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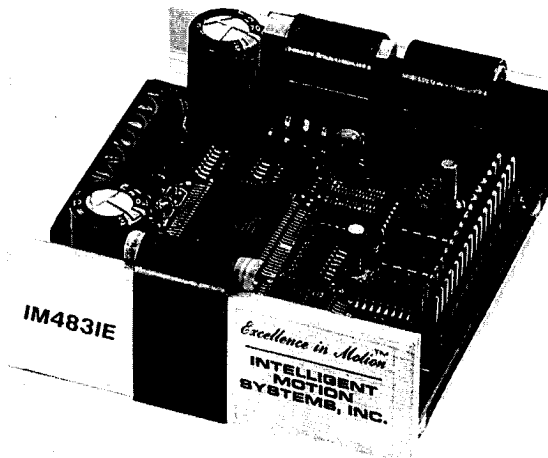
INTELLIGENT MOTION SYSTEMS, INC.

*Excellence in Motion™*

# IM483I & IM483IE

MINIATURE HIGH PERFORMANCE  
MICROSTEPPING SYSTEM

OPERATING INSTRUCTIONS



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## INTRODUCTION

The IM483I & IM483IE with optional indexer and encode feedback are highly integrated controllers and drivers in an extremely small package measuring only 3.0" X 2.7" X 1.2". The IM483I & IM483IE make use of advanced surface mount and ASIC technology for unmatched performance, reliability, and value.

The IM483I & IM483IE'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 positioning for silent, resonance-free operation. As shaft speed increases, the output step resolution is expanded using "on-motor-pole" synchronization. At the completion of a move, the target micro position is trimmed to 1/100 of a step to achieve and maintain precise positioning.

Incorporated into the IM483I & IM483IE 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 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, & ENCODER FEEDBACK
- OPTIONAL DIFFERENTIAL ENCODER INPUTS
- EXTREMELY COMPACT 3 X 2.75 X 1.2
- LOW COST
- SHORT CIRCUIT AND OVER TEMPERATURE PROTECTION
- HIGH INPUT VOLTAGE ( 48V )
- HIGH OUTPUT CURRENT  
(3 AMPS RMS, 4 AMPS PEAK)
- ADVANCED SURFACE MOUNT & ASIC TECHNOLOGY
- SINGLE SUPPLY
- 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 RS-232 COMMUNICATIONS)
- 2K BYTES OF NON-VOLATILE MEMORY FOR PROGRAM STORAGE
- 6 BUFFERED USER I/O PORTS
- OPTICALLY ISOLATED HOME AND LIMIT SWITCH INPUTS
- DUAL SPEED 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

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PATENTS PENDING

## PIN ASSIGNMENTS

### Connector P1

PIN #	FUNCTION	PIN #	FUNCTION
1	TX -	18	TX +
2	RX -	19	RX +
3	Resolution Select 3	20	Input 1
4	Limit A	21	Step Clock Out / Receive (with RS232 option)
5	Output 2	22	Direction Out / Transmit (with RS232 option)
6	Parity	23	NC / Channel A - (with Differential Encoder option)
7	Input 3	24	Resolution Select 2 / Channel B - (with Differential Encoder option)
8	Opto Supply Voltage	25	+5V Output
9	Output 1	26	Fullstep / Index - (with Differential Encoder option)
10	Limit B	27	Ground
11	Jog +	28	Output 3
12	Home	29	Moving
13	Jog speed	30	Input 2
14	Fault	31	Soft stop
15	Index, + (with Encoder / Differential encoder option)	32	Go
16	Fullstep	33	Jog -
17	Channel B, + (with Encoder / Differential encoder option)	34	Channel A, + (with Encoder / Differential encoder option)

### Connector P2

PIN #	FUNCTION
1	NC
2	NC
3	Supply Ground
4	+V (Supply Voltage)
5	Phase B̄
6	Phase B
7	Phase Ā
8	Phase A

### †Connector P3

*PIN #	FUNCTION
2	Transmit Data (RS-232)
3	Receive Data (RS-232)
5	Ground (RS-232)

\* Pins NOT Shown are not used.

† Connector supplied with optional RS-232 interface.

**Note:** NC = No connection. These pins must be left floating.

## PIN DESCRIPTION

PIN #	PIN NAME	FUNCTION
1	TX -	RS422 Transmit -, (data out from indexer).
2	RX -	RS422 Receive -, (data in to indexer).
3	MSEL3	Resolution Selection 3 input. Internally pulled down via 1.5K resistor.
4	Limit A	Optically isolated, active low limit switch input for '+' direction. (See 'I' command).
5	Output 2	User controlled output #2 (active low). This is an open collector output with an internal 10k pullup resistor. (See 'A' command).
6	Party	Optically isolated party mode select pin: 0 = Party, 1(Floating) = Single.
7	Input 3	User controlled input #3, (active low). Internally pulled up to +5vdc through a 10K resistor. (See 'A' command).
8	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).
9	Output 1	User controlled output #1 (active low). This is an open collector output with an internal 10k pullup resistor. (See 'A' command).
10	Limit B	Optically isolated, active low limit switch input for '-' direction. (See 'I' command)
11	Jog +	Active low Jog input for '+' direction. Internally pulled up to +5vdc through a 10k resistor.
12	Home	Optically isolated, active low Home switch input. (See 'F' command).
13	Jog Speed	Jog Speed input. low = hi speed, hi(floating) = low speed. (See 'B' command).
14	Fault	Open collector output indicating driver fault condition. This output will be active when the IM2000 detects an internal fault such as overcurrent or phase short. This output must be pulled high externally. A reset or power down is required to clear the fault condition.
15	Index. +	Encoder index marker input. Internally pulled up to +5vdc through a 10k resistor. (Differential Encoder Index Mark + input.)
16	Full Step	Open drain output, active for one clock pulse at each on-pole position.
17	Channel B. +	Encoder channel B input. Internally pulled up to +5vdc through a 10k resistor. (Differential Encoder Index Mark + input.)
18	TX +	RS422 Transmit +, (data out from indexer).
19	RX +	RS422 Receive +, (data in to indexer).
20	Input 1	User controlled input #1, (active low). Internally pulled up to +5vdc through a 10K resistor. (See 'A' command).
21	SCLK Out/ Receive	Step Clock Output from Indexer / RS 232 data in to Indexer
22	DIR Out/ Transmit	Direction Output from Indexer / RS 232 data out from Indexer
23	NC/ Channel A -	NO Connection. / Differential Encoder Channel A - input.
24	MSEL2/ Channel B -	Resolution select 2 output pin / Differential encoder Channel B - input. <b>DO NOT</b> connect to pin without Differential Encoder option installed!!
25	+5VDC	Logic supply output for Encoder power.
26	Fullstep/ Index -	Fullstep output (see pin 16) / Differential Encoder Index - input
27	Ground	Logic Supply Ground connection.
28	Output 3	User controlled output #3 (active low). This is an open collector output with an internal 10k pullup resistor. (See 'A' command).
29	Moving	NON-BUFFERED output, low when indexing is in progress. High when not moving.
30	Input 2	User controlled input #2, (active low). Internally pulled up to +5vdc through a 10K resistor. (See 'A' command).
31	Soft Stop	Active low input to stop indexing using deceleration ramp. Internally pulled up to +5vdc through a 10k resistor.
32	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.
33	Jog -	Active low Jog input for '-' direction. Internally pulled up to +5vdc through a 10k resistor.
34	Channel A. +	Encoder Channel A input. Internally pulled up to +5vdc through a 10k resistor. (Differential Encoder Index Mark + input.)



## ABSOLUTE MAXIMUM RATING

Table 1

INPUT VOLTAGE .....	+ 48 VDC**
OUTPUT CURRENT .....	4 AMPS PEAK
PLATE TEMPERATURE .....	+ 70 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

\* ADDITIONAL COOLING MAY BE REQUIRED TO LIMIT PLATE TEMPERATURE TO 70 C.

\*\* INCLUDES BACK EMF

NOTE: An optional thermal pad is available for the IM483I & IM483IE.

## ELECTRICAL SPECIFICATIONS

Table 2

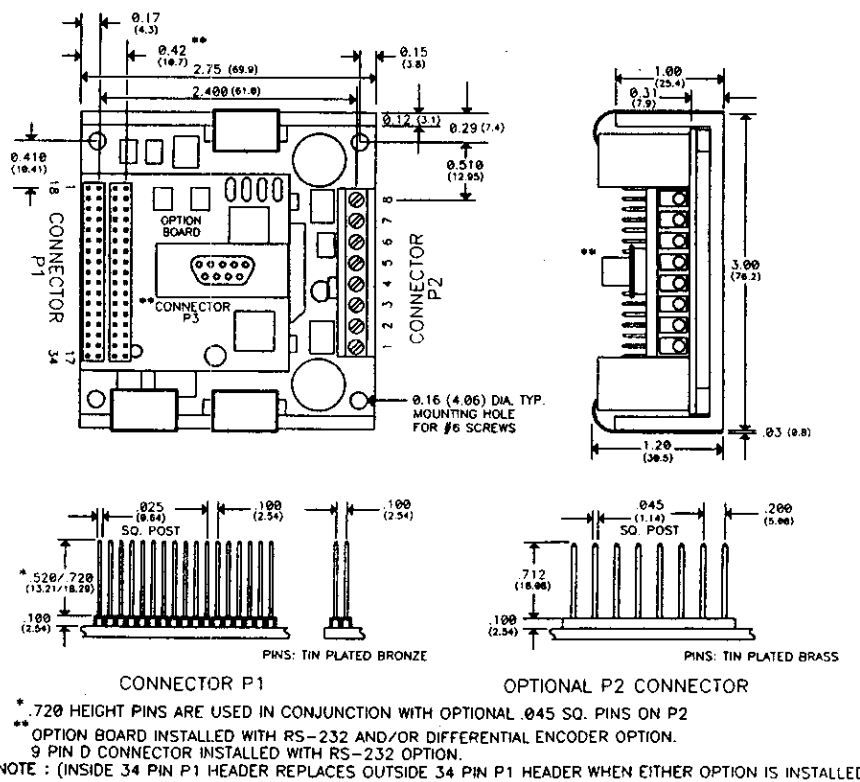
$T_A = 25\text{ C}$ ,  $V_+ = 48\text{ V}$

	TEST CONDITION	MIN	TYP	MAX	UNITS
INPUT VOLTAGE		12	36	48	V
PHASE OUTPUT CURRENT	RMS	0.4		3	A
PHASE OUTPUT CURRENT	PEAK			4	A
QUIESCENT CURRENT	INPUTS/OUTPUTS FLOATING		85		mA
ACTIVE POWER DISSIPATION	$I_{OUT} = 3\text{ AMPS RMS}$			12	W
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	FAULT OUTPUT			25	mA
COLLECTOR-EMITTER VOLTAGE	FAULT OUTPUT			140	V
COLLECTOR-EMITTER SATURATION VOLTAGE	FAULT OUTPUT			0.2	V

$I_{CS} = 25\text{ mA DC}$

**NOTE:** The aluminum housing is electrically isolated

# MECHANICAL SPECIFICATIONS



DIMENSIONS ARE INCHES (mm)

Fig. 1

## THERMAL SPECIFICATIONS

Table 3

OPERATING TEMPERATURE .....	0 TO +50 C
STORAGE TEMPERATURE .....	-40 TO +125 C
* PLATE TEMPERATURE ( MAX ) .....	+ 70 C

\* ADDITIONAL COOLING MAY BE REQUIRED TO LIMIT PLATE TEMPERATURE TO 70 C.

NOTE: An optional thermal pad is available for the IM483I & IM483IE.

## 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 IM483I & IM483IE, 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 IM483I & IM483IE 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 IM483I & IM483IE will be set.

#### EXAMPLE:

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

Therefore  $2.7 \times 1.4 = 3.78$  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.

## SETTING OUTPUT CURRENT

The OUTPUT CURRENT for both Run and Hold are set using an on board digital potentiometer. Refer to the software reference manual for further information.

## ENCODER INTERFACE

An encoder with TTL level outputs is required to interface with the IM483IE. On board 10K pullups are provided so that encoders with open collector outputs may be used. Figure 2 shows a typical encoder interface.

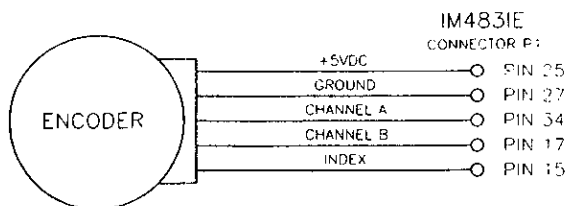


Fig. 2

Figure 2A shows a typical encoder interface for the IM483IE-DE with differential encoder inputs.

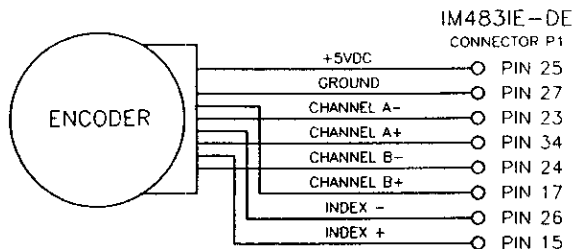


Fig. 2A

## MOTOR SELECTION

The IM483I & IM483IE 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 IM483I & IM483IE 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 IM483I & IM483IE 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 IM483I & IM483IE 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 7 and 8 on connector P2. Phase B of the Stepping Motor is connected between pins 5 and 6 on connector P2. The following drawings illustrate the connection of 4, 6, and 8 Lead Stepping Motors to the IM483I & IM483IE Drivers.

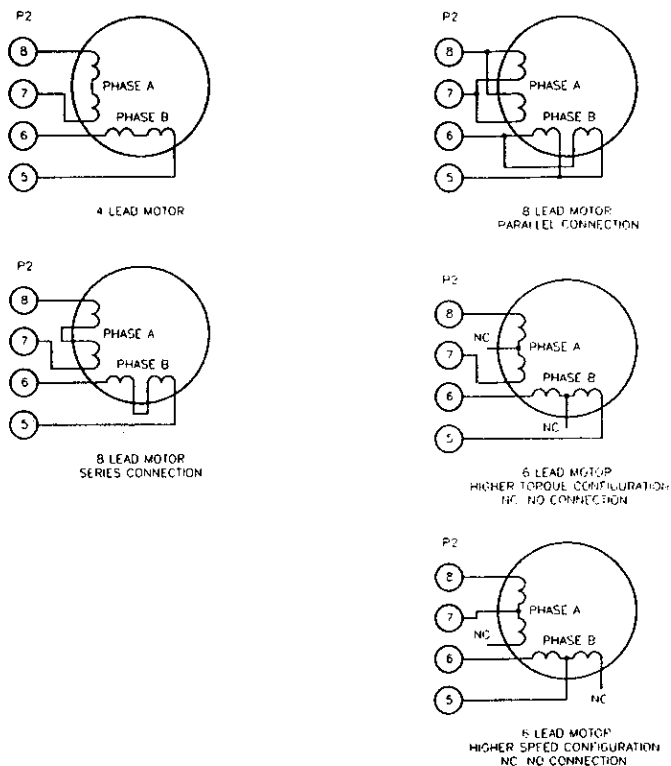


Fig. 3

**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!!**



## CONNECTING POWER

Pins 3 and 4 on connector P2 are used to connect the DC Power Supply to the IM483I & IM483IE. The wire size used to connect the power source to the driver should be at least 18 gauge. Heavier wire should be used for longer distances between the power supply and the driver. The power supply requirements are as follows:

Table 4

### POWER SUPPLY SPECIFICATIONS

Recommended Type:..... Unregulated DC.

Ripple Voltage: .....  $\pm 10\%$

Output Voltage: ..... 12 to 48v DC \*\*

\* Output Current..... 2 Amps (TYPICAL)

\*\* INCLUDES BACK EMF

**NOTE:** Switching Power Supplies and regulated linears with overcurrent protection are not recommended because of their inability to handle surge currents.

If multiple drivers are to be run off of one power supply each drive should have separate power and ground wires that connect directly to the output capacitor of the power supply.

**WARNING:** When using an unregulated power supply, care should be taken that the output voltage does not exceed the maximum driver input voltage because of line voltage fluctuations.

It is recommended that a Input line filter be used on the power supply to limit voltage spikes to the driver.

\* THE OUTPUT CURRENT NEEDED IS DEPENDENT ON THE SUPPLY VOLTAGE, MOTOR SELECTION, AND LOAD.

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

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

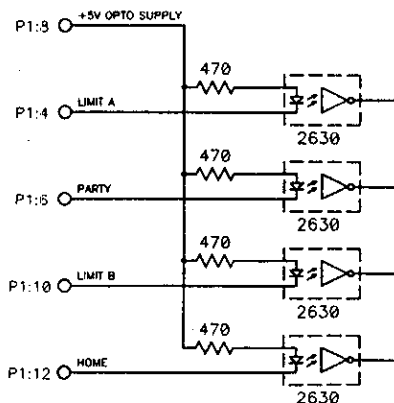
The following inputs to the IM483I & IM483IE are Optically Isolated.

Table 5

### Connector P1

Limit A .....	Pin 4
Limit B .....	Pin 10
Home .....	Pin 12
Party .....	Pin 6

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



OPTICALLY ISOLATED INPUTS

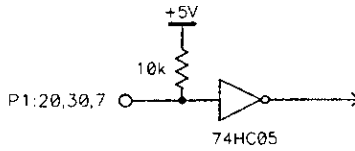
Fig. 4

The isolated inputs may be powered by 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 (4,10,12,6). 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 IM483I & IM483IE contain 3 general purpose inputs and 3 general purpose outputs. The inputs are TTL compatible and are pulled up via a 10K resistor to +5V on the Input. (see Fig below)



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

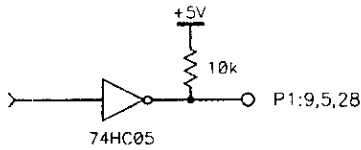


Fig. 5

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

## DEDICATED INPUTS

The IM483I & IM483IE contain 5 dedicated inputs: Go, Soft Stop, Jog +, Jog -, and Jog speed. 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).

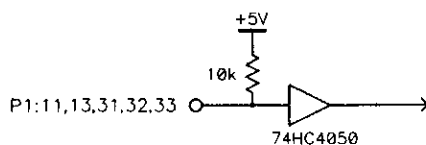


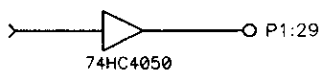
Fig. 6

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 line is buffered as shown below.



## **FAULT PROTECTION**

The IM483I & IM483IE are internally protected against over temperature and short circuits.

The over temperature protection in the IM483I & IM483IE is built into the power output bridge ICs. This circuit will disable the output if the junction temperature within the IC reaches 150 °C. When the temperature has fallen to a safe level the outputs will be reenable.

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

If a short circuit is detected by the IM483I & IM483IE, the outputs will be disabled and can not be re-enabled without resetting or powering down the driver. At the same time the open collector FAULT output is turned on.

This Fault output is non-isolated and has the ability to sustain the maximum driver voltage. It is capable of sinking up to 25mA which can be used to drive a small relay or LED.

## PARTY LINE OPERATION

The IM483I & IM483IE 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.

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 IM483I & IM483IE in a Stand Alone mode (i.e. P1 pin 6 floating).

After an address is assigned, the IM483I & IM483IE can be tied to the Multi Unit System by enabling the Party Line Input (P1 pin 6).

Figure 7 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.

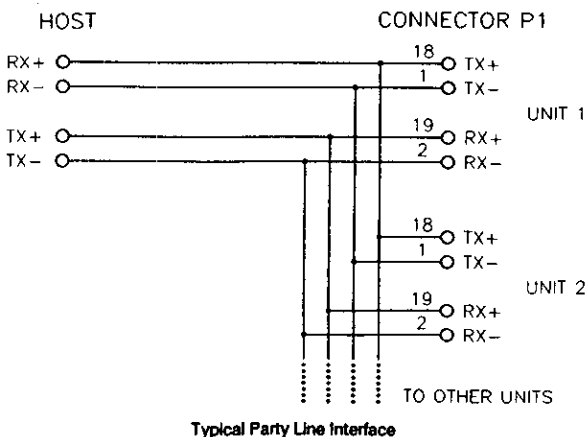


Fig. 7

## 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 either the 9 pin D type connector (P3) or the 34 pin (P1) connector. 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 would be as described in the Party Line Operations above.

## + 5V DC OUTPUT

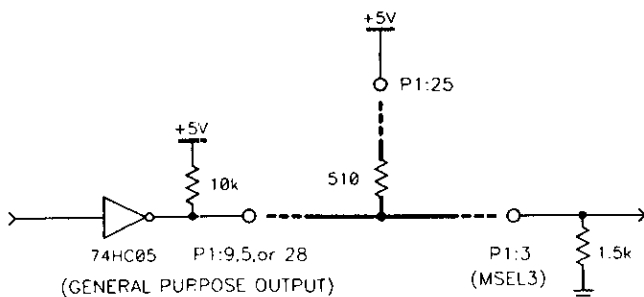
The +5V DC output on the IM483I & IM483IE is intended to drive the encoder feedback device ONLY. This output should NOT be used as a general purpose power supply. When using this supply care should be taken not to inject noise back into the driver. An increase in case temperature may also occur due to the increase in current through the linear regulator.

## OPTIONS/ACCESSORIES

Discription	Part Number
Optional on board RS-232 to RS422 Converter	IM483I2 IM483IE2
Optional Differential Encoder Inputs	- DE
Thermal Pad	TN - 48
8 position .045 sq. pins (P2 connector)	- 8P2
34 pin Breakout Box	BB - 34
RS232 to RS422 converter	CV - 3222
GUI Controller Software (Requires *Windows V3.0 or greater)	Quickstart 1

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## APPLICATION NOTES



USING A GENERAL PURPOSE OUTPUT TO ENABLE  
THE SELECTION OF DECIMAL RESOLUTIONS

RESOLUTION (D COMMAND)	STEP SIZE (MICROSTEPS/STEP)
0.....	ILLEGAL STATE
1.....	5
2.....	10
3.....	25
4.....	50
5.....	125
6.....	250
7.....	ILLEGAL STATE
8.....	ILLEGAL STATE

**Warning!** Decimal resolutions can only be used in fixed resolution mode. Refer to the "D" command in the Software Reference Manual for further information.



## **WARRANTY**

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

Intelligent Motion Systems, Inc. warrants its products against defects in materials and workmanship for a period of 24 months from receipt by the end-user. During the warranty period, IMS will either, at its option, repair or replace Products which prove to be defective.

### **EXCLUSIONS**

The above warranty shall not apply to defects resulting from: improper or inadequate handling by customer; improper or inadequate customer wiring; unauthorized modification or misuse; or operation outside of the electrical and/or environmental specifications for the Product.

### **OBTAINING WARRANTY SERVICE**

To obtain warranty service, Products must be returned to a service facility designated by IMS.

Customer shall prepay shipping charges for Products returned to IMS for warranty service and IMS shall pay for return of Products to customer. However, customer shall pay all shipping charges, duties, and taxes for Products returned to IMS from another country.

### **WARRANTY LIMITATIONS**

IMS makes no other warranty, either expressed or implied, with respect to the Product. IMS specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Some jurisdictions do not allow limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the 24 month duration of this written warranty.

### **EXCLUSIVE REMEDIES**

During the Warranty Period. If your Product should fail during the warranty period, send the failed Product to: Intelligent Motion Systems, 370 North Main Street, Marlborough, Connecticut 06447. Also enclose information regarding the circumstances prior to Product failure.



## 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