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INTELLIGENT MOTION SYSTEMS, INC.

*Excellence in Motion™*

## USC-48-2

DUAL DRIVER UNIVERSAL SPEED CONTROL BOARD

# OPERATING INSTRUCTIONS



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Change Log		
Date	Revision	Changes
03/27/2006	R032706	Updated IMS Contact info, warranty and disclaimer info on cover.

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*USC-48-2 Operating Instructions  
Revision R032706*

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Table of Contents	
Section 1: The USC-48-2 Universal Driver And Speed Control	3
Section Overview	3
Introduction to the USC-48-2	3
IMS SPI Interface	4
Features and Benefits of the USC-48-2	4
Section 2: USC-48-2 Power & Thermal Requirements	5
Power Supply Current Requirements	5
Recommended IMS Power Supply	5
Thermal Specifications	5
Section 3: USC-48-2 Specifications	6
Section Overview	6
Mechanical Specifications	6
Electrical Specifications	7
Section 4: Interfacing The USC-48-2	8
Section Overview	8
Interface Guidelines	8
Interfacing the I/O	8
Connecting Motors	9
Motor Connections	10
Digital I/O	11
Description of the Digital I/O	12
Analog Speed Control I/O	14
Optional On-Board 10kW Speed Control Potentiometers	16
Speed 1 & 2 Select Options	17
Minimum Required Connections	18
Connecting the USC-48-2 SPI Interface	19
Section 5: Configuring The USC-48-2	21
Configuration Parameters Explained	22
Setting the Configuration Parameters	25
Configuring the USC-48-2 for Unidirectional Operation	25
Configuring the USC-48-2 for Bidirectional Operation	26
Configuring the USC-48-2 Using SPI	26
Timing Notes	26
SPI Commands	27
Examples	28

## List of Figures

Figure 3.1 USC-48-2 Mechanical Specifications .....	6
Figure 3.2 USC-48-2 Pin Locations .....	7
Figure 4.1 Connecting the Motors with the ADP-4210-FL Power Cable .....	9
Figure 4.2 Interfacing the Digital I/O with the ADP-2508-FL Signal Cable .....	11
Figure 4.3 Interfacing the Analog I/O with the ADP-2508-FL Signal Cable .....	14
Figure 4.4 Optional On-Board 10k $\Omega$ Potentiometers for Speed 1&2 .....	16
Figure 4.5 Velocity Input Options .....	17
Figure 4.6 Minimum Required Connections .....	18
Figure 4.7 SPI Interface Wiring and Connections .....	19
Figure 4.8 SPI Master/USC-48-2 Data Flow .....	20
Figure 5.1 Speed Control Configuration Utility Screen .....	21
Figure 5.2 Speed Control Configuration Utility Screen .....	25
Figure 5.3 SPI Waveforms .....	28
Figure 5.4 SPI Timing Diagram .....	29

## List of Tables

Table 2.1 Recommended Power Supply Specifications .....	5
Table 4.1 P1 Connector Pin Assignments .....	9
Table 4.2 P2 Digital I/O Pin Assignment and Description .....	11
Table 4.3 P3 Analog Speed Control Pin Assignments .....	14
Table 4.4 Velocity Input Combinations for Speed Select 1&2 .....	17
Table 4.5 SPI Pin Assignment and Description .....	19
Table 5.1 Speed Control Parameter Summary .....	22
Table 5.2 MSEL Settings .....	24
Table 5.3 Range Parameter Settings .....	24
Table 5.4 USC-48-2 SPI Command Summary .....	27

# SECTION 1

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## *The USC-48-2 Universal Driver And Speed Control*

### Section Overview

The purpose of this section is to introduce the user to the USC-48-2 Universal Driver/ Speed Control Interface Board. Covered are:

- Introduction to the USC-48-2
- USC-48-2 Features and Benefits

### Introduction to the USC-48-2

The USC-48-2 Universal Driver/Speed Control Interface Board offers the system designer a low cost, intelligent velocity control with dual on-board Microstepping Drives. The USC-48-2 is powered by a single +12 to +48 VDC power supply.

The USC-48-2 features a digital oscillator for accurate velocity control with an output frequency of up to 100 kilohertz. Output frequency will vary with the signal applied to the speed control inputs. The speed can be adjusted by a 15 to 25kHz PWM, 4 to 20mA, 0 to 20mA or 0 to 5 volts input signal.

The Speed Control Board incorporates two 1.6Amp RMS per phase drives. This gives users a single pulse source synchronized to the internal clock or external step and direction input. With this feature, wiring and controlling machines with large tables or wide conveyors requiring the use of dual motors can be simplified, and there is no drift between motor speeds.

One of the two speed inputs available with the USC-48-2 can be selected using the SPEED1/SPEED2 input. This allows the user to have two preset, external speed inputs that can be selected through an optically isolated input. The USC-48-2 will then accelerate/decelerate to the new value.

Optional on-board dual 10k potentiometers are available for the USC-48-2. These 15-turn potentiometers help to reduce wiring where remote access is not required.

## ***IMS SPI Interface***

The IMS SPI Interface software is an easy to install and use graphical user interface (GUI) for configuring the USC-48-2 from the parallel/SPI port on your computer. Access the GUI via the IMS SPI Interface included on the CD shipped with the product, or download at [www.imshome.com](http://www.imshome.com). Optional parameter setup cables are also available for ease of connecting and configuring this product.

IMS SPI Interface features include:

- Easy installation.
- Automatic communication configuration.
- Will not set out-of-range values.
- Tool-tips display valid range setting for each option.
- Ease of use via single screen interface.

## **Features and Benefits of the USC-48-2**

- Two On-Board 1.6A/Phase Microstepping Drives
- Digital Oscillator for Accurate Speed Control
- Optically Isolated Inputs will Accept +5 to +24 VDC Signals, Sourcing or Sinking
- Selectable Speed Control from One of Two 0 to +5 VDC Inputs (One Configurable as 4 to 20mA, 0 to 20mA or a 15 to 25kHz Isolated PWM Input), all with Programmable Center Point
- Low Cost
- Extremely Compact (3.5 x 3 x 1.25 inches) (89 x 76 x 32 mm)
- Configurable:
  - Motor Run/Hold Current
  - Speed Control Input Source
  - Motor Rotation vs. Direction Input
  - Acceleration/Deceleration
  - Initial and Max Velocity
  - Microstep Resolution to 256 Microsteps/Full Step
- Operation Modes: Joystick or Velocity
- Step Clock and Direction Out for Cascading Multiple Drives
- Single Supply +12 to +48 VDC
- Keyed and Locking Pin and Receptacle Connectors
- Graphical User Interface (GUI) for Quick and Easy Parameter Setup
- Optional On-Board Potentiometers

# SECTION 2


## USC-48-2 Power & Thermal Requirements

### Power Supply Current Requirements

The power supply current requirements for the USC-48-2 is 2.0A PER MOTOR (MAX). Actual Power Supply Current will depend upon load and duty cycle.

Motor Power Supply Requirements	
Recommended Supply Type	Unregulated DC
Ripple Voltage	±10%
Output Voltage	+12 to +48 VDC
Output Current	4.0A Peak

Table 2.1: Recommended Power Supply Specifications

	<b>WARNING! DO NOT</b> connect or disconnect power leads when power is applied! Disconnect the AC power side to power down the DC power supply. For battery operated systems, connect a “transient suppressor” across the power switch to prevent arcs and high voltage spikes.
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A characteristic of all motors is back EMF. Back EMF is a source of voltage 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 Drive.

### Recommended IMS Power Supply

#### IP404 Unregulated Linear Supply

##### Input Range

120 VAC Version ..... 102-132 VAC

240 VAC Version ..... 204-264 VAC

##### Output

No Load Output Voltage\* ..... 43 VDC @ 0 Amps

Continuous Output Rating\* ..... 32 VDC @ 2 Amps

Peak Output Rating\* ..... 26 VDC @ 4 Amps

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

### Thermal Specifications

Close attention must be paid to the thermal specifications of the electronics. The following maximum temperatures apply to the USC-48-2:

Maximum Ambient Temperature ..... 0 to +50°C

Maximum Storage Temperature ..... -40 to +125°C

Maximum Operating Temperature ..... +70°C

# SECTION 3

## USC-48-2 Specifications

### Section Overview

This section contains mechanical and electrical specifications of the USC-48-2 Universal Driver/Speed Control. Shown are:

- Mechanical Specifications
- Electrical Specifications

### Mechanical Specifications

Dimensions in inches (mm)

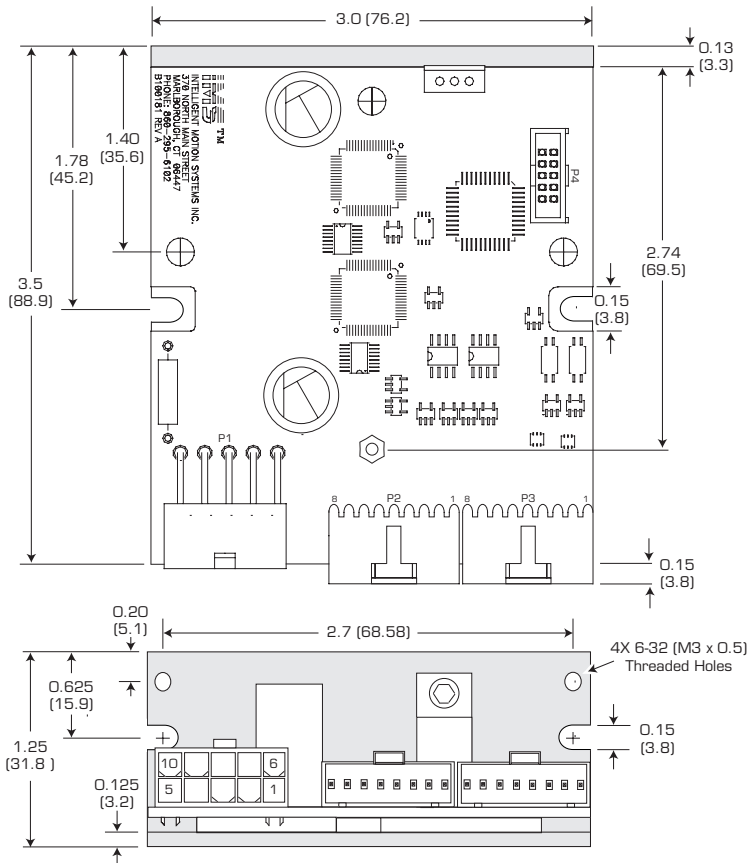


Figure 3.1: USC-48-2 Mechanical Specifications

# Electrical Specifications

Input Voltage (+V) Range .....	+12 to +48 VDC
Speed Control Input 1 .....	0 to +5 VDC, 4 to 20mA or 0 to 20mA
Speed Control 2.....	0 to +5 VDC
A/D Resolution .....	10 bit
Speed Control Potentiometer Resistance .....	10 kW
Step Clock, Direction Out (Drain Source Voltage Max).....	100 VDC
Step Clock, Direction Out (Continuous Drain Current) .....	100 mA
Isolated Inputs.....	Speed1/Speed2/PWM, Start/Stop, Direction, SCLK In, Enable
Isolated Input Voltage Range (Sourcing or Sinking).....	+5 to +24 VDC
Isolated Input Current (Max) .....	18 mA
PWM Input Frequency.....	15 to 25 kHz
Maximum Output Frequency.....	100 kHz

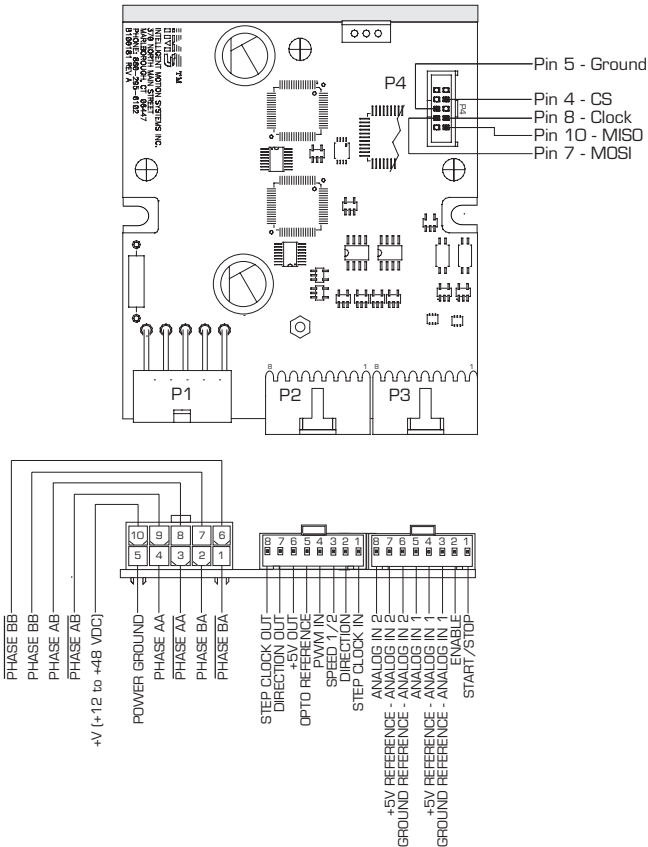


Figure 3.2: USC-48-2 Pin Locations

# SECTION 4

## *Interfacing The USC-48-2*

### Section Overview

This section will acquaint the user with connecting and using the USC-48-2 Universal Driver/Speed Control. Covered in this section are:

- Interface Guidelines
- Interfacing the I/O
- Interfacing the SPI Interface

### 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 AC ground. 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.

Leads from the Power Supply to the USC-48-2, and from the USC-48-2 to the motors must be a twisted pair.

### Interfacing the I/O

The USC-48-2 utilizes one 10 Position, Keyed and Locking Pin and Receptacle for interfacing the Power and Motor; Two 8 Position Keyed and Locking Pin and Receptacles for Digital I/O and for Analog Speed Control I/O; One 10 Pin IDC Connector for the SPI Interface. For quick connection and setup of the USC-48-2, the following cables are available from IMS.

#### Parameter Setup Cable

A low cost accessory which eliminates the need for the user to wire communications. Included in this cable is built-in logic level shifting circuitry to accommodate the 3.3v ports on some PCs.

Order Cable Part No. MD-CC100-000 to connect the USC-48-2 to a standard DB-25 PC Parallel/SPI port.

#### Prototype Interface Cables

To expedite interfacing to USC-48-2, there are two Prototype cables. One for power and the other for logic signals.

Power Cable Order Number..... ADP-4210-FL

Signal Cable Order Number (2 Required) ..... ADP-2508-FL



**WARNING! DO NOT** connect or disconnect power leads when power is applied! Disconnect the AC power side to power down the DC power supply. For battery operated systems, connect a "transient suppressor" across the power switch to prevent arcs and high voltage spikes.

## Mating Connector Information

In production situations, customers 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.

Connector:	P1	P2&P3
Manufacturer:	Molex	Tyco
Receptacle:	39012105	104257-7
Contact:	44476-111	104480-7

\*Please refer to manufacturer's data sheets for additional information.

## Connecting Motors

The USC-48-2 Universal Driver/Speed Control is capable of driving two motors simultaneously. The connections for the motors is accomplished at receptacle P1.

Pin #	Pin Name	Function
1	Phase /BA	Phase /B of the A Motor Circuit
2	Phase BA	Phase B of the A Motor Circuit
3	Phase /AA	Phase /A of the A Motor Circuit
4	Phase AA	Phase A of the A Motor Circuit
5	GND	Power Ground
6	Phase /BB	Phase /B of the B Motor Circuit
7	Phase BB	Phase B of the B Motor Circuit
8	Phase AB	Phase A of the B Motor Circuit
9	Phase /AB	Phase /A of the B Motor Circuit
10	V+	+12 to +48 VDC Power

Table 4.1: P1 Connector Pin Assignments

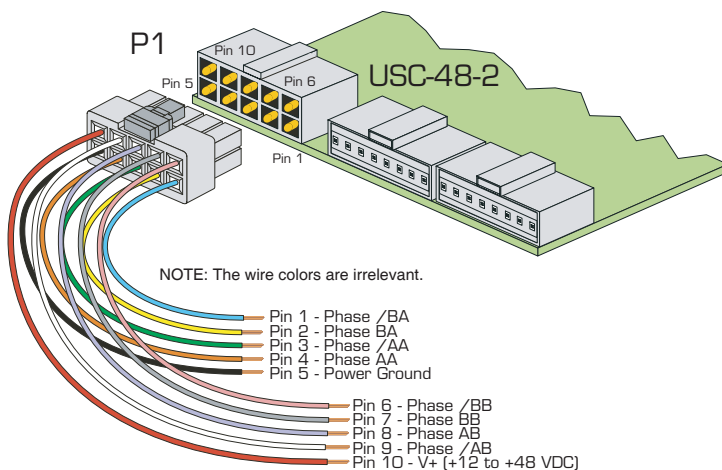
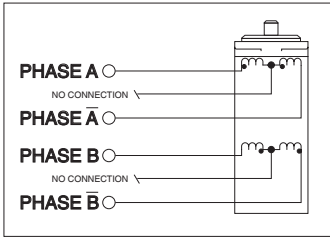


Figure 4.1: Connecting the Motors with the ADP-4210-FL Power Cable

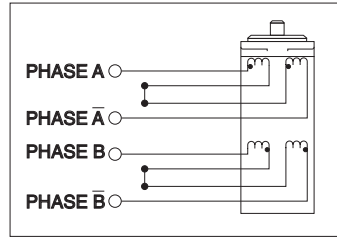
# Motor Connections

## 6 Lead Motors Full Coil Configuration



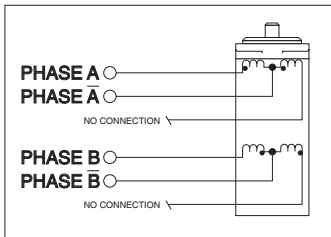
Motor Peak Current =  
Rated Amps/Phase

## 8 Lead Motors Series Connection



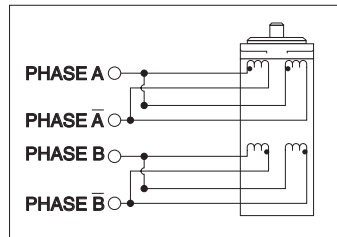
Motor Peak Current =  
Rated Amps/Phase  
or  
Motor Peak Current =  
Bipolar Current Rating x 1.4

## Half Coil Configuration



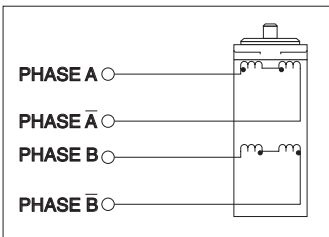
Motor Peak Current =  
Rated Amps/Phase x 1.4

## Parallel Connection



Motor Peak Current =  
Rated Amps/Phase x 2  
or  
Motor Peak Current =  
Bipolar Current Rating x 1.4

## 4 Lead Motors



Motor Peak Current =  
Rated Amps/Phase x 1.4

**MAXIMUM**  
Motor Inductance (mH/Phase) =  
 $0.2 \times \text{Minimum Supply Voltage}$

# Digital I/O

The Digital Inputs and Outputs are interfaced through Connector P2.

Pin #	Pin Name	Function
1	SCLK IN	Step Clock Input from the user's control circuitry.
2	DIR	Direction Input from the user's control circuitry. Controls CW/CCW direction of the motor.
3	SPEED 1/2	Selects Speed 1 or Speed 2 settings. A logic HIGH = Speed 1. A logic LOW = Speed 2
4	PWM IN	Pulse Width Modulated. A 15 to 25 kHz Speed Control Input.
5	OPTO REF	Optocoupler Reference. Either +5 to +24 VDC (sinking) or Ground (sourcing).
6	+5V OUT	+5 VDC Output (10 mA max).
7	DIR OUT	The Direction Output follows the Direction Input to be used on a third axis driver.
8	SCLK OUT	The Step Clock Output follows the Step Clock Input to be used on a third axis driver.

Table 4.2: P2 - Digital I/O Pin Assignment and Description

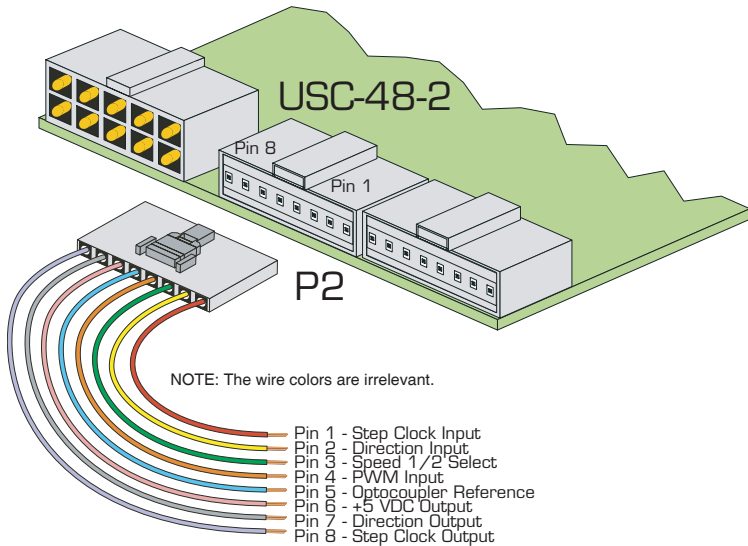


Figure 4.2: Interfacing the Digital I/O with the ADP-2508-FL Signal Cable

## ***Description of the Digital I/O***

### **Pin 1 - Step Clock (Input)**

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 on the state of the direction input) on the transition of the input from closed to open. The size of this increment or decrement will depend on the microstep resolution setting.

### **Pin 2 - Direction (Input)**

The Direction Input controls the Clockwise/Counterclockwise direction of the motor. It may be configured as sinking or sourcing depending on the state of the Optocoupler Reference. The direction, based on the state of the input, may be set using the IMS Motor Interface software accessed through the IMS SPI Interface on the CD included with the USC-48-2. The direction input may be connected by means of a switch between Pin 2 and the Optocoupler Return when the Optocoupler reference is +5 to +24 VDC (sinking) or between Pin 2 and the Optocoupler +5 to +24 VDC supply when the Optocoupler reference is ground (sourcing).

### **Pin 3 - Speed 1/2 Select**

This input is used to select which Speed Control Input (Speed 1 or 2) is used to control the velocity of the axis if the device is in the voltage mode. When the circuit is open, or at 5 - 24VDC, the velocity of the axis will be controlled by Speed Control Input #1. When the circuit is closed, velocity will be controlled Speed Control Input #2.

Configure as either sinking or sourcing, based upon the state of the Optocoupler Reference.

### **Pin 4 - PWM Input**

If PWM Mode is selected in the Speed Control Interface Software, then this input will be a 15 to 25 kHz PWM Input and is the input by which the internal step clock frequency, hence the velocity of the motor, is controlled.

### **Pin 5 - Opto Reference**

The Optocoupler Reference supplies +5 to +24 VDC for sinking or logic ground for sourcing.

When using the inputs as sinking inputs, a reference voltage between +5 and +24VDC is connected to the Optocoupler Reference. To maintain isolation, this power source should not be connected to the motor power source. The isolated inputs are then interfaced to a sinking output (which utilizes the same supply as the opto coupler reference input) such as a switch, open collector, or PLC output.

When using the inputs as sourcing inputs, the Optocoupler Reference will be connected to ground. To maintain isolation, this power source should not be connected to the motor power source. The isolated inputs are then sourced to between +5 to +24VDC (which utilizes the same supply as the opto coupler

reference input) and interfaced using a switch, open collector, or PLC output.

**Pin 6 - +5V Output**

A +5 VDC Output. 10 mA maximum Output Current.

**Pin 7 - Direction Output**

The Direction output is buffered through an open-drain N-channel FET. This output will follow the direction signal used internally to control the direction of the speed control.

**Pin 8 - Step Clock Output**

The Step Clock output is buffered through an open-drain N-channel FET. This

# Analog Speed Control I/O

Pin #	Pin Name	Function
1	START/STOP	When the Start/Stop circuit is open, the Internal Step Clock will be off. When the Start/Stop circuit is closed, the Internal Step Clock will be on.
2	ENABLE	When the Enable circuit is open, the Driver Outputs are enabled. When the Enable circuit is closed, the Driver Outputs will be disabled.
3	GND_REF_ANLG IN_1	Logic Ground for the 10kΩ Potentiometer for Analog Speed Control Input 1.
4	+5 REF_ANLG IN_1	+5 VDC for 10kΩ Potentiometer for Analog Speed Control Input 1. (1mA max).
5	ANALOG IN 1	Analog Speed Control Input 1. (0 to +5V, 4-20mA/0-20mA)
6	GND_REF_ANLG IN_2	Logic Ground for the 10kΩ Potentiometer for Analog Speed Control Input 2.
7	+5 REF_ANLG IN_2	+5 VDC for 10kΩ Potentiometer for Analog Speed Control Input 2. (1mA max).
8	ANALOG IN 2	Analog Speed Control Input 2. (0 to 5V).

Table 4.3: P3 - Analog Speed Control Pin Assignments

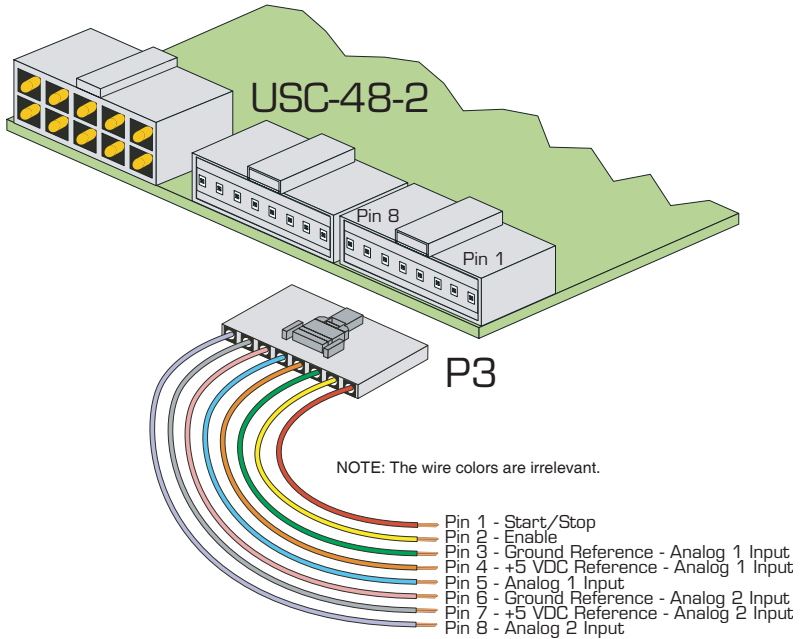


Figure 4.3: Interfacing the Analog I/O with the ADP-2508-FL Signal Cable

### **Pin 1 - Start/Stop Input**

When the start/stop circuit is open sinking or sourcing, the internal step clock generator will be off. When the circuit is closed sinking or sourcing, the internal step clock generator will be enabled.

### **Pin 2 - Enable Input**

The Enable Input can be used to enable or disable the driver outputs. When the Enable circuit is open, for either sinking or sourcing, the Driver outputs will be enabled and the step clock pulses will cause the Drive to advance the stepping motor. When the Enable circuit is closed, the Driver outputs will be disabled.

Note: This Input does not inhibit the Step Clock. Therefore, the Driver Outputs will update by the number of Clock Pulses (if any) applied to the driver while it was disabled.

### **Pin 3 - Ground Reference Analog In 1**

Logic ground for 10k $\Omega$  potentiometer for Analog Speed Input 1.

### **Pin 4 - +5 VDC Analog In 1**

A +5 VDC Output for 10k $\Omega$  potentiometer for Analog Speed Input 1.

### **Pin 5 - Analog Speed Control Input 1**

The Speed Control Input is the input by which the internal step clock frequency, hence the velocity of the motor, is controlled.

This 0 - 5 volt analog input may be interfaced using a 10k $\Omega$  potentiometer a joystick wiper, or a 4-20mA / 0-20mA analog output. If a constant velocity is desired, the speed control input can be connected directly to the +5VDC output and the desired velocity set using the VM parameter. When the input is greater than DB (value of the potentiometer deadband parameter), the step clock frequency will begin at the value specified by the initial velocity (VI) parameter. When at FS (the value specified by the full scale parameter), the step clock will be at the value specified by the maximum velocity (VM) parameter.

### **Pin 6 - Ground Reference Analog In 2**

Logic ground for 10k $\Omega$  potentiometer for Analog Speed Input 2.

### **Pin 7 - +5 VDC Analog In 2**

A +5 VDC Output for 10k $\Omega$  potentiometer for Analog Speed Input 2.

### **Pin 8 - Analog Speed Control Input 2**

The Speed Control Input is the input by which the internal step clock frequency, hence the velocity of the motor, is controlled.

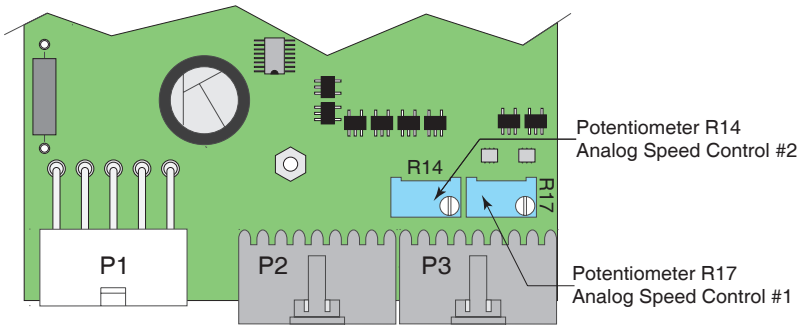
This 0 - 5 volt analog input may be interfaced using a 10k $\Omega$  potentiometer or a joystick wiper. If a constant velocity is desired, the speed control input can be connected directly to the +5VDC output and the desired velocity set using the VM parameter. When the input is greater than DB (value of the potentiometer deadband parameter), the step clock frequency will begin at the value specified by the initial velocity (VI) parameter. When at FS (the value specified by the full scale parameter), it will be at the value specified by the maximum velocity (VM) parameter.

## ***Optional On-Board 10kΩ Speed Control Potentiometers***

An option on the USC-48-2 Universal Driver/Speed Control Board are dual on-board 10kΩ Speed Control Potentiometers. These 15 turn, 10kΩ on-board potentiometers allow the user to have two preset speeds that can be selected digitally. Speed settings are more secure and less likely to be tampered with or accidentally changed as with external potentiometers. The on-board potentiometers also reduce wiring where remote access is not required.

Potentiometer R17 sets the Speed 1 value.

Potentiometer R14 sets the Speed 2 value.



*Figure 4.4: Optional On-Board 10kΩ Potentiometers for Speed 1&2*

# Speed 1 & 2 Select Options

The speed (velocity control) can be set through several different methods. They are all enabled with the Configuration Utility in the Graphical User Interface (GUI). Once enabled they are selected with the Speed 1/2 Input. The choices are:

■ **Analog Input:**

A 0 to +5 VDC input controlled by external 10kΩ potentiometers or optional on-board 10kΩ potentiometers.

■ **4 to 20mA and 0 to 20mA Input**

■ **15 to 25 kHz PWM Input**

The table below illustrates the possible Speed Control Inputs available on the USC-48-2 Universal Speed Control Board.

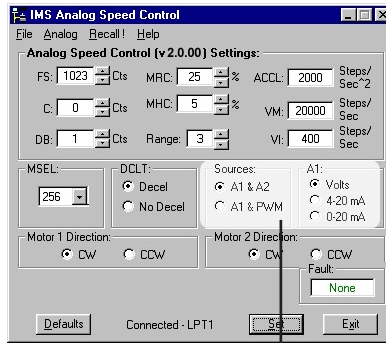
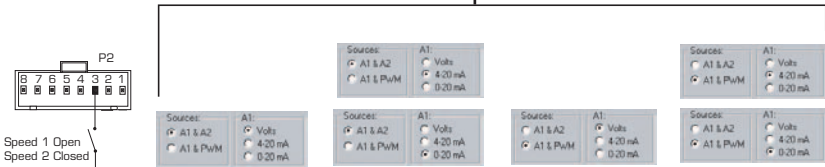


Figure 4.5: Velocity Input Options



Speed 1 or 2 Select (Digital I/O P2-3)	A1 & A2 Mode with Volts Selected	A1 & A2 Mode with 4-20/0-20mA Selected	A1 & PWM with Volts Selected (Analog 2 Disabled)	A1 & PWM with 4-20/0-20mA Selected (Analog 2 Disabled)
Open Circuit (High) Speed 1 Selected	Analog Input 1 (P3): 0 to +5 VDC controlled by external source, 10kΩ Pot or optional R17 on-board Pot	Analog Input: 1 (P3): 4-20mA or 0-20mA Input	Analog Input 1 (P3): 0 to +5 VDC controlled by external source, 10kΩ Pot or optional R17 on-board Pot	Analog Input 1 (P3): 4-20mA or 0-20mA Input
Closed Circuit (Low) Speed 2 Selected	Analog Input 2 (P3): 0 to +5 VDC controlled by external source, 10kΩ Pot or optional R14 on-board Pot	Analog Input 2 (P3): 0 to +5 VDC controlled by external source, 10kΩ Pot or optional R14 on-board Pot	PWM Input (P2-4): 15 to 25 kHz	PWM Input (P2-4): 15 to 25 kHz

Table 4.4: Velocity Input Combinations for Speed Select 1&2

# Minimum Required Connections

The connections shown in Figure 4.6 are the minimum required to operate a motor with the USC-48-2 Universal Driver/Speed Control.

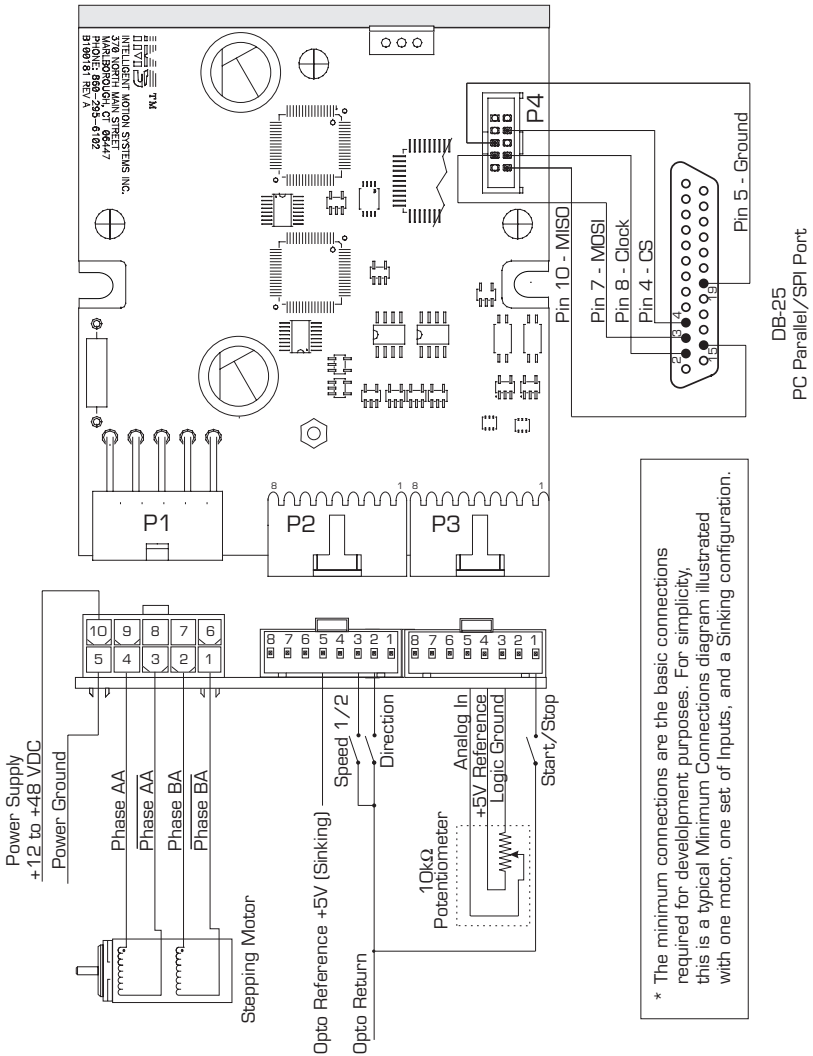


Figure 4.6: Minimum Required Connections



NOTE: The USC-48-2 Universal Speed Control/Driver is capable of driving two motors. It also has two Analog Speed Control circuits. For simplicity, only one motor and one Analog Input is shown. The circuit is configured as sinking.

# Connecting the USC-48-2 SPI Interface

The SPI (Serial Peripheral Interface) communications connector uses a 10 Pin Header (P4). The recommended method of connecting to this header is the Parameter Setup Cable. This is a low cost accessory which eliminates the need for the user to wire communications. Included in this cable is built-in logic level shifting circuitry to accommodate the 3.3v ports on some PCs. This cable plugs in easily to connect a standard DB-25 PC parallel/SPI port to the 10 Pin Pin-Header on the USC-48-2. Order Cable Part Number MD-CC100-000.

**N** NOTE: Should you choose to make your own parameter setup cable, be advised the 3.3V output parallel ports on some laptop PCs may not be sufficient to communicate with the device.

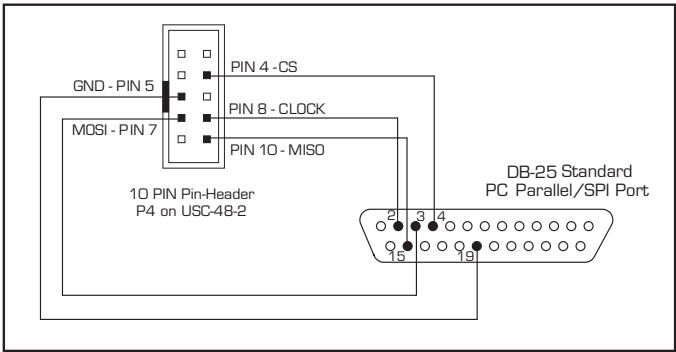


Figure 4.7: SPI Interface Wiring and Connections

Pin #	Pin Name	Function
1	N/C	No Connect
2	N/C	No Connect
3	N/C	No Connect
4	CS	Chip Select
5	GND	Logic Ground
6	N/C	No Connect
7	MOSI	Master Out/Slave In
8	CLOCK	Step Clock In
9	N/C	No Connect
10	MISO	Master In/Slave Out

Table 4.5: SPI Pin Assignment and Description

**Pin 4 - CS (SPI Chip Select)**

This signal is used to select the Drive for SPI communications.

**Pin 5 - Logic Ground**

**Pin 7 - MOSI (Master Out / Slave In)**

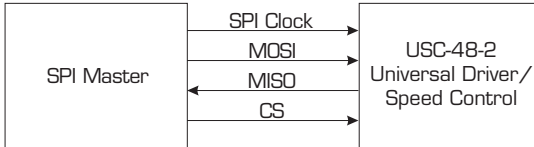
Carries output data from the SPI Master to the Drive.

**Pin 8 - 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.

**Pin 10 - MISO (Master In / Slave Out)**

Carries output data from the Drive back to the SPI Master.



*Figure 4.8: SPI Master/USC-48-2 Data Flow*

# SECTION 5

## Configuring The USC-48-2

The IMS Analog Speed Control Interface is easy to install and use software for configuring the USC-48-2. Access this powerful tool by installing the IMS SPI Interface available on the IMS CD, or download at [www.imshome.com](http://www.imshome.com). The configuration utility features the following:

- Easy installation.
- Ease of use via single screen interface.
- Automatic communication configuration via LPT port.
- Will not allow out-of-range values to be set.
- Tool-tips display valid range settings for each option.

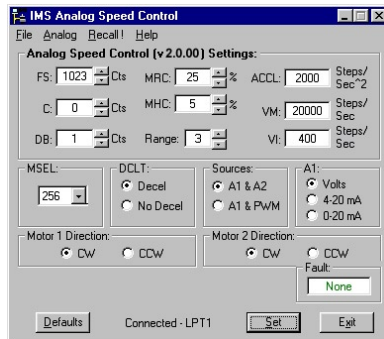


Figure 5.1: Speed Control Configuration Utility Screen

### Installation

To install and use the IMS Analog Speed Control Interface, you need a Pentium class or higher PC running Windows 95/98. The Windows NT version of this software is required for Windows NT 4.0 (SP6 or greater), Windows 2000 (SP2 or greater) or Windows XP. The installation procedure is:

- 1] Place the IMS CD in your CD-ROM drive.
- 2] The CD Front End should automatically start, if not, click Start>Run on the Start Menu. Browse to your CD-ROM Drive and select "IMS.exe"
- 3] On the screen that will open click the MDrive button.
- 4] Select the SPI Interface. Follow the onscreen prompts to complete installation.

### Start-up

Select "Start>Programs>IMS SPI Interface>IMS SPI Interface". The configuration utility will automatically scan your LPT ports for the connected USC-48-2 and configure communications. The connection status and port are displayed at the bottom of the configuration screen (Figure 5.1).

# Configuration Parameters Explained

There are 12 configuration parameters for the USC-48-2. Parameter settings are automatically saved to memory when the “SET” button is clicked on the configuration utility screen.

Table 5.1 summarizes the parameters and their function, range, units and default setting.

SETUP PARAMETERS				
NAME	FUNCTION	RANGE	UNITS	DEFAULT
ACCL	Accel/Decel	2000 to 65,000	steps/sec <sup>2</sup>	2,000
C	Joystick Center	0 to 1022	counts	0
DB	Deadband	0 to 255	counts	1
DCLT	Decel Type	Decel at ACCL Rate/No Decel	-	Decell
IMODE	Source	A1 and A2, or PWM	-	0
	Analog Input	Voltage/4-20mA/0-20mA	-	0
	Clockwise/Counter Clockwise 1	0 or 1	-	0
	Clockwise/Counter Clockwise 2	0 or 1	-	0
FS	Full Scale	1 to 1023	counts	1,023
MHC	Hold Current	0 to 100	percent	5
MRC	Run Current	1 to 100	percent	25
MSEL	Microstep Resolution	2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 125, 128, 250, 256	µsteps per step	256
RANGE	VI/VM Range	1 to 8	-	3
VI	Initial Velocity	1 to 99,999	steps/sec	400
VM	Maximum Velocity	2 to 100,000	steps/sec	20,000

## Acceleration (ACCL)

The ACCL parameter sets the acceleration and deceleration in steps per second<sup>2</sup>.

## Joystick Center Position (C)

The parameter sets the center position of the joystick. It can be set by two methods. Using method one the user will manually enter a value between 0 (default) and 1022 into the parameter box. This count will represent the voltage that the USC-48-2 Universal Speed Control will interpret as the zero-reference position. Any voltage seen on the speed control input will accelerate from 0 to the maximum set velocity. The second method is to select Analog>Initialize from the menu bar of the configuration utility. Move the joystick or rotate the pot to the end of travel in both directions, move or rotate the input device to the desired center and click the “Accept” button. See the setup procedure located in “Setting the Configuration Parameters”, the next subsection of this document.

## Potentiometer Deadband (DB)

The DB parameter sets the deadband of the potentiometer. The range for this parameter is a relative term as the actual deadband value is based upon the settings of the VI and VM parameters. The deadband is the amount of de- ection seen on the potentiometer until the velocity is changed. With DB=1 it is possible that the motor will oscillate between two velocities. This can be eliminated by setting the deadband to a higher value.



**USAGE NOTE:** If the motor oscillates between two velocities, increase the potentiometer deadband to a higher value. This will add coarseness to the pot and eliminate the oscillation.

Note that when the voltage seen at the speed control input is  $\leq 0.005V$ , the step clock output of the oscillator will be 0. When the potentiometer or joystick de- ects to the level specified by the DB parameter the axis will start to accelerate, beginning at the velocity specified by the VI or initial velocity parameter.

## Deceleration Type (DCLT)

This parameter sets the motor deceleration to an ON/OFF state. If Decel is selected on the speed control utility, the motor will decelerate to stop at the rate specified by the ACCL parameter. If No Decel is selected, the motor will hard stop.

### Input Mode (IMODE)

There are three conditions for the Input Mode Parameter. This parameter specifies the input mode for the speed control. These conditions are:

#### 1] Source

This selects the input source for the speed control, either A1/A2 which will sense the speed control inputs, or PWM which will select the PWM Input.

#### 2] Analog Input

This condition specifies whether the speed control inputs will be in voltage mode (0-5V) or current mode (4-20mA or 0-20mA).

#### 3] CW/CCW Direction 1

This selects the direction of Motor A rotation.

#### 4] CW/CCW Direction 2

This selects the direction of Motor B rotation.

## Full Scale (FS)

The full scale parameter sets the de- ection of the potentiometer or joystick.

While the min/max range of the speed control input is 0 to 1023 counts (0.005 to 4.995 volts) (0 counts = no motion, 1023 counts = max velocity, or VM) the user has the option of setting the full scale to a different value. For instance, setting FS=500 counts (2.441 volts) will cause the Drive's oscillator to output the appropriate step clock frequency set for VM when the voltage on the speed control input is 2.441V.

### Motor Holding Current (MHC)

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 will disable when the hold current setting becomes active.

The hold current setting becomes active 200ms following the last step clock pulse.

### Motor Run Current (MRC)

The Motor Run Current (MRC) parameter sets the motor run current to a percentage of the full output current of the driver

### Microstep Resolution Select (MSEL)

The MSEL parameter specifies the microstep resolution of the USC-48-2. See table at right for valid MSEL parameter settings.

MSEL Settings	
MSEL	Steps/Rev
Binary Settings	
2	200
4	800
8	1,600
16	3,200
32	6,400
64	12,800
128	25,600
256	51,200
Decimal Settings	
5	1,000
10	2,000
25	5,000
50	10,000
125	25,000
250	50,000

Table 5.2: MSEL Parameter Settings

### Velocity Range (RANGE)

The RANGE parameter specifies the maximum ranges available for the initial velocity (VI) and the maximum velocity (VM). When the range is set to a value, the VI and VM parameters will automatically default to the value specified by the range setting. The value of VI and VM can then be set within the range specified by RANGE. Table 8.2 illustrates the range settings.

### Initial Velocity (VI)

The VI parameter establishes the initial velocity of the controlled axis in steps per second. The setting of this parameter represents the slowest speed the motor will turn. This is the velocity of the axis when the voltage on the speed control input = 0V. The valid settings for VI is dependent on the RANGE setting and must be set lower than VM.

### Maximum Velocity (VM)

The VM parameter establishes the maximum velocity of the controlled axis in steps per second. The setting of this parameter represents the highest speed that the motor will turn. This is the velocity of the axis when the voltage on the speed control input = 5V. The valid setting for VM is dependent on the RANGE setting and must be set higher than VI.

RANGE PARAMETER SETTINGS								
Range	1	2	3	4	5	6	7	8
Initial Velocity (Minimum Value)	200	100	50	20	10	5	2	1
Maximum Velocity (Maximum Value)	100000	50000	25000	10000	5000	2500	1000	500

Table 5.3: RANGE Parameter Settings

# Setting the Configuration Parameters

In order to follow the procedures set forth in this subsection, the following is necessary:

- The Parameter Setup Cable (MD-CC100-000) or equivalent must be connected between your PC Parallel (Printer) Port and the 10 pin IDC connector (P2) on the USC-48-2.
- The Analog Speed Control configuration utility must be installed and operating on your PC. Correct connection of the device and operation of the software will be indicated by a “Connected - LPTx” message at the bottom of the configuration screen.
- The Stop/Start input must be in a HIGH (Disconnected, Stopped) state.

## Configuring the USC-48-2 for Unidirectional Operation

When operating as a unidirectional device, the internal clock pulse generator will output step clock pulses to the USC-48-2 driver section. The initial and maximum frequency of these pulses, and the rate which they accelerate between these values, is established by the following four parameters:

- 1] Initial Velocity (VI)
- 2] Maximum Velocity (VM)
- 3] Acceleration (ACCL)
- 4] Velocity Range (RANGE)

Set the Run Current (MRC) and Holding Current (MHC) to the desired value.

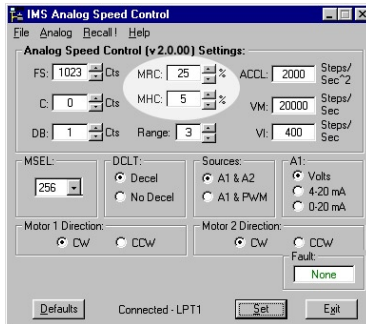


Figure 5.2: Speed Control Configuration Utility Screen

When using the USC-48-2 Universal Speed Control in velocity mode the settings for FS, C and DB will likely be left in their default state. These three parameters may be displayed as either counts or volts. The displayed value is changed by clicking the “Cts” to the right of the parameter’s text box. It may be changed from volts back to counts by clicking “volts”.

If the motor oscillates between frequencies, increase the potentiometer dead-band (DB). If desired, these may be changed. For example: Setting the FS parameter to 511 would configure the USC-48-2 such that it will be at maximum velocity when the potentiometer is at 1/2 of its full de cation.

Test the settings by pulling the Stop/Start input to ground by means of a switch or sinking output. Turn the potentiometer between its stops, the motor should accelerate and decelerate between the VI and VM settings. Note that there will be no motion at the zero reference point of the potentiometer. The motion will not start until the Speed Control Input is at the voltage equivalent of 0 + DB.

Fine-tune the ACCL, VI, VM and RANGE settings to the requirements of your application. Clicking the “Set” button saves the parameter settings to non-volatile memory.

### ***Configuring the USC-48-2 for Bidirectional Operation***

When setting the USC-48-2 for bidirectional operation, it is necessary that the joystick or pot be calibrated. First, a center position must be established, as well as the full scale range of the input device in two directions. The following steps outline the calibration procedures.

- 1] With the input device in the center position, click “Analog>Initialize” on the menu bar.
- 2] Move the input device to its full scale position, first in the max direction, then in the min direction. Re-center the input device.
- 3] Click the “Accept” button.
- 4] Set the other parameters to the desired value.
- 5] Click the “Set” button to save the parameter settings to non-volatile memory.

## **Configuring the USC-48-2 Using SPI**

The USC-48-2 may be setup and operated without the included IMS Analog Speed Control GUI.

If the optional cable is not being used you will need to make one using the diagram shown on page 19 of this document.

## **Timing Notes**

- 1) First MSb (most significant bit) and MSB (most significant byte)
- 2) 8 bit bytes
- 3) 25kHz SCK
- 4) Data In (MOSI) on rising clock
- 5) Data Out (MISO) on falling clock

# SPI Commands

SPI COMMANDS AND PARAMETERS				
	CMD/PRM	HEX/DEFAULT	RANGE	NOTES
SPI Commands	READ ALL	0x40		Reads the hex value of all parameters
	WRITE ALL	0x80		Writes the hex value to the following parameters.
Data READ	"u"	0x75		"u" character precedes every read
	Version MSD	0x12		Defines the SPI Version and revision number. ie. Version 2.0, Rev. 02
	Version LSB	0x02		
	ACCL, MSB	0x07	2000-65000	Acceleration in Steps/Sec <sup>2</sup> The default is 2000
	ACCL, LSB	0x00		
	DB	0x01	0-255	Potentiometer/Joystick Deadband
	RANGE	0x03	1-8	VI/VM Range Setting
	VI, MSB	0x00	1-100000	Establishes the initial velocity (slowest speed) of the controlled axis in steps per second. The default is 800.
	VI, MB	0x01		
	VI, LSB	0x90		
	VM, MSB	0x00	1-100000	Establishes the maximum velocity (highest speed) of the controlled axis in steps per second. The default is 20000
	VM, MB	0x4E		
	VM, LSB	0x20		
	FULLSCALE, MSB	0x03	1-1023	Sets the deflection of the potentiometer or joystick
	FULLSCALE, LSB	0xFF		
	CENTER, MSB	0x00	1-1022	Sets the center positon of the joystick. The default is 0.0000
	CENTER, LSB	0x00		
	MRC	0x19	1-100%	Motor Run Current - Default = 25
	MHC	0x05	0-100%	Motor Hold Current - Default = 5
	DCLT	0x00	0-1	Deceleration (On/Off) Default = 0
	MSEL	0x00	0, 2-250	Microstep Resolution Default = 256
TYPE	0x01	1 Microstep	Fixed	
INP_MODE ... A1A2_PWM MA_4_20 DIR1 DIR2	0x00 0x01 0x04 0x40 0x80	A1&A2, A1V, CW 0=A1-A2, 1=PWM 0=A1V, 1=A1C 0=CW, 1=CCW 0=CW, 1=CCW	Defined by the following parameters... A1 and A2 or PWM Volts, 4-20mA/0-20mA Direction Override 1 Direction Override 2	
Data WRITE	ACCL, MSB	0x07	2000-65000	Acceleration in Steps/Sec <sup>2</sup> The default is 2000
	ACCL, LSB	0x00		
	DB	0x01	0-255	Potentiometer/Joystick Deadband
	RANGE	0x03	1-8	VI/VM Range Setting
	VI, MSB	0x00	1-100000	Establishes the initial velocity (slowest speed) of the controlled axis in steps per second. The default is 800
	VI, MB	0x01		
	VI, LSB	0x90		
	VM, MSB	0x00	1-100000	Establishes the maximum velocity (highest speed) of the controlled axis in steps per second. The default is 800
	VM, MB	0x4E		
	VM, LSB	0x20		
	FULLSCALE, MSB	0x03	1-1023	Sets the deflection of the potentiometer or joystick
	FULLSCALE, LSB	0xFF		
	CENTER, MSB	0x00	1-1022	Sets the center positon of the joystick. The default is 0.0000
	CENTER, LSB	0x00		
	MRC	0x19	1-100%	Motor Run Current - Default = 25
	MHC	0x05	0-100%	Motor Hold Current - Default = 5
	DCLT	0x00	0-1	Deceleration (On/Off) Default = 0
	MSEL	0x00	0, 2-250	Microstep Resolution Default = 256
	INP_MODE ... A1A2_PWM MA_4_20 DIR1 DIR2	0x00 0x01 0x04 0x40 0x80	A1&A2, A1V, CW 0=A1-A2, 1=PWM 0=A1V, 1=A1C 0=CW, 1=CCW 0=CW, 1=CCW	Defined by the following parameters... A1 and A2 or PWM Volts, 4-20mA/0-20mA Direction Override 1 Direction Override 2

Table 5.4: USC-48-2 SPI Command Summary

## Examples

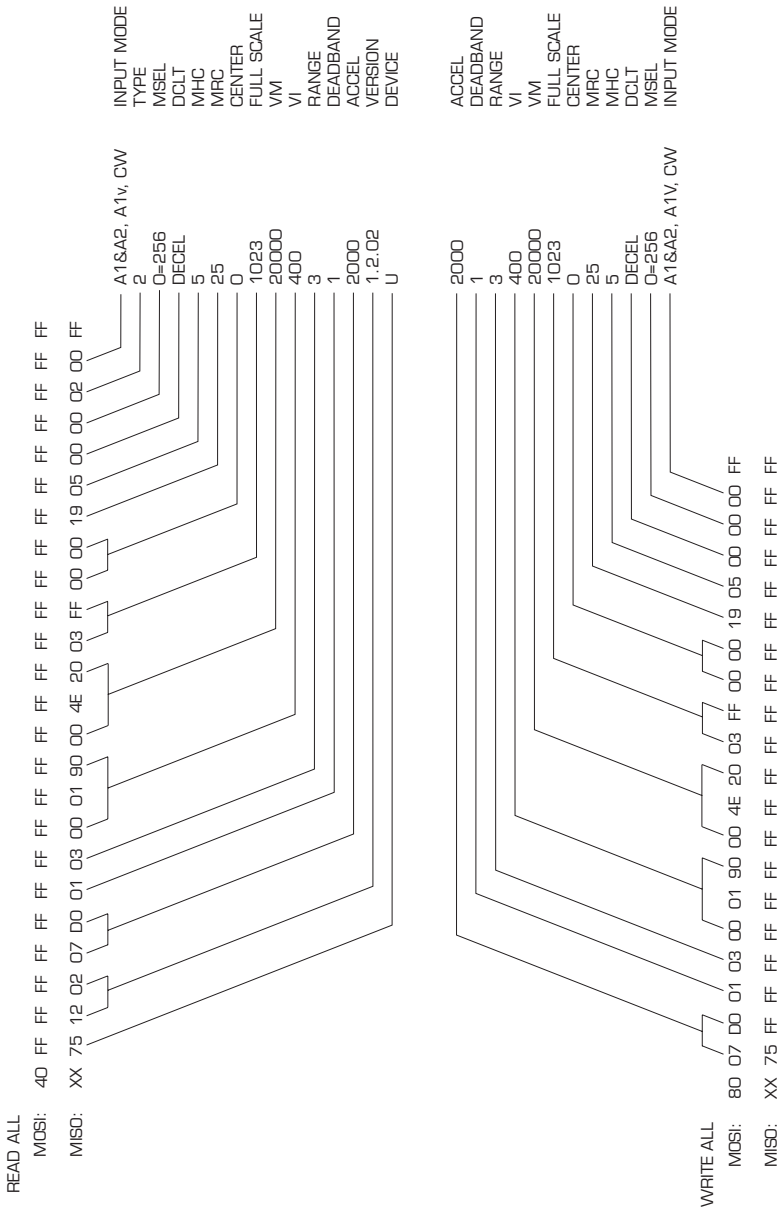


Figure 5.3: SPI Waveforms

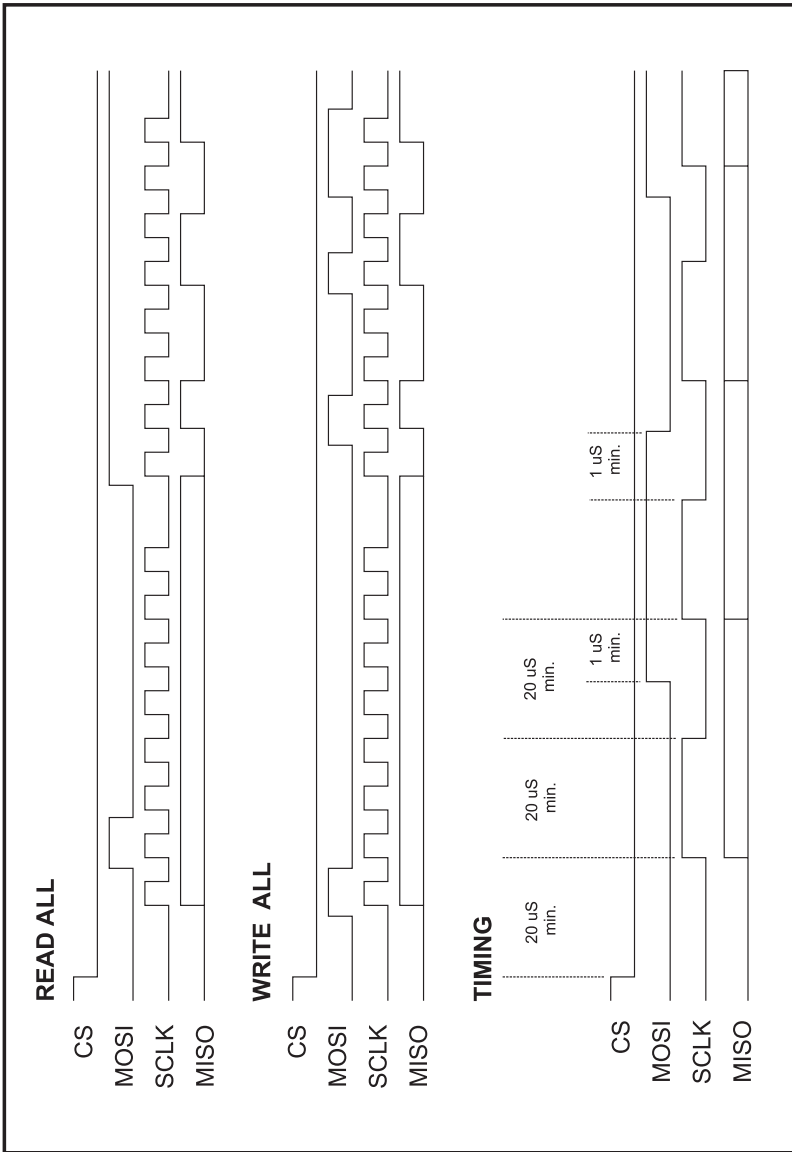


Figure 5.4: SPI Timing Diagram

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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 be 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 charges 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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