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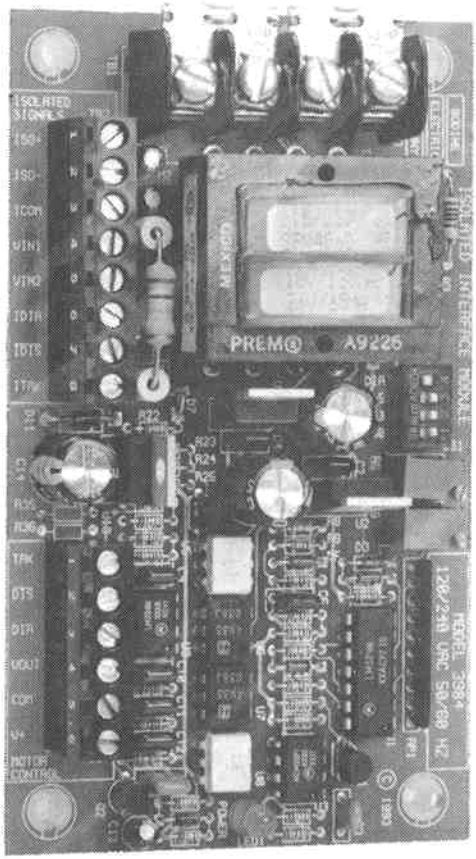
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Instructions for Installation and Operation
Motion Control Accessories
Model 3984 Isolated Interface Module



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Part No. 074 00187B

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IMPORTANT

Read this manual completely and carefully. Pay special attention to all warnings, cautions, and safety rules. Failure to follow the instructions could produce safety hazards which could injure personnel or damage the module, control, motor, or other equipment. If you have any doubts about how to connect this module refer to the detailed sections of this manual and the specific control manual.

QUICK REFERENCE

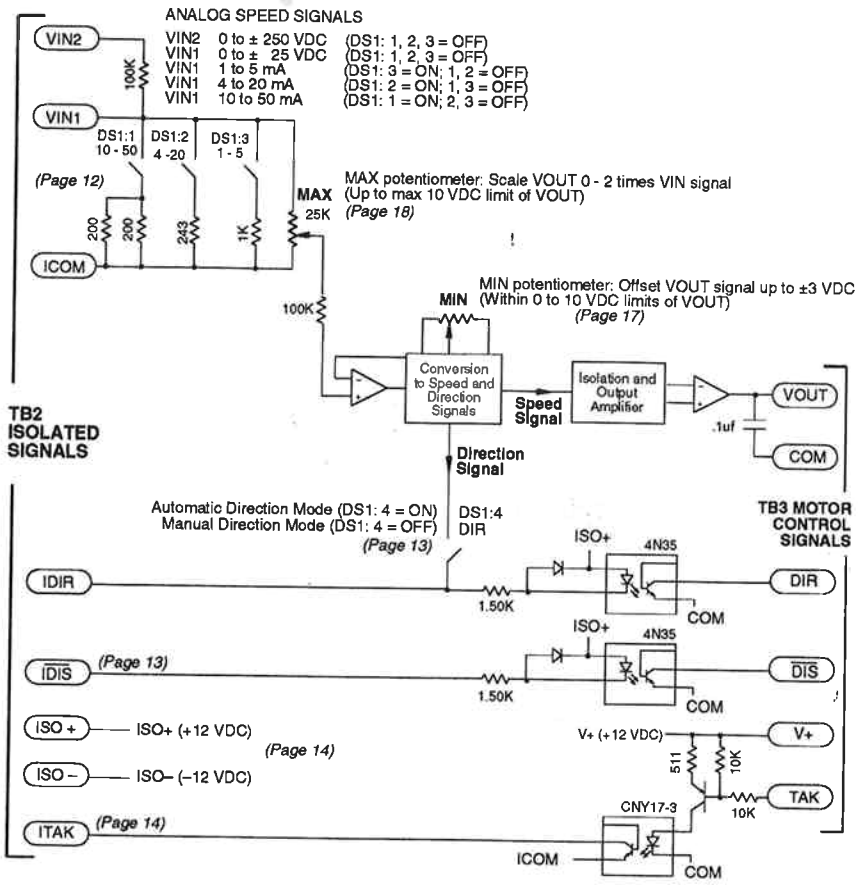


Figure 1 - Quick Reference Diagram

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Control Mounting Template ..... Centerfold

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GENERAL INFORMATION

Thank you for selecting the Bodine Model 3984 Isolated Interface Module. It will provide the same excellent performance and reliability that have been a Bodine tradition since 1905. Bodine Electric Company takes pride in the quality of its products and in satisfying its customers. Every effort has been made to provide you with a product free of defects in design, workmanship, and materials. In order for us to maintain our tradition of quality, please report any cases of unsatisfactory service or products to Bodine Electric Company promptly.

About This Manual

This manual contains the basic information needed to install and operate the Bodine Model 3984 Isolated Interface Module. It is organized in a systematic, step-by-step fashion so that it may be installed in the shortest possible time. It does not profess to cover all details or variations in equipment, nor to provide for every possible contingency associated with installation, operation, or maintenance. No warranty of fitness for purpose is expressed or implied. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purpose, the matter should be referred to the Bodine Electric Company.

The issuance of this manual does not confer to the recipient any license to manufacture under any patents owned or controlled by the Bodine Electric Company.

Safety Standards

Bodine products are designed and manufactured to comply to applicable safety standards and in particular to those issued by ANSI (American National Standards Institute), NEMA (National Electrical Manufacturers Association), U.L. (Underwriters Laboratories, Inc.), and CSA (Canadian Standards Association).

Bodine equipment "recognized by U.L., Inc." are labeled with the symbol. In addition, products that are CSA certified are identified by a symbol. If you need specific information regarding the third-party approval status of Bodine products, contact the nearest Bodine representative, or the home office.

DESCRIPTION AND FEATURES

Most Bodine motor controls have floating signal commons (i.e. the signal common is not at ground potential). Input signals from transducers, microprocessor controls, programmable logic controllers, and other electronic control devices may produce grounded signals or signals which are at a different potential from those used in Bodine motor controls. The Model 3984 Isolated Interface Module is designed to provide an interface which optically isolates the motor control

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signals from external electronic control signals, while still providing full use of Bodine control features.

The Model 3984 is a scalable voltage following device that accepts a wide range of current and voltage analog speed input signals and delivers an isolated output speed signal of 0 to +10 VDC @ 10 mA. A built-in sensor circuit monitors the polarity of the analog voltage speed input and changes the motor's direction of rotation when the signal goes from positive to negative. Adjustable minimum and maximum potentiometers allow the output speed signal to be scaled or offset in order to achieve a desired response based on a given value of input signal.

Isolated motor disable and direction of rotation signals are also provided as well as an isolated tachometer output which can be used to monitor the speed of Bodine brushless DC motors. Isolated power supply connections are provided on both the input and output sides of the Model 3984 for convenience. The power supply delivers ±12 VDC @10 mA at the +ISO/–ISO terminals and +12 VDC @ 10 mA at the V+ terminal.

The Model 3984 can be used in a variety of configurations to control several slave motor/control circuits from a single master. Configuration examples are described in the Application Information Section of this manual.

SPECIFICATIONS

AC Input Power: 120 or 240 VAC, 50/60 Hz

Motor Speed Signals

Input Voltage Range:	–25 to +25 VDC; –250 to +250 VDC
Input Current Range:	1 to 5 mA; 4 to 20 mA; 10 to 50 mA
Output Signal Range:	0 to +10 VDC @ 10 mA
Input/Output Linearity:	±0.1% @ 10 VDC (Typical)
Thermal Drift:	4 mV/°C
MIN potentiometer range:	Offset VOUT ±3 VDC*
MAX potentiometer range:	Scale VOUT 0 to 2 times*

Auxiliary Signals: Motor Direction
Motor Disable
Digital Tachometer

Ambient Operating Temperature: 0° to 50°C

Dimensions: in: 4.75 L x 2.75 W x 1.55 H
cm: 12.1 L x 7.0 W x 4.0 H

* MIN and MAX adjustments are limited to within the 0-10 VDC limits of VOUT.

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IMPORTANT SAFETY PRECAUTIONS

The following safety precautions must be observed during all phases of installation, operation, service, and repair of this module. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the product. Bodine Electric Company assumes no liability for the customer's failure to comply with safety requirements and practices.

The use of electric motors and gearmotors, like that of all utilization of concentrated power, is potentially hazardous. The degree of hazard can be greatly reduced by proper design, selection, installation, and use, but all hazards cannot be completely eliminated. The reduction of hazards is a joint responsibility between the user; the manufacturer of the driven or driving equipment and the manufacturer of the control or motor and interface circuitry.

The user should refer to Publication No. ANSI C5.1/NEMA MG 2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators."*

Available from:

National Electrical Manufacturers Association
2101 L Street N.W.
Washington, D.C. 20037, U.S.A.

☛ **Warnings** highlight procedures which present potential danger to people. **Cautions** highlight possible danger to equipment. Both are used throughout this manual and must always be followed.

WARNING

The chance of explosions, fires or electric shocks can be reduced with thermal and over-current protection, proper grounding, enclosure selection, and good maintenance. The following safety considerations are not intended to be all-inclusive. Specific references throughout the manual should also be consulted.

Inspection

Check the items you received against your purchase order. Carefully examine the interface module for shipping damage. Report parts errors to Bodine. Shipping damage claims should be made to the freight carrier.

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Before installing this interface module, review the application to confirm that the proper motor and control have been selected. This should be done after reading the manual provided with the motor and all applicable safety standards. If in doubt, contact your Bodine representative, or the home office if there is no representative in your area. Although Bodine Electric Company assists its customers in selecting motors and controls for specific applications, determination of fitness for purpose or use is solely the customer's responsibility.

Grounding

Both electronic controls and motors must be securely mounted and adequately grounded. Failure to ground properly may cause serious injury to personnel.

Fusing

The AC input to the isolated interface module should be fuse protected. The fuse must conform to the value and rating listed on page 15.

Environment

Open circuit boards in ventilated enclosures may emit flame during failure. Bodine does not offer an explosion-proof line of motion control accessories for hazardous locations (e.g., environments of flammable or explosive gas, vapor, or dust). Bodine recommends using only approved explosion-proof products in hazardous locations. The National Electric Code (NEC) allows exceptions, but NEC and NEMA safety standards should be studied thoroughly before exercising this option.

Moisture increases the electrical shock hazard of electrical insulation. Therefore, this module and other open-type or unsealed accessories or controls not specifically designed for such use, should be protected from contact with liquids or moisture.

Ventilated Products

Open, ventilated products are suitable for clean, dry locations where cooling air is not restricted. Do not insert anything into a product's ventilation openings.

Servicing

Emergency field repairs must be made only by authorized Bodine service representatives. Repairs made by persons not authorized by the Bodine Electric Company will void the warranty. Field repairs must be limited to replacing the entire printed circuit board assembly. Because of the danger of introducing safety hazards, do not install substitute parts or perform any unauthorized modifications to electronic PC boards or components. To ensure continued compliance with the design specifications and safety standards, the interface circuit module should be returned to Bodine Electric Company or an Authorized Service Center for servicing.

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WARNING

To avoid injury because of unsuspected mechanical motion, always disconnect the power supply to the motor control before performing any service procedures on the motor, control, interface circuitry or driven equipment.

This manual does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance - no warranty of fitness for purpose is expressed or implied. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purpose, the matter should be referred to the Bodine Electric Company.

The issuance of this manual does not confer to the recipient any license to manufacture under any patents owned or controlled by the Bodine Electric Company.

APPLICATION INFORMATION

The Bodine Model 3984 Isolated Interface Module is a versatile device which can be used with a single motor and control or combined with other 3984 modules, motors, and controls to satisfy a variety of motion control applications. The following information is provided as reference material; it does not include every possible configuration. If you have any doubts about using the Model 3984 for a specific application, contact your local Bodine representative or the home office.

CAUTION

This section is not a substitute for the installation and operating instructions. Refer to those sections for details on mounting, wiring, and operation.

Typical Control Signal Isolation

In simple applications involving a single motor and control, the Model 3984 accepts signals from a variety of motion control sources and generates isolated output signals which are compatible with Bodine motor control inputs. Figure 2 illustrates typical inputs and outputs for a Model 3984 when it's used to isolate ABL-3910 or 3911 and UDC-800 or 803 control inputs. Refer to the Installation Instruction Section of this manual for specific wiring variations, DIP switch settings, and other pertinent information.

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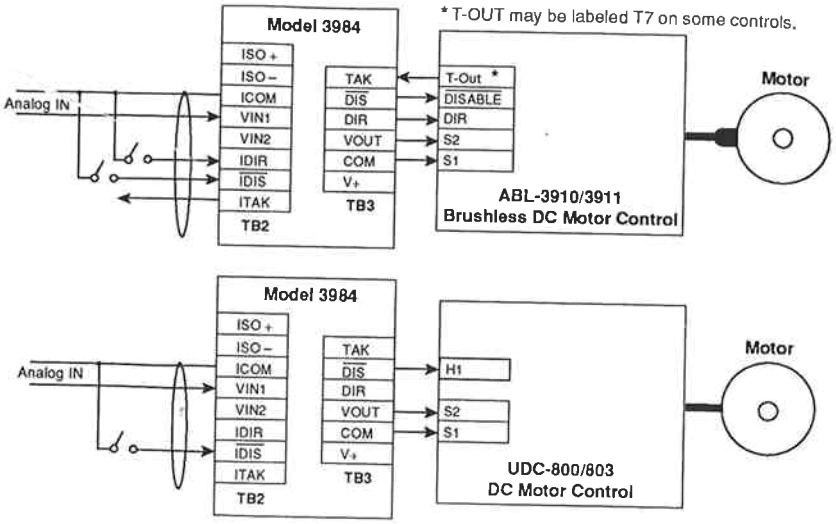
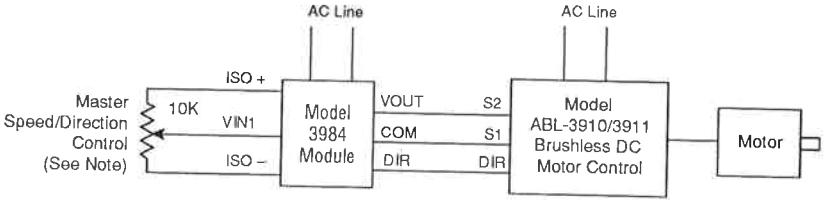


Figure 2 - Typical Isolated Inputs for Bodine Controls.

Bi-Directional Master Speed Control

The input side of the Model 3984 provides connections to an internal ± 12 VDC power supply. If a 10 KΩ potentiometer is connected across the power supply and the wiper is connected to the VIN1 terminal of the Model 3984, as shown in Figure 3, a voltage divider circuit is formed. When the wiper is in the center position, zero volts is applied to VIN1, so the motor speed is zero RPM.

When the wiper is turned in one direction, a positive voltage is applied to VIN1 causing the motor to turn in a clockwise direction. When the potentiometer is turned in the other direction, a negative voltage is applied to VIN1 causing the motor to turn in the counterclockwise direction. The motor speed is always directly proportional to the absolute value of the voltage applied to VIN1.



Note: DS1:4 must be ON for this configuration to function properly.
See Page 13 - Automatic Control of Motor Direction

Figure 3 - Master Speed/Direction Control Configuration

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Master/Slave Signal Generator

Several Model 3984 modules may be configured in a master/slave arrangement as shown in Figure 4. The speed outputs of each slave module can be scaled or offset to achieve different results for each slave module can be scaled or offset to achieve different results for each slave motor. Each slave module can control a different type of motor/control system.

The output of the master module can drive up to 10 slave modules. Each slave module will follow the output of the master but will vary proportionally depending on the scaling or offset factor. For more information on adjusting the speed control, refer to "Internal Adjustments/Calibration" in the Operating Instruction Section of this manual.

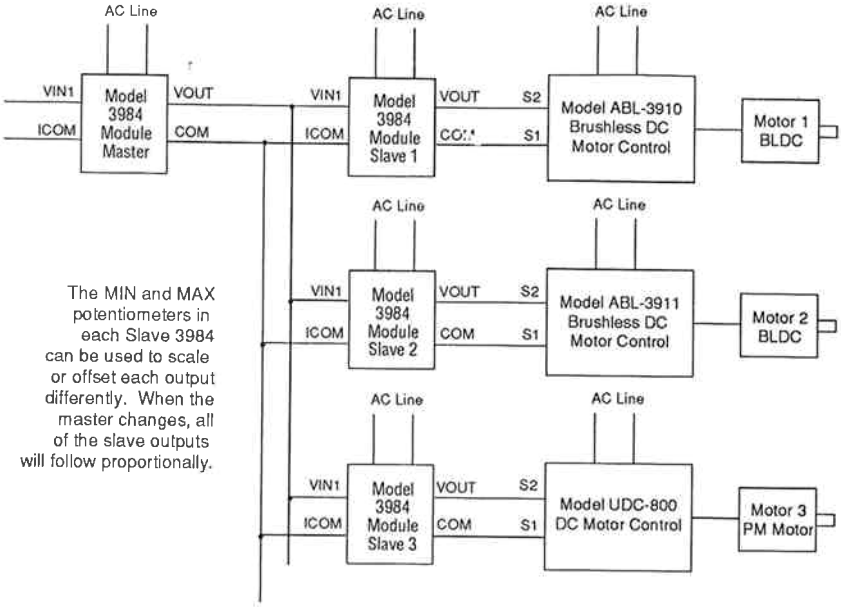


Figure 4 -Master/Slave Configuration

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INSTALLATION INSTRUCTIONS

WARNING

This module should only be installed by a qualified technician, electrician, or electrical maintenance person familiar with its operation and associated hazards. The National Electrical Code (NEC), local electrical and safety codes, and when applicable, the Occupational Safety and Health Act (OSHA) should be observed to reduce hazards to personnel and property.

The user must provide a proper enclosure. Circuitry is not at ground potential. Do not perform work on or near the module while it is connected to the AC line.

CAUTION

Exposed circuit boards should be protected from electrostatic discharge. The interface module uses CMOS circuitry. Static discharge into the circuit board must be avoided to prevent component damage.

Mounting the Model 3984 Interface Module

The mounting template (provided with this manual) can be used to position and mark the location of mounting holes on the surface where the module is to be located. The module may be mounted in any position provided there is adequate air flow. It is equipped with four nylon spacers which provide ample clearance between the mounting surface and the circuit board. The spacer holes will accept No. 8 machine screws.

Electrical Connections

All connections to the Model 3984 are made at screw terminal blocks TB1, TB2, and TB3. See Figure 5. Read the following instructions and all of the applicable safety recommendations, before making any electrical connections.

WARNING

AC power should be the last connection made in order to prevent accidental start-up. Disconnect the AC power before making any other electrical connections.

CAUTION

Only copper wire with a minimum 60° C rated insulation is recommended for all cable assemblies

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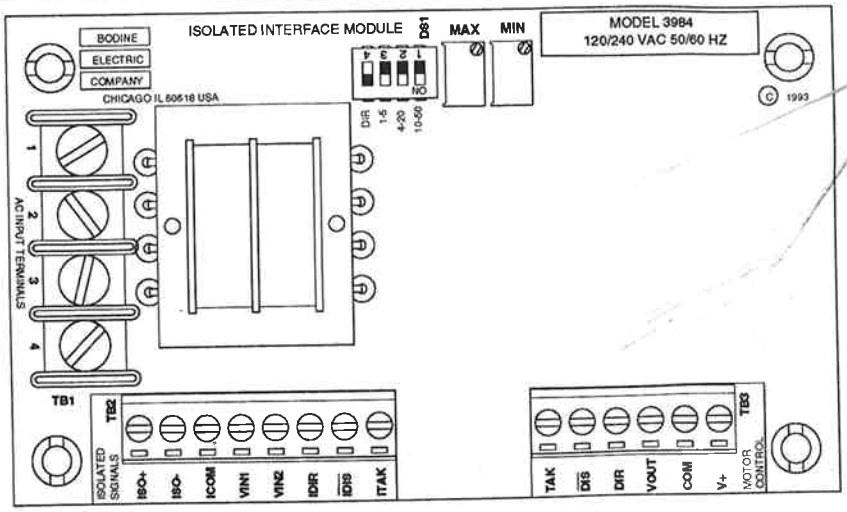


Figure 5 - Model 3984 Circuit Board

Controlling Speed With an Analog Input Voltage: Analog voltage speed input signals are connected across the VIN1 or VIN2 and ICOM terminals on terminal block TB2, depending on the level of the voltage. In addition, DIP Switch DS1 levers must be set properly. Refer to Chart 1.

Chart 1- Voltage Speed Input Connections And DIP Switch Settings

Input Voltage Level	TB2 Terminal Connection	DS1 DIP Switch Levers In ON Position*	DS1 DIP Switch Levers In OFF Position*
0 to ± 25 VDC	VIN1	None	1, 2, 3
0 to ± 250 VDC	VIN2	None	1, 2, 3

* DS1 lever 4 can be either ON or OFF depending on the direction control requirements.
See Page 13 – Automatic Direction Mode.

Controlling Speed with an Analog Input Current: The Model 3984 will also accept current speed inputs. Current speed control signals are applied to VIN1 on TB2. For proper operation, DIP Switch DS1 levers must be set correctly based on the level of the input current. Refer to Chart 2.

Chart 2- Current Speed Input Connections And DIP Switch Settings

Input Current Level	TB2 Terminal Connection	DS1 DIP Switch Levers In ON Position*	DS1 DIP Switch Levers In OFF Position*
1 to 5 mA	VIN1	3	1, 2
4 to 20 mA	VIN1	2	1, 3
10 to 50 mA	VIN1	1	2, 3

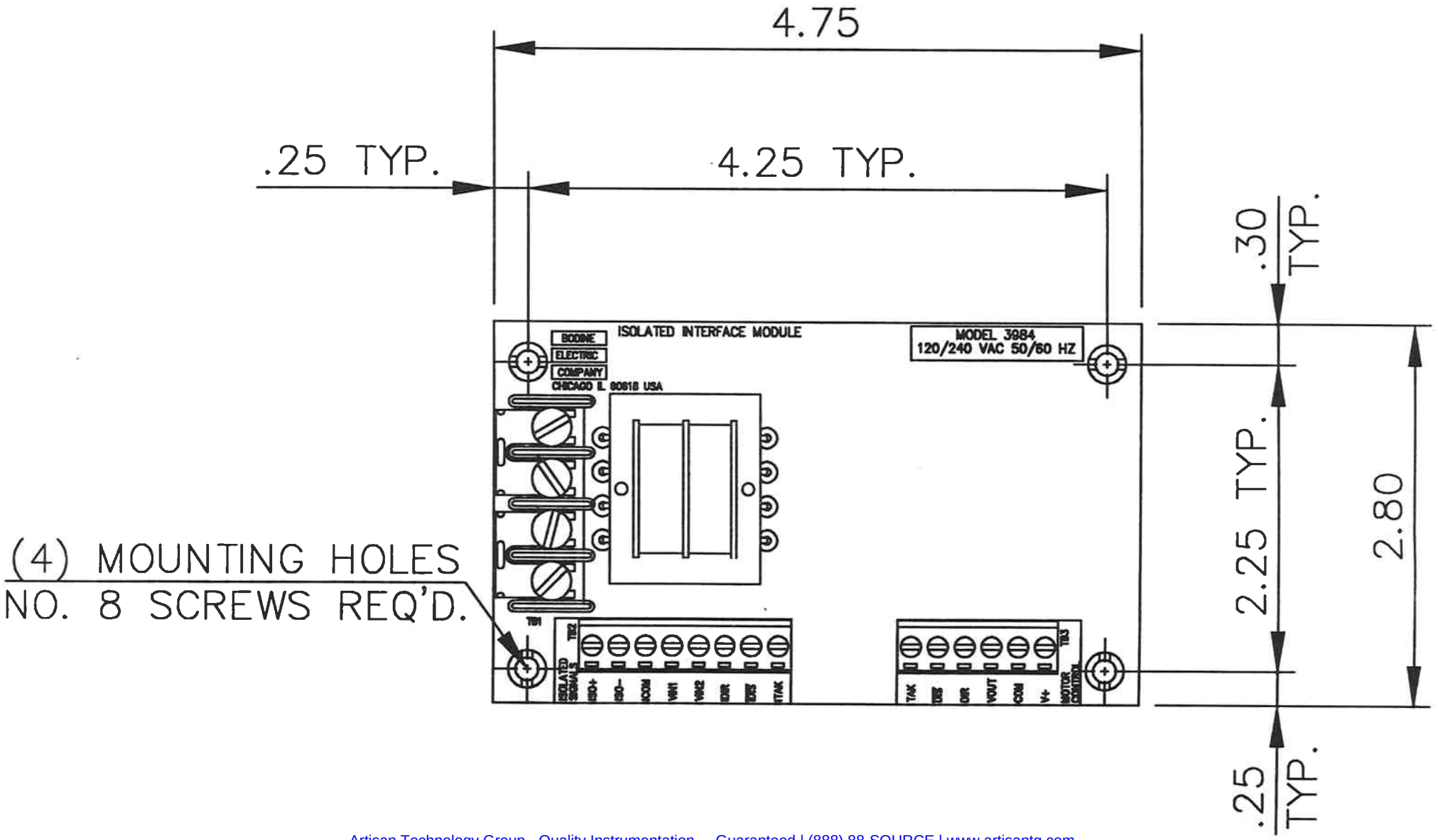
* DS1 lever 4 can be either ON or OFF depending on the direction control requirements.
See Page 13 - Automatic Direction Mode.

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Mounting Template for Bodine Model No. 3984 Isolated Interface Module

(Top View)

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Speed Control Output: The Model 3984 Module provides a scalable speed control output signal between 0 and +10 VDC. The output signal is delivered across VOUT and COM on terminal block TB3. On Bodine motor controls, the VOUT signal should be connected to S2. The COM signal should be connected to S1 (Control Signal Common). Refer to "Internal Adjustments/Calibrations" in the Operating Instruction Section of this manual for output speed control adjustment procedures.

Controlling Motor Disable: An isolated motor disable input $\overline{\text{IDIS}}$ is provided at terminal block TB2. A switch closure or activation by an open collector device capable of sinking 10 mA minimum will generate a disable signal at $\overline{\text{DIS}}$ on terminal block TB3.

WARNING

Never rely on logic circuitry as a means of disabling the motor or control. To prevent unsuspected mechanical motion and potential injury, the AC power should always be disconnected from the control power supply whenever logic circuits or the driven equipment are serviced.

Connect the disable input across ICOM and $\overline{\text{IDIS}}$ on terminal block TB2. Connect the $\overline{\text{DIS}}$ output to the $\overline{\text{disable}}$ input on the motor control.

Automatic Control of Motor Direction: The Model 3984 has a built-in circuit which can be used to set motor direction based on the polarity of the voltage signal applied to VIN1 or VIN2 on Terminal block TB2. This automatic circuit is enabled by switching Dip Switch DS1, lever 4 ON. When used with Bodine ABL-3910/3911 controls as shown in Figure 2, the motor will rotate in a CW direction when VIN > 0; it will rotate in a CCW direction when VIN < 0.

NOTE: If a voltage divider potentiometer is connected across ISO+ and ISO- to create a master speed/direction control, DS1: 4 must be ON. See Figure 3.

The DIR output at the TB3 terminal block should be connected to the DIR input on Bodine motor controls (if applicable).

Independent Control of Motor Direction: The automatic direction mode can be disabled by switching DIP switch DS1, lever 4 OFF. When disabled, a separate switched input may be connected across IDIR and ICOM to control motor direction of rotation. The switched input can be a manual switch, relay contact, or digital signal from any open collector type device capable of sinking a current of 10 mA minimum and withstanding 12 VDC.

The DIR output at the TB3 terminal block should be connected to the DIR input on Bodine motor controls (if applicable).

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Tachometer Output: When used with the Bodine ABL-3910/3911 Brushless DC Motor Controls, the Model 3984 module provides a digital tachometer output at the ITAK terminal for monitoring motor speed. The output pulse levels are low to high to low. The pulse width is 0.8 to 1.2 msec. Twelve pulses correspond to one motor revolution. The ITAK output provides an unterminated open collector output. A pull-up resistor or another logic device is required for measuring the output. See Figure 6 for assistance in interfacing the ITAK output.

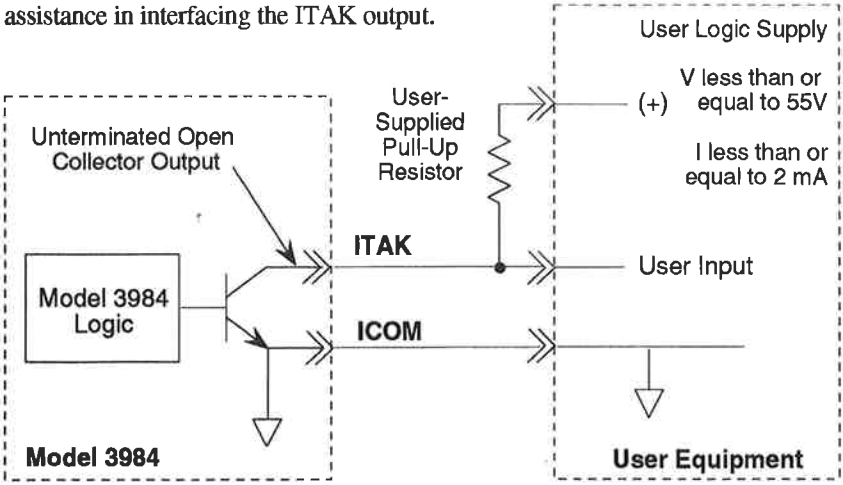


Figure 6 - ITAK Output

Internal Auxiliary Power Supply: The Model 3984 Isolated Interface Module has as internal ±12 VDC, 10 mA power supply which may be used for external components if needed. It is accessible via the ISO+, ISO–, and ICOM terminals on terminal block TB2.

AC Power Connections

AC Power should always be the last connection made during installation and the first item disconnected before servicing. The Model 3984 may be connected to either a 120 VAC, 50/60 Hz or a 240 VAC, 50/60 Hz source.

For 120 VAC:

Connect a jumper from terminals 1 to 2 and from 3 to 4. Refer to Figure 7. Then connect 120 VAC source to terminals 1 and 4 of terminal block TB1.

For 240 VAC:

Connect a jumper from terminal 2 to 3, then connect 240 VAC source to terminals 1 and 4. Refer to Figure 7.

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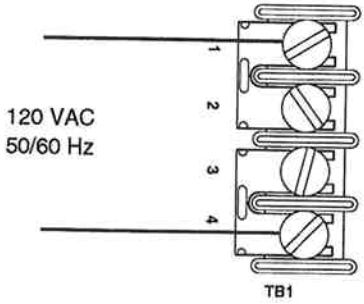
Fuse Installation: It is recommended that the Model 3984 be protected with an external fuse. The amperage rating of the fuse depends on the AC line voltage used to power the module as shown in Chart 3. In a multi-control system, each module should have a separate fuse. (SEE CAUTION BELOW.)

Chart 3 - Recommended AC Fuse Value

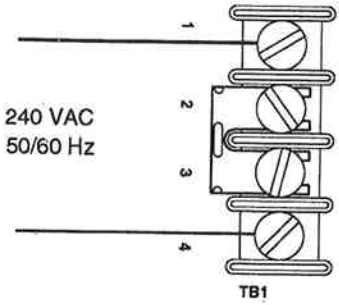
Line Input	Fuse Value	Fuse Type	Manufacturer P/N
120 VAC	.062 Amp	Slow Blow	Littlefuse 313.062
240 VAC	.031 Amp	Slow Blow	Littlefuse 313.031

CAUTION

In installations where one side of the AC supply is at ground potential, only the hot side will require a fuse. If both sides of the AC line are at a potential with respect to ground, each line will require a separate fuse.



USE JUMPERS TO CONNECT TERMINALS 1 TO 2 AND 3 TO 4 AS SHOWN



USE JUMPER TO CONNECT TERMINALS 2 TO 3 AS SHOWN

Figure 7 - AC Power Connections

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OPERATING INSTRUCTIONS

WARNING

Explosions, fires, or electric shock hazards can be reduced through thermal and over-current protection, good maintenance, proper grounding, and enclosure selection. Review safety considerations outlined in the Important Safety Precautions and Installation Instruction Sections.

Preliminary Checks

1. Before applying signals to the Model 3984, check all fuses, connections, and adjustments as outlined in this manual and in the motor control manual.
2. Proper consideration should be given to all rotating members. Before starting, be sure keys, pulleys, etc. are securely fastened. Proper guards should be provided to prevent hazards to personnel while the equipment is rotating.
3. Mechanical considerations such as proper mounting and alignment of products, and safe loads on shafts and gears should be reviewed. Do not depend upon gear friction to hold loads.
4. The motor or gearmotor should be securely mounted (because of possible reaction torque). Test the motor/gearmotor unloaded to be certain that proper connections have been made.
5. If the motor/gearmotor does not start promptly and run smoothly, or if the control does not react to input signals, disconnect the AC power immediately. Double check all wiring, and refer to "Trouble-shooting" in this manual and the motor control manual.
6. If the problem persists, contact your Bodine representative or a Bodine Authorized Service Center and describe the problem in detail. Include all the motor/gearmotor nameplate data and control information. Do not disassemble or attempt to service any products unless authorized by Bodine. Removing screws voids the Warranty.

Operation

1. Disconnect the AC power to the Model 3984 and the motor control and double check all control connections as outlined in the motor control manual.
2. Set external speed potentiometers to ZERO or null positions. If a $\overline{\text{Disable}}$ switch is used, close the switch.
3. Connect the AC power to the Model 3984 module and the motor control.
4. Set the manual Direction switch, if provided, for the proper direction of rotation.
5. Open the $\overline{\text{Disable}}$ switch if used.

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6. Turn the speed potentiometer until the motor rotates. Then adjust the potentiometer to achieve the desired speed.
7. If the motor does not operate, check all connections and fuses. If a fuse is blown and the motor is not locked (stalled) or overloaded, do not replace the fuse. The control may be damaged. Refer to "Troubleshooting" in this manual and the motor control manual. If the motor is overloaded, reduce the load and replace blown fuses with new ones of the proper rating. (See page 15.)

Internal Adjustments/Calibration

The Model 3984 is factory adjusted to provide a VOUT signal of 0 to 10 VDC for a 0 to ±10 VDC signal applied to VIN. The polarity of the output voltage is always positive regardless of the input.

If other input signal ranges are required, the Model 3984 can be calibrated using the following procedures for adjusting the MIN and MAX potentiometers.

WARNING

Use a non-metallic or insulated adjustment tool (such as a television alignment tool) for internal adjustments. Circuit components are not at ground potential and accidental short circuiting and shock hazard may occur with conducting tools. Adjustment should be made only by qualified service personnel.

MIN Speed Trim Potentiometer: The MIN trim potentiometer is used to adjust the minimum speed of the motor to correspond to a specific input voltage or current signal. For example, by adjusting the MIN potentiometer CW it is possible for the motor to run at a minimum speed in the absence of an input signal. This is useful in applications where the motor must keep running.

To adjust the MIN trim potentiometer:

1. Apply the desired voltage or current signal across terminals VIN1 or VIN2 and ICOM on terminal block TB2.
2. Adjust the MIN potentiometer until the motor RPM reaches the desired level.

CAUTION

Adjusting the MIN potentiometer will affect the MAX potentiometer setting and the MAX potentiometer will have to be readjusted.

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MAX Speed Trim Potentiometer: The MAX trim potentiometer is used to adjust the maximum speed of the motor to correspond to a specific input voltage. For example, adjusting the MAX potentiometer CW will allow an input voltage less than ±10 VDC to generate a maximum +10 VDC output to run the motor at rated speed.

Conversely, it may be adjusted CCW so that input signals greater than ±10 VDC can be used to operate the motor at its full rated speed.

To adjust the MAX trim potentiometer:

1. Apply the desired voltage or current signal across terminals VIN1 or VIN2 and ICOM on terminal block TB2.
2. Adjust the MAX potentiometer until the motor RPM reaches the desired level.

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TROUBLESHOOTING

> ***WARNING***
> *Disconnect the AC power to the Model 3984 before troubleshooting.*

The charts on the following pages provide assistance in troubleshooting common problems which occur during normal installation and operation. If the problem persists, contact your source of purchase or a Bodine Authorized Service Center and describe the problem in detail. Do not disassemble the product unless authorized by Bodine Electric Company. Performing unauthorized repairs will void the Warranty.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
MODULE BLOWS FUSE	Incorrect AC power wiring	Check connections, look for shorts and repair as required.
	Damaged module Components	Contact Bodine or Service Center for assistance.
MOTOR WILL NOT START	Open AC power fuse	Replace fuse. Refer to page 15 for proper value.
	Wrong input settings	Check DS1 settings, page 12.
	Input signal too low	Increase input signal or scale. VOUT using MAX trim potentiometer, page 18.
	$\overline{\text{Disable}}$ switch closed	Open $\overline{\text{Disable}}$ switch
MOTOR WILL NOT COME UP TO SPEED	MAX trim pot set too low	Adjust MAX trim pot, page 18.
	Input signal too low	Increase input signal or scale. VOUT using MAX trim potentiometer, page 18.
	Motor overloaded	Re-examine the load parameters.
MOTOR SPEED IS UNSTABLE OR PULSATES	Input signal too low	Increase input signal or scale VOUT using MAX trim potentiometer, page 18.

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SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
MOTOR WILL NOT STOP WITH SPEED POT ADJUSTED AT ZERO OR WITH NO INPUT SIGNAL*	MIN potentiometer out of adjustment	Adjust MIN potentiometer, page 17.
	Wrong DIP switch settings	Check DIP switch settings, page 12.
	Defective input circuitry	Check VIN1, VIN2, and ICOM for presence of input signal.
NO SPEED ADJUSTMENT	Defective input circuitry	Check VIN1, VIN2, and ICOM for presence of input signal.
MOTOR TURNS IN WRONG DIRECTION	Polarity of input signal reversed	Check polarity of voltage at VIN1 or VIN2. See page 13, Automatic Control of Motor Direction.
MOTOR DOES NOT CHANGE DIRECTION WHEN POLARITY OF VIN CHANGES	DIP switch DS1, lever 4 is in the OFF position	Turn DS1:4 to ON position.

*Note: The $\overline{\text{disable}}$ input should be activated or the disable switch closed when the motor is expected to remain stopped.

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NOTES

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BODINE LIMITED WARRANTY

The Bodine Electric Company warrants all products it manufactures to be free of defects in workmanship and materials when used under Normal Operating Conditions and when applied in accordance with nameplate specifications. This warranty shall be in effect for a period of twelve months from date of purchase or eighteen months from date of manufacture, whichever comes first.

The Bodine Electric Company will repair or replace at its option, any of its products which has been found to be defective and is within the warranty period, provided that the product is shipped freight prepaid, with previous authorization, to Bodine's plant in Chicago, Illinois 60618 U.S.A., or to the nearest Bodine Authorized Service Center. At its option, all return shipments are F.O.B. Bodine's plant or Authorized Service Center. Bodine is not responsible for removal, installation, or any other incidental expenses incurred in shipping the products to or from Bodine.

This warranty is in lieu of any other expressed or implied warranty—including (but not limited to) any implied warranties of merchantability and/or fitness for a particular use or purpose.

Bodine's liability under this warranty shall be solely limited to repair or replacement of the Bodine product within the warranty period and Bodine shall not be liable, under any circumstances, for any consequential, incidental or indirect damages or expenses associated with the warranted products.

Commutator and/or brush wear and its associated effects are a normal occurrence and are not covered by this warranty, unless otherwise agreed to by Bodine in writing.

Any Bodine product which is damaged due to misuse, abuse, negligence or has been modified or dismantled without the knowledge or written consent of Bodine, is not covered by this warranty.

Control Type _____ Serial No. _____

Date of Purchase _____ Place of Purchase _____

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