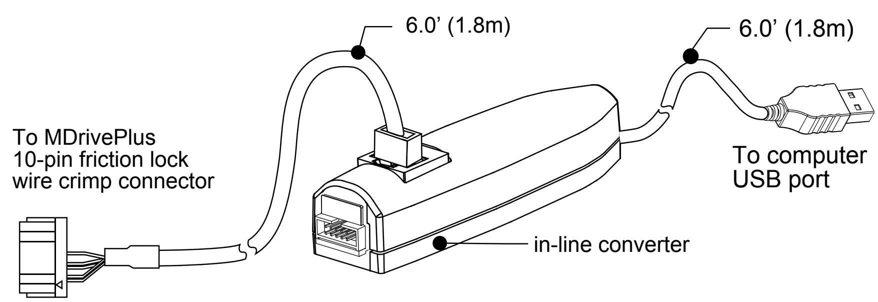


Figure 4.2 MD-CC402-001 communication converter cable

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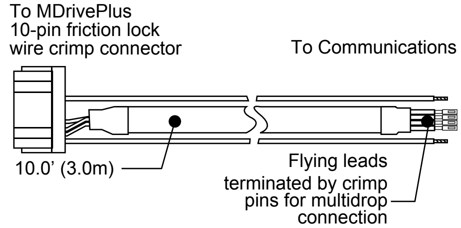
4.4.2 Prototype development cables

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

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



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

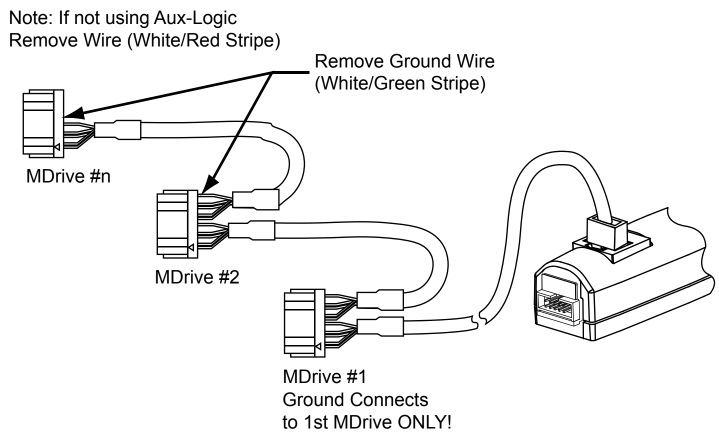
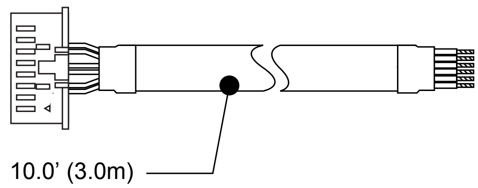


Figure 4.3 Multi-drop communication using the PD10-1434-FL3

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 f ying leads on the opposite end to interface to power, I/O and/or remote encoder.



Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
16	Black	GND	GND	X
15	Red	+V	+V	
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	White	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

Figure 4.4 Prototype development cable PD16-1417-FL3

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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 f t onto ribbon cable. Cable not supplied.

P2 10-pin IDC..CK-01

MDrive® 23 Linear Actuator
Motion Control

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Table of Contents

List of Figures

List of Tables

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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

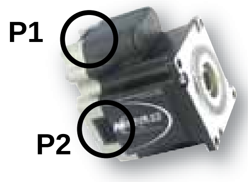
MDrive14 linear actuators feature high torque 1.8° brushless NEMA 23 single length step motors with integrated electronics, providing the leading technology solution for all-in-one linear motion applications.

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**.

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		Optional encoder		
	MLI1	F,P	R (RS-422/485 comm)	D,L	23A7	– EQ: Internal magnetic encoder with 512-line count and index mark.	– L	linear actuator
	MLI1	F,P	C (CANopen comm)	B	23A7		– L	linear actuator
Plus2	MLI3	C	R (RS-422/485 comm)	D,L	23A7	– EQ (see above) or – EE: Plus2 version only: optional inputs for differential remote encoder (not supplied). May not be combined with internal encoder.	– L	linear actuator
Plus2	MLI3	C	C (CANopen comm)	B	23A7		– L	linear actuator

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

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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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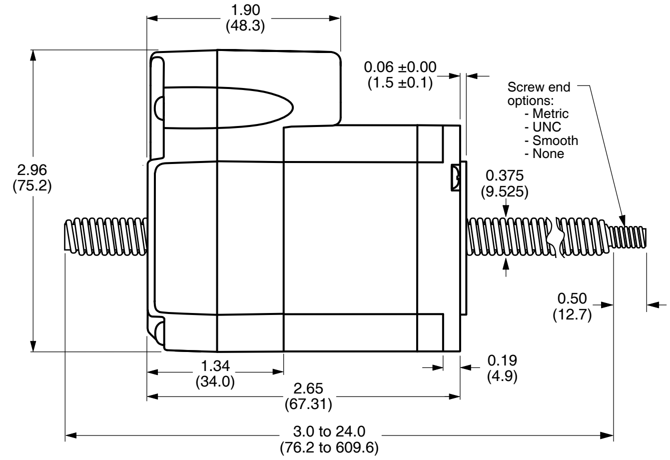
2 Specifications

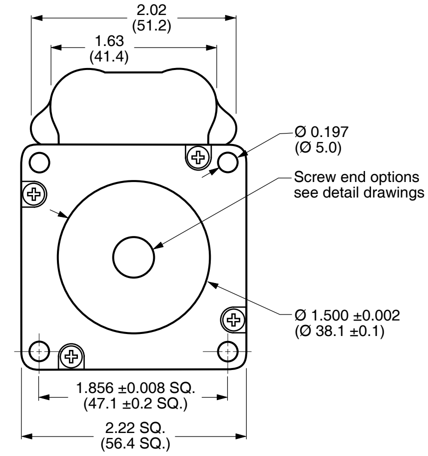
2.1 Mechanical specifications

2.1.1 Non-Captive Shaft

Side view



Front view



Load limit

Nominal load limit: 200 lbs (91 kg)

Screw specifications

Screw material

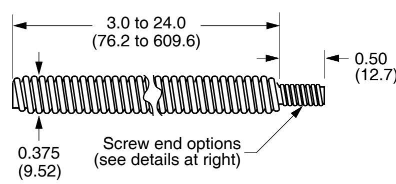
MDrive Linear Actuator precision rolled lead screws are designed specifically for motion control applications to deliver maximum life and quiet operation. Corrosion resistant and non-magnetic, screws are manufactured from premium grade stainless steel.

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

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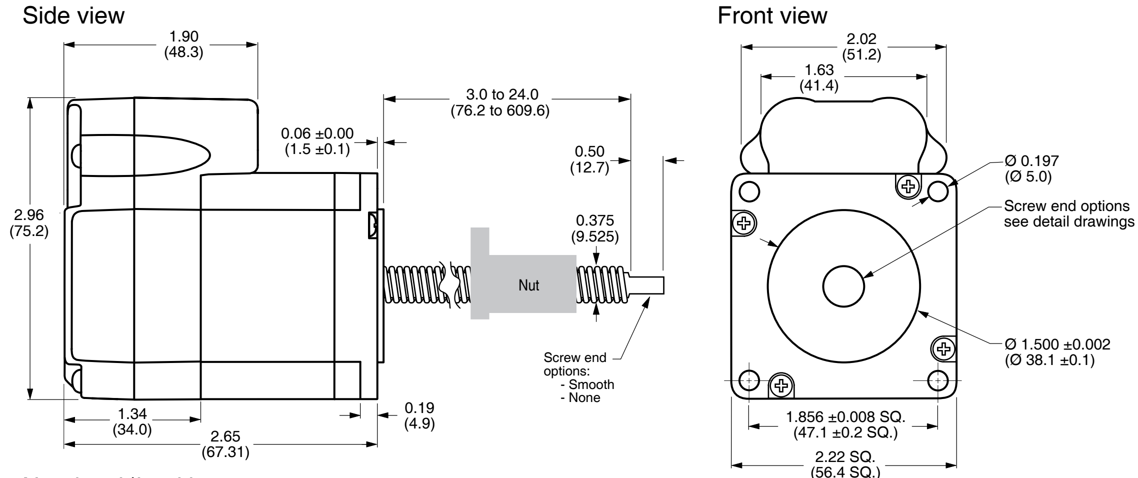
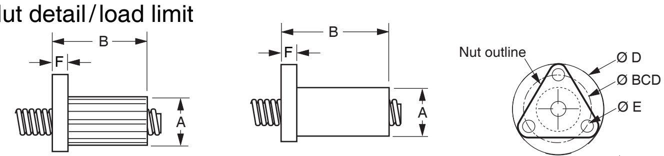
2.1.2 External Shaft

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.

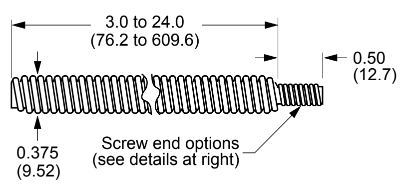
inches (mm)	A	B	D	E	F	BCD	*load limit*	*drag torque*
General purpose	0.71 (18.0)	1.50 (38.1)	1.5 (38.1)	0.20 (5.08)	0.20 (5.08)	1.125 (28.6)	60lbs/ 27kg	free wheeling
Anti-backlash	0.82 (20.8)	1.875 (47.63) max	1.5 (38.1)	0.20 (5.08)	0.20 (5.08)	1.125 (28.6)	25lbs/ 11kg	1–3

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.

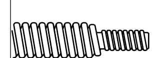
Standard screw
Dimensions in inches (mm)



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

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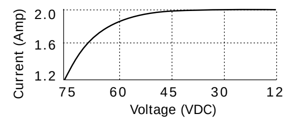
2.2 General specifications

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

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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

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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 Communication 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 Communication 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 x 10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 2.6 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 2.7 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

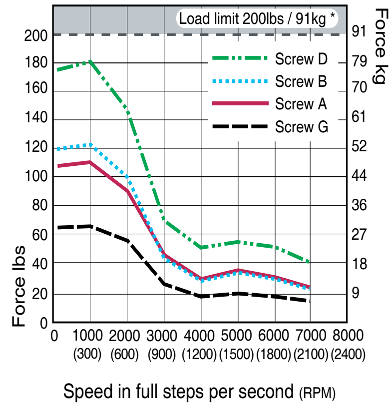

Figure 2.3 Motor performance curve — +24 VDC

+48 VDC

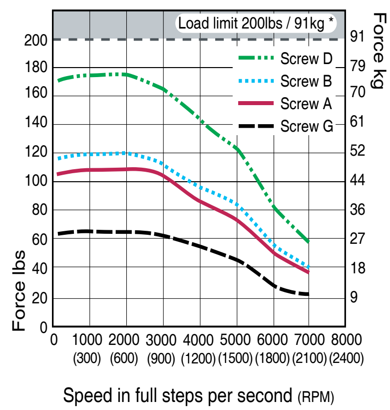

Figure 2.4 Motor performance curve — +48 VDC

+75 VDC

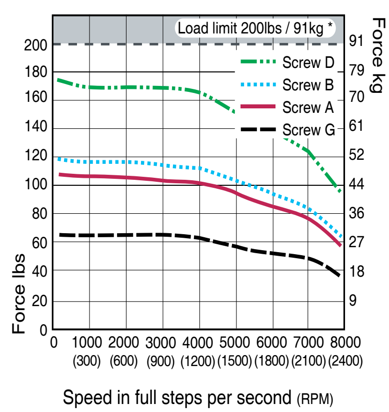

Figure 2.5 Motor performance curve — +75 VDCr

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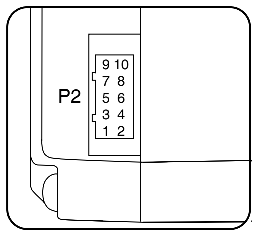
2.3 Connectivity specifications/pin assignments — Communication

2.3.1 RS-422/485 communication

10-pin friction lock wire crimp



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

Mating connector kit:
CK-02

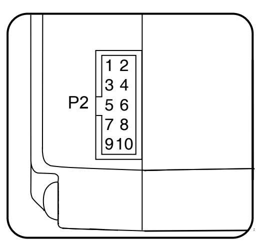
Mfg P/N:
Shell
Hirose DF11-10DS-2C

Pins
Hirose: DF11-2428SC

Pin #	Function	Description
1	TX +	Transmit plus
2	Comm GND	Communication 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 communication, 10-pin locking wire crimp

10-pin press-f t (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

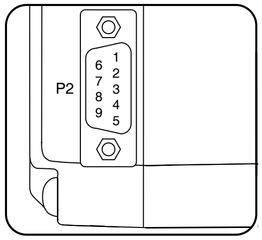
Ribbon cable
Tyco: 1-57051-9

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	Communication ground only. Do not ground aux-logic to this pin.

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

2.3.2 CANopen communication 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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

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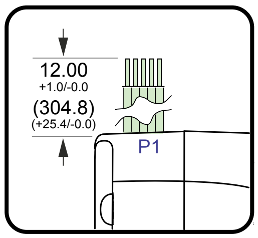
2.4 Connectivity specifications/pin assignments - Power and I/O

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

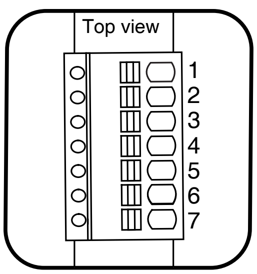
12” (304.8 mm) f ying leads



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

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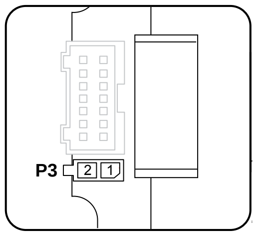
2.4.2 DC motor power

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*

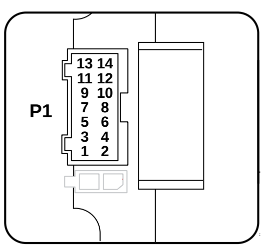
Mating connector kit:
CK-04

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

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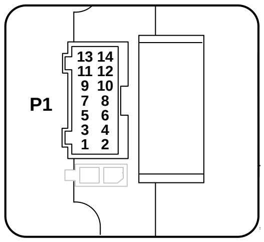
2.4.4 I/O - remote encoder (Plus²)

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

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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

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 communication 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 restrained 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.

3.1 Mounting

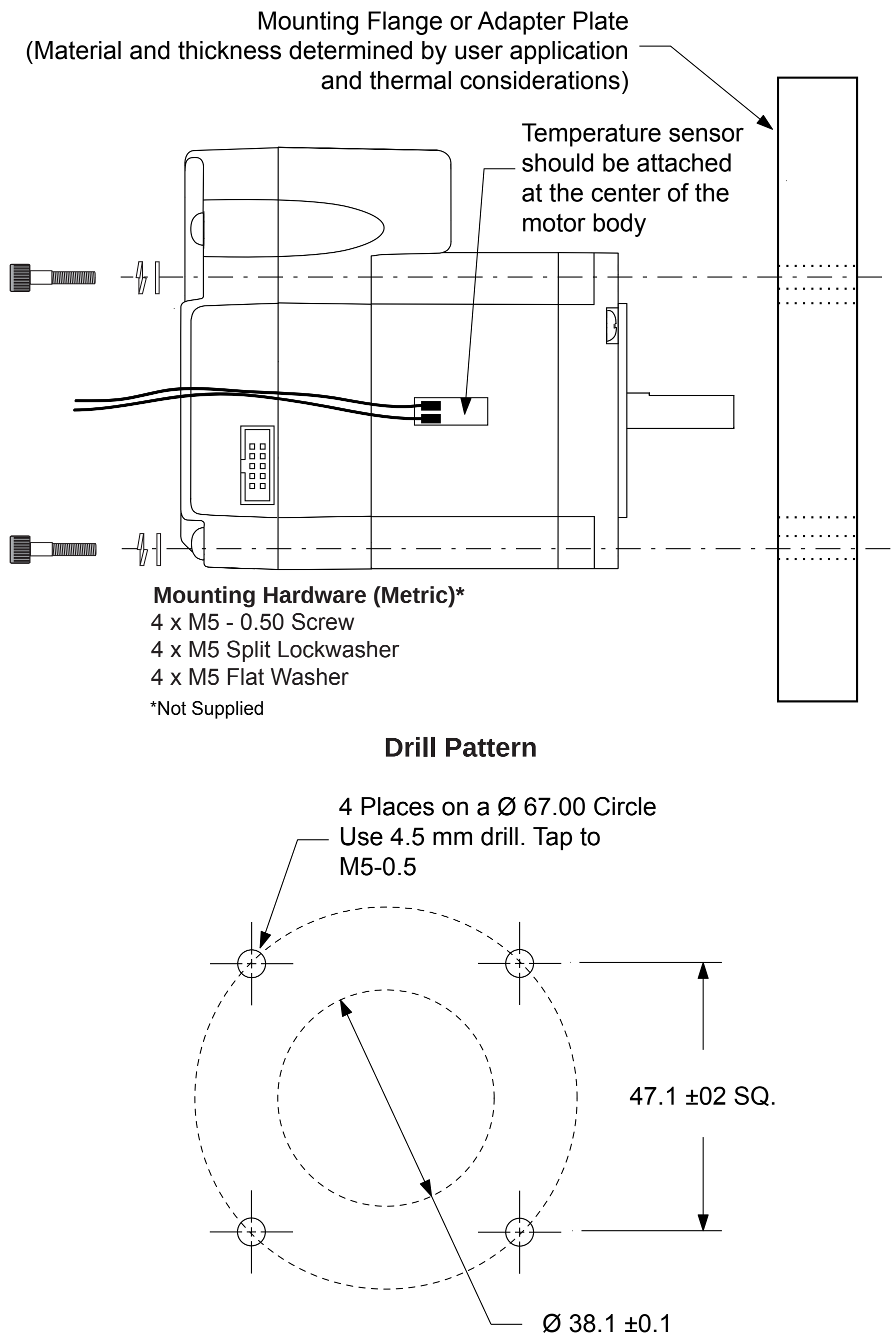

Figure 3.1 MDrive 23 mounting and drill pattern

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.

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

Communication

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

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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.

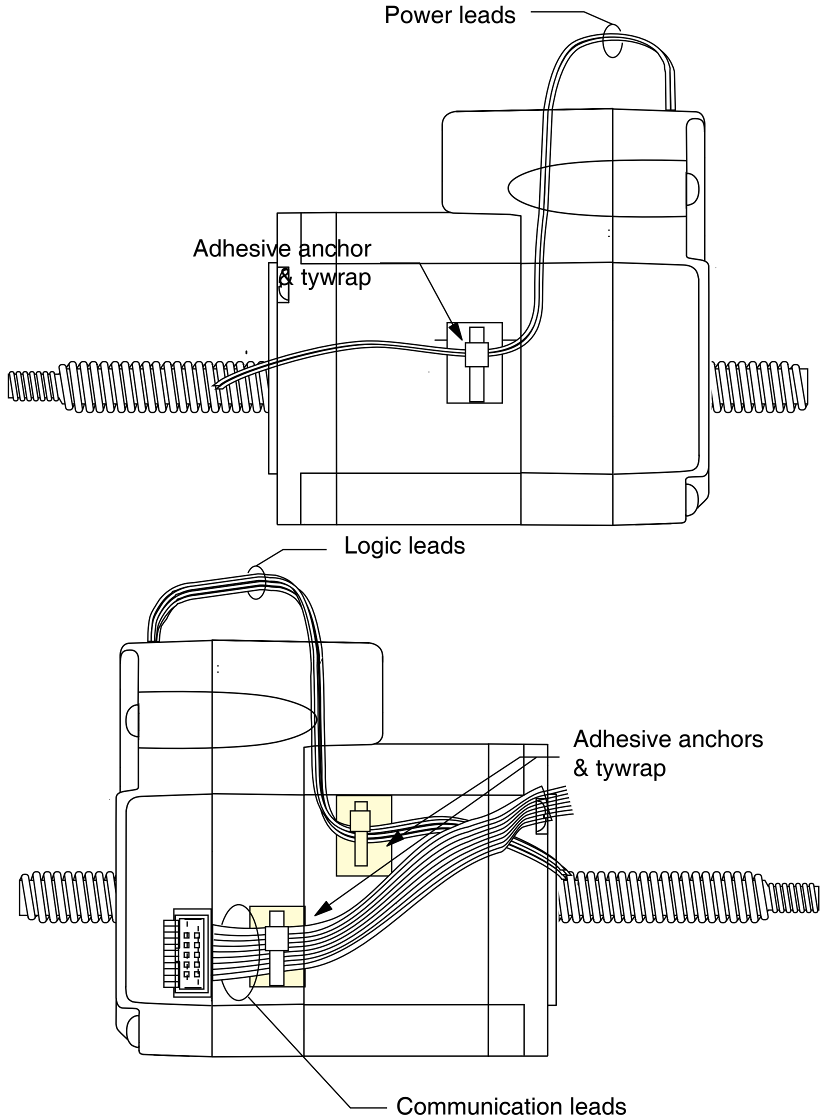

Figure 3.2 Securing leads

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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.

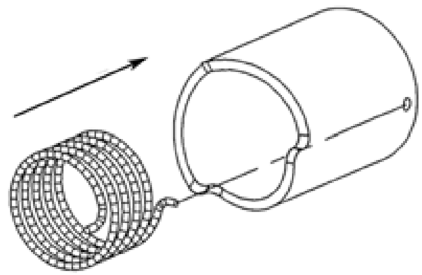

Figure 3.3 Insert spring tang

2) Ensure that the spring is engaged.

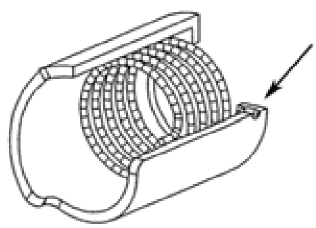

Figure 3.4 Spring engaged

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.

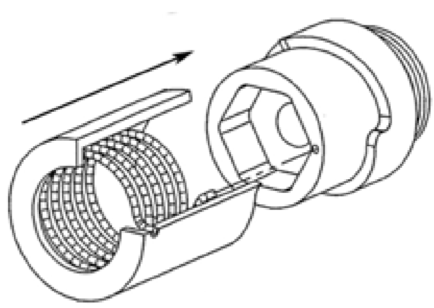

Figure 3.5 Insert opposite tang

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1) With washer installed, insert the back nut into the front nut.

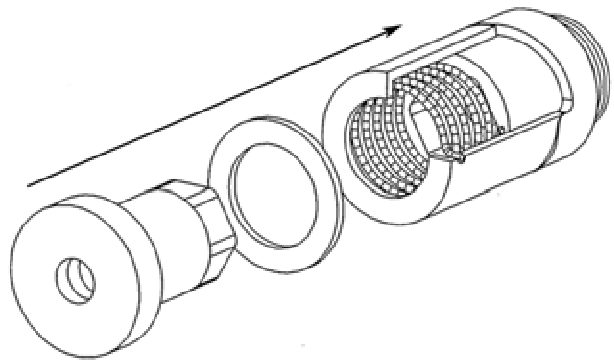

Figure 3.6 Inserting the back nut

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.

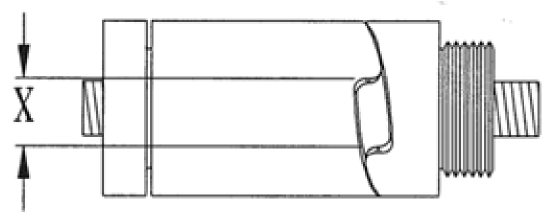

Figure 3.7 Measuring the gap distance

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.

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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.

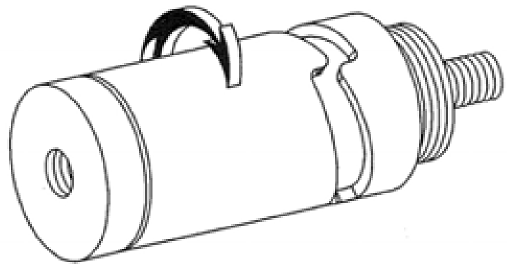

Figure 3.8 Pre-loading the nut

5) The anti-backlash nut is now pre-loaded and fully assembled.

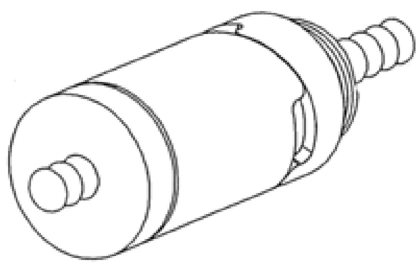

Figure 3.9 Nut pre-loaded and fully assembled

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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 communication 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 communication

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

⚠ **CAUTION**

Communication GROUND LOOPS

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

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

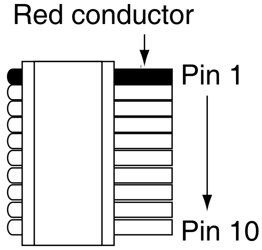
⚠ **CAUTION**

HOT PLUGGING!

Do not connect or disconnect communication 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	Communication ground only. Do not ground aux-logic to this pin.

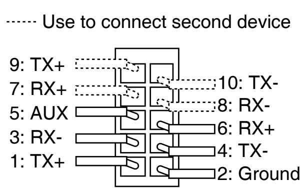
Table 4.1 Communication connections, P2 - 10-pin IDC

Connectivity accessories

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

Communication 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	Communication 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 communication, 10-pin locking wire crimp

Connectivity accessories

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

Communication converter cable (10’/3.0 m).............MD-CC402-001

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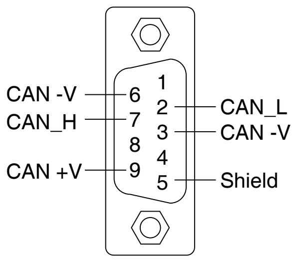
4.2 Interfacing CANopen communication

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 communication 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 communication, P2: 9-pin D-sub female (DB-9F)

Connectivity accessories

Communication converter cable MD-CC500-000

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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

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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

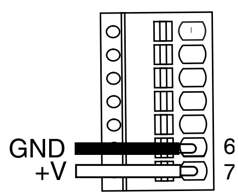
Table 4.61 Recommended power supply wire gauge

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

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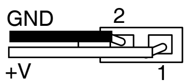
4.3.5 P1 — 2-pin wire crimp interface



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)

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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.

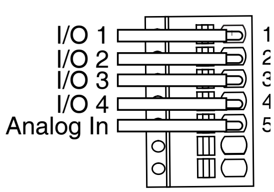
Failure to follow these instructions can result in equipment damage.

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 — 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

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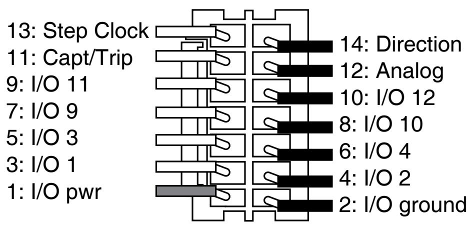
4.4.3 P1 — 14-pin locking wire crimp interface (expanded I/O)



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)

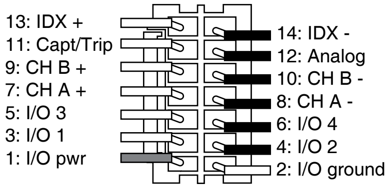
Prototype development cable (10’/3.0 m)................ PD14-2334-FL3

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 communication 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

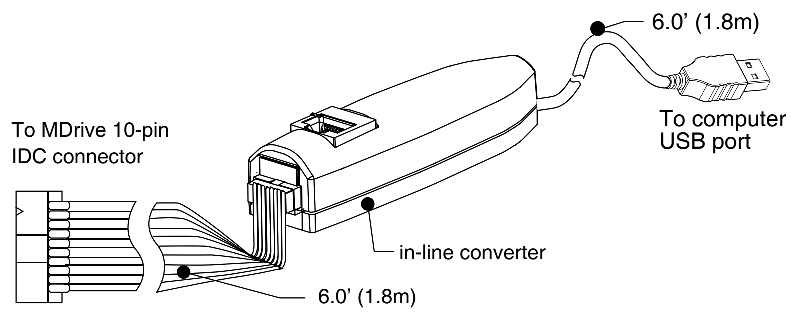


Figure 4.1 MD-CC400-000 communication converter cable

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

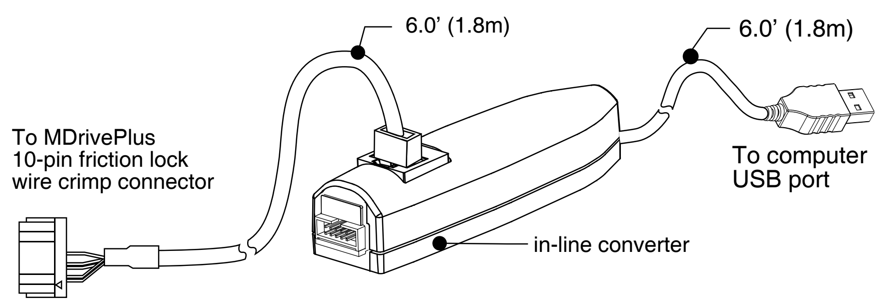


Figure 4.2 MD-CC402-001 communication converter cable

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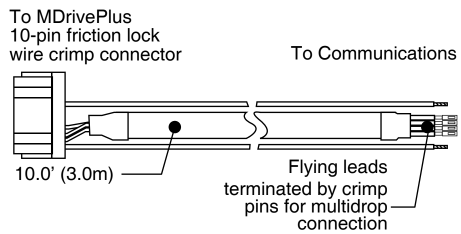
4.5.2 Prototype development cables

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

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



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

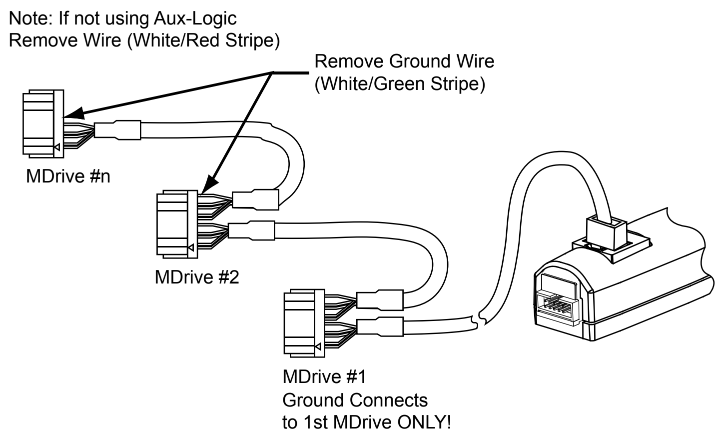


Figure 4.4 Multi-drop communication using the PD10-1434-FL3

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

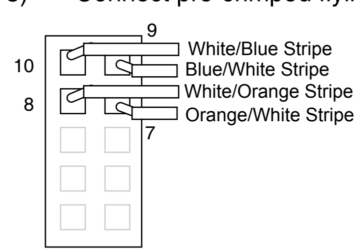


Figure 4.5 Wiring a second PD10-1434-FL3 into the 10-pin wire crimp connector.

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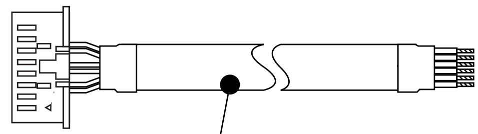
Flying leads to14-pin locking wire crimp connector P2 -P/N: PD14-2334-FL3

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.



Pin #	***Wire Colors***	***Signal (Expanded features)***	***Signal (Remote encoder)***	***Pairs***
14	Black	Step Clock I/O	Index –	X
13	White	Direction I/O	Index +	
12	Black	Analog Input	Analog Input	X
11	Green	Capture/Trip I/O	Capture/Trip I/O	
10	Black	I/O 12	Channel B –	X
9	Blue	I/O 11	Channel B +	
8	Black	I/O 10	Channel A –	X
7	Yellow	I/O 9	Channel A +	
6	Black	I/O 4	I/O 4	X
5	Brown	I/O 3	I/O 3	
4	Black	I/O 2	I/O 2	X
3	Orange	I/O 1	I/O 1	
2	Black	I/O Ground	I/O Ground	X
1	Red	I/O Power	I/O Power	

Figure 4.6 Prototype development cable PD14-2334-FL3

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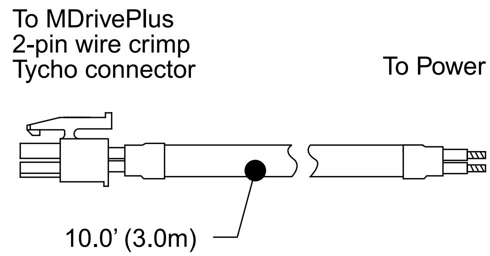
Flying leads to 2-pin locking wire crimp connector P2 -P/N: PD02-2300-FL3

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.



Pin #	***Wire Colors***	***Signal (Expanded features)***
2	Black	Ground
1	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.

IMS SCHNEIDER ELECTRIC MOTION USA HEREBY DISCLAIMS ALL OTHER WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESS OR IMPLIED BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. CUSTOMER'S SOLE REMEDY FOR ANY DEFECTIVE PRODUCT WILL BE AS STATED ABOVE, AND IN NO EVENT WILL IMS BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES IN CONNECTION WITH THE PRODUCT.

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.

IMS Schneider Electric Motion USA and its directors, officers, employees, subsidiaries and affiliates shall not be liable for any damages arising from any loss of equipment, loss or distortion of data, loss of time, loss or destruction of software or other property, loss of production or profits, overhead costs, claims of third parties, labor or materials, penalties or liquidated damages or punitive damages, whatsoever, whether based upon breach of warranty, breach of contract, negligence, strict liability or any other legal theory, or other losses or expenses incurred by the Customer or any third party.

OBTAINING WARRANTY SERVICE

If the Product was purchased from an IMS Schneider Electric Motion USA Distributor, please contact that Distributor to obtain a Returned Material Authorization (RMA). If the Product was purchased directly from IMS Schneider Electric Motion USA, please contact Customer Service at info@imshome.com or 860-295-6102 (Eastern Time Zone).

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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