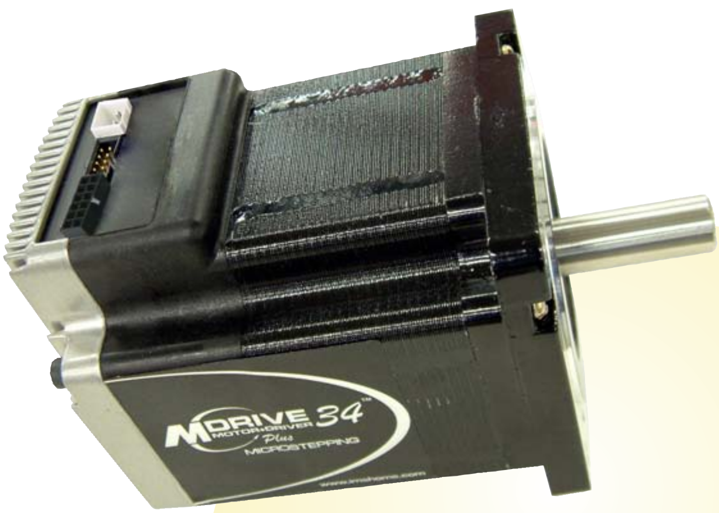
INTELLIGENT MOTION SYSTEMS, INC.

*Excellence in Motion*™

# MDRIVE 34™ MOTOR+DRIVER Plus

MICROSTEPPING

# OPERATING INSTRUCTIONS




www.imshome.com

| MDrivePlus Microstepping Hardware Reference Change Log | | |
|---|---|---|
| Date | Revision | Changes |
| 06/26/2006 | R062606 | Initial Release |
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*MDrive34Plus Microstepping*
*Revision R062606*

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## MDrive34Plus Microstepping

WARNING! The MDrive has components which are sensitive to Electrostatic Discharge (ESD). All handling should be done at an ESD protected workstation.

WARNING! Hazardous voltage levels may be present if using an open frame power supply to power your MDrive product.

WARNING! Ensure that the power supply output voltage does not exceed the maximum input voltage of the MDrive34Plus (+75VDC).

### Before You Begin

The Quick Start guide is designed to help quickly connect and begin using your MDrive34Plus Microstepping integrated motor and driver. The following examples will help you get the motor turning for the first time and introduce you to the basic settings of the drive.

### Tools and Equipment Required

- MDrive34Plus Microstepping Unit (MDM34).
- Parameter setup cable MD-CC300-000 (USB to SPI) or equivalent and adapter MD-ADP-1723C for pluggable interface.
- MDrivePlus Product CD or Internet access to www.imshome.com.
- Control Device for Step/Direction.
- +5 to +24 VDC optocoupler supply.
- An Unregulated +12 to +75 VDC Power Supply.
- Basic Tools: Wire Cutters / Strippers / Screwdriver.
- 18 AWG Wire for Power Supply, 22-28 AWG Wire for Logic Connections (Not Required for Flying Leads version).
- A PC with Windows XP SP2.

### Connecting the Power Supply

Using the 18 AWG wire, connect the DC output of the power supply to the +V input of the MDrive34Plus (P3:1 - Wire Crimp, Red Flying Lead).

Connect the power supply ground to Power Ground (P3:2 - Wire Crimp, Black Flying Lead).

See Figure GS.1.

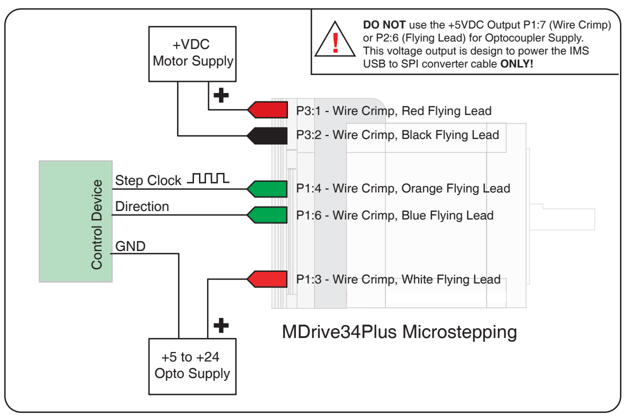



*Figure GS.1: Minimum Logic and Power Connections*

Note: A 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. Care should be taken so that the back EMF does not exceed the maximum input voltage rating of +75 VDC.

### Connect Opto Power and Logic Inputs

Using the recommended wire, connect the following to your controller or PLC:

- Optocoupler Supply (+5 to +24 VDC)
- Step Clock Input
- Direction Input

### Connecting Parameter Setup Cable

Connect the Host PC to the MDrive34Plus Microstepping using the IMS Parameter Setup Cable or equivalent. See Appendix D of this document for Cable installation instructions.

### Install the IMS SPI Motor Interface

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDrive34Plus

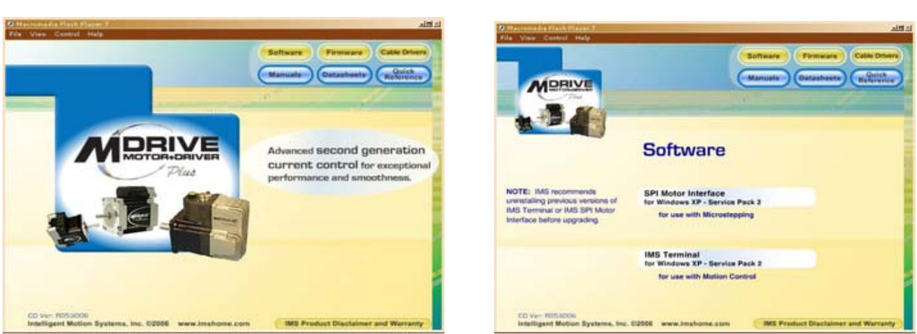



*Figure GS.2: MDrivePlus CD*

WARNING! Because the MDrive consists of two core components, a drive and a motor, close attention must be paid to the thermal environment where the device is used. Operating Range is -40 to +85°C.

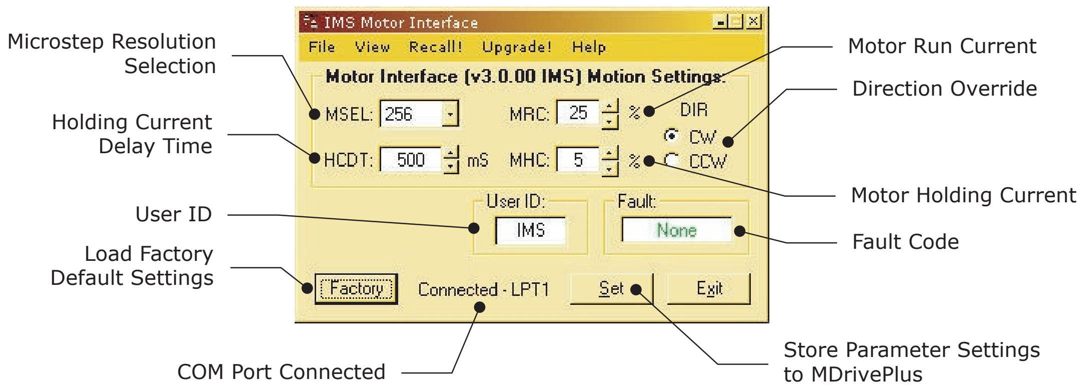
Note: Interactive usage tutorials are available at the IMS Web Site at http://www.imshome.com/tutorials.html

Microstepping. It is available both on the MDrive34Plus CD that came with your product and on the IMS web site at http://www.imshome.com/software_interfaces.html.

1. Insert the MDrive CD into the CD Drive of your PC.
   If not available, go to http://www.imshome.com/software_interfaces.html.
2. The CD will auto-start.
3. Click the Software Button in the top-right navigation area.
4. Click the IMS SPI Interface link appropriate to your operating system.
5. Click SETUP in the Setup dialog box and follow the on-screen instructions.
6. Once IMS SPI Motor Interface is installed, the MDrive34Plus Microstepping settings can be checked and/or set.

Once installed you can change the motor run current, holding current, microstep resolution and other configuration settings. By sending clock pulses to the drive you can now change these settings safely on-the-fly as the IMS SPI Motor interface will not allow you to set an out-of-range value.

## Motion Settings Screen




## I/O Settings Screen

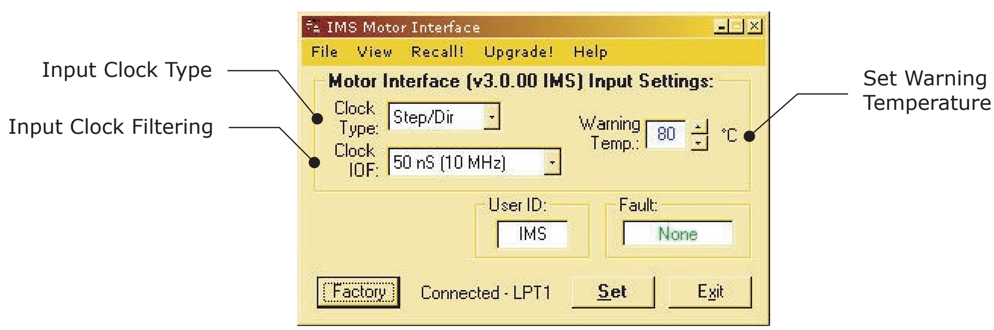
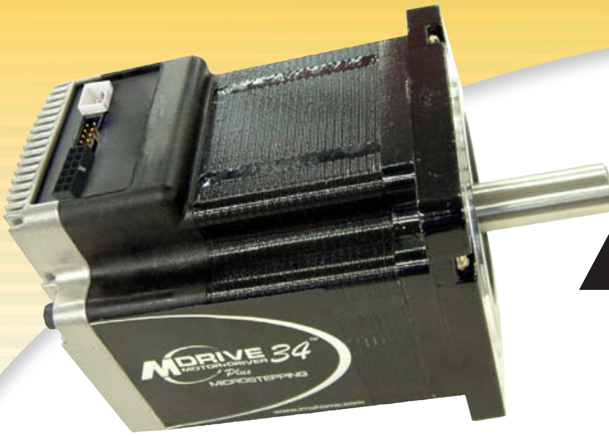



*Figure GS.3: IMS Motor Interface Showing Default Settings*



MDRIVE MOTOR+DRIVER 34™ Plus
MICROSTEPPING

# PART 1: HARDWARE SPECIFICATIONS

**Section 1.1: MDrive34Plus Microstepping Product Introduction**

**Section 1.2: MDrive34Plus Microstepping Detailed Specifications**

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# SECTION 1.1

## *Introduction to the MDrive34Plus Microstepping*

The MDrive34Plus Microstepping high torque integrated motor and driver is ideal for designers who want the simplicity of a motor with on-board electronics. The integrated electronics of the MDrive34Plus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise.

The unsurpassed smoothness and performance delivered by the MDrive34Plus Microstepping are achieved through IMS's advanced 2nd generation current control. By applying innovative techniques to control current flow through the motor, resonance is significantly dampened over the entire speed range and audible noise is reduced.

The MDrive34Plus 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 runs and multiple drive systems. An extended operating range of –40° to +85°C provides long life, trouble free service in demanding environments.

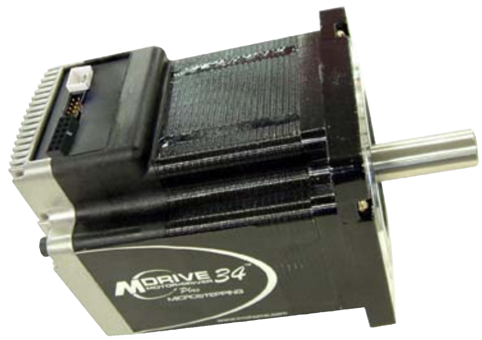


*Figure 1.1.1: MDrive34Plus Microstepping Integrated Motor and Driver Electronics*

The MDrive34Plus uses a NEMA 34 frame size high torque brushless motor combined with a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes. These settings may be changed on-the-fly or downloaded and stored in nonvolatile memory with the use of a simple GUI which is provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

The versatile MDrive34Plus Microstepping is available in multiple configurations to fit various system needs. Rotary motor versions come in three lengths and may include an internal optical encoder, control knob or planetary gearbox. Interface connections are accomplished with either a pluggable locking wire crimp or 12.0" (30.5cm) flying leads.

The MDrive34Plus is a compact, powerful and inexpensive solution that will reduce system cost, design and assembly time for a large range of brushless motor applications.

### *Configuration Interface*

The IMS Motor Interface software is an easy to install and use GUI for configuring the MDrive34Plus from a computer's USB port. GUI access is via the IMS SPI Motor Interface included on the CD shipped with the product, or from www.imshome.com. Optional cables are available for ease of connecting and configuring the MDrive.

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

## Features and Benefits

- Highly Integrated Microstepping Driver and NEMA 34 High Torque Brushless Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: +12 to +75 VDC
  - Low Cost
  - Extremely Compact
- 20 Microstep Resolutions up to
  - 51,200 Steps Per Rev Including:
  - Degrees, Metric, Arc Minutes
- Optically Isolated Logic Inputs will
  - Accept +5 to +24 VDC Signals
  - Sourcing or Sinking
- Automatic Current Reduction

- Configurable:
  - Motor Run/Hold Current
  - Motor Direction vs. Direction Input
  - Microstep Resolution
  - Clock Type: Step and Direction, Quadrature, Step Up and Step Down
  - Programmable Digital Filtering for Clock and Direction Inputs
- Available Options:
  - Internal Optical Encoder
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
- 3 Rotary Motor Lengths Available
- Current and Microstep Resolution May Be Switched On-The-Fly
- Interface Options:
  - Pluggable Locking Wire Crimp
  - 12.0” (30.5cm) Flying Leads
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

## MDrive34Plus Microstepping

> WARNING! Because the MDrive consists of two core components, a drive and a motor, close attention must be paid to the thermal environment where the device is used. See Thermal Specifications.

### General Specifications

#### Input Voltage (+V)

Range* ....................................................................+12 to +75 VDC

**Power supply current requirements = 4A (maximum) per MDrive34Plus. Actual supply current will depend on voltage and load.*

#### Isolated Input

Step Clock, Direction & Enable

Voltage Range (Sourcing or Sinking)..........................+5 to +24 VDC

Current

+5 Volt (Max) ..........................................................8.7 mA

+24 Volt (Max)..........................................................14.6 mA

#### Motion

Digital Filter Range.............................. 50 nS to 12.9µS (10 MHz to 38.8kHz)

Clock Types.............................. Step/Direction, Quadrature, Step Up/Step Down

Step Frequency (Max) ..................................................2 MHz

Number of Microstep Settings..................................................20

Step Frequency Minimum Pulse Width..........................................250 nS

Number of Microstep Resolution Settings....................................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

#### Thermal

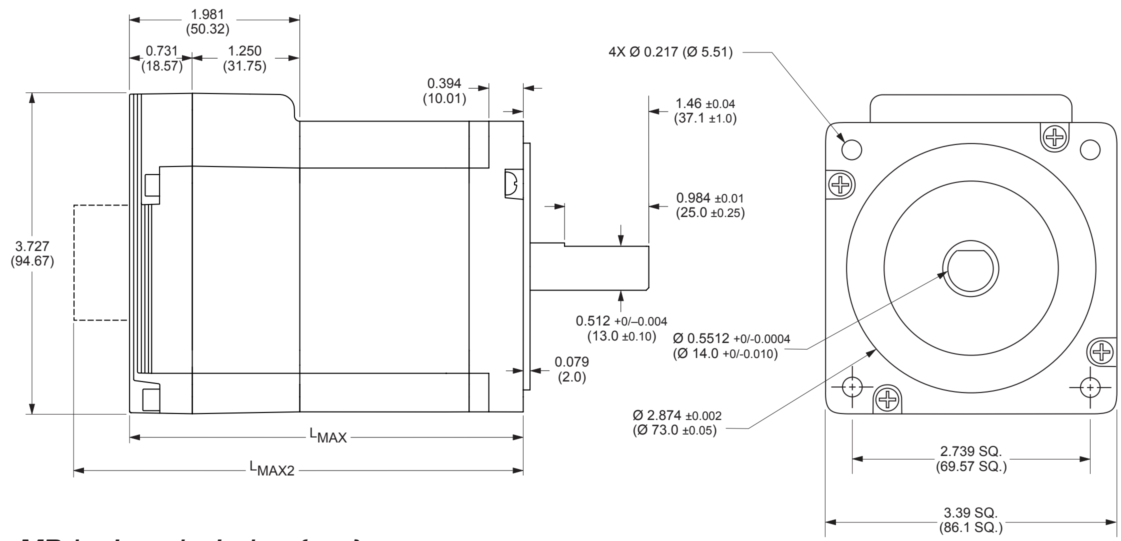
Operating Temperature ..................................................-40 to +85°C

### Setup Parameters

| MDrive34Plus Microstepping Setup Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Function** | **Range** | **Units** | **Default** |
| MHC | Motor Hold Current | 0 to 100 | percent | 5 |
| MRC | Motor Run Current | 1 to 100 | percent | 25 |
| MSEL | Microstep Resolution | 1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256 | µsteps per full step | 256 |
| DIR | Motor Direction Override | 0/1 | – | CW |
| HCDT | Hold Current Delay Time | 0 or 2-65535 | mSec | 500 |
| CLK TYPE | Clock Type | Step/Dir. Quadrature, Up/ Down | – | Step/Dir |
| CLK IOF | Clock and Direction Filter | 50 nS to 12.9 µS (10 MHz to 38.8kHz) | nS (MHz) | 50nS(10 MHz) |
| USER ID | User ID | Customizable | 1-3 characters | IMS |

*Table 1.2.1: Setup Parameters*

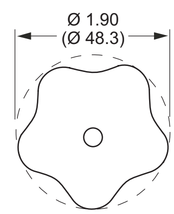
## MECHANICAL SPECIFICATIONS - Dimensions in Inches (mm)




### *MDrive Lengths Inches (mm)*

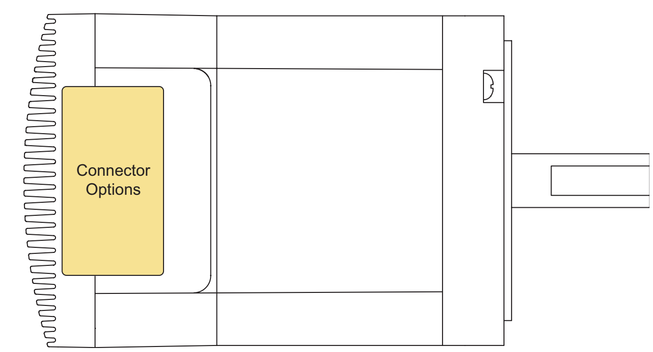
| Motor Length | LMAX | LMAX2 |
|---|---|---|
| | SINGLE SHAFT, INTERNAL ENCODER or LINEAR ACTUATOR VERSION | CONTROL KNOB VERSION |
| Single | 3.71 (94.23) | 4.42 (112.27) |
| Double | 4.50 (114.30) | 5.21 (132.33) |
| Triple | 6.07 (154.18) | 6.78 (172.21) |

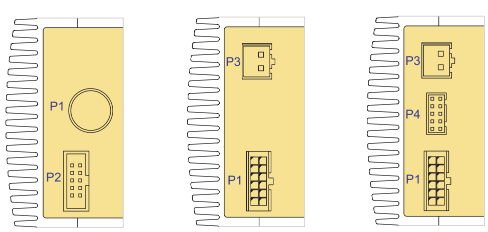
### *$L_{MAX2}$ Option*




*Control Knob*

### *Connector Options*




*Flying Leads* — *Pluggable Locking Wire Crimp* — *Pluggable Locking Wire Crimp with Internal Encoder*

*Figure 1.2.1: MDrive34Plus Mechanical Specifications*

## WIRE/PIN ASSIGNMENTS

### Flying Leads Interface

| P1: I/O & POWER CONNECTOR | | | |
|---|---|---|---|
| Wire Colors | Wire Colors with Internal Encoder | Function | |
| White | White | Optocoupler Reference | |
| Orange | Orange | Step Clock Input | |
| Blue | Blue | CW/CCW Direction Input | |
| Brown | Brown | Enable Input | |
| Black | Black | Power Ground | |
| Red | Red | +V (+12 to +75 VDC) | |
| | — | Differential Encoder | Single-End Encoder |
| | Yellow/Black | Ground | Ground |
| | Yellow/Violet | Index + | Index |
| | Yellow/Blue | Channel A + | Channel A |
| | Yellow/Red | +5 VDC Input | +5 VDC Input |
| | Yellow/Brown | Channel B + | Channel B |
| | Yellow/Gray | Index – | — |
| | Yellow/Green | Channel A – | |
| | Yellow/Orange | Channel B – | |

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

*Table 1.2.2: MDrive34Plus Microstepping Pin Configuration - Flying Leads Interface*

### Pluggable Interface

| P1: I/O & COMM CONNECTOR | |
|---|---|
| Pluggable Locking Wire Crimp | Function |
| Pin 1 | No Connect |
| Pin 2 | No Connect |
| Pin 3 | Optocoupler Reference |
| Pin 4 | Step Clock Input |
| Pin 5 | Enable Input |
| Pin 6 | CW/CCW Direction Input |
| Pin 7 | +5 VDC Output |
| Pin 8 | SPI Clock |
| Pin 9 | Communications Ground |
| Pin 10 | SPI Master Out – Slave In |
| Pin 11 | SPI Chip Select |
| Pin 12 | SPI Master In – Slave Out |

| P3: POWER CONNECTOR | |
|---|---|
| Pluggable Locking Wire Crimp | Function |
| Pin 1 | +V (+12 to +75 VDC) |
| Pin 2 | Power Ground |

| P4: DIFFERENTIAL INTERNAL ENCODER (OPTIONAL) | |
|---|---|
| Friction Lock Wire Crimp | Function |
| Pin 1 | Ground |
| Pin 2 | Channel A + |
| Pin 3 | Channel A – |
| Pin 4 | Channel B + |
| Pin 5 | Channel B – |
| Pin 6 | Index + |
| Pin 7 | Index – |
| Pin 8 | +5 VDC Input |
| Pin 9 | No Connect |
| Pin 10 | No Connect |

*Table 1.2.3: MDrive34Plus Microstepping Pin Configuration - Pluggable Interface*

## Motor Specifications

### Single Length

Holding Torque ................ 381 oz-in/269 N-cm
Detent Torque ................ 10.9 oz-in/7.7 N-cm
Rotor Inertia ................ 0.01416 oz-in-sec$^2$/1.0 kg-cm$^2$
Weight (Motor + Driver) ................ 4.1 lb/1.9 kg

### Double Length

Holding Torque ................ 575 oz-in/406 N-cm
Detent Torque ................ 14.16 oz-in/10.0 N-cm
Rotor Inertia ................ 0.02266 oz-in-sec$^2$/1.6 kg-cm$^2$
Weight (Motor + Driver) ................ 5.5 lb/2.5 kg

### Triple Length

Holding Torque ................ 1061 oz-in/749 N-cm
Detent Torque ................ 19.83 oz-in/14.0 N-cm
Rotor Inertia ................ 0.04815 oz-in-sec$^2$/3.4 kg-cm$^2$
Weight (Motor + Driver) ................ 8.8 lb/4.0 kg

## Options and Accessories

### Internal Encoder

Internal optical encoders are offered factory-mounted with the MDrive34Plus Microstepping. Refer to Appendix E: Interfacing an Encoder for available styles, line counts and part numbers. All encoders come with an index mark.

### Control Knob

The MDrive34Plus 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 MDrive34Plus. See Appendix C: Gearboxes.

### Parameter Setup Cable and Adapters

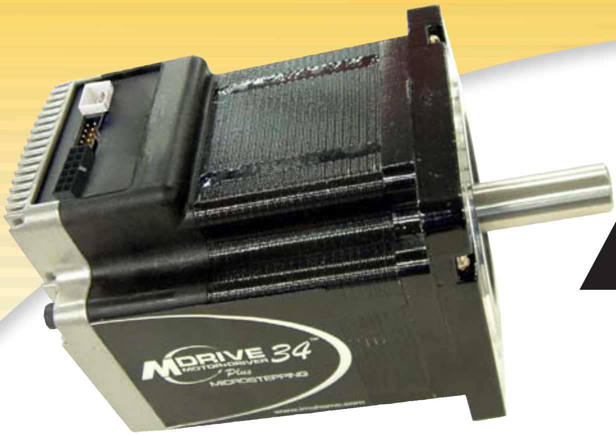
The optional 12.0' (3.6m)* parameter setup cable part number MD-CC300-000 facilitates communications wiring and is recommended with first order. It connects an MDrive to a PC's USB port. MDrives with 12-pin pluggable locking wire crimp require adapter MD-ADP-1723C.

*12' (3.6m) total, includes 6' (1.8m) USB Cable

### Prototype Development Cable

For testing and development of MDrives with pluggable locking wire crimp connectors, the following 10.0' (3m) interface cables are recommended with first orders:

I/O and Communications: 12-Pin Cable ................ PD12-1434-FL3
Power: 2-Pin Wire Crimp Cable ................ PD02-3400-FL3
Internal Encoder: 10-Pin Cable ................ PD10-1434-FL3



MDRIVE 34 MOTOR+DRIVER Plus
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# PART 2: INTERFACING AND CONFIGURING

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# MDrive34Plus Mounting and Connection Recommendations

## Mounting Recommendations

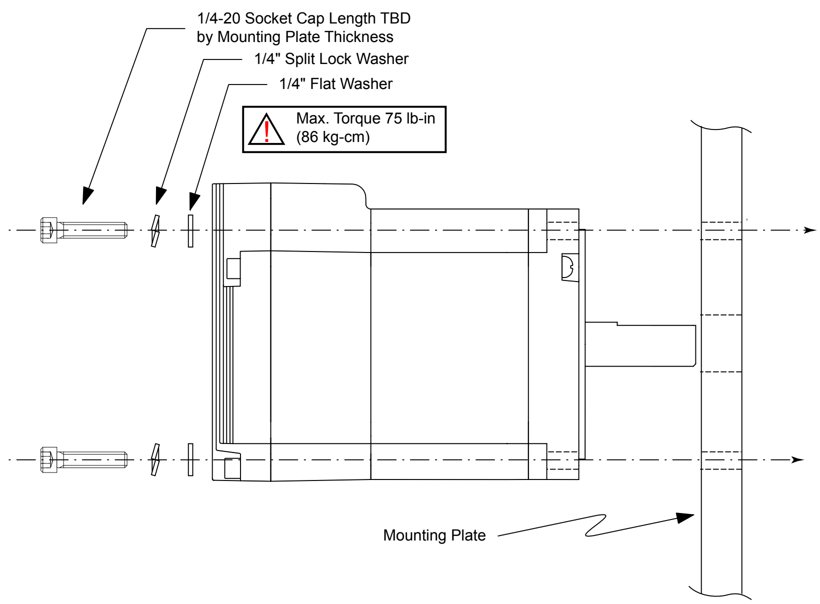


*Figure 2.1.1: Mounting the MDrive34Plus Microstepping*

## 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 MDrive34Plus 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.

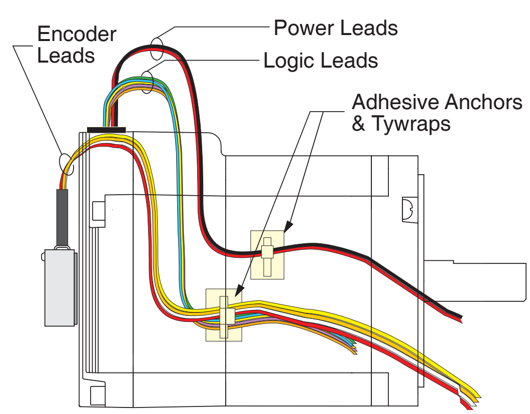


*Figure 2.1.2: Typical MDrive34Plus Shown with Leads Secured*

### *Recommended Wiring*

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

Logic Wiring ........................................................ 22 AWG
Wire Strip Length ........................................................ 0.25” (6.0 mm)
Power and Ground ........................................................ 18 AWG

### *Securing Power Leads and Logic Leads*

Some applications may require that the MDrive34Plus move with the axis motion. If this is a requirement of your application, the wiring must be properly anchored. This will prevent flexing and tugging which can cause damage at critical connection points within the MDrivePlus.

**WARNING! DO NOT** connect or disconnect power leads when power is applied! Disconnect the AC power side to power down the DC power supply.

## DC Power Recommendations

The MDrive34Plus Microstepping operates from a single unregulated linear or unregulated switching power supply to power the control circuits and provide motor power. For recommended IMS power supplies and cable recommendations see Appendix B: Recommended Power and Cable Configurations.

The power requirements for the MDrive34Plus Microstepping are:

Output Voltage ...........................................................................................+12 to +75 VDC
Current (max. per unit).....................................................................4A (Max Per MDrive34Plus)
*(Actual power supply current requirement will depend upon voltage and load)*

### *Recommended DC Power Supply Connections*

The MDrive34Plus Microstepping operates from a single unregulated linear or unregulated switching power supply to power the control circuits and provide motor power.

Wiring should be accomplished using shielded twisted pair of appropriately gauged wires. The shield should be attached to earth at the power supply end and left floating at the MDrive34Plus end. For recommended IMS Power Supplies and cable specifications please refer to Appendix B: Recommended Power and Cable Configurations.

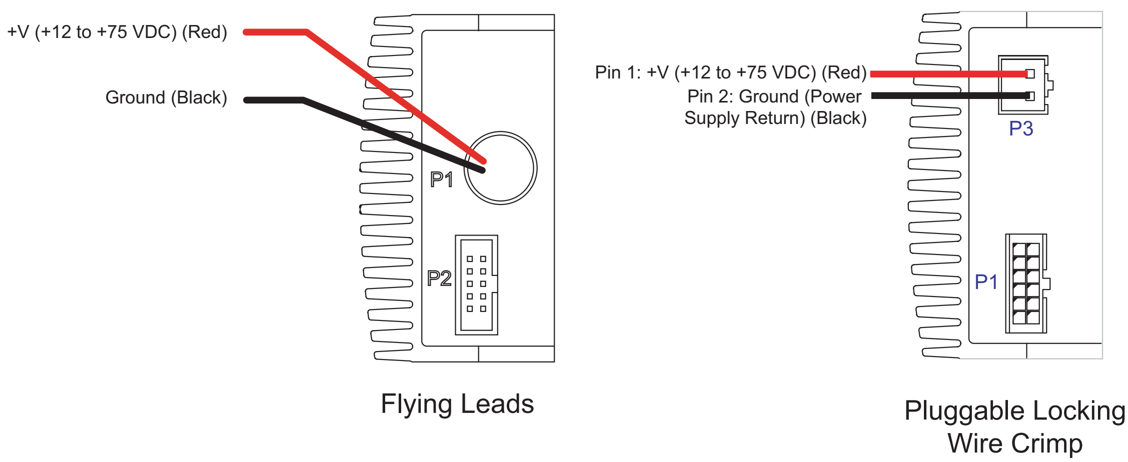


*Figure 2.1.3: MDrive34Plus Power Connection*

## Logic Interface and Connection

### MDrive34Plus Microstepping Optically Isolated Logic Inputs

The MDrive34Plus has three optically isolated logic inputs which are located on connector P1. These inputs are isolated to minimize or eliminate electrical noise coupled onto the drive control signals. Each input is internally pulled-up to the level of the optocoupler supply and may be connected to sinking outputs on a controller such as the IMS LYNX or a PLC. These inputs are:

1] Step Clock (SCLK)/Quadrature (CH A)/Clock UP

2] Direction (DIR)/Quadrature (CH B)/ Clock DOWN

3] Enable (EN)

Of these inputs only step clock and direction are required to operate the MDrive34Plus Microstepping.

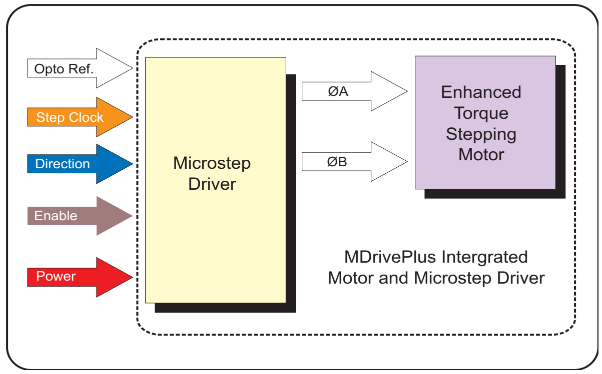


*Figure 2.2.1: MDrive34Plus Microstepping Block Diagram*

### Isolated Logic Input Pins and Connections

The following diagram illustrates the pins and connections for the MDrive34Plus Microstepping family of products. Careful attention should be paid to verify the connections on the model MDrive34Plus Microstepping you are using.

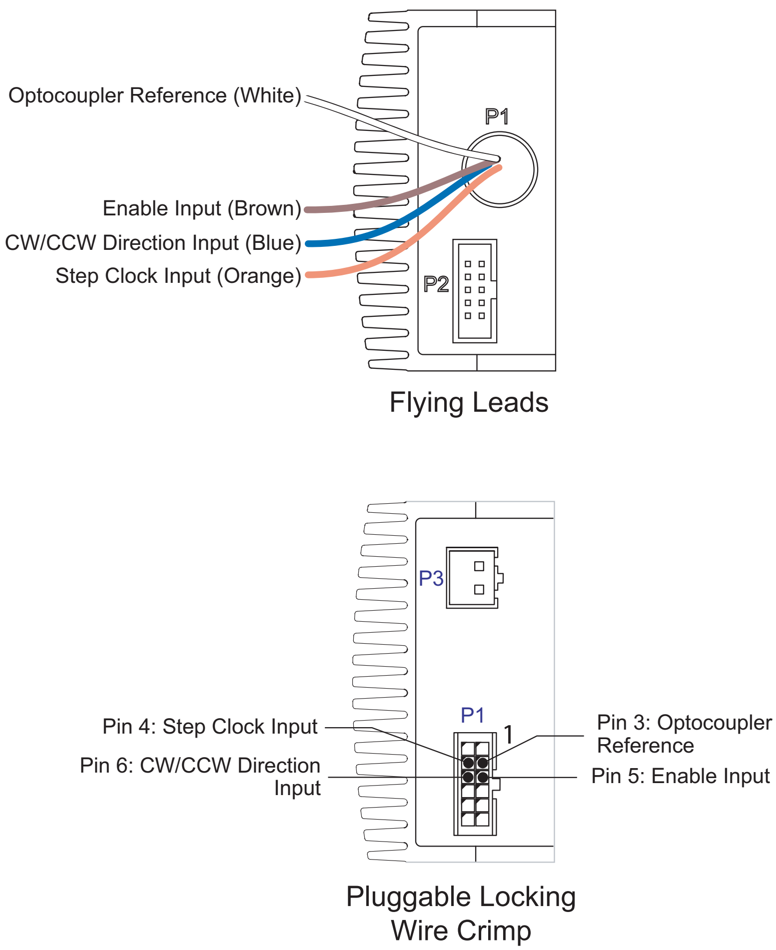


*Figure 2.2.2: Isolated Logic Pins and Connections*

## Isolated Logic Input Characteristics

### *Enable Input*

This input can be used to enable or disable the driver output circuitry. Leaving the enable switch open (Logic HIGH, Disconnected) for sinking or sourcing configuration, the driver outputs will be enabled and the step clock pulses will cause the motor to advance. When this input switch is closed (Logic LOW) in both sinking and sourcing configurations, the driver output circuitry will be disabled. Please note that the internal sine/cosine position generator will continue to increment or decrement as long as step clock pluses are being received by the MDrive34Plus Microstepping.

### *Clock Inputs*

The MDrive34Plus Microstepping features the ability to configure the clock inputs based upon how the user will desire to control the drive. By default the unit is configured for the Step/Direction function.

#### Step Clock

The step clock input is where the motion clock from your control circuitry will be connected. The motor will advance one microstep in the plus or minus direction (based upon the state of the direction input) on the rising edge of each clock pulse. The size of this increment or decrement will depend on the microstep resolution setting.

#### Direction

The direction input controls the CW/CCW direction of the motor. The input may be configured as sinking or sourcing based upon the state of the Optocoupler Reference. The CW/CCW rotation, based upon the state of the input may be set using the IMS Motor Interface software included with the MDrive34Plus Microstepping.

#### Quadrature

NOTE: When using Quadrature inputs, attention must be paid to the velocity of the MDrive. The MDrive will follow the acceleration/deceleration profile of the master encoder. If the MDrive is enabled when the encoder is at full velocity the MDrive Motor may stall.

The Quadrature clock function would typically be used for following applications where the MDrive34Plus Microstepping would be slaved to an encoder for an electronic gearing application.

The MDrive34Plus will take 1 motor step for each edge of the Quadrature Clock Input. For example, a 500 line encoder will output 2000 edges per revolution (4 Edges per line), the MDrivePlus Microstepping will move 2000 motor steps per revolution of the master encoder. The MDrive can be electronically geared to the master encoder using the MSEL parameter to ratio the input. At an MSEL setting of 10 (2000 µSteps/Rev) the MDRive34Plus Microstepping will follow a 500 line encoder at a ratio of 1:1.

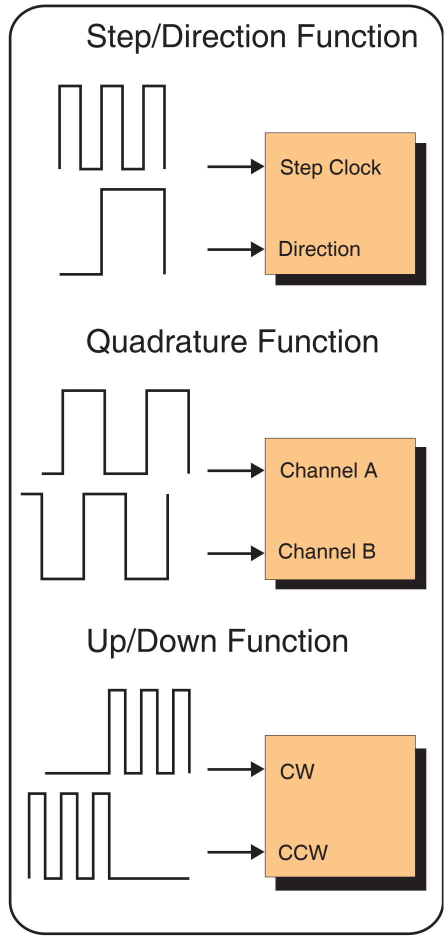

*Figure 2.2.3: Input Clock Functions*

#### Up/Down

The Up/Down clock would typically be used in a dual-clock direction control application.

#### Enable

This input can be used to enable or disable the driver output circuitry. Leaving the enable switch open for sinking or sourcing configuration, the driver outputs will be enabled and the step clock pulses will cause the motor to advance. When this input switch is closed in both sinking and sourcing configurations, the driver output circuitry will be disabled. Please note that the internal sine/cosine position generator will continue to increment or decrement as long as step clock pluses are being received by the MDrive34Plus Microstepping.

#### Input Timing

The direction input and the microstep resolution inputs are internally synchronized to the positive going edge of the step clock input. When a step clock pulse goes HIGH, the state of the direction input and microstep resolution settings are latched. Any changes made to the direction and/or microstep resolution will occur on

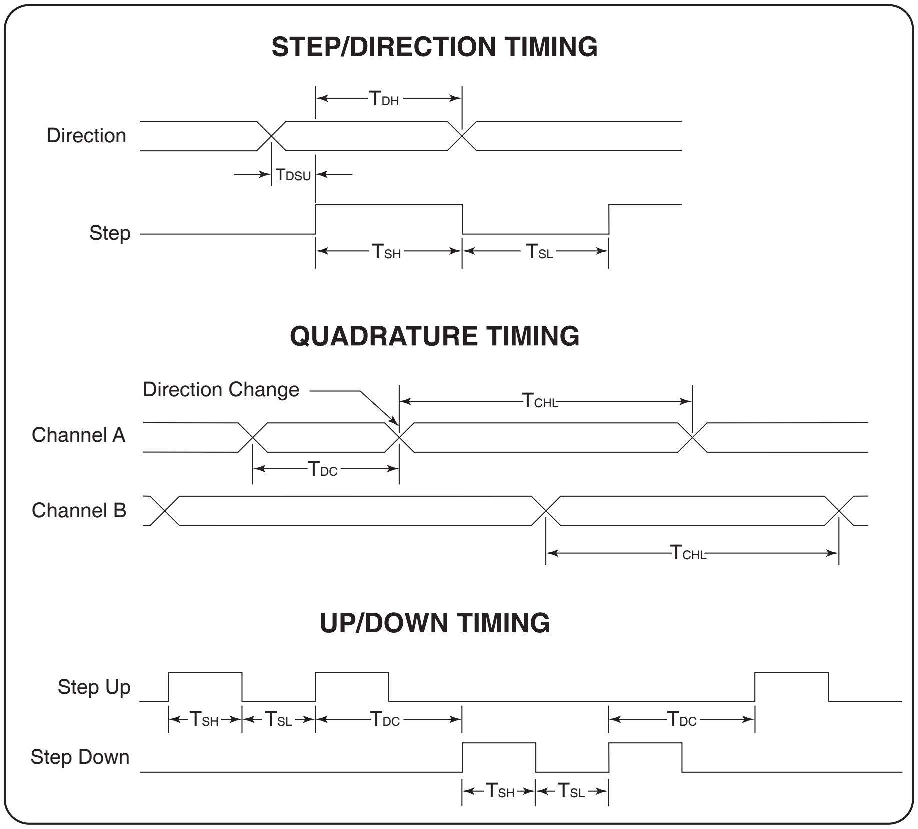


*Figure 2.2.4: Clock Input Timing Characteristics*

| Clock Input Timing | | | | | |
|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Type and Value** | | | |
| | | **Step/Direction** | **Step Up/Down** | **Quadrature** | **Units** |
| $T_{DSU}$ | T Direction Set Up | 0 | — | — | nS min |
| $T_{DH}$ | T Direction Hold | 50 | — | — | nS min |
| $T_{SH}$ | T Step High | 250 | 250 | — | nS min |
| $T_{SL}$ | T Step Low | 250 | 250 | — | nS min |
| $T_{DL}$ | T Direction Change | — | 250 | 250 | nS min |
| $T_{CHL}$ | T Channel High/Low | — | — | 400 | nS min |
| $F_{SMAX}$ | F Step Maximum | 5 | 2 | — | MHz Max |
| $F_{CHMAX}$ | F Channel Maximum | — | — | 1.25 | MHz Max |
| $F_{ER}$ | F Edge Rate | — | — | 5 | MHz Max |

*Table 2.2.1: Input Clocks Timing Table*

the rising edge of the step clock pulse following this change. Run and Hold Current changes are updated immediately. The following figure and table list the timing specifications.

### Input Filtering

The clock inputs may also be filtered using the Clock IOF pull down of the IMS SPI Motor Interface. The filter range is from 50 nS (10 MHz) to 12.9 µSec. (38.8 kHz).

The configuration parameters for the input filtering is covered in detail in Section 2.4: Configuring the MDrive34Plus Microstepping.

NOTE: When connecting the Optocoupler Supply, it is recommended that you do not use MDrive Power Ground as Ground as this will defeat the optical isolation.

## Optocoupler Reference

The MDrive34Plus Microstepping Logic Inputs are optically isolated to prevent electrical noise being coupled into the inputs and causing erratic operation.

There are two ways that the Optocoupler Reference will be connected depending whether the Inputs are to be configured as sinking or sourcing.

| Optocoupler Reference | |
|---|---|
| **Input Type** | **Optocoupler Reference Connection** |
| Sinking | +5 to +24 VDC |
| Sourcing | Controller Ground |

*Table 2.2.2: Optocoupler Reference Connection*

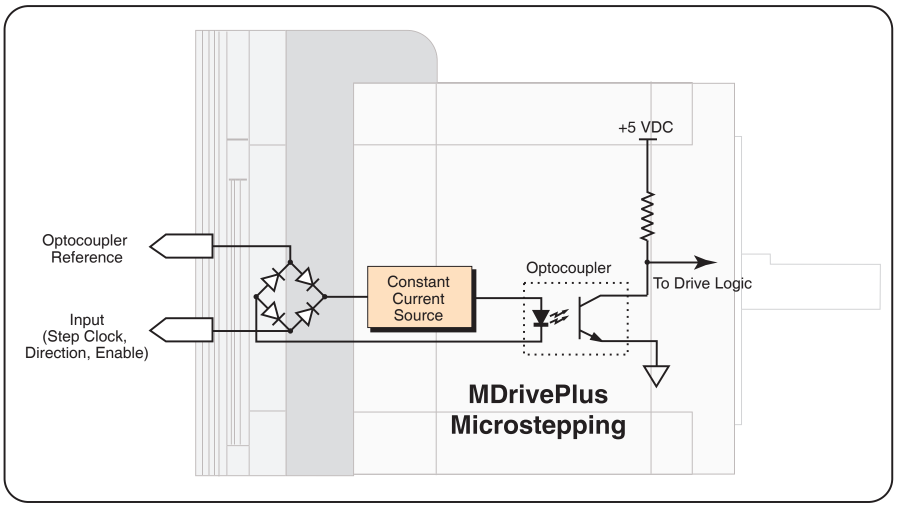


*Figure 2.2.5: Optocoupler Input Circuit Diagram*

## Input Connection Examples

The following diagrams illustrate possible connection/application of the MDrive34Plus Microstepping Logic Inputs.

### *Open Collector Interface Example*

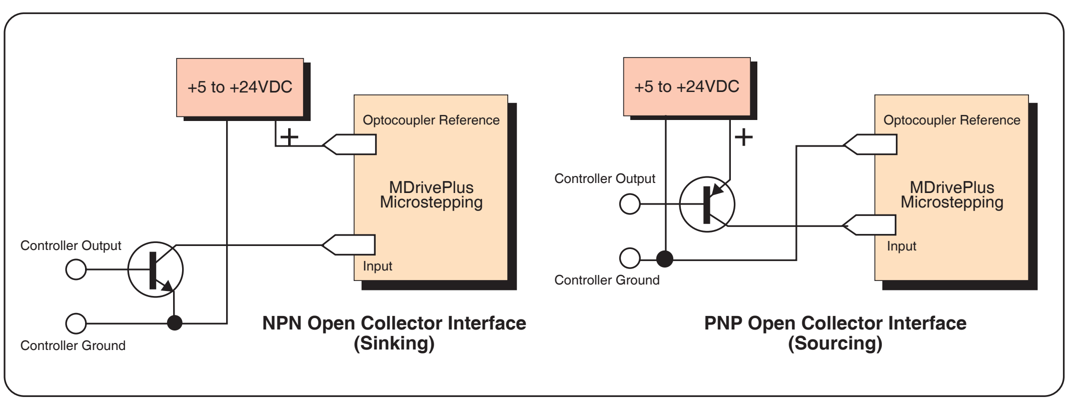


*Figure 2.2.6: Open Collector Interface Example*

### *Switch Interface Example*

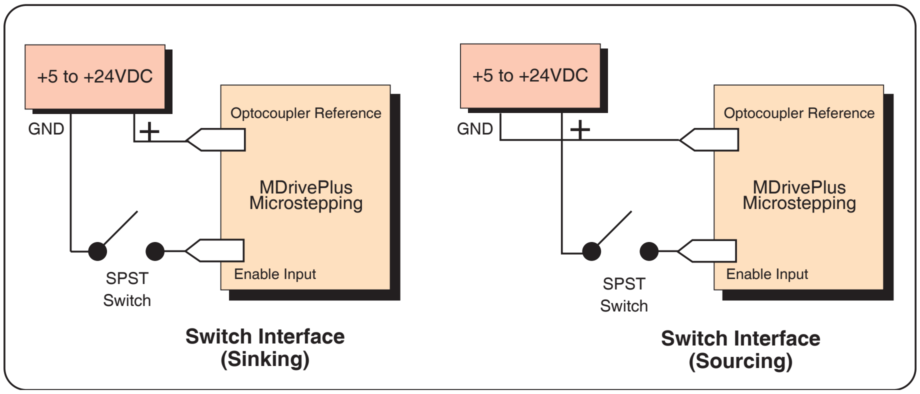


*Figure 2.2.7: Switch Interface Example*

## Minimum Required Connections

The connections shown are the minimum required to operate the MDrive34Plus Microstepping. These are illustrated in both Sinking and Sourcing Configurations. Please reference the Pin Configuration diagram and Specification Tables for the MDrive connector option you are using.

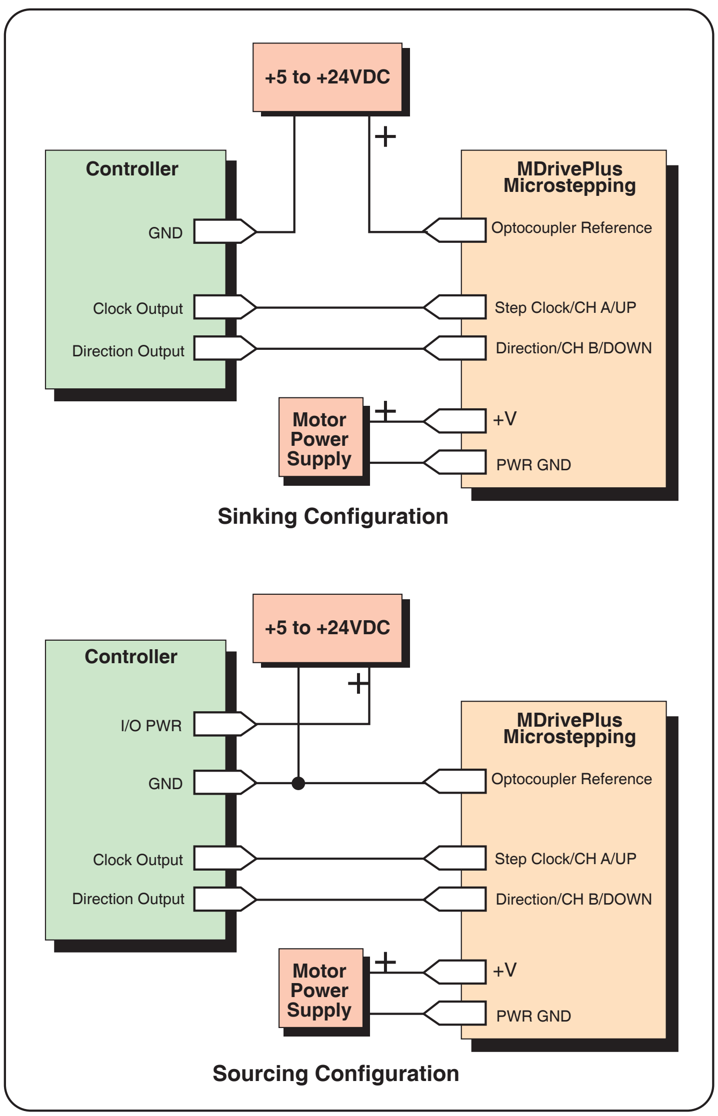


*Figure 2.2.8: Minimum Required Connections*

# SPI Connection and Interface

## Connecting the SPI Interface

The SPI (Serial Peripheral Interface) is the communications and configuration interface for the MDrive34Plus Microstepping integrated motor/driver.

For prototyping we recommend the purchase of the parameter setup cable MD-CC300-000. If using the MDrive34Plus Microstepping with the 10-Pin IDC on P2, this cable will plug directly into the MDrivePlus.

*Figure 2.3.1: MD-CC300-000 Parameter Setup Cable*

For more information on cables and cordsets, please see Appendix D: Cables and Cordsets.

## SPI Signal Overview

### +5 VDC (Output)

This output is a voltage supply for the setup cable only. It is not designed to power any external devices.

### SPI Clock

The Clock is driven by the Master and regulates the flow of the data bits. The Master may transmit data at a variety of baud rates. The Clock cycles once for each bit that is transferred.

### Logic Ground

This is the ground for all Communications.

### MISO (Master In/Slave Out)

Carries output data from the MDrive34Plus Microstepping units back to the SPI Master. Only one MDrive34Plus can transmit data during any particular transfer.

### CS (SPI Chip Select)

This signal is used to turn multiple MDrive34Plus Microstepping units on or off.

### MOSI (Master Out/Slave In)

Carries output data from the SPI Master to the MDrive34Plus Microstepping.

## SPI Pins and Connections

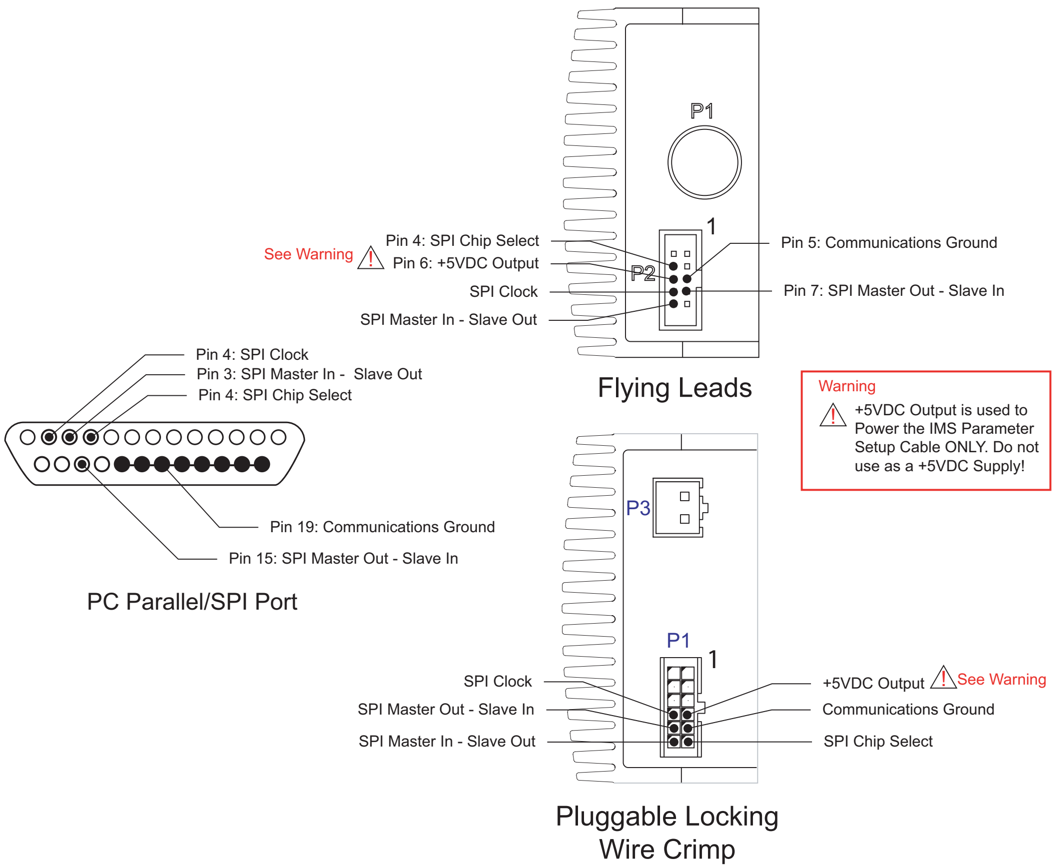


*Figure 2.3.2: SPI Pins and Connections*

## SPI Master with Multiple MDrive34Plus Microstepping

It is possible to link multiple MDrive34Plus Microstepping units in an array from a single SPI Master by wiring the system and programming the user interface to write to multiple chip selects.

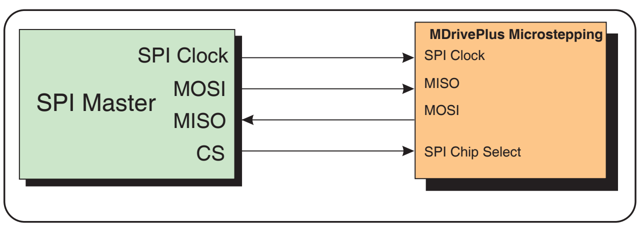


*Figure 2.3.3: SPI Master with a Single MDrive34Plus Microstepping*

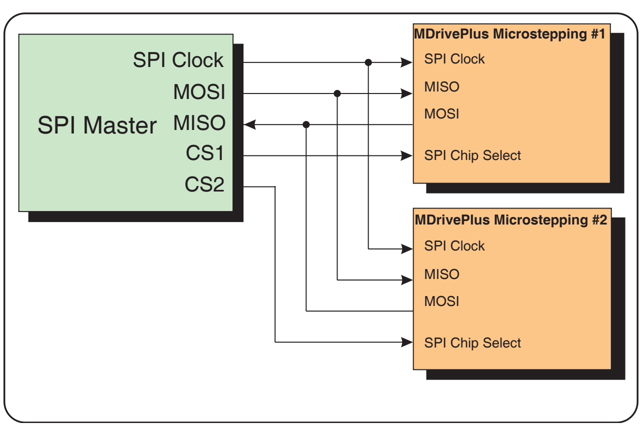


*Figure 2.3.4: SPI Master with Multiple MDrive34Plus Microstepping*

Note: Interactive usage tutorials are available at the IMS Web Site at http://www.imshome.com/tutorials.html

## Configuring Using the IMS SPI Motor Interface

### Installation

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDrive34Plus Microstepping. It is available both on the MDrivePlus CD that came with your product and on the IMS web site at http://www.imshome.com/software_interfaces.html.

1. Insert the MDrive CD into the CD Drive of your PC.
   If not available, go to http://www.imshome.com/software_interfaces.html.


*Figure 2.4.1: MDrive34Plus CD*

2. The CD will auto-start.
3. Click the Software Button in the top-right navigation Area.
4. Click the IMS SPI Interface link appropriate to your operating system.
5. Click SETUP in the Setup dialog box and follow the on-screen instructions.
6. Once IMS SPI Motor Interface is installed, the MDrive34Plus Microstepping settings can be checked and/or set.

### Configuration Parameters and Ranges

| MDrive34Plus Microstepping Setup Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Function** | **Range** | **Units** | **Default** |
| MHC | Motor Hold Current | 0 to 100 | percent | 5 |
| MRC | Motor Run Current | 1 to 100 | percent | 25 |
| MSEL | Microstep Resolution | 1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256 | µsteps per full step | 256 |
| DIR | Motor Direction Override | 0/1 | – | CW |
| HCDT | Hold Current Delay Time | 0 or 2-65535 | mSec | 500 |
| CLK TYPE | Clock Type | Step/Dir. Quadrature, Up/Down | – | Step/Dir |
| CLK IOF | Clock and Direction Filter | 50 nS to 12.9 µS (10 MHz to 38.8kHz) | nS (MHz) | 50nS (10 MHz) |
| USER ID | User ID | Customizable | 1-3 characters | IMS |

*Table 2.4.1: Setup Parameters and Ranges*

The IMS SPI Motor Interface will not allow the user to set ou-of-range values. If a value is out-of-range, it will display in the motor interface text field in red text, hovering the mouse pointer over the field will display the acceptable range in a tool tip.

## IMS SPI Motor Interface Menu Options

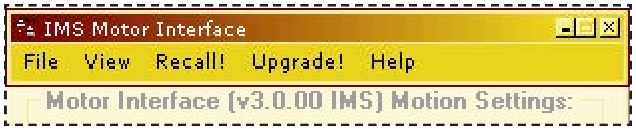


*Figure 2.4.2: IMS SPI Motor Interface Menu Options*

### File

> Open: Opens a saved *.mot (Motor Settings) file
> Save: Saves the current motor settings as a *.mot file for later re-use
> Save As
> Exit

### View

> Motion Settings: Displays the Motion Settings screen
> IO Settings: Displays the IO Settings Screen
> Part and Serial Number: Displays the MDM34 part and serial number

### Recall!

Retrieves the settings from the MDrive34Plus Microstepping.

### Upgrade!

Upgrades the MDrive34Plus Microstepping firmware.

### Help

> About

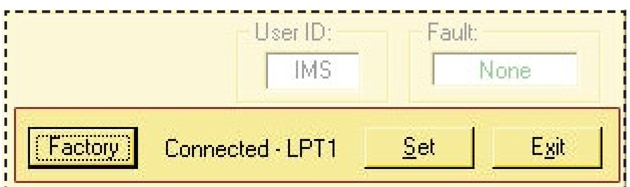


*Figure 2.4.3: IMS SPI Motor Interface Buttons*

## IMS SPI Motor Interface Button Functions

### Factory

Clicking the Factory button will load the MDrive34Plus Microstepping unit's factory default settings into the IMS SPI Motor Interface.

### Connected/Disconnected Indicator

Displays the connected/disconnected state of the software and, if connected, the PC COM Port connected.

### Set

Set writes the new settings to the MDrivePlus. Un-set settings will display as blue text in the setting fields, Once set they will appear in black text.

### Exit

Disconnects and closes the program.

## Motion Settings Configuration Screen

The IMS SPI Motor Interface Software opens by default to the Motion Settings Screen shown below.

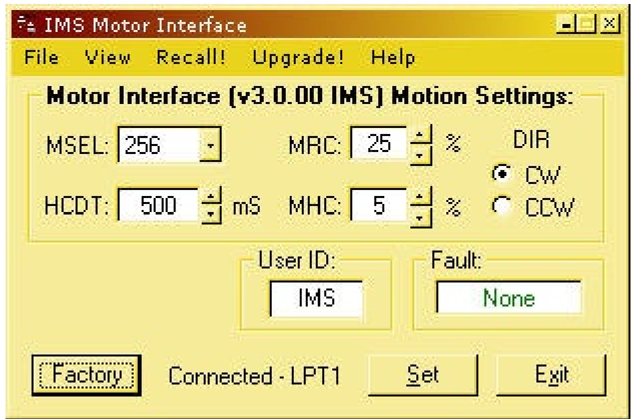


*Figure 2.4.4: IMS SPI Motor Interface Motion Settings Screen*

There are six basic parameters that may be set here:

1. MSEL: Microstep Resolution Select.
2. HCDT: Holding Current Delay Time.
3. MRC: Motor Run Current.
4. Motor Holding Current.
5. User ID: 3-character ID.
6. Direction Override: Allows the user to set the CW/CCW direction of the motor in relation to the Direction Input from the SPI Motor Interface.

### *MSEL (Microstep Resolution Selection)*

The MDrive34Plus Microstepping features 20 microstep resolutions. This setting specifies the number of microsteps per step the motor will move.

The MDrive34Plus uses a 200 step (1.8°) stepping motor which at the highest (default) resolution of 256 will yield 51,200 steps per revolution of the motor shaft.

| Microstep Resolution Settings | | | |
|---|---|---|---|
| Binary µStep Resolution Settings | | Decimal µStep Resolution Settings | |
| MS=<µSteps/Step> | Steps/Revolution | MS=<µSteps/Step> | Steps/Revolution |
| 1 | 200 | 5 | 1000 |
| 2 | 400 | 10 | 2000 |
| 4 | 800 | 25 | 5000 |
| 8 | 1600 | 50 | 10000 |
| 16 | 3200 | 100 | 20000 |
| 32 | 6400 | 125 | 25000 |
| 64 | 12800 | 200 | 40000 |
| 128 | 25600 | 250 | 50000 |
| 256 | 51200 | | |
| Additional Resolution Settings | | | |
| 180 | 36000 (0.01°/µStep) | | |
| 108 | 21600 (1 Arc Minute/µStep) | | |
| 127 | 25400 (0.001mm/µStep) | | |

*Table 2.4.2: Microstep Resolution Settings*

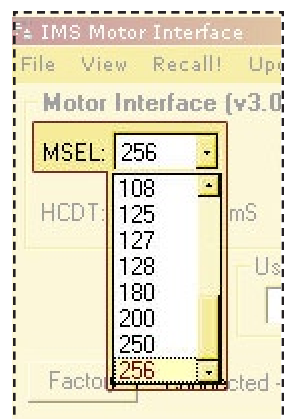


*Figure 2.4.5: Microstep Resolution Select Settings*

### HCDT (Hold Current Delay Time)

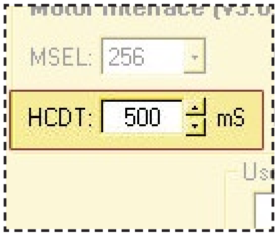


*Figure 2.4.6: Hold Current Delay Time*

The HCDT Motor Hold Current Delay sets time in milliseconds for the Run Current to switch to Hold Current when motion is complete. When motion is complete, the MDrive will change to Hold Current when the specified time elapses.

### MRC (Motor Run Current)

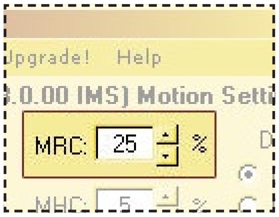


*Figure 2.4.7: Motor Run Current*

The MRC Motor Run Current parameter sets the motor run current to a percentage of the full output current of the MDrive driver section.

### MHC (Motor Hold Current)

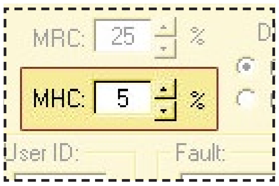


*Figure 2.4.8: Motor Hold Current*

The MHC parameter sets the motor holding current as a percentage of the full output current of the driver. If the hold current is set to 0, the output circuitry of the driver section will disable when the hold current setting becomes active. The hold current setting becomes active HCDT setting mS following the last clock pulse.

### DIR (Motor Direction)

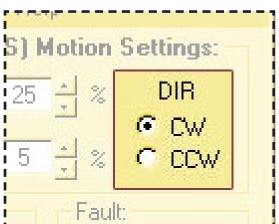


*Figure 2.4.9: Motor Direction Override*

The DIR Motor Direction parameter changes the motor direction relative to the direction input signal, adapting the direction of the MDrive34Plus to operate as your system expects.

### User ID


*Figure 2.4.10: User ID*

The User ID is a three character (viewable ASCII) identifier which can be assigned by the user. Default is IMS.

## IO Settings Configuration Screen

To access the IO Settings Screen click "View > IO Settings Screen" There are three main parameters that can be set from this screen.

1. Input Clock Type
2. Input Clock Filtering
3. Warning Temperature

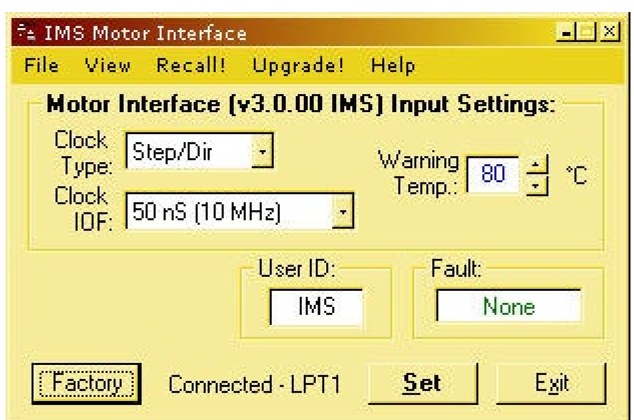


*Figure 2.4.11: IMS SPI Motor Interface IO Settings Screen*

### *Input Clock Type*

The Input Clock Type translates the specified pulse source that the motor will use as a reference for establishing stepping resolution based on the frequency.

The three clock types supported are:

1. Step/Direction
2. Quadrature
3. Up/Down

The Clock types are covered in detail in Section 2.2: Logic Interface and Connection.

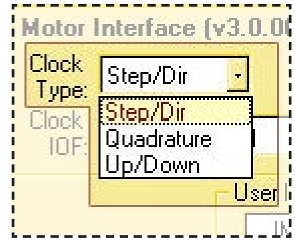


*Figure 2.4.12: Input Clock Type*

### *Input Clock Filter*

The clock inputs may also be filtered using the Clock IOF pull down of the IMS SPI Motor Interface. The filter range is from 50 nS (10 MHz) to 12.9 µSec. (38.8 kHz). The table below shows the filter settings.

| Input Clock Filter Settings | |
|---|---|
| Min Pulse | Cutoff Frequency |
| 50 nS | 10 MHz |
| 150 nS | 3.3 MHz |
| 200 nS | 2.5 MHz |
| 300 nS | 1.67 MHz |
| 500 nS | 1.0 MHz |
| 900 nS | 555 kHz |
| 1.7 µS | 294.1 kHz |
| 3.3 µS | 151 kHz |
| 6.5 µS | 76.9 kHz |
| 12.9 µS | 38.8 kHz |

*Table 2.4.3: Input Clock Filter Settings*

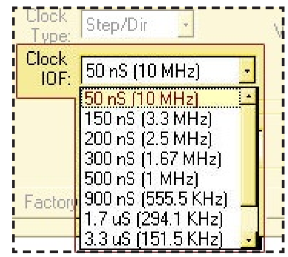


*Figure 2.4.13: Input Clock Filter*

### *Warning Temperature*

The warning temperature allows the user to set a warning threshold. If the MDrive34Plus Microstepping crosses that threshold a fault condition will occur and be displayed to the Fault field on the IMS SPI Motor Interface Screen. The warning displayed will be "TW".

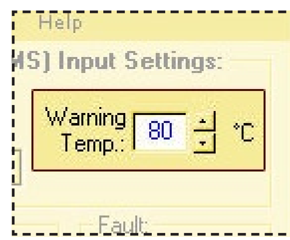


*Figure 2.4.14: Warning Temperature*

## IMS Part Number/Serial Number Screen

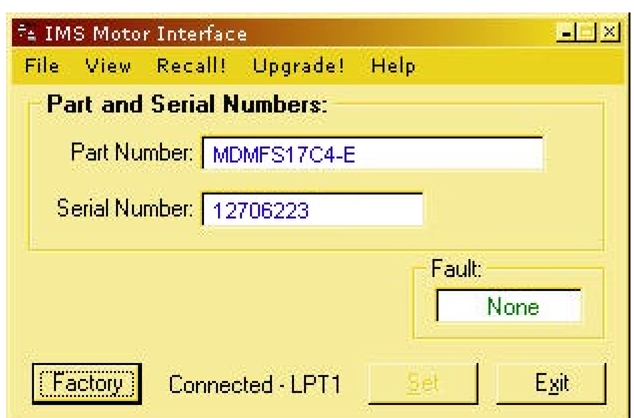


*Figure 2.4.15: IMS Part and Serial Number Screen*

The IMS Part Number and Serial Number screen is accessed by clicking "View > Part and Serial Numbers".

This screen is read-only and will display the part and serial number, as well as the fault code if existing. IMS may require this information if calling the factory for support.

## Fault Indication

All of the IMS SPI Motor Interface Screens have the Fault field visible. This read-only field will display a 2 character error code to indicate the type of fault. Table 2.4.4 below shows the error codes.

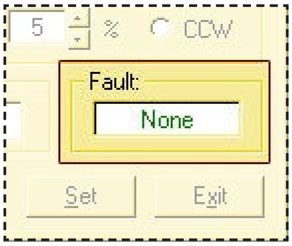


*Figure 2.4.16: Fault Display*

| MDrive34Plus Microstepping Fault Codes | | | | |
|---|---|---|---|---|
| Binary Case* | Error Code | Description | Action | To Clear |
| — | None | No Fault | — | — |
| 1 | T | Over Temperature | Drive Disabled | Recall or Power Cycle |
| 4 | CS | SPI Checksum Error | Error Displayed | Write to MDM (Set Button) |
| 8 | SC/CS | SPI Checksum Error/ Sector Changing | Error Displayed | Write to MDM (Set Button) |
| 16 | DFLT | Defaults Checksum Error | Error Displayed | Write to MDM (Set Button) |
| 32 | DATA | Settings Checksum Error | Error Displayed | Write to MDM (Set Button) |
| 64 | TW | Temperature Warning | Error Displayed | Write to MDM (Set Button) |

*All Fault Codes are OR'ed together

*Table 2.4.4: MDrive34Plus Microstepping Fault Codes*

## Upgrading the Firmware in the MDrive34Plus Microstepping

### *The IMS SPI Upgrader Screen*

New firmware releases are posted to the IMS web site at http://www.imshome.com.

The IMS SPI Motor Interface is required to upgrade your MDrive34Plus Microstepping product. To launch the Upgrader, click "Upgrade!" on the IMS SPI Motor Interface menu. The Upgrader screen has 4 read-only text fields that will display the necessary info about your MDrive34Plus Microstepping.

1. Previous Version: this is the version of the firmware currently on your MDrive34Plus Microstepping.
2. Serial Number: the serial number of your unit.
3. Upgrade Version: will display the version number of the firmware being installed.
4. Messages: the messages text area will display step by step instructions through the upgrade process.

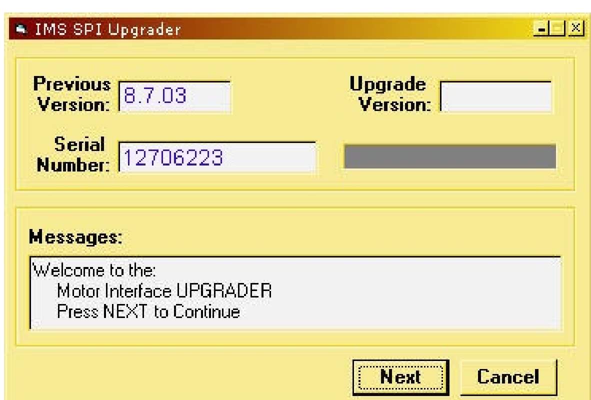


*Figure 2.4.17: IMS SPI Upgrader Screen*

### *Upgrade Instructions*

Below are listed the upgrade instructions as they will appear in the message box of the IMS SPI Upgrader. Note that some steps are not shown as they are accomplished internally, or are not relevant to the model IMS product you are updating. The only steps shown are those requiring user action.

```
Welcome Message: Welcome to the Motor Interface UPGRADER! Click NEXT to
continue.

Step 2: Select Upgrade File
```

When this loads, an explorer dialog will open asking you to browse for the firmware upgrade file. This file will have the extension *.ims.

```
Step 3: Connect SPI Cable
Step 4: Power up or Cycle Power to the MDrive
Step 6: Press Upgrade Button
```

Progress bar will show upgrade progress in blue, Message box will read "Resetting Motor Interface"

```
Step 8: Press DONE, then select Port/Reconnect.
```

## Configuring Using User-Defined SPI

The MDrive34Plus Microstepping can be configured and operated through the end-user's SPI interface without using the IMS SPI Motor Interface software and optional parameter setup cable.

Typically an MDrive34Plus Microstepping will have the parameters set one time on a bench using the IMS communications converter cable or equivalent prior to being installed in a machine.

There are instances where an SPI communications system may be desired as a part of the machine designed. For example, a machine design requiring the parameters to be changed on-the-fly.

### SPI Timing Notes

1. MSb (Most Significant bit) first and MSB (Most Significant Byte) first.
2. 8 bit bytes.
3. 25 kHz SPI Clock (SCK).
4. Data In (MOSI) on rising clock.
5. Data Out (MISO) on falling clock.

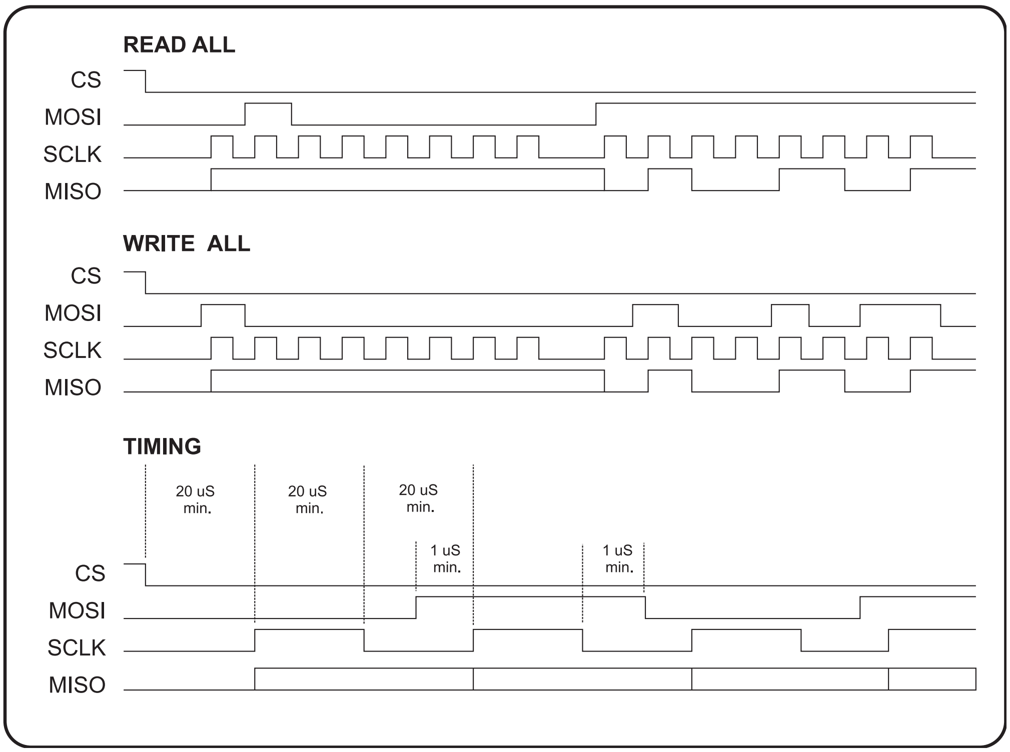


*Figure 2.5.1: SPI Timing Diagram*

### Check Sum Calculation for SPI

The values in the example below are 8-bit binary hexadecimal conversions for the following SPI parameters: MRC=25%, MHC=5%, MSEL=256, HCDT=500 mSec, WARNTEMP=80.

The Check Sum is calculated as follows:

(Hex) 80+19+05+00+00+01+F4+50

| | |
|---|---|
| Sum = E3 | 1110 0011 |
| 1's complement = 1C | 0001 1100 (Invert) |
| 2's complement = 1D | 0001 1101 (Add 1) |

Send the check sum value of 1D

Note: 80 is always the first command on a write.

Note: Once a write is performed, a read needs to be performed to see if there is a fault. The fault is the last byte of the read.

## SPI Commands and Parameters

Use the following table and figure found on the following page together as the Byte order read and written from the MDrive34Plus Microstepping, as well as the checksum at the end of a WRITE is critical.

| SPI Commands and Parameters | | | | |
|---|---|---|---|---|
| | Command/ Parameter | HEX (Default) | Range | Notes |
| | READ ALL | 0x40 | — | Reads the hex value of all parameters |
| MSB | Device (M) | 0x4D | — | M Character precedes every READ |
| | Version_MSB | 0x10 | <1-8>.<0-9> | Firmware Version.Sub-version, eg 1.0 |
| | Version_LSB | 0x00 | <0-99> | Firmware Version Appends to Version_ MSB, eg.00 |
| | USR_ID1 | 0x49 | — | Uppercase Letter <I> |
| | USR_ID2 | 0x4D | — | Uppercase Letter <M> |
| | USR_ID3 | 0x53 | — | Uppercase Letter <S> |
| | MRC | 0x19 | 1-100% | Motor Run Current |
| | MHC | 0x05 | 0-100% | Motor Hold Current |
| | MSEL | 0x00 | 0*, 1-259 *0=256 | Microstep Resolution (See Table in Section 2.4 for settings) |
| | DIR_OVRID | 0x00 | 0=no override 1=override dir | Direction Override |
| | HCDT_HI | 0x01 | 0 or 2-65535 | Hold Current Delay Time High Byte |
| | HCDT_LO | 0xF4 | | Hold Current Delay Time Low Byte |
| | CLKTYP | 0x00 | 0=s/d, 1=quad, 2=u/d | Input Clock Type |
| | CLKIOF | 0x00 | <0-9> | Clock Input Filtering |
| | WARNTEMP | 0x50 | | OVER_TEMP - 5° C |
| LSB | FAULT | 0x00 | — | See Fault Table, Section 2.4 |
| | WRITE ALL | 0x80 | — | Writes the hex value to the following parameters. |
| MSB | USR_ID1 | 0x49 | — | Uppercase Letter <I> |
| | USR_ID2 | 0x4D | — | Uppercase Letter <M> |
| | USR_ID3 | 0x53 | — | Uppercase Letter <S> |
| | MRC | 0x19 | 1-100% | Motor Run Current |
| | MHC | 0x05 | 0-100% | Motor Hold Current |
| | MSEL | 0x00 | 0*, 1-259 *0=256 | Microstep Resolution (See Table in Section 2.4 for settings) |
| | DIR_OVRID | 0x00 | 0=no override 1=override dir | Direction Override |
| | HCDT_HI | 0x01 | 0 or 2-65535 | Hold Current Delay Time High Byte |
| | HCDT_LO | 0xF4 | | Hold Current Delay Time Low Byte |
| | CLKTYP | 0x00 | 0=s/d, 1=quad, 2=u/d | Input Clock Type |
| | CLKIOF | 0x00 | <0-9> | Clock Input Filtering |
| | WARNTEMP | 0x50 | | OVER_TEMP - 5° C |
| LSB | CKSUM | | | 34 |

*Table 2.5.1: SPI Commands and Parameters*

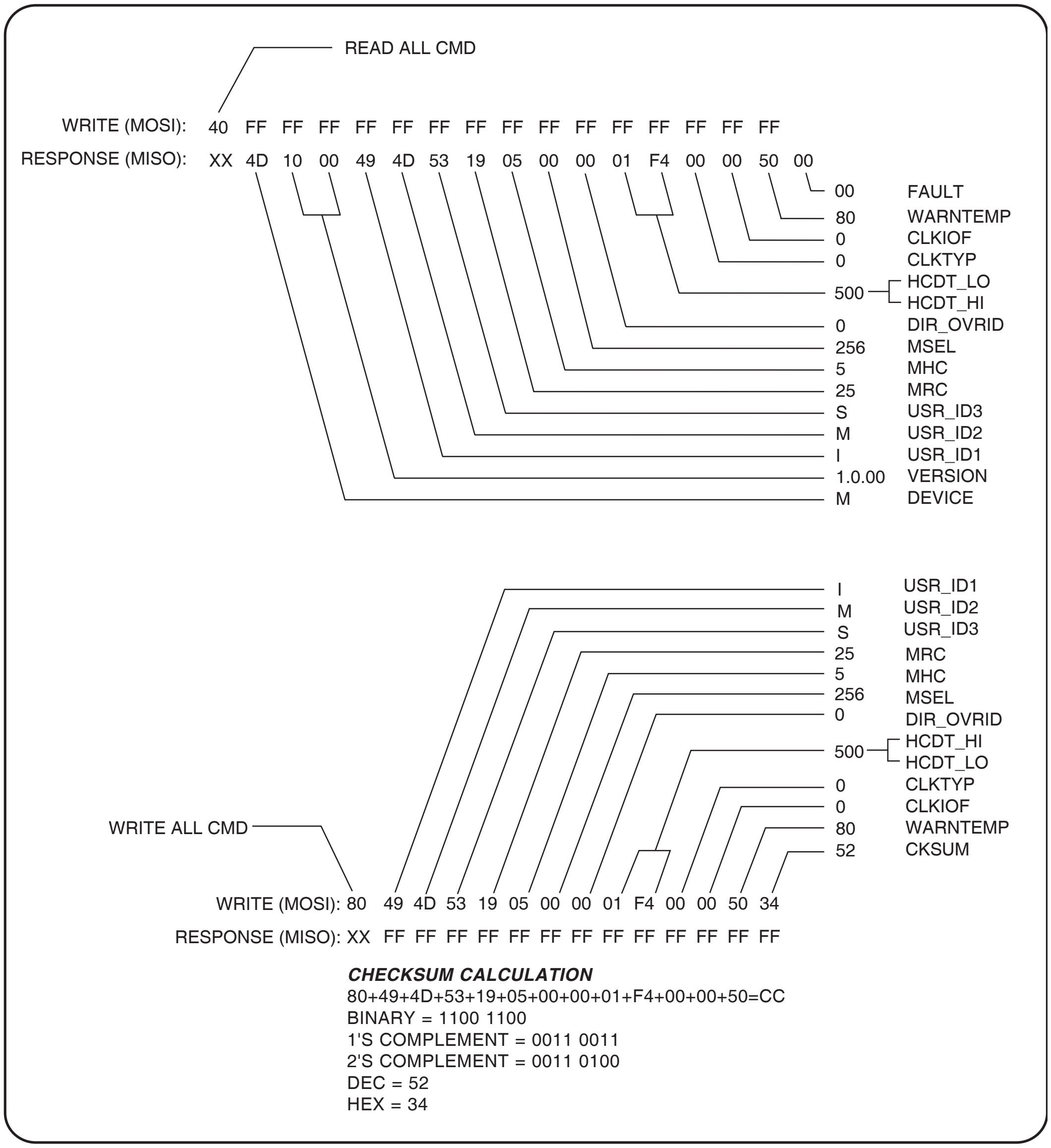


*Figure 2.5.2: Read/Write Byte Order for Parameter Settings (Default Parameters Shown)*

### SPI Communications Sequence

See Timing Diagram and Byte Order figures.

#### READ

1. Send READ ALL Command 0x40 down MOSI to MDrive34Plus Microstepping followed by FF (15 Bytes).

2. Receive Parameter settings From MISO MSB First (M-Device) and ending with LSB (Fault).

#### Write

1. Send WRITE ALL Command (0x80) down MOSI followed by Parameter Bytes beginning with MSB (MRC) and ending with the LSB (Checksum of all parameter Bytes).

2. Response from MISO will be FF (10) Bytes.

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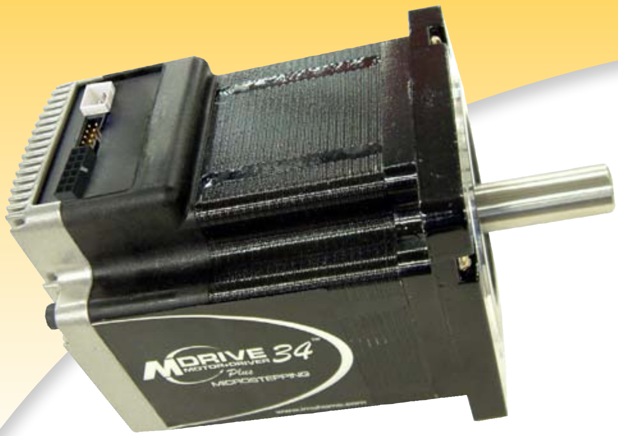

MDRIVE 34™ MOTOR+DRIVER Plus
MICROSTEPPING

# APPENDICES

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# MDrive34Plus Microstepping Motor Performance

## Speed-Torque Curves

### Single Length Rotary Motor

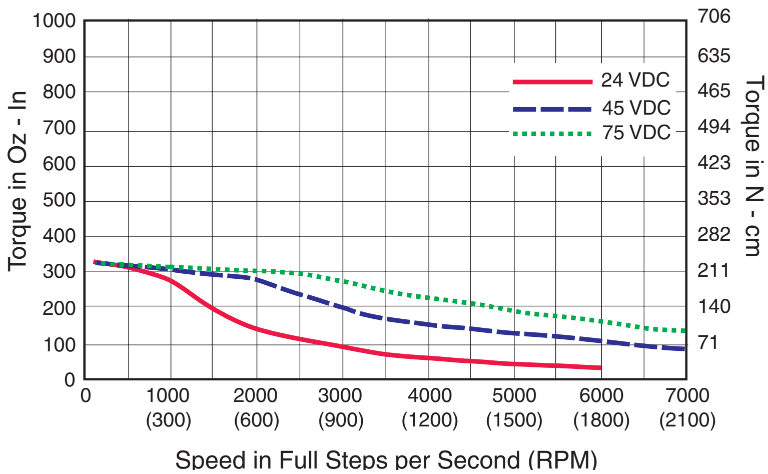



*Figure A.1: MDrive34Plus Microstepping Single Length Speed-Torque Curves*

### Double Length Rotary Motor

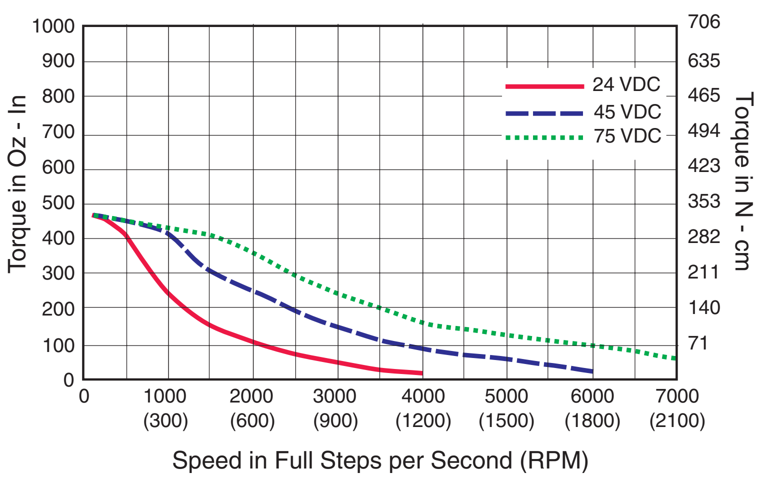



*Figure A.2: MDrive34Plus Microstepping Double Length Speed-Torque Curves*

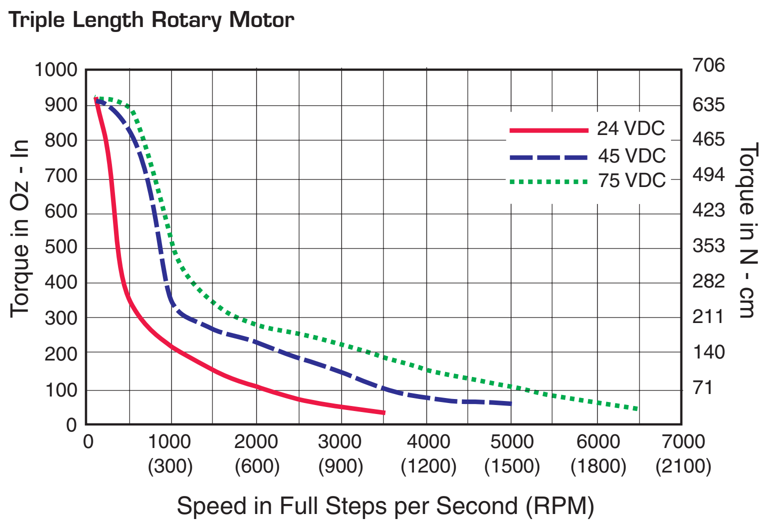



*Figure A.3: MDrive34Plus Microstepping Triple Length Speed-Torque Curves*

## Motor Specifications

### Single Length

Holding Torque............................................381 oz-in/269 N-cm
Detent Torque............................................10.9 oz-in/7.7 N-cm
Rotor Inertia ............................................0.01416 oz-in-sec$^2$/1.0 kg-cm$^2$
Weight (Motor + Driver)............................................4.1 lb/1.9 kg

### Double Length

Holding Torque............................................575 oz-in/406 N-cm
Detent Torque............................................14.16 oz-in/14.0 N-cm
Rotor Inertia ............................................0.02266 oz-in-sec$^2$/1.6 kg-cm$^2$
Weight (Motor + Driver)............................................5.5 lb/2.5 kg

### Triple Length

Holding Torque............................................1061 oz-in/749 N-cm
Detent Torque............................................19.83 oz-in/10.0 N-cm
Rotor Inertia ............................................0.04815 oz-in-sec$^2$/3.4 kg-cm$^2$
Weight (Motor + Driver)............................................8.8 lb/4.0 kg

## Recommended Power Supplies and Cabling

WARNING! For battery operated systems, conditioning measures should be taken to prevent device damage caused by in-rush current draws, transient arcs and high voltage spikes.

Actual power supply current requirements to run one or multiple drives will depend on operating voltage and maximum load.

A characteristic of all motors is back EMF which 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. Care should be taken so that the back EMF does not exceed the maximum input voltage rating of the MDrivePlus.

Because the MDrivePlus consists of two core components, a drive and a motor, close attention must be paid to the thermal environment where the device is used. The following maximum temperatures apply to the MDrivePlus:

| MDrivePlus Power Supply Requirements | |
|---|---|
| Recommended Supply Type | Unregulated DC |
| Ripple Voltage | ±10 % |
| Output Voltage | +12 to +75 VDC |
| Output Current | 4A Peak |

*Table B.1: MDrivePlus Microstepping Power Supply Requirements*

Operating Temperature ...............................................-40 to +85°C

| Recommended IMS Power Supplies for MDrive34Plus | | |
|---|---|---|
| IMS Unregulated DC Supply | IP804 (120 VAC) | IP804-240 (240 VAC) |
| Input Range | 102 -132 VAC | 204-264 VAC |
| No Load Output Voltage* | 76 VDC @ 0 Amp | |
| Continuous Output Rating* | 65 VDC @ 2 Amp | |
| Peak Output Rating* | 58 VDC @ 4 Amp | |

* All measurements were taken at 25°C, 120 VAC, 60 Hz

*Table B.2: Recommended IMS Power Supplies*

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

NOTE: The length of the DC power supply cable to an MDrive should not exceed 50 feet.

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

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

## Recommended Power Cabling Configuration

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

Example A demonstrates the recommended cable configuration for DC power supply cabling under 50 feet long. If cabling of 50 feet or longer is required, the additional length may be gained by adding an AC power supply cable (see Examples B & C).

Correct AWG wire size is determined by the current requirement plus cable length. Please see the MDrive Supply Cable AWG Table at the end of this Appendix.

### Example A – Cabling Under 50 Feet, DC Power

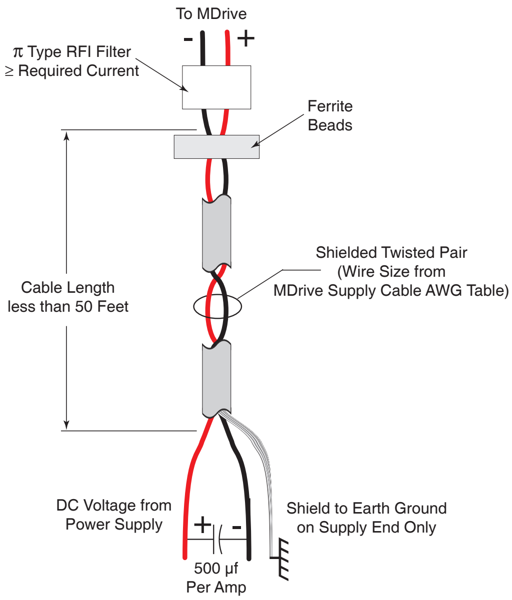



*Figure B.1: DC Cabling - Under 50 Feet*

### Example B – Cabling 50 Feet or Greater, AC Power to Full Wave Bridge

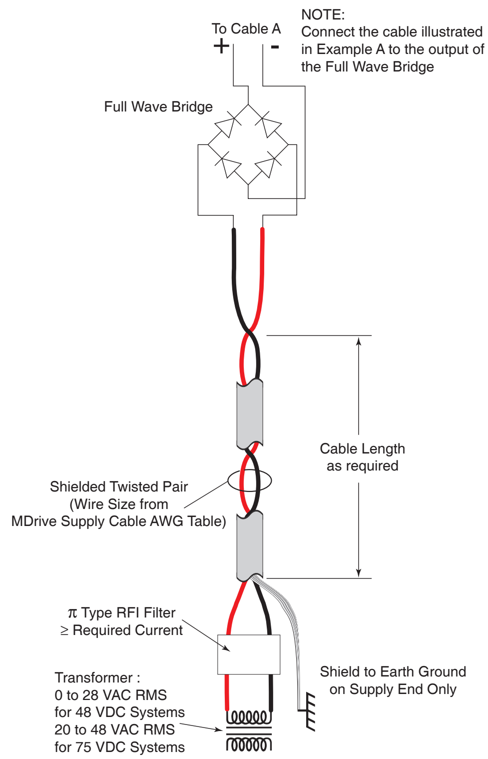



*Figure B.2: DC Cabling - 50 Feet or Greater - AC To Full Wave Bridge Rectifier*

### Example C – Cabling 50 Feet or Greater, AC Power to Power Supply

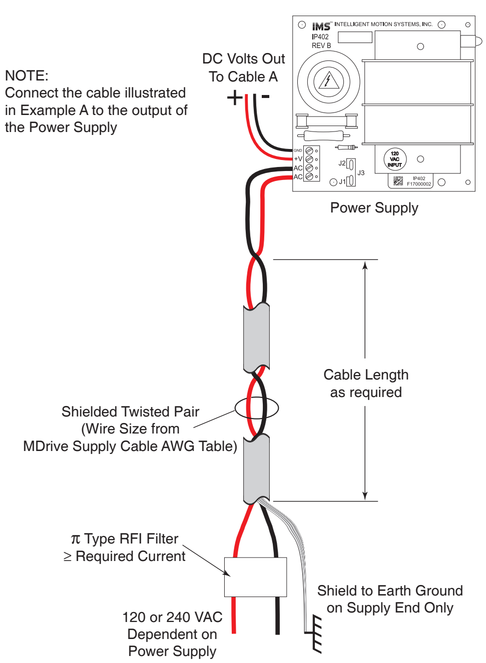



*Figure B.3: AC Cabling - 50 Feet or Greater - AC To Power Supply*

## Recommended Power Supply Cabling

| MDrivePlus Supply Cable AWG Table | | | | | |
|---|---|---|---|---|---|
| 4 Amperes (Peak) | | | | | |
| Length (Feet) | 10 | 25 | 50* | 75* | 100* |
| Minimum AWG | 18 | 16 | 14 | 12 | 12 |
| *Use the alternative methods illustrated in examples B and C when cable length is ≥ 50 feet. Also, use the same current rating when the alternate AC power is used. | | | | | |

*Table B.3: Recommended Supply Cables*

## Mating Connector Information

| P1: I/O | P1 Connector Type | Mating Connector Shell | Mating Connector Pins (20-24 AWG)* |
|---|---|---|---|
| Plus | Flying Leads | n/a | n/a |
| Plus | 12 Pin Locking Wire Crimp | JST PADP-12V-1-S | JST SPH-001T-P0.5L |

| P2: Comm | Mating Connector Shell | Pins |
|---|---|---|
| 10 Pin IDC | Samtec TCSD-05-01-N | n/a |

| P3: Power | Mating Connector Shell (18 AWG) | Pins (18 AWG) |
|---|---|---|
| 2 Pin | Molex 51067-200 | Molex 50217-9101 Brass |

| P4: Encoder | P1 Connector Type | Mating Connector Shell | Mating Connector Pins (22-30 AWG)* |
|---|---|---|---|
| Plus w/Internal Encoder | 10 Pin Friction Lock Wire Crimp | Hirose DF11-10DS-2C | 22 AWG: DF11-22SC<br>24/28 AWG: DF11-2428SC<br>30 AWG: DF11-30SC |

*Table B.4: 10-Pin Locking Wire Crimp Connector Contact and Tool Part Numbers*


*Figure B.4: Connector Locations*

## Planetary Gearboxes

### Section Overview

This section contains guidelines and specifications for MDrives equipped with an optional Planetary Gearbox, and may include product sizes not relevant to this manual.

Shown are:

- Product Overview
- Selecting a Planetary Gearbox
- Mechanical Specifications

### Product Overview

All gearboxes are factory installed.

#### Mode of Function

Optional Planetary Gearbox operate as their name implies: the motor-driven sun wheel is in the center, transmitting its movement to three circumferential planet gears which form one stage. They are arranged on the bearing pins of a planet carrier. The last planet carrier in each sequence is rigidly linked to the output shaft and so ensures the power transmission to the output shaft. The planet gears run in an internally toothed outer ring gear.

#### Service Life

Depending on ambient and environmental conditions and the operational specification of the driving system, the useful service life of a Planetary Gearbox is up to 10,000 hours. The wide variety of potential applications prohibits generalizing values for the useful service life.

#### Lubrication

All Planetary Gearbox are grease-packed and therefore maintenance-free throughout their life. The best possible lubricant is used for our MDrive/Planetary Gearbox combinations.

#### Mounting Position

The grease lubrication and the different sealing modes allow the Planetary Gearbox to be installed in any position.

#### Operating Temperature

The temperature range for the Planetary Gearbox is between –30 and +140° C. However, the temperature range recommended for the Heat Sink of the MDrive is -40 to +85º C.

#### Overload Torque

The permitted overload torque (shock load) is defined as a short-term increase in output torque, e.g. during the start-up of a motor. In these all-metal Planetary Gearbox, the overload torque can be as much as 1.5 times the permitted output torque.

#### Available Planetary Gearbox

The following lists available Planetary Gearbox, diameter and corresponding MDrive.

| Gearbox Diameter | MDrive |
|---|---|
| 81 mm | MDrive34Plus |

## Selecting a Planetary Gearbox

There are many variables and parameters that must be considered when choosing an appropriate reduction ratio for an MDrive with Planetary Gearbox. This Addendum includes information to assist in determining a suitable combination for your application.

### *Calculating the Shock Load Output Torque ($T_{AB}$)*

Note: The following examples are based on picking "temporary variables" which may be adjusted.

The shock load output torque ($T_{AB}$) is not the actual torque generated by the MDrive and Planetary Gearbox combination, but is a calculated value that includes an operating factor ($C_B$) to compensate for any shock loads applied to the Planetary Gearbox due to starting and stopping with no acceleration ramps, payloads and directional changes. The main reason the shock load output torque ($T_{AB}$) is calculated is to ensure that it does not exceed the maximum specified torque for a Planetary Gearbox.

Note: There are many variables that affect the calculation of the shock load output torque. Motor speed, motor voltage, motor torque and reduction ratio play an important role in determining shock load output torque. Some variables must be approximated to perform the calculations for the first time. If the result does not meet your requirements, change the variables and re-calculate the shock load output torque. Use the equation compendium below to calculate the shock load output torque.

#### Factors

| | | |
|---|---|---|
| $i$ | = | Reduction Ratio - The ratio of the Planetary Gearbox. |
| $n_M$ | = | Motor Speed - In Revolutions Per Minute (Full Steps/Second). |
| $n_{AB}$ | = | Output Speed - The speed at the output shaft of the Planetary Gearbox. |
| $T_N$ | = | Nominal Output Torque - The output torque at the output shaft of the Planetary Gearbox. |
| $T_M$ | = | Motor Torque - The base MDrive torque. Refer to MDrive Speed Torque Tables. |
| $\eta$ | = | Gear Efficiency - A value factored into the calculation to allow for any friction in the gears. |
| $T_{AB}$ | = | Shock Load Output Torque - A torque value calculated to allow for short term loads greater than the nominal output torque. |
| $C_B$ | = | Operating Factor - A value that is used to factor the shock load output torque. |
| $s_f$ | = | Safety Factor - A 0.5 to 0.7 factor used to create a margin for the MDrive torque requirement. |

#### Reduction Ratio

Reduction ratio (i) is used to reduce a relatively high motor speed ($n_M$) to a lower output speed ($n_{AB}$).

With: $i = n_M \div n_{AB}$ or: motor speed ÷ output speed = reduction ratio

***Example:***

The required speed at the output shaft of the Planetary Gearbox is 90 RPM.

You would divide motor speed ($n_M$) by output speed ($n_{AB}$) to calculate the proper gearbox ratio.

The MDrive speed you would like to run is approximately 2000 full steps/second or 600 RPM.

**NOTE:** In reference to the MDrive speed values, they are given in full steps/second on the Speed/Torque Tables. Most speed specifications for the Planetary Gearbox will be given in RPM (revolutions per minute). To convert full steps/second to RPM, divide by 200 and multiply by 60.

Where: 200 is the full steps per revolution of a 1.8° stepping motor.

2000 full steps/second ÷ 200 = 10 RPS (revolutions per second) × 60 Seconds = 600 RPM

For the Reduction Ratio (i), divide the MDrive speed by the required Planetary Gearbox output speed.

600 RPM ÷ 90 = 6.67:1 Reduction Ratio

Referring to the Available Ratio Table at the end of this section, the reduction ratio (i) of the Planetary Gearbox will be 7:1. The numbers in the left column are the rounded ratios while the numbers in the right column are the actual ratios. The closest actual ratio is 6.75:1 which is the rounded ratio of 7:1. The slight difference can be made up in MDrive speed.

## Nominal Output Torque

Calculate the nominal output torque using the torque values from the MDrive's Speed/Torque Tables.

Nominal output torque ($T_N$) is the actual torque generated at the Planetary Gearbox output shaft which includes reduction ratio (i), gear efficiency (η) and the safety factor ($s_f$) for the MDrive. Once the reduction ratio (i) is determined, the nominal output torque ($T_N$) can be calculated as follows:

$T_N = T_M \times i \times \eta \div s_f$ or:

Motor torque × reduction ratio × gear efficiency ÷ safety factor = nominal output torque.

For gear efficiency (η) refer to the Mechanical Specifications for the 7:1 Planetary Gearbox designed for your MDrive.

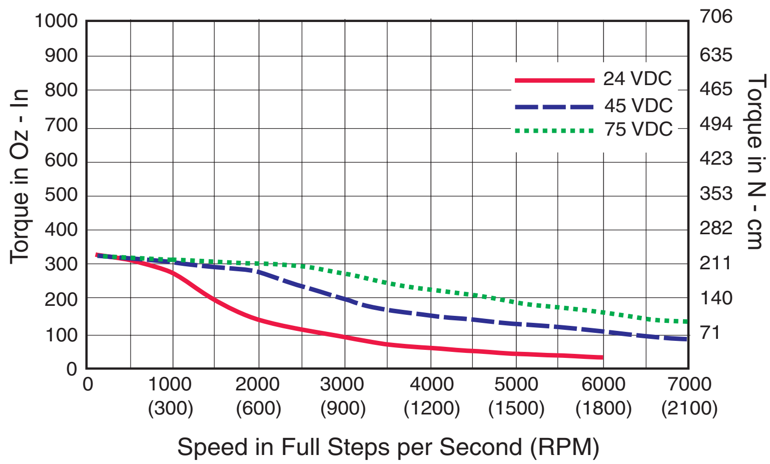



*Figure C.1: MDrive34 Torque-Speed Curve*

For motor torque ($T_M$) see the appropriate MDrive Speed/Torque Table. Dependent on which MDrive you have, the torque range will vary. The torque will fall between the high voltage line and the low voltage line at the indicated speed for the MDrive. (See the example Speed/Torque Table below.)

The Speed/Torque Table above is for an MDrive23 Double Length Motor. This MDrive will produce a torque range of 51 to 95 oz-in in the full voltage range at the speed of 2000 Full Steps/Second (600 RPM).

Please note that this is not the usable torque range. The torque output to the Planetary Gearbox must include a safety factor ($s_f$) to allow for any voltage and current deviations supplied to the MDrive.

The motor torque must include a safety factor ($s_f$) ranging from 0.5 to 0.7. This must be factored into the nominal output torque calculation. A 0.5 safety factor is aggressive while a 0.7 safety factor is more conservative.

Example:

The available motor torque ($T_M$) is 51 to 95 oz-in.

**NOTE:** You may specify a torque less than but not greater than the motor torque range.

For this example the motor torque ($T_M$) will be 35 oz-in.

A 6.75:1 reduction ratio (i) has been determined.

Gear efficiency (η) = 80% from the appropriate table for the Planetary Gearbox which is used with an MDrive23.

Nominal output torque would be:

Motor torque ($T_M$ = 35) × reduction ratio (i = 6.75) × gear efficiency (η = 0.8) ÷ safety factor ($s_f$ = 0.5 or 0.7)

35 × 6.75 = 236.25 × 0.8 = 189 ÷ 0.5 = 378 oz-in nominal output torque ($T_N$)

or

35 × 6.75 = 236.25 × 0.8 = 189 ÷ 0.7 = 270 oz-in nominal output torque ($T_N$)

With the safety factor ($s_f$) and gear efficiency (η) included in the calculation, the nominal output torque ($T_N$) may be greater than the user requirement.

### Shock Load Output Torque

The nominal output torque ($T_N$) is the actual working torque the Planetary Gearbox will generate. The shock load output torque ($T_{AB}$) is the additional torque that can be generated by starting and stopping with no acceleration ramps, payloads, inertia and directional changes. Although the nominal output torque ($T_N$) of the Planetary Gearbox is accurately calculated, shock loads can greatly increase the dynamic torque on the Planetary Gearbox.

Each Planetary Gearbox has a maximum specified output torque. In this example a 7:1 single stage MD23 Planetary Gearbox is being used. The maximum specified output torque is 566 oz-in. By calculating the shock load output torque ($T_{AB}$) you can verify that value is not exceeding the maximum specified output torque.

When calculating the shock load output torque ($T_{AB}$), the calculated nominal output torque ($T_N$) and the operating factor ($C_B$) are taken into account. $C_B$ is merely a factor which addresses the different working conditions of a Planetary Gearbox and is the result of your subjective appraisal. It is therefore only meant as a guide value. The following factors are included in the approximate estimation of the operating factor ($C_B$):

- Direction of rotation (constant or alternating)
- Load (shocks)
- Daily operating time

**Note:** The higher the operating factor ($C_B$), the closer the shock load output torque ($T_{AB}$) will be to the maximum specified output torque for the Planetary Gearbox. Refer to the table below to calculate the approximate operating factor ($C_B$).

With the most extreme conditions which would be a $C_B$ of 1.9, the shock load output torque ($T_{AB}$) is over the maximum specified torque of the Planetary Gearbox with a 0.5 safety factor but under with a 0.7 safety factor.

The nominal output torque ($T_N$) × the operating factor ($C_B$) = shock load or maximum output torque ($T_{AB}$).

With a 0.5 safety factor, the shock load output torque is greater than the maximum output torque specification of the MDrive23 Planetary Gearbox.

(378 × 1.9 = 718.2 oz-in.)

With a 0.7 safety factor the shock load output torque is within maximum output torque specification of the MDrive23 Planetary Gearbox.

(270 × 1.9 = 513 oz-in.)

The 0.5 safety factor could only be used with a lower operating factor ($C_B$) such as 1.5 or less, or a lower motor torque.

**Note:** All published torque specifications are based on $C_B$ = 1.0. Therefore, the shock load output torque ($T_{AB}$) = nominal output torque ($T_N$).

**WARNING!** Excessive torque may damage your Planetary Gearbox. If the MDrive/Planetary Gearbox should hit an obstruction, especially at lower speeds (300 RPM or 1000 Full Steps/Second), the torque generated will exceed the maximum torque for the Planetary Gearbox. Precautions must be taken to ensure there are no obstructions in the system.

| Determining the Operating Factor ($C_B$) | | | | |
|---|---|---|---|---|
| Direction of Rotation | Load (Shocks) | Daily Operating Time | | |
| | | 3 Hours | 8 Hours | 24 Hours |
| Constant | Low* | $C_B$=1.0 | $C_B$=1.1 | $C_B$=1.3 |
| | Medium** | $C_B$=1.2 | $C_B$=1.3 | $C_B$=1.5 |
| Alternating | Low† | $C_B$=1.3 | $C_B$=1.4 | $C_B$=1.6 |
| | Medium†† | $C_B$=1.6 | $C_B$=1.7 | $C_B$=1.9 |

* Low Shock = Motor turns in one direction and has ramp up at start.
** Medium Shock = Motor turns in one direction and has no ramp up at start.
† Low Shock = Motor turns in both directions and has ramp up at start.
†† Medium Shock = Motor turns in both directions and has no ramp up at start.

*Table C.1: Planetary Gearbox Operating Factor*

## System Inertia

System inertia must be included in the selection of an MDrive and Planetary Gearbox. Inertia is the resistance an object has relative to changes in velocity. Inertia must be calculated and matched to the motor inertia. The Planetary Gearbox ratio plays an important role in matching system inertia to motor inertia. There are many variable factors that affect the inertia. Some of these factors are:

- The type of system being driven.
- Weight and frictional forces of that system.
- The load the system is moving or carrying.

The ratio of the system inertia to motor inertia should be between 1:1 and 10:1. With 1:1 being ideal, a 1:1 to 5:1 ratio is good while a ratio greater than 5:1 and up to 10:1 is the maximum.

### Type of System

There are many systems and drives, from simple to complex, which react differently and possess varied amounts of inertia. All of the moving components of a given system will have some inertia factor which must be included in the total inertia calculation. Some of these systems include:

- Lead screw
- Rack and pinion
- Conveyor belt
- Rotary table
- Belt drive
- Chain drive

Not only must the inertia of the system be calculated, but also any load that it may be moving or carrying. The examples below illustrate some of the factors that must be considered when calculating the inertia of a system.

### Lead Screw

In a system with a lead screw, the following must be considered:

- The weight and preload of the screw
- The weight of the lead screw nut
- The weight of a table or slide
- The friction caused by the table guideways
- The weight of any parts

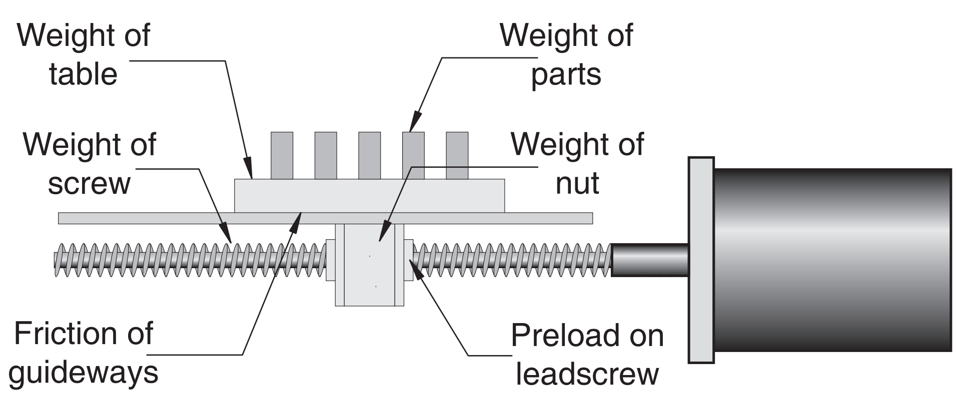



*Figure C.2: Lead Screw System Inertia Considerations*

## Rack and Pinion

In a system with a rack and pinion, the following must be considered:

- The weight or mass of the pinion
- The weight or mass of the rack
- The friction and/or preload between the pinion and the rack
- Any friction in the guidance of the rack
- The weight or mass of the object the rack is moving

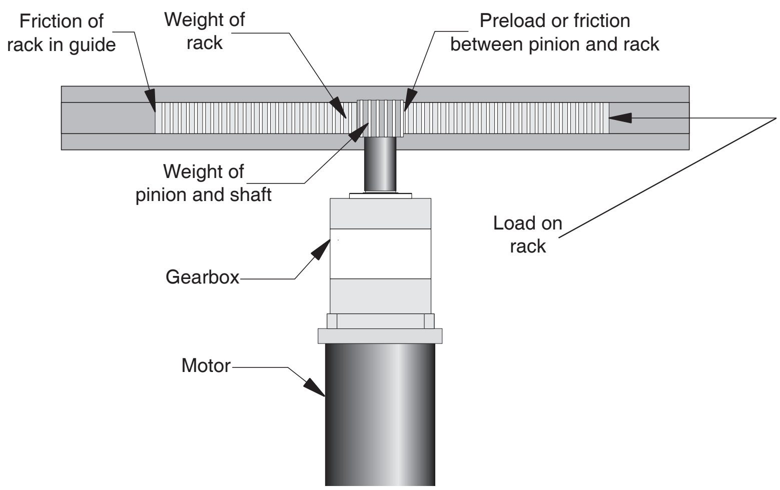



*Figure C.3: Rack and Pinion System Inertia Considerations*

## Conveyor Belt

In a system with a conveyor belt, the following must be considered:

- The weight and size of the cylindrical driving pulley or roller
- The weight of the belt
- The weight or mass and size of the idler roller or pulley on the opposite end
- The angle or elevation of the belt
- Any load the belt may be carrying

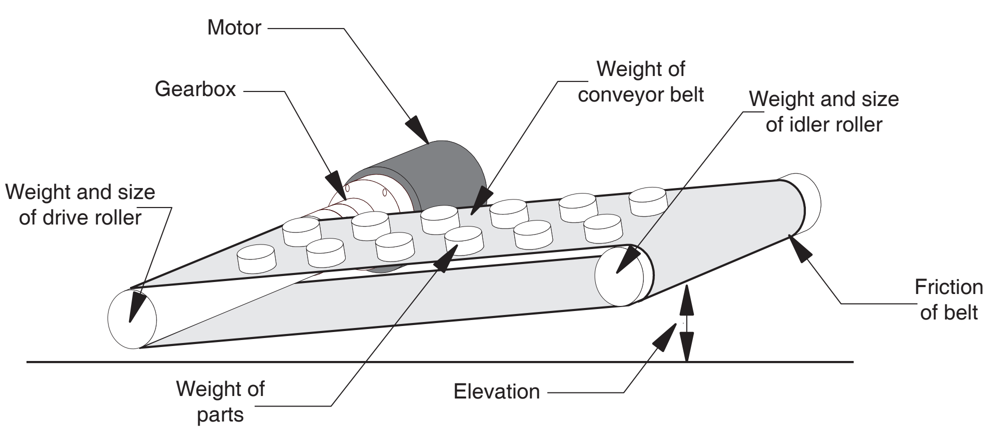



*Figure C.4: Conveyor System Inertia Considerations*

### Rotary Table

In a system with a rotary table, the following must be considered:

- The weight or mass and size of the table
- Any parts or load the table is carrying
- The position of the load on the table, the distance from the center of the table will affect the inertia
- How the table is being driven and supported also affects the inertia

### Belt Drive

In a system with a belt drive, the following must be considered:

- The weight or mass and size of the driving pulley
- The tension and/or friction of the belt
- The weight or mass and size of the driven pulley
- Any load the system may be moving or carrying

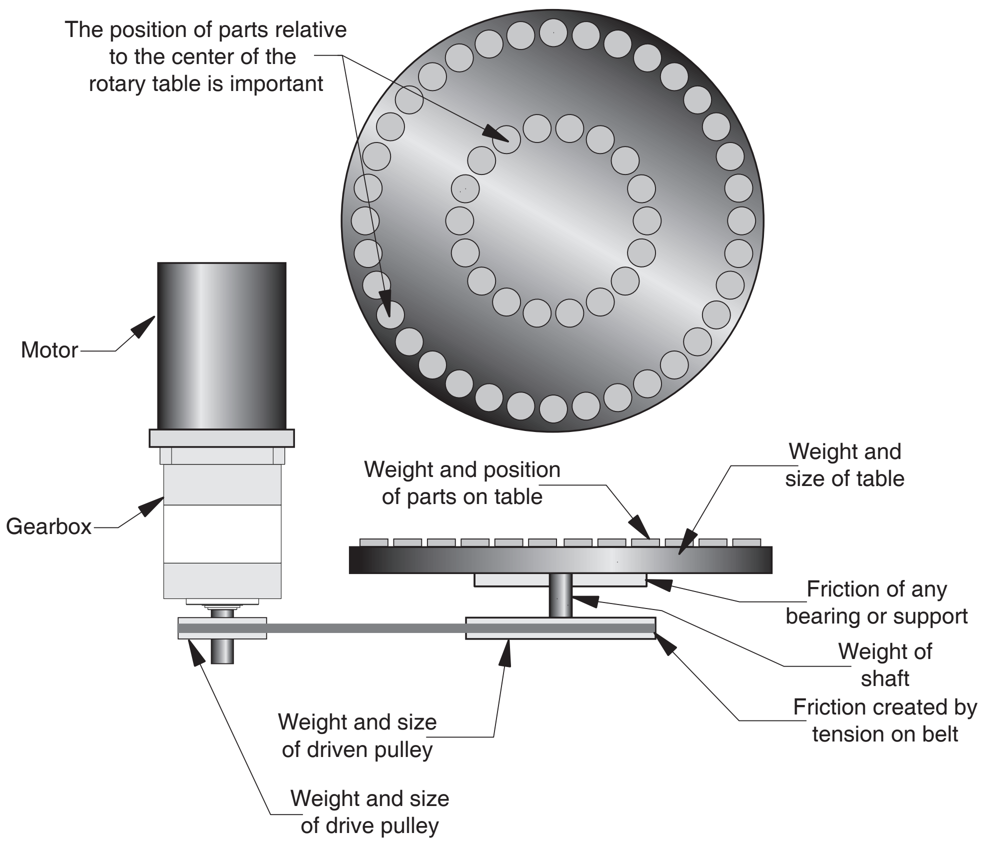



*Figure C.5: Rotary Table System Inertia Considerations*

## Chain Drive

In a system with a chain drive, the following must be considered:

- the weight and size of drive sprocket and any attaching hub
- the weight and size of the driven sprocket and shaft
- the weight of the chain
- the weight of any material or parts being moved

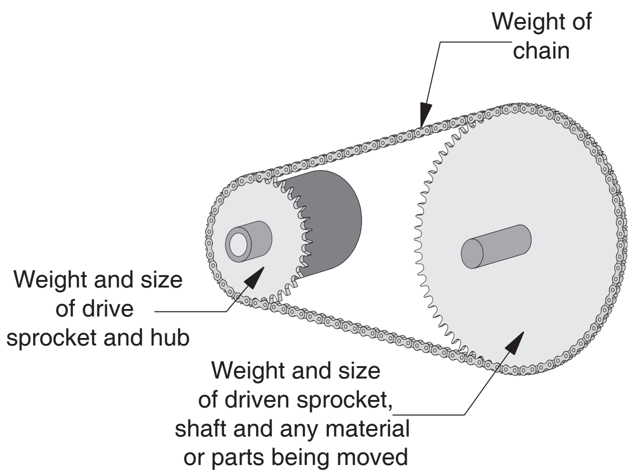



*Figure C.6: Chain Drive System Inertia Considerations*

Once the system inertia ($J_L$) has been calculated in oz-in-sec$^2$, it can be matched to the motor inertia. To match the system inertia to the motor inertia, divide the system inertia by the square of the gearbox ratio. The result is called Reflected Inertia or ($J_{ref}$).

$$J_{ref} = J_L \div Z^2$$

Where:

$J_L$ = System Inertia in oz-in-sec$^2$

$J_{ref}$ = Reflected Inertia in oz-in-sec$^2$

$Z$ = Gearbox Ratio

The ideal situation would be to have a 1:1 system inertia to motor inertia ratio. This will yield the best positioning and accuracy. The reflected inertia ($J_{ref}$) must not exceed 10 times the motor inertia.

Your system may require a reflected inertia ratio as close to 1:1 as possible. To achieve the 1:1 ratio, you must calculate an Optimal Gearbox Ratio ($Z_{opt}$) which would be the square root of $J_L$ divided by the desired $J_{ref}$. In this case since you want the system inertia to match the motor inertia with a 1:1 ratio, $J_{ref}$ would be equal to the motor inertia.

$$Z_{opt} = \quad J_L \div J_{ref}$$

Where:

$Z_{opt}$ = Optimal Gearbox Ratio

$J_L$ = System Inertia in oz-in-sec$^2$

$J_{ref}$ = Desired Reflected Inertia in oz-in-sec$^2$ (Motor Inertia)

## Planetary Gearbox Inertia

In addition to System Inertia, the Planetary Gearbox inertia must also be included when matching system inertia to motor inertia. The Planetary Gearbox inertia varies with the ratio and the number of stages. The table below lists the inertia values for the MDrive34 Planetary Gearbox. The values are in oz-in-sec$^2$ (ounce-inches-second squared). To calculate the inertia in kg-cm$^2$ (kilograms-centimeter squared) multiply oz-in-sec$^2$ by 70.6154.

| Planetary Gearbox Inertia Moments (oz-in-sec$^2$) | | |
|---|---|---|
| Stages | Rounded Ratio | MDrive 34 Gearbox |
| 1-Stage | 4:1 | 0.00233660 |
| | 5:1 | 0.00154357 |
| | 7:1 | 0.00128867 |
| 2-Stage | 14:1 | 0.00219499 |
| | 16:1 | 0.00179847 |
| | 18:1 | 0.00182679 |
| | 19:1 | 0.00141612 |
| | 22:1 | 0.00148693 |
| | 25:1 | 0.00177015 |
| | 27:1 | 0.00148693 |
| | 29:1 | 0.00124619 |
| | 35:1 | 0.00126035 |
| | 46:1 | 0.00126035 |
| 3-Stage | 51:1 | 0.00218082 |
| | 59:1 | 0.00178431 |
| | 68:1 | 0.00179847 |
| | 71:1 | 0.00147276 |
| | 79:1 | 0.00179847 |
| | 93:1 | 0.00124619 |
| | 95:1 | 0.00147276 |
| | 100:1 | 0.00148693 |
| | 107:1 | 0.00124619 |
| | 115:1 | 0.00148693 |
| | 124:1 | 0.00124619 |
| | 130:1 | 0.00124619 |
| | 139:1 | 0.00144444 |
| | 150:1 | 0.00124619 |
| | 169:1 | 0.00126035 |
| | 181:1 | 0.00124619 |
| | 195:1 | 0.00126035 |
| | 236:1 | 0.00126035 |
| | 308:1 | 0.00126035 |

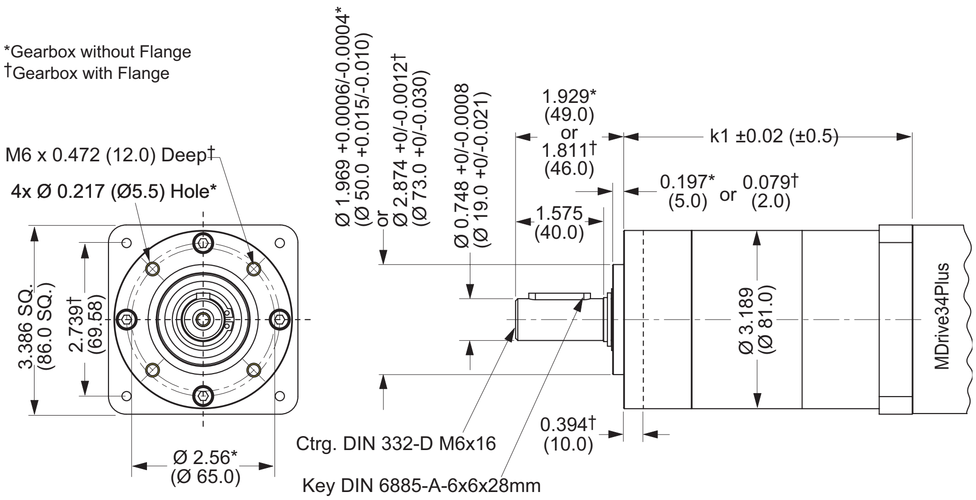
*Table C2: Planetary Gearbox Inertia Moments*

Dimensions in Inches (mm)

## Planetary Gearbox Parameters

| | Permitted Output Torque (oz-in/Nm) | Gearbox Efficiency | Maximum Backlash | Output Side with Ball Bearing | | | |
|---|---|---|---|---|---|---|---|
| | | | | Maximum Load (lb-force/N) | | Weight (oz/g) | |
| | | | | Radial | Axial | Gearbox | with Flange |
| **1-STAGE** | 2832/20.0 | 0.80 | 1.0° | 90/400 | 18/80 | 64.4/1827 | 66.7/1890 |
| **2-STAGE** | 8496/60.0 | 0.75 | 1.5° | 135/600 | 27/120 | 89.5/2538 | 92.6/2625 |
| **3-STAGE** | 16992/120.0 | 0.70 | 2.0° | 225/1000 | 45/200 | 92.6/2625 | 118.5/3360 |

*Table B3: Planetary Gearbox Specifications*




**Gearbox Lengths** *Inches (mm)*

| | k1 GEARBOX* | k2 with FLANGE† |
|---|---|---|
| 1-Stage | 4.315 (109.6) | 4.433 (112.6) |
| 2-Stage | 5.169 (131.3) | 5.287 (134.3) |
| 3-Stage | 6.024 (153.0) | 6.142 (156.0) |

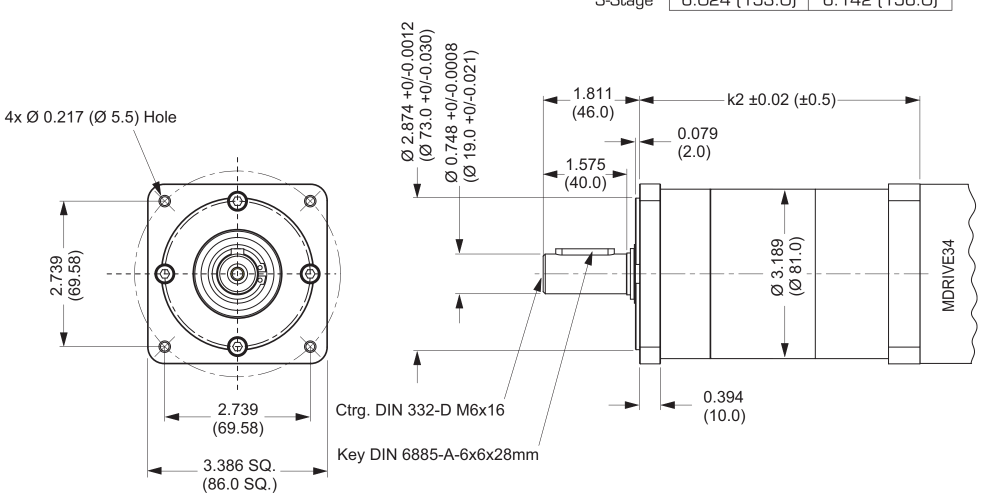



*Figure C.7: Planetary Gearbox Specifications for MDrive34AC Plus*

## Ratios and Part Numbers

| Planetary Gearbox | Ratio (Rounded) | Part Number |
|---|---|---|
| **1-Stage** | 3.71:1 | G1A1 |
| **1-Stage** | 5.18:1 | G1A2 |
| **1-Stage** | 6.75:1 | G1A3 |
| **2-Stage** | 13.73:1 | G1A4 |
| **2-Stage** | 15.88:1 | G1A5 |
| **2-Stage** | 18.37:1 | G1A6 |
| **2-Stage** | 19.20:1 | G1A7 |
| **2-Stage** | 22.21:1 | G1A8 |
| **2-Stage** | 25.01:1 | G1A9 |
| **2-Stage** | 26.85:1 | G1B1 |
| **2-Stage** | 28.93:1 | G1B2 |
| **2-Stage** | 34.98:1 | G1B3 |
| **2-Stage** | 45.56:1 | G1B4 |
| **3-Stage** | 50.89:1 | G1B5 |
| **3-Stage** | 58.86:1 | G1B6 |
| **3-Stage** | 68.07:1 | G1B7 |
| **3-Stage** | 71.16:1 | G1B8 |
| **3-Stage** | 78.72:1 | G1B9 |
| **3-Stage** | 92.70:1 | G1C1 |
| **3-Stage** | 95.18:1 | G1C2 |
| **3-Stage** | 99.51:1 | G1C3 |
| **3-Stage** | 107.21:1 | G1C4 |
| **3-Stage** | 115.08:1 | G1C5 |
| **3-Stage** | 123.98:1 | G1C6 |
| **3-Stage** | 129.62:1 | G1C7 |
| **3-Stage** | 139.14:1 | G1C8 |
| **3-Stage** | 149.90:1 | G1C9 |
| **3-Stage** | 168.85:1 | G1D1 |
| **3-Stage** | 181.25:1 | G1D2 |
| **3-Stage** | 195.27:1 | G1D3 |
| **3-Stage** | 236.10:1 | G1D4 |
| **3-Stage** | 307.55:1 | G1D5 |

*Table C.3: Planetary Gearbox Ratios and Part Numbers*

NOTE: The USB drivers must be installed before the Communications Converter Cable is plugged into the computer.

WARNING! DO NOT connect or disconnect the MD-CC300-000 Communications Converter Cable from MDrive while power is applied!

## Optional Cables and Cordsets

### MD-CC300-000: USB to SPI Parameter Setup Cable

The MD-CC300-000 USB to SPI Parameter Setup Cable provides a communication connection between the 10-pin connector on some Microstepping MDrives and the USB port on a PC.

IMS SPI Interface Software communicates to the Parameter Setup Cable through the PC's USB port.

The Parameter Setup Cable interprets SPI commands and sends these commands to the MDrivePlus through the SPI interface.

Supplied Components: MD-CC300-000 Parameter Setup Cable, USB Cable, USB Drivers, IMS SPI Interface Software.


*Figure D.1: MD-CC300-000 USB to SPI Converter*

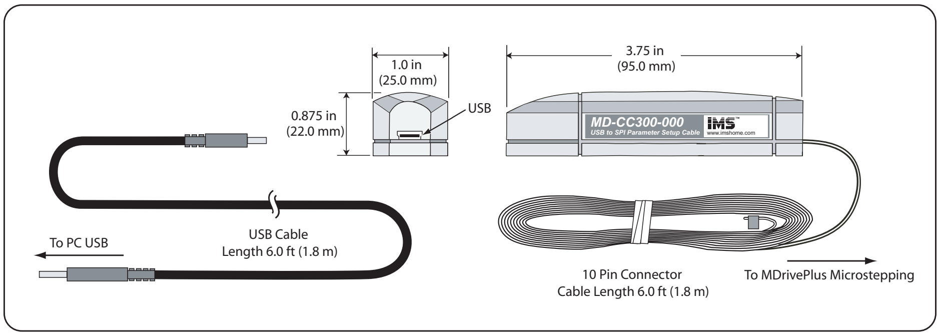



*Figure D.2: MD-CC300-000 Mechanical Specifications*

### Adapter

The MDM34 with the 12 Pin Pluggable Locking Wire Crimp option requires the MD-ADP-1723C adapter board to interface to the MD-CC300-000 USB to SPI converter cable. See Figure D.3 on the following page for dimensional and connection information.

### Prototype Development Cable

For testing and development of MDrives with pluggable locking wire crimp connector, the following 10' (3.0 m) interface cables are recommended:

I/O and Communications: 12-Pin Cable .................................................. PD12-1434-FL3

Power: 2-Pin Cable.................................................................................... PD02-3400-FL3

Internal Encoder: 10-Pin Cable ................................................................. PD10-1434-FL3

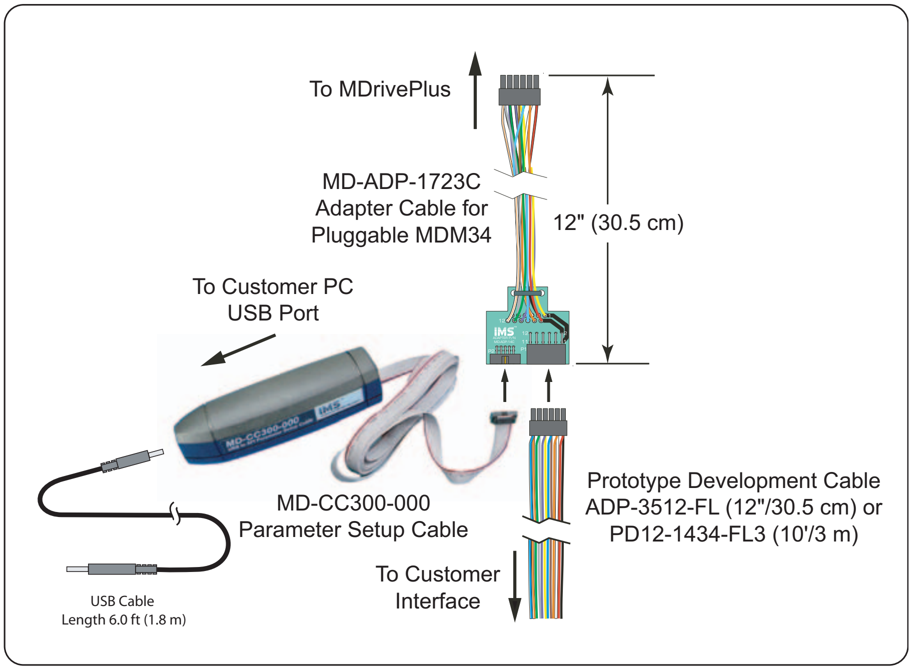



*Figure D.3: Typical Setup, Adapter and Prototype Development Cable*

## Installation Procedure for the MD-CC300-000

These Installation procedures are written for Microsoft Windows XP Service Pack 2. Users with earlier versions of Windows please see the alternate installation instructions at the IMS web site (http://www.imshome.com).

The installation of the MD-CC300-000 requires the installation of two sets of drivers:

- Drivers for the IMS USB to SPI Converter Hardware.
- Drivers for the Virtual Communications Port (VCP) used to communicate to your IMS 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.

**N** Note: Interactive installation tutorials are available at the IMS Web Site at http://www.imshome.com/tutorials.html

### *Installing the Cable/VCP Drivers*

1) Plug the USB Converter Cable into the USB port of the MD-CC300-000.

2) Plug the other end of the USB cable into an open USB port on your PC.

3) Your PC will recognize the new hardware and open the Hardware Update dialog.

4) 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” (Figure D.4).


*Figure D.4: Hardware Update Wizard*

5) Select "Install from a list or specific location (Advanced)"on the radio button in answer to the query "What do you want the wizard to do?" Click "Next" (Figure D.5).

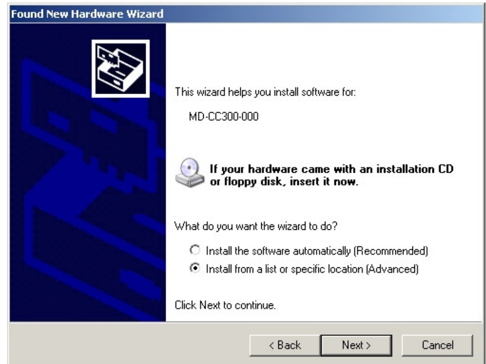



*Figure D.5: Hardware Update Wizard Screen 2*

6) Select "Search for the best driver in these locations."
   (a) Check "Include this location in the search."
   (b) Browse to the MDrive CD [Drive Letter]:\ Cable_Drivers\MD-CC303-000_DRIVERS.
   (c) Click Next (Figure D.6).

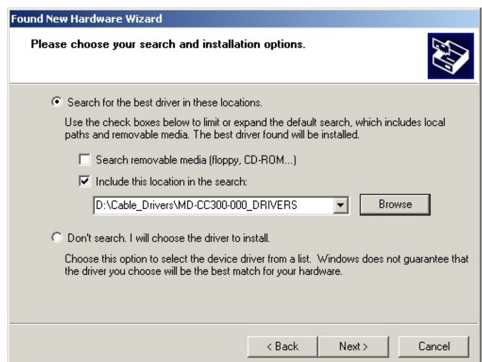



*Figure D.6: Hardware Update Wizard Screen 3*

7) The drivers will begin to copy.

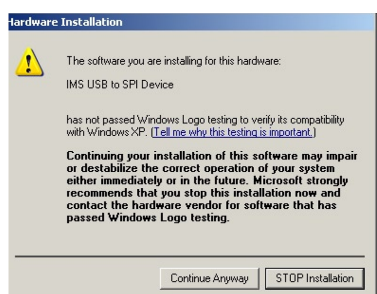



*Figure D.7: Windows Logo Compatibility Testing*

8) On the Dialog for Windows Logo Compatibility Testing, click "Continue Anyway" (Figure D.7).

9) The Driver Installation will proceed. When the Completing the Found New Hardware Wizard dialog appears, Click "Finish" (Figure D.8).


*Figure D.8: Hardware Update Wizard Finish Installation*

10) Upon finish, the Welcome to the Hardware Update Wizard will reappear to guide you through the second part of the install process. Repeat steps 1 through 9 above to complete the cable installation.

11) Your IMS MD-CC300-000 is now ready to use.

### Determining the Virtual COM Port (VCP)

The MD-CC300-000 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-CC300-000 will automatically assign a VCP to the device during installation. The VCP port number will be needed when IMS Terminal is set up in order that IMS Terminal will know where to find and communicate with your IMS Product.

To locate the Virtual COM Port.

1) Right-Click the “My Computer” Icon and select “Properties”.
2) Browse to the Hardware Tab (Figure D.9), Click the Button labeled “Device Manager”.
3) Look in the heading “Ports (COM & LPT)” IMS USB to SPI Converter Cable (COMx) will be listed (Figure D.10). The COM # will be the Virtual COM Port connected. You will enter this number into your IMS SPI Motor Interface Configuration.

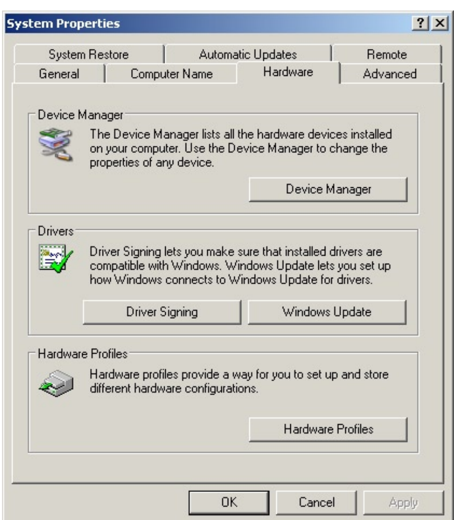



*Figure D.9: Hardware Properties*

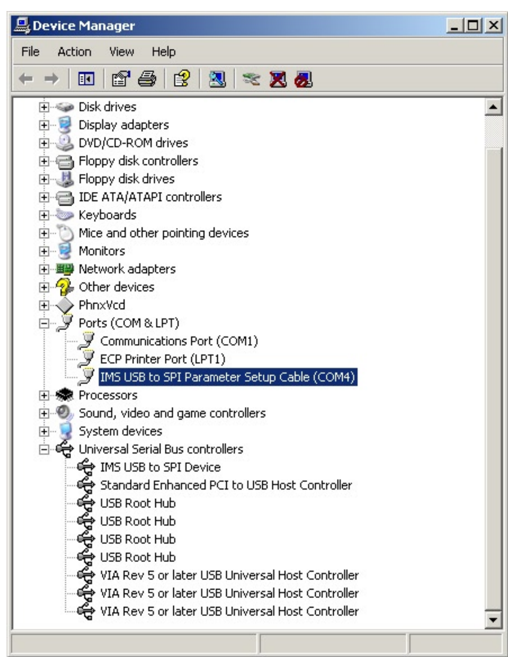



*Figure D.10: Windows Device Manager*

## Interfacing an Encoder

### Factory Mounted Internal Encoder

The MDrivePlus Microstepping are available with a factory-mounted internal optical encoder. See Table E.1 for available line counts. Encoders are available in both single-end and differential configurations. All encoders have an index mark.

Use of the encoder feedback feature of this product requires a controller such as an IMS MicroLYNX or PLC.

The encoder has a 100 kHz maximum output frequency.

| | DIFFERENTIAL ENCODER | SINGLE-END ENCODER |
|---|---|---|
| Line Count | Part Number | Part Number |
| 100 | EA | E1 |
| 200 | EB | E2 |
| 250 | EC | E3 |
| 256 | EW | EP |
| 400 | ED | E4 |
| 500 | EH | E5 |
| 512 | EX | EQ |
| 1000 | EJ | E6 |
| 1024 | EY | ER |

*Table E1: Available Encoder Line Counts and Part Numbers*

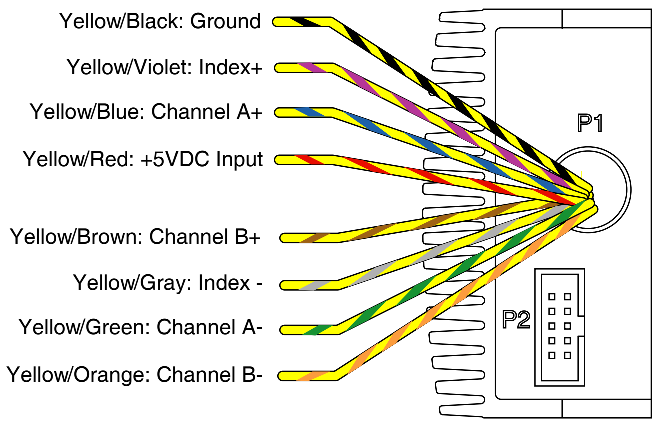
Note: The MDrive34Plus with Pluggable Interface is available with Differential Encoder only. The MDrive34Plus with Flying Leads is available with both Single-End or Differential Encoder.

### General Specifications

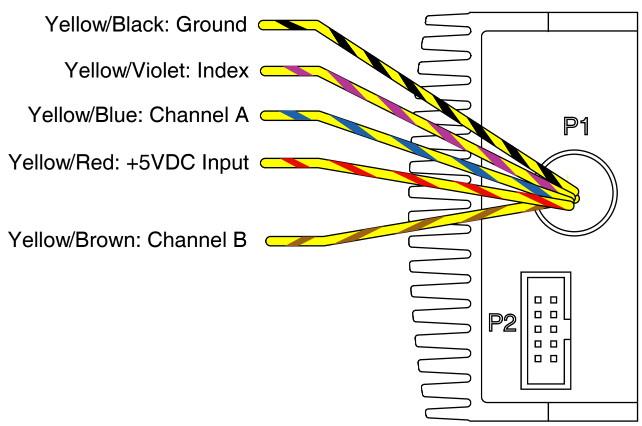
| | Min | Typ | Max | Units |
|---|---|---|---|---|
| Supply Voltage (VDC) | -0.5 | | 7 | Volts |
| Supply Current | 30 | 57 | 85 | mA |
| Output Voltage | -0.5 | | Vcc | Volts |
| Output Current (Per Channel) | -1.0 | | 5 | mA |
| Maximum Frequency | | | | 100kHz |
| Inertia | | | | 0.565 g-cm$^2$ (8.0 x 10$^{-6}$ oz-in-sec$^2$) |
| Temperature | | | | |
| Operating | | | | -40 to +100° C |
| Storage | | | | -40 to +100° C |
| Humidity | | | | 90% (non-condensing) |

## Encoder Connections

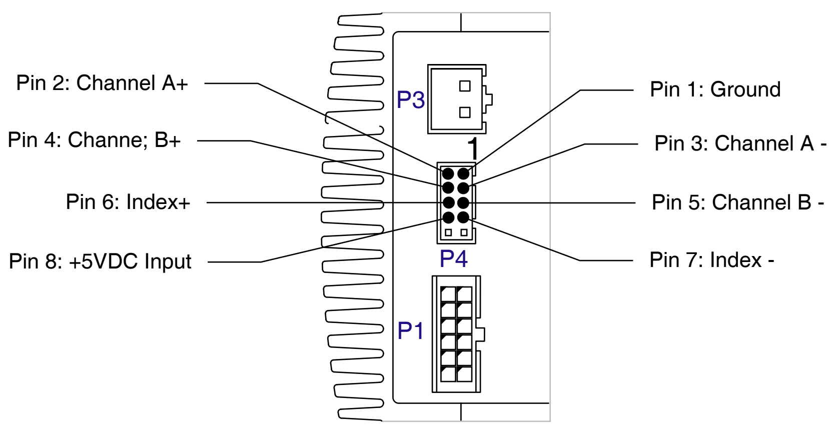
> **N** Note: The MDM34 with Pluggable Interface is only available with a differential encoder.




Differental Encoder
Flying Leads




Single-End Encoder
Flying Leads




Differental Encoder
Pluggable Interface

*Figure E.1: Single-End and Differential Encoder Connections*

## Encoder Signals

### Single-End Encoder

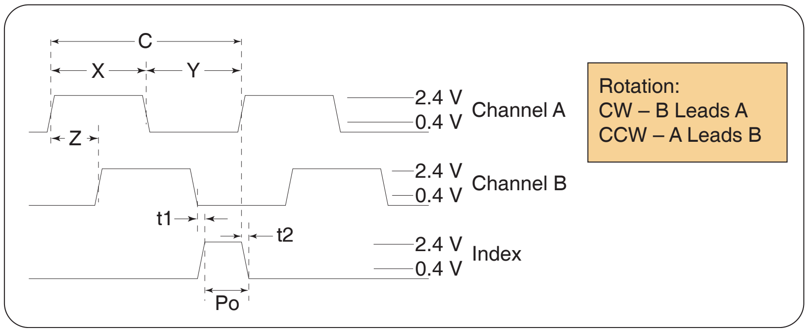



*Figure E.2: Single-End Encoder Signal Timing*

### Differential Encoder

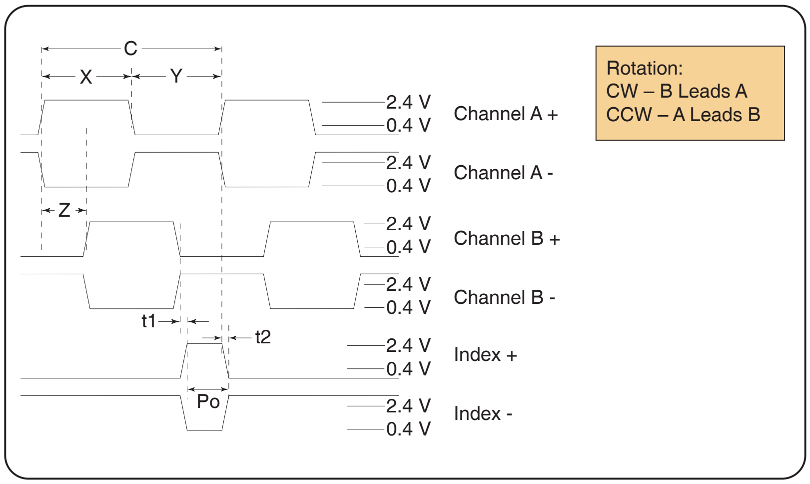



*Figure E.3: Differential Encoder Signal Timing*

Note: Rotation is as viewed from the cover side.

(C) One Cycle: 360 electrical degrees (°e)

(X/Y) Symmetry: A measure of the relationship between X and Y, nominally 180°e.

(Z) Quadrature: The phase lag or lead between channels A and B, nominally 90°e.

(Po) Index Pulse Width: Nominally 90°e.

### Characteristics

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Cycle Error | | | 3 | 5.5 | °e |
| Symmetry | | 130 | 180 | 230 | °e |
| Quadrature | | 40 | 90 | 140 | °e |
| Index Pulse Width | Po | 60 | 90 | 120 | °e |
| Index Rise After CH B or CH A fall | t1 | -300 | 100 | 250 | ns |
| Index Fall After CH A or CH B rise | t2 | 70 | 150 | 1000 | ns |

Over recommended operating range. Values are for worst error over a full rotation.

## Encoder Cable

IMS offers an assembled cable for use with the Differential Encoder on MDM34 with the Pluggable Locking Wire Crimp interface . The IMS Part Number is listed below.

Differential Encoder Cable (10' leads) ........................................................................ PD10-1434-FL3

### Recommended Encoder Mating Connectors

IMS recommends the following mating connectors (or equivalent) if you make your own cables.

#### Differential Encoder

10-Pin Friction Lock Wire Crimp................................................................Hirose DF11-10DS-2C

Pins

22 AWG ............................................................................................................Hirose DF11-22SC
24/28 AWG ....................................................................................................Hirose DF11-2428SC
30 AWG ............................................................................................................Hirose DF11-30SC

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# WARRANTY

## TWENTY-FOUR (24) MONTH LIMITED WARRANTY

Intelligent Motion Systems, Inc. (“IMS”), warrants only to the purchaser of the Product from IMS (the “Customer”) that the product purchased from IMS (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 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.”

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; improper maintenance or repair of the Product; or any other reason or event not caused by IMS.

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## OBTAINING WARRANTY SERVICE

Warranty service may obtained by a distributor, if the Product was purchased from IMS by a distributor, or by the Customer directly from IMS, if the Product was purchased directly from IMS. Prior to returning the Product for service, a Returned Material Authorization (RMA) number must be obtained. Complete the form at http://www.imshome.com/rma.html after which an RMA Authorization Form with RMA number will then be faxed to you. Any questions, contact IMS Customer Service (860) 295-6102.

Include a copy of the RMA Authorization Form, contact name and address, and any additional notes regarding the Product failure with shipment. Return Product in its original packaging, or packaged so it is protected against electrostatic discharge or physical damage in transit. The RMA number MUST appear on the box or packing slip. Send Product to: Intelligent Motion Systems, Inc., 370 N. Main Street, Marlborough, CT 06447.

Customer shall prepay shipping changes for Products returned to IMS for warranty service and IMS 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 from outside the United States.

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**370 N. Main St., P.O. Box 457**
**Marlborough, CT 06447 U.S.A.**
**Phone: 860/295-6102**
**Fax: 860/295-6107**
**E-mail: info@imshome.com**

**TECHNICAL SUPPORT**
**Eastern U.S.A.**
Phone: 860/295-6102
Fax: 860/295-6107
E-mail: etech@imshome.com
**Western U.S.A.**
Phone: 760/966-3162
Fax: 760/966-3165
E-mail: wtech@imshome.com
**Germany/UK**
Phone: +49/7720/94138-0
Fax: +49/7720/94138-2
E-mail: mweber@imshome.com

**U.S.A. SALES OFFICES**
**Eastern Region**
Phone: 862/208-9742
Fax: 973/661-1275
E-mail: jroake@imshome.com
**Central Region**
Phone: 260/402-6016
Fax: 419/858-0375
E-mail: dwaksman@imshome.com
**Western Region**
Phone: 602/578-7201
E-mail: dweisenberger@imshome.com

**IMS MOTORS DIVISION**
105 Copperwood Way, Suite H
Oceanside, CA 92054
Phone: 760/966-3162
Fax: 760/966-3165
E-mail: motors@imshome.com

**IMS EUROPE GmbH**
Hahnstrasse 10, VS-Schwenningen
Germany D-78054
Phone: +49/7720/94138-0
Fax: +49/7720/94138-2
E-mail: info@imseuropehome.com
**European Sales Management**
4 Quai Des Etroits
69005 Lyon, France
Phone: +33/4 7256 5113
Fax: +33/4 7838 1537
E-mail: bmartinez@imshome.com
**Germany Sales**
Phone: +49/35205/4587-8
Fax: +49/35205/4587-9
E-mail: hruhland@imshome.com
**Germany/UK Technical Support**
Phone: +49/7720/94138-0
Fax: +49/7720/94138-2
E-mail: mweber@imshome.com

**IMS UK Ltd.**
25 Barnes Wallis Road
Segensworth East
Fareham, Hampshire P015 5TT
Phone: +44/0 1489-889825
Fax: +44/0 1489-889857
E-mail: mcheckley@imshome.com

**IMS ASIA PACIFIC OFFICE**
30 Raffles Pl., 23-00 Caltex House
Singapore 048622
Phone: +65/6233/6846
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