INTELLIGENT MOTION SYSTEMS, INC.

Excellence in Motion™

MDRIVE™ MOTOR+DRIVER AC Plus

MICROSTEPPING OPERATING INSTRUCTIONS

MDRIVE 34™ MOTOR+DRIVER AC Plus MICROSTEPPING

MDRIVE 42™ MOTOR+DRIVER AC Plus MICROSTEPPING

www.imshome.com

MDriveAC Plus Motion Control Hardware Reference Change Log		
Date	Revision	Changes
03/07/2006	R030706	Initial Release
04/13/2006	R041306	Corrected Motor+Driver weight specification for MDM34AC Plus, added notes on recommended mating connector for the M23 19-pin connector P1. Added MD-CS10x-000 and MD-CS-20x-000 To Appendix C.
05/04/2006	R050406	Removed Ambient Temperature Specification
05/25/2006	R052506	Replaced USB to SPI Cable Driver Installation with instructions relavent to Windows XP Service Pack 2.

MDriveAC Plus Microstepping
Revision R052506

Table Of Contents

Appendices

List Of Figures

Part 1: Hardware Specifications

Part 2: Interfacing and Configuration

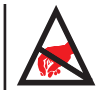
Appendices

List of Tables

Part 1: Hardware Specifications

Part 2: Interfacing and Configuration

Appendices



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

Before You Begin

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

Tools and Equipment Required

- MDriveAC Plus Microstepping Unit
- Parameter setup cable MD-CC300-000 and Adapter MD-ADP-M23 or equivalent (USB to SPI)
- MDriveAC Plus Product CD or Internet access to www.imshome.com
- Control Device for Step/Direction
- +5 to +24 VDC optocoupler supply
- Basic Tools: Wire Cutters / Strippers / Screwdriver
- Wiring/Cabling for AC Power and Logic Connections
- A PC with Windows 9x, Windows 2000, Windows XP
- 10 MB hard drive space

Connecting AC Power

AC Power to Connector P3.

AC Power To P3			
P3	Function	US Color	Euro Color
1	Earth GND	Green	Green/ Yellow
2	AC Line	Black	Brown
3	AC Neutral	White	Blue

Table GS.1: AC Wire Colors

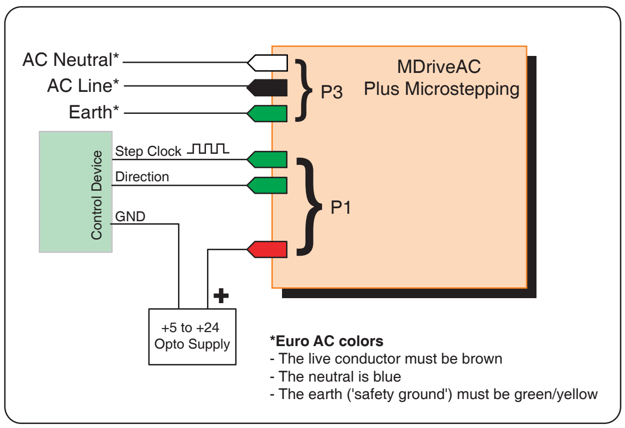


Figure GS.1: Minimum Logic and Power Connections

Connect Opto Power and Logic Inputs (See Section 2.1 for Details)

Using the recommended wire (see the specifications for your MDriveAC Plus), connect the DC output of the optocoupler power supply to the P1, Pin 1 of your MDriveAC Plus Microstepping model.

Connect the opto supply ground to the Power Ground pin appropriate for your controller/control circuitry.

Connecting Parameter Setup Cable (See Section 2.2 for Details)

Connect the Host PC to the MDriveAC Plus Microstepping using the IMS Parameter Setup Cable or equivalent.

Install the IMS SPI Motor Interface (See Section 2.3 for Details)

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

Figure GS.2: MDriveAC Plus CD

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

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

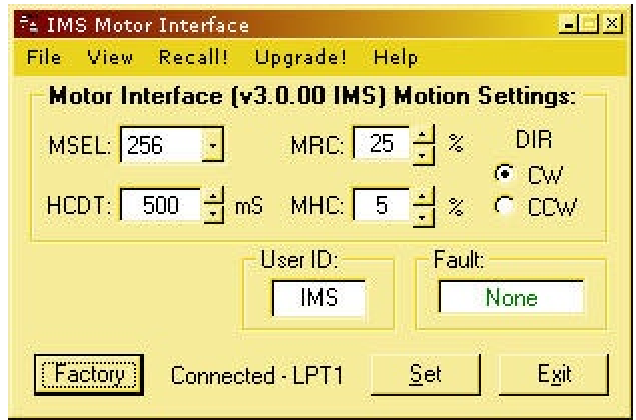


Figure GS.3: IMS Motor Interface Showing Default Settings

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

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PART 1: HARDWARE SPECIFICATIONS

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SECTION 1.1

Introduction to the MDrive34AC Plus Microstepping

The MDrive34AC Plus Microstepping high torque integrated motor and driver is ideal for designers who want the simplicity of a motor with on-board electronics. The integrated electronics of the MDrive34AC Plus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise.

The unsurpassed smoothness and performance delivered by the MDrive34AC Plus Microstepping are achieved through IMS's advanced 2nd generation current control. By applying innovative techniques to control current flow through the motor, resonance is significantly dampened over the entire speed range and audible noise is reduced.

The MDrive34AC Plus accepts a broad input voltage range from 95 to 264 VAC, delivering enhanced performance and speed. Oversized input capacitors are used to minimize power line surges, reducing problems that can occur with long runs and multiple drive systems. An extended operating range of –40° to +85°C provides long life, trouble free service in demanding environments.

Figure 1.1.1: MDrive34AC Plus Microstepping Integrated Motor, Power Supply, and Drive Electronics

The MDrive34AC Plus uses a NEMA 34 frame size high torque brushless motor combined with a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes. These settings may be changed on-the-fly or downloaded and stored in nonvolatile memory with the use of a simple GUI which is provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

For use in environments where exposure to dust and liquids may occur, a sealed MDrive34AC Plus Microstepping unit with circular connectors meets IP65 specifications.

The versatile MDrive34AC Plus Microstepping is available in multiple configurations to fit various system needs. Three rotary motor lengths are available as are optional: internal optical encoder; control knob for manual positioning; integrated planetary gearbox. A long life Acme screw linear actuator version is also available. Interface connections are accomplished using standard industrial connectors.

The MDrive34AC Plus is a compact, powerful and inexpensive solution that will reduce system cost, design and assembly time for a large range of brushless motor applications.

Configuring

The IMS Motor Interface software is an easy to install and use GUI for configuring the MDrive34AC Plus from a computer's USB port. GUI access is via the IMS SPI Motor Interface included on the CD shipped with the product, or from www.imshome.com. Optional cables are available for ease of connecting and configuring the MDrive.

The IMS SPI Motor Interface features:

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

Features and Benefits

- Highly Integrated Microstepping Driver and NEMA 34 High Torque Brushless Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: 120 or 240 VAC
- Low Cost
- Extremely Compact

- 20 Microstep Resolutions up to
  - 51,200 Steps Per Rev Including:
  - Degrees, Metric, Arc Minutes
- Optically Isolated Logic Inputs will
  - Accept +5 to +24 VDC Signals,
  - Sourcing or Sinking
- Automatic Current Reduction
- Configurable:
  - Motor Run/Hold Current
  - Motor Direction vs. Direction Input
  - Microstep Resolution
  - Clock Type: Step and Direction, Quadrature, Step Up and Step Down
  - Programmable Digital Filtering for Clock and Direction Inputs
- Available Options:
  - Internal Differential Optical Encoder
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
  - IP65 Sealed Configuration
- 3 Rotary Motor Lengths Available
- Current and Microstep Resolution May Be Switched On-The-Fly
- Interface Options:
  - Circular 19-Pin M23
  - Circular 3-Pin Euro AC
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

MDrive34AC Plus Microstepping Detailed Specifications

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

General Specifications

Input Voltage (+V)

120V MDrive ....95 to 132 VAC @ 50/60 Hz
240V MDrive ....95 to 264 VAC @ 50/60 Hz

Isolated Input

Step Clock, Direction & Enable
Voltage Range (Sourcing or Sinking)....................+5 to +24 VDC
Current
+5 Volt (Max) ....8.7 mA
+24 Volt (Max)....................14.6 mA

Motion

Digital Filter Range.................... 50 nS to 12.9µS (10MHz to 38.8 kHz)
Clock Types.................... Step/Direction, Quadrature, Step Up/Step Down
Step Frequency (Max) ....2 MHz
Number of Microstep Settings.................... 20
Step Frequency Minimum Pulse Width.................... 250 nS
Steps per Revolution .... 200, 400, 800, 1000, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 20000, 25000, 25600, 40000, 50000, 51200, 36000 (0.01 deg/µstep), 21600 (1 arc minute/µstep), 25400 (0.001 mm/µstep)

Thermal

Motor Temperature ....100°C (maximum)
Operating Tempurature....................-40 to +85°C

Sealing (-65 Version)

Specification....................IP65

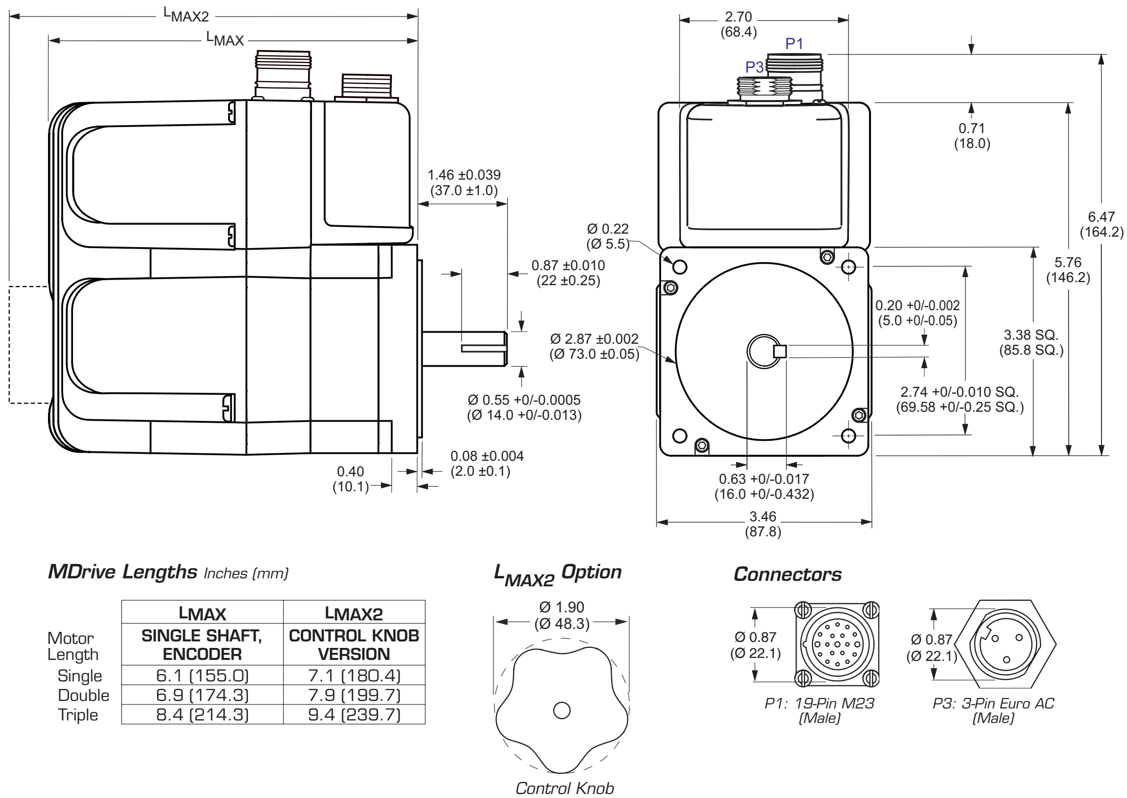
Setup Parameters

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.

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

Table 1.2.1: Setup Parameters

MECHANICAL SPECIFICATIONS - Dimensions in Inches (mm)



MDrive Lengths *Inches (mm)*

Motor Length	LMAX SINGLE SHAFT, ENCODER	LMAX2 CONTROL KNOB VERSION
Single	6.1 (155.0)	7.1 (180.4)
Double	6.9 (174.3)	7.9 (199.7)
Triple	8.4 (214.3)	9.4 (239.7)

Figure 1.2.1: MDrive34AC Plus Mechanical Specifications

Connector Specifications

P1: I/O & COMM (SPI) CONNECTOR		
M23 Circular (Male)	Function	Function with Encoder
Pin 1	Optocoupler Reference	Optocoupler Reference
Pin 2	Enable Input	Enable Input
Pin 3	No Connect	Index +
Pin 4	No Connect	Channel B +
Pin 5	No Connect	Channel B –
Pin 6	No Connect	No Connect
Pin 7	No Connect	Channel A +
Pin 8	SPI Master Out – Slave In	SPI Master Out – Slave In
Pin 9	SPI Chip Select	SPI Chip Select
Pin 10	+5 VDC Output	+5 VDC Output
Pin 11	Communications Ground	Communications Ground
Pin 12	No Connect	No Connect
Pin 13	CW/CCW Direction Input	CW/CCW Direction Input
Pin 14	No Connect	Index –
Pin 15	No Connect	Channel A –
Pin 16	SPI Clock	SPI Clock
Pin 17	SPI Master In – Slave Out	SPI Master In – Slave Out
Pin 18	Step Clock Input	Step Clock Input
Pin 19	Fault Output	Fault Output

P3: POWER CONNECTOR	
Euro AC (Male)	Function
Pin 1	Chassis Ground
Pin 2	AC Power Line
Pin 3	AC Power Neutral

Table 1.2.2: Pin Configuration

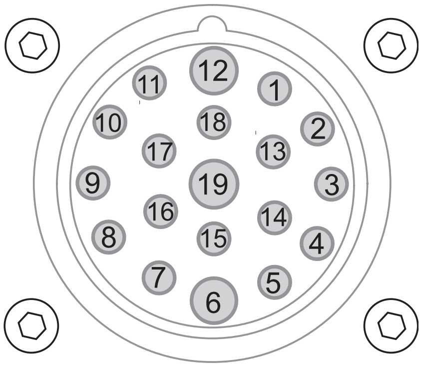


Figure 1.2.2: 19-Pin M23 (Male) Connector Pin Numbers

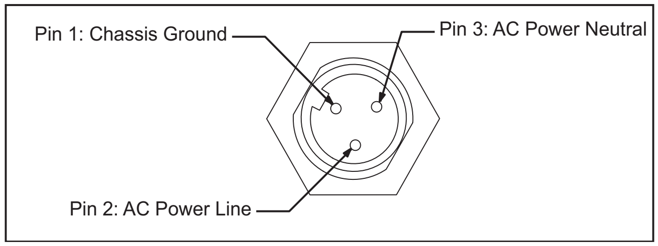


Figure 1.2.3: P3 3-Pin Euro AC Connector

Note: Recommended Mating Connector for the M23 19-Pin P1:
Phoenix Order # 1000042
Female M23 Straight Solder Cup Connector

Motor Specifications

Single Length

Holding Torque.. 330 oz-in/233 N-cm
Detent Torque.. 10.9 oz-in/7.7 N-cm
Rotor Inertia ....0.01416 oz-in-sec^2/1.0 kg-cm^2
Weight (Motor + Driver).. 6.4 lb/2.9 kg

Double Length

Holding Torque.. 500 oz-in/353 N-cm
Detent Torque.. 14.16 oz-in/14.0 N-cm
Rotor Inertia ....0.02266 oz-in-sec^2/1.6 kg-cm^2
Weight (Motor + Driver).. 7.7 lb/3.5 kg

Triple Length

Holding Torque.. 750 oz-in/529 N-cm
Detent Torque.. 19.83 oz-in/10.0 N-cm
Rotor Inertia ....0.04815 oz-in-sec^2/3.4 kg-cm^2
Weight (Motor + Driver).. 11.0 lb/5.0 kg

Options and Accessories

Internal Encoder

Internal differential optical encoders are offered factory-installed with the MDrive34AC Plus Microstepping. Refer to the Encoder Specifications section for available line counts. All encoders come with an index mark.

Control Knob

The MDrive34AC Plus is available with a factory-mounted rear control knob for manual shaft positioning. Not available with Sealed (-65) versions.

Planetary Gearbox

Efficient, low maintenance planetary gearboxes are offered assembled with the MDrive34AC Plus. Refer to gearbox Appendix for details and part numbers.

Parameter Setup Cable and Adapter

The optional 12.0' (3.6m) parameter setup cable part number MD-CC300-000 with adapter MD-ADP-M23 facilitates communications wiring and is recommended with first order. It connects to the MDrive's P1 19-pin male M23 connector.

Cordsets

19-pin M23 single-ended cordsets are offered to speed prototyping of the MDrive34AC Plus. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination MD-CS100-000
Right Angle Termination... MD-CS101-000

Introduction to the MDrive42AC Plus Microstepping

The MDrive42AC Plus Microstepping high torque integrated motor and driver is ideal for designers who want the simplicity of a motor with on-board electronics. The integrated electronics of the MDrive42AC Plus eliminate the need to run motor cabling through the machine, reducing the potential for problems due to electrical noise.

The unsurpassed smoothness and performance delivered by the MDrive42AC Plus Microstepping are achieved through IMS's advanced 2nd generation current control. By applying innovative techniques to control current flow through the motor, resonance is significantly dampened over the entire speed range and audible noise is reduced.

Figure 1.3.1: MDrive42AC Plus Microstepping Integrated Motor, Power Supply, and Drive Electronics

The MDrive42AC Plus accepts a broad input voltage range from 95 to 264 VAC, delivering enhanced performance and speed. Oversized input capacitors are used to minimize power line surges, reducing problems that can occur with long runs and multiple drive systems. An extended operating range of –40° to +85°C provides long life, trouble free service in demanding environments.

The MDrive42AC Plus uses a NEMA 42 frame size high torque brushless motor combined with a microstepping driver, and accepts up to 20 resolution settings from full to 256 microsteps per full step, including: degrees, metric and arc minutes. These settings may be changed on-the-fly or downloaded and stored in nonvolatile memory with the use of a simple GUI which is provided. This eliminates the need for external switches or resistors. Parameters are changed via an SPI port.

For use in environments where exposure to dust and liquids may occur, a sealed MDrive42AC Plus Microstepping unit with circular connectors meets IP65 specifications.

The versatile MDrive42AC Plus Microstepping is available in multiple configurations to fit various system needs. Two rotary motor lengths are available as are optional: internal optical encoder; control knob for manual positioning; integrated planetary gearbox. Interface connections are accomplished using standard industrial connectors.

The MDrive42AC Plus is a compact, powerful and inexpensive solution that will reduce system cost, design and assembly time for a large range of brushless motor applications.

Configuring

The IMS Motor Interface software is an easy to install and use GUI for configuring the MDrive42AC Plus from a computer's USB port. GUI access is via the IMS SPI Motor Interface included on the CD shipped with the product, or from www.imshome.com. Optional cables are available for ease of connecting and configuring the MDrive.

The IMS SPI Motor Interface features:

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

Features and Benefits

- Highly Integrated Microstepping Driver and NEMA 42 High Torque Brushless Motor
- Advanced 2nd Generation Current Control for Exceptional Performance and Smoothness
- Single Supply: 120 or 240 VAC
- Low Cost
- Extremely Compact

- 20 Microstep Resolutions up to
  - 51,200 Steps Per Rev Including:
  - Degrees, Metric, Arc Minutes
- Optically Isolated Logic Inputs will
  - Accept +5 to +24 VDC Signals,
  - Sourcing or Sinking
- Automatic Current Reduction
- Configurable:
  - Motor Run/Hold Current
  - Motor Direction vs. Direction Input
  - Microstep Resolution
  - Clock Type: Step and Direction, Quadrature, Step Up and Step Down
  - Programmable Digital Filtering for Clock and Direction Inputs
- Available Options:
  - Internal Differential Optical Encoder
  - Integrated Planetary Gearbox
  - Control Knob for Manual Positioning
  - IP65 Sealed Configuration
- 3 Rotary Motor Lengths Available
- Current and Microstep Resolution May Be Switched On-The-Fly
- Interface Options:
  - Circular 19-Pin M23
  - Circular 3-Pin Euro AC
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup

SECTION 1.4

MDrive42AC Plus Microstepping Detailed Specifications

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

General Specifications

Input Voltage (+V)

120V MDrive ....95 to 132 VAC @ 50/60 Hz
240V MDrive ....95 to 264 VAC @ 50/60 Hz

Isolated Input

Step Clock, Direction & Enable
Voltage Range (Sourcing or Sinking)..+5 to +24 VDC
Current
+5 Volt (Max) ....8.7 mA
+24 Volt (Max)..14.6 mA

Motion

Digital Filter Range.................................. 50 nS to 12.9µS (10MHz to 38.8 kHz)
Clock Types.................................. Step/Direction, Quadrature, Step Up/Step Down
Step Frequency (Max) ....2 MHz
Number of Microstep Settings.. 20
Step Frequency Minimum Pulse Width.. 250 nS
Steps per Revolution .... 200, 400, 800, 1000, 1600, 2000, 3200, 5000, 6400, 10000, 12800, 20000, 25000, 25600, 40000, 50000, 51200, 36000 (0.01 deg/µstep), 21600 (1 arc minute/µstep), 25400 (0.001 mm/µstep)

Thermal

Motor Temperature ....100°C (maximum)
Operating Tempurature..-40 to +85°C

Sealing (-65 Version)

Specification..IP65

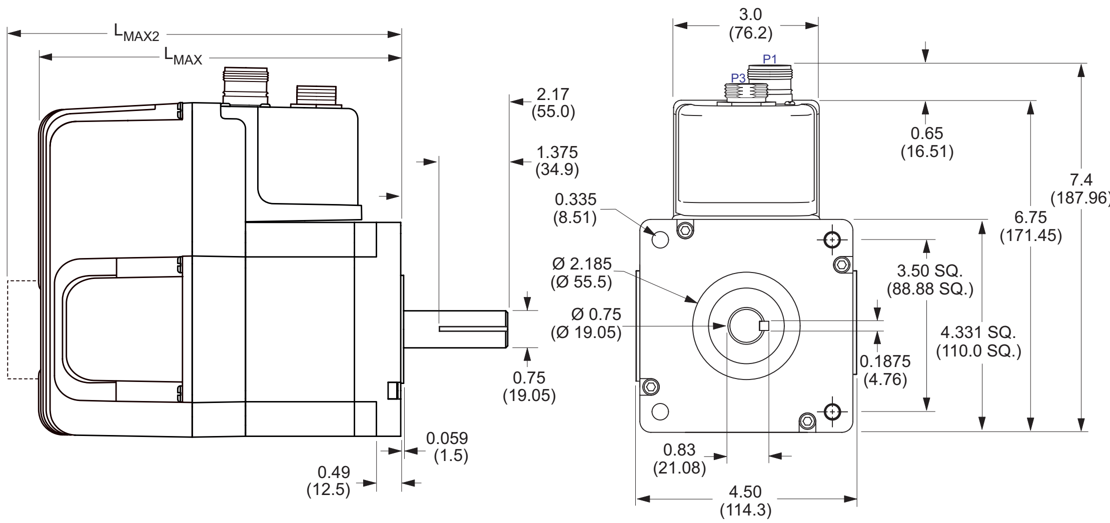
Setup Parameters

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.

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

Table 1.4.1: Setup Parameters

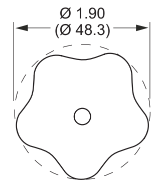
MECHANICAL SPECIFICATIONS - Dimensions in Inches (mm)



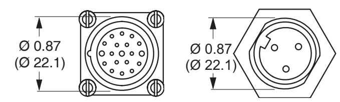
MDrive Lengths *Inches (mm)*

Motor Length	LMAX SINGLE SHAFT or ENCODER VERSION	LMAX2 CONTROL KNOB VERSION
Single	7.4 (187.96)	9.4 (238.76)
Double	8.4 (213.36)	10.4 (264.16)

Control Knob



Connectors



P1: 19-Pin M23 (Male)

P3: 3-Pin Euro AC (Male)

Figure 1.4.1: MDrive42AC Plus Mechanical Specifications

Connector Specifications

P1: I/O & COMM (SPI) CONNECTOR		
M23 Circular (Male)	Function	Function with Encoder
Pin 1	Optocoupler Reference	Optocoupler Reference
Pin 2	Enable Input	Enable Input
Pin 3	No Connect	Index +
Pin 4	No Connect	Channel B +
Pin 5	No Connect	Channel B –
Pin 6	No Connect	No Connect
Pin 7	No Connect	Channel A +
Pin 8	SPI Master Out – Slave In	SPI Master Out – Slave In
Pin 9	SPI Chip Select	SPI Chip Select
Pin 10	+5 VDC Output	+5 VDC Output
Pin 11	Communications Ground	Communications Ground
Pin 12	No Connect	No Connect
Pin 13	CW/CCW Direction Input	CW/CCW Direction Input
Pin 14	No Connect	Index –
Pin 15	No Connect	Channel A –
Pin 16	SPI Clock	SPI Clock
Pin 17	SPI Master In – Slave Out	SPI Master In – Slave Out
Pin 18	Step Clock Input	Step Clock Input
Pin 19	Fault Output	Fault Output

P3: POWER CONNECTOR	
Euro AC (Male)	Function
Pin 1	Chassis Ground
Pin 2	AC Power Line
Pin 3	AC Power Neutral

Table 1.4.2: Pin Configuration

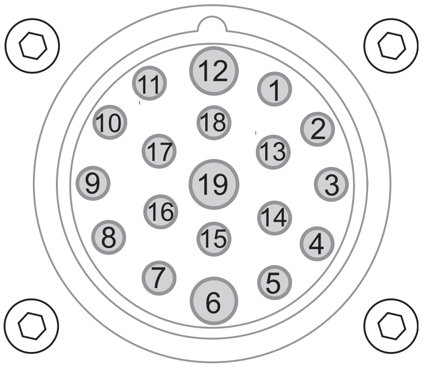


Figure 1.4.2: 19-Pin M23 (Male) Connector Pin Numbers

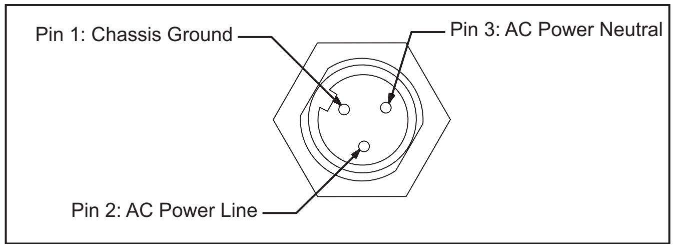


Figure 1.4.3: P3 3-Pin Euro AC Connector

N Note: Recommended Mating Connector for the M23 19-Pin P1: Phoenix Order # 1000042 Female M23 Straight Solder Cup Connector

Motor Specifications

Single Length

Holding Torque.. 1147 oz-in/810 N-cm
Detent Torque...35 oz-in/25 N-cm
Rotor Inertia ....0.0917 oz-in-sec^2/6.5 kg-cm^2
Weight (Motor + Driver)... 14.07 lb/6.38 kg

Double Length

Holding Torque.. 2294 oz-in/1620 N-cm
Detent Torque...84 oz-in/59 N-cm
Rotor Inertia ....0.1833 oz-in-sec^2/13 kg-cm^2
Weight (Motor + Driver)...21.25 oz/9.64 kg

Options and Accessories

Internal Encoder

Internal differential optical encoders are offered factory-installed with the MDrive42AC Plus Microstepping. Refer to the Encoder Specifications section for available line counts. All encoders come with an index mark, unless noted.

Control Knob

The MDrive42AC Plus is available with a factory-mounted rear control knob for manual shaft positioning. Not available with the Sealed (-65) version.

Parameter Setup Cable and Adapter

The optional 12.0' (3.6m) parameter setup cable part number MD-CC300-000 with adapter MD-ADP-M23 facilitates communications wiring and is recommended with first order. It connects to the MDrive's P1 19-pin male M23 connector.

Cordsets

19-pin M23 single-ended cordsets are offered to speed prototyping of the MDrive34AC Plus. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination MD-CS100-000
Right Angle Termination... MD-CS101-000

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PART 2: INTERFACING AND CONFIGURING

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Logic Interface and Connection

MDriveAC Plus Microstepping Optically Isolated Logic Inputs

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

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

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

3] Enable (EN)

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

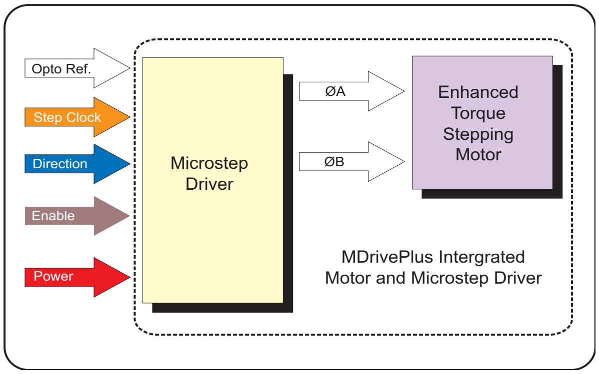

Figure 2.1.1: MDriveAC Plus Microstepping Block Diagram

Isolated Logic Input Pins and Connections

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

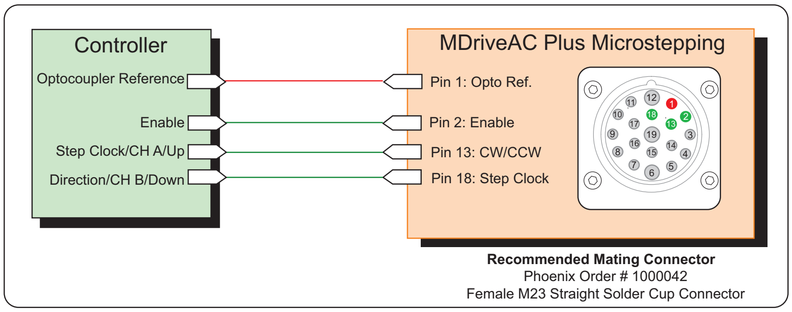

Figure 2.1.2: Isolated Logic Pins and Connections

Isolated Logic Input Characteristics

Enable Input

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

Clock Inputs

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

Step Clock

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

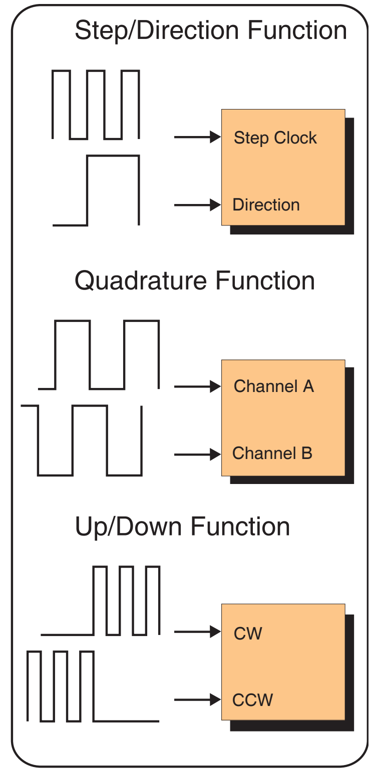

Figure 2.1.3: Input Clock Functions

Direction

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

Quadrature

The Quadrature clock function would typically be used for following applications where the MDriveAC Plus Microstepping would be slaved to an MDriveAC Plus Motion Control (or other controller) in an electronic gearing application.

Up/Down

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

Enable

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

Input Timing

The direction input and the microstep resolution inputs are internally synchronized to the positive going edge of the step clock input. When a step clock pulse goes HIGH, the state of the direction input and microstep resolution settings are latched. Any changes made to the direction and/or microstep resolution will occur on the rising edge of the step clock pulse following this change. Run and Hold Current changes are updated immediately. The following figure and table list the timing specifications.

Input Filtering

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

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

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

Table 2.1.1: Input Clocks Timing Table

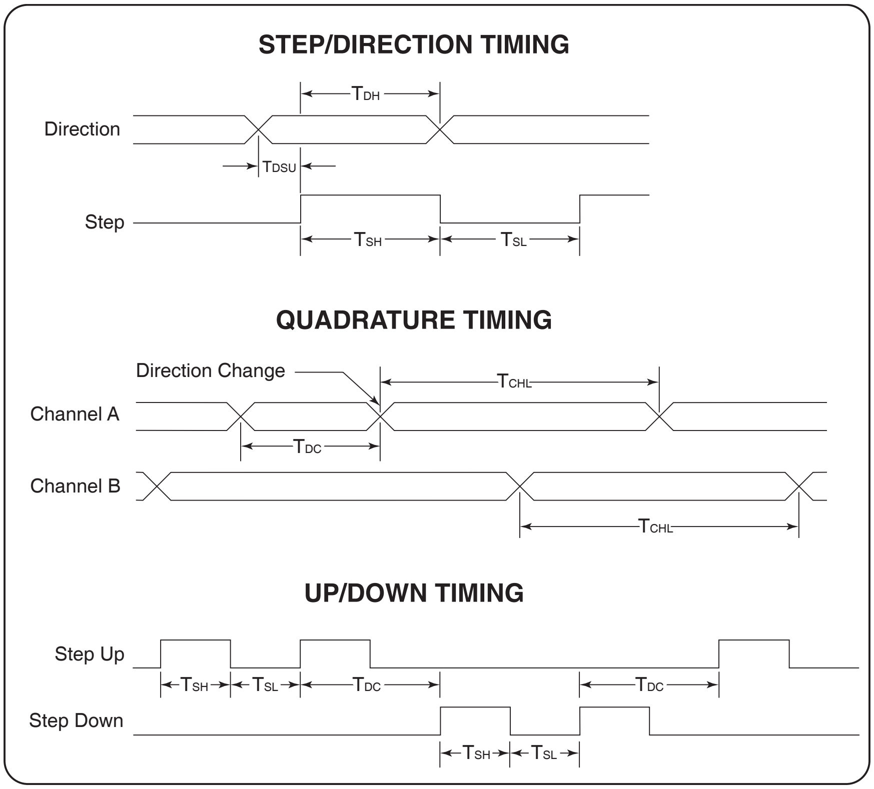

Figure 2.1.4: Clock Input Timing Characteristics

Optocoupler Reference

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

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

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

Table 2.1.2: Optocouple Reference Connection

Input Connection Examples

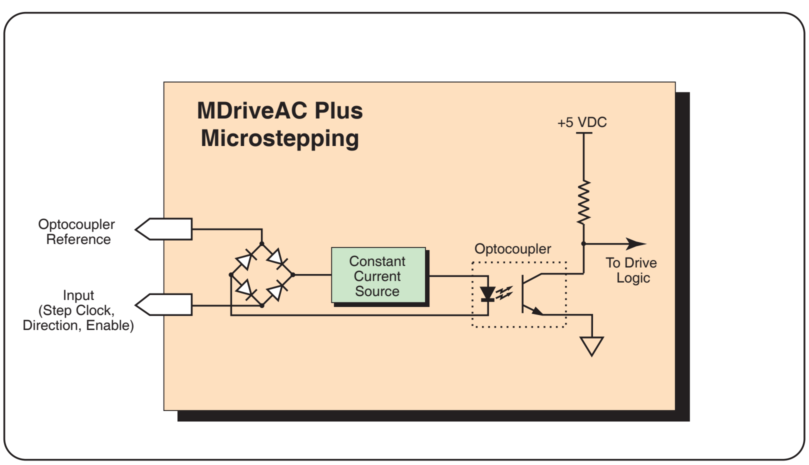

Figure 2.1.5: Optocoupler Input Circuit Diagram

NOTE: When connecting the Optocouple Supply, It is recommended that you do not use MDrive Power Ground as Ground as this will defeat the Optical

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

Open Collector Interface Example

Switch Interface Example

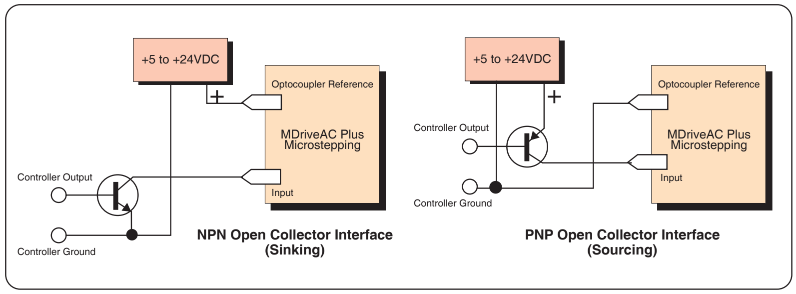

Figure 2.1.6: Open Collector Interface Example

Minimum Required Connections

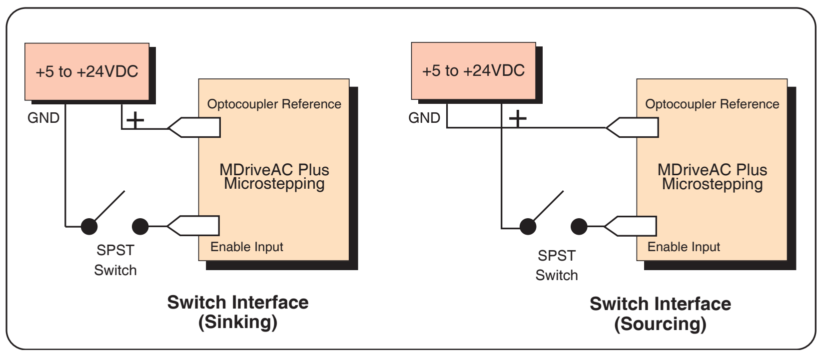

Figure 2.1.7: Switch Interface Example

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

Fault Output

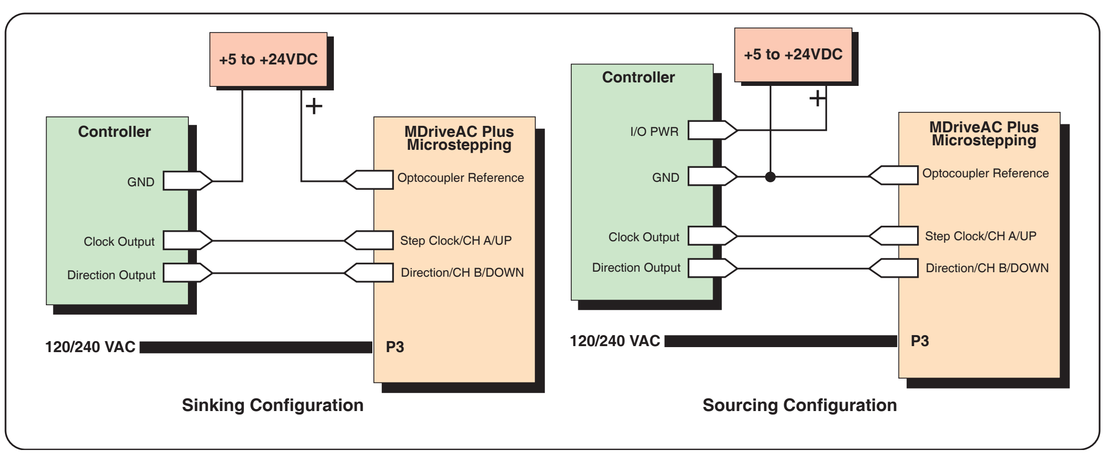

Figure 2.1.8: Minimum Required Connections

The MDriveAC Plus Microstepping features an open-drain Fault Output located at Pin 19 of the 19-pin M23 Connector P1. This is an impending over-temperature and over-temperature fault.

When the internal temperature of the device reaches the warning temperature set using the WARN TEMP Parameter, the output will pulse at 1 second intervals (½ second on, ½ second off).

When an over-temperature fault state is reached, the output will be on continually.

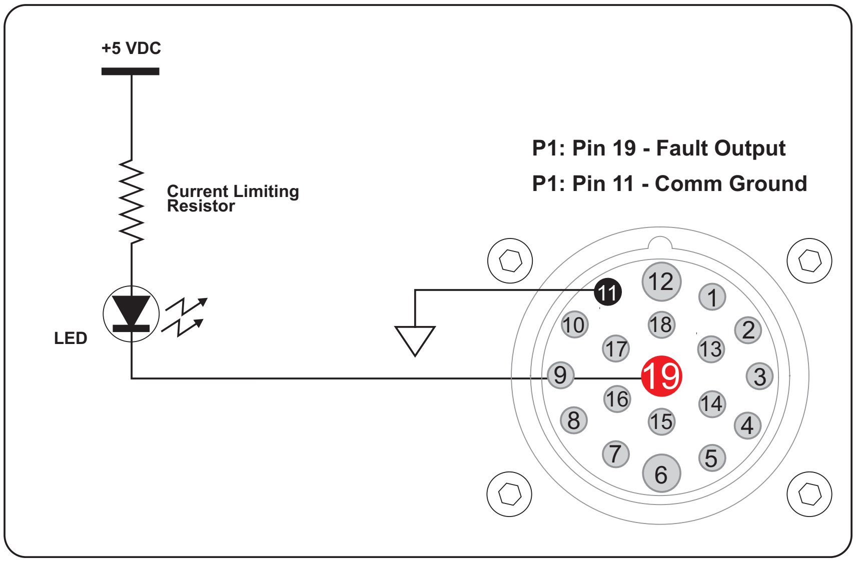

Figure 2.1.9: Fault Output Interfaced to an LED

SPI Connection and Interface

Connecting the SPI Interface

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

For prototyping we recommend the purchase of the parameter setup cable MD-CC300-000 and adapter MD-ADP-M23 attach directly to the MDriveAC Plus via a single-end Cordset..

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

Figure 2.2.1: MD-CC300-000 Parameter Setup Cable

SPI Signal Overview

+5 VDC (Output)

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

SPI Clock

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

Logic Ground

This is the ground for all Communications.

MISO (Master In/Slave Out)

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

CS (SPI Chip Select)

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

MOSI (Master Out/Slave In)

Carries output data from the SPI Master to the MDriveAC Plus Microstepping.

SPI Pins and Connections

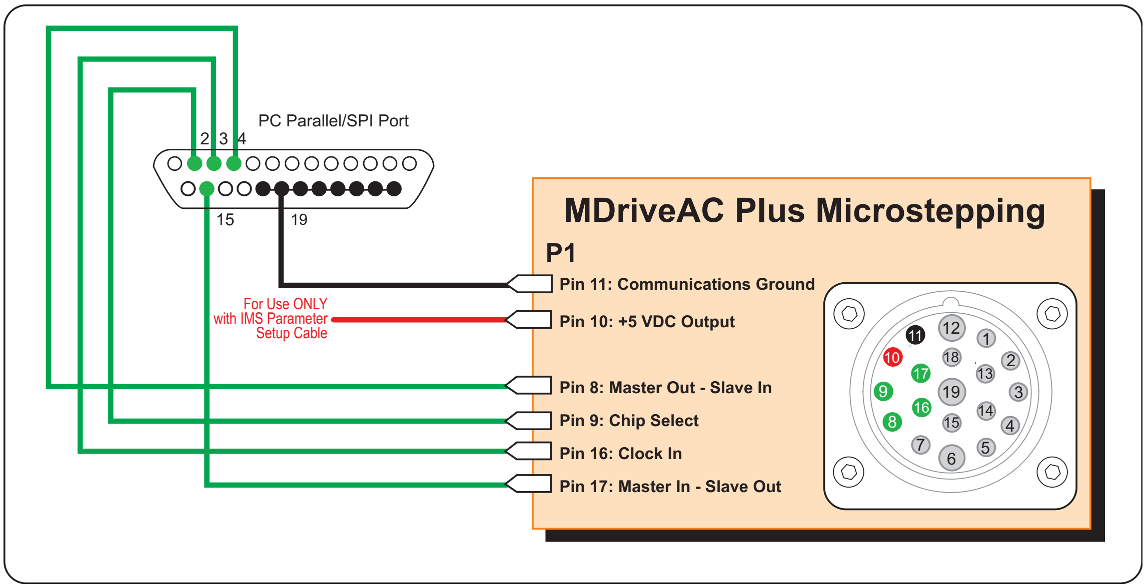

Figure 2.2.2: SPI Pins and Connections

SPI Master with Multiple MDriveAC Plus Microstepping

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

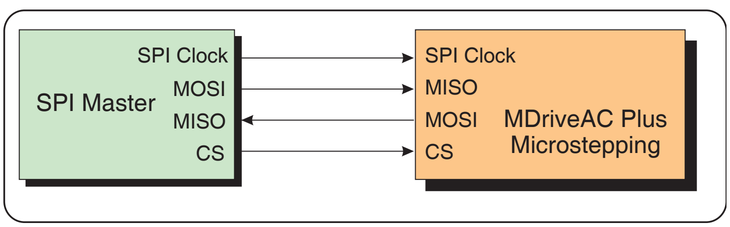

Figure 2.2.3: SPI Master with a Single MDriveAC Plus Microstepping

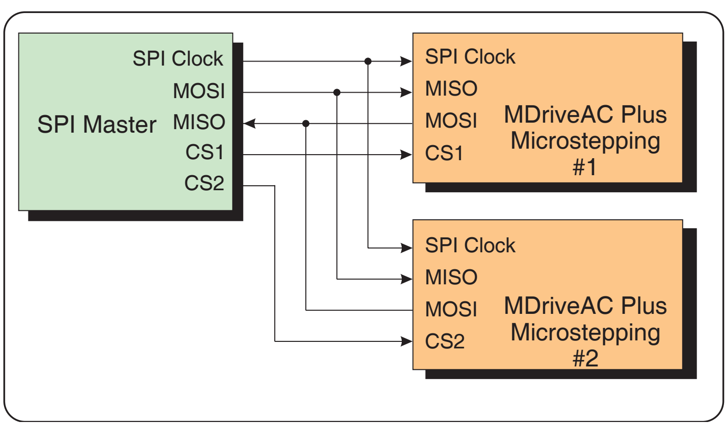

Figure 2.2.4: SPI Master with Multiple MDriveAC Plus Microstepping

Configuring the MDriveAC Plus Microstepping Using the IMS SPI Motor Interface

Installation

The IMS SPI Motor Interface is a utility that easily allows you to set up the parameters of your MDriveAC Plus Microstepping. It is available both on the MDriveAC Plus CD that came with your product and on the IMS web site at

Figure 2.3.1: MDriveAC Plus CD

http://www.imshome.com/software_interfaces.html.

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

Configuration Parameters and Ranges

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

Table 2.3.1: 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

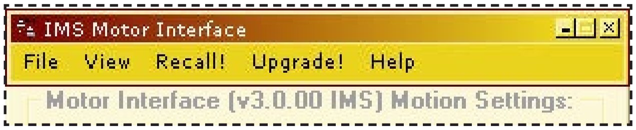

Figure 2.3.2: IMS SPI Motor Interface Menu Options

File

> Open: Opens a saved *.mot (Motor Settings) file.

> Save: Saves the current motor settings as a *.mot file for later re-use

> Save As

> Exit

View

> Motion Settings: Displays the Motion Settings screen

> IO Settings: Displays the IO Settings Screen

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

Recall!

Retrieves the settings from the MDriveAC Plus Microstepping.

Upgrade!

Upgrades the MDriveAC Plus Microstepping firmware.

Help

> About

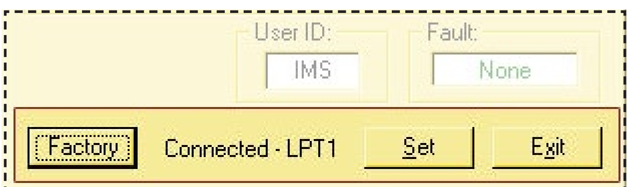

Figure 2.3.3: IMS SPI Motor Interface Buttons

IMS SPI Motor Interface Button Functions

Factory

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

Connected/Disconnected Indicator

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

Set

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

Exit

Disconnects and closes the program.

Motion Settings Configuration Screen

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

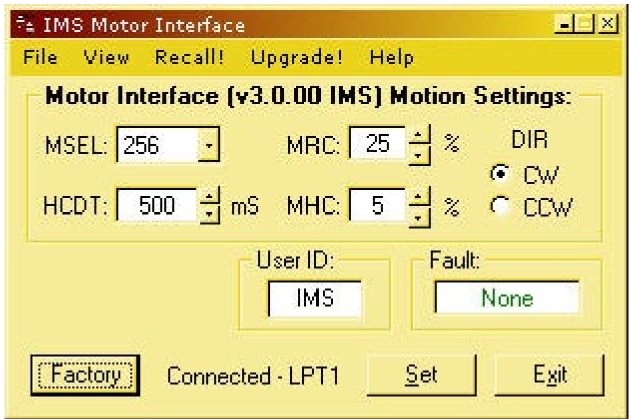

Figure 2.3.4: IMS SPI Motor Interface Motion Settings Screen

There are six basic parameters that may be set here:

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

MSEL (Microstep Resolution Selection)

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

The MDriveAC Plus 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 2.3.2: Microstep Resolution Settings

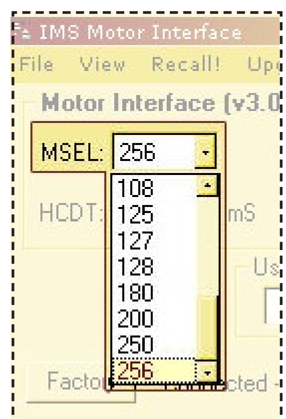

Figure 2.3.5: Microstep Resolution Select Settings

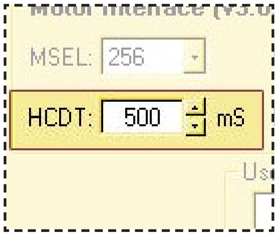

Figure 2.3.6: Hold Current Delay Time

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 MDrive will change to Hold Current when the specified time elapses.

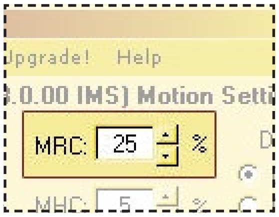

Figure 2.3.7: Motor Run Current

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 MDrive driver section.

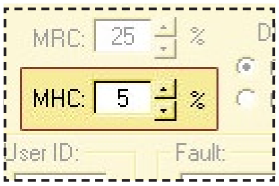

Figure 2.3.8: Motor Hold Current

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 HCDT setting mS following the last clock pulse.

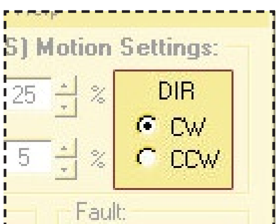

Figure 2.3.9: Motor Direction Override

DIR (Motor Direction)

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

Figure 2.3.10: User ID

User ID

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

IO Settings Configuration Screen

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

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

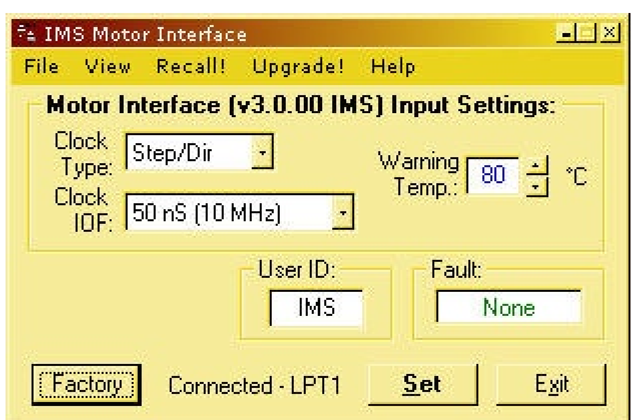

Figure 2.3.11: IMS SPI Motor Interface IO Settings Screen

Input Clock Type

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

The three clock types supported are:

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

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

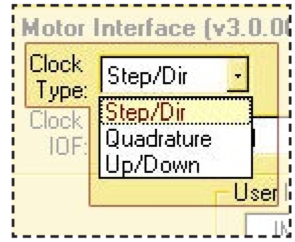

Figure 2.3.12: Input Clock Type

Input Clock Filter

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

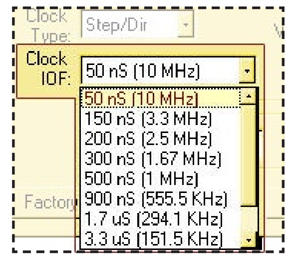

Figure 2.3.13: Input Clock Filter

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

Table 2.3.3: Input Clock Filter Settings

Warning Temperature

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

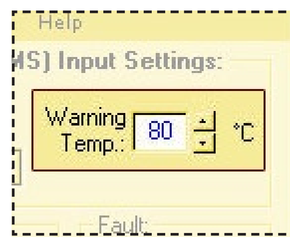

Figure 2.3.14: Warning Temperature

IMS Part Number/Serial Number Screen

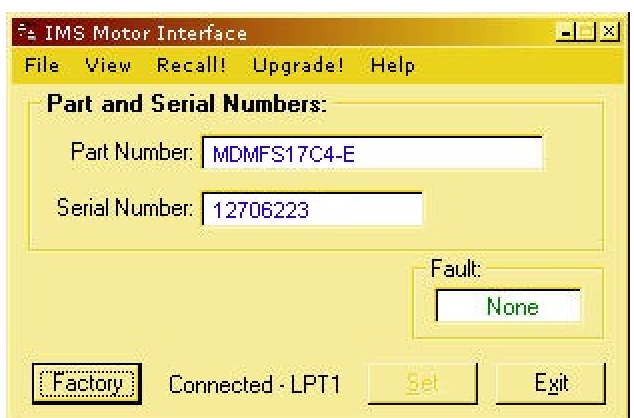

Figure 2.3.15: IMS Part and Serial Number Screen

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

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

Fault Indication

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

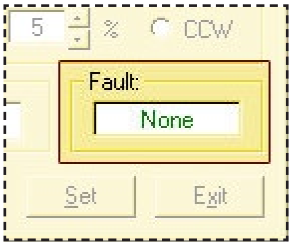

Figure 2.3.16: Fault Display

MDriveAC Plus Microstepping Fault Codes

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

*All Fault Codes are OR'ed together † MDrive23Plus Microstepping and Larger

Table 2.3.4: MDriveAC Plus Microstepping Fault Codes

Upgrading the Firmware in the MDriveAC Plus Microstepping

The IMS SPI Upgrader Screen

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

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

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

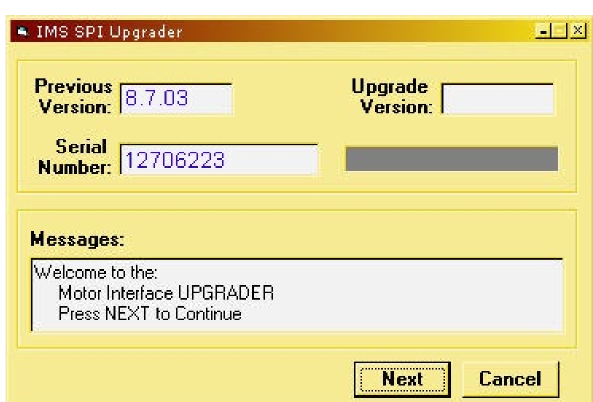

Figure 2.3.17: IMS SPI Upgrader Screen

Upgrade Instructions

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

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

Step 2: Select Upgrade File
```

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

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

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

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

Configuring the MDriveAC Plus Microstepping Using User-Defined SPI

The MDrive 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 system MDriveAC Plus Microstepping units parameter states being written/read.

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.

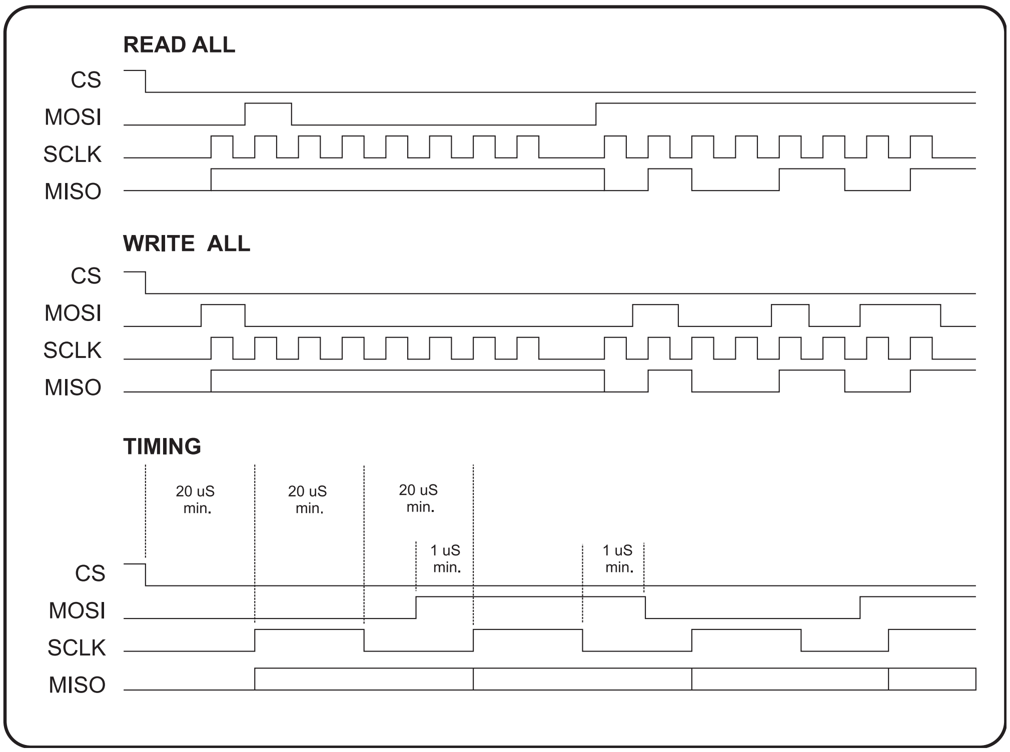

Figure 2.4.1: SPI Timing Diagram

Check Sum Calculation for SPI

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

The Check Sum is calculated as follows:

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

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

Send the check sum value of 1D

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

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

SPI Commands and Parameters

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

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

Table 2.4.1: SPI Commands and Parameters

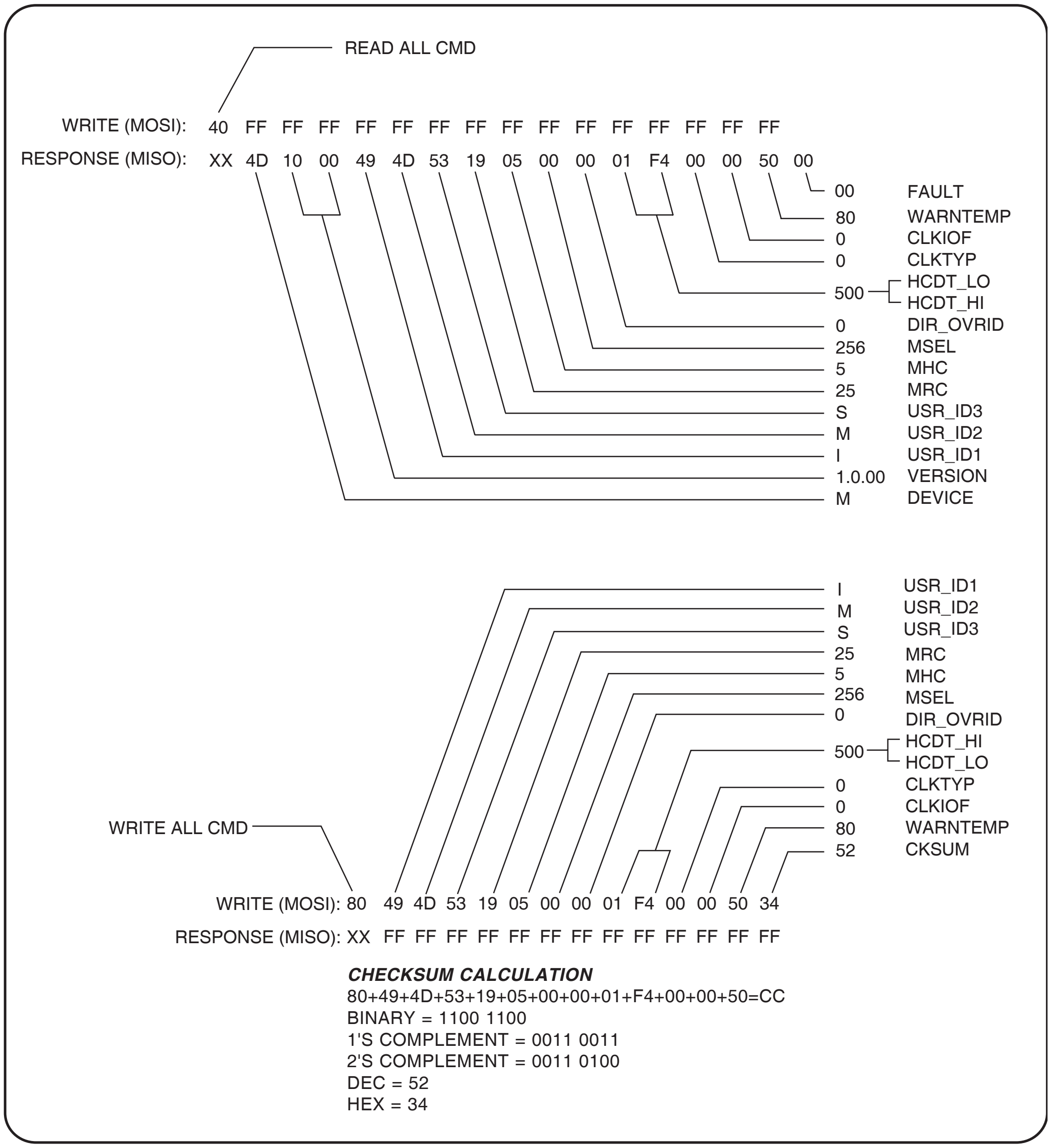

Figure 2.4.2: Read/Write Byte Order for Parameter Settings (Default Parameters Shown)

SPI Communications Sequence

See Timing Diagram and Byte Order figures.

READ

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

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

Write

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

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

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AC Plus
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APPENDICES

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MDriveAC Plus Microstepping Motor Performance

MDrive34AC Plus Microstepping

Speed-Torque Curves

MDrive34AC – 120VAC

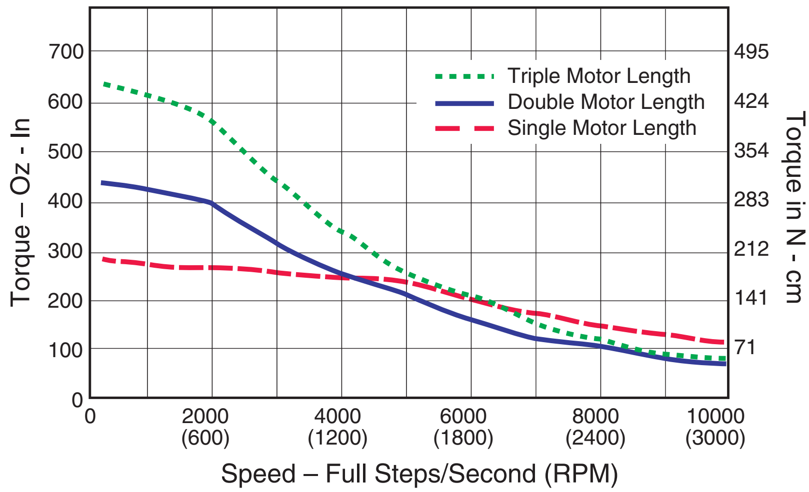


Figure A.1: MDrive34AC Plus 120VAC Microstepping Speed-Torque Curves

MDrive34AC – 240VAC

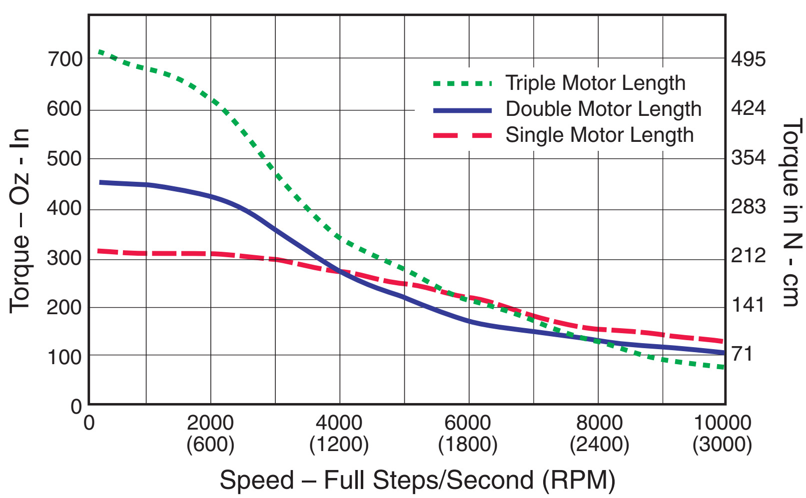


Figure A.2: MDrive34AC Plus 240VAC Microstepping Speed-Torque Curves

Motor Specifications

Single Length

Holding Torque...330 oz-in/233 N-cm
Detent Torque...10.9 oz-in/7.7 N-cm
Rotor Inertia ....0.01416 oz-in-sec^2/1.0 kg-cm^2
Weight (Motor + Driver)...6.4 lb/2.9 kg

Double Length

Holding Torque.......... 500 oz-in/353 N-cm
Detent Torque.......... 14.16 oz-in/14.0 N-cm
Rotor Inertia .... 0.02266 oz-in-sec^2/1.6 kg-cm^2
Weight (Motor + Driver).......... 7.7 lb/3.5 kg

Triple Length

Holding Torque.......... 750 oz-in/529 N-cm
Detent Torque.......... 19.83 oz-in/10.0 N-cm
Rotor Inertia .... 0.04815 oz-in-sec^2/3.4 kg-cm^2
Weight (Motor + Driver).......... 11.0 lb/5.0 kg

MDrive42AC Plus Microstepping

Speed-Torque Curves

MDrive42AC – 120VAC

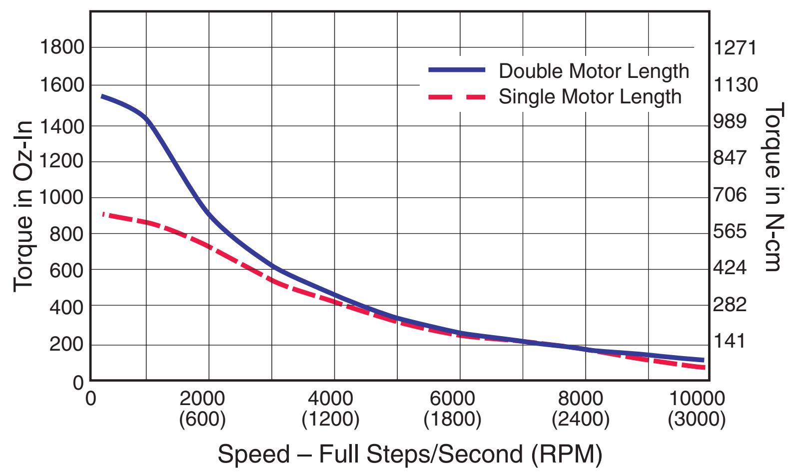


Figure A.3: MDrive42AC Plus 120VAC Microstepping Speed-Torque Curves

MDrive42AC – 240VAC

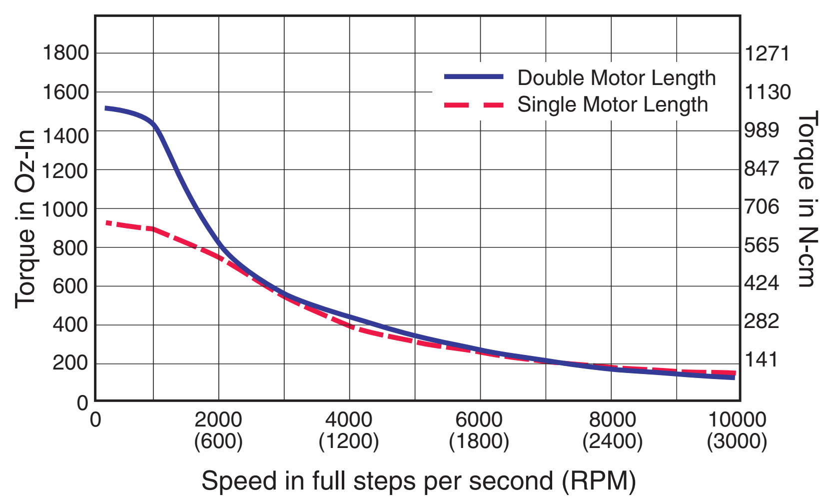


Figure A.4: MDrive42AC Plus 240VAC Microstepping Speed-Torque Curves

Motor Specifications

Single Length

Holding Torque.. 1147 oz-in/810 N-cm
Detent Torque.. 35 oz-in/25 N-cm
Rotor Inertia .... 0.0917 oz-in-sec^2/6.5 kg-cm^2
Weight (Motor + Driver).. 14.07 lb/6.38 kg

Double Length

Holding Torque.. 2294 oz-in/1620 N-cm
Detent Torque.. 84 oz-in/59 N-cm
Rotor Inertia .... 0.1833 oz-in-sec^2/13 kg-cm^2
Weight (Motor + Driver).. 21.25 oz/9.64 kg

MDrive with Planetary Gearbox

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 0 to +85º C.

Overload Torque

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

Available Planetary Gearbox

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

Gearbox Diameter	MDrive
81 mm	MDrive34
105 mm or 120 mm	MDrive42

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.

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.

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.)

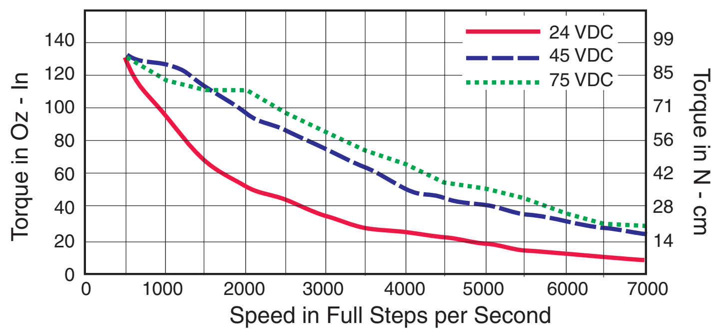


Figure B.1: MDrive23 Torque-Speed Curve

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 B.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

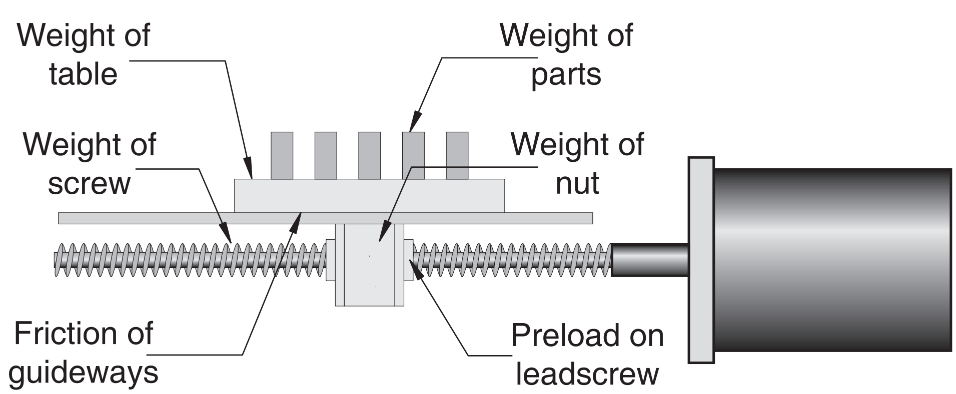


Figure B.2: Lead Screw System Inertia Considerations

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

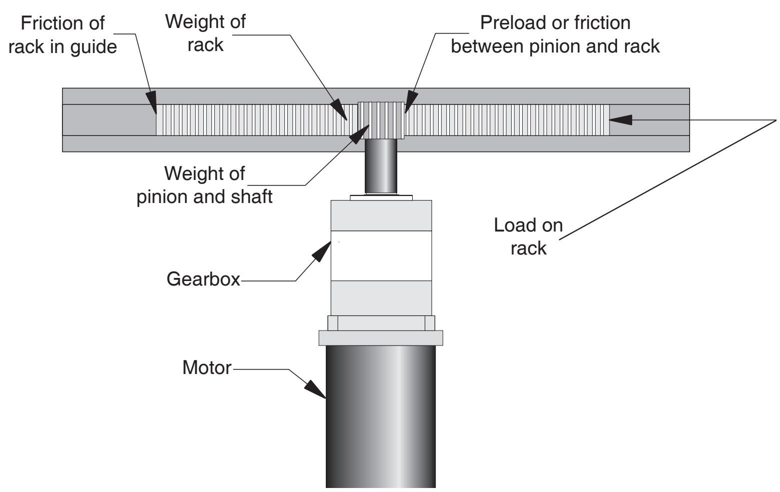


Figure B.3: Rack and Pinion System Inertia Considerations

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

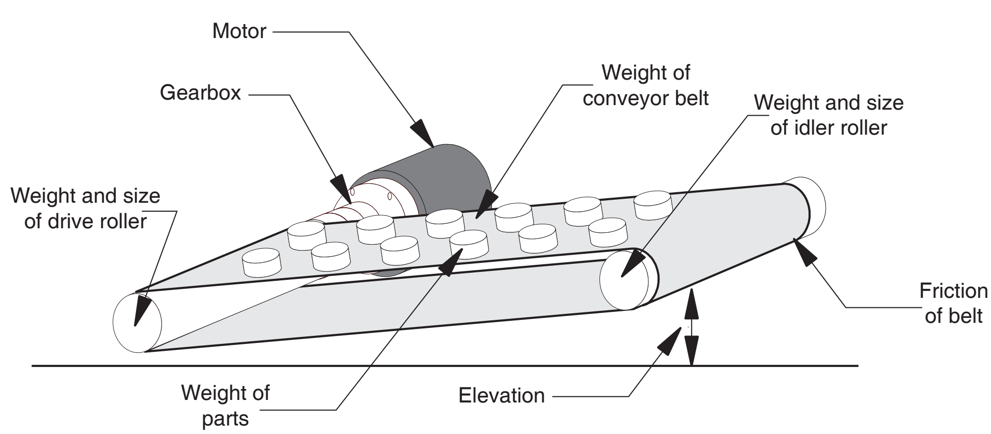


Figure B.4: Conveyor System Inertia Considerations

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

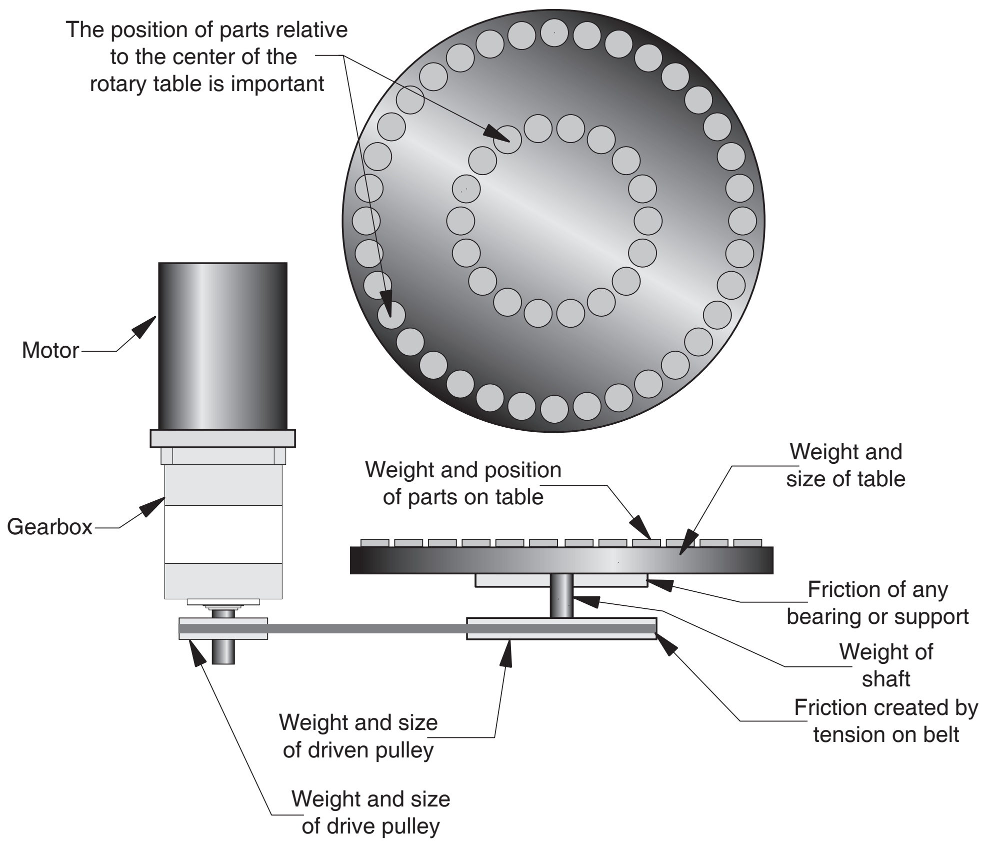


Figure B.5: Rotary Table System Inertia Considerations

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

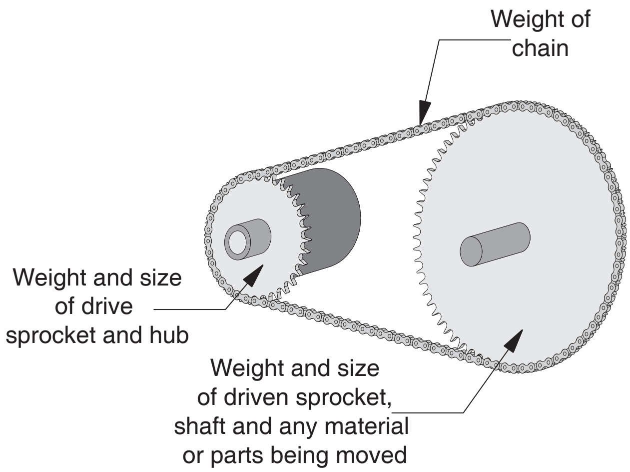


Figure B.6: Chain Drive System Inertia Considerations

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

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

Where:

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

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

Z = Gearbox Ratio

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

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

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

Where:

Z_{opt} = Optimal Gearbox Ratio

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

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

Planetary Gearbox Inertia

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

Planetary Gearbox Inertia Moments (oz-in-sec^2)			
Stages	Rounded Ratio	MDrive 34 Gearbox	MDrive 42 Gearbox
1-Stage	4:1	0.00233660	TBD
	5:1	0.00154357	
	7:1	0.00128867	
2-Stage	14:1	0.00219499	
	16:1	0.00179847	
	18:1	0.00182679	
	19:1	0.00141612	
	22:1	0.00148693	
	25:1	0.00177015	
	27:1	0.00148693	
	29:1	0.00124619	
	35:1	0.00126035	
	46:1	0.00126035	
3-Stage	51:1	0.00218082	
	59:1	0.00178431	
	68:1	0.00179847	
	71:1	0.00147276	
	79:1	0.00179847	
	93:1	0.00124619	
	95:1	0.00147276	
	100:1	0.00148693	
	107:1	0.00124619	
	115:1	0.00148693	
	124:1	0.00124619	
	130:1	0.00124619	
	139:1	0.00144444	
	150:1	0.00124619	
	169:1	0.00126035	
	181:1	0.00124619	
	195:1	0.00126035	
	236:1	0.00126035	
	308:1	0.00126035	

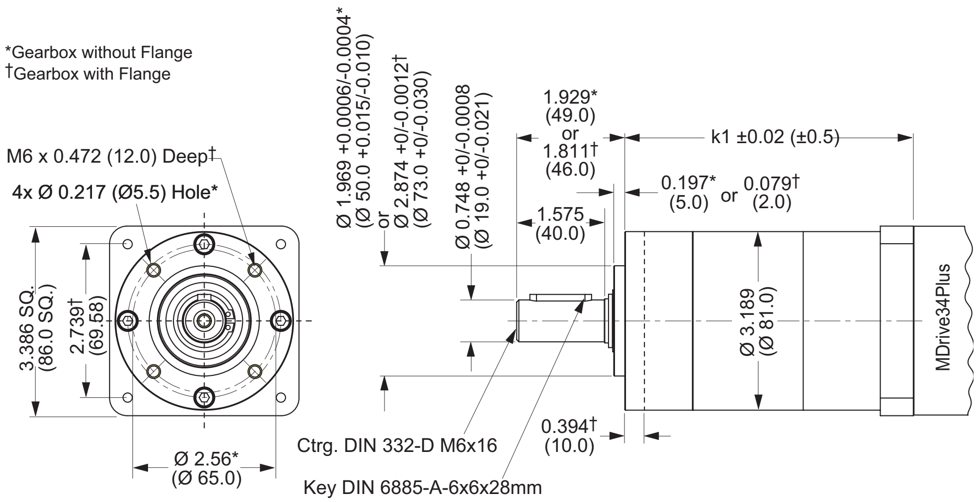
Table B2: Planetary Gearbox Inertia Moments

Dimensions in Inches (mm)

Planetary Gearbox Parameters

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

Table B3: Planetary Gearbox Specifications



Gearbox Lengths Inches (mm)

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

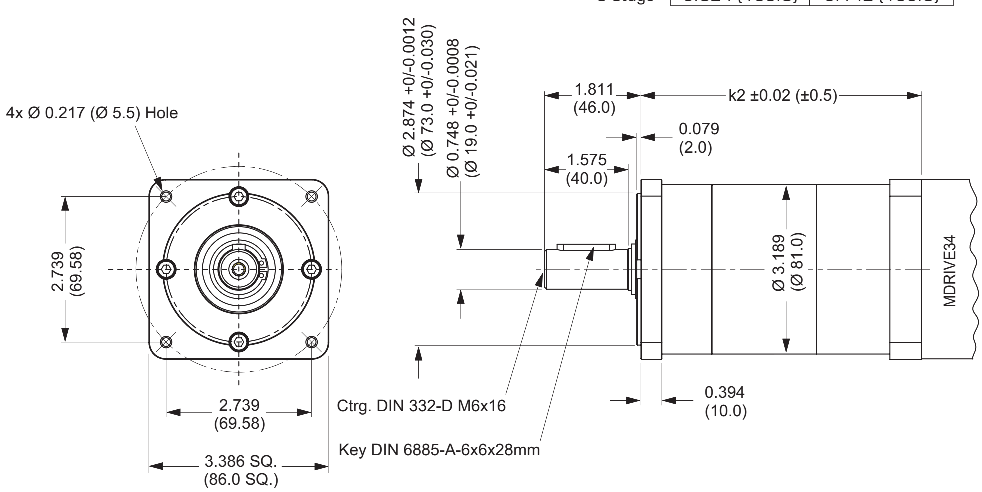


Figure B.7: Planetary Gearbox Specifications for MDrive34AC Plus

Ratios and Part Numbers

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

Table B4: Planetary Gearbox Ratios and Part Numbers

Optional Cables and Cordsets

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

NOTE: All three components, the MD-CC300-000, MD-ADP-M23 and MD-CS10x-000, or their equivalent are required for prototyping.

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

The MD-CC300-000 USB to SPI Parameter Setup Cable with adapter MD-ADP-M23 provides a communication connection between the 19-pin M23 connector on the MDriveAC Plus Microstepping and the USB port on a PC.

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

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

Figure C.1: MD-CC300-000

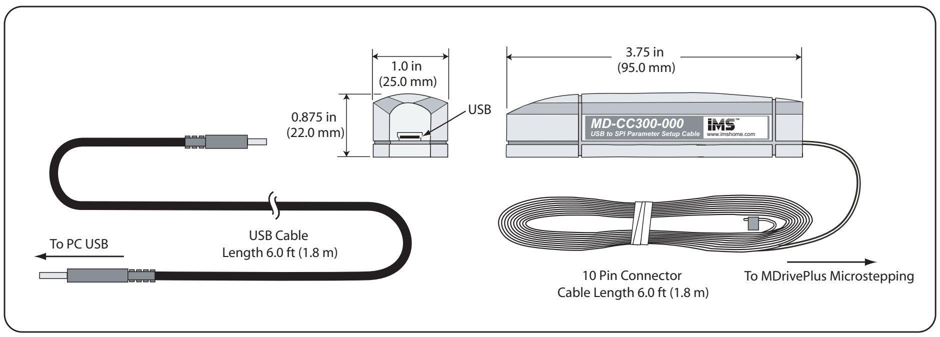


Figure C.2: MD-CC300-000 Mechanical Specifications

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

Installation Procedure for the MX-CC300-000

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

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

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

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

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

Installing the Cable/VCP Drivers

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

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

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

4) Select “No, not this time” on the radio buttons in answer to the query “Can Windows Connect to Windows Update to search for software?” Click “Next” (Figure C.3).

Figure C.3: Hardware Update Wizard

5) Select “Install from a list or specific location (Advanced)” on the radio buttons in answer to the query “What do you want the wizard to do?” Click “Next” (Figure C.4).

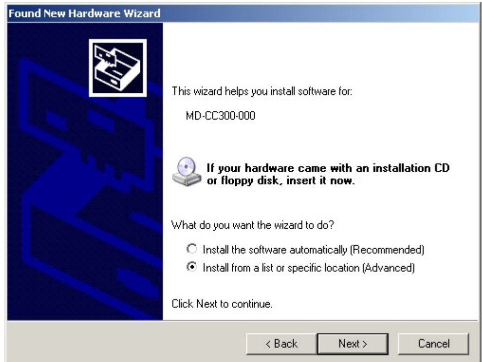


Figure C.4: Hardware Update Wizard Screen 2

6) Select “Search for the best driver in these locations.”
(a) Check “Include this location in the search.”
(b) Browse to the MDrive CD [Drive Letter]:\ Cable_Drivers\MD-CC303-000_DRIVERS.
(c) Click Next (Figure C.5).

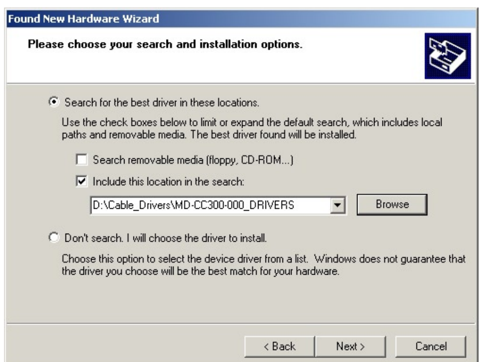


Figure C.5: Hardware Update Wizard Screen 3

7) The drivers will begin to copy.

8) On the Dialog for Windows Logo Compatibility Testing, click “Continue Anyway” (Figure C.6).

Figure C.6: Windows Logo Compatibility Testing

9) The Driver Installation will proceed. When the Completing the Found New Hardware Wizard dialog appears, Click “Finish” (Figure C.7).

Figure C.7: Hardware Update Wizard Finish Installation

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

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

Determining the Virtual COM Port (VCP)

The MD-CC300-000 uses a Virtual COM Port to communicate through the USB port to the MDrive. A VCP is a software driven serial port which emulates a hardware port in Windows.

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

To locate the Virtual COM Port.

1) Right-Click the “My Computer” Icon and select “Properties”.
2) Browse to the Hardware Tab (Figure C.8), 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 C.9). The COM # will be the Virtual COM Port connected. You will enter this number into your IMS SPI Motor Interface Configuration.

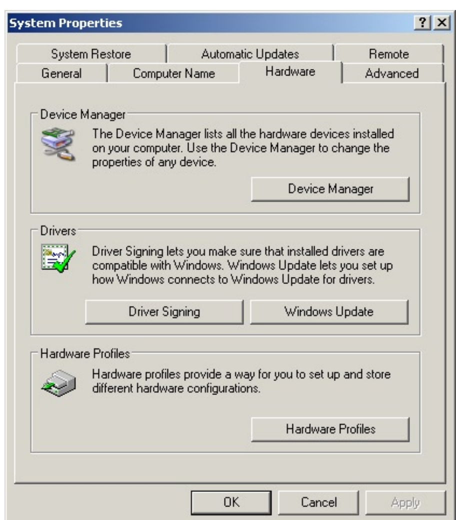


Figure C.8: Hardware Properties

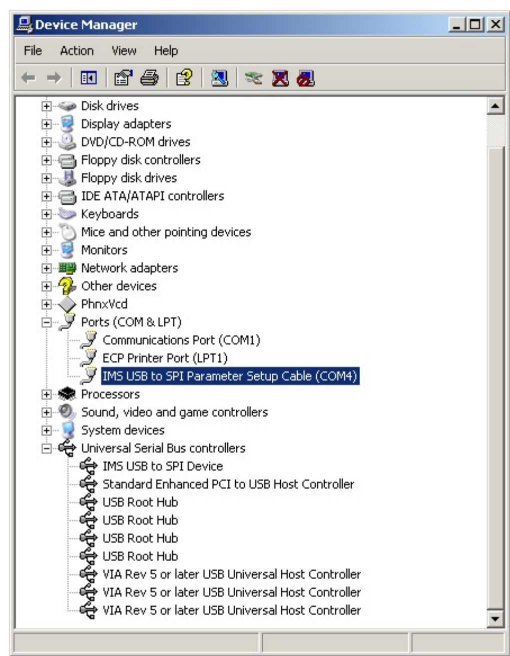


Figure C.9: Windows Device Manager

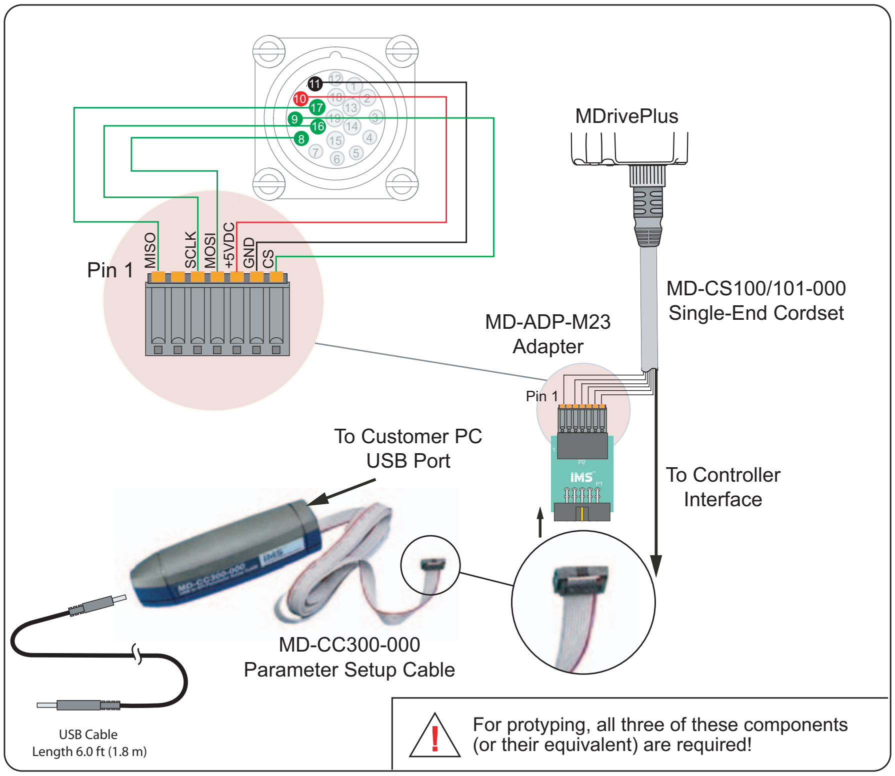


Figure C10: Typical Setup, Adapter and Single-End Cordset

Adapter

The MD-ADP-M23 Adapter provides connection capability between the MD-CC300-000 Parameter Setup Cable and the 19-Pin M23 connector on the MDriveAC Plus via a single-end cordset. The MD-ADP-M23 has two connectors: a 10-pin IDC, into which the MD-CC300-000 plugs dirctly, and a 7-Pin Pluggable Terminal Strip into which the Cordset is connected.

Figure C.11: MD-ADP-M23

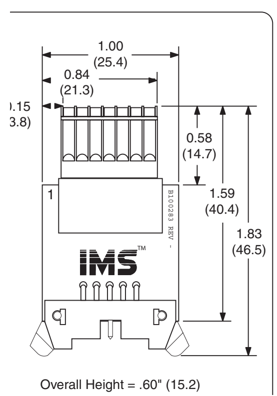


Figure C.12: MD-ADP-M23 Mechanical Specifications

Cordsets

MD-CS10x-000

19-pin M23 single-ended cordsets are offered to speed prototyping of the sealed MDriveAC Plus-65. Measuring 13.0' (4.0m) long, they are available in either straight or right angle termination. PVC jacketed cables come with a foil shield and unconnected drain wire.

Straight Termination MD-CS100-000
Right Angle Termination MD-CS101-000

M23 Cordset			
M23 Circular	M23 Cordset DC Color Code	M23 Circular	M23 Cordset DC Color Code
Pin 1	Violet	Pin 11	Black
Pin 2	Red	Pin 12 *	Green/Yellow
Pin 3	Grey	Pin 13	Yellow/Brown
Pin 4	Red/Blue	Pin 14	Brown/Green
Pin 5	Green	Pin 15	White
Pin 6	Blue	Pin 16	Yellow
Pin 7	Grey/Pink	Pin 17	Pink
Pin 8	White/Green	Pin 18	Grey/Brown
Pin 9	White/Yellow	Pin 19	Brown
Pin 10	White/Grey		

* Pin 12 makes an electrical contact to the M23 connector shell.

Table C.1: MD-CS10x-000 Wire Color Chart

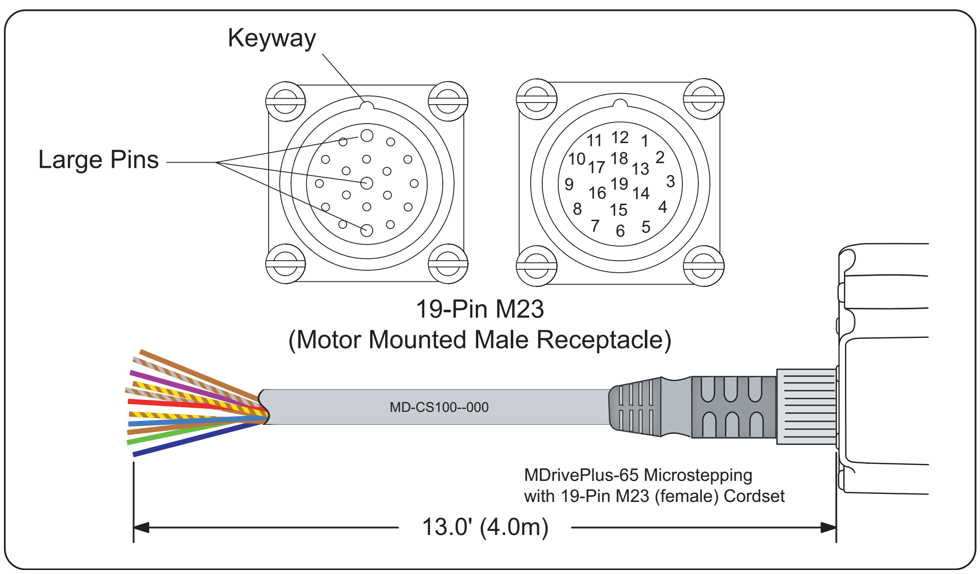


Figure C.13: MD-CS10x-000

MD-CS20x-000

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

Euro AC Cordset	
Euro AC	Euro Cordset Color Code
Pin 1	Yellow/Green
Pin 2	Brown
Pin 3	Blue

Table C.2: Euro AC Wire Color Chart

Straight Termination MD-CS200-000
Right Angle Termination MD-CS201-000

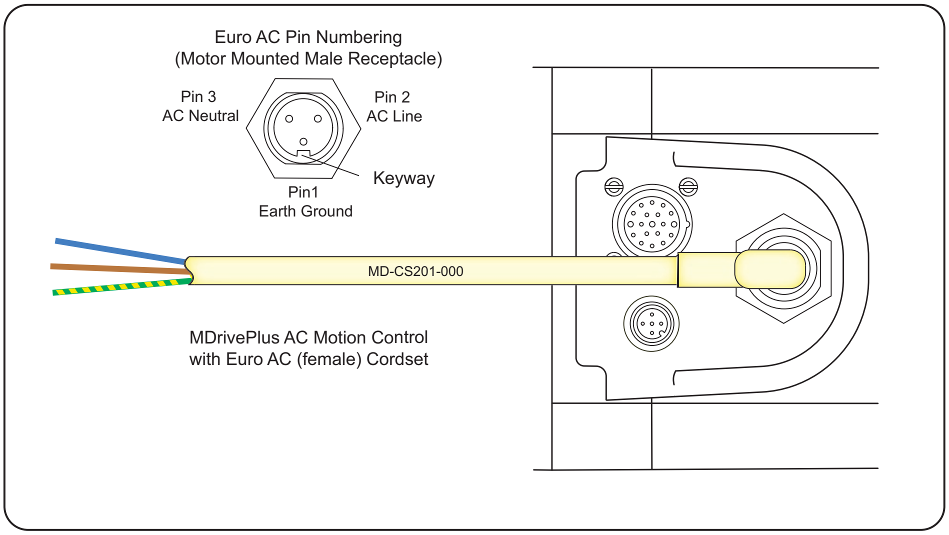


Figure C.14: MD-CS20x-000

Interfacing the Internal Differential Optical Encoder

Factory Mounted Encoder

Encoders are available in differential configurations. All encoders have an index mark, except the MDrive42AC 400 line count.

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.

The MDriveAC Plus Microstepping are available with an internal differential optical encoder. Available line counts are:

MDrive34AC		MDrive42AC	
Line Count	Part Number	Line Count	Part Number
100	EA	100	EA
200	EB	200	EB
250	EC	——	——
256	EW	——	——
400	ED	400	ED
500	EH	500	EH
512	EX	512	EX
1000	EJ	1000	EJ
1024	EY	1024	EY

Table D1: 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

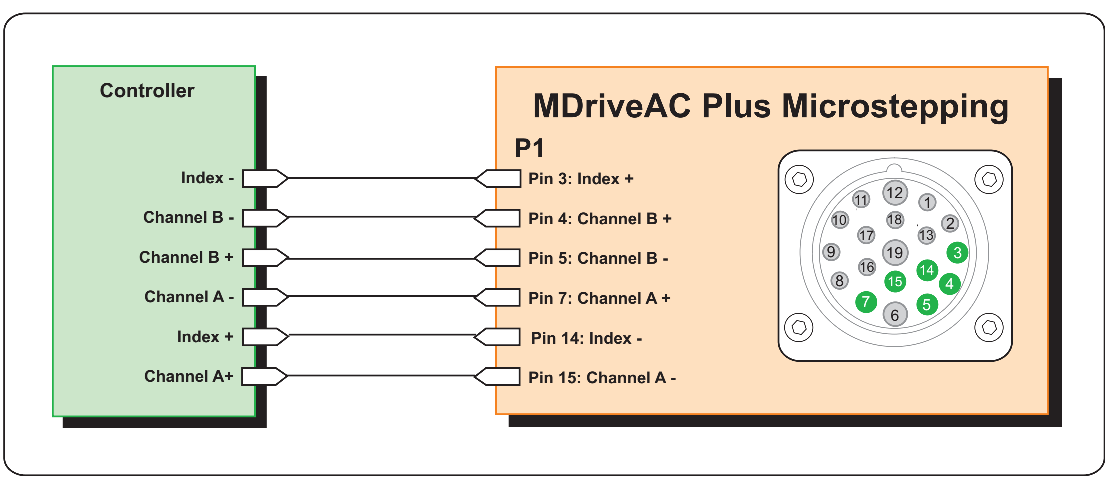


Figure D.1: Internal Differential Encoder Pin Configuration

Encoder Signals

Differential Encoder

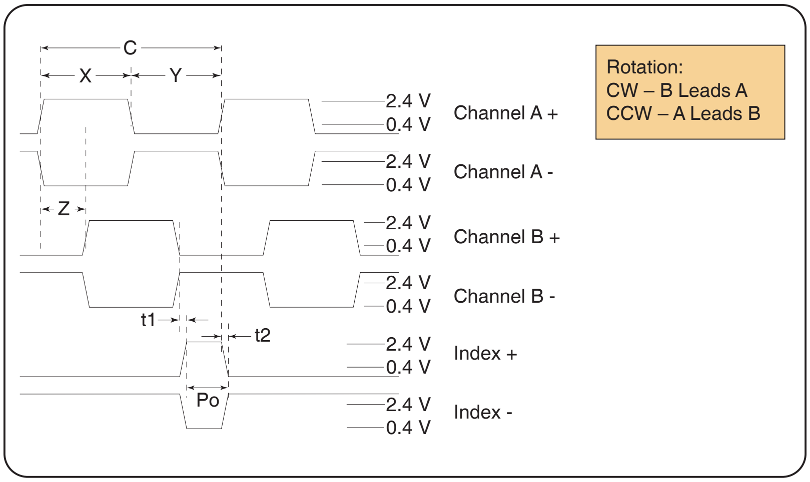


Figure D.2: Differential Encoder Signal Timing

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.

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WARRANTY

TWENTY-FOUR (24) MONTH LIMITED WARRANTY

Intelligent Motion Systems, Inc. ("IMS"), warrants only to the purchaser of the Product from IMS (the "Customer") that the product purchased from IMS (the "Product") will be free from defects in materials and workmanship under the normal use and service for which the Product was designed for a period of 24 months from the date of purchase of the Product by the Customer. Customer's exclusive remedy under this Limited Warranty shall be the repair or replacement, at Company's sole option, of the Product, or any part of the Product, determined by IMS to be defective. In order to exercise its warranty rights, Customer must notify Company in accordance with the instructions described under the heading "Obtaining Warranty Service."

This Limited Warranty does not extend to any Product damaged by reason of alteration, accident, abuse, neglect or misuse or improper or inadequate handling; improper or inadequate wiring utilized or installed in connection with the Product; installation, operation or use of the Product not made in strict accordance with the specifications and written instructions provided by IMS; use of the Product for any purpose other than those for which it was designed; ordinary wear and tear; disasters or Acts of God; unauthorized attachments, alterations or modifications to the Product; the misuse or failure of any item or equipment connected to the Product not supplied by IMS; improper maintenance or repair of the Product; or any other reason or event not caused by IMS.

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

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

Customer shall prepay shipping changes for Products returned to IMS for warranty service and IMS shall pay for return of Products to Customer by ground transportation. However, Customer shall pay all shipping charges, duties and taxes for Products returned to IMS from outside the United States.

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

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

U.S.A. SALES OFFICES
Eastern Region
Phone: 862/208-9742
Fax: 973/661-1275
E-mail: jroake@imshome.com
Central Region
Phone: 260/402-6016
Fax: 419/858-0375
E-mail: dwaksman@imshome.com
Western Region
Phone: 408/472-1971
Fax: 408/268-0716
E-mail: mwietharn@imshome.com

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

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

IMS UK Ltd.
25 Barnes Wallis Road
Segensworth East
Fareham, Hampshire, UK P0155TT
Phone: +44/1489/889-825
Fax: +44/1489/889-857
E-mail: mcheckley@imshome.com

IMS ASIA PACIFIC OFFICE
30 Raffles Pl., 23-00 Caltex House
Singapore 048622
Phone: +65/6233/6846
Fax: +65/6233/5044
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