MDrive 17 & 23 Plus
Speed Control
Integrated Motor and Driver

IMS™ INTELLIGENT MOTION SYSTEMS, INC.

by Schneider Electric

MDrivePlus Speed Control Operating Instructions Change Log		
Date	Revision	Changes
01/26/2007	R011607	Initial Release
12/11/2007	R121107	Minor changes. Relevant to MDO Firmware version 3.0.03
03/18/2008	R031808	Added qualification os personnel and intended use statements to inside front.
06/24/08	R062408	Added information on updates to communications cables.
11/11/2008	R111108	Added specifications for NEMA 23 Quad Length

MDrivePlus Speed Control
Revision R111108

Important information

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

Qualification of personnel

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

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

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

Intended Use

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

For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

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

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

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

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

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

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Part 1: Hardware Specifications

Part 2: Connections and Interfacing

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Before You Begin

The Getting Started Section is designed to help quickly connect and begin using your MDrivePlus Speed. The following examples will help you get the motor turning for the first time and introduce you to the basic settings of the device.

Tools and Equipment Required

- MDrivePlus Speed Control Unit (MDO)
- Parameter setup cable MD-CC300-000 or equivalent (USB to SPI)
- Product CD or Internet access to www.imshome.com
- Control device for Start/Stop and Direction (Switch, PLC etc.)
- 10 kΩ potentiometer, 0-20 mA or 4-20 mA current source
- An Unregulated Power Supply (See specifications for your exact MDrivePlus Speed Control and required voltage.)
- Basic Tools: Wire Cutters / Strippers / Screwdriver
- Wire for Power Supply (See specifications for your exact MDO.)
- A PC with Windows XP Service Pack 2 or greater.

Connecting the Power Supply

Using the recommended wire (see the specifications for your MDrivePlus), connect the DC output of the power supply to the +V input of the connector appropriate for your MDrivePlus Speed Control model.

Connect the power supply ground to the Power Ground pin appropriate for your MDrivePlus Speed Control.

Connect Speed Control and Logic Inputs

Using the recommended wire (see the specifications for your MDrivePlus), connect the Start/Stop input and CW/CCW direction Inputs to switches or controller I/O point (Inputs are of the Sinking Type) using Figure GS.1 as a guide.

Connect the speed control potentiometer in accordance with Figure GS.1

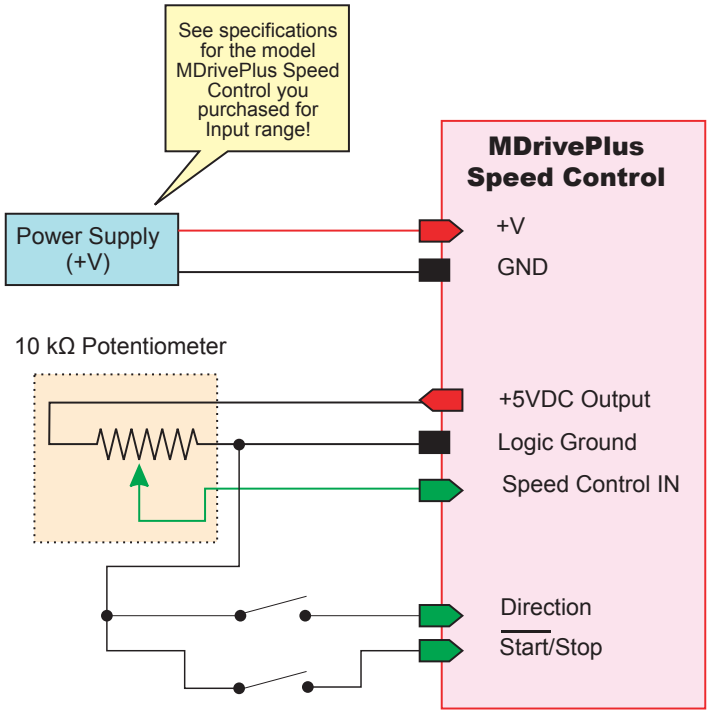

Figure GS.1: Minimum Logic and Power Connections

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 MDrivePlus product.

WARNING! Ensure that the power supply output voltage does not exceed the maximum input voltage of the MDrivePlus product that you are using!

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 MdrivePlus 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 device:
MDrive17Plus.....+48 VDC
MDrive23Plus.....+75 VDC

WARNING! 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 operating range of the MDrivePlus Speed Control is -40 to +85°C.

Connecting Parameter Setup Cable

Connect the Host PC to the MDrivePlus Speed Control using the IMS Parameter Setup Cable or equivalent.

Install the IMS SPI Motor Interface (See Section 2.4 for Details)

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

1. Download and install the SPI Motor Interface from http://www.imshome.com/software_interfaces.html.
2. Once IMS SPI Motor Interface is installed, the parameter settings can be checked and/or set.

Once installed you can change the configuration parameters of the MDrivePlus Speed Control. By default the speed control input is configured to run with a 0 - 5 V Input as shown in Figure GS.1.

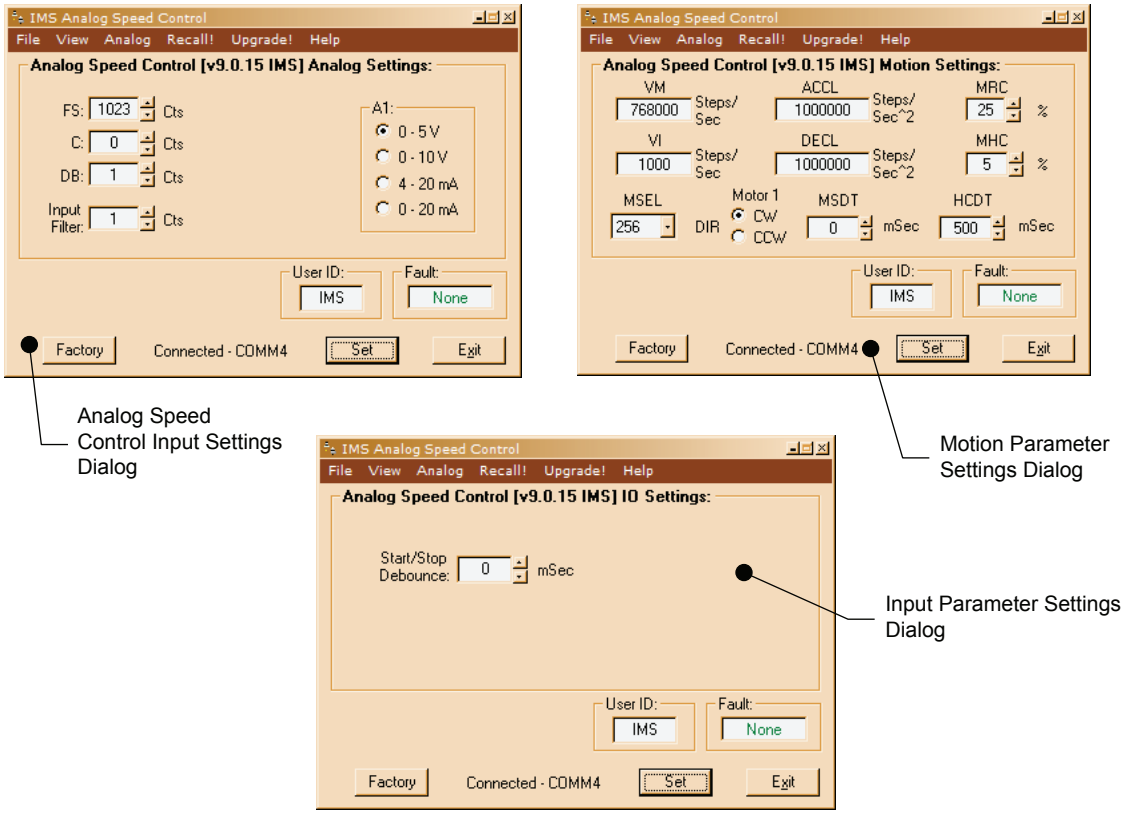

Figure GS.2: IMS SPI Motor Interface Showing Default Speed Control Settings

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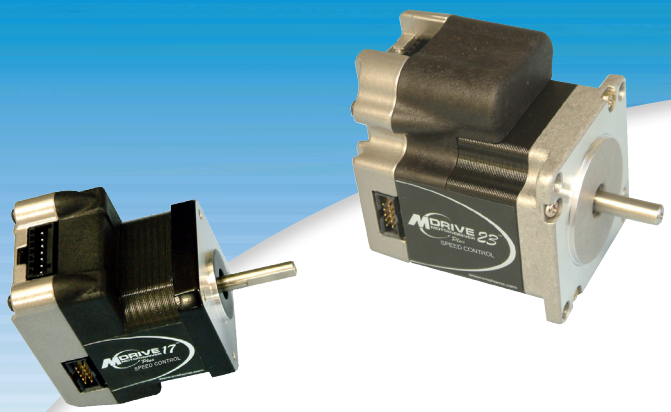

MDRIVE™
MOTOR+DRIVER
Plus
SPEED CONTROL

PART 1: HARDWARE SPECIFICATIONS

Section 1.1: MDrivePlus Speed Control Product Introduction

Section 1.2: MDrive17Plus Speed Control Detailed Specifications

Section 1.3: MDrive23Plus Speed Control Detailed Specifications

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SECTION 1.1

Introduction to the MDrivePlus Speed Control

The MDrivePlus Speed Control offers the system designer low cost, intelligent velocity control integrated with a NEMA 17 or NEMA 23 high torque brushless motor and a +12 to +48 volt (Size 17) or a +12 to +75 volt (Size 23) microstepping driver.

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

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

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

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

The versatile, compact MDrivePlus Speed Control is available in multiple configurations to fit various system needs. Rotary motor versions come in three lengths and may include an optical encoder, control knob, planetary gearbox or linear slide. Interface connections are accomplished using either a 7 position pluggable terminal strip or 12.0” (30.5cm) flying leads.

CONFIGURING

The IMS Analog Speed Control is a software GUI for quick and easy parameter setup of the MDrivePlus Speed Control from a computer's USB port. GUI access is via the IMS SPI Motor Interface included on the CD shipped with the product, or from www.imshome.com. The IMS interface is also required to upgrade MDrivePlus Speed Control firmware.

An optional Parameter Setup Cable is available for ease of connecting and configuring the MDrivePlus Speed Control.

IMS Analog Speed Control features:

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

Features and Benefits

- Highly Integrated Variable Speed Controller, Microstepping Driver and NEMA 23 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
- 10-bit Analog Speed Control Input Accepts:
    - 0 to +5 VDC
    - 0 to +10 VDC
    - 4 to 20 mA
    - 0 to 20 mA
    - 15 to 25 kHz PWM
- Automatic Current Reduction
- Electronically Configurable:
    - Motor Run/Hold Current
    - Microstep Resolution
    - Acceleration/Deceleration
    - Initial and Max Velocity
    - Hold Current Delay Time/Motor Settling Delay Time
    - Programmable Filtering for the Start/Stop Input
- Available Options:
    - External Optical Encoder
    - Integrated Planetary Gearbox
    - Control Knob for Manual Positioning
- 3 Rotary Motor Lengths Available
- Setup Parameters May Be Switched On-The-Fly
- Interface Options:
    - Pluggable Terminal Strip
    - 12.0” (30.5cm) Flying Leads
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

General Specifications

Electrical Specifications	
Input Voltage (+V) Range*	+12 to +48 VDC
Max Power Supply Current (Per MDrive17Plus Speed Control)*	2 A

** Actual power supply current will depend on voltage and load.*

Table 1.2.1: MDrive17Plus Speed Control Electrical Specifications

Environmental Specifications	
Operating Temperature	-40°C to +85°C

Table 1.2.2: MDrive17Plus Speed Control Environmental Specifications

I/O Specifications	
Analog Input	
A/D Resolution	10 Bit
Range (Voltage Mode)	0 to +5 VDC, 0 to +10 VDC
Range (Current Mode)	4 to 20 mA, 0 to 20mA
Range (PWM)	15 to 25 kHz
Stop/Start and Direction	
Range	TTL
Logic Threshold (Logic 0)	< 0.8 VDC
Logic Threshold (Logic 1)	> 2.2 VDC
Internal Pull-up Resistance	20kΩ
Protection	Transient

Table 1.2.3: MDrive17Plus Speed Control I/O Specifications

Communications Specifications	
Protocol	SPI
Isolation	Galvanic

Table 1.2.4: MDrive17Plus Speed Control Communications Specifications

Motion Specifications	
Microstep Resolution	
Number of Resolutions	20

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

1=0.01 deg/µstep 2=1 arc minute/µstep 3=0.001 mm/µstep

Velocity	
Oscillator Frequency (Max)	5 MHz
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 1.2.5: MDrive17Plus Speed Control Motion Specifications

Motor Specifications	
Single Length	
Holding Torque	32 oz-in/22.6 N-cm
Detent Torque	1.66 oz-in/1.17 N-cm
Rotor Inertia	0.00053 oz-in-sec^2/0.038 kg-cm^2
Weight (Motor + Driver)	9.8 oz/277.8 g
Double Length	
Holding Torque	60 oz-in/42.46 N-cm
Detent Torque	2.08 oz-in/1.47 N-cm
Rotor Inertia	0.00080 oz-in-sec^2/0.057 kg-cm^2
Weight (Motor + Driver)	10.5 oz/297.7 g
Triple Length	
Holding Torque	74.9 oz-in/52.9 N-cm
Detent Torque	3.47 oz-in/2.45 N-cm
Rotor Inertia	0.00116 oz-in-sec^2/0.082 kg-cm^2
Weight (Motor + Driver)	15.1 oz/428.1 g

Table 1.2.6: MDrive17Plus Speed Control Motor Specifications

Setup Parameters

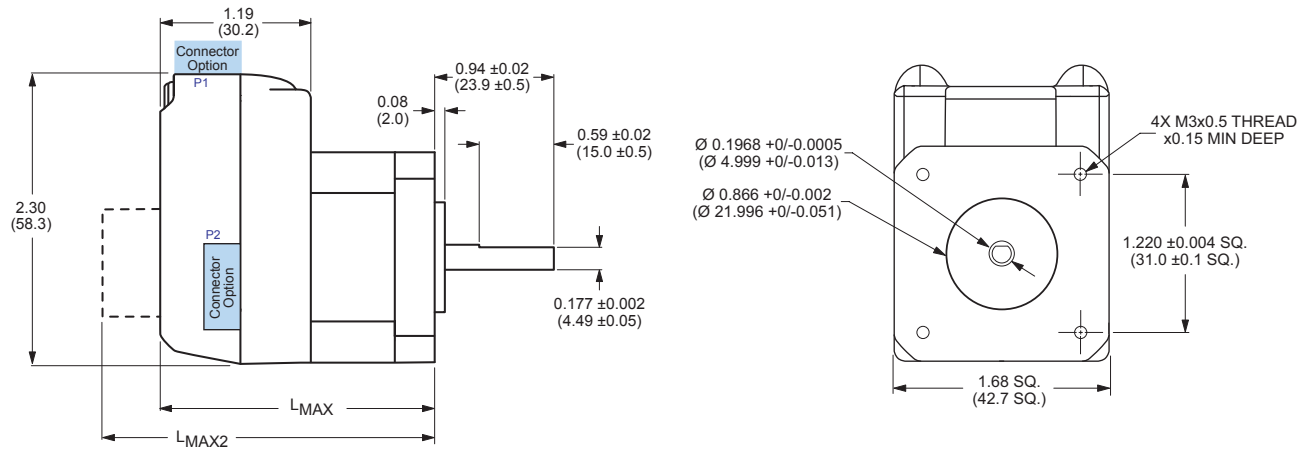
The following table lists the setup parameters. These are easily configured using the IMS SPI Motor Interface configuration utility. An optional Parameter Setup Cable p/n MD-CC300-000 is available and recommended with the first order.

MDrivePlus Speed Control Setup Parameters				
Name	**Function**	**Range**	**Units**	**Default**
A1	Analog Input Mode	0 to +5 V, 0 to +10 V, 4 to 20 mA, 0 to 20 mA, 15 to 25kHz PWM	—	0 to +5 VDC
ACCL	Acceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
C	Joystick Center	0 to 1022	counts	0
DB	Deadband	0 to 255	counts	1
DECL	Deceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
DIR	Motor Direction Override	Clockwise/Counterclockwise	–	CW
FAULT	Fault/Checksum Error	Error Code	—	None
FS	Full Scale	1 to 1023 (205 to 1023 – 4 to 20 mA)	counts	1023
HCDT	Hold Current Delay Time	0 (No Hold Current) or 2 to 65535 - MSDT	milliseconds	500
IF	Analog Input Filter	1 to 1000	counts	1
MHC	Motor Hold Current	0 – 100	percent	5
MRC	Motor Run Current	1 – 100	percent	25
MSDT	Motor Settling Delay Time	0 to 65535 - HCDT	milliseconds	0
MSEL	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256	µsteps per full step	256
SSD	Stop/Start Debounce	0 – 255	milliseconds	0
VI	Initial Velocity	0 – < VM	steps/sec	1000
VM	Maximum Velocity	VI to 5,000,000	steps/sec	768000
USER ID	User ID	Customizable	1-3 characters	IMS

Table 1.2.7: Setup Parameters

Mechanical Specifications

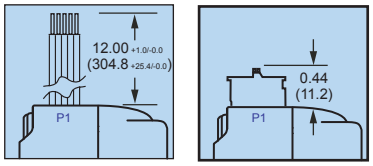
Dimensions in Inches (mm)



***MDrive Lengths** Inches (mm)*

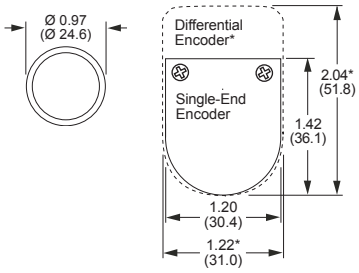
Motor Length	L_{MAX} SINGLE SHAFT VERSION	L_{MAX2} CONTROL KNOB or ENCODER VERSION
Single	2.20 (55.9)	2.79 (70.9)
Double	2.43 (61.7)	3.02 (76.7)
Triple	2.77 (70.4)	3.37 (85.6)

P1 Connector Options



Flying Leads — *7-Pin Pluggable Clamp Type Terminal Strip*

L_{MAX2} Options



P2 Connector Options

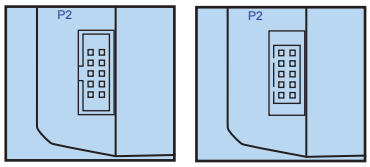


Figure 1.2.1: MDrive17Plus Mechanical Specifications

Pin Assignment and Description

P1 Connector - Power and I/O

Pin Assignment - P1 Power and I/O Connections

Flying Lead Wire Color	*7-Pin Pluggable Terminal Strip*	*Function*	*Description*
Violet	Pin 1	Stop/Start	The Stop/Start input will stop (high/ disconnected) or start (Active when Low) the internal pulse generator.
Blue	Pin 2	Direction	The direction input will toggle the axis direction relative to the state of the Direction parameter.
Green	Pin 3	Speed Control Input	0 to +5 VDC, 0 to +10 V, 0 to 20 mA, 4 to 20 mA or 15 to 25 kHz PWM speed control input.
Yellow	Pin 4	+5 VDC Output	Used with a 10kΩ Potentiometer to the Speed Control input.
Gray	Pin 5	Logic Ground	Used with a 10kΩ Potentiometer to the Speed Control input.
Black	Pin 6	GND	Power and Auxiliary Ground.
Red	Pin 7	+V	+12 to +48 VDC Motor Power Supply input.

Table 1.2.8: P1 — Pin Assignment, Power and I/O

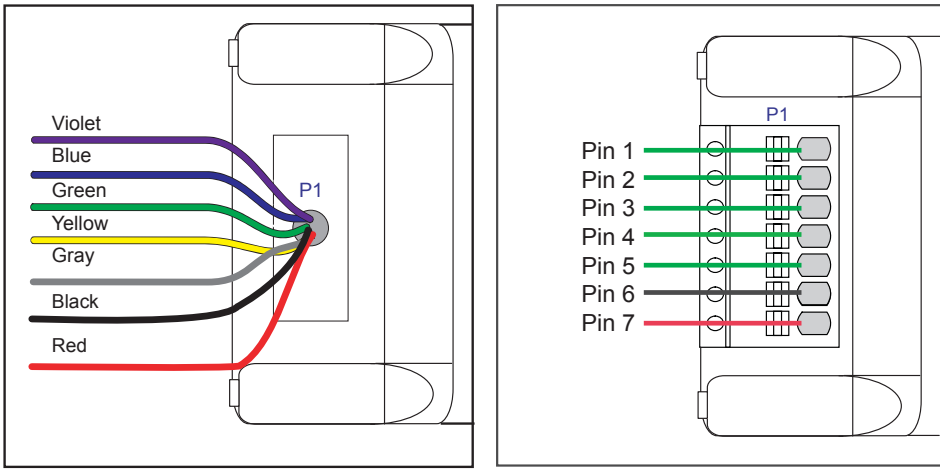
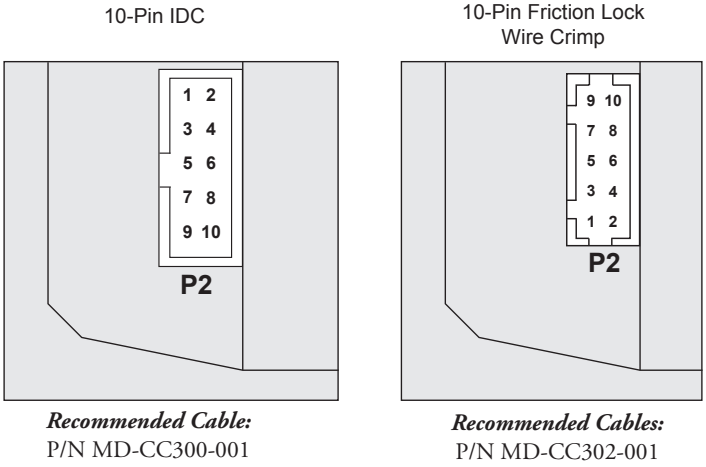


Figure 1.2.2: P1 Connector - I/O and Power

P2 Connector - SPI Communications

Pin Assignment - P2 SPI Communications			
10-Pin IDC	***10-Pin Wire Crimp***	***Function***	***Description***
Pin 1	Pin 9	—	No Connect.
Pin 2	Pin 10	—	No Connect.
Pin 3	Pin 7	—	No Connect.
Pin 4	Pin 8	CS	SPI Chip Select. This signal is used to turn communications to multiple MDO units on or off.
Pin 5	Pin 5	GND	Communications Ground.
Pin 6	Pin 6	+5 VDC Output	Supply voltage for the MD-CC300-000 Cable ONLY!
Pin 7	Pin 3	MOSI	Master-Out/Slave-In. Carries output data from the SPI Master to the MDO.
Pin 8	Pin 4	SPI Clock	The Clock is driven by the SPI Master. The clock cycles once for each data bit.
Pin 9	Pin 1	—	No Connect.
Pin 10	Pin 2	MISO	Master-In/Slave-Out. Carries output data from the MDO back to the SPI Master.
Recommended Cable	***Recommended Cable***		
MD-CC300-001	MD-CC302-001		

Table 1.2.9 P2 — Pin Assignment, SPI Communications



Recommended Cable:
P/N MD-CC300-001

Recommended Cables:
P/N MD-CC302-001

Figure 1.2.3: P2 Connector - SPI Communications

Factory Mounted Encoder

Pin Assignment - Factory Mounted Encoder		
Encoder Pin	***Function — Differential Encoder***	***Function — Single-End Encoder***
Pin 1	No Connect	Ground
Pin 2	+5 VDC Input	Index
Pin 3	Ground	Channel A
Pin 4	No Connect	+5 VDC Input
Pin 5	Channel A –	Channel B
Pin 6	Channel A +	
Pin 7	Channel B –	
Pin 8	Channel B +	
Pin 9	Index –	
Pin 10	Index +	

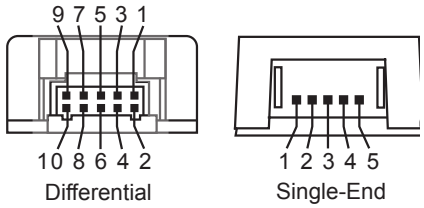


Table 1.2.10: P1 — Pin Assignment, Factory Mounted Encoder

Options and Accessories

QuickStart Kit

For rapid design verification, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrivePlus initial functional setup and system testing.

Communication Converters

Electrically isolated, in-line converters pre-wired with mating connectors to conveniently set/program communication parameters for a single MDrivePlus via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

10-Pin IDC.....MD-CC300-001
10-Pin Wire Crimp MD-CC302-001

Mating Connector Kits

Use to build your own cables. Kit contains 5 mating shells with pins. Cable not supplied. Manufacturer's crimp tool recommended.

Mates to connector:

10-Pin Wire Crimp CK-02

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

10-Pin IDC.....CK-01

External Encoder

External optical encoders, single-end or differential, are offered factory-mounted with the MDrive17Plus. Refer to the Encoder Specifications section for available line counts. All encoders come with an index mark.

Optional encoder cables are available. Order separately.

Single-end Cable (12.0”/30.5cm) ES-CABLE-2
Differential Locking Cable (6.0’/1.8mm) ED-CABLE-6

Control Knob

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

Planetary Gearbox

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

Linear Slide

Integrated linear slides are available factory installed for precision linear movement. Screw leads are 0.1", 0.2", 0.5" or 1.0" of travel per rev. Slides are 12.0" (30.5cm) to 36.0" (91.44cm) long. Contact factory for custom lengths. Refer to separate datasheet or web site for complete details.

General Specifications

WARNING! The MDrive23Plus with a Quad Length motor has a Maximum input voltage of +60 VDC. Do not exceed this limit.

Electrical Specifications	
Input Voltage (+V) Range* (Single, Double and Triple Length)	+12 to +75 VDC
Input Voltage (+V) Range* (Quad Length)	***+12 to +60 VDC***
Max Power Supply Current (Per MDrive23Plus Speed Control)*	2 A

** Actual power supply current will depend on voltage and load.*

Table 1.3.1: MDrive23Plus Speed Control Electrical Specifications

Environmental Specifications	
Operating Temperature	-40°C to +85°C

Table 1.3.2: MDrive23Plus Speed Control Environmental Specifications

I/O Specifications	
Analog Input	
A/D Resolution	10 Bit
Range (Voltage Mode)	0 to +5 VDC, 0 to +10 VDC
Range (Current Mode)	4 to 20 mA, 0 to 20mA
Range (PWM)	15 to 25 kHz
Stop/Start and Direction	
Range	TTL
Logic Threshold (Logic 0)	< 0.8 VDC
Logic Threshold (Logic 1)	> 2.2 VDC
Internal Pull-up Resistance	20kΩ
Protection	Transient

Table 1.3.3: MDrive23Plus Speed Control I/O Specifications

Communications Specifications	
Protocol	SPI

Motion Specifications	
Microstep Resolution	
Number of Resolutions	20

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

1=0.01 deg/µstep 2=1 arc minute/µstep 3=0.001 mm/µstep

Velocity	
Oscillator Frequency (Max)	5 MHz
Resolution	0.5961 Steps/Sec.
Acceleration/Deceleration	
Range	1.5×10^9 Steps/Sec.^{2}
Resolution	90.9 Steps/Sec.^{2}

Table 1.3.4: MDrive23Plus Speed Control Motion Specifications

Motor Specifications	
Single Length	
Holding Torque	90 oz-in/64 N-cm
Detent Torque	3.9 oz-in/2.7 N-cm
Rotor Inertia	0.0025 oz-in-sec^2/0.26 kg-cm^2
Weight (Motor + Driver)	21.6 oz/784.4 g
Double Length	
Holding Torque	144 oz-in/102 N-cm
Detent Torque	5.6 oz-in/3.92 N-cm
Rotor Inertia	0.0037 oz-in-sec^2/0.26 kg-cm^2
Weight (Motor + Driver)	26.4 oz/784.4 g
Triple Length	
Holding Torque	239 oz-in/169 N-cm
Detent Torque	9.7 oz-in/6.86 N-cm
Rotor Inertia	0.065 oz-in-sec^2/0.46 kg-cm^2
Weight (Motor + Driver)	39.2 oz/1111.3 g
Quad Length	
Holding Torque	283 oz-in/200 N-cm
Detent Torque	14.2 oz-in/10.0 N-cm
Rotor Inertia	0.018 oz-in-sec^2/0.76 kg-cm^2
Weight (Motor + Driver)	61.6 oz/1746.3 g

Table 1.3.5: MDrive23Plus Speed Control Motor Specifications

Setup Parameters

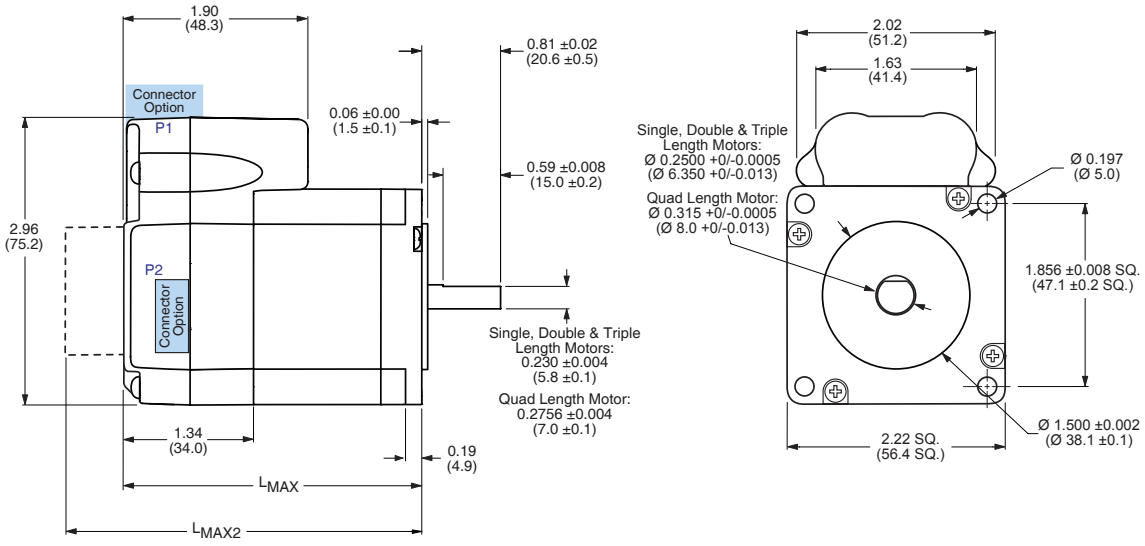
The following table illustrates the setup parameters. These are easily configured using the IMS SPI Motor Interface configuration utility. An optional Parameter Setup Cable is available and recommended with the first order.

MDrivePlus Speed Control Setup Parameters				
Name	**Function**	**Range**	**Units**	**Default**
A1	Analog Input Mode	0 to +5 V, 0 to +10 V, 4 to 20 mA, 0 to 20 mA, 15 to 25kHz PWM	—	0 to +5 VDC
ACCL	Acceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
C	Joystick Center	0 to 1022	counts	0
DB	Deadband	0 to 255	counts	1
DECL	Deceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
DIR	Motor Direction Override	Clockwise/Counterclockwise	–	CW
FAULT	Fault/Checksum Error	Error Code	—	None
FS	Full Scale	1 to 1023 (205 to 1023 – 4 to 20 mA)	counts	1023
HCDT	Hold Current Delay Time	0 (No Hold Current) or 2 to 65535 - MSDT	milliseconds	500
IF	Analog Input Filter	1 to 1000	counts	1
MHC	Motor Hold Current	0 – 100	percent	5
MRC	Motor Run Current	1 – 100	percent	25
MSDT	Motor Settling Delay Time	0 to 65535 - HCDT	milliseconds	0
MSEL	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256	µsteps per full step	256
SSD	Stop/Start Debounce	0 – 255	milliseconds	0
VI	Initial Velocity	0 – < VM	steps/sec	1000
VM	Maximum Velocity	VI to 5,000,000	steps/sec	768000
USER ID	User ID	Customizable	1-3 characters	IMS

Table 1.3.6: Setup Parameters

Mechanical Specifications

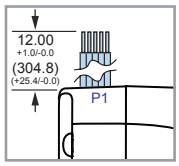
Dimensions in Inches (mm)



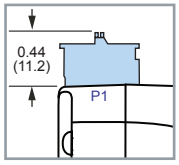
MDrive Lengths *Inches (mm)*

Motor Length	L_{MAX} SINGLE SHAFT or LINEAR ACTUATOR	L_{MAX2} CONTROL KNOB or ENCODER
Single	2.65 (67.31)	3.36 (85.34)
Double	3.02 (76.71)	3.73 (94.74)
Triple	3.88 (98.55)	4.59 (116.59)
Quad	5.28 (134.15)	5.99 (152.19)

P1 Connector Options

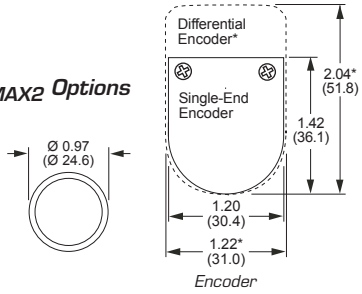


Flying Leads



7-Pin Pluggable Clamp Type Terminal Strip

L_{MAX2} Options



Encoder

Pin Assignment and Description

P1 Connector - Power and I/O

Pin Assignment - P1 Power and I/O Connections

Flying Lead Wire Color	*7-Pin Pluggable Terminal Strip*	*Function*	*Description*
Violet	Pin 1	Stop/Start	The Stop/Start input will stop (high/ disconnected) or start (Active when Low) the internal pulse generator.
Blue	Pin 2	Direction	The direction input will toggle the axis direction relative to the state of the Direction parameter.
Green	Pin 3	Speed Control Input	0 to +5 VDC, 0 to +10 V, 0 to 20 mA, 4 to 20 mA or 15 to 25 kHz PWM speed control input.
Yellow	Pin 4	+5 VDC Output	Used with a 10kΩ Potentiometer to the Speed Control input.
Gray	Pin 5	Logic Ground	Used with a 10kΩ Potentiometer to the Speed Control input.
Black	Pin 6	GND	Power and Auxiliary Ground.
Red	Pin 7	+V	+12 to +75 VDC Motor Power Supply input.

Table 1.3.7: P1 — Pin Assignment, Power and I/O

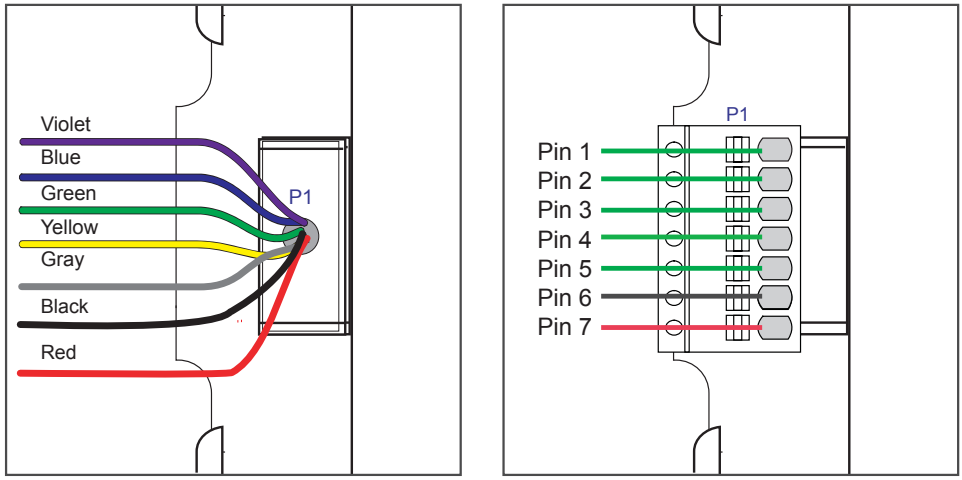
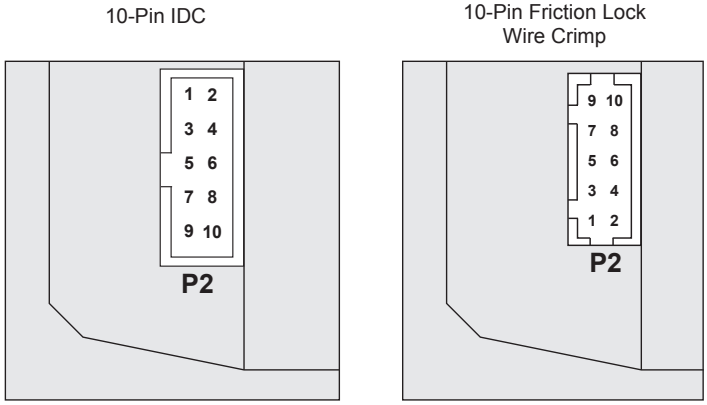


Figure 1.3.2: P1 Connector — Power and I/O Connections

P2 Connector - RS-422/485 Communications

Pin Assignment - P2 RS-422/485 Communications			
10-Pin IDC	***10-Pin Wire Crimp***	***Function***	***Description***
Pin 1	Pin 9	—	No Connect.
Pin 2	Pin 10	—	No Connect.
Pin 3	Pin 7	—	No Connect.
Pin 4	Pin 8	CS	SPI Chip Select. This signal is used to turn communications to multiple MDO units on or off.
Pin 5	Pin 5	GND	Communications Ground.
Pin 6	Pin 6	+5 VDC Output	Supply voltage for the MD-CC300-000 Cable ONLY!
Pin 7	Pin 3	MOSI	Master-Out/Slave-In. Carries output data from the SPI Master to the MDO.
Pin 8	Pin 4	SPI Clock	The Clock is driven by the SPI Master. The clock cycles once for each data bit.
Pin 9	Pin 1	—	No Connect.
Pin 10	Pin 2	MISO	Master-In/Slave-Out. Carries output data from the MDO back to the SPI Master.
Recommended Cable	***Recommended Cable***		
MD-CC300-000	MD-CC300-000 and MD-ADP-H Adapter		

Table 1.3.8 P2 — Pin Assignment, SPI Communications



Recommended Cable:
P/N MD-CC300-001

Recommended Cables:
P/N MD-CC302-001

Figure 1.3.3: P2 Connector - SPI Communications

Factory Mounted Encoder

Pin Assignment - Factory Mounted Encoder		
Encoder Pin	***Function — Differential Encoder***	***Function — Single-End Encoder***
Pin 1	No Connect	Ground
Pin 2	+5 VDC Input	Index
Pin 3	Ground	Channel A
Pin 4	No Connect	+5 VDC Input
Pin 5	Channel A –	Channel B
Pin 6	Channel A +	
Pin 7	Channel B –	
Pin 8	Channel B +	
Pin 9	Index –	
Pin 10	Index +	

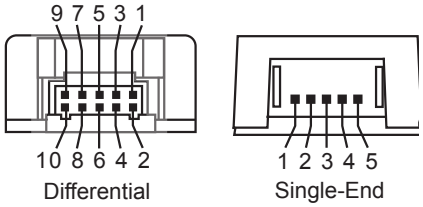


Table 1.3.4: P1 — Pin Assignment, Factory Mounted Encoder

Options and Accessories

QuickStart Kit

For rapid design verification, all-inclusive QuickStart Kits have communication converter, prototype development cable(s), instructions and CD for MDrivePlus initial functional setup and system testing.

Communication Converters

Electrically isolated, in-line converters pre-wired with mating connectors to conveniently set/program communication parameters for a single MDrivePlus via a PC's USB port. Length 12.0' (3.6m).

Mates to connector:

10-Pin IDC.....MD-CC300-001
10-Pin Wire Crimp MD-CC302-001

Mating Connector Kits

Use to build your own cables. Kit contains 5 mating shells with pins. Cable not supplied. Manufacturer's crimp tool recommended.

Mates to connector:

10-Pin Wire Crimp CK-02

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

10-Pin IDC.....CK-01

External Encoder

External optical encoders, single-end or differential, are offered factory-mounted with the MDrive17Plus. Refer to the Encoder Specifications section for available line counts. All encoders come with an index mark.

Optional encoder cables are available. Order separately.

Single-end Cable (12.0"/30.5cm) ES-CABLE-2
Differential Locking Cable (6.0'/1.8mm) ED-CABLE-6

Control Knob

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

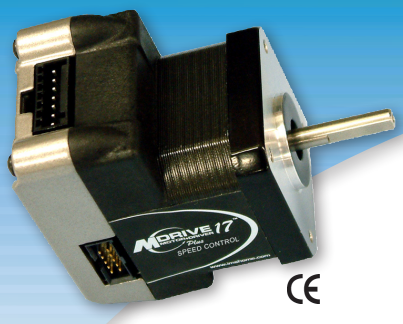
Planetary Gearbox

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

Linear Slide

Integrated linear slides are available factory installed for precision linear movement. Screw leads are 0.1", 0.2", 0.5" or 1.0" of travel per rev. Slides are 12.0" (30.5cm) to 36.0" (91.44cm) long. Contact factory for custom lengths. Refer to separate datasheet or web site for complete details.

INTELLIGENT MOTION SYSTEMS, INC.



MDRIVE™ MOTOR+DRIVER Plus

SPEED CONTROL

PART 2: CONNECTIONS AND INTERFACE

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Mounting Recommendations

MDrive17Plus Speed Control

Care must be observed when installing the mounting screws on ALL MDrive17Plus versions. The mounting holes on the flange are not drilled through and have a maximum depth of 0.150" (3.81 mm).

The warning note and Figure 2.1.1 illustrate the maximum safe thread length and maximum torque for mounting all versions of the MDrive17Plus.

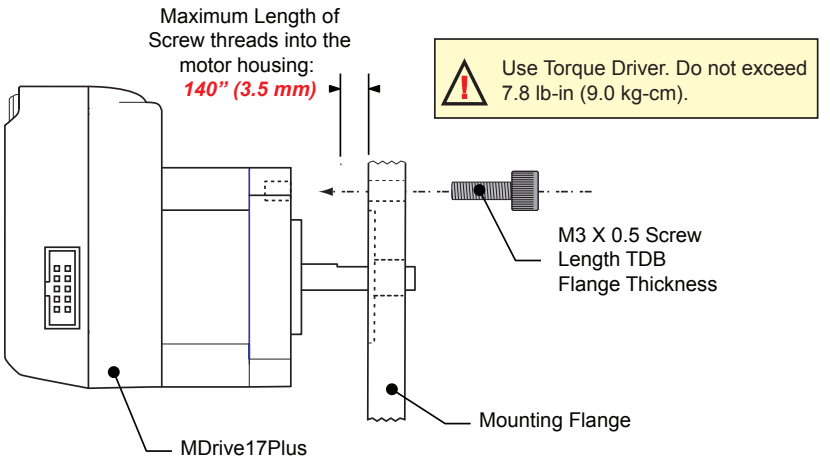


Figure 2.1.1: Mounting the MDrive17Plus Speed Control

MDrive23Plus Speed Control

There are no special mounting considerations for this device. Flange mounting holes are drilled through with a diameter of 0.197" (5.0mm) to take standard M5 screws. The length of the screw used will be determined by the mounting flange width. See Mechanical Specifications in Section 1.3 for mounting hole pattern.

Thermal Considerations

The maximum temperature for all MDrivePlus Speed Control models is 85°C. Ensure that the unit is mounted to adequate heat sink plating to ensure that the temperature does not exceed 85°C.

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 MDrivePlus 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.

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 ..... See Appendix B: Recommended Power and Cable Configurations

Securing Power Leads and Logic Leads

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

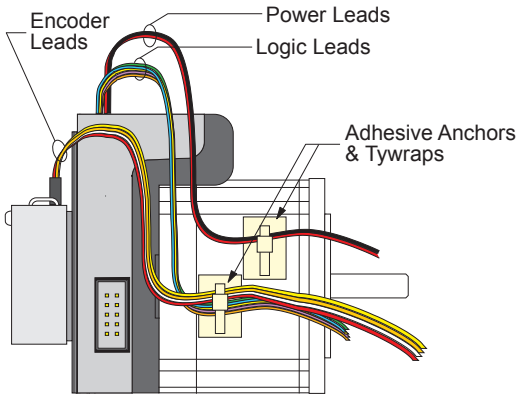


Figure 2.1.2: Securing the Power and Logic Leads

DC Power Recommendations

The MDrivePlus Speed Control 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.

MDrive17Plus Speed Control

The power requirements for the MDrive17Plus Speed Control are:

Output Voltage .....+12 to +48 VDC
Current (max. per unit).....2A
(Actual power supply current requirement will depend upon voltage and load.)

MDrive23Plus Speed Control

The power requirements for the MDrive23Plus Speed Control are:

Output Voltage .....+12 to +75 VDC
Current (max. per unit).....2A
(Actual power supply current requirement will depend upon voltage and load.)

Recommended DC Power Supply Connections

The MDrivePlus Speed Control 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 MDrivePlus end. For recommended IMS Power Supplies and cable specifications please refer to Appendix B: Recommended Power and Cable Configurations.

MDrivePlus Speed Control Logic Inputs

The MDrivePlus has two logic inputs which are located on connector P1. These inputs control the ON/OFF state of the internal clock generator and the axis direction. These inputs are:

1] Stop/Start

2] Direction

Input Pins and Connections

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

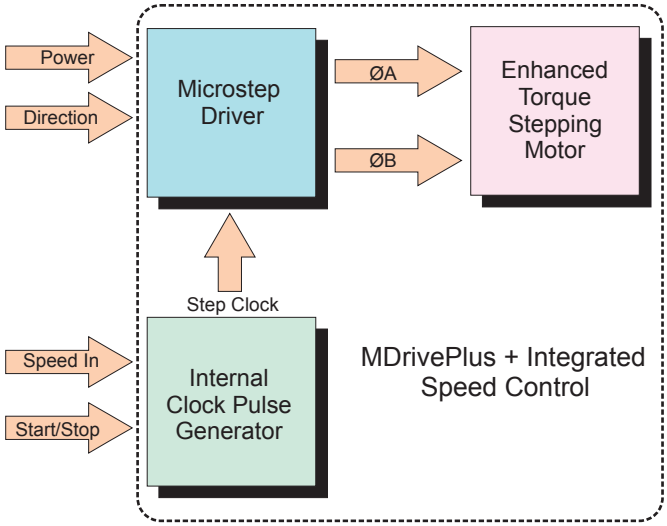


Figure 2.2.1: MDrivePlus Speed Control Block Diagram

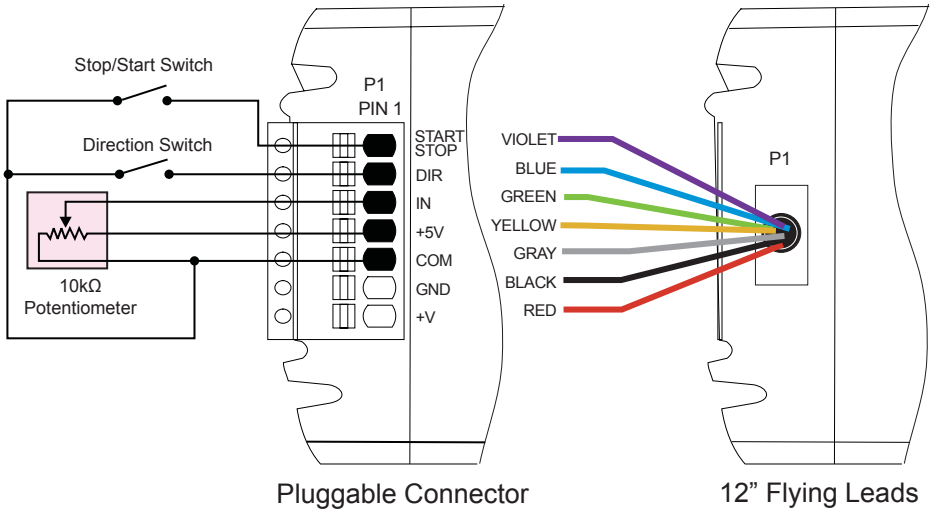


Figure 2.2.2: Potentiometer Interface to the MDrivePlus Speed Control

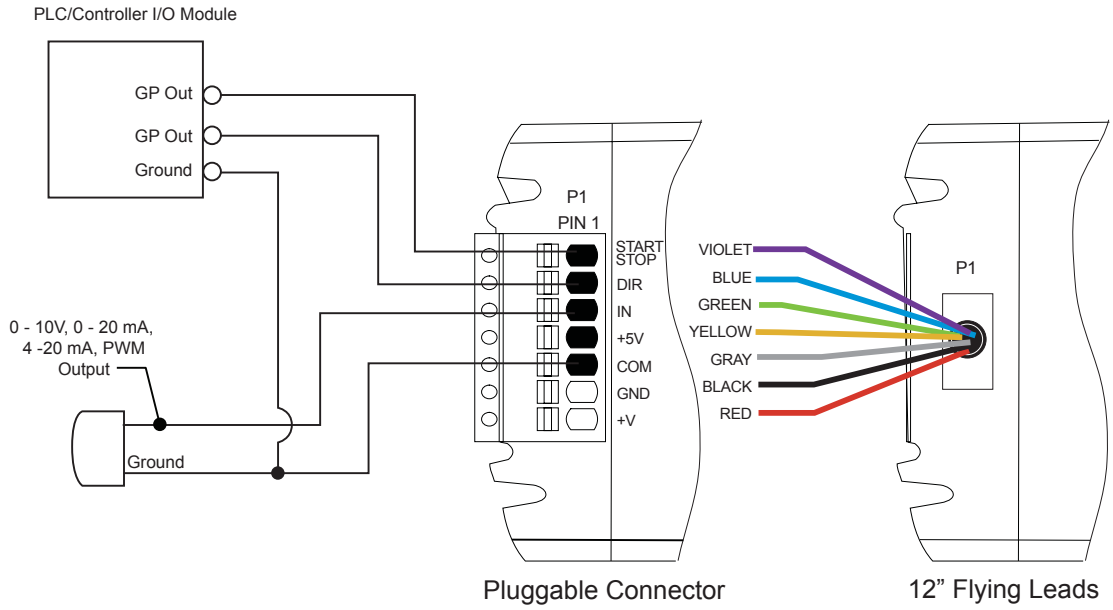


Figure 2.2.3: PLC and Sensor Interface to the MDrivePlus Speed Control

P1 Connector - Power and I/O

Pin Assignment - P1 Power and I/O Connections

Flying Lead Wire Color	*7-Pin Pluggable Terminal Strip*	*Function*	*Description*
Violet	+Pin 1	Stop/Start	The Stop/Start input will stop (high/ disconnected) or start (Active when Low) the internal pulse generator.
Blue	Pin 2	Direction	The direction input will toggle the axis direction relative to the state of the Direction parameter.
Green	Pin 3	Speed Control Input	0 to +5 VDC, 0 to +10 V, 0 to 20 mA, 4 to 20 mA or 15 to 25 kHz PWM speed control input.
Yellow	Pin 4	+5 VDC Output	Used with a 10kΩ Potentiometer to the Speed Control input.
Gray	Pin 5	Logic Ground	Used with a 10kΩ Potentiometer to the Speed Control input.
Black	Pin 6	GND	Power and Auxiliary Ground.
Red	Pin 7	+V	+12 to +48 VDC Motor Power Supply input.

Table 2.2.2: P1 — Pin Assignment, Power and I/O

Connecting the SPI Interface

The SPI (Serial Peripheral Interface) is the communications and configuration interface for the MDrivePlus Speed Control.

For prototyping we recommend the purchase of the parameter setup cable MD-CC300-000. If using the MDrivePlus Speed Control 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

If using the 10-Pin wire crimp style connector at P2, the adapter MD-ADP-H is also required.

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

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 SPI Clock is output by the SPI Master (Host PC or controller) and regulates the flow of the data bits. The SPI Master may transmit data at a variety of baud rates. The SPI 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 MDrivePlus Speed Control units back to the SPI Master. Only one MDrivePlus can transmit data during any particular transfer. The SPI Master will READ the parameter settings via this line.

CS (SPI Chip Select)

This signal is used to turn multiple MDrivePlus Speed Control units on or off.

MOSI (Master Out/Slave In)

Carries output data from the SPI Master to the MDrivePlus Speed Control. The SPI Master will WRITE new parameter settings via MOSI.

SPI Pins and Connections

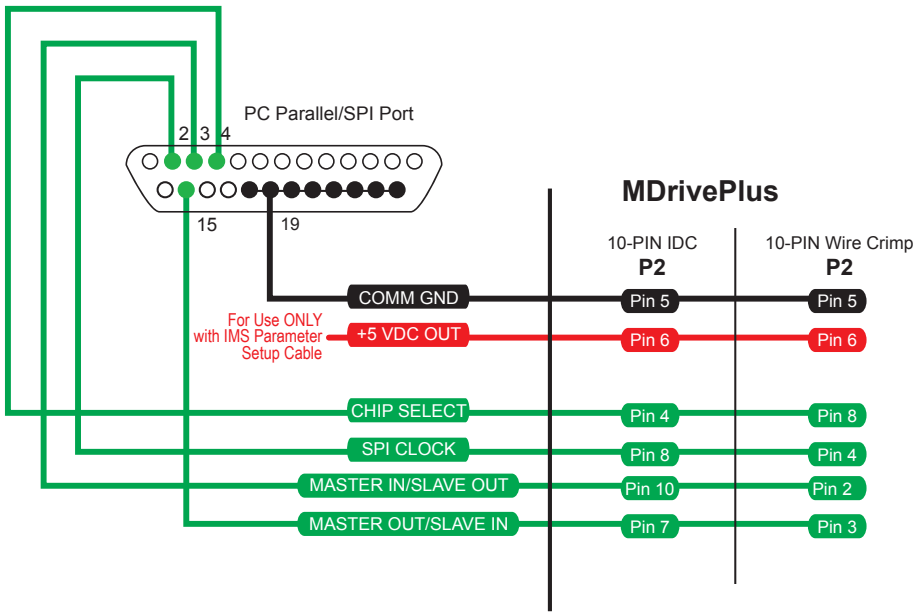


Figure 2.3.2: SPI Pins and Connections

SPI Master with Multiple MDrivePlus Speed Control

It is possible to link multiple MDrivePlus Speed Control units in an array using a single SPI Master by wiring the system and programming the user interface to write to multiple chip selects.

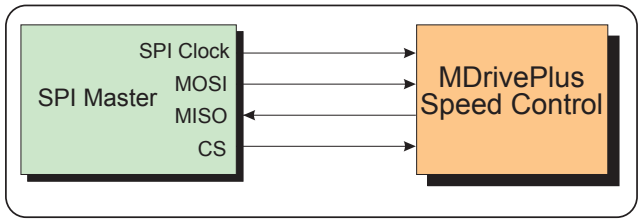


Figure 2.3.3: SPI Master with a Single MDrivePlus Speed Control

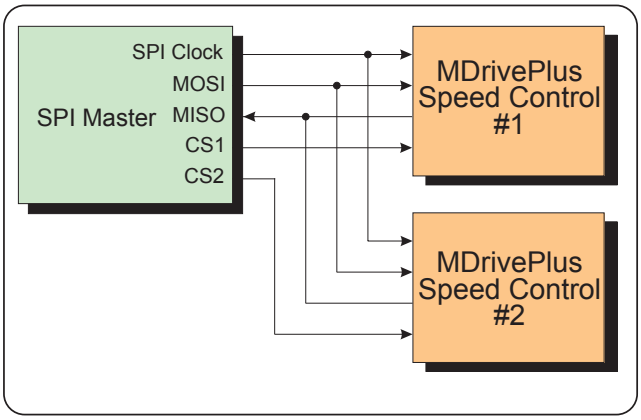


Figure 2.3.4: SPI Master with Multiple MDrivePlus Speed Control

Installation

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDrivePlus Speed Control. It is available on the IMS web site at http://www.imshome.com/software_interfaces.html.

1. Download the software from http://www.imshome.com/software_interfaces.html.
2. Double-click the setup.exe file.
3. Follow the on-screen prompts to install.
4. Once IMS SPI Motor Interface is installed, the parameter settings can be checked and/or set.

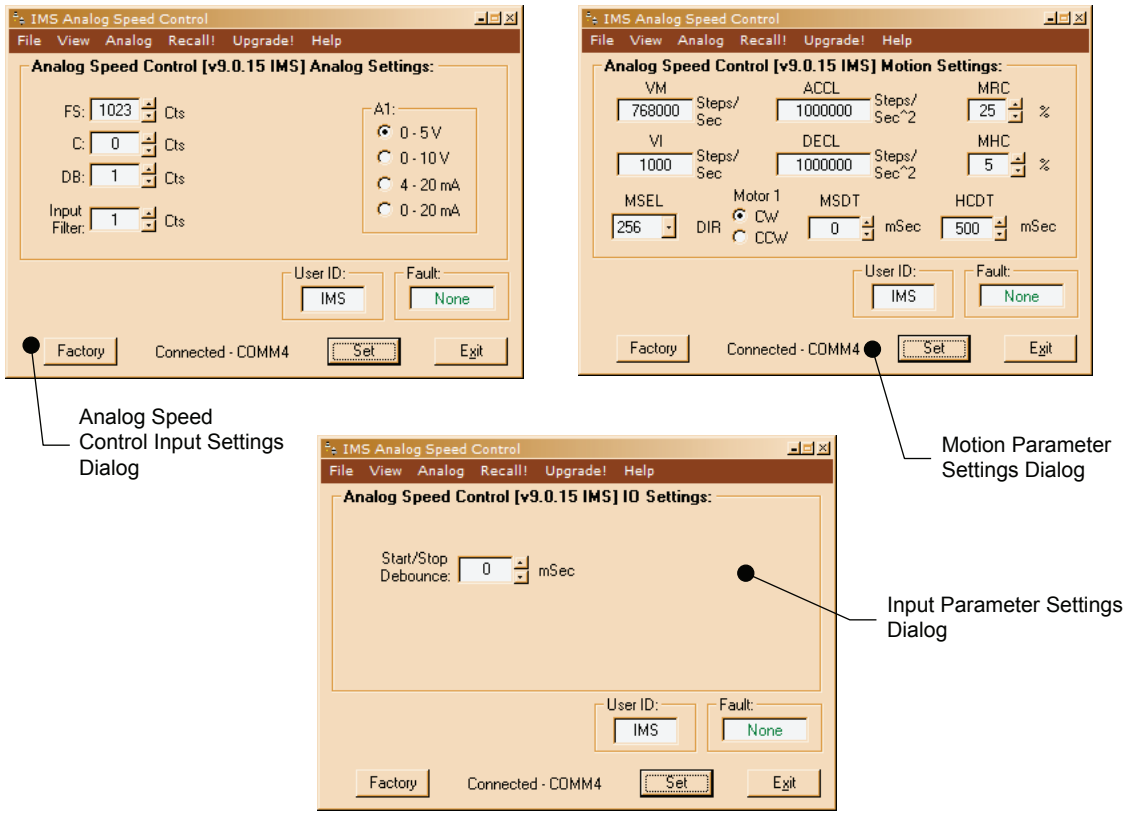


Figure 2.4.1: IMS Motor Interface Showing Default Speed Control Settings

Configuration Parameters and Ranges

MDrivePlus Speed Control Setup Parameters				
Name	**Function**	**Range**	**Units**	**Default**
A1	Input Mode	0 to +5 V, 0 to +10 V, 4 to 20 mA, 0 to 20 mA, 15 to 25kHz PWM	—	0 to +5 VDC
ACCL	Acceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
C	Joystick Center	0 to 1022	counts	0
DB	Deadband	0 to 255	counts	1
DECL	Deceleration	91 – 1.5 X 10^9	steps/sec^2	1000000
DIR	Motor Direction Override	0/1	–	CW
FAULT	Fault/Checksum Error	Error Code	—	None
FS	Full Scale	1 to 1023 (205 to 1023 – 4 to 20 mA)	counts	1023
HCDT	Hold Current Delay Time	0 (No Hold Current) or 2 to 65535 - MSDT	milliseconds	500
IF	Analog Input Filter	1 to 1000	counts	1
MHC	Motor Hold Current	0 – 100	percent	5
MRC	Motor Run Current	1 – 100	percent	25
MSDT	Motor Settling Delay Time	0 to 65535 - HCDT	milliseconds	0
MSEL	Microstep Resolution	1, 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 100,108, 125, 127,128, 180, 200, 250, 256	µsteps per full step	256
SSD	Stop/Start Debounce	0 – 255	milliseconds	0
VI	Initial Velocity	0 – < VM	steps/sec	1000
VM	Maximum Velocity	VI to 5,000,000	steps/sec	768000
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 out 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

File

- Open: Opens a saved *.osc (Speed Control Configuration) file.
- Save: Saves the current settings as a *.osc file for later re-use.
- Save As.
- Exit.

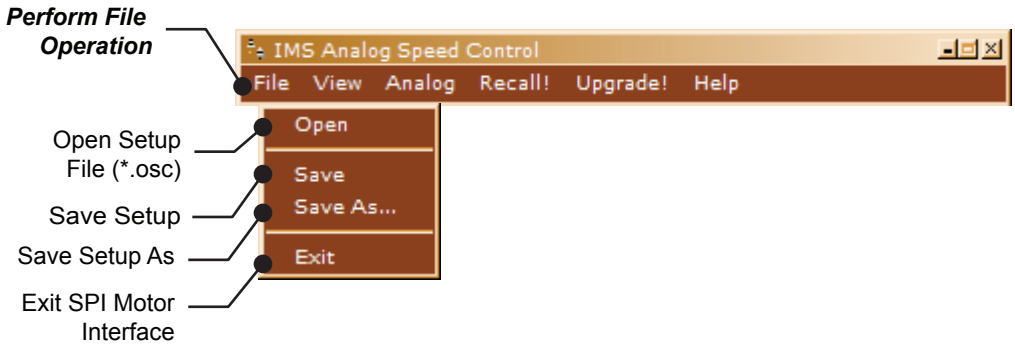


Figure 2.4.2: File Menu Operations

View

> Motion Settings: Displays the Motion Settings screen.

> IO Settings: Displays the IO Settings Screen.

> Part and Serial Number: Displays the MDM part and serial number.

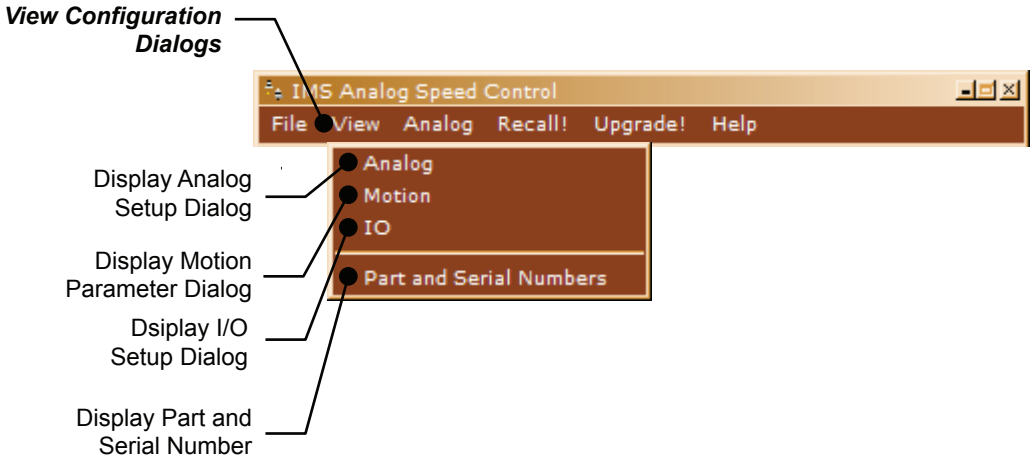


Figure 2.4.3: View Menu Operations

Analog

> Initialize: Allows the user to set the Analog input parameters by exercising the pointentiometer

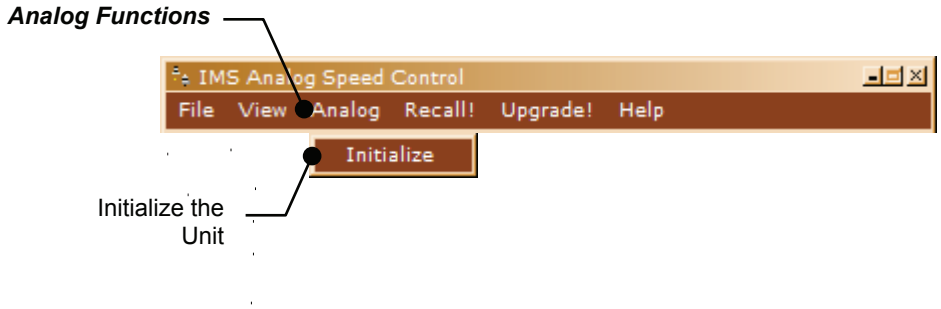


Figure 2.4.4: Analog Menu Operations

The user will click the Initialize Item then will have 30 seconds to set the Upper range, lower range and center posotion by adjusting the potentiometer.

Recall!

Retrieves the previously stored settings from the MDrivePlus Speed Control.

Upgrade!

Upgrades the MDrivePlus Speed Control firmware.

Help

> About.

Color Coded Parameter Values

The SPI Motor Interface features color coded text to assist the user in identifying the status of the parameters. Figure 2.4.6 illustrates the color coding functionality.

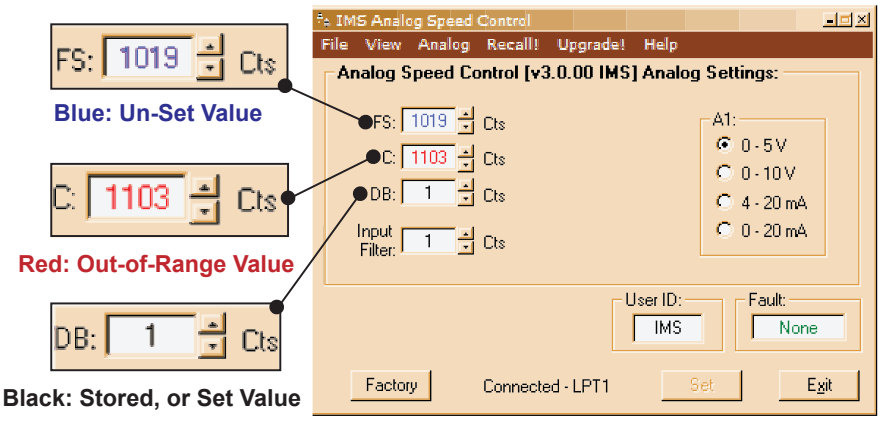


Figure 2.4.5: Color Coded Parameter Values

Adjustable Units for Analog Parameters

The SPI Motor interface allows the user to change units from counts to volts or milliamperes by clicking the unit beside the parameter field. the default Unit is counts, if using a voltage mode of operation the unit can be changed to volts. If using the current method of controlling velocity, the alternate unit is in milliamperes.

Only the Analog Input setup parameter units are changeable. The Input Filter is not. It is set to only display counts.

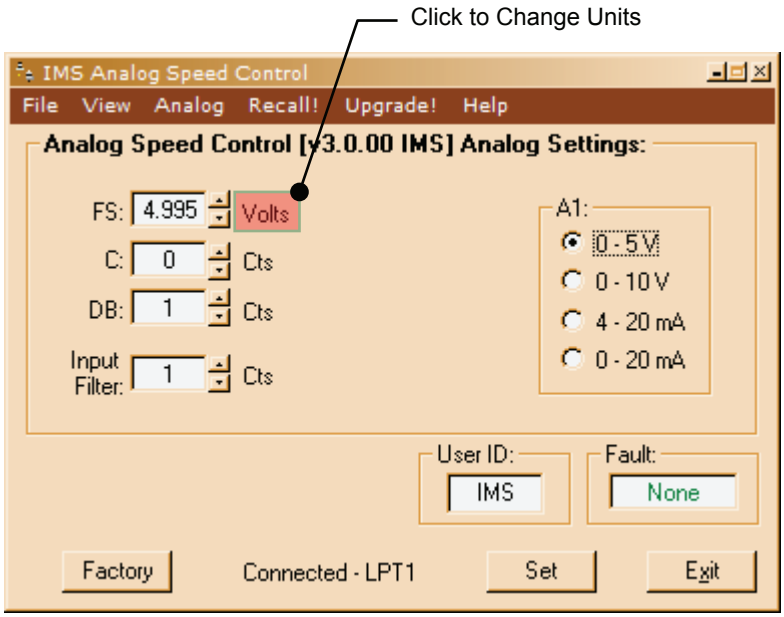


Figure 2.4.6: Adjustable Units for Analog Parameters

IMS SPI Motor Interface Button Functions

Factory

Clicking the Factory button will load the MDrivePlus Speed Control unit's factory default settings into the IMS SPI Motor Interface.

Connected/Disconnected Indicator

Displays the connected/disconnected state of the communications port, and if connected, the communications port connected.

Set

The Set button writes the new settings to the MDrivePlus. Parameter settings which have not been set will display as blue text in the setting fields. Once set they will be in black text.

Exit

Disconnects the communications and closes the program.

Analog Settings Configuration Screen

The IMS SPI Motor Interface Software opens by default to the Motion Settings Screen shown in Figure 2.4.8.

There are six basic parameters that may be set here:

1. **FS:** Analog Input Full Scale.
2. **C:** Joystick Center Position.
3. **DB:** Analog Input Deadband.
4. **IF:** Analog Input Filter.
5. **A1:** Sets the Analog Input Mode.
6. **User ID:** 3 ASCII Character User ID (The User ID Field is available on all of the dialogs).

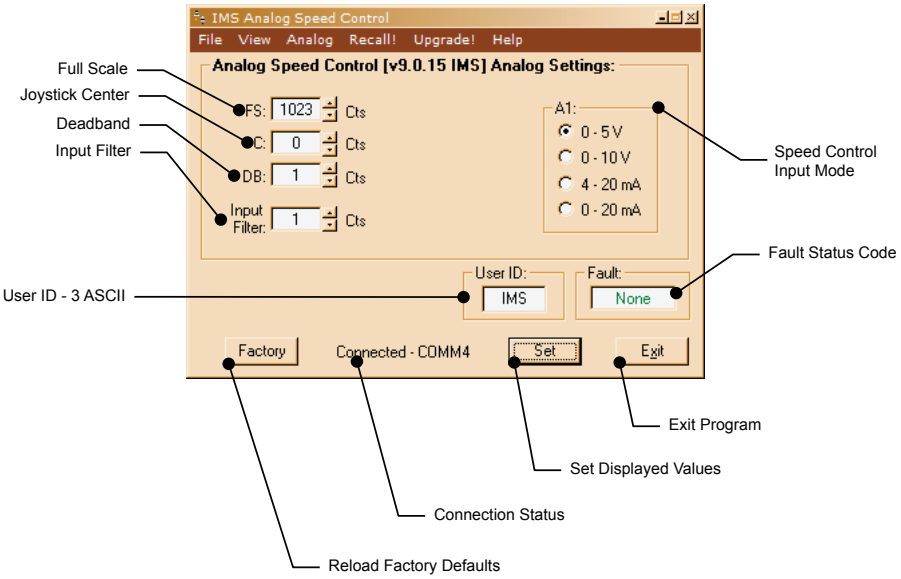


Figure 2.4.7: Analog Settings Screen

FS: Analog Full Scale

The Analog Full Scale Parameter sets the Full range of the speed control input. The range will be contingent on the input mode specified by the Input Mode Parameter A1 and the Units set by clicking the caption located at the right of the parameter input box.

Range for Full Scale			
Input Mode	Counts	Volts	Milliamperes
0 to +5 VDC	1 to 1023	0.005 to 4.999	—
0 to +10 VDC	1 to 1023	0.005 to 9.999	—
4 to 20 mA	205 to 1023	—	4.00 to 19.98
0 to 20 mA	1 to 1023	—	0.02 to 19.98

Table 2.4.2: Full Scale Parameter Range

C: Joystick Center Position

The Speed control device can operate in two directional modes Unidirectional or Bidirectional. To use Bidirectional mode set the Joystick Center to the desired value. To use Unidirectional mode leave the Joystick Center at its default (0) setting. Control Axis direction with the Direction hardware input.

The Joystick Center parameter sets the center position for directional control of the speed control input. The range will be contingent on the input mode specified by the Input Mode parameter A1 and the Units set by clicking the caption located at the right of the parameter input box. The axis direction will be one direction when below the center position and will change direction once the Center level is reached and the Deadband exceeded. The axis direction will be with respect to the logic state of the direction control input and the bit state of the Direction Override Parameter on the Motion Settings Screen.

Range for Joystick Center			
Input Mode	Counts	Volts	Milliamperes
0 to +5 VDC	0 to 1022	0.005 to 4.990	—
0 to 1+0 VDC	0 to 1022	0.010 to 9.980	—
4 to 20 mA	205 to 1022	—	4.00 to 19.96
0 to 20 mA	0 to 1022	—	0.02 to 19.96

Table 2.4.3: Joystick Parameter Range

DB: Joystick DeadBand

The Joystick Deadband Parameter sets the deadband around the Joystick Center Position of the speed control input. The range will be contingent on the input mode specified by the Input Mode Parameter A1 and the units set by clicking the caption located at the right of the parameter input box. The speed control input will ignore changes in voltage or current within that range.

Range for Deadband			
Input Mode	Counts	Volts	Milliamperes
0 to 5 VDC	0 to 255	0 to 1.245	—
0 to 10 VDC	0 to 255	0 to 2.490	—
4 to 20 mA	0 to 255	—	0 to 4.98
0 to 20 mA	0 to 255	—	0 to 4.98

Table 2.4.4: Deadband Parameter Range

IF: Analog Input Filter

The Filter parameter for the Analog Speed Control Input. The filter range is 0 to 1000 counts

A1: Analog Input Operating Mode

The A1 parameter selects the mode for the speed control input. There are four input modes which may be selected:

1. 0 to +5 VDC
2. 0 to +10 VDC
3. 4 to 20 mA
4. 0 to 20 mA

The speed control input will also accept a PWM input. There is no setting required to use PWM, the input will automatically configure itself to that mode of operation.

UID: User ID

Allows the user to enter a User ID or Device ID for the MDrivePlus Speed Control. The ID is 3 characters in length. The first character must be alphanumeric, the remaining two may be any viewable ASCII character. This field appears on all of the screens.

Motion Settings Configuration Screen

The Motion Settings screen is shown in Figure 2.4.9. There are ten basic parameters that may be set here:

1. VM: Maximum Velocity
2. VI: Initial Velocity
3. MSEL: Microstep Resolution Select
4. DIR: Direction Override
5. ACCL: Acceleration
6. DECL: Deceleration
7. MSDT: Motor Settling Delay Time
8. HCDT: Holding Current Delay Time
9. MRC: Motor Run Current
10. MHC: Motor Hold Current

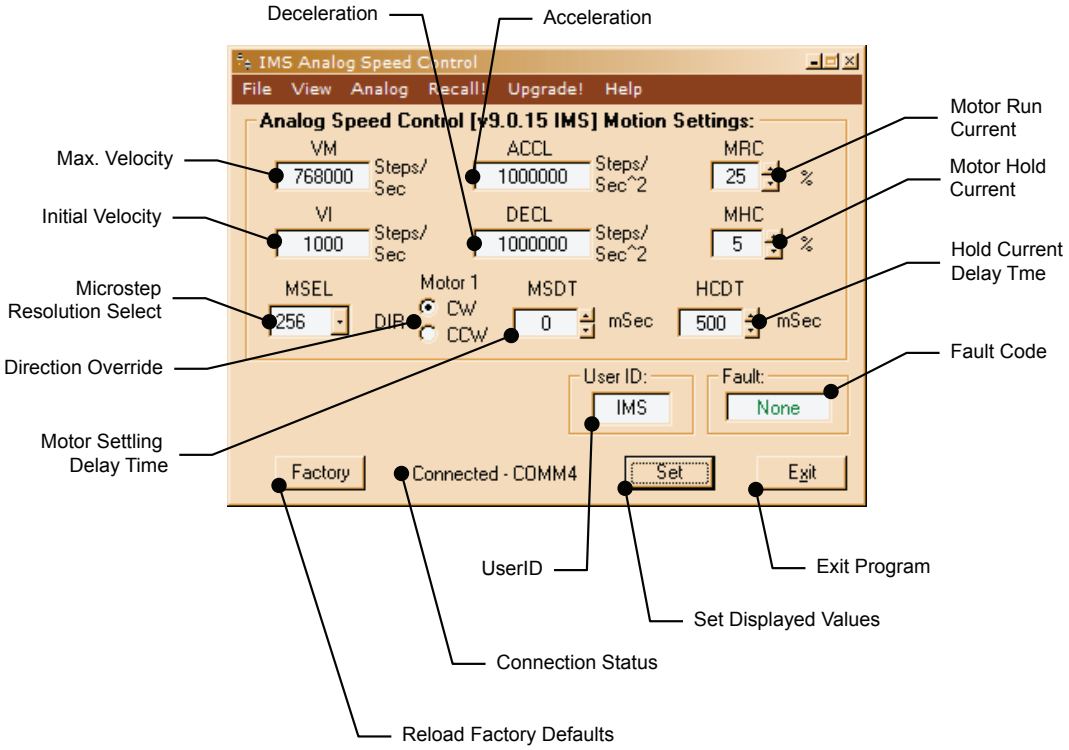


Figure 2.4.8: Motion Settings Screen

VM: Maximum Velocity

The Maximum Velocity parameter represents the velocity in steps per second of the Axis when the speed control input is at its upper end of the Full Scale value, or the upper and lower ends if the Joystick Center is used.

VI: Initial Velocity

The Initial Velocity parameter represents the velocity of the Axis when the speed control input is at the lower end of the Full Scale value, or the Joystick Center position plus or minus the dead band setting if Bidirectional control is used.

MSEL: Microstep Resolution Selection

The MDrivePlus Speed Control features 20 microstep resolutions. This setting specifies the number of microsteps per step the motor will move.

The MDrivePlus 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 2.4.5: Microstep Resolution Settings

ACCL: Acceleration

The ACCL Parameter set the acceleration of the axis in Steps per Second^2. This setting is independent of the Analog Speed Control Input, regardless of how fast the voltage, current or PWM frequency ramps on the input, the axis will accelerate at this setting.

DECL: Deceleration

The DECL Parameter set the Deceleration of the axis in Steps per Second^2. This setting is independent of the Analog Speed Control Input, regardless of how fast the voltage, current or PWM frequency drops on the input, the axis will decelerate at this setting.

The deceleration setting will be active in three conditions: Stop Hardware Input, Change of Direction, whether initiated by the hardware input or by a Joystick Center, and when the input is at the lower Full Scale limit in unidirectional mode.

MSDT: Motor Settling Delay Time

The MSDT parameter specifies the time allocated in milliseconds for the motor to settle into position following a move. Note that MSDT is additive with HCDT. The sum of the two cannot exceed 65535 milliseconds. See Figure 2.4.10 for the MSDT/HCDT Relationship.

HCDT: 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 MDrivePlus will change to Hold Current when the specified time elapses. Note that HCDT is additive with MSDT. The sum of the two cannot exceed 65535 milliseconds. See Figure 2.4.10 for the HCDT/MSDT Relationship.

Note that if HCDT=0 the unit will never go into current reduction, but will stay at the run current percent.

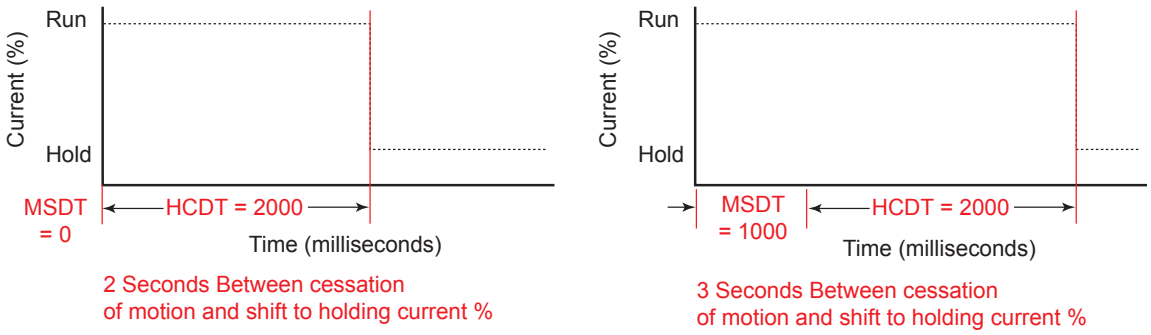


Figure 2.4.9: MSDT and HCDT Relationship

MRC: Motor Run Current

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

MHC: 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 the clock pulse following the time in milliseconds specified by MSDT+HCDT.

DIR: Motor Direction

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

IO Settings Configuration Screen

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

1. SSD: Start/Stop Switch Debounce

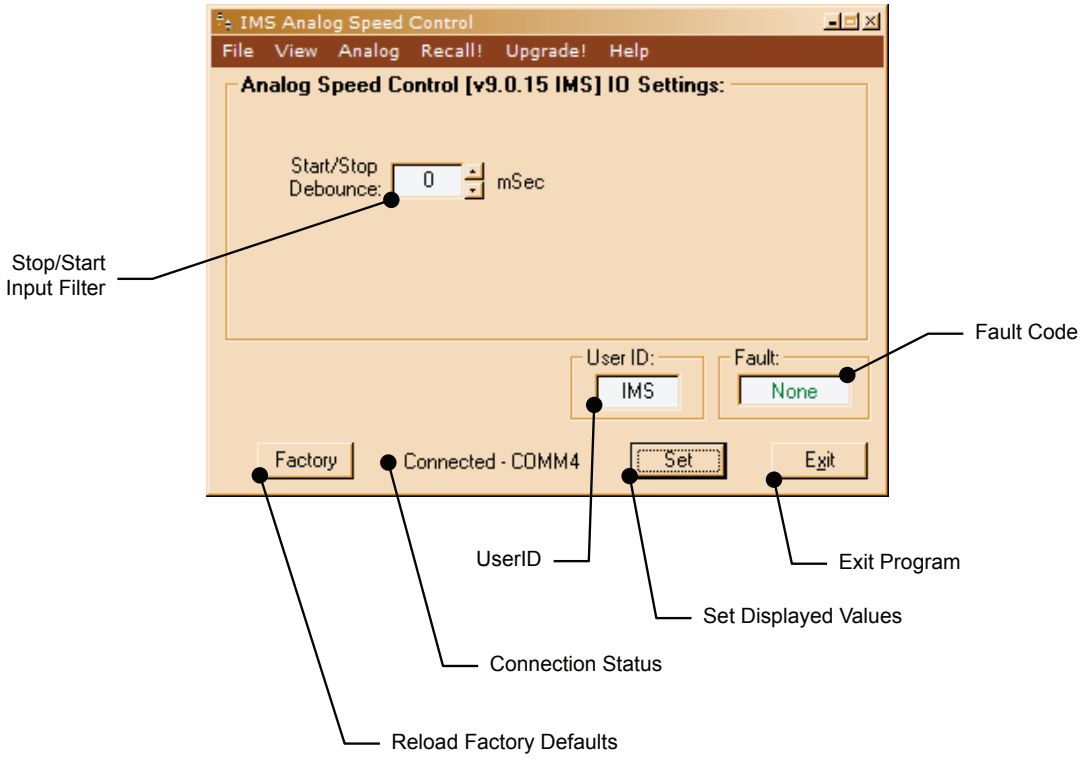


Figure 2.4.10: I/O Settings Screen

SSD: Start/Stop Switch Debounce (Filtering)

The SSD parameter sets the input filtering for the Start/Stop switch. The range is 0 to 255 milliseconds.

Part Number/Serial Number Screen

The Part number serial number screen is a read-only screen that shows both the IMS Part Number and the unit Serial Number. This is useful if the unit is installed in a remote location and cannot be readily accessed. These numbers may be required if requesting technical or applications support.

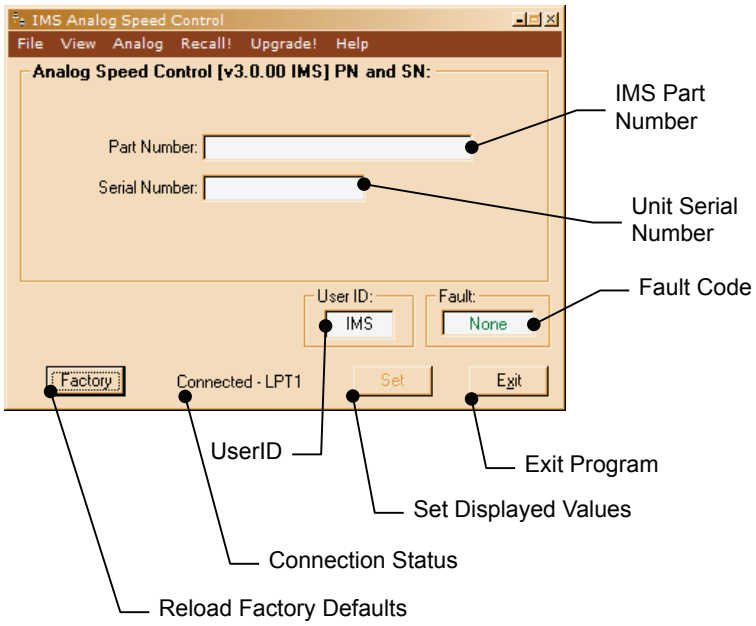


Figure 2.4.11: Part and Serial Number Screen

Fault Codes

All of the SPI Motor Interface screens has the Fault Field visible. This read only field will display an error code to indicate the type of fault. The normal, operational code is "None" in green text, the fault code will display in Red.

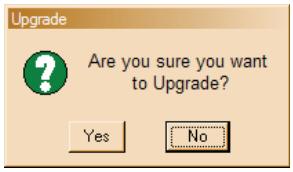
Fault Codes				
Binary Case*	Error Code	Description	Action	To Clear
—	None	No Fault	—	—
4	CS	SPI Checksum Error	Error Displayed	Write To MDO (Set Button)
8	SC/CS	SPI Checksum Error/Sector Changing	Error Displayed	Write To MDO (Set Button)
16	DFLT	Defaults Checksum Error	Error Displayed	Write To MDO (Set Button)
32	DATA	Settings Checksum Error	Error Displayed	Write To MDO (Set Button)

*All Fault Codes are OR'ed together.

Table 2.4.6: SPI Motor Interface Fault Codes

Upgrading the Firmware in the MDrivePlus Speed Control

NOTE: Once entered into Upgrade Mode, you MUST complete the upgrade. If the upgrade process is incomplete the IMS SPI Motor Interface will continue to open to the Upgrade dialog until the process is completed!



The IMS SPI Motor Interface is required to upgrade firmware. To launch the Upgrader, click "Upgrade!" on the IMS SPI Motor Interface menu. New firmware releases are posted to the IMS web site at http://www.imshome.com.

The IMS SPI Upgrader Screen

The Upgrader screen has 4 read-only text fields that will display the necessary info about your MDrivePlus Speed Control.

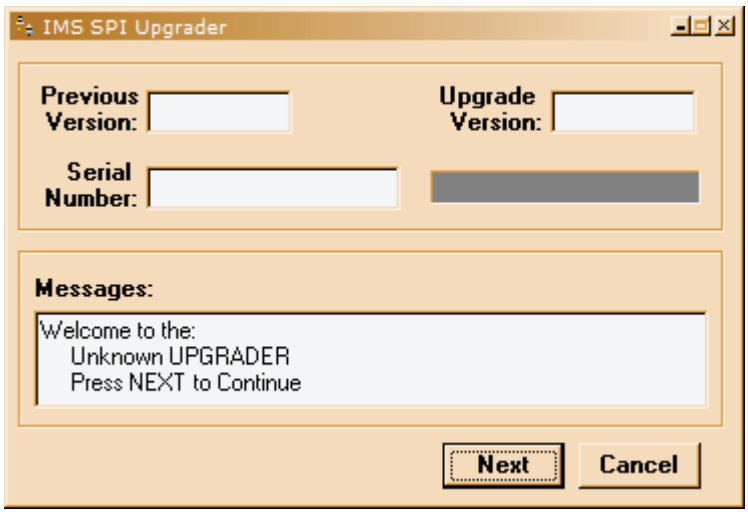


Figure 2.4.12: SPI Motor Interface Upgrade Utility

1. Previous Version: this is the version of the firmware currently on your MDrivePlus Speed Control.
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.

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
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.
```

Initialization Screen

This screen will be active under five conditions:

1. When the program initially starts up and seek a compatible device.
2. The user selects File > Exit when connected to the device.
3. The user clicks the Exit button while connected to the device.
4. The upgrade process completes.
5. The SPI Motor Interface is unable to connect to a compatible device.

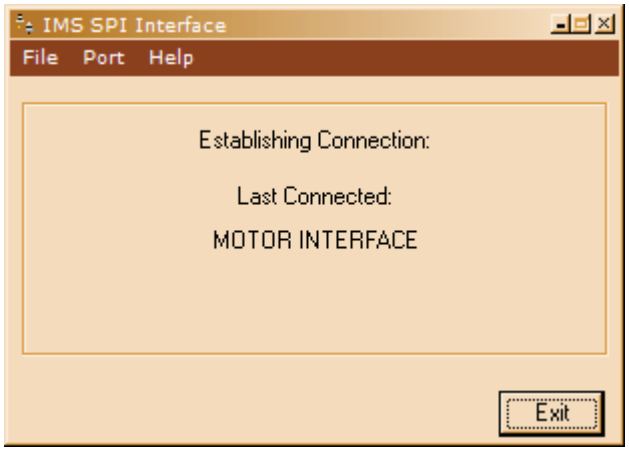


Figure 2.4.13: SPI Motor Interface Initialization

Port Menu

The Port Menu allows the user to select the COM Port that the device is connected to, either a parallel (LPT) Port, a Hardware Serial Port or Virtual Serial Port via USB.

The Reconnect option allows the user to reconnect to a unit using the previously used settings.

On open or reconnect, the SPI Motor Interface will also try to auto seek for a connected device.

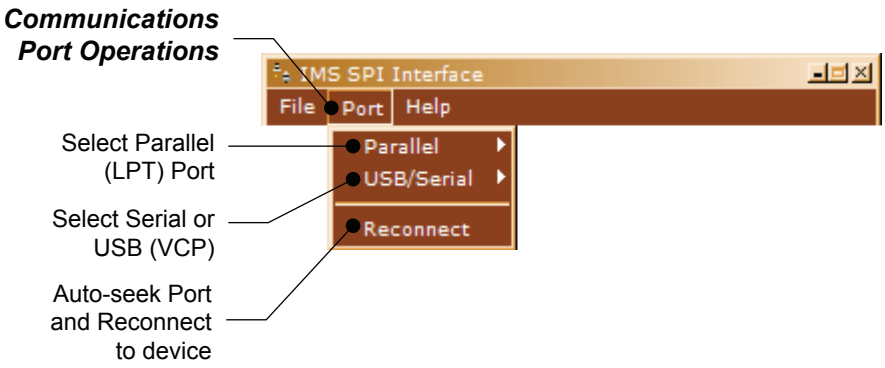


Figure 2.4.14: SPI Motor Interface Port Menu

Note: This section does not apply if you are using the IMS SPI Motor Interface to set the parameters of the MDrivePlus Speed Control

Using User-Defined SPI

The MDrivePlus Speed Control 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.

An example of when this might be used is in cases where the machine design requires parameter settings to be changed on-the-fly by a software program or multiple MDrivePlus Speed Control system.

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.

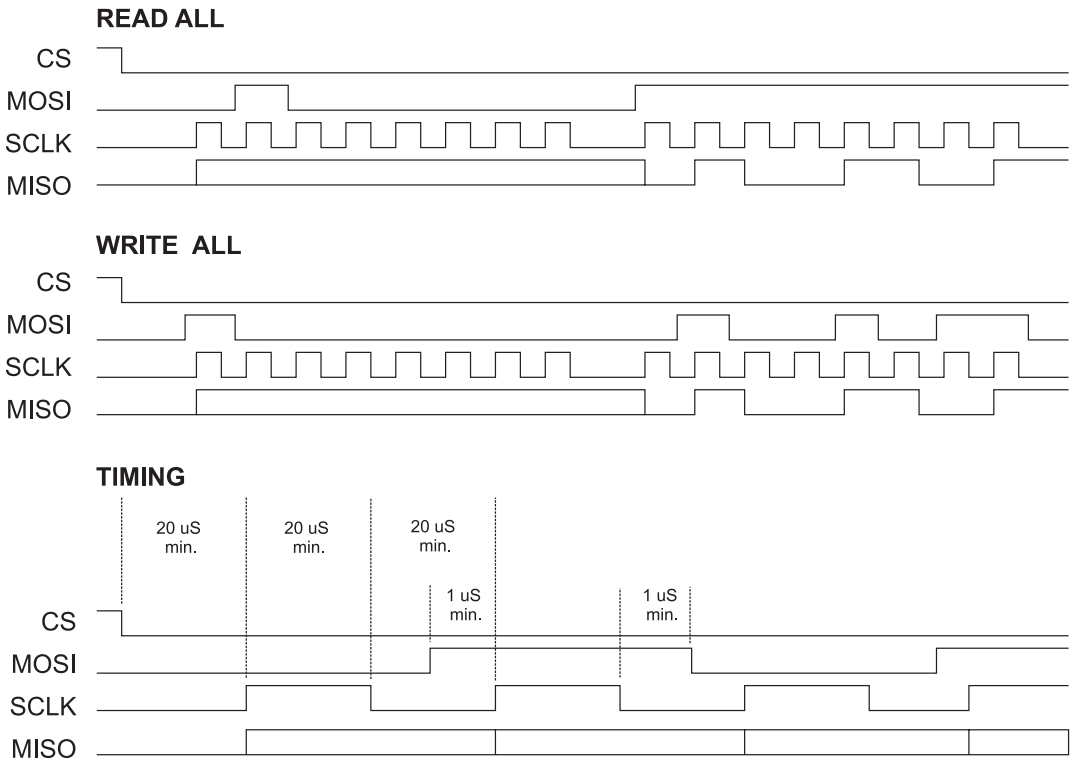


Figure 2.5.1: SPI Timing

	MOSI	MISO	Default (Decimal)	Parameter
LSB	FF	FF	Not Used	Not Used
	FF	FF	Not Used	Not Used
	FF	00	0	Fault
	FF	01	1	Analog Input Filter
	FF	00		
	FF	50	80	Warning Temperature
	FF	00	0	Stop Start Debounce
	FF	0A	10	Output Clock Width
	FF	00	0	Output Clock Type
	FF	00	0	Motor Settling Delay time
	FF	00		
	FF	00	0 (256 usteps/step)	Microstep Resolution
	FF	01	500 (milliseconds)	Hold Current Delay Time
	FF	F4		
	FF	05	5 (%)	Motor Hold Current
	FF	19	25 (%)	Motor Run Current
	FF	0B	768000	Maximum Velocity
	FF	B8		
	FF	00		
	FF	00	1000	Initial Velocity
	FF	03		
	FF	E8		
	FF	00	1000000	Deceleration
	FF	0F		
	FF	42		
	FF	40		
	FF	00	1000000	Acceleration
	FF	0F		
	FF	42		
	FF	40		
	FF	01	1 (0 to +5 VDC)	Input Mode
	FF	01	1 (Count)	Dead Band
	FF	00	0 (Counts)	Joystick Center
	FF	00		
	FF	03	1023	Analog Full Scale
	FF	FF		
	FF	02	3.0.02	Version
	FF	30		
	FF	53	IMS	User ID
	FF	4D		
		49		
MSB	FF	75	u	Device Type
Read AIII	40	XX		

MSB First LSB

75 49 4D 53 30 02 FF 03 00 00 00 01 40 42 0F 00 40 42 0F 00 F8 03 00 00 B8 0B 19 05 F4 01 00 00 00 01 0A 00 50 00 01 00 FF FF

Table 2.5.1: SPI Read All Byte Order and Defaults

SPI Read All Byte Order

The table on the left shows the byte order for setting the parameters using user defined SPI software interface.

1. Send READ ALL Command 0x40 down MOSI to MDrivePlus Speed Control followed by FF (38 Bytes).
2. Receive Parameter settings from MISO MSB First (Device Type) and ending with LSB (Fault).

Note: Red Highlighted parameters are not applicable to the product you are using, however default settings will be read in the string for these parameters.

	MOSI	MISO	Default (Decimal)	Parameter
LSB	FF	FF	Not Used	Not Used
	FF	FF	Not Used	Not Used
	56	FF	86	Checksum
	01	FF	1	Analog Input Filter
	00	FF		
	50	FF	80	Warning Temperature
	00	FF	0	Stop Start Debounce
	0A	FF	10	Output Clock Width
	00	FF	0	Output Clock Type
	00	FF	0	Motor Settling Delay time
	00	FF		
	00	FF	0 (256 usteps/step)	Microstep Resolution
	01	FF	500 (milliseconds)	Hold Current Delay Time
	F4	FF		
	05	FF	5 (%)	Motor Hold Current
	19	FF	25 (%)	Motor Run Current
	0B	FF	768000	Maximum Velocity
	B8	FF		
	00	FF		
	00	FF	1000	Initial Velocity
	03	FF		
	E8	FF		
	00	FF	1000000	Deceleration
	0F	FF		
	42	FF		
	40	FF		
	00	FF	1000000	Acceleration
	0F	FF		
	42	FF		
	40	FF		
	01	FF	1 (0 to +5 VDC)	Input Mode
	00	FF	1 (Count)	Dead Band
	00	FF	0 (Counts)	Joystick Center
	00	FF		
	03	FF	1023	Analog Full Scale
	FF	FF		
	53	FF	IMS	User ID
	4D	FF		
MSB	49	75		
Write All	80	XX	On a write all command the device will initially respond with the	

SPI WRITE All Byte Order

The table on the left shows the byte order for setting the parameters using user defined SPI software interface.

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

2. Response from MISO will be FF (39) Bytes.

Calculating the Checksum

Step 1: Add all bytes in the parameter string from the write command byte to the Analog Input Filter Byte

80+49+4D+53+FF+03+00+00+00+01+40+42+0F+00+40+42+0F+00+E8+03+00+00+B8+0B+19+05+F4+01+00+00+00+00+0A+00+50+01+00+56

= 0x6AA

Step 2: Convert to Binary

110 1010 1010

Step 3: One's Complement

001 0101 0101

Step 4: Two's Complement

001 0101 0110

Step 5: Convert To HEX

= 0x156

Step 6: AND 0xFF to 0x156 to Remove Upper Byte:

Checksum = 0x56

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.

Note: Red Highlighted parameters are not applicable to the product you are using, however a hex value from 0x00 to 0xFF MUST be written to these parameters and included in the checksum calculation. Data contained in these bytes will not be acted on.

MSB First LSB

80 49 4D 53 FF 03 00 00 00 01 40 42 0F 00 40 42 0F 00 E8 03 00 00 B8 0B 19 05 F4 01 00 00 00 00 0A 00 50 01 00 56

Table 2.5.2: SPI Write All Byte Order and Defaults

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 MDrivePlus Speed Control, as well as the checksum at the end of a WRITE is critical.

SPI Commands and Parameters						
Command/ Parameter	Hex Default	Decimal Default	Hex Range	Decimal Range	# of Bytes	Notes
USRID1	0x49	73 (ASCI: I)	0x20-0x7F, 0x80-0xFF	32-126, 128-255	1	Three Character User ID, may be any viewable ASCII character.
USRID2	0x4D	77(ASCII: M)	0x20-0x7F, 0x80-0xFF	32-126, 128-255	1	
USRID3	0x53	83(ASCII: S)	0x20-0x7F, 0x80-0xFF	32-126, 128-255	1	
FULL SCALE	0x03FF	1023	0x0001-0x003F	1-1023	2	Analog Input Full Scale
CENTER	0x0000	0	0x0000-0x03FE	0-1022	2	Analog Input Center
DEADBAND	0x01	1	0-255	0x00-0xFF	1	Center Point Deadband
INPUT MODE	0x00	0	0x01+0x02+ 0x04+0x08+0x40+0x80	1+2+4+8+64+128	1	Input Mode* See Table 2.5.4
ACCEL	0x000F4240	100000	0x0000005B-0x59682F00	90.9-1500000000	4	Acceleration
DECL	0x000F4240	100000	0x0000005B-0x59682F00	90.9-1500000000	4	Deceleration
VI	0x0003E8	1000	0x000000-0x4C4B40	0-5000000	3	Initial Velocity
VM	0x0BB800	768000	0x000001-0x4C4B40	1-5000000	3	Maximum Velocity
MRC	0x19	25	0x01-0x64	1-100	1	Motor Running Current
MHC	0x05	5	0x00-0x64	0-100	1	Motor Holding Current
HCDT	0x01F4	500	0x0000-0x7FFD	0-32765	2	Holding Current Delay Time
MSEL	0x00	0 (256 usteps/step)	0x00, 0x01 - 0xFF	1-256	1	Microstep Resolution
MSDT	0x0000	0	0x0000-0x7FFD	0-32765	2	Motor Settling Delay Time
OUT_CLKTYP	0x00	0	0x00-0x03	0 (off), 1-3	1	Output Clock Type
OUT_CLKWIDTH	0x0A	10	0x00-0xFF	0-255	1	Output Clock Width
SSD	0x00	0	0x00-0xFF	0-255	1	Stop Start Switch Debounce
WARN_TEMP	0x50	80	0x00-0x7D	0-125	1	Warning Temperature
ADC_AVG	0x0001	1	0x0001-0x03E8	1-1000	2	Analog Input Filter

Table 2.5.3: SPI Commands and Parameters

Setting the Input Mode Byte

Bit Position	0x80	0x40	0x20	0x10	0x08	0x04	0x02	0x01
0	DIR2 CW*	DIR1 CW	Reserved	Reserved	0 to 20mA	Voltage Mode	0 to +5VDC	A1 and A2*
1	DIR2 CCW*	DIR1 CCW	Reserved	Reserved	4 to 20mA	Current Mode	0 to +10 VDC	PWM
Default	0	0	0	0	0	0	0	0
Example	0	1	0	0	1	1	0	0

* DIR2 and A2 do not apply to this device, they are reserved for future use.

Table 2.5.4: Setting the Input Mode

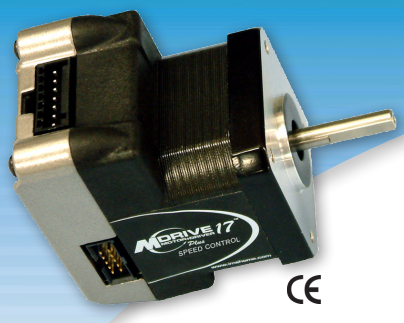
Example

In this example the Analog Input will be set to Current Mode using a 4 to 20mA Input type with the Direction override set to CCW.

01001100 = 0x4C

The INPUT MODE Byte would be 4C.

INTELLIGENT MOTION SYSTEMS, INC.



MDRIVE™
MOTOR+DRIVER
Plus
SPEED CONTROL

APPENDICES

Appendix A: Motor Performance

Appendix B: Recommended Power Supplies and Cabling

Appendix C: Planetary Gearbox Overview and Specification

Appendix D: Connectivity

Appendix E: Interfacing an Encoder

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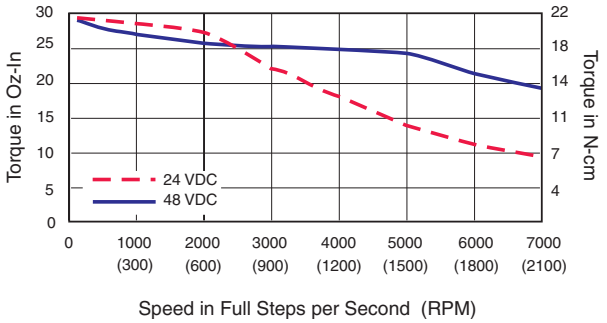
MDrive17Plus Motor Specifications

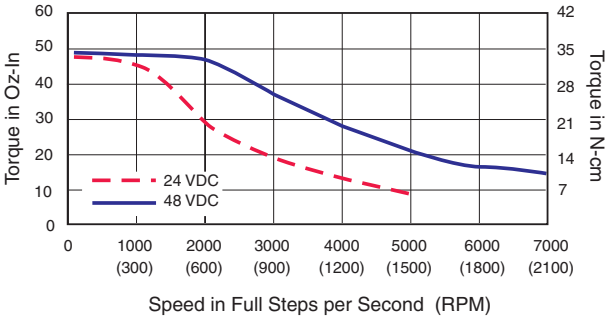
Motor Specs and Speed/Torque Curves — Single Length

Single Length Rotary Motor	
Holding Torque oz-in (N-cm)	32 (22.6)
Detent Torque oz-in (N-cm)	1.66 (1.17)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.00053 (0.038)
Weight (Motor+Driver) oz (g)	10.4 (294.8)



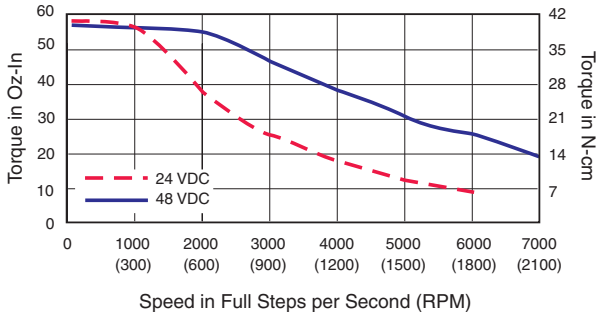
Motor Specs and Speed/Torque Curves — Double Length

Double Length Rotary Motor	
Holding Torque oz-in (N-cm)	60 (42.4)
Detent Torque oz-in (N-cm)	2.08 (1.47)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.00080 (0.057)
Weight (Motor+Driver) oz (g)	12.0 (340.2)



Motor Specs and Speed/Torque Curves — Triple Length

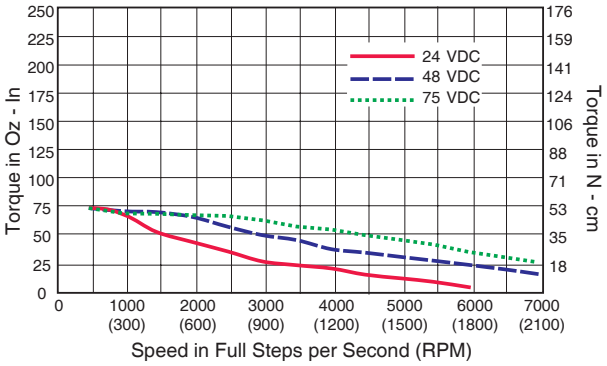
Triple Length Rotary Motor	
Holding Torque oz-in (N-cm)	74.9 (52.9)
Detent Torque oz-in (N-cm)	3.47 (2.45)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.00116 (0.082)
Weight (Motor+Driver) oz (g)	15.2 (430.9)



MDrive23Plus Motor Specifications

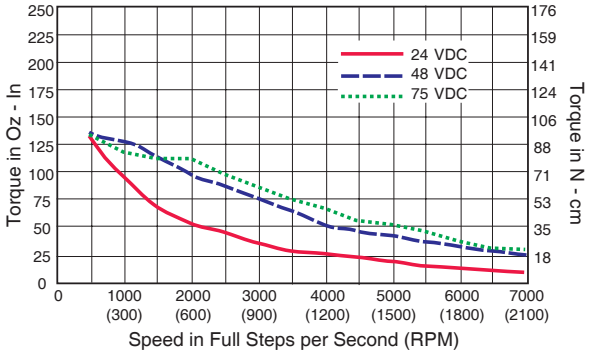
Motor Specs and Speed/Torque Curves — Single Length

Single Length Rotary Motor	
Holding Torque oz-in (N-cm)	90 (64)
Detent Torque oz-in (N-cm)	3.9 (2.7)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.0025 (0.18)
Weight (Motor+Driver) oz (g)	21.6 (612.3)



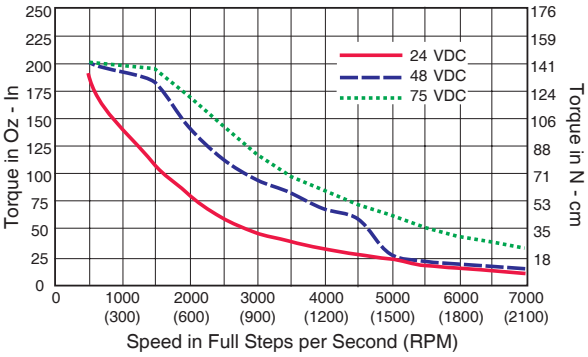
Motor Specs and Speed/Torque Curves — Double Length

Double Length Rotary Motor	
Holding Torque oz-in (N-cm)	144 (102)
Detent Torque oz-in (N-cm)	5.6 (3.92)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.0037 (0.26)
Weight (Motor+Driver) oz (g)	26.4 (748.4)



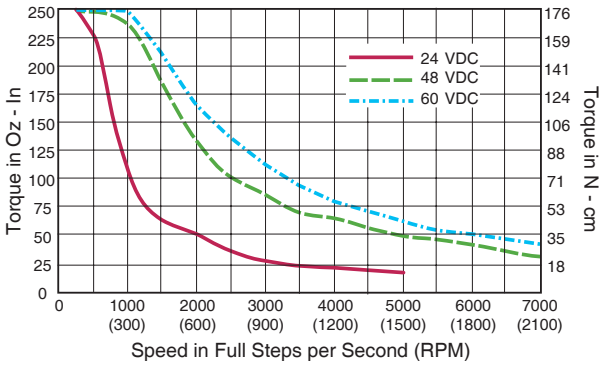
Motor Specs and Speed/Torque Curves — Triple Length

Triple Length Rotary Motor	
Holding Torque oz-in (N-cm)	239 (169)
Detent Torque oz-in (N-cm)	9.7 (6.86)
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.0065 (0.46)
Weight (Motor+Driver) oz (g)	39.2 (1111.3)



Motor Specs and Speed/Torque Curves — Quad Length

Quad Length Rotary Motor	
Holding Torque oz-in (N-cm)	283 (200
Detent Torque oz-in (N-cm)	14.2 (10.0
Rotor Inertia oz-in-sec^2 (kg-cm^2)	0.0108 (0.76)
Weight (Motor+Driver) oz (g)	61.6 (1746.3)



APPENDIX B

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 operating temperature range is -40 to +85°C.

MDrivePlus Power Supply Requirements		
Specifications	MDrive17Plus	MDrive23Plus
Recommended Supply Type	Unregulated DC	
Ripple Voltage	±10 %	
Output Voltage	+12 to +45 VDC	+12 to +75 VDC +12 to +60 Quad Length
Output Current	3A Peak	4A Peak

Table B.1: MDrivePlus Microstepping Power Supply Requirements

Recommended IMS Power Supply for MDrive17Plus		
IMS Unregulated DC Supply	IP402 (120 VAC)	IP402-240 (240 VAC)
Input Range	102 -132 VAC	204-264 VAC
No Load Output Voltage*	39 VDC @ 0 Amp	
Continuous Output Rating*	30 VDC @ 1 Amp	
Peak Output Rating*	25 VDC @ 2 Amp	

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

Recommended IMS Power Supplies for MDrive23Plus				
IMS Unregulated DC Supply	IP404 (120 VAC)	IP404-240 (240 VAC)	IP804 (120 VAC)	IP804-240 (240 VAC)
Input Range	102 -132 VAC	204-264 VAC	102 -132 VAC	204-264 VAC
No Load Output Voltage*	43 VDC @ 0 Amp		76 VDC @ 0 Amp	
Continuous Output Rating*	32 VDC @ 2 Amp		65 VDC @ 2 Amp	
Peak Output Rating*	26 VDC @ 4 Amp		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

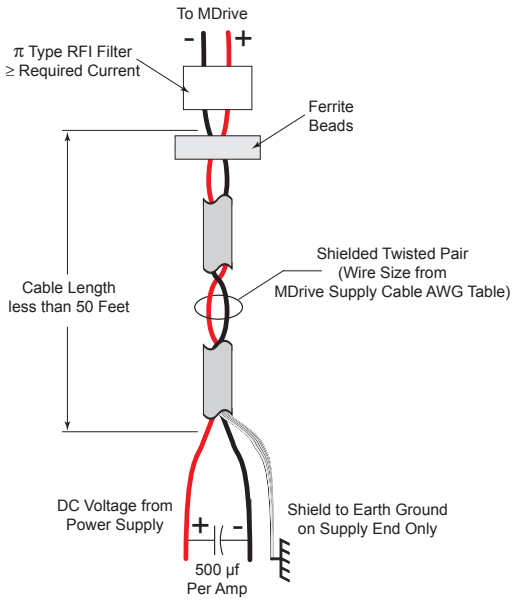


Figure B.2: DC Cabling - 50 Feet or Greater - AC To Full Wave Bridge Rectifier

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

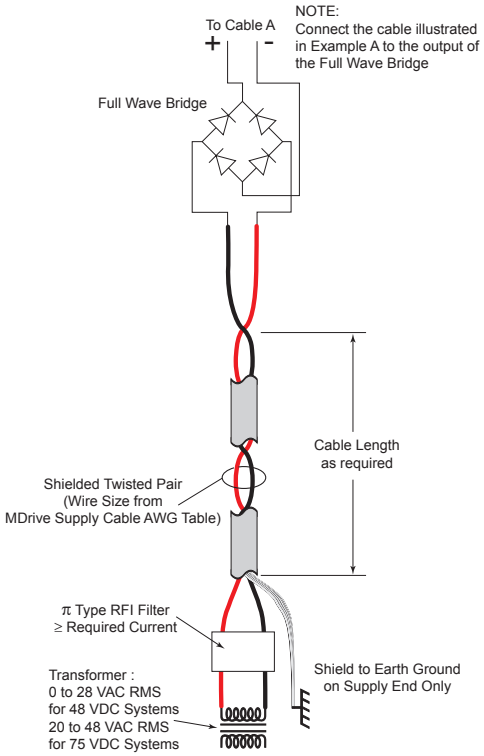


Figure B.3: AC Cabling - 50 Feet or Greater - AC To Power Supply

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

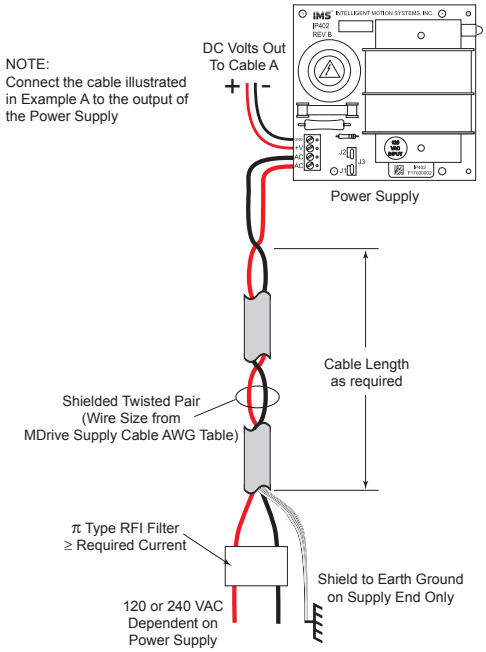


Figure B.1: DC Cabling - Under 50 Feet

Recommended Power Supply Cabling

MDrivePlus Supply Cable AWG Table					
1 Ampere (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	20	18	18	16
2 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	20	18	16	14	14
3 Amperes (Peak)					
Length (Feet)	10	25	50*	75*	100*
Minimum AWG	18	16	14	12	12
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 12-Pin Locking Wire Crimp Connector Information

For production customers can specify socket type and type of wire termination and purchase directly from the Connector Distributor. The following information is provided as an aid in this process.

Manufacturer:	Tyco Electronics	Molex
Type:	Micro Mate-N-Lock	Micro-Fit 3.0
Receptacle Housing:	1-794617-2	43025-1200
Receptacle Contacts:	See Tyco Electronics Table	See Molex Table

Tyco Electronics Contact and Tool Part Numbers						
Wire Size	Contact Plating	Strip Part Number	Loose Piece Part Number	Semi-Automatic Applicator	Insertion Hand Tool	Extraction Hand Tool
20-24 AWG	Tin	794606-1	794610-1	680893-*	91501-1	843996-6
	15µ" Gold	794606-2	794610-2			
	30µ" Gold	794606-3	794610-3			
26-30 AWG	Tin	794607-1	794611-1	680894-*	91502-1	843996-6
	15µ" Gold	794607-2	794611-2			
	30µ" Gold	794607-3	794611-3			

* 1 = 2 CLS, 2 = K Terminator, 3 = G Terminator For more information contact www.tycoelectronics.com

Molex Contact and Tool Part Numbers						
Wire Size	Contact Plating	Strip Part Number	Loose Piece Part Number	Semi-Automatic Applicator	Insertion Hand Tool	Extraction Hand Tool
20-24 AWG	Tin	43030-0001	43030-0007	63820-8100	63811-2800	11-03-0043
	30µ" Gold	43030-0002	43030-0008			
	15µ" Gold	43030-0003	43030-0009			
26-30 AWG	Tin	43030-0004	43030-0010	63820-8100	63811-2800	11-03-0043
	15µ" Gold	43030-0005	43030-0011			
	30µ" Gold	43030-0006	43030-0012			

For more information contact www.molex.com

Table B.4: 12-Pin Locking Wire Crimp Connector Contact and Tool Part Numbers

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APPENDIX C

Planetary Gearbox Overview and Specification

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 +85° 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
42 mm	MDrive17
52 mm	MDrive23

Note: ***The MDrive23*** and the numbers and values used in these examples have been chosen randomly for demonstration purposes. Be certain you obtain the correct data for the MDrive you have purchased.

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.
η	=	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.

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.)

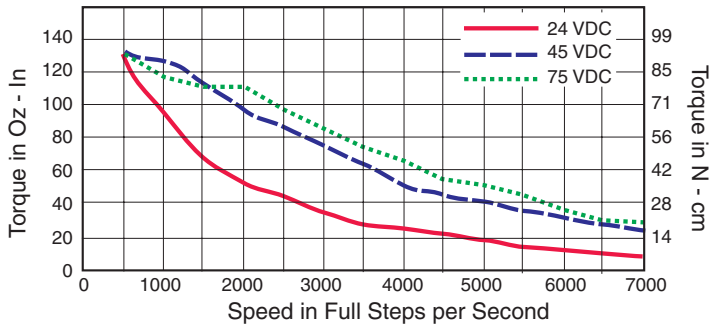

Figure C.1: MDrive23 Torque-Speed Curve

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

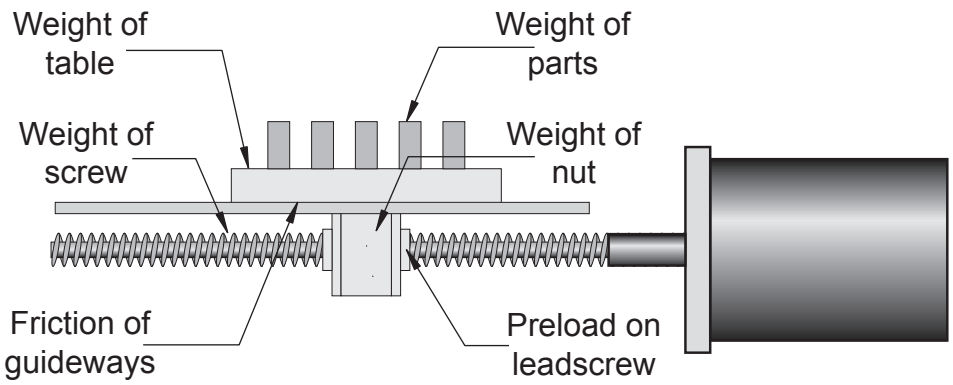

Figure C.2: Lead Screw System Inertia Considerations

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

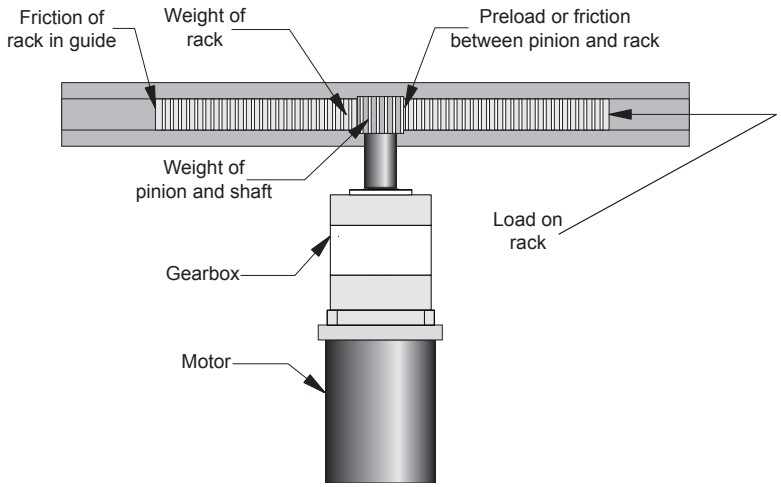

Figure C.3: Rack and Pinion System Inertia Considerations

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

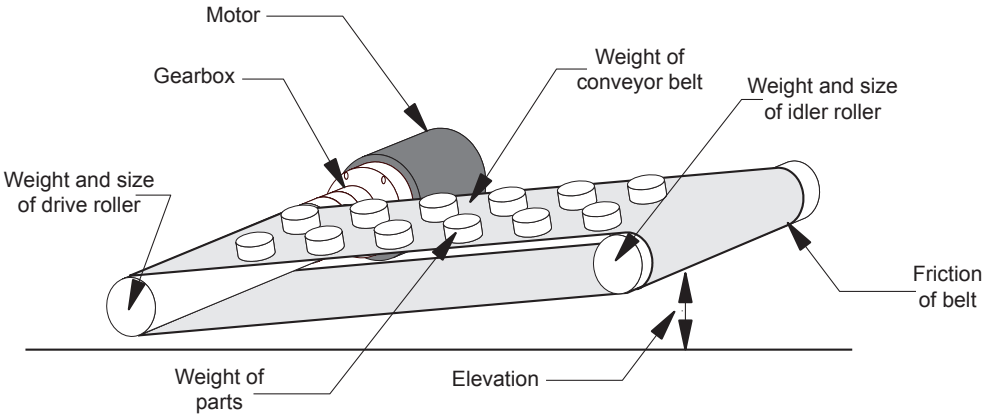

Figure C.4: Conveyor System Inertia Considerations

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

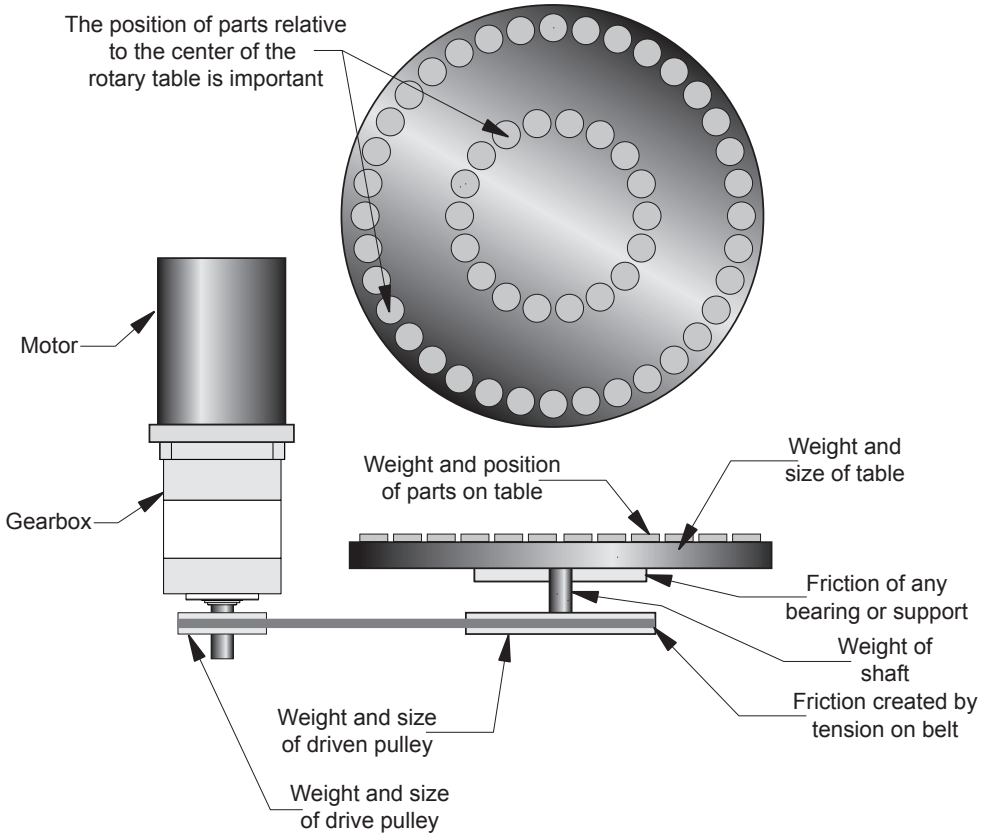

Figure C.5: Rotary Table System Inertia Considerations

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

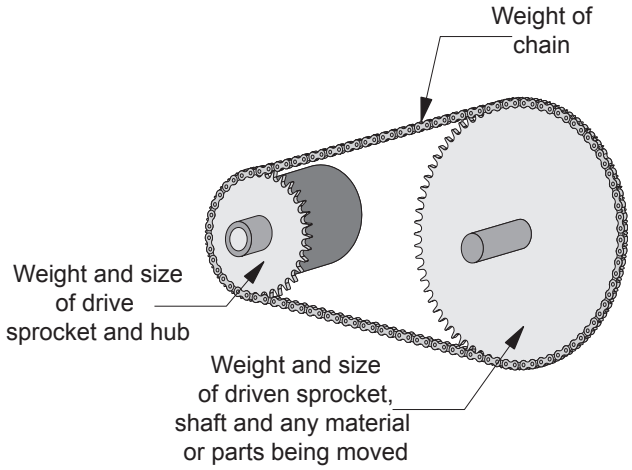

Figure C.6: Chain Drive System Inertia Considerations

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.

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

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)

MDrive17Plus with Planetary Gearbox

The MDrive17Plus is available with a Planetary Gearbox option developed to increase torque at lower speeds, enable better inertia matching and produce finer positional resolutions. These efficient, low maintenance Planetary Gearbox come fully assembled with the MDrive and are offered in a large number of reduction ratios in 1-, 2- and 3-stage configurations.

An optional NEMA Flange allows mounting the Planetary Gearbox to the load using a standard NEMA bolt circle. Planetary Gearbox may be combined with other MDrive17Plus options.

MDrive17Plus Planetary Gearbox Parameters

	Permitted Output Torque (oz-in/Nm)	Gearbox Efficiency	Maximum Backlash	Output Side with Ball Bearing			
				Maximum Load (lb-force/N)		Weight (oz/g)	
				Radial	Axial	Gearbox	with Flange
1-STAGE	425/3.0	0.80	0.80°	36/60	11/50	14.3/406	14.8/420
2-STAGE	1062/7.5	0.75	0.85°	52/230	18/80	17.9/508	18.5/525
3-STAGE	2124/15.0	0.70	0.90°	67.5/300	25/110	21.5/609	22.2/630

Table C.2: MDrive17Plus Planetary Gearbox Parameters

MDrive17Plus Gearbox Ratios

Planetary Gearbox	Ratio (Rounded)
1-Stage	3.71:1
1-Stage	5.18:1
1-Stage	6.75:1
2-Stage	13.73:1
2-Stage	15.88:1
2-Stage	18.37:1
2-Stage	19.20:1
2-Stage	22.21:1
2-Stage	25.01:1
2-Stage	26.85:1
2-Stage	28.93:1
2-Stage	34.98:1
2-Stage	45.56:1

Planetary Gearbox	Ratio (Rounded)
3-Stage	50.89:1
3-Stage	58.86:1
3-Stage	68.07:1
3-Stage	71.16:1
3-Stage	78.72:1
3-Stage	92.70:1
3-Stage	95.18:1
3-Stage	99.51:1
3-Stage	107.21:1
3-Stage	115.08:1
3-Stage	123.98:1
3-Stage	129.62:1
3-Stage	139.14:1
3-Stage	149.90:1
3-Stage	168.85:1
3-Stage	181.25:1
3-Stage	195.27:1
3-Stage	236.10:1
3-Stage	307.55:1

Table C.3: MDrive17Plus Planetary Gearbox Ratios

MDrive17Plus Planetary Gearbox

Dimensions in Inches (mm)

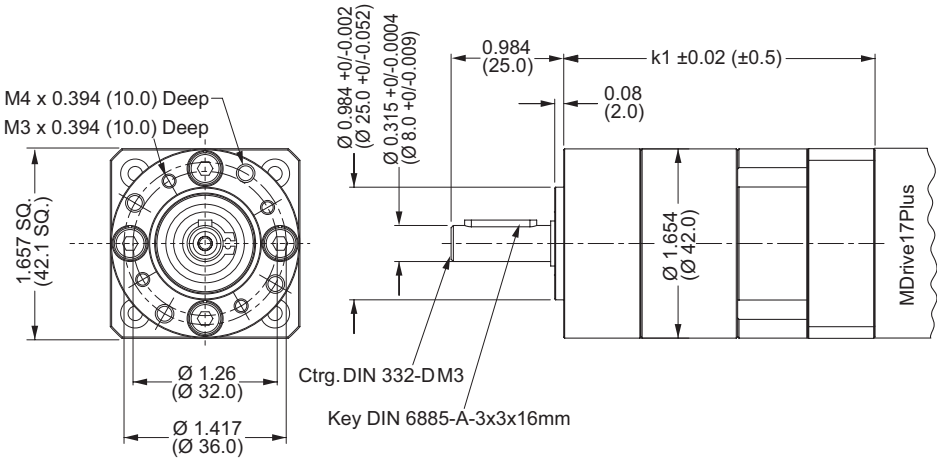

Figure C.7: Planetary Gearbox Specifications for MDrive17Plus

MDrive17Plus Planetary Gearbox With Optional NEMA Output Flange

Dimensions in Inches (mm)

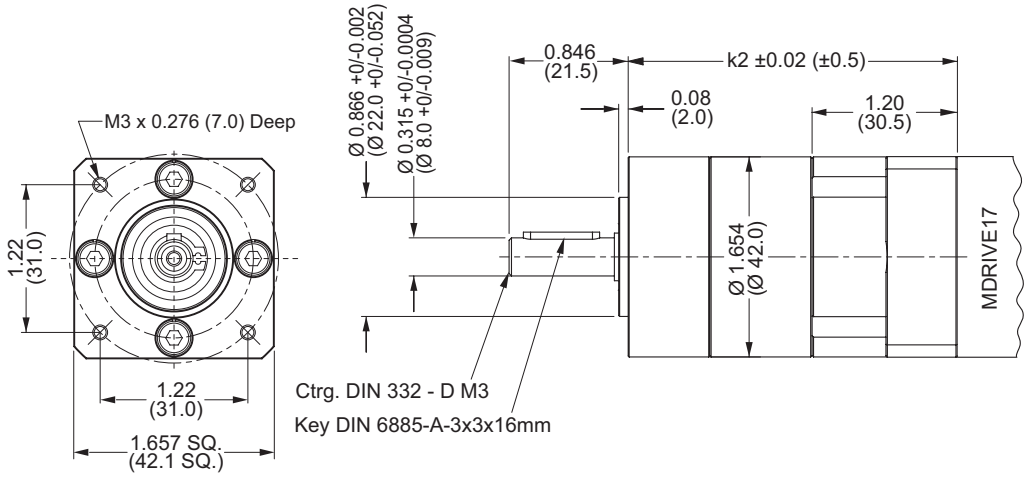

Figure C.8: Planetary Gearbox Specifications for MDrive17Plus with NEMA Output Flange

MDrive23Plus with Planetary Gearbox

The MDrive23Plus is available with a Planetary Gearbox option developed to increase torque at lower speeds, enable better inertia matching and produce finer positional resolutions. These efficient, low maintenance Planetary Gearbox come fully assembled with the MDrive and are offered in a large number of reduction ratios in 1-, 2- and 3-stage configurations.

An optional NEMA Flange allows mounting the Planetary Gearbox to the load using a standard NEMA bolt circle. Planetary Gearbox may be combined with other MDrive23Plus options.

MDrive23Plus Planetary Gearbox Parameters

	Permitted Output Torque (oz-in/Nm)	Gearbox Efficiency	Maximum Backlash	Output Side with Ball Bearing			
				Maximum Load (lb-force/N)		Weight (oz/g)	
				Radial	Axial	Gearbox	with Flange
1-STAGE	566/4.0	0.80	0.70°	45/200	13/60	25.0/711	25.9/735
2-STAGE	1699/12.0	0.75	0.75°	72/320	22/100	32.2/914	33.3/945
3-STAGE	3540/25.0	0.70	0.80°	101/450	34/150	39.4/1117	40.7/1155

Table C.4: MDrive23Plus Planetary Gearbox Parameters

MDrive23Plus Gearbox Ratios

Planetary Gearbox	Ratio (Rounded)
1-Stage	3.71:1
1-Stage	5.18:1
1-Stage	6.75:1
2-Stage	13.73:1
2-Stage	15.88:1
2-Stage	18.37:1
2-Stage	19.20:1
2-Stage	22.21:1
2-Stage	25.01:1
2-Stage	26.85:1
2-Stage	28.93:1
2-Stage	34.98:1
2-Stage	45.56:1

Planetary Gearbox	Ratio (Rounded)
3-Stage	50.89:1
3-Stage	58.86:1
3-Stage	68.07:1
3-Stage	71.16:1
3-Stage	78.72:1
3-Stage	92.70:1
3-Stage	95.18:1
3-Stage	99.51:1
3-Stage	107.21:1
3-Stage	115.08:1
3-Stage	123.98:1
3-Stage	129.62:1
3-Stage	139.14:1
3-Stage	149.90:1
3-Stage	168.85:1
3-Stage	181.25:1
3-Stage	195.27:1
3-Stage	236.10:1
3-Stage	307.55:1

Table C.5: MDrive23Plus Planetary Gearbox Ratios

MDrive23Plus Planetary Gearbox

Dimensions in Inches (mm)

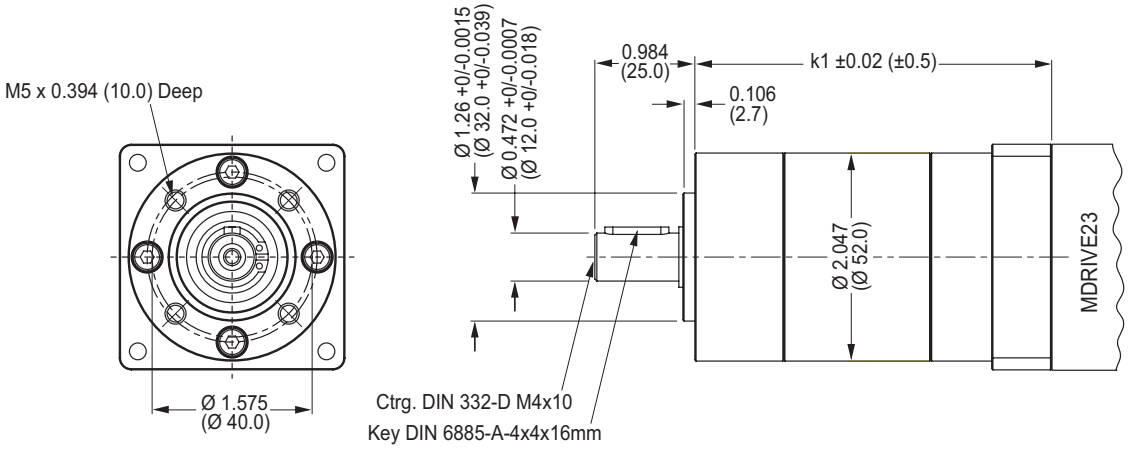

Figure C.9: Planetary Gearbox Specifications for MDrive23Plus

MDrive23Plus Planetary Gearbox With Optional NEMA Output Flange

Dimensions in Inches (mm)

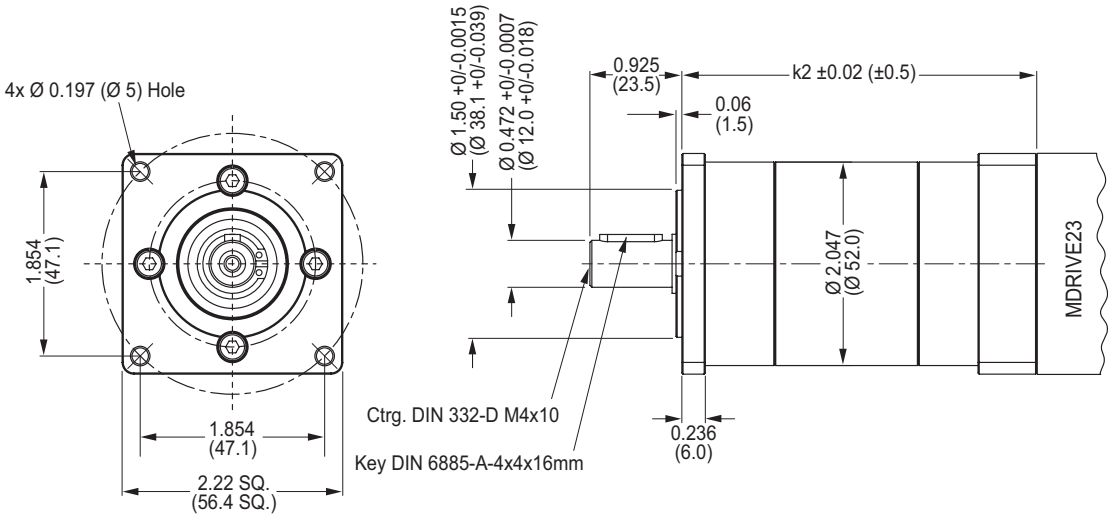

Figure C.10: Planetary Gearbox Specifications for MDrive23Plus with NEMA Flange

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

USB to SPI Communications Converters

The MD-CC300-001 USB to SPI Communications Converter provides a communication connection between the MDrivePlus 10-pin connector at P2 and the USB port on a PC.

IMS SPI Interface Software communicates to the Communications Converter through the PC's USB port.

The Communications Converter interprets SPI commands and sends these commands to the MDrivePlus through the SPI interface.

Supplied Components: MD-CC300-001 Communications Converter, USB Cable, USB Drivers, IMS SPI Interface Software.

MD-CC300-001 Mechanical Specifications and Connection

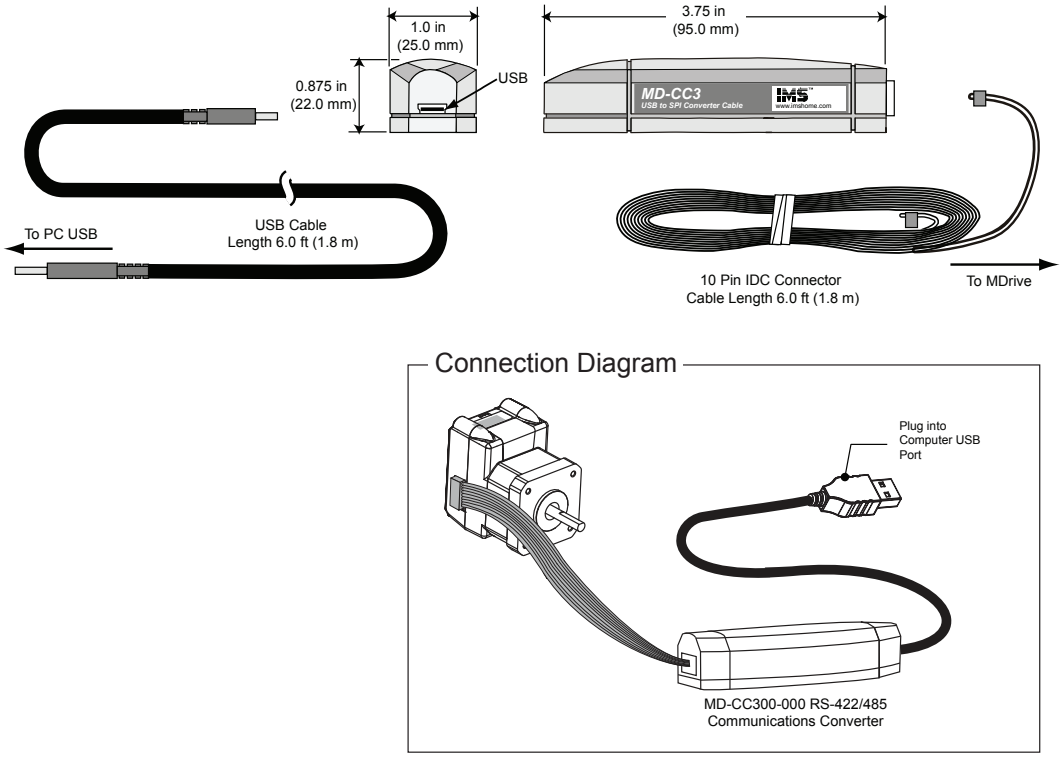
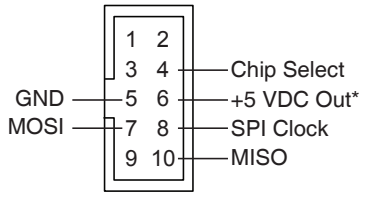


Figure D1: MD-CC300-001 Communications Converter

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins (if applicable) to create five interface cables.

Connector Details



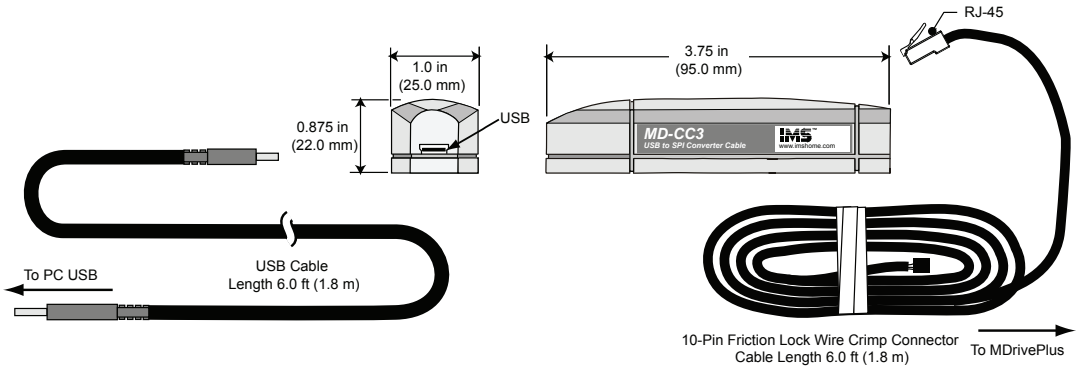
pins not labeled are no connect.

*used to power the MD-CC300-001 only.

Figure D.2: 10-Pin IDC

Mating Connector Kit p/n: CK-01

Description:	5 mating connector shells for making interface cables to MDrive's 10-pin IDC connector. 2-piece connector shell crimps onto a 10 conductor AMP ribbon cable. Ribbon Cable is not included.	
IDC Parts:	Shell:	SAMTEC TCSD-05-01-N
	Ribbon Cable:	AMP 1-57051-9



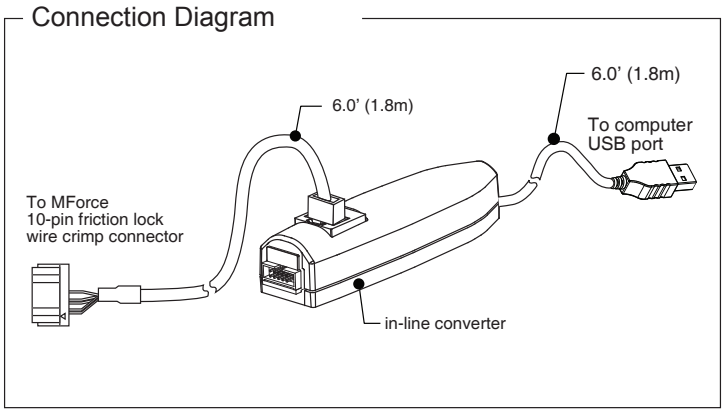
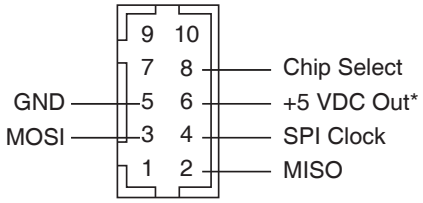


Figure D.3: MD-CC402-000 Mechanical Specifications and Connection

Connector Detail and Mating Connector Kit

Should you choose to create your own interface cable IMS now has mating connector kits available which assist you in creating interface cables in small quantities. These kits come with the connector shells and crimp pins to create five interface cables.

Connector Details



pins not labeled are no connect.

*used to power the MD-CC302-001 only.

Figure D.4: 10-Pin Wire Crimp

Mating Connector Kit p/n: CK-02

Description:	5 mating connector shells and crimp pins. Recommend Hirose Crimp tool (Not included).	
Hirose Parts:	Shell:	DF11-10DS-2C
	Pins:	DF11-2428SC
	Crimp Tool:	DF11-TA2428HC

Installation Procedure for the MD-CC30x-001

These Installation procedures are written for Microsoft Windows XP Service Pack 2 or greater.

The installation of the MD-CC30x-001 requires the installation of two sets of drivers, which may be downloaded from http://www.imshome.com:

- 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.

Installing the Cable/VCP Drivers

1) Download drvers from http://www.imshome.com/cable_drivers.html.
2) Extract the driver files from the *.zip archive, remember the extracted location.
3) Plug the USB Converter Cable into the USB port of the MD-CC30x-001.
4) Plug the other end of the USB cable into an open USB port on your PC.
5) Your PC will recognize the new hardware and open the Hardware Update dialog.
6) 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).
7) Select “Install from a list or specific location (Advanced)” on the radio buttons in answer to the query

Figure D.5: Hardware Update Wizard

“What do you want the wizard to do?” Click “Next” (Figure D.5).

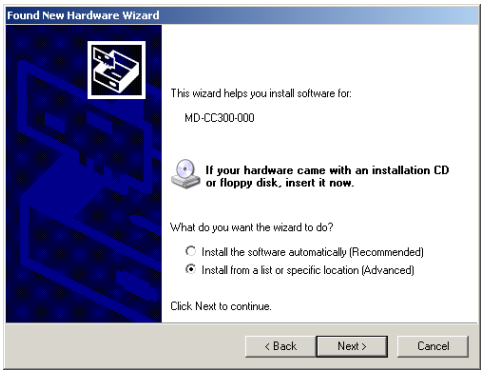


Figure D.6: Hardware Update Wizard Screen 2

86) Select “Search for the best driver in these locations.”
(a) Check “Include this location in the search.”
(b) Browse to the location where you extracted the files in Step #2.
(c) Click Next (Figure D.6).

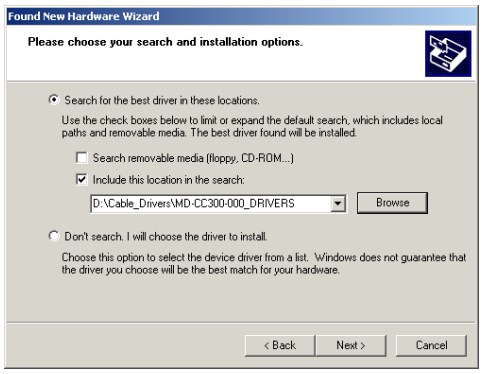


Figure D.7: Hardware Update Wizard Screen 3

9) The drivers will begin to copy.

10) On the Dialog for Windows Logo Compatibility Testing, click “Continue Anyway” (Figure D.7).

11) The Driver Installation will proceed. When the Completing the Found New Hardware Wizard dialog

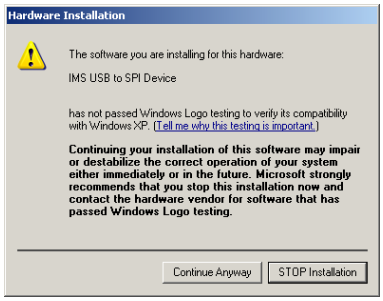


Figure D.8: Windows Logo Compatibility Testing

appears, Click “Finish” (Figure D.8).

12) Upon finish, the Welcome to the Hardware Update Wizard will reappear to guide you through the

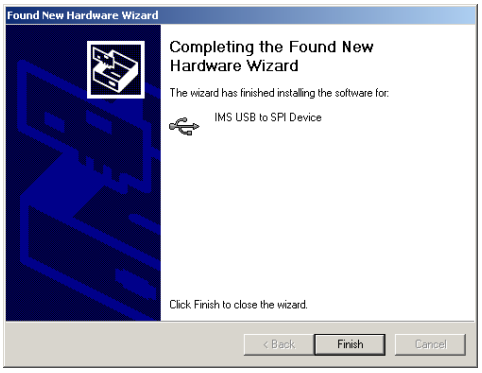


Figure D.9: Hardware Update Wizard Finish Installation

second part of the install process. Repeat steps 3 through 11 above to complete the cable installation.

11) Your IMS MD-CC30x-001 is now ready to use.

Determining the Virtual COM Port (VCP)

The MD-CC30x-001 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-CC30x-001 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.

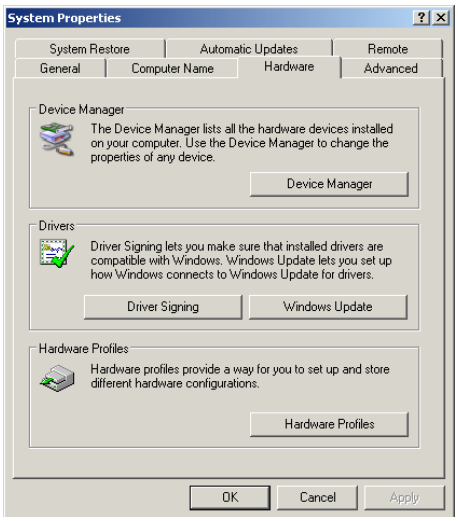


Figure D.10: Hardware Properties

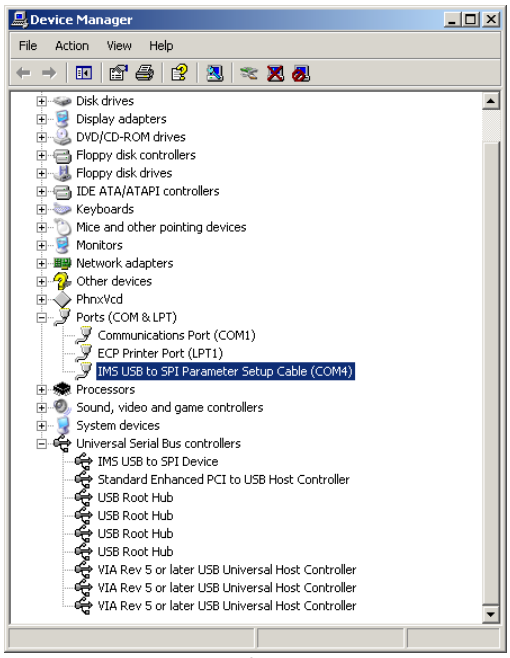


Figure D.11: Windows Device Manager

APPENDIX E

Interfacing an Encoder

Factory Mounted Encoder

The MDrivePlus Speed Control are available with a factory-mounted optical encoder. 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	EAL	E1
200	EBL	E2
250	ECL	E3
256	EWL	EP
400	EDL	E4
500	EHL	E5
512	EXL	EQ
1000	EJL	E6
1024	EYL	ER

Table E.1: Available Encoder Line Counts and Part Numbers

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)

Pin Configuration

Pin Assignment - Factory Mounted Encoder		
Encoder Pin	***Function — Differential Encoder***	***Function — Single-End Encoder***
Pin 1	No Connect	Ground
Pin 2	+5 VDC Input	Index
Pin 3	Ground	Channel A
Pin 4	No Connect	+5 VDC Input
Pin 5	Channel A –	Channel B
Pin 6	Channel A +	
Pin 7	Channel B –	
Pin 8	Channel B +	
Pin 9	Index –	
Pin 10	Index +	

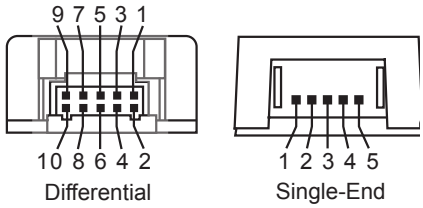


Table E.2: Single-End and Differential Encoder Pin Configuration

Encoder Signals

Single-End Encoder

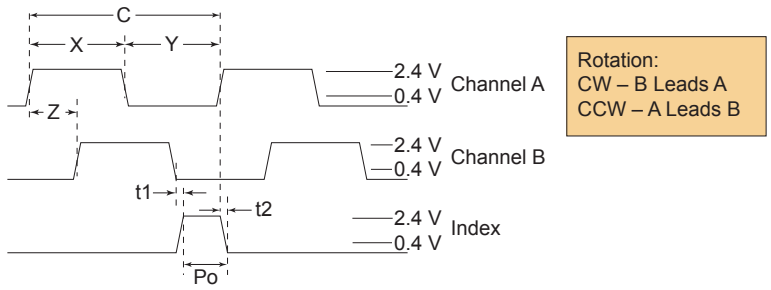


Figure E.2: Single-End Encoder Signal Timing

Differential Encoder

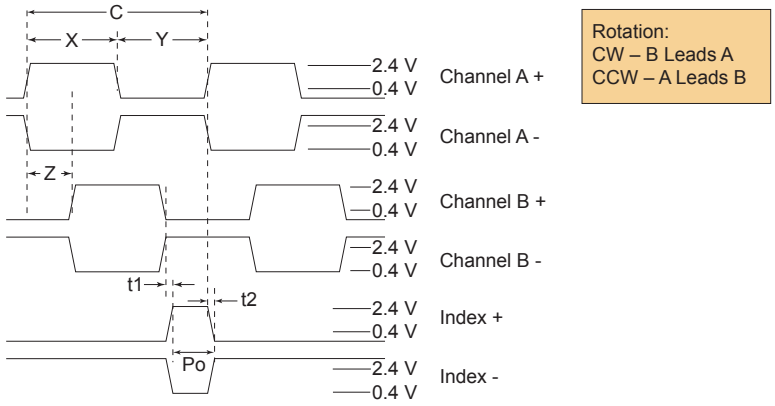


Figure E.3: Differential Encoder Signal Timing

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 Cables

IMS offers assembled cables for both the Single-End and Differential Encoders. The IMS Part Numbers are listed below.

External Encoder
Single-End Encoder Cable (12" leads) ES-CABLE-2
Differential Encoder Cable (6'/1.8 m) ED-CABLE-6

Internal Encoder
Cable (6'/1.8 m) ED-CABLE-JST10

Recommended Encoder Mating Connectors

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

Single-End Encoder

Tyco Electronics 5 Pin Connector Shell 1-87175-2
Pins* (5 required) AMP Part Number 87165-1
*For AWG 22 to 28 wires.

Tyco Electronics MTA 0.1 IDC Loaded Connector
AWG 22 (Red) 640440-5
AWG 24 (Natural) 640441-5
AWG 26 (Blue) 640442-5
AWG 28 (Green) 640443-5

Differential Encoder

Molex 10-pin Connector Shell 15-04-5104
Molex 5-Pin* IDC Inserts (2 required) 14-60-0058
*For AWG 22 to 26 wires.

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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.

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

This Limited Warranty shall be void if the Customer fails to comply with all of the terms set forth in this Limited Warranty. This Limited Warranty is the sole warranty offered by IMS with respect to the Product. IMS does not assume any other liability in connection with the sale of the Product. No representative of IMS is authorized to extend this Limited Warranty or to change it in any manner whatsoever. No warranty applies to any party other than the original Customer.

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

OBTAINING WARRANTY SERVICE

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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