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IB462H

HIGH PERFORMANCE MICROSTEPPING DRIVE

FEATURING THE INT-462H INTERFACE BOARD AND THE OSC-462H VARIABLE SPEED CONTROL

OPERATING INSTRUCTIONS







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IB462H Half/Full Step Driver Hybrid Operating Instructions
Revision 12.19.2002

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PART I

IB462H

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Section 1.2–Hardware Specifications

Section 1.3–Mounting

Section 1.4–Theory of Operation

Section 1.5–Power Supply Requirements

Section 1.6–Motor Requirements

Section 1.7–Interfacing

Section 1.8–Troubleshooting



SECTION 1.1

The IB462H

The IB462H is a low cost, high performance alternative to larger drives. The small size of the IB462H makes it ideal for system designs where space is at a premium without having to sacrifice performance as a result.

The IB462H operates between +12 and +40VDC. This high voltage allows for increased torque at higher speeds. Combine this with 2 amps per phase of output current and 160 watts of power and you have a low cost alternative to chipsets. All contained in a package that minimizes expensive real estate!

The IB462H reduces time to market and increases reliability, and comes with a 2 year warranty. The IB462H represents affordable, state-of-the-art technology for the competitive edge needed in today's market.

Miniature Package

The IB462H packs a powerful 160 Watts into an area of .806 cu. in.

High Current

The IB462H will effortlessly output up to 2 amps per Phase.

High Voltage

The IB462H operates from +12 to +40 volts. This high voltage allows for greater speeds at higher torque without resorting to expensive drives or larger motors.

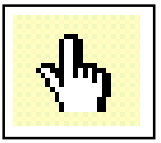
The high efficiency of the IB462H chopper drive, along with its miniature size, makes it ideally suited to replace the less efficient L/R drives. In addition, the low cost and off-the-shelf availability if the IB462H permits an immediate cost effective solution to chip sets.

Features and Benefits

- Very Low Cost
- Ultra Miniature (1.2" x 2.4" x 0.28") (30 x 61 x 7 mm)
- Advanced Hybrid Design
- High Input Voltage (+12 to +40 Volts)
- High Output Current (2A per Phase)
- 20 kHz chopping rate
- Full or Half Step

The Product Manual

The IB462H/INT-462 Product Manual in its electronic format (IB462H.pdf) can be downloaded from the IMS website at *www.imshome.com*. This version includes a Bookmark feature that allows the reader to link from a Bookmarked Topic in the Table of Contents to a full description of that feature's attributes and functions. You can also select a Topic directly from the Table of Contents Pages. Topics with a Bookmark function are further identifiable because the cursor changes from a normal pointer to a "finger" pointer when placed over the word.



Notes and Warnings

The following notes and warnings must be observed when handling or using the IB462H driver hybrid.



WARNING! The IB462H and INT-462 components are sensitive to Electrostatic Discharge (ESD). All handling should be done at an ESD protected workstation.



WARNING! Hazardous Voltage Levels may be present if using an open frame power supply to power the IB462H/INT-462!



WARNING! Ensure that the Power Supply output voltage does not exceed the maximum input voltage of the IB462H/INT-462!



WARNING! The IB462H rear plate MUST be kept to 70° or below or damage may occur to the device! Use of an external heat sink and the included thermal pad is required to maintain a rear plate temperature of 70°C or below!



WARNING! The rear mounting surface of the IB462H contains different voltages and must be kept isolated when attached to a conductive surface!

SECTION 1.2

Hardware Specifications

Section Overview

This section will acquaint you with the dimensional information, pin description, power, environmental and thermal requirements of the IB462H. It is broken down as follows:

- Mechanical Specifications
- Electrical Specifications
- Thermal Specifications
- Pin Description

Mechanical Specifications

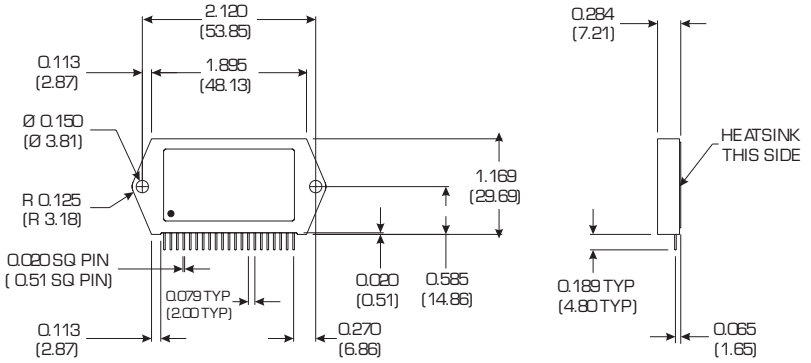


Figure 1.2.1: IB462H Dimensions

NOTE: Dot on lower left of label indicates the location of pin 1.

Electrical Specifications

IB462H Electrical Specifications					
Specification	**Test Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Voltage		12		40	V
Phase Output Current	Per Phase			2	A
Quiescent Current (+V)	Outputs Floating			4	mA
Quiescent Current (+5V Input)	Outputs Floating		50	80	mA
Current Adjust Input Voltage				1.0	V
Low Level Input Voltage	SCLK, DIR, H/F, Reset			0.6	V
High Level Input Voltage	SCLK, DIR, H/F, Reset	2		5	V
Low Level Input Current	SCLK, DIR, H/F, Enable			-1.2	mA
Low Level Input Current	Reset Input Only			-200	µA
High Level Input Current	SCLK, DIR, H/F, Enable			10	µA
Enable Low Level Input Voltage	Enable Input Only			1.3	V
Enable High Level Input Voltage	Enable Input Only	2		5	V
Input Pull-up Resistance	SCLK, DIR, H/F, Enable	4.5	4.7	4.9	kΩ
Input Pull-up Resistance	Reset Input Only	50	51	52	kΩ

Table 1.2.1: IB462H Electrical Specifications

Thermal Specifications

IB462H Thermal Specifications	
Specification	**Unit**
Ambient Temperature	0 to +50°C
Storage Temperature	-40 to +125°C
Maximum Plate Temperature	70°C

Table 1.2.2: IB462H Thermal Specifications

WARNING! The IB462H rear plate MUST be kept to 70° or below or damage may occur to the device! USe of an external heat sink and the included thermal pad is required to maintain a rear plate temperature of 70°C or below!

WARNING! The rear mounting surface of the IB462H contains different voltages and must be kept isolated when attached to a conductive surface!

NOTE: When choosing a heat sink, ensure that there is good thermal flow, otherwise hot spots may occur in the IB462H, reducing the effectiveness of the thermal protection.

Pin Assignment and Description

IB462H Pin Configuration		
PIN #	**FUNCTION**	**DETAILS**
1	Current Adjust	Phase current adjustment pin. A voltage must be applied to this pin to set the phase output current.
2	$\overline{\text{Reset}}$	Reset input. An active LOW pulse on this input resets the driver.
3	Half/$\overline{\text{Full Step}}$	Selects half or full step operation for the driver. Logic States: HIGH - Half Step Operation. LOW - Full Step Operation.
4	$\overline{\text{Step Clock}}$	Step clock input. An active LOW pulse on this input advances the motor one increment. The step occurs on the falling edge of this signal.
5	+5 VDC Input	+5 VDC supply input.
6	Direction	Clockwise/counterclockwise direction control input. Physical direction of motor rotation depends on the connection of the motor windings. Internally synchronized.
7	Enable	Enables/disables the output section of the driver. When in a logic HIGH state (not connected) the driver outputs are enabled. Sinking this input will disable the driver outputs.
8	Sense B	Phase B current sense output.
9 & 10	Phase $\overline{\text{B}}$	Phase $\overline{\text{B}}$ of the stepping motor.
11 & 12	Phase B	Phase B of the stepping motor.
13 & 14	+V	12 to +40VDC power supply input.
15 & 16	GND	Power supply return (ground).
17 & 18	Phase $\overline{\text{A}}$	Phase $\overline{\text{A}}$ of the stepping motor.
19 & 20	Phase A	Phase A of the stepping motor.
21	Sense A	Phase A current sense output.

Table 1.2.3: IB462H Pin Assignment and Description

NOTE: Dot on lower left of label indicates the location of pin 1.

SECTION 1.3

Mounting the IB462H

Section Overview

This section covers the following:

- Direct Mounting the IB462H to a PC board.
- Mounting the IB462H to a PC Board using a receptacle.

Direct Mounting the IB462H to a PC Board

The IB462H is designed to be soldered directly into a PC board. The following diagram contains the hole pattern and recommended pad sizes for direct mounting of the IM483H/IM805H.

WARNING! The IB462H rear plate MUST be kept to 70° or below or damage may occur to the device! The use of both an external heat sink **AND** the included thermal pad is required to maintain a rear plate temperature of 70°C or below at **ALL** power levels!

Heatsinking and use of the included insulating thermal pad are absolutely **REQUIRED** for the IB462H at all power levels. See the *Thermal Specifications* subsection of Section 1.2 of this document for notes, warnings and thermal specifications.

Recommended Soldering Practices

Max. Soldering Temp ..... 300°C
Max. Soldering Time ..... 10 sec.

Recommended Solder

Kester “245” No Clean
Alpha Metals “Telecore Plus”
Multicore “X39B” No Clean

Recommended Cleaning Solvent

Tech Spray “Envirotech 1679”
Chemtronics “Flux-off NR 2000”

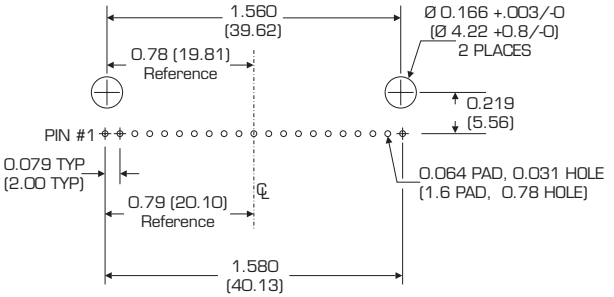


Figure 1.3.1: PCB Hole/Pad Pattern

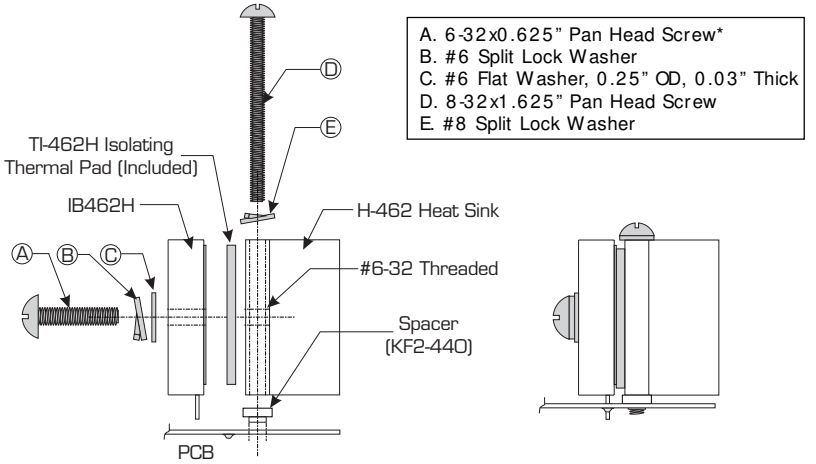
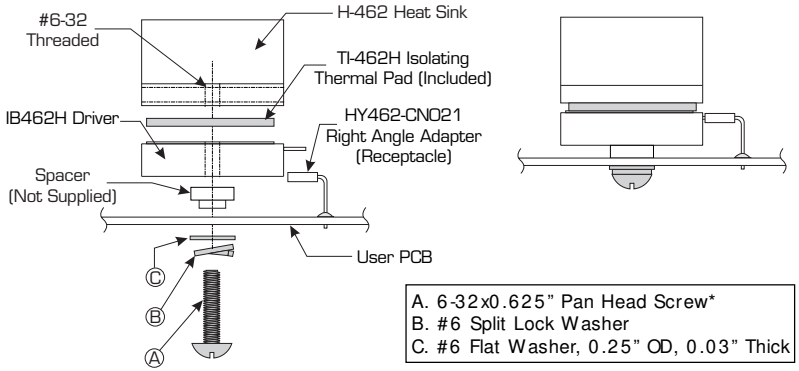


Figure 1.3.2: Direct PCB Mounting

Mounting the IB462H using a Receptacle

If desired, a receptacle may be used to connect the IB462H to the user's PCB. The receptacle shown in the diagram is a HY462-CN021.

The recommended soldering practices from *Direct Mounting the IB462H to a PC Board* also apply here.



** The torque specification for the 6-32 mounting screws is 5.0 to 7.0 lb-in (0.60 to 0.80 N-m).*

Figure 1.3.3: PCB Mounting using a Receptacle

WARNING! The Heat Sink mounting surface must be a smooth, flat surface with no burrs, protrusions, cuttings or other foreign objects.

WARNING! If you are planning to wash your PCB it must be done prior to adding the IB462H Driver or damage will occur.

SECTION 1.4

Theory of Operation

Section Overview

This section will cover the circuit operation for the IB462H Half/Full Step driver hybrid.

- Circuit Operation
- Output Wave Sequences
- Timing

Circuit Operation

The IB462H is a bipolar chopping stepper motor drive. It receives step clock, direction and mode signals from the system controller to generate constant phase currents which are adjustable in magnitude.

The principal function blocks are: a translator which generates the motor phase sequences, a dual PWM chopper circuit which regulates the current in

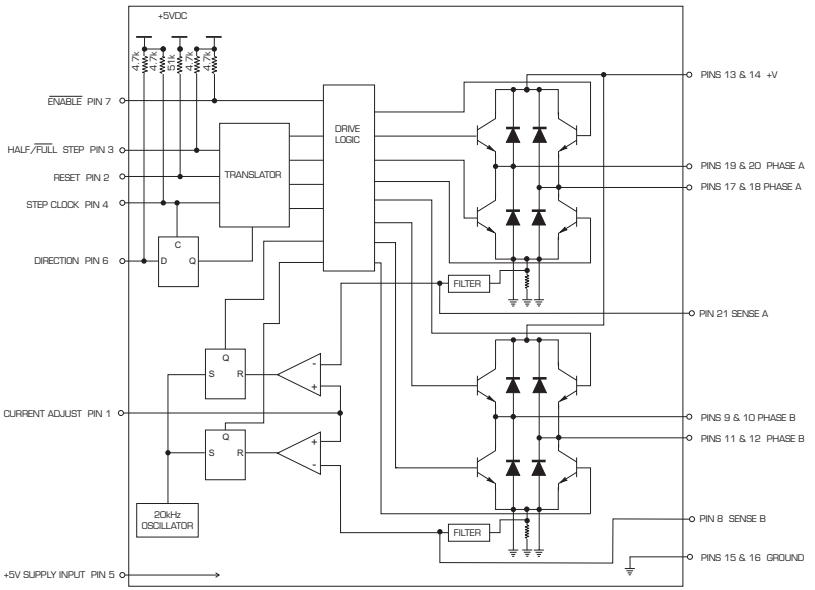


Figure 1.4.1: IB462H Block Diagram

the motor windings and a power stage to drive the motor. The translator generates three different sequences selected by the half/full step input. These are normal (two phases energized), wave drive (one phase energized) and half step (alternately one phase energized/two phases energized).

A common on-board oscillator drives the dual chopper. It supplies pulses which set two flip-flops. When the current in a winding reaches the set peak value a corresponding comparator resets its flip-flop, shutting down the output stage until the next oscillator pulse comes along.

Because the windings in the motor store energy, current will continue to flow through the windings during the off period. The peak current for both windings is set by the current adjust input.

The output stage consists of dual full bridge drivers. The IB462H can be disabled by a logic LOW signal on the enable input. Ultra fast recovery flyback rectifiers are used to improve efficiency and help reduce noise.

Output Wave Sequences

The IB462H generates phase sequences for normal, wave, and half step modes. The state diagram and output waveforms are shown below. In all modes the transition occurs on the falling edge of the Step Clock signal.

Normal Mode

In normal drive mode two phases are energized at all times. This mode is selected by sinking the Half/Full Step input.

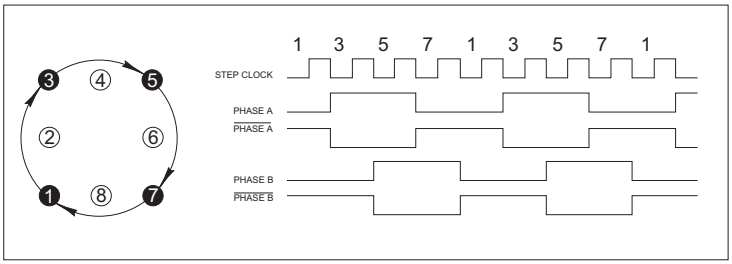


Figure 1.4.2: Normal Mode Phase Sequence

Wave Mode

In wave drive mode one phase is energized at a time. This mode is enabled by selecting full step mode when the IB462H is in an even numbered state. To select this mode, power the IB462H, send a single step clock pulse then sink the Half/Full Step input.

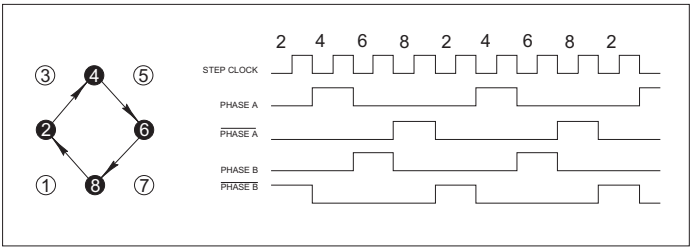


Figure 1.4.3: Wave Mode Phase Sequence

Half Step Mode

In half step mode the phasing alternates from one phase energized to two phases energized. Half step mode is selected by a high on the Half/Full Step input.

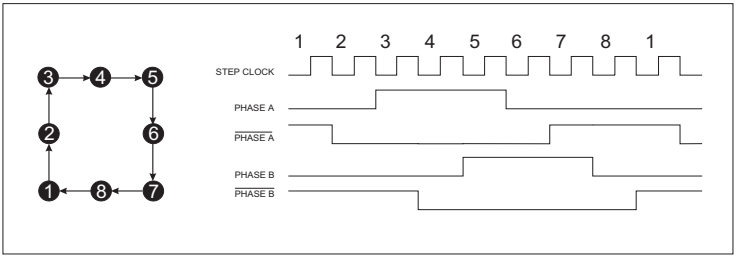
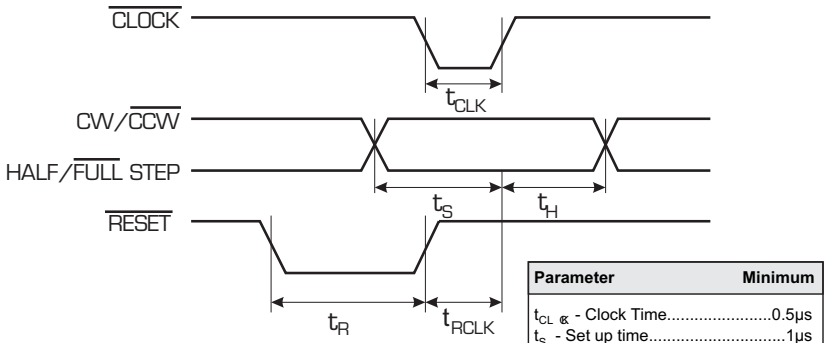


Figure 1.4.3: Half Step Mode Phase Sequence

Timing



Parameter	Minimum
t_{CL} ⇕ - Clock Time	0.5µs
t_S - Set up time	1µs
t_H - Hold Time	4µs
t_{RLCK} - Reset to Clock Delay	3µs
t_R - Reset Time	1µs

Figure 1.4.5: Timing Diagram

SECTION 1.5

Power Supply Requirements

Section Overview

This section covers the power supply requirements the IB462H. Precise wiring and connection details may be found in Section 1.7, *Interfacing to the IB462H*. The following is covered by this section:

- Selecting power supplies.
- Recommended wiring.
- AC line filtering.

Selecting Power Supplies

Selecting a Motor Supply (+V)

Proper selection of a power supply to be used in a motion system is as important as selecting the drive itself. When choosing a power supply for a stepping motor driver there are several performance issues that must be addressed. An undersized power supply can lead to poor performance and possibly even damage to your drive.

The Power Supply - Motor Relationship

Motor windings can be basically viewed as inductors. Winding resistance and inductance result in an L/R time constant that resists the change in current. To effectively manipulate the rate of charge, the voltage applied is increased. When traveling at high speeds there is less time between steps to reach current. The point where the rate of commutation does not allow the driver to reach full current is referred to as Voltage Mode. Ideally you want to be in Current Mode, which is when the drive is achieving the desired current between steps. Simply stated, a higher voltage will decrease the time it takes to charge the coil and, therefore, will allow for increased torque at higher speeds.

Another characteristic of all motors is back EMF. Back EMF is a source of current that can push the output of a power supply beyond the maximum operating voltage of the driver and, as a result, could damage the stepper driver.

The Power Supply - Driver Relationship

The IB462H is very current efficient as far as the power supply is concerned. Once the motor has charged one or both windings of the motor, all the power supply has to do is replace losses in the system. The charged winding acts as an energy storage in that the current will recirculate within the bridge, and in and out of each phase reservoir. This results in a less than expected current draw on the supply.

Stepping motor drivers are designed with the intention that a user's power supply output will ramp up to greater or equal to the minimum operating voltage. The initial current surge is quite substantial and could damage the driver if the supply is undersized. The output of the power supply could fall below the operating range of the driver upon a current surge if it is undersized. This could cause the power supply to start oscillating in and out of the voltage range of the driver and result in damage to either the supply, the driver, or both. There are two types of supplies commonly used, regulated and unregulated, both of which can be switching or linear. All have their advantages and disadvantages.

Regulated vs. Unregulated

An unregulated linear supply is less expensive and more resilient to current surges, however, the voltage decreases with increasing current draw. This can cause problems if the voltage drops below the working range of the drive. Also of concern is the fluctuation in line voltage. This can cause the unregulated linear supply to be above or below the anticipated or acceptable voltage.

A regulated supply maintains a stable output voltage which is good for high speed performance. They are also not bothered by line fluctuations, however, they are more expensive. Depending on the current regulation, a regulated supply may crowbar or current clamp and lead to an oscillation that, as previously stated, can cause damage to the driver and/or supply. Back EMF can cause problems for regulated supplies as well. The current regeneration may be too large for the regulated supply to absorb. This could lead to an over voltage condition which could damage the output circuitry of the IB462H.

Non IMS switching power supplies and regulated linear supplies with overcurrent protection are not recommended because of their inability to handle the surge currents inherit in stepping motor systems.

Power Supply Specifications

Recommended type	Unregulated DC
Ripple Voltage	±10%
Output Voltage	+12 to +40VDC
*Output Current	2A Peak

* The output current needed is dependant on the power supply voltage, motor selection and load.



WARNING! Verify that the power supply wiring is correct prior to power application. If +V and GND are connected in reverse order catastrophic damage to the IB462H may occur! Ensure that the power supply output voltage does not exceed +40VDC, the maximum input voltage of the IB462H!



WARNING! Hazardous voltage levels may be present if using an open frame power supply to power the IB462H!

Recommended IMS Power Supplies

IMS has designed a series of low cost miniature unregulated switchers and unregulated linear supplies that can handle varying load conditions. This makes them ideal for stepper motor drives and DC servo motors as well. Each of these is available in either 120 or 240 VAC configuration. See the IMS Catalog or website *(www.imshome.com*) for information on these supplies. Listed below is the power supply recommended for use with the IB462H.

IP402/ IP402-240†
Unregulated Linear Supply

		Range
Input	120 VAC Version	102-132 VAC
	240 VAC Version	204-264 VAC
No Load Output Voltage*		39 VDC @ 0 Amps
Continuous Output Rating*		30 VDC @ 1 Amps
Peak Output Rating*		25 VDC @ 2 Amps

** Measurements taken at 25°C, 120 VAC, 60 Hz.*
† Optional 240 VAC Version

Selecting a +5VDC Supply

In the event that you are manufacturing your own interface for the IB462H you will need to supply +5VDC to power the logic circuitry inside the hybrid. Section 1.7, *Interfacing to the IB462H,* will contain PCB layout guidelines and precise details on powering +5VDC.

Recommended Wiring

Rules of Wiring and Shielding

Noise is always present in a system that involves high power and small signal circuitry. Regardless of the power configuration used for your system there are some wiring and shielding rules that should be followed to keep the noise-to-signal ratio as small as possible.

Rules of Wiring

- Power supply and motor wiring should be shielded twisted pairs run separately from signal carrying wires.
- A minimum of 1 twist per inch is recommended.
- Motor wiring should be shielded twisted pairs using 20-gauge wire or, for distance greater than 5 feet, 18 gauge or better.
- Power ground return should be as short as possible to established ground.
- Power supply wiring should be shielded twisted pairs. Use 18 gauge wire if load is less than 4 amps, or 16 gauge for more than 4 amps.

- Do not “Daisy-Chain” power wiring to system components.

Rules of Shielding

- The shield must be tied to zero-signal reference potential. In order for shielding to be effective it is necessary for the signal to be earthed or grounded.
- Do not assume that earth ground is true earth ground. Depending on the distance to the main power cabinet it may be necessary to sink a ground rod at a critical location.
- The shield must be connected so that shield currents drain to signal-earth connections.
- The number of separate shields required in a system is equal to the number of independent signals being processed plus one for each power entrance.
- The shield should be tied to a single point to prevent ground loops.
- A second shield can be used over the primary shield, however, the second shield is tied to ground at both ends.

Recommended Power Supply Cables

Power supply cables must not run parallel to logic level wiring as noise will be coupled onto the logic signals from the power supply cables. If more than one driver is to be connected to the same power supply, run separate power and ground leads to each driver from the power supply. The following Belden cables (or equivalent) are recommended for use with the IB462H.

- Belden Part# 9740 or equivalent 18 AWG.

AC Line Filtering

Since the output voltage of an unregulated power supply will vary with the AC input applied it is recommended that an AC line filter be used to prevent damage to the IB462H due to a lightning strike or power surge.



WARNING! Verify that the power supply wiring is correct prior to power application. If +V and GND are connected in reverse order catastrophic damage to the IB462H may occur! Ensure that the power supply output voltage does not exceed +40VDC, the maximum input voltage of the IB462H!



WARNING! Hazardous voltage levels may be present if using an open frame power supply to power the IB462H!

Section Overview

This section covers the motor configurations for the IB462H.

- Selecting a motor.
- Motor wiring.
- Connecting the motor.

Selecting a Motor

When selecting a stepper motor for your application there are several factors that need to be taken into consideration.

- How will the motor be coupled to the load?
- How much torque is required to move the load?
- How fast does the load need to move or accelerate?
- What degree of accuracy is required when positioning the load?

While determining the answers to these and other questions is beyond the scope of this document, they are details that you must know in order to select a motor that is appropriate for your application. These details will effect everything from the power supply voltage to the type and wiring configuration of your stepper motor, as well as the current and Half/Full step settings of your IB462H drive.

Types and Construction of Stepping Motors

The stepping motor, while classed as a DC motor, is actually an AC motor that is operated by trains of pulses. Though it is called a “stepping motor” it is in reality a Polyphase Synchronous Motor. This means it has multiple phases wound in the stator and the rotor is dragged along in synchronism with the rotating magnetic field. The IB462H is designed to work with the following types of stepping motors:

1) Permanent Magnet (PM)

2) Hybrid Stepping Motors

Hybrid Stepping motors combine the features of the PM Stepping Motors with the features of another type of stepping motor called a Variable Reluctance Motor (VR), which is a low torque and load capacity motor that is typically used in instrumentation. The IB462 cannot be used with VR motors as they have no permanent magnet.

On Hybrid motors the phases are wound on toothed segments of the stator assembly. The rotor consists of a permanent magnet with a toothed outer surface which allows precision motion accurate to within ± 3 percent.

Hybrid stepping motors are available with step angles varying from 0.45° to 15° with 1.8° being the most commonly used. Torque capacity in hybrid steppers range from 5 - 8000 ounce-inches. Because of their smaller step angles, hybrid motors have a higher degree of suitability in applications where precise load positioning and smooth motion is required.

Sizing a Motor for Your System

The IB462H is a Bipolar driver which works equally well with both Bipolar and Unipolar motors (i.e. 8 and 4 lead motors, and 6 lead center tapped motors).

To maintain a given set motor current the IB462H chops the voltage using a constant 20kHz chopping frequency and a varying duty cycle. Duty cycles that exceed 50% can cause unstable chopping. This characteristic is directly related to the motor's winding inductance. In order to avoid this situation, it is necessary to choose a motor with a low winding inductance. The lower the winding inductance, the higher the step rate possible.

Winding Inductance

Since the IB462H is a constant current source, it is not necessary to use a motor that is rated at the same voltage as the supply voltage. What is important is that the IB462H is set to the motor's rated current. See *Section 1.7: Interfacing to the IB462H* for more details.

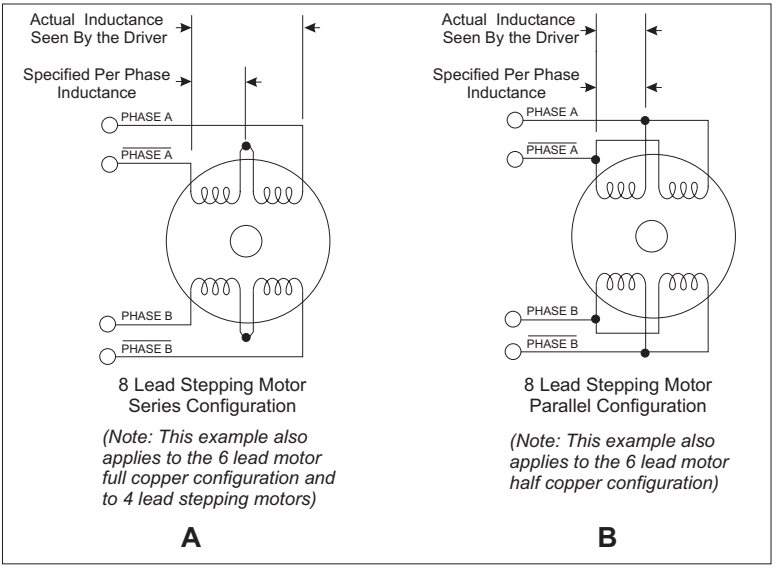


Figure 1.6.1 A & B: Per Phase Winding Inductance

As was discussed in the previous section, *Power Supply Requirements,* the higher the voltage used the faster the current can flow through the motor windings. This in turn means a higher step rate, or motor speed. Care should be taken not to exceed the maximum voltage of the driver. Therefore, in choosing a motor for a system design, the best performance for a specified torque is a motor with the lowest possible winding inductance used in conjunction with highest possible driver voltage.

NOTE: In calculating the maximum phase inductance, the minimum supply output voltage should be used when using an unregulated supply.

The winding inductance will determine the motor type and wiring configuration best suited for your system. While the equation used to size a motor for your system is quite simple, several factors fall into play at this point.

The winding inductance of a motor is rated in milliHenrys(mH) per Phase. The amount of inductance will depend on the wiring configuration of the motor.

The per phase winding inductance specified may be different than the per phase inductance seen by your IB462H driver depending on the wiring configuration used. Your calculations must allow for the actual inductance that the driver will see based upon the motor's wiring configuration.

Maximum Motor Inductance (mH per Phase) =
.4 X Minimum Supply Voltage

Figure 1.6.1A shows a stepper motor in a series configuration. In this configuration the per phase inductance will be 4 times that specified.

For example: a stepping motor has a specified per phase inductance of 1.47mH. In this configuration the driver will see 5.88 mH per phase.

Figure 1.6.1B shows an 8 lead motor wired in parallel. Using this configuration the per phase inductance seen by the driver will be as specified.

Using the following equation we will show an example of sizing a motor for a IB462H used with an unregulated power supply with a minimum voltage (+V) of 18 VDC:

.4 X 18 = 7.2 mH

The maximum per phase winding inductance recommended is 7.2 mH.

Recommended IMS Motors

IMS stocks the following 1.8° hybrid stepping motors that are recommended for the IB462H. All IMS motors are CE marked. For more detailed information on these motors please see the IMS Full Line Catalog or the IMS web site at *www.imshome.com.*

17 Frame

Single Shaft	Double Shaft
M2-1713-S	M2-1713-D
M2-1715-S	M2-1715-D
M2-1719-S	M2-1719-D

23 Frame

Single Shaft	Double Shaft
M2-2215-S	M2-2215-D
M2-2220-S	M2-2220-D
M2-2232-S	M2-2232-D
M2-2240-S	M2-2240-D

IMS also carries a new series of 23 frame enhanced stepping motors that are recommended for use with the IB462H. These motors use a unique relationship between the rotor and stator to generate more torque per frame size while ensuring more precise positioning and increased accuracy.

The special design allows the motors to provide higher torque than standard stepping motors while maintaining a steadier torque and reducing torque drop-off.

The motors are available in 3 stack sizes, single or double shaft, with or without encoders. They handle currents up to 3 Amps in series or 6 Amps parallel, and holding torque ranges from 95 oz-in. to 230 oz-in (67 N-cm to 162 N-cm).

23 Frame Enhanced Motors

Single Shaft	Double Shaft
MH-2218-S	MH-2218-D
MH-2222-S	MH-2222-D
MH-2231-S	MH-2231-D

Motor Wiring

As with the power supply wiring, motor wiring should be run separately from logic wiring to minimize noise coupled onto the logic signals. Motor cabling exceeding 1' in length should be shielded twisted pairs to reduce the transmission of EMI (ElectroMagnetic Interference) which can lead to rough motor operation and poor system performance overall. For more information on wiring and shielding, please refer to *Rules of Wiring and Shielding* in Section 1.5 of this manual.

Recommended motor cables:

Dual Twisted Pair Shielded (Separate Shields)

< 5 feet ..... Belden Part# 9402 or equivalent 20 Gauge
> 5 feet ..... Belden Part# 9368 or equivalent 18 Gauge

When using a bipolar motor, the motor must be within 100 feet of the drive.

NOTE: The physical direction of the motor with respect to the direction input will depend upon the connection of the motor windings. To switch the direction of the motor with respect to the direction input, switch the wires on either phase A or phase B outputs.

WARNING! Do not connect or disconnect motor or power leads with power applied!

Connecting the Motor

The motor leads are connected to the following connector pins:

IB462H

Phase	Connector Pin
Phase B\	9, 10
Phase B	11, 12
Phase A\	17, 18
Phase A	19, 20

8 Lead Motors

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

Series Connection

A series motor configuration would typically be used in applications where a higher torque at low speeds is needed. Because this configuration has the most inductance, the performance will start to degrade at higher speeds.

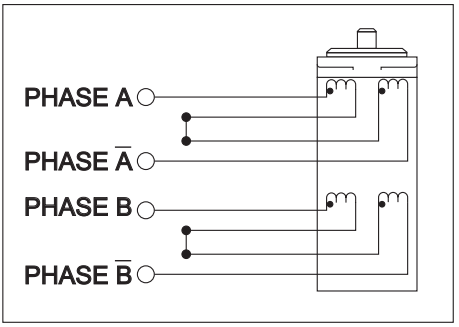


Figure 1.6.2: 8 Lead Series Motor Configuration

Parallel Connection

An 8 lead motor in a parallel configuration offers a more stable but lower torque at lower speeds, but because of the lower inductance there will be higher torque at higher speeds.

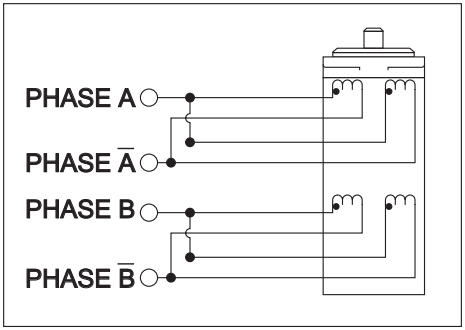


Figure 1.6.3: 8 Lead Parallel Motor Configuration

6 Lead Motors

As with 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operation. The higher speed configuration, or *half coil,* is so described because it uses one half of the motor's inductor windings. The higher torque configuration, or *full coil,* uses the full windings of the phases.

Half Coil Configuration

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence, lower torque output. As with the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as *half copper*.

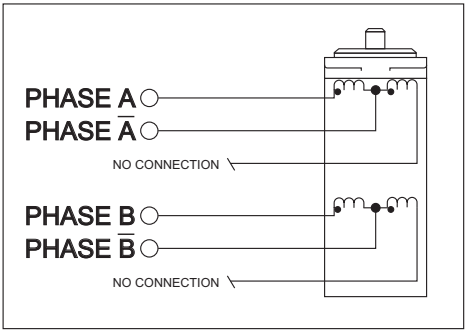


Figure 1.6.4: 6 Lead Half Coil (Higher Speed) Motor Configuration

Full Coil Configuration

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speeds is desired. This configuration is also referred to as *full copper*.

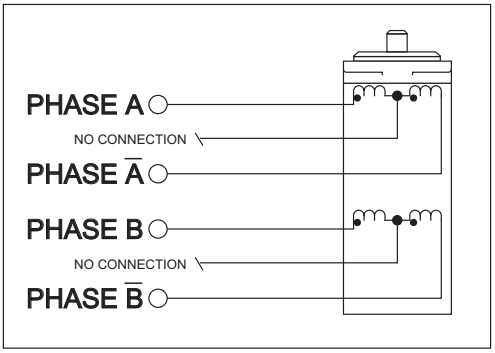


Figure 1.6.5: 6 Lead Full Coil (Higher Torque) Motor Configuration

4 Lead Motors

Four lead motors are the least flexible but easiest to wire. With this type of motor the user has no options for different wiring configurations.

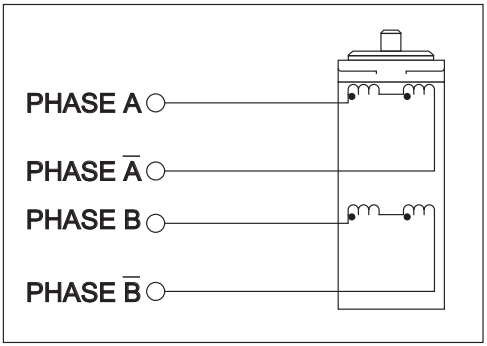


Figure 1.6.6: 4 Lead Motor Configuration

SECTION 1.7

Interfacing to the IB462H

Section Overview

The IB462H was designed to be incorporated directly in the user's printed circuit board. In order to operate, the IB462H must have the following connections:

- Layout and interface guidelines.
- Motor power (+V).
- +5 VDC input.
- Current adjust reference voltage.
- Logic interface.
- Minimum required connections.

The section will also demonstrate the use of the Sense A and Sense B outputs, which can be utilized for over current protection, as well as a circuit which will automatically reduce the current in the motor windings when the step clock signal is removed. Their use is optional.

Layout and Interface Guidelines

Logic level signals should not run parallel to motor phase signals. The motor phase signals will couple noise onto the logic level signals. This will cause rough motor motion and unreliable system operation. Motor phase signals should be run as pairs and should be separated from other signals by ground traces where possible.

When leaving the board, motor cables should not run parallel with other wires. Phases should be wired as using twisted pairs. If motor cabling in excess of one foot is required, motor cabling should be shielded twisted pairs to reduce the transmission of EMI. The shield must be tied to AC ground at driver end only. The motor end must be left floating.

If more than one driver is connected to the power supply, separate power and ground connections from each driver to the power supply should be used.

The power supply cables need to be a twisted pair if power is connected from a source external to the board. If multiple drivers are used with an external power source and it is not possible to run separate power and ground connections to each driver, a low impedance electrolytic capacitor equivalent to two times the total capacitance of all driver capacitors and of equal voltage must be placed at the power input of the board.

Motor Power

Pins 13, 14 (+V), and 15, 16 (Ground) are used to connect motor DC power to the IB462H. Two local capacitors are needed, connected between pins 13, 14 and 15, 16. These must be located as close to the IB462H's motor power input pins as possible to ensure stable operation.

Required Capacitors

1) The first capacitor is a low impedance aluminum electrolytic. The continuous operating voltage of the capacitor should exceed the maximum supply voltage as well as any additional voltage caused by the motor's back EMF. The value of the capacitor should be approximately 150µF for every amp of peak per phase output current.

EXAMPLE: 1.4A (Peak Output Current)@ 40VDC X 150µF = 220µF 60V

2) A 0.1 microfarad ceramic capacitor must be used to filter out high frequency noise. It should be located between the IB462H's motor power input pins and the aluminum electrolytic capacitor. The continuous operating voltage of the capacitor should exceed the maximum supply voltage as well as any additional voltage caused by the motor's back EMF.

For Power Supply Specifications and Recommendations see Section 1.5: *Power Supply Requirements.*

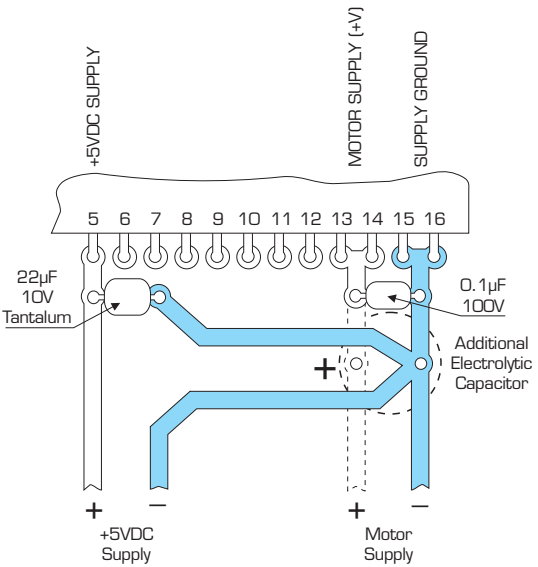


Figure 1.7.1: Power Interface

+5 VDC Input

The IB462H requires an external regulated +5VDC ±5% power supply. The supply is connected between pin 5 (+5VDC Supply) and Pins 15, 16 (Power Ground).

The +5VDC supply ground and the motor supply ground should not be connected together at the power supplies. The common ground connection between the motor power supply and the +5VDC supply should be made at the ground pin of the additional electrolytic capacitor used for the motor supply (See figure 1.7.1).

Required Capacitor

A 22 microfarad 10V tantalum capacitor must be placed as close to the IB462H as possible between the +5VDC input pin 5 and ground (See figure 1.7.1 for PCB layout example).

Interfacing the Current Adjust Input

The output current of the IB462H is controlled by applying a voltage to pin 1 of the hybrid. The output current is set as follows:

EXAMPLE: Per Phase Output Current = 2 X Voltage applied to Pin 1

Voltage Applied to Pin 1 = 0.2V
0.2 X 2 = 0.4
Per Phase output current = 0.4 Amps

Below is a table illustrating the Current Adjust reference voltage to output current relationship. Figure 1.7.2 illustrates a voltage divider circuit that can be used to set the current adjust.

Current Adjustment Resistor Table			
Phase Current (A)	**Resistor Value (1% Ohms)**	**Phase Current (A)**	**Resistor Value (1% Ohms)**
0.1	49	1.1	549
0.2	100	1.2	604
0.3	150	1.3	649
0.4	200	1.4	698
0.5	249	1.5	750
0.6	301	1.6	806
0.7	348	1.7	845
0.8	402	1.8	909
0.9	453	1.9	953
1.0	499	2.0	1000

Table 1.7.1 Current Adjust ReferenceVoltage/Output Current

WARNING! Do not exceed 1.0 volts on the Current Adjust Input!

Reducing the Output Current

Figure 1.7.2 below illustrates a simple circuit which can be used to automatically reduce the current in the motor windings after a move. Using this will greatly reduce the amount of motor and drive heating in your system.

The amount of current reduced will depend upon the value of the Reduction Adjust Resistor (R_{Red}) and the value of the Current Adjust Resistor (R_{Adj}) . The Current will be reduced 200 msec after the rising edge of the last Step Clock Pulse. The values of R_{Red} and R_{Adj} are calculated as follows:

$$R_{Adj} = 2000 \times \frac{I_{Run}}{(10 - I_{Run})}$$

$$R_{Red} = 2000 \times \frac{I_{Run} \times I_{Hold}}{(I_{Run} - I_{Hold})}$$

I_{Run} is the desired running current. Range 0.1A to 2A per Phase.

I_{Hold} is the desired holding current. Range 0A to 2A per Phase.

NOTE! These equations ONLY apply to the circuit example below. If using the IB462H with an INT-462 see Section 2.1: *The INT-462,* for details on adjust and reduction resistor values.

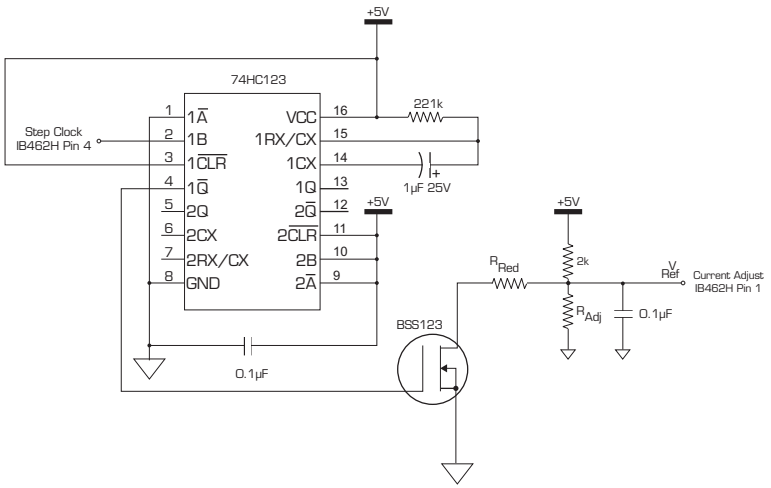


Figure 1.7.2: Current Adjust/Reduction Circuit

Interfacing the Logic Inputs

The inputs to the IB462H are internally pulled up to the +5VDC supply. Figure 1.7.3 shows the inputs and their associated pull up resistor values. See *Section 1.2: Hardware Specifications,* for input tolerance.

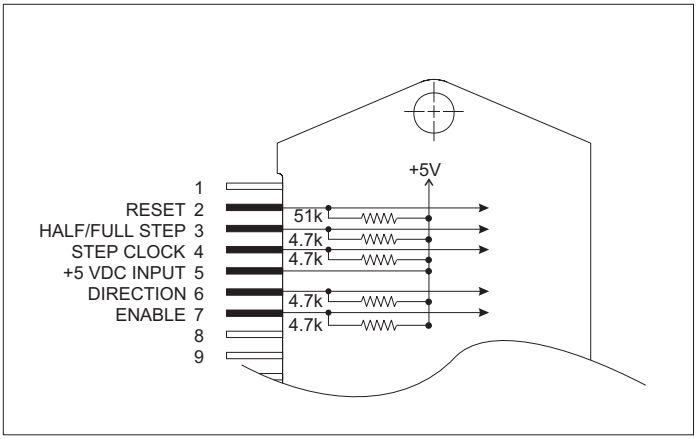


Figure 1.7.3: Internal Input Pull-up Resistor Values

When interfacing to the IB462H logic inputs an open collector output is recommended.

Interfacing the Sense A & B Outputs

These outputs, located on pins 8 (Sense B) and 21 (Sense A) allow monitoring of the output current waveform. They can be compared with a user defined trip reference signal for the purpose of per phase over current protection. Figure 7.4 below illustrates a circuit that can be used to accomplish this.

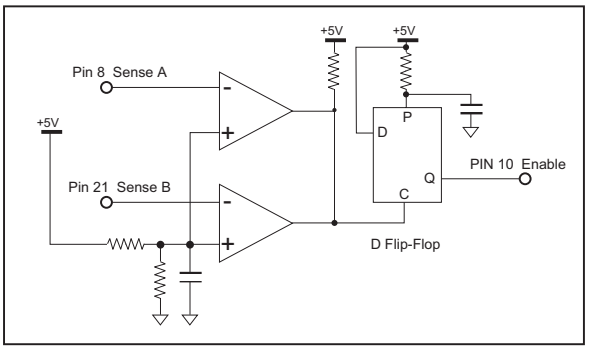


Figure 1.7.4 Over Current Trip Circuit

Minimum Required Connections

The following diagram illustrates the minimum connections required to operate the IB462H.

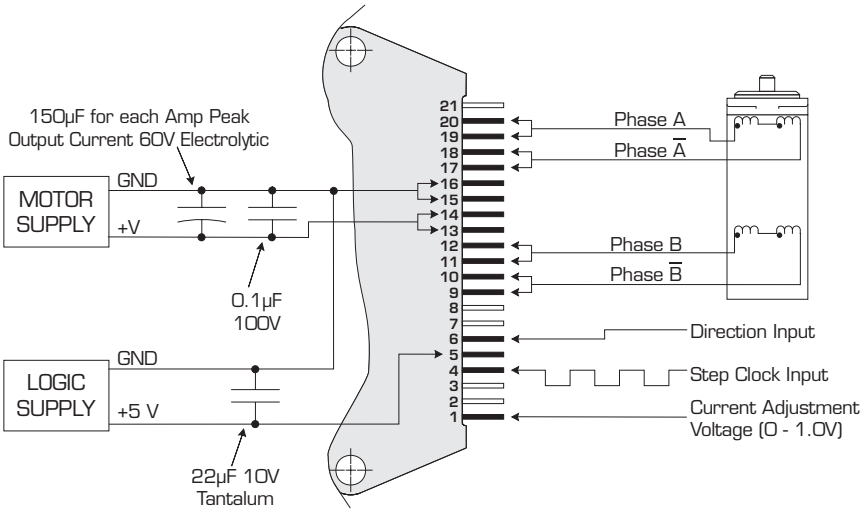


Figure 1.7.5: Minimum Required Connections

SECTION 1.8

Troubleshooting

Section Overview

This section will cover the following:

- Basic troubleshooting.
- Common problems/solutions.
- Contacting application support.
- Product return procedure.

Basic Troubleshooting

In the event that your IB462H doesn't operate properly the first step is to identify whether the problem is electrical or mechanical in nature. The next step is to isolate the system component that is causing the problem. As part of this process you may have to disconnect the individual components that make up your system and verify that they operate independently. It is important to document each step in the troubleshooting process. You may need this documentation to refer back to at a later date, or these details will greatly assist one of our application engineers in determining the problem should you need assistance.

Many of the problems that effect motion control systems can be traced to electrical noise, software errors, or mistakes in wiring.

Problem Symptoms and Possible Causes

Symptom

Motor does not move

Possible Problem

No power.

Step Clock is not grounded to opto supply ground.

Unit is in a reset condition.

Current adjust voltage is incorrect or not applied.

Fault condition exists.

Unit is disabled.

Symptom

Motor moves in the wrong direction.

Possible Problem

Motor phases may be connected in reverse.

Symptom

Fault LED on Interface Board is illuminated.

Possible Problem

Current Adjust Resistor is incorrect value or not in place.

Motor phase winding shorted.

Power Input or Output driver electrically overstressed.

Unit overheating.

Symptom

Erratic motor motion.

Possible Problem

Motor/power wiring unshielded or not twisted pair.

Logic wiring next to motor/power wiring.

Ground loop in system.

Opto-isolation defeated by powering optos with motor supply.

Open winding of motor.

Phase blown on drive.

Symptom

Motor stalls during acceleration.

Possible Problem

Incorrect current adjust setting or resistor value.

Motor is undersized for application.

Acceleration on controller is set to high.

Power supply voltage too low.

Symptom

Excessive motor and driver heating.

Possible Problem

Inadequate heat sinking/cooling.

Current reduction not being utilized.

Current set too high.

Symptom

Inadequate holding torque.

Possible Problem

Incorrect current adjust setting or resistor value.

Increase holding current with the current reduction adjust resistor.

Contacting Application Support

In the event that you are unable to isolate the problem with your IB462H the first action you should take is to contact the distributor from whom you originally purchased your product or IMS Application Support at 860-295-6102 or by fax at 860-295-6107. Be prepared to answer the following questions:

- What is the application?
- In detail, how is the system configured?
- What is the system environment? (Temperature, humidity, exposure to chemical vapors, etc.)
- What external equipment is the system interfaced to?

The IMS Web Site

Another product support resource is the IMS web site located at *www.imshome.com*. This site is updated monthly with tech tips, applications and new product updates.

Returning Your Product to IMS

If Application Support determines that your IB462H needs to be returned the factory for repair or replacement you will need to take the following steps:

- Obtain an RMA (Returned Material Authorization) number and shipping instructions from Customer Service.
- Fill out the Reported Problem field in detail on the RMA form that Customer Service will fax you.
- Enclose the product being returned and the RMA form in the box. Package product in its original container if possible. If original packaging is unavailable ensure that the product is enclosed in approved antistatic packing material. Write the RMA Number on the box.

The normal repair lead time is 10 business days, should you need your product returned in a shorter time period you may request that a “HOT” status be placed upon it while obtaining an RMA Number. Should the factory determine that the product repair is not covered under warranty, you will be notified of any charges.

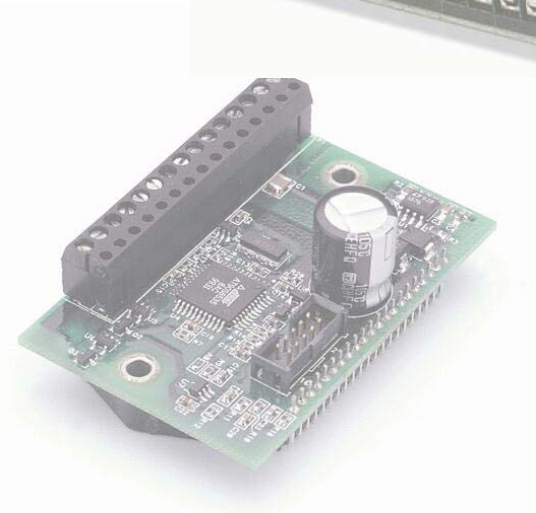
PART II

Options And Accessories

Section 2.1–INT-462

Section 2.2–OSC-462H





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SECTION 2.1

The INT-462 Interface Board

INT-462 Features



This section covers the INT-462 interface board for the IB-462H. The interface board adds the tools needed for rapid prototyping and product evaluation by eliminating the need of laying out and testing a PC board.

This interface features the following:

- On-board +5VDC supply.
- Fault output.
- Optical isolation for logic inputs.
- Resistor programmable current adjust/reduction circuitry.
- Over current protection
- Power and fault LEDs.
- Pluggable screw terminal interface.
- Input capacitor.

Mechanical Specifications

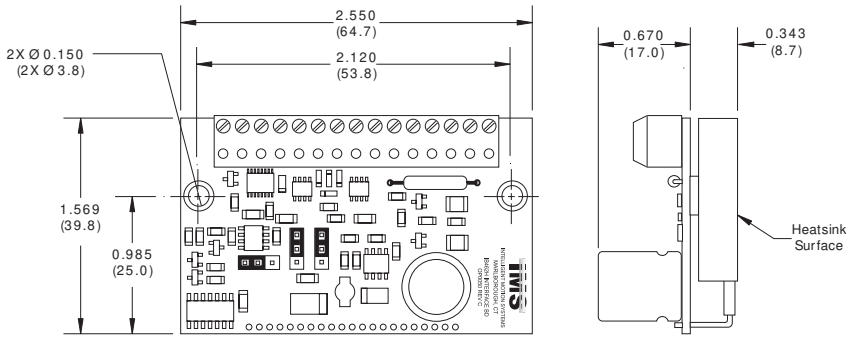


Figure 2.1.1: INT-462 Dimensional Information

Pin Assignment and Description

INT-462 Pin Configuration		
PIN #	**FUNCTION**	**DETAILS**
1	GND	Power supply ground (return).
2	+V	+12 to +40 VDC power supply input.
3	Phase A	Phase A of the stepping motor.
4	Phase $\overline{A}$	Phase $\overline{A}$ of the stepping motor.
5	Phase B	Phase B of the stepping motor.
6	Phase $\overline{B}$	Phase $\overline{B}$ of the stepping motor.
7	Direction	Internally synchronized clockwise/counterclockwise direction control input. This input is optically isolated. Physical direction of the motor will depend on the connection of the motor windings.
8	Step Clock	Optically isolated active HIGH motion clock input. The motor will advance 1 increment, or step, upon the rising edge of the clock pulse.
9	Opto-Isolator Supply	+5 to +40 VDC power input for the optocouplers used for logic input isolation. See Isolated Inputs subsection in this section for more details.
10	Enable	Optically isolated enable input. A logic HIGH state (or input disconnected) will enable the driver outputs. The outputs are disabled by sinking the input.
11	$\overline{\text{Reset}}$	Optically isolated active LOW driver reset input. A logic LOW pulse on this input will reset the IB462H.
12	Fault Output	Active LOW fault output. This open-collector output will latch in a logic LOW state when short circuit or over-current condition occurs. See the Fault Protection subsection of this section for more details.
13	Ground	Current adjust ground. This pin will be used in connecting the current adjustment resistor. Common with power ground.
14	Current Adjust	Phase current adjustment input. A resistor connected between this input and ground (Pin 13) will program the maximum phase current of the driver. A resistor MUST be placed here or an overcurrent fault condition will occur. See the Setting the Output Current subsection.
15	Reduction Adjust	Automatic current reduction adjustment input. A resistor is connected between this pin and Current Adjust (Pin 14) to automatically reduce the current in the motor winding following a move. See the Setting the Output Current subsection.

Table 2.1.1: INT-462 Pin Assignment and Description

Electrical Specifications

INT-462 Electrical Specifications					
Specification	**Test Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Voltage (IB462H Driver)		12		40	V
Phase Output Current (IB462H Driver)	Per Phase			2	A
Input Forward Current	Isolated Inputs	8	10	12	mA
Input Forward Voltage	Isolated Inputs	5		40	V
Quiescent Current (IB462H Connected)	Inputs/Outputs Floating			85	mA
Signal Output Current	Fault Output			25	mA
Drain-Source Voltage	Fault Output			100	V
Drain-Source Resistance	Fault Output		6.5		Ω

Table 2.1.2: INT-462 Electrical Specifications

Thermal Specifications

The following thermal information is repeated from Section 1.2 of the IB462H portion of this document.

IB462H Thermal Specifications	
Specification	**Unit**
Ambient Temperature	0 to +50°C
Storage Temperature	-40 to +125°C
Maximum Plate Temperature	70°C

Table 2.1.3: IB462H Thermal Specifications

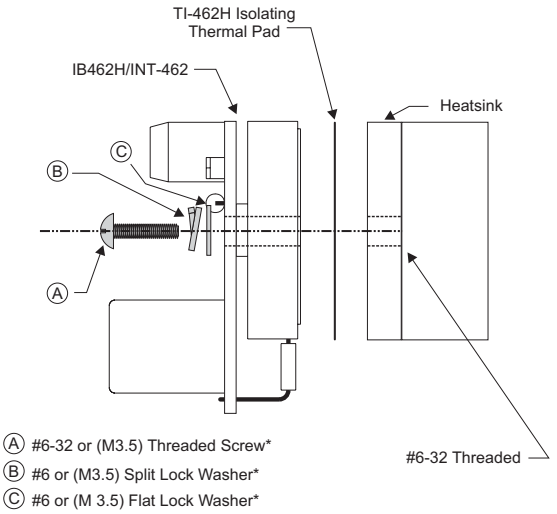
WARNING! The IB462H rear plate **MUST** be kept to 70° or below or damage may occur to the device! Use of an external heat sink and the included thermal pad is required to maintain a rear plate temperature of 70°C or below.

WARNING! The rear mounting surface of the driver contains different voltages and must be kept isolated when attached to a conductive surface! The included thermal pad will isolate these voltages.

NOTE: When choosing a heat sink, ensure that there is good thermal flow, otherwise hot spots may occur in the IB462H, reducing the effectiveness of the thermal protection.

Mounting the INT-462

WARNING! The IB462H Driver must be mounted to a Heat Sink at all power levels. The Isolated Thermal Pad supplied with the H-462H Heat Sink must aslo be used.



* *The torque specification for the 6-32 mounting screws is 5.0 to 7.0 lb-in (0.60 to 0.80 N-m).*

Figure 2.1.2: Mounting the INT-462

Connecting and Configuring the INT-462

Wiring Specifications

The INT-462 uses a removeable 15 pin screw terminal for wiring connection. The following wiring practices are recommended when connecting to the INT-462:

- Wire Size: 18 - 26 AWG.
- Strip Length: 0.197" (5mm).
- Screw Torque: 3.0 lb-in (0.33 N-m).

Power and Motor Connection and Specifications

Motor Power (+V)

Motor power for the INT-462H/IB462H will have the same recommended specifications as found in *Section 1.5: Power Supply Requirements* of this document.

The power supply ground will be connected to Pin 1 (GND) and the DC output to Pin 2 (+V). See the *Minimum Required Connections* figure in this appendix for a connection diagram.

Stepping Motor

Motor selection for the INT-462H/IB462H will have the same recommended specifications as found in *Section 1.6: Motor Requirements* of this document.

See the *Minimum Required Connections* figure in this section for a connection diagram.

Opto-Coupler Supply

The INT-462 features optically isolated logic inputs to prevent system noise from being coupled onto control signals. These inputs may optionally be powered from a separate external +5 VDC to +24 VDC regulated power supply.

If an external supply is not used, Jumper JP2 **must** be re-positioned to connect pins 2 & 3 to power the opto-couplers using the on-board +5 VDC. Note that if this is done optical isolation of the logic inputs is defeated. See the *Isolated Inputs* portion of this appendix for further details.

Setting the Output Current

The INT-462 uses a 1mA current source to provide a reference level to the current adjust pin (Pin 1) of the IB462H driver. To control the output curent a resistor is placed between Pins 13 and 14 of the interface board. Connection of this resistor is essential for the IB462H/INT-462 to operate. The recommended resistor type is: 1/8W 1%.

Table 2.1.4 shows the standard 1% resistor values for each output current setting. A connection diagram is shown in figure 2.1.3.

Current Adjustment Resistor Table			
Phase Current (A)	Resistor Value (1% Ohms)	Phase Current (A)	Resistor Value (1% Ohms)
0.1	49	1.1	549
0.2	100	1.2	604
0.3	150	1.3	649
0.4	200	1.4	698
0.5	249	1.5	750
0.6	301	1.6	806
0.7	348	1.7	845
0.8	402	1.8	909
0.9	453	1.9	953
1.0	499	2.0	1000

Table 2.1.4: Current Adjust Resistor Values

NOTE: The current adjustment resistor MUST be in place or a fault condition will occur!

Reducing the Output Current

The INT-462 will automatically reduce the current in the motor windings .5 seconds after the falling edge of the last step clock pulse. There are two possible ways that this may be done.

Using a Current Reduction Adjustment Resistor (ENOFF Mode)

The first way is to use a reduction adjustment resistor connected as shown in figure 2.1.3. Using this method, the current in the motor windings will be reduced to a holding current specified by the resistor value used. The value of this resistor is calculated using the equation shown below.

If this method of reducing current in the motor windings is used, JP3 (see figure 2.1.3) will have the shunt positioned between pins 1 and 2 (factory default).

$$R_{RED} = 500 \times \left(\frac{I_{RUN} \times I_{HOLD}}{I_{RUN} - I_{HOLD}} \right)$$

EXAMPLE: This will determine the Current Reduction Adjust Resistor value for a per phase Output Current (I_{RUN}) of 1.5A and a Holding Current (I_{HOLD}) of 0.5A.

$$R_{RED} = 500 \times \left(\frac{1.5 \times 0.5}{1.5 - 0.5} \right) = 375$$

Thus, the value of the Current Reduction Resistor will be 375 Ohms.

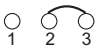
JP3	Position	Mode
		ENOFF - Current Reduction by Resistor.
		ENON - Outputs Disable Following a Move.

Table 2.1.5: Jumper JP3 Shunt Placement Options

Disabling the Driver Outputs (ENON Mode)

The second method is to disable the driver outputs. In this configuration the driver outputs will disable 0.5 seconds after the following edge of the last step clock pulse. This would be the preferred method if zero holding current is required.

To set this mode, reposition the shunt on JP3 to pins 2 and 3. Ensure that a current reduction adjust resistor is not connected, as this will cause erratic operation.

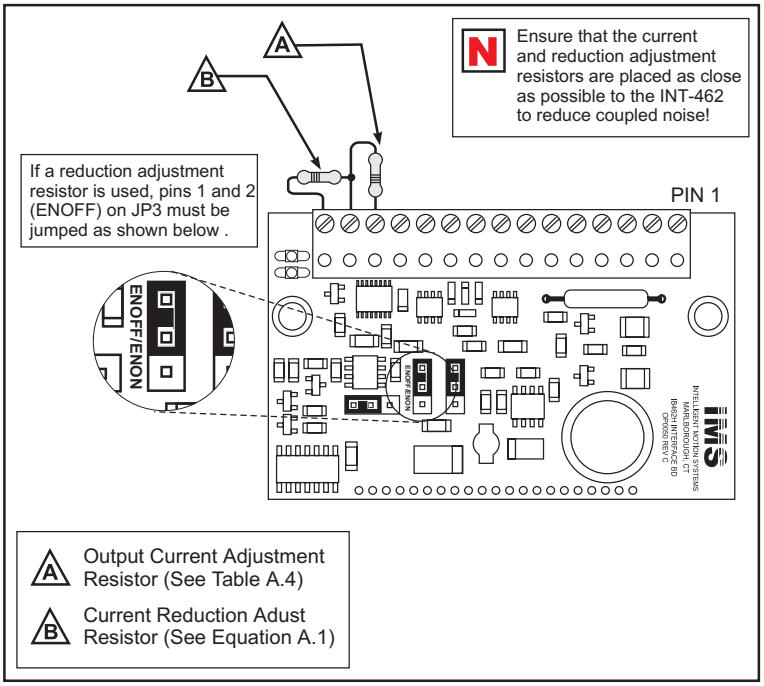


Figure 2.1.3: Current and Reduction Adustment Resistor Connection

WARNING! When using the **ENON** mode of disabling the outputs following a move, the current reduction resistor **MUST NOT** be used or the driver will operate erratically!

Isolated Inputs

The INT-462 features optically isolated, +5 to +24 VDC logic inputs which are internally limited to 8mA (See schematic, figure 2.1.4). The robust input circuitry of the INT-462 allows for easy "plug and play" interfacing with an array of controllers ranging from the IMS LYNX to a variety of PLCs.

These inputs may be powered using one of two methods: An external +5 to +24 VDC power supply or by using the on-board +5 volts.

See *Table 2.1.2* of this appendix for input electrical specifications.

External +5 to +24 VDC Supply

In order to take advantage of the built-in optical isolation of the logic inputs, the opto-couplers must be powered by an external power supply.

IMS recommends that a regulated supply be used. Its voltage range can be from +5 VDC to +24 VDC.

The voltage output of the power supply will be connected to Pin 9 of the interface board, the ground of the logic supply will be connected to the power ground of the device being used as a controller.

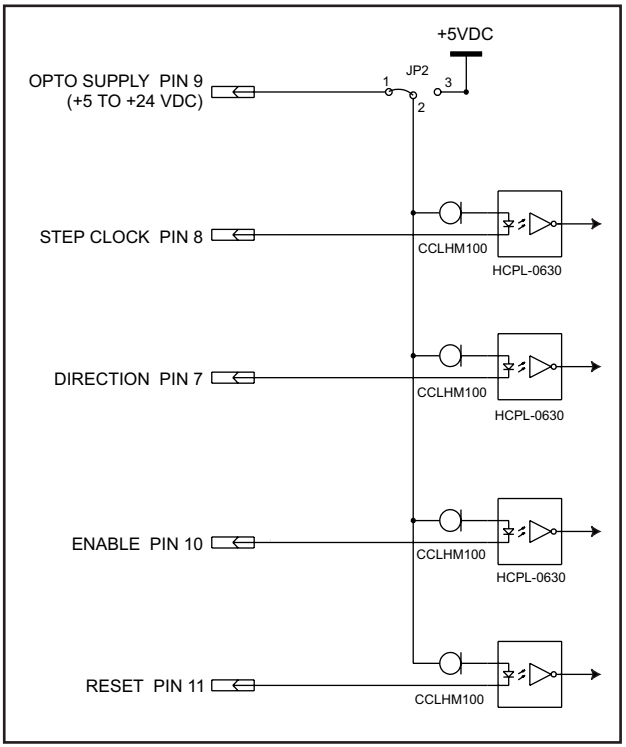


Figure 2.1.4: Optically Isolated Input Circuitry

If the controller or PLC being used with the INT-462/IB462H has a voltage output, this may also be used to power the opto-couplers.

If this mode of powering the logic inputs is used, the shunt on JP2 must be placed between pins 1 and 2 (factory default placement).

Using the On-board +5 VDC Supply

JP2	Position	Mode
		Opto-couplers Powered By External +5 To +24 VDC.
		Opto-couplers Powered By On-board +5 VDC.

Table 2.1.6: Jumper JP2 Shunt Placement Options

The on-board +5 VDC can be used to power the logic circuitry by positioning the shunt on jumper JP2 between pins 2 and 3 (See figure 2.1.5).

Note that if this method is used, optical isolation is defeated and any electrical noise on the logic inputs will be coupled onto the driver output, i.e. noise on the step clock input will cause the motor to run rough.

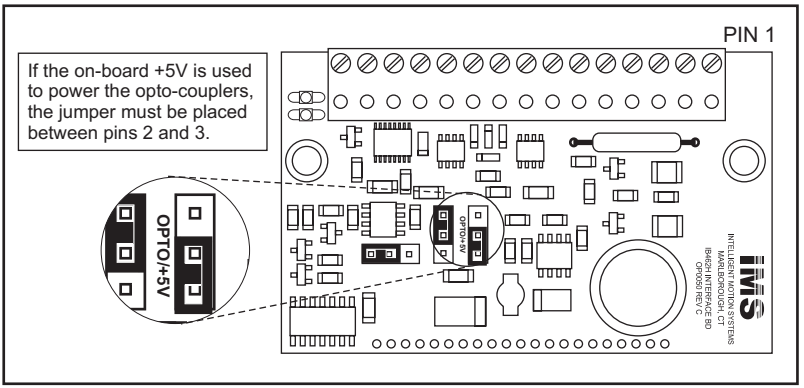


Figure 2.1.5: Powering the Opto-couplers using the On-board +5 VDC

NOTE: If the on-board +5 Volts is used to power the logic circuitry, Optical Isolation will be defeated.

Half/ Full Step Selection

Half or full step mode is selected by the position of jumper JP1. See *Section 1.4: Theory of Operation*, for an explanation of the modes.

JP1	Position	Mode
	1 2 3	Driver in Full Step Mode.
	1 2 3	Driver in Half Step Mode.

Table 2.1.7: Jumper JP1 Shunt Placement Options

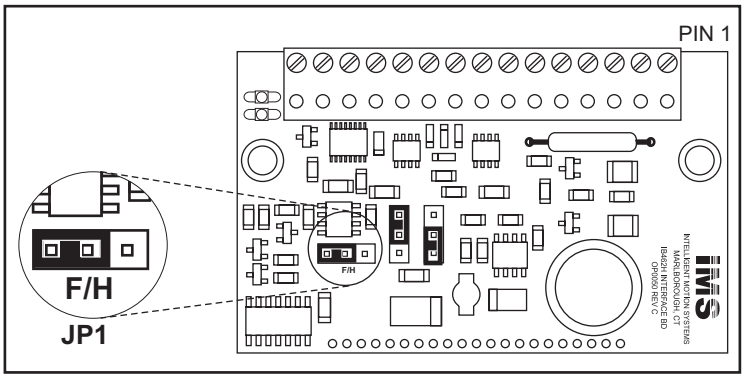


Figure 2.1.6: Jumper JP1 Showing Full Step Mode Selected

Fault Protection Circuitry/ Fault Output

The INT-462H adds phase to ground fault protection to the IB462H. If a phase to ground fault is detected, the driver will set the fault output and the red LED will illuminate.

In order to clear a fault condition, the power must be cycled or the RESET input toggled.

Fault Output

The INT-462 buffers the fault output signal through an open drain N-channel FET. The signal at the terminal strip is inverted, thus it is active when in a logic LOW state. See *Table 2.1.2* of this section for the electrical characteristics of this output.

LED Indicators

Green

The green LED is powered by the on-board +5V supply and indicates a "power on" condition when illuminated.

Red

The red LED is controlled by the fault protection circuitry on the INT-462H. If the red LED is illuminated, remove power and check for a system fault. Verify that the current adjust resistor is in place and the correct value. A fault condition can only be cleared by cycling power or toggling the RESET input at Pin 11 of the terminal strip.

Minimum Required Connections

Figure 2.1.7 illustrates the connections required to operate the INT-462/IB462H Interface board/driver combination.

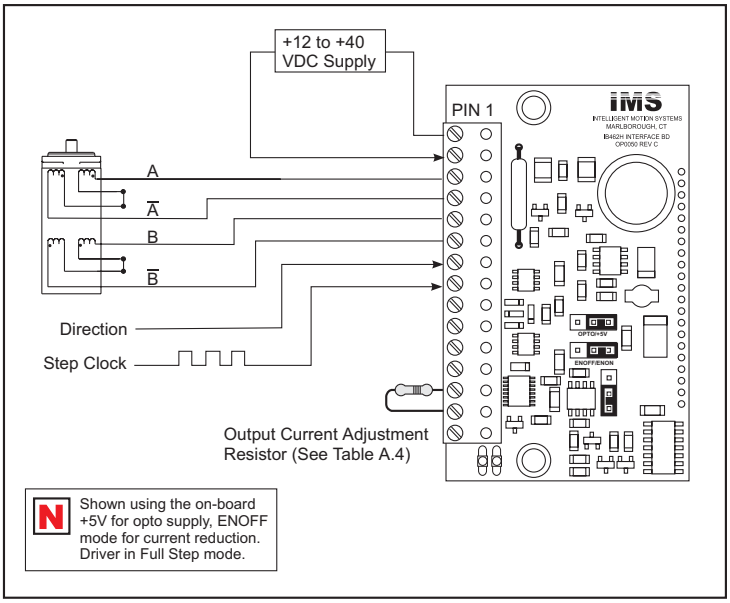


Figure 2.1.7: Minimum Required Connections

SECTION 2.2

The OSC-462H Variable Speed Control

Section Overview

The purpose of this appendix is to aquaint the user with the OSC-462H variable speed control optional add-on for the IB462H driver hybrid. Covered are:

- OSC-462H Features
- OSC-462H Specifications
- Installation and Wiring
- The Analog Speed Control Configuration Utility
- Configuring the OSC-462H
- Application Example

OSC-462H Features



The OSC-462H Analog Speed Control Interface Board offers the system designer the capability of adding low cost, intelligent velocity control to the functionality of the IB462H Half/Full Step Hybrid motor driver. The IB462H plugs easily into a 21 pin receptacle on the bottom-side of the interface board.

The OSC-462H features a tunable digital oscillator for accurate velocity control. This oscillator has an output frequency range of 0 - 60 kilohertz. The output frequency of the oscillator will vary with the level of the 0 to +5 volt speed control input.

The speed control board has 10 setup parameters which are configured using an included software utility. This utility enables the user to communicate to the OSC-462H via its Serial Peripheral Interface (SPI) to set up the operational parameters.

The OSC-462H is powered by a single +12 to +40 VDC power supply, which will also provide power to the IB462H driver.

The OSC-462H may be configured to be used with a joystick or as a linear velocity device. A joystick or potentiometer is connected between the on-board +5 VDC output and the speed control input. The joystick center position may then be set using the configuration utility to the desired position, which will be seen by the OSC-462H as a zero reference position. Moving the joystick will then control the axis speed and direction.

To use velocity mode, a 10 kOhm potentiometer or 0 to +5 VDC reference voltage is used to control the axis velocity and the center position is set to 0.

The velocity will vary between a user configured initial velocity and a maximum velocity with voltage level applied to the input. Axis direction is controlled by the direction input.

In addition to this powerful array of features, the OSC-462H has buffered step clock and direction outputs to facilitate cascading of drives. These outputs will follow the primary step clock and direction outputs of the speed control board.

Interface wiring is accomplished using a convenient 15 pin removable screw terminal (P1). The parameter setup cable simply plugs into the 10 pin IDC header (P3) and your PC parallel port.

The OSC-462H allows for a simple, cost effective solution in applications requiring variable velocity or joystick control.

The OSC-462H features:

- Digital oscillator for accurate speed control.
- Low cost.
- Extremely compact (2.54 x 1.69 x 1.02 inches)(64 x 43 x 26 mm).
- May be configured for Joystick and Velocity operation.
- 0 to +5 VDC speed control input.
- Step clock & direction outputs for cascading multiple drives.
- Single supply.
- Included graphical user interface (GUI) for parameter setup.
- Serial Peripheral Interface (SPI) communications interface.
- 15 pin removable screw terminal interface.
- Optional Mounting L-Bracket (MB-21).

OSC-462H Specifications

Mechanical Specifications

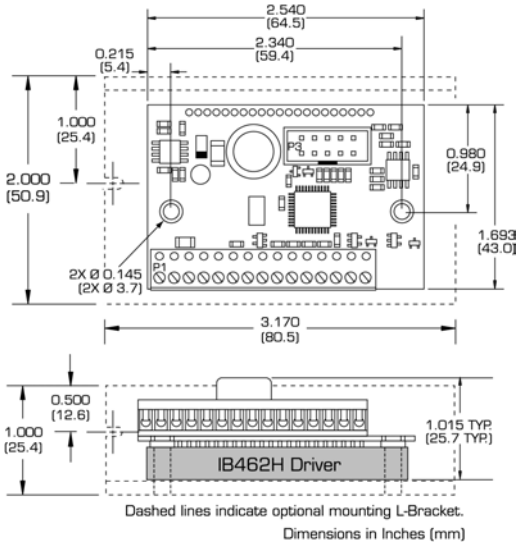


Figure 2.2.1: OSC-462H Dimensional Information

Thermal Specifications

SC-462 Thermal Specifications (C°)	
Specification	**Unit**
Ambient Temperature	0 to +50°C
Storage Temperature	-40 to +125°C
Maximum Plate Temperature	70°C

Table 2.2.1: OSC-462H Thermal Specifications

Electrical Specifications

OSC-462H Electrical Characteristics					
Specification	**Test Condition**	**Min**	**Typ**	**Max**	**Unit**
Speed Control Input Voltage		0		5	V
A/D Resolution			10		Bits
Speed Control Potentiometer Resistance			10		kΩ
Input Voltage (+V)		12		40	V
Phase Output Current	Per Phase (IB462H Driver)			2	A
Low Level Input Voltage	Stop/Start, Direction and Step Clock	-0.5		1.5	V
High Level Input Voltage	Stop/Start, Direction and Step Clock	3.0		5.5	V
Low Level Input Voltage	Enable	0.5		1.65	V
High Level Input Voltage	Enable	3.85		5.5	V
Input Pull-up Resistance	Stop/Start, Direction and Step Clock	35		120	kΩ
Input Pull-up Resistance	Enable			4.99	kΩ
Output Drain-Source Voltage	Direction and Step Clock Outputs			80	V
Output Drain Current	Direction and Step Clock Outputs			120	mA
Drain-Source On-Resistance	Drain Current = 120mA			6	Ω

Table 2.2.2: OSC-462H Electrical Specifications

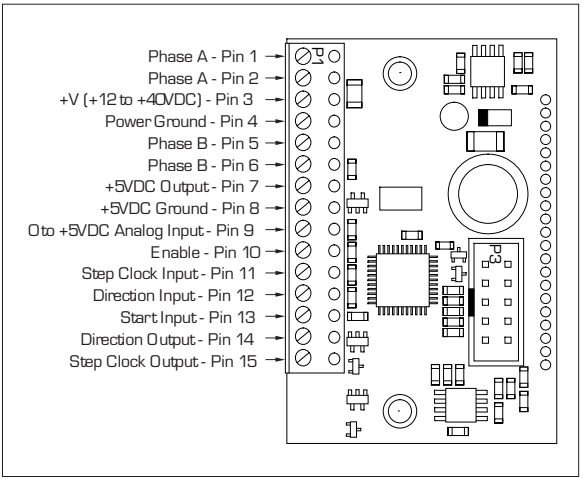


Figure 2.2.2: OSC-462H Connector P1 Pin Configuration

P1 - 15 Position Removeable Screw Terminal Pin Assignment And Description		
Pin #	**Function**	**Description**
1	Phase A	Phase A of the stepping motor.
2	Phase $\overline{A}$	Phase $\overline{A}$ of the stepping motor.
3	+V (+12 to 40VDC)	+12 to +40VDC unregulated power supply input.
4	Power Ground	Power supply ground (return).
5	Phase B	Phase B of the stepping motor.
6	Phase $\overline{B}$	Phase $\overline{B}$ of the stepping motor.
7	+5VDC Output	+5VDC output (10kΩ potentiometer signal end).
8	Logic Ground	+5V Ground 10kΩ potentiometer ground end).
9	Speed Control Input	0 to +5VDC velocity control input (10kΩ potentiometer wiper).
10	Enable Input	Active HIGH driver enable input.
11	Step Clock Input	Step clock input. Internally pulled-up to +5VDC.
12	Direction Input	CW/CCW direction input. Thefunction of this input is dependant on the mode specified by the MODE instruction. Internally pulled-up to +5VDC.
13	Stop/$\overline{\text{Start}}$ Input	Active LOW Stop/$\overline{\text{Start}}$ Input toggles the internal step clocl generator. The function of this input is specified by the MODE instruction. Internally pulled-up to +5VDC.
14	Direction Output	Buffered direction output.
15	Step Clock Output	Buffered step clock output.

Table 2.2.3: OSC-462H Connector P1 Pin Assignment and Description

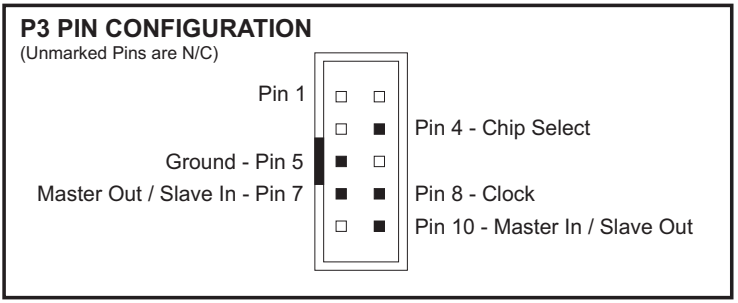


Figure 2.2.3: Connector P3 Pin Configuration

NOTE: Recommended Parameter Setup Cable:
IMS Part # OSC-CC100-000

P3 - 10 Pin IDC Header Pin Assignment And Description		
Pin #	**Function**	**Description**
1	N/C	No Connect
2	N/C	No Connect
3	N/C	No Connect
4	$\overline{CS}$	Chip Select
5	GND	Communications ground.
6	N/C	No Connect
7	MOSI	Master Out/Slave In
8	CLK	Step Clock
9	N/C	No Connect
10	MISO	Master In/Slave Out

Table 2.2.4: Connector P3 Pin Assignment and Description

NOTE: See IB462H Operating Instructions for IB462H pin configuration and specifications!

Mounting the OSC-462H

The OSC-462H/IB462H must be mounted to a heat sink in order to maintain a rear plate temperature of less than 70°C on the IB462H driver.

The first installation step is to insert your IB462H into the OSC-462H P2 connector located on the bottom side of the OSC-462H board. When inserting, the rear plate will be facing away from the OSC-462H PCB (Figure 2.2.4).

The second step is to mount the IB462H/OSC-462H assembly to a heat sink plate (Figure 2.2.5). Included with your IB462H driver is the thermal isolating pad TI-462H. This isolating pad **MUST** be positioned between the IB462H

rear plate and the heat sink surface! See *Section 1.2* of this document for thermal specifications and warnings. For additional mounting configurations, an L-gracket is also available as an option.

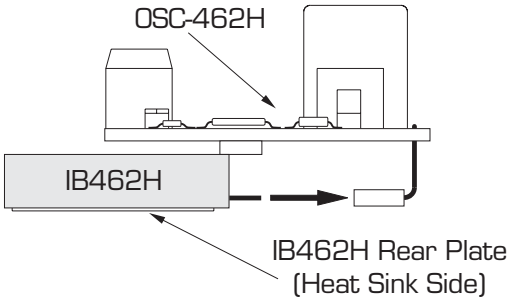


Figure 2.2.4: Inserting the IB462H into the OSC-462H

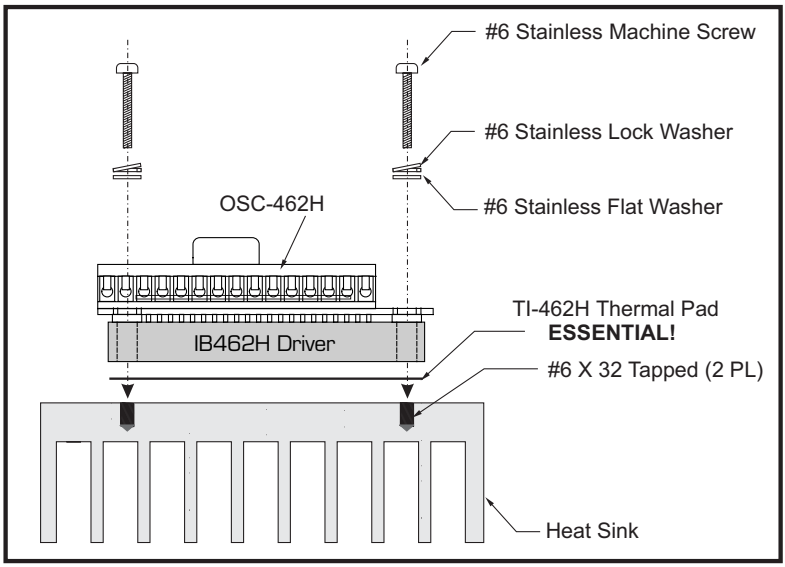


Figure 2.2.5: Mounting the IB462H/OSC-462H Assembly

NOTE: The #6 Mounting Screw Torque is 5.0 to 7.0 lb-in. (0.6 to 0.8 N-m)

WARNING: The Heat Sink mounting surface must be smooth, flat, and free from burrs, protrusions, cuttings, or other foreign objects.

OSC-462H Wiring and Connections

Wiring Specifications

P1: Power, Motor, Control Signals

The OSC-462H uses a removeable 15 pin screw terminal for wiring connection. The following wiring practices are recommended when connecting to the OSC-462H:

- Wire Size: 18 - 26 AWG
- Strip Length: 0.197" (5mm)
- Screw Torque: 3.0 lb-in (0.33 N-m)

P3: SPI Communications

The SPI communications connector uses a 10 pin IDC header. The recommended method of connecting to this connector is the Parameter Setup Cable MX-CC300-000.

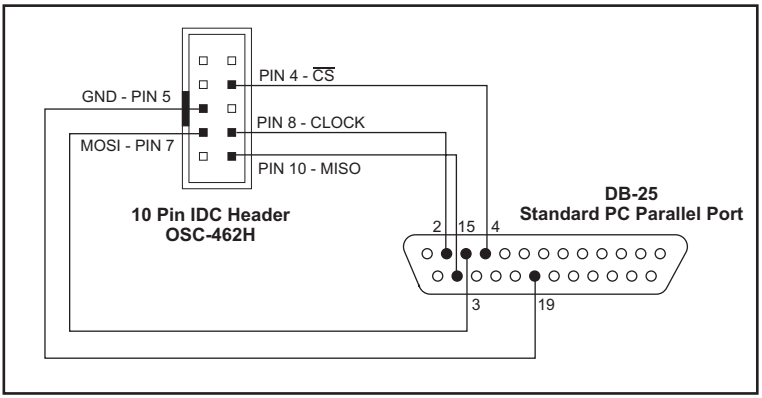


Figure 2.2.6: Connecting the SPI Interface

Power and Motor Connection and Specifications

Motor Power/ Ground (+V - Pin 3, GND - Pin 4)

Motor power for the OSC-462H/IB462H assembly will have the same recommended specifications as found in *Section 1.5: Power Supply Requirements* of this document.

The power supply ground will be connected to Pin 4 (GND) and the DC output to Pin 3 (+V). See the *Minimum Required Connections* figure in this appendix for a connection diagram.

Stepping Motor (ØA - Pins 1 & 2, ØB - Pins 5 & 6)

Motor selection for the OSC-462H/IB462H will have the same recommended specifications as found in *Section 1.6: Motor Requirements* of this document.

See the *Minimum Required Connections* figure in this appendix for a connection diagram.

Input Connections

Speed Control Input (Pin 9)

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

This 0 - 5 volt analog input will typically be interfaced using a 10kΩ potentiometer as illustrated in Figure 2.2.7, a joystick wiper or by a 0 to 5V (4 - 20 mA) 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 at 0 volts + DB (value of the potentiometer deadband parameter) the step clock frequency will be at the value specified by the initial velocity (VI) parameter. When at FS (the value specified by the full

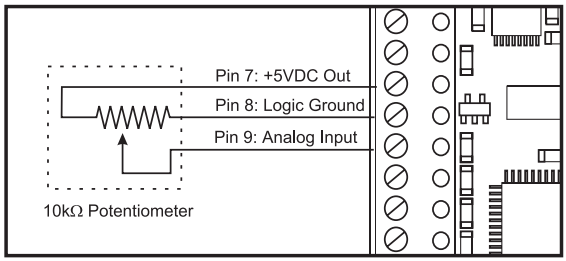


Figure 2.2.7: Interfacing the Speed Control Input with a Potentiometer

scale parameter), it will be at the value specified by the maximum velocity (VM) parameter. See *Setting the Initial/Maximum Velocity*, for more details.

Recommended Potentiometer

Bourns 53AAA-B28-B15. This is available from Digikey (P/N 53AAA-B28-B15-ND) and Newark Electronics (Stock No. 90F6563).

Enable Input (Pin 10)

The enable input is internally pulled-up to +5VDC through a 4.99kΩ resistor. When HIGH, or disconnected, the driver outputs are enabled. A LOW will disable the driver outputs. This input is independent of the step clock input.

This input may be connected by means of a switch between the input (Pin 10) and logic ground (Pin 8) or a sinking output.

Step Clock (Pin 11)

The Step Clock input is internally pulled-up to +5VDC through a 4.99kΩ resistor. This input would be used if an external 0 - 40kHz clock input is being used as a motion clock for the IB462H. This input will increment the motor **only** if the /Start input is in a logic HIGH (internal oscillator stopped) state. The Direction input will function normally.

Direction (Pin - 12)

The CW/CCW direction input is internally pulled-up to +5VDC through a 4.99kΩ resistor.

This input may be connected by means of a switch between the input (Pin 12) and logic ground (Pin 8) or a sinking output.

NOTE: The physical direction of the motor with respect to the direction input will depend upon the connection of the motor windings.

/ Start (Pin 13)

The Stop/Start input is internally pulled-up to +5VDC through a 4.99kΩ resistor. When in a logic HIGH, or disconnected, state the internal step clock generator will be off. Connecting this input to logic ground (pin 8) or a sinking output in a LOW state will enable the internal step clock oscillator.

This input may be controlled by means of a switch between the input (pin 13) and logic ground (pin 8) or a sinking output.

NOTE: The Stop/Start input must be in the stopped position (logic HIGH) in order to use an external step clock to index the motor.

Output Connections

+5VDC Output (Pin 7)

The +5VDC output is to be connected to the signal end of the 10kΩ potentiometer used to control velocity **only**.

WARNING! It is not the design intent of the +5VDC output to supply power to external loads! This voltage output is only to be used to supply voltage to the internal circuitry of the OSC-462H/IB462H assembly and the speed control input!

Direction Output (Pin 14)

The Direction output is buffered through an open-drain N-channel FET. This output will follow the direction input.

Step Clock Input (Pin 15)

The Step Clock output is buffered through an open-drain N-channel FET. This output will follow the step clock signal.

Minimum Required Connections

The following connections illustrated in Table 2.2.5 and Figure 2.2.8 are required to operate the OSC-462H/IB462H assembly.

OSC-462H Required Connections		
P1 - 15 Pin Screw Terminal		
Pin #	**Function**	**Description**
1	Phase A	Phase A of the stepping motor.
2	Phase $\overline{A}$	Phase $\overline{A}$ of the stepping motor.
3	+V (+12 to 40VDC)	+12 to +40VDC unregulated power supply input.
4	Power Ground	Power supply ground (return).
5	Phase B	Phase B of the stepping motor.
6	Phase $\overline{B}$	Phase $\overline{B}$ of the stepping motor.
7	+5VDC Output	+5VDC output (10kΩ potentiometer signal end).
8	Logic Ground	+5V ground (10kΩ potentiometer ground end).
9	Speed Control Input	0 to +5VDC velocity control input (10kΩ potentiometer wiper).
12	Direction Input	CW/CCW direction input. Internally pulled-up to +5VDC.
13	$\overline{\text{Start}}$ Input	Active LOW $\overline{\text{Start}}$ input enables the internal step clock generator. Internally pulled-up to +5VDC.
P3 - 10 Pin IDC Header		
4	$\overline{CS}$	Chip Select.
5	GND	Ground.
7	MOSI	Master Out/Slave In.
8	CLK	Clock.
10	MISO	Master In/Slave Out.

Table 2.2.5: OSC-462H Required Connections

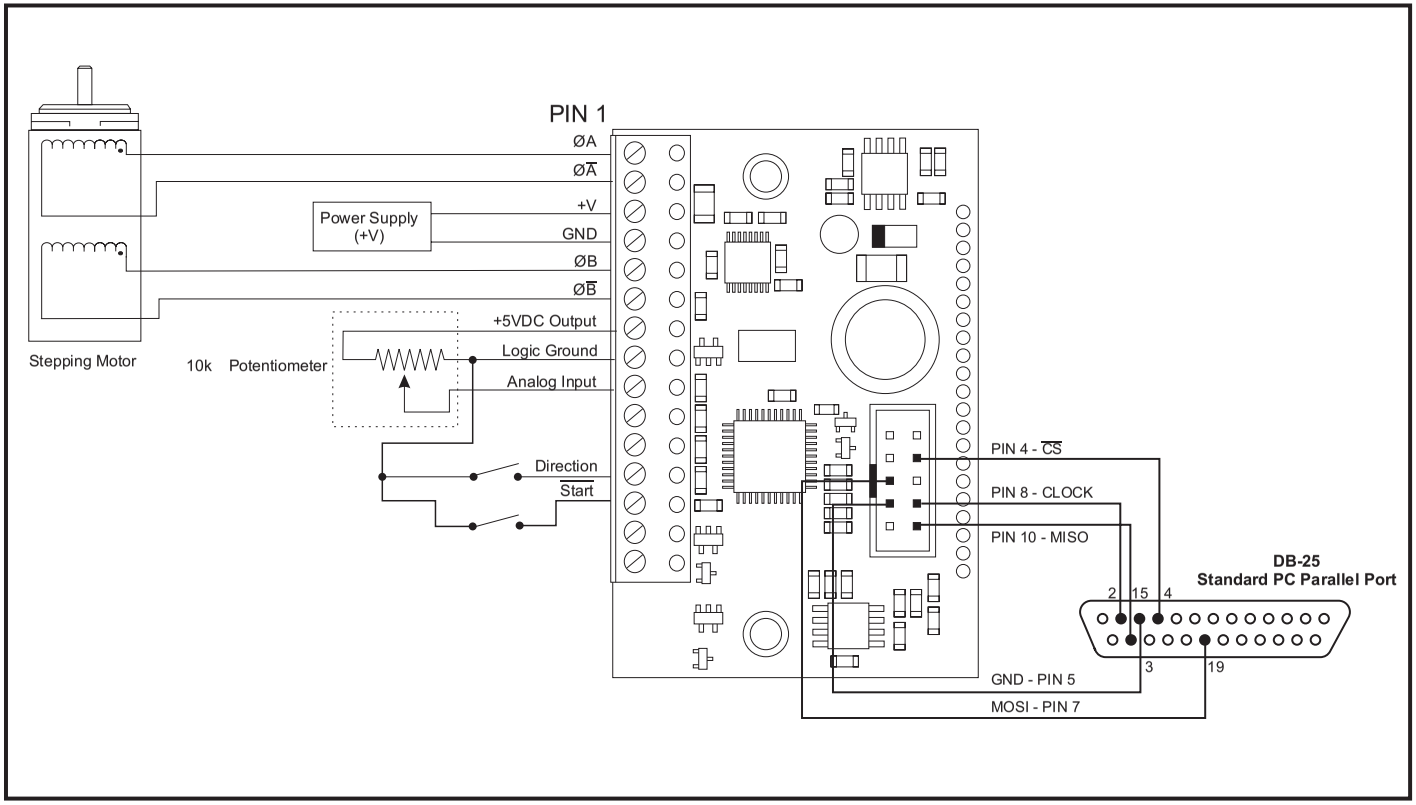


Figure 2.2.8: IB462H/OSC-462H Minimum Connections

Configuring The OSC-462H

Using the Configuration Utility

The IMS Analog Speed Control Configuration Utility is an easy to install and use software program. Use of this utility is required in order to configure the OSC-462H. It is included on the CD that ships with the OSC-462H or is available for download at *www.imshome.com.* This utility features the following:

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

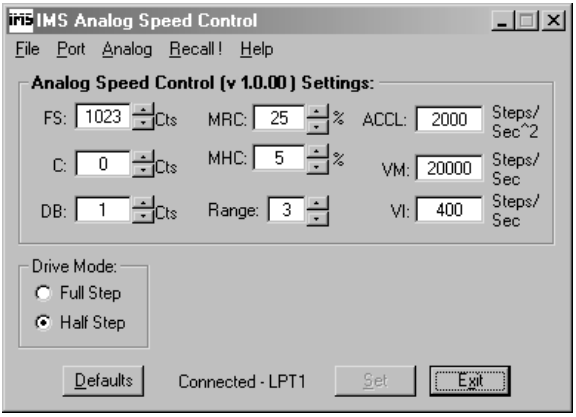


Figure 2.2.9:OSC-462H Configuration Utility Screen

Installation

To install and use the configuration utility a Pentium class or higher PC running Windows 98, NT 4.0 or 2000 is required. The installation procedure is:

1] Place the CD in your CD-ROM drive, the 3.5" CD will work in any horizontally mounted tray type drive.
2] On the Start Menu, click, "Start>Run".
3] Type the following into the text box: X:\OSC462\Setup.exe (Replace the "X" with the letter which designates your CD-ROM drive).
4] Follow the on-screen prompts to complete the installation.

Start-up

Select "Start>Programs>Analog Speed Control>Analog Speed Control". The Configuration Utility will automatically scan your LPT ports for the connected OSC-462H/IB462H assembly and configure communications.

The connection status and port are displayed at the bottom of the configuration screen (See Figure 2.2.8).

NOTE: It is only possible to configure the OSC-462H when the /Start input is in the "Stopped" state!

Configuration Parameters Explained

There are 10 configuration parameters for the OSC-462H. Parameter settings are automatically saved to memory when the "SET" button is clicked on the Configuration Utility screen.

Table 2.2.6 summarizes the parameters and their function, range, units and default setting.

Acceleration (ACCL)

The ACCL parameter sets the acceleration and deceleration in steps per second^2. If the IB462H is in half step mode (STEP=H) the acceleration/deceleration will be in half steps per second^2. If in full step mode (STEP=F) then the units for ACCL will be in full steps per second^2.

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 OSC-462H will interpret as the zero-reference position. Any

OSC-462H Parameters				
Parameter	**Function**	**Range**	**Units**	**Default**
ACCL	Acceleration/Deceleration	2000-65000	Steps/sec^2	2000
C	Joystick Center Position	0 to 1022 (0.005 to 4.995)	Counts (Volts)	0 (0.000)
DB	Potentiometer/Joystick Deadband	0 to 255 (0.000 to 1.245)	Counts (Volts)	1 (0.005)
FS	Full Scale of the Potentiometer/Joystick	1 to 1023 (0.005 to 4.995)	Counts (Volts)	1023 (4.995)
MHC	Motor Holding Current	0 - 100	Percent	5
MRC	Motor Run Current	1 - 100	Percent	25
RANGE	VI / VM Range Setting	1 - 8	-	3
STEP	Half/Full Step Operation Select	H or F	-	H
VI	Initial Velocity	1-60000	Steps/sec.	800
VM	Maximum Velocity	1-60000	Steps/sec.	20000

Table 2.2.6: OSC-462H Parameter Summary

voltage seen on the speed control input will accelerate from 0 to the maximum set velocity. See the setup procedure located in “Setting the Configuration Parameters”, the next sub-section of this document.

NOTE: In order to acheive the maximum set velocity (VM) on both sides of the joystick center position, the “C” parameter must be set between 500 and 900 counts (2.441 and 4.395 volts).

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 deflection 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.

Note that when the voltage seen at the speed control input is ≤ 0.005V, the step clock output of the oscillator will be 0. When the potentiometer or joystick deflects 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.

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.

Full Scale (FS)

The full scale parameter sets the deflection 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 (2.411 volts) will cause the OSC-462’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.

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 2.2.7 illustrates the range settings.

Range Parameter Settings								
Range	1	2	3	4	5	6	7	8
VI	200	100	50	20	10	5	2	1
VM	100000	50000	25000	10000	5000	2500	1000	500

Table 2.2.7: RANGE Parameter Values

Half/ Full Step Mode (STEP)

The STEP parameter specifies the mode of operation for the IB462H, either half step or full step.

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.

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.

Setting the Configuration Parameters

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

- The Parameter Setup Cable (MX-CC300-000) or equivalent must be connected between your PC Parallel (Printer) Port and the 10 pin IDC connector (P3) on the OSC-462H.
- 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 configurator screen.
- The Stop/Start input must be in a HIGH (Disconnected, Stopped) state.

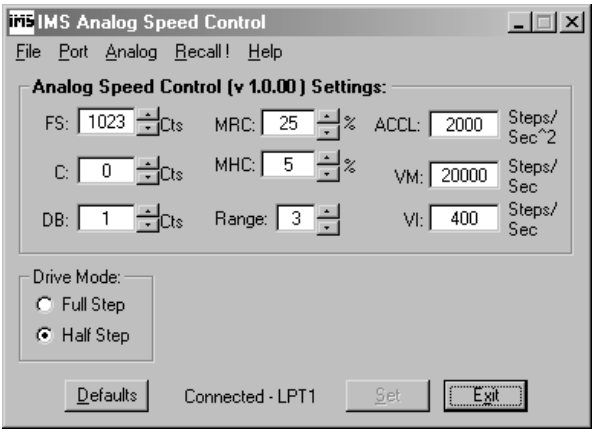


Figure 2.2.10:OSC-462H Configuration Utility Screen

Setting the OSC-462H Up For Velocity

When operating as a velocity device the OSC-462H will output step clock pulses to the IB462H driver. 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 the Holding Current (MHC) to the desired value. See the IB462H manual and the documentation from your motor's manufacturer for information on determining the output current

When using the OSC-462H in this fashion 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 deadband (DB). If desired these may be changed. For example: Setting the FS parameter to 511 would configure the OSC-462H such that it will be at maximum velocity when the potentiometer is at 1/2 of its full deflection.

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 sees 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 nonvolatile memory.

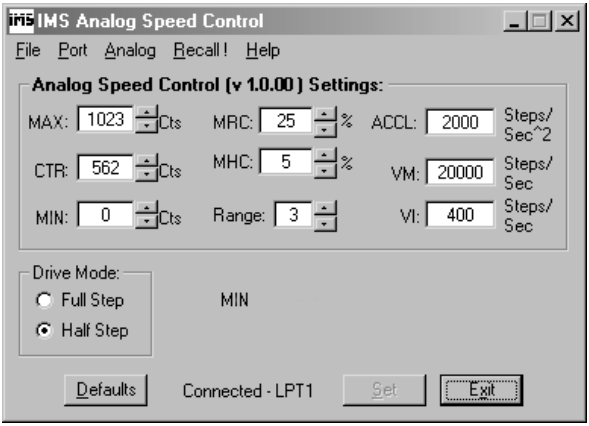


Figure 2.2.11: Intitialization Mode

Setting the OSC-462H as a Joystick Interface

When operating as a joystick interface it is necessary that the joystick be calibrated. First, a joystick center position must be established, as well as the full scale range of the joystick in two directions. The following steps outline the joystick calibration procedures.

1] With the joystick in the center position, click "Analog>Initialize" on the menu bar.

2] Move the joystick to its full scale position, first in the max direction, then in the min direction. Re-center the joystick.

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 the OSC-462H NVM.

Application Example #1: Sample Connection and External Step/ Direction

This application example shows the OSC-462H/IB462H connected to an external step clock/direction source, in this case a LYNX Control Module. The IB462H's motion can be controlled by the LYNX, or third party motion controller with TTL or sinking (NPN) outputs. The OSC-462H responds to step clock and direction inputs when the /Start input is left N/C.

This same configuration applies if the OSC-462H is being used as a joystick interface. The joystick connects the same as the potentiometer.

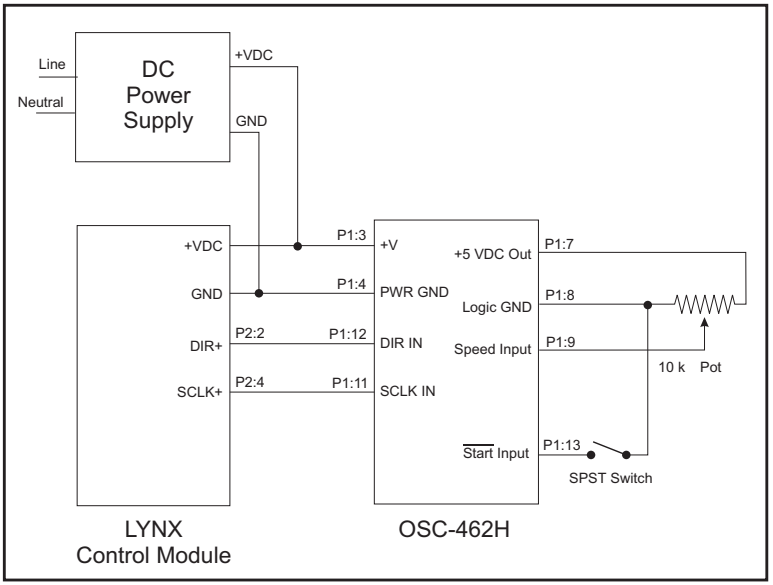


Figure 2.2.12: OSC-462H Application Example #1

Application Example #2: Sample Connection of OSC-462 to Additional Half/ Full Step Driver

This application sample shows a secondary IB series drive, such as an IB463 or IB1010, cascaded off of the OSC-462H step clock and direction outputs. Connected in this fashion the secondary driver will "follow" the primary drive, the IB462H.

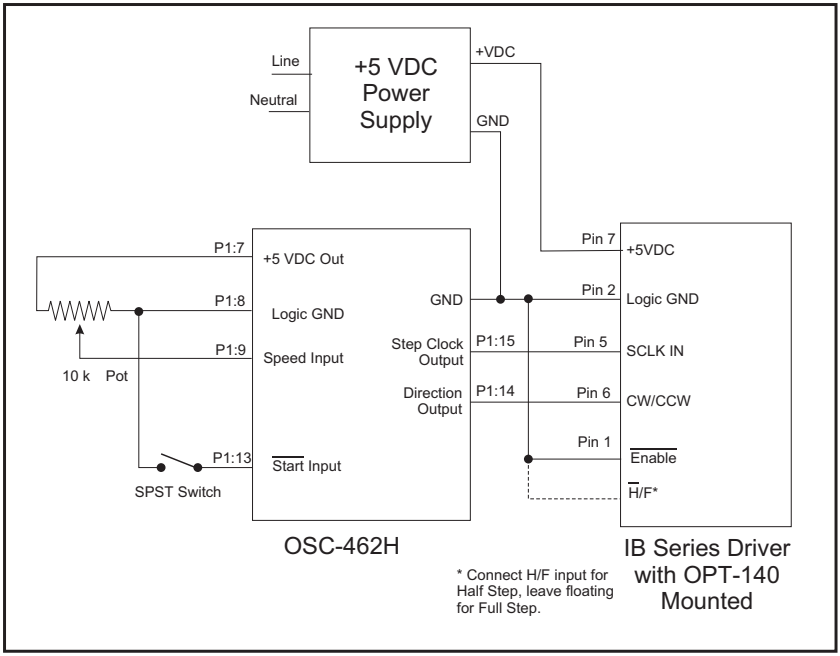


Figure 2.2.13: OSC-462H Application Example #2

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