# IMS™

## INTELLIGENT MOTION SYSTEMS, INC.

*Excellence in Motion*™

# PANTHER HI & PANTHER HE

## MINIATURE HIGH PERFORMANCE
## MICROSTEPPER DRIVER, INDEXER & POWER SUPPLY

### HARDWARE REFERENCE MANUAL

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# INTRODUCTION

The PANTHER HI & HE with intergral driver, indexer, power supply, and encoder feedback are complete high performance microstepping systems in a small, self contained package. The Panther HI & HE use advanced surface mount and ASIC technology for unmatched performance, reliability, and value.

The heart of the Panther HI & HE is our IM1007I & IM1007IE high power OEM microstepping driver with on board intelligent indexer.

The PANTHER HI & HE's indexer delivers superior results by intergrating standard hardware with a technology called Variable Resolution Microstep Control. At low shaft speeds, the indexer produces high resolution microstep resolution used for silent, resonance-free operation. As shaft speed increases, the output step resolution is expanded using "on-motor-pole" syncronization to achieve high step rates. At the completion of a move, the target micro position is trimmed to 1/100 of a step to achieve and maintain precise positioning.

Combined with the IM1007I & IM1007IE is a highly efficient switching power supply that runs the drivers at peak performance while reducing package weight and size.

Incorporated into the PANTHER HI & HE drivers are circuits that minimize ripple current while maintaining a 20KHz chopping rate. This prevents additional motor heating that is common with drivers requiring higher chopping rates. Now low inductance step motors can be used to improve high speed performance and peak system efficiency.

The results of this unique driver/indexer/power supply combination is a cost effective, off the shelf solution, that can provide designers with a powerful and versatile unit that is unmatched in today's industry.


# FEATURES

- INTEGRAL INDEXER, DRIVER, POWER SUPPLY, AND ENCODER FEEDBACK
- EXTREMELY COMPACT 4.0 X 6.7 X 4.4
- LOW COST
- SHORT CIRCUIT, OVER TEMPERATURE AND OVER/UNDER VOLTAGE PROTECTION
- FAULT AND POWER INDICATORS
- HIGH OUTPUT CURRENT
  (7 AMPS RMS, 10 AMPS PEAK)
- ADVANCED SURFACE MOUNT & ASIC TECHNOLOGY
- OPTIONAL RACK MOUNTING
- FIXED OR VARIABLE STEP RESOLUTION
- 1/100 STEP COMMAND RESOLUTION
- 1/256 STEP MOTOR RESOLUTION
- PROGRAMMABLE ACCEL & DECEL RAMPS
- PROGRAMMABLE MOTOR RUN AND HOLD CURRENTS
- RS-422 PARTY LINE OPERATION (OPTIONAL RS232 COMMUNICATION)
- 2K BYTES OF NON-VOLATILE MEMORY FOR PROGRAM STORAGE
- 6 BUFFERED USER I/O PORTS
- OPTICALLY ISOLATED HOME AND LIMIT SWITCH INPUTS
- JOG INPUTS
- GO AND SOFT STOP INPUTS
- OPTIONAL *WINDOWS BASED PROGRAMMING SOFTWARE
- MOTOR SPEEDS TO 6,000 RPMs
- PROGRAMMABLE TRIP POINTS
- OVER 50 MOTION CONTROL COMMANDS

*Windows is a registered trademark of the MICROSOFT CORP.          PATENTS PENDING

# PIN ASSIGNMENTS

## Connector P1

| PIN # | FUNCTION |
|---|---|
| 1 | Phase A |
| 2 | Phase $\overline{A}$ |
| 3 | Phase B |
| 4 | Phase $\overline{B}$ |
| 5 | AC Input: Neutral* |
| 6 | AC Input: Line* |

## †Connector P4

| *PIN # | FUNCTION |
|---|---|
| 2 | Transmit Data (RS-232) |
| 3 | Receive Data (RS-232) |
| 5 | GROUND (RS-232) |
| 9 | + 5VDC (for optional Hand Held Terminal) |

*Pins not shown are not used.

†Connector supplied with optional RS232 Interface.

## Connector P2

| PIN # | FUNCTION |
|---|---|
| 1 | TX − (RS-422/485) |
| 2 | TX + (RS-422/485) |
| 3 | RX − (RS-422/485) |
| 4 | RX + (RS-422/485) |
| 5 | Limit A |
| 6 | Party |
| 7 | Limit B |
| 8 | Home |
| 9 | Opto Supply Voltage |
| 10 | Fault |
| 11 | Ground |
| 12 | Go |
| 13 | Soft Stop |

## Connector P3

| PIN # | FUNCTION |
|---|---|
| 1 | Input 3 |
| 2 | Input 2 |
| 3 | Input 1 |
| 4 | + 5V DC Output |
| 5 | Output 3 |
| 6 | Output 2 |
| 7 | Output 1 |
| 8 | Moving |
| 9 | Jog + |
| 10 | Jog − |
| †11 | Index − (HE models only with differential option) |
| †12 | Index (HE models only) (Index+ for differential option) |
| †13 | Channel A − (HE models only with differential option) |
| †14 | Channel A (HE models only) (Channel A+ differential option) |
| †15 | Channel B − (HE models only with differential option) |
| †16 | Channel B (HE models only) (Channel B+ differential option) |

\* WARNING !! It is improtant to follow the correct polarity of the AC input to prevent device damage.

\* WARNING !! The Panther requires an AC Earth Ground connection for AC noice rejection. The connection is made to the post next to the P1 connector.

†For HI model - these inputs are not used.

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# PIN DESCRIPTION

## Connector P2

| PIN # | PIN NAME | FUNCTION |
|---|---|---|
| 1 | TX– | RS422/485 Transmit –, (data out from indexer).. |
| 2 | TX+ | RS422/485 Transmit +, (data out from indexer). |
| 3 | RX– | RS422/485 Receive –, (data in to indexer). |
| 4 | RX+ | RS422/485 Receive +, (data in to indexer). |
| 5 | Limit A | Optically isolated, limit switch input for "+" direction.  (see "I" command). |
| 6 | Party | Optically isolated party mode select pin: 0 = party, 1(floating) = single. |
| 7 | Limit B | Optically isolated, limit switch input for "–" direction.  (see "I" command) |
| 8 | Home | Optically isolated, home switch input. (see "F" command). |
| 9 | Opto Supply | VDC+ bias for input opto couplers. Internal current limiting resistors for +5vdc are supplied. user must connect resistors in series with optically isolated input signals for voltages greater than 5vdc (see figure 4). |
| 10 | Fault | Open collector output indicating driver fault condition. This output will be active when the Panther detects an internal fault such as overcurrent, overvoltage or phase short. This output must be pulled high externally. A reset or power down is required to clear the fault condition. |
| 11 | Ground | Logic supply ground connection. |
| 12 | Go | Active low level input to execute a program stored in nvm. Program execution begins at location 0 in memory. Internally pulled up to +5vdc through a 10k resistor. Once executing, the go input is ignored until the program completes or an abort/stop is first executed. |
| 13 | Soft Stop | Active low input to stop indexing using deceleration ramp. Internally pulled up to +5vdc through a 10k resistor. |

## Connector P3

| PIN # | PIN NAME | FUNCTION |
|---|---|---|
| 1 | Input 3 | User controlled input #3. Internally pulled up to +5vdc through a 10k resistor. (see "A" command). |
| 2 | Input 2 | User controlled input #2. Internally pulled up to +5vdc through a 10k resistor. (See "A" command). |
| 3 | Input 1 | User controlled input #1. Internally pulled up to +5vdc through a 10k resistor. (see "A" command). |
| 4 | +5VDC | Logic supply output for Encoder power. |
| 5 | Output 3 | User controlled output #3. This is an open collector output with an internal 10k pullup resistor. (see "A" command). |
| 6 | Output 2 | User controlled output #2. This is an open collector output with an internal 10k pullup resistor. (see "A" command). |
| 7 | Output 1 | User controlled output #1. This is an open collector output with an internal 10k pullup resistor. (see "A" command). |
| 8 | Moving | Indexing output, low when indexing is in progress. High when not moving. |
| 9 | Jog + | Active low jog input for "+" direction. Internally pulled up to +5vdc through a 10k resistor. |
| 10 | Jog – | Active low jog input for "–" direction. Internally pulled up to +5vdc through a 10k resistor. |
| 11 | Index – | Differential Encoder Index Mark – input. |
| 12 | Index, + | Encoder index mark input.  Internally pulled up to +5vdc through a 10k resistor.  (Differential encoder index mark + input.) |
| 13 | Channel A – | Differential encoder Channel A – input. |
| 14 | Channel A, + | Encoder channel A input. Internally pulled up to +5vdc through a 10k resistor. (Differential encoder channel a + input.) |
| 15 | Channel B – | Differential encoder Channel B – input. |
| 16 | Channel B, + | Encoder channel B input.  Internally pulled up to +5vdc through a 10k resistor. (Differential encoder channel b + input.) |

# ABSOLUTE MAXIMUM RATING

Table 1

INPUT VOLTAGE ................................................. 135 VAC

OUTPUT CURRENT....................................... 12 AMPS PEAK

HOUSING TEMPERATURE.................................. +60  C

STORAGE TEMPERATURE...........................-40 TO +125  C

LOGIC INPUT CURRENT (ISOLATED INPUTS)........... 15 mA

LOGIC OUTPUT CURRENT ................................. 25mA

POWER DISSIPATION (Logic Outputs) ...............450 mW

INPUT VOLTAGE (Dedicated Logic Inputs) .... -1.5 to +18 V

WARNING !! Absolute maximum ratings indicate limits beyond which
damage to the device may occur. Electrical specifications do
not apply when operating the device beyond its specified
operating conditions.

# ELECTRICAL SPECIFICATIONS

## Table 2

$T_A = 25$ C, V = 120 VAC

| | TEST CONDITION | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| PHASE OUTPUT CURRENT | RMS | | 2 | 7 | A |
| PHASE OUTPUT CURRENT | PEAK | | | 10 | A |
| INPUT FORWARD CURRENT | ISOLATED INPUTS | | 7.0 | 15 | mA |
| INPUT FORWARD VOLTAGE | ISOLATED INPUTS | | 1.5 | 1.7 | V |
| INPUT REVERSE BREAKDOWN VOLTAGE | ISOLATED INPUTS | 5 | | | V |
| INPUT VOLTAGE | DEDICATED LOGIC INPUTS | 0 | | 15 | V |
| INPUT VOLTAGE | GENERAL PURPOSE INPUTS | 0 | | 5 | V |
| OUTPUT CURRENT | GENERAL PURPOSE OUTPUTS | | | 15 | mA |
| COLLECTOR-EMITTER VOLTAGE | FAULT OUTPUT | | | 120 | V |
| COLLECTOR-EMITTER SATURATION VOLTAGE | FAULT OUTPUT $I_{cs} = 2$ mA | | | 0.3 | V |
| BAUD RATE | RS232/RS422 | | 9,600 | | BD |

# MECHANICAL SPECIFICATIONS

REAR MOUNT [STANDARD]

RACK MOUNT [OPTIONAL]

**Fig. 1**

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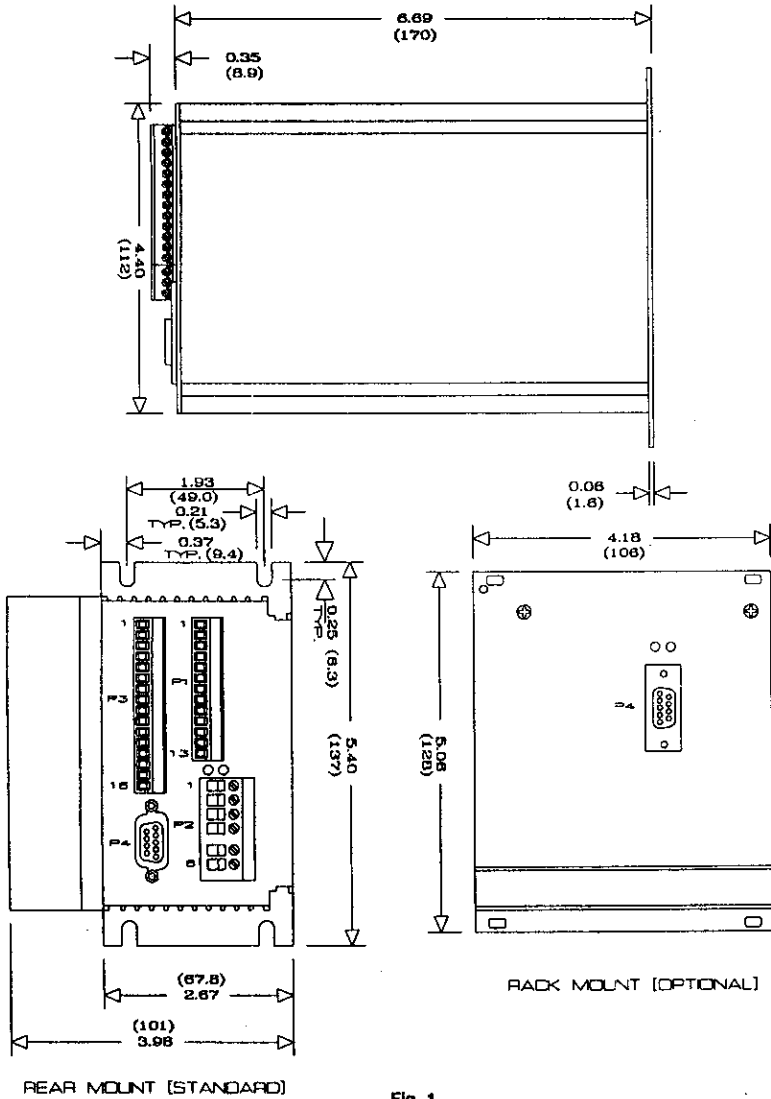
## THERMAL SPECIFICATIONS

**Table 3**

OPERATING TEMPERATURE .............................0 TO +50 C

STORAGE TEMPERATURE ............................–40 TO +125 C

HOUSING TEMPERATURE ( MAX )...................... +60 C

## MOUNTING

To insure proper cooling, units must be mounted oriented as shown in the Machanical Specifcation Section, with a minimum of 4 inches of clearance above and below the unit, and 2 inches of side clearance. Units must not be mounted in a sealed enclosure unless properly derated.

# OUTPUT CURRENT

## DETERMINING OUTPUT CURRENT

The OUTPUT CURRENT for motor used for MICROSTEPPING Is determined differently from that of a HALF/FULL STEP driver.

In the PANTHER HI & HE, a sine/cosine output function is used in rotating the motor. Therefore the output current of the specified motor is equal to the RMS current of the driver.

The DIGITAL POTENTIOMETER used to set the output current of the PANTHER HI & HE sets the PEAK output current of the sine/cosine waves. Therefore the specified motor current (which is the RMS value) should be multiplied by 1.4 in order to determine the PEAK value to which the PANTHER HI & HE will be set.

EXAMPLE:

IMS motor number HM200-2232-190 A8 wired in parallel has a specified PHASE CURRENT of 2.7 amps.

Therefore     2.7 X 1.4 = 3.78 amps

**Note:** Stepper motors can be configured as 4, 6, or 8 leads. Each configuration requires different currents. shown below are the different lead configurations and the procedures to determine their output current

**4 Lead Motors:**   Use specified motor current to determine the current adjustment resistor value.

**6 Lead Motors:**   1) When configuring a 6 lead motor in a HALF coil configuration ( i.e. connected from one end of the coil to the center tap( higher speed configuration)) use the specified per phase (or unipolar) current rating to determine the current adjustment resistor value.

2) When configuring the motor so the ENTIRE coil is used (i.e. connected from end to end with the center tap floating (higher torque configuration)) multiply the per phase (or unipolar) current rating by 0.7. Use this result to determine the current adjustment resistor value.

**8 Lead Motors:**   SERIES CONNECTION When configuring the motor windings in series, multiply the per phase (or unipolar) current rating by 0.7. Use this result to determine the current adjustment resistor value.

PARALLEL CONNECTION When configuring the motor windings in parallel, multiply the per phase (or unipolar) current rating by 1.4. Use this result to determine the current adjustment resistor value.

**Note:**  After the current has been determined, according to the motor connections above, follow the procedure Determining Output Current above to find the PEAK current value.

**WARNING!** Although stepping motors will run hot when configured correctly, damage may occur to the motor if a higher than specified current is used. Most specified motor currents are maximum values. Care should be taken when exceeding these ratings.

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## SETTING OUTPUT CURRENT

The OUTPUT CURRENT for both Run and Hold are set using an on board digital potentiometer. The potentiometer sets the peak of the sine/cosine output current. It is represented in software as a percentage of the full scale peak output current. The range is from 0 to 100 percent. For example, a setting of 20 would provide 2 amps of peak (per phase) output current and a setting of 100 percent will provide 10 amps of peak output current per phase. Refer to the Determining Output Current section in this manual as well as the Software Reference manual for futher information.


## ENCODER INTERFACE

An encoder with TTL level outputs is required to interface with the PANTHER HE. On board 10K pullups are provided so that encoders with open collector outputs may be used. Figure 2 shows a typical encoder interface.

PANTHER LE

| ENCODER | | |
|---|---|---|
| | +5VDC | P3 PIN 4 |
| | GROUND | P2 PIN 11 |
| | CHANNEL A | P3 PIN 14 |
| | CHANNEL B | P3 PIN 16 |
| | INDEX | P3 PIN 12 |
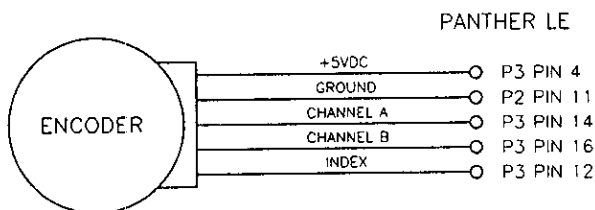
**Fig. 2**

Figure 2A shows a typical encoder interface for the Panther HE - DE with differential interface.

PANTHER LE-DE

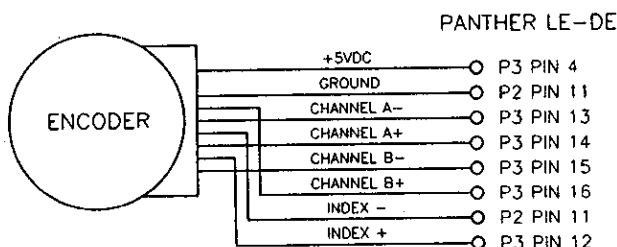| ENCODER | | |
|---|---|---|
| | +5VDC | P3 PIN 4 |
| | GROUND | P2 PIN 11 |
| | CHANNEL A- | P3 PIN 13 |
| | CHANNEL A+ | P3 PIN 14 |
| | CHANNEL B- | P3 PIN 15 |
| | CHANNEL B+ | P3 PIN 16 |
| | INDEX - | P2 PIN 11 |
| | INDEX + | P3 PIN 12 |

**Fig. 2A**

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## MOTOR SELECTION

The PANTHER HI & HE are Bipolar drivers which work equally well with both Bipolar and Unipolar motors,( i.e. 8 and 4 lead motors and 6 lead center tapped motors (see section 10.2, Connecting the Motor)).

To maintain a given set motor current, the PANTHER HI & HE chops the voltage using a constant 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 resistance. To avoid this situation, it is necessary to choose a motor with a low winding resistance. The lower the winding resistance (hence lower winding inductance) the higher the step rate.

Since the PANTHER HI & HE are constant current sources, 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 PANTHER HI & HE are set to the motor's rated current.

The higher the voltage used the faster the current can flow through the motor coils. This in turn means a higher step rate. 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 resistance used in conjunction with the highest possible driver voltage.

# CONNECTING THE MOTOR

Phase A of the Stepping Motor is connected between pins 1 and 2 on connector P1. Phase B of the Stepping Motor is connected between pins 3 and 4 on connector P1. The following drawings illustrate the connection of 4,6, and 8 Lead Stepping Motors to the PANTHER HI & HE Drivers.
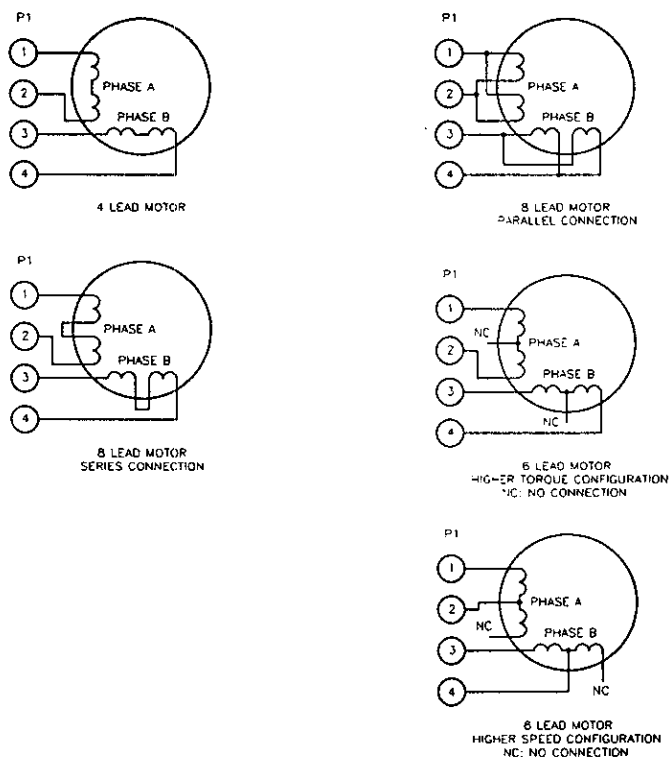


Fig. 3

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

**Warning!!** Do not connect or disconnect motor wires while power is applied!! When connecting the motor leads, make sure each lead is tightly connected. Tug on each motor lead for proper connection !!

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## CONNECTING POWER

Pins 5 and 6 on connector P1 are used to connect the AC Power to the PANTHER HI & HE. The wire size used to connect the power source to the driver should be at least 18 gauge. The power supply requirement are as follows:

Table 4

## POWER SUPPLY SPECIFICATIONS

AC INPUT ...........................................................95 to 128 VAC

* Current ........................................................ 1.5 Amps (TYP)


* The current needed is dependent on the supply voltage, motor selection, and load.

Warning!! Do not connect or disconnect motor wires while power is applied!!


NOTE: If the unit operates incorrectly or if there is no power indicator present when the unit is powered, the unit should be returned to the factory for service. There are no user serviceable parts in this device.

WARNING !! It is improtant to follow the correct polarity of the AC input to prevent device damage.

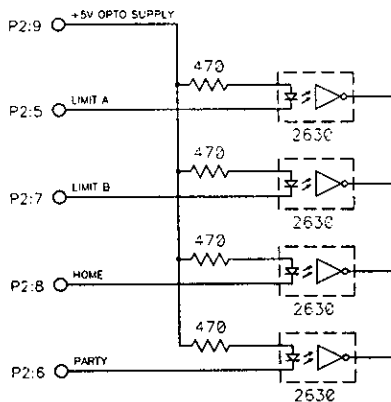## OPTICALLY ISOLATED INPUTS (Limit A, Limit B, Home, Party)

The following inputs to the PANTHER HI & HE are Optically Isolated.

### Connector P1

Limit A ................................................................. Pin 5 on P2
Limit B ................................................................. Pin 7 on P2
Home................................................................... Pin 8 on P2
Party .................................................................... Pin 6 on P2

For functional use of these inputs refer to the software referance manual.



OPTICALLY ISOLATED INPUTS

**Fig. 4**

The isolated inputs may be powered be a DC voltage other than +5 VDC. In doing so, care should be taken to limit this current, an external resistor should be placed in series with the input pins (5,6,7,8). The value of the resistor should be calculated such that the input current is approximately equal to the value listed in the Electrical Specifications in Table 2.

**WARNING!** If using a voltage other than +5VDC, the current through the optocoupler must NOT exceed the maximum limit.

## GENERAL PURPOSE INPUTS AND OUTPUTS

The PANTHER HI & HE contain 3 general purpose inputs and 3 general purpose outputs. The inputs are TTL compatable and are pulled up via a 10K resistor to +5V on the input. (see Fig below)
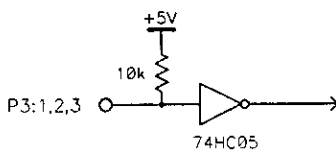


The outputs are TTL compatable open collector type and are also pulled to +5V via a 10K resistor. (see Fig. below).
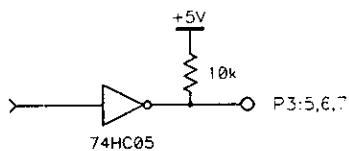


**Fig. 5**

For functional use of these inputs and outputs refer to the Software Reference Manual.

## DEDICATED INPUTS

The PANTHER HI & HE contain 4 dedicated inputs: Go, Soft Stop, Jog +, and Jog −. They are capable of handling logic level inputs that range from +5 VDC to +15 VDC. The inputs are pulled up to +5V via a 10K resistor on the inputs (see Fig below).
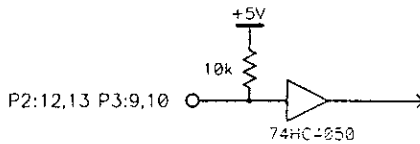


**Fig. 6**

For functional use of these inputs refer to the Software Reference Manual.

## MOVING OUTPUT

The moving output is used to indicate when the motor is in motion. When LOW, the indexer is stepping the motor (in either direction). When HIGH the motor is at rest. The MOVING output is TTL compatable (see Fig. below).
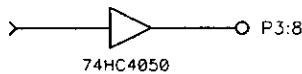


**Fig. 7**

## FAULT PROTECTION

The PANTHER HI & HE are internally protected against over temperature, short circuits and over/under voltage.

### OVER TEMPERATURE:

The over temperature protection in the PANTHER HI & HE will generate a fault if the housing or internal ambient temperature reaches 65 C. Only when the temperature has fallen to a safe level will it be possible to clear the fault and re-enable the Panther outputs.

### SHORT CIRCUIT:

The short circuit protection consist of PHASE to PHASE, PHASE to GROUND, and +V to PHASE.

### OVER/UNDER VOLTAGE:

The over/under voltage protection monitors the voltage to the driver as well as an under voltage condition on the AC power input.

If a short circuit, over temperature or over voltage condition is detected by the PANTHER HI & HE, the outputs will be disabled and can not be re-enabled without resetting or powering down the unit. At the same time the open collector FAULT output is turned on and the FAULT LED is activated.

This Fault output is an optoisolated open collector high voltage output which is referenced to the ground location on connector P2 pin 11. It is capable of sustaining up to 120 VDC (max) and sinking up to 25mA.

## RS232 INTERCONNECT

The optional RS232 communication interface to the Panther HI & HE, utilizes a female 9 pin subminiature D connector. The cable interface diagram is shown below:

```
Panther HI & HE ................. Computer
PIN#..................................... PIN#
2   TD................................... 2  RD
3   RD ................................. 3  TD
5   GND ............................... 5  GND
9   +5VDC .......................... (power for optional Hand Held Terminal)
```

NOTE: Pins not shown are not used

## PARTY LINE OPERATION

The PANTHER HI & HE can operate as stand alone units or they can be configured to communicate over a party line which responds to a unique address. Up to 32 units can be linked together on one line (using the RS422 differential interface).

To communicate over the party line, the unit must first be assigned an address. This assignment takes place via the Serial Communication line with the PANTHER HI & HE in a Stand Alone mode (ie. P2 pin 6 floating).

After an address is assigned, the PANTHER HI & HE can be tied to the Multi Unit System by enabling the Party Line Input (P2 pin 6).

Figure 8 shows a typical Party Line Connection.

For more information on interfacing to the Party Line Input, refer to Section 11.

For more information on Assigning Addresses, refer to the Software Reference Manual.
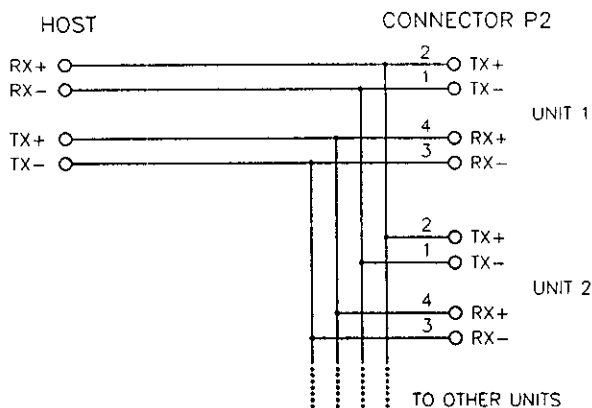


Fig. 8

## PARTY LINE CONNECTION USING RS-232 OPTION

When running in Party Line Mode with the RS-232 option, the host communicates with the unit via RS-232 by using the 9 pin D type connector (P4). This unit would then be connected to the other units in the system operating in the party line mode such that all of the TX+'s would be tied together, as well as the TX-, RX+, and RX-, respectively. The address assignment and the communications are described in the Party Line Operations section above.

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## +5V DC OUTPUT

The +5V DC output on the PANTHER HI & HE is intended to drive the encoder feedback device ONLY. This output should NOT be used as a general purpose power supply. When using this supply care should be taken not to inject noise back into the driver. This output is limited to 100mA and is * fused internally.

## OPTIONS/ACCESSORIES

| Description | Part Number |
|---|---|
| Built in RS232 to RS422/485 converter | Panther HI2, HE2 |
| Graphics User Interface Controller Software (Requires **Windows V3.1 or greater) | QuickSTEP II™ |
| Rack Mounting Option | –RM |
| Differential Encoder Option | –DE |
| Hand Held Programming Terminal | Quickpro™ |

*Fuse is not field replacable and must be returned to factory for service.

**Windows is a registered trademark of the MICROSOFT CORP.

# WARRANTY

### TWENTY-FOUR (24) MONTH LIMITED WARRANTY

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

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

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

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

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

### OBTAINING WARRANTY SERVICE

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

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

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

# IMS Driver Manual Addendum

## Recommended Wiring

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.

Motor cabling in excess of 1 foot requires twisted pair shielded cable to reduce the transmission of EMI. The shield must be connected to AC ground at the driver. The other end of the shield *must not* be tied to anything, but allowed to float. This allows the shield to act as a drain.

Power supply leads to the driver need to be twisted. If more than one driver is to be connected to the same power supply, run separate power and ground leads from the supply to each driver.

Recommended Motor and Power Supply Cables:

### Motor Cables

Dual Twisted Pair Shielded (Separate Shields)

| | | |
|---|---|---|
| ≤ 4 Amps RMS per phase motor current.................Belden Part #9368 or equivalent | 18 Gauge |
| ≥ 4 Amps RMS per phase motor current.................Belden Part #1492A or equivalent | 16 Gauge |

### Power Supply Cables

Twisted Pair (Jacketed)

| | | |
|---|---|---|
| ≤ 4 Amps DC current.........................................................Belden Part #9740 or equivalent | 18 Gauge |
| ≥ 4 Amps DC current.........................................................Belden Part #8471 or equivalent | 16 Gauge |

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