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Whedco

DspMotion®

INDEPENDENT MOTION CONTROLLERS

HARDWARE MANUAL (299/0)

IMC-78005832

IMC-313E-X-D with 20505834 Application Software
for Binks Sames Corporation

Pub. No. 299 ■ Revision 0 ■ Copyright 1998

WHEDCO INCORPORATED
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Since this equipment can be applied in many diverse situations and in conjunctions with equipment from other vendors, the user and those responsible for specifying this equipment must determine for themselves its suitability for the use intended. In no event, shall Whedco Incorporated be liable for loss of use, profit or consequential damages, or damage to other equipment, resulting from the use of this equipment.

The figures and examples in this manual are designed to demonstrate general concepts for the installation and maintenance of this equipment. The users should always verify interconnection requirements to and for other equipment as well as confirm installation and maintenance requirements for the specific application. In no case, shall Whedco Incorporated be liable for actual use based on the guidelines mentioned herein.

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Specifications

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CHAPTER 1

DRIVE SPECIFICATIONS

1.1 INPUT POWER

1.1.1 IMC-3

The IMC-3/D is suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 250 volts maximum when protected by RK5 class 15 A fuses. Table 1.3 summarizes the IMC-3/D's maximum continuous input power requirements. The actual input power and current is a function of the motor's operating point and the duty cycle.

Voltage range	90 - 250 VAC, 1 or 3 phase
Frequency range	50 - 440 Hz
Current, max. continuous	See Table 1.1 below
Power, max. continuous	See Table 1.1 below
Fuses	No internal fuses in motor power section. Logic power supply fused internally with 2A, 250 volt fuse (Littelfuse 224002 or equivalent) on L1 input only. The L2 input is not fused. See Table 1.1 below for recommended branch circuit fuse current ratings.
Isolation transformer	None required. If the supply voltage is above 250 vac, the voltage must be dropped to 230 vac. The transformer should be sized to provide adequate power under all operating conditions. For single phase operation, choose a transformer rated for a minimum of 125% of the drive maximum continuous input KVA. For three phase operation, choose a transformer rated for a minimum of 100% of the drive maximum continuous input KVA.

Model	**1 phase or 3 phase**	**Maximum Continuous Input Current**	**Maximum Continuous Input KVA @ 230 vac**	**Recommended Branch Circuit Fuse Current Ratings RK5 Class Fuses**
IMC-313E-X-D	1	7 Arms	1.6 KVA	10A time delay
IMC-313E-X-D	3	4 Arms	1.6 KVA	5A time delay
All: Logic Supply	1	.5 A @ 115 V .25 A @ 230 V	60 VA	1 A time delay

Table 1.1 Maximum Continuous Input Current and KVA

1.2 OUTPUT POWER

1.2.1 IMC-3

Voltage range	90-250V rms 3 phase
Frequency	0 - 1000 Hz fundamental (19.2 KHz PWM)
Current	IMC-313E-X-D: 3A rms continuous per phase, 6A rms peak

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1.3 ENVIRONMENTAL

Operating temperature [a]	32 to 122 degrees F (0 to 50 degrees C)
Storage and shipping temperature [b]	-40 to 176 degrees F (-40 to 80 degrees C)
Relative humidity	0 to 95%, non-condensing
(a) assumes heatsink orientation is vertical (b) contents of user-programed BBRAM may be lost if temperature drops below 0 degrees C	

1.4 COMMUNICATION

Format	**RS-232**	**RS-422**
Maximum Addressable Units	32[a]	31[b]
Maximum Distance from Host to Unit	50 feet	1000 feet
Maximum Length of Serial Data Link	1000 feet	1000 feet
Baud Rate	1200, 9600, 19200 or 38400	
(a) Operator Interface counts as a unit (b) Operator Interface does not count as a unit (c) 500 meters @ 125 kbaud with 100% thick cable		

1.5 DISCRETE INPUTS AND OUTPUTS

Inputs

Operating Range	12-24 Vdc, 30 Vdc maximum
Maximum Off Input Voltage	4 Vdc
Minimum On input Voltage	10 Vdc
Load	2K Ohms
Interface Format	source/sink user configurable

Outputs

Operating Range	12-24 Vdc, 30 Vdc maximum
Maximum On Resistance	35 Ohms
Maximum Load Current	100 mA
Maximum Off Leakage Current	200 nA
Interface Format	source/sink user configurable

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1.6 ANALOG INPUTS AND OUTPUTS

Inputs

Model	IMC-313E-X-D
Number	1
Operating Range	+/- 10 Vdc
Resolution	12 bits
Input Impedance	50K Ohms

Outputs

Model	IMC-313E-X-D
Number	1
Parameter	user programmable, or velocity, current, or following error
Operating Range	+/- 10 Vdc
Resolution	12 bits
Current	5 mA

1.7 POSITION FEEDBACK

Resolver

Model	IMC-313E-X-D
Number	1
Resolution	4096 pulses per revolution
Maximum Speed	15,000 rpm
Type	control transmitter
Phase Shift	+/- 5.0 degrees @ 5 kHz
Null Voltage	< 20 mV @ 5 kHz
Transformation Ratio	0.50 to 2.0

1.8 DC POWER SUPPLIES

Model	IMC-313E-X-D
+5 volts	0.5 Amps
+12 volts	0.5 Amps

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1.9 AUXILIARY POSITION FEEDBACK

Incremental Encoder

Model	IMC-313E-X-D
Number	1
Input Voltage	5, 12, or 15 Vdc
Input Format	single-ended or differential, quadrature, square or sine wave
Maximum Line Count Frequency	2 MHz

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Installation

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CHAPTER 2

INSTALLATION

2.1 PHYSICAL INSTALLATION

2.1.1 Location

Location of the IMC is important to achieve proper performance and operating life. The IMC is designed with "open" construction. The unit must be installed in an enclosure that protects personel from contact with wiring terminals and protects the IMC from:

- √ Corrosive gases or liquids
- √ Vibration
- √ Conductive pollution including extreme or condensing humidity and airborne metallic particles
- √ Accidental contact by persons using the equipment
- √ Temperature extremes beyond the equipment ratings

2.1.2 Panel Layout

The mounting dimensions appear in Chapter 5. The location in the equipment panel must be chosen to meet panel electrical safety, electrical signal integrity, and temperature specifications.

2.1.3 Heat Load and Cooling

The heat load of the IMC-3/D is approximately 35 watts + (45 * duty_cycle) watts, 80 watts maximum. The IMC-3/D is designed to operate up to 50% of full rated output with only natural convection cooling at ambient temperatures up to 50 degrees C. For duty cycles exceeding 50%, fan cooling is required.

For effective cooling the IMC must be installed vertically. There must be a minimum clearance of 3 inches above and below the IMC. A minimum of 2 to 3 inches clearance is also recommended on the right and left sides of the IMC.

2.2 WIRING

Wiring diagrams for all models are included in Chapter 4, "User Connections". See Section 1.1 **Input Power** for branch circuit power requirements and fuse and isolation transformer ratings.

2.2.1 General Wiring Considerations

Attach wiring connections for the main circuit according to Table 2.1, 2.2, 2.3 while observing the following **cautions:**

- Use vinyl-sheathed or equivalent wire rated at 250 vac or greater. Wire size should be determined considering ampacity and codes.
- Never connect AC main power to output terminals.
- Never allow wire leads to contact the enclosure.

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Terminal Symbol	Description	Connect to	Wire Size AWG	Notes
⏚	Ground	Power system ground	18-14	1
2L2	Logic supply input power	90 - 250 VAC	18-14	1
2L1	Logic supply input power	90 - 250 VAC	18-14	1
1L3	Drive input power - do not connect for 1 phase input	90 - 250 VAC	18-14	1
1L2	Drive input power	90 - 250 VAC	18-14	1
1L1	Drive input power	90 - 250 VAC	18-14	1
DC-	High voltage DC bus	No connection (3)	18-14	1,3
CLP	Clamp resistor	No connection (4)	18-14	1,4
DC+	High voltage DC bus	No connection (3)	18-14	1,3
⏚	Ground	Motor ground terminal	18-14	1,2
T	Output phase T	Motor phase T	18-14	1,2
S	Output phase S	Motor phase S	18-14	1,2
R	Output phase R	Motor phase R	18-14	1,2

Table 2.1 IMC-3/D Power Terminal Connections and Wire Sizing

Notes for table 2.1:

1 - AWG size for stranded copper wire. Minimum wire size required will depend on motor and load. Consult applicable electrical code ampacities tables for proper wire size.
2 - Use cable with overall shield for motor connections. Cable available from Whedco as part number CBL-34-MP-xx where xx is the cable length in feet.
3 - DC+ and DC- make direct connection to the internal DC bus. These terminals can connect the high voltage DC bus between two or more IMC-3/D's to allow one drive to use the power another drive produces during regeneration.
4 - The IMC-3/D's dissipate regenerated energy in an internal clamp resistor. If the application produces more regenerated power than the rating of the internal clamp resistor, the IMC will report "Motor Power Clamp Excessive Duty Cycle - Under-voltage". Contact Whedco, Inc. to determine if an external clamp resistor is required and the recommended value and procedure for connecting an external clamp resistor.

2.2.2 Input Mains Wiring and Grounding

The mains input and motor output connections are made to the connector located on the bottom of the IMC. The IMC-3/D is designed to operate with input voltages from 90 to 250 vac. No isolation transformer is required. If the supply voltage is above the maximum rated value, the voltage must be dropped to a value in the operating range. See Section 1.1 for the required transformer rating if a transformer is necessary. For the IMC-3/D the maximum achievable motor speed is directly related to the input voltage. For best performance, connect teminals 1L1, 1L2, and 1L3 to 3 phase 230 vac.

For the IMC-3/D there are separate inputs for the motor power and for the (low power) logic supply which supplies power to the control section.. The logic power input is also designed for 90 to 250 vac. There is no performance penality for wiring the logic supply to any voltage in this range. The logic power can be wired to a circuit which is separate from the motor power circuit. This allows the IMC-3/D to continue to track the motor position and execute all program functions except motor control while the motor power is removed.

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All of the terminals marked with the symbol ⏚ are connected to the chassis ground. Connect the ⏚ terminal at the mains input end of the connector to the panel earth ground. Connect the ⏚ terminal near the motor ouput terminals to the motor frame ground wire in the motor power cable. DO NOT OPERATE THE IMC UNIT WITHOUT AN EARTH GROUND.

2.2.3 Motor Power Wiring and Grounding

Motor power cables are available from Whedco, Inc. for the IMC-3/D series controllers as part number CBL-34-MP-xx, where xx is the length in feet. The motor cable must have a motor ground wire and a cable shield wire. The motor ground wire must connect a frame ground terminal on the controller to the frame ground pin on the motor connector . The cable shield should connect to a frame ground terminal on the controller and to the connector at the motor end.

2.2.4 Position Feedback Wiring

Position feedback cables are available from Whedco, Inc. for the IMC-3/D series controllers as part number CBL-3C-RD-xx for resolver feedback or CBL-3C-ED-xx for encoder feedback where xx is the cable length in feet. Plug the motor end of the feedback cable into the connector on the motor and the DB-type end of the cable into the DB-15 socket on the front of the controller. The best system reliablilty is achieved when the feedback cable is returned in a seperate conduit from that housing the motor power cable. The feedback cable must be shielded. Resolver feedback cables must contain individually shielded pairs for the feedback signals. The shields must be terminated to the isolated ground pins on the DB-15 connector.

2.2.5 I/O Connector Wiring

The discrete inputs and outputs may be wired for either sinking or sourcing operation. The operational voltage range is 12 to 24 volts dc. The output can sink or source 100ma maximum. The wiring to this connector should be of appropriate size and insulation quality for the application. For wiring diagrams, see Chapter 4, "User Connections".

2.3 MOTORS

The IMC-3/D controllers are designed for use with ac brushless servo motors rated for 0.75 to 6 amperes per phase with 2 mh per phase minimum inductance. See the Motors section of the Whedco Servo and Stepping Motor Control Systems catalog for available motors. In general, the best system performance is achieved by choosing a motor with a continuous current rating approxmately equal to or less than the continuous current rating of the IMC-3/D.

The IMC-3/D controllers are designed to be used with motors which include a thermal switch or positive-temperature-coefficient (PTC) thermistor. The switch should be closed at acceptable motor operating temperatures and open at temperatures which exceed the motor's thermal rating. If a PTC is employed, it should exhibit a resistance less than 1000 ohms at acceptable motor temperatures and above 10,000 ohms at temperatures which exceed the motor's thermal rating. All Whedco brushless ac servo motors include a PTC.

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Setup

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CHAPTER 3

SETUP

3.1 COMMUNICATIONS LINK

This section describes how to set up the communications link between the IMC controller and the terminal. Three main things must be done in order to ensure proper communication between the controller and the terminal:

1. the address of the unit must be set;
2. the serial baud rate, data bits, etc. must be set; and
3. the data link connectors must be properly wired and attached to the controller(s).

3.1.1 Unit Address

The address of the IMC unit is set by the DIP switch. Using switch positions 1 through 5, the address of the unit can be set from 0 through 31. The address sent to the controller for addresses greater than nine, is the corresponding letter as indicated in the table. Table 3.1 shows which DIP switch setting is to be used for a specific address. Note that the unit address can also be set by setting the ADDS register after the controller is powered up. The DIP switch setting therefore gives the default value for ADDS.

Unit Address	1	2	3	4	5
0	R	R	R	R	R
1	L	R	R	R	R
2	R	L	R	R	R
3	L	L	R	R	R
4	R	R	L	R	R
5	L	R	L	R	R
6	R	L	L	R	R
7	L	L	L	R	R
8	R	R	R	L	R
9	L	R	R	L	R
10 (A)	R	L	R	L	R
11 (B)	L	L	R	L	R
12 (C)	R	R	L	L	R
13 (D)	L	R	L	L	R
14 (E)	R	L	L	L	R
15 (F)	L	L	L	L	R

Unit Address	1	2	3	4	5
16 (G)	R	R	R	R	L
17 (H)	L	R	R	R	L
18 (I)	R	L	R	R	L
19 (J)	L	L	R	R	L
20 (K)	R	R	L	R	L
21 (L)	L	R	L	R	L
22 (M)	R	L	L	R	L
23 (N)	L	L	L	R	L
24 (O)	R	R	R	L	L
25 (P)	L	R	R	L	L
26 (Q)	R	L	R	L	L
27 (R)	L	L	R	L	L
28 (S)	R	R	L	L	L
29 (T)	L	R	L	L	L
30 (U)	R	L	L	L	L
31 (V)	L	L	L	L	L

Table 3.1 DIP switch setting for address of an IMC unit

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3.1.2 Serial Baud Rate & other settings

The serial baud rate is also set by the DIP switch. Using switch positions 6 and 7, you can set the baud rate to 1200, 9600, 19200, or 38400. Note that the baud rate can also be set by setting the BAUD register after the controller is powered up. The DIP switch setting therefore gives the default value for BAUD. Table 3.2 shows which DIP switch setting is to be used for what baud rate.

When using the display, you must also set the baud rate on the DIP switch of the display. Using switch positions 1 and 2, you can set the baud rate to 1200, 9600, 19200, or 38400. Table 3.3 shows which DIP switch setting is to be used for what baud rate.

Baud Rate	6	7
1200	R	R
9600	L	R
19200	R	L
38400	L	L

Table 3.2 DIP switch setting for baud rate of controller

Baud Rate	1	2
1200	U	U
9600	D	U
19200	U	D
38400	D	D

Table 3.3 DIP switch setting for baud rate of display

Lastly, in order for the controller to communicate properly with the terminal (i.e., personal computer), you will need to change the setting for the COM port you are using. This is done in Windows by opening the Control Panel and *changing the settings to 7 data bits, 1 stop bit and odd parity.*

1. Double click on the **Control Panel**; then, once it is opened, double click on the **Ports** icon.
2. Next, double click on the COM port that you are using.
3. Change the following settings: Data Bits to 7, Parity to Odd, and Stop Bits to 1.
4. Click on **OK**, then click on **Close** in the Ports dialog box.

3.1.3 Serial data link

All IMC units are compatible with RS-232 and RS-422 serial communication standards. In order to properly wire the connectors, refer to the diagram entitled "Serial Data Link" in Chapter 4, "User Connections" for your specific IMC controller.

Once the connectors are wired correctly, the cable from the terminal should be attached to the "Host" port on the first IMC. Then, if you wish to daisy chain other IMC's, the cable from the "Link" port should be attached to the "Host" port of the next IMC, and so on. The last IMC should have no cable attached to the "Link" port. Note that when using RS-232 protocol, you can have up to 32 units without the display or 31 units with the display. When using RS-422 protocol, you can have only 31 units whether using the display or not.

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Binks-Sames Programming

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CHAPTER 4

BINKS-SAMES PROGRAMMING

4.1 PROGRAMMABLE PARAMETERS

4.1.1 Summary of DIP Switch Functions

Refer to Chapter 3 – "Setup" for an explanation of the DIP Switch functions. Set the DIP switches for Unit Address 1 and controller serial port baud rate of 9600.

4.1.2 Software Programmable Parameters

The SMD emulator program in the IMC allows all of the original SMD parameters to be set in software in the IMC. Following is a list of the parameters. These parameters must be set with the power on but with the Enable input set to OFF.

To query a parameter, type **(addr)variable?<Enter>** where <Enter> is the Enter key on your terminal. For example **1VB10?<Enter>** will report the mode: 0 = pulse input, 1 = analog input.

To set a parameter, type **(addr)variable?<Enter>** where <Enter> is the Enter key on your terminal. For example **1PLA=512.<Enter>** sets the gear ratio to 1:1.

Parameter	Function	Minimum	Maximum	Default
PLA	Sets gear ratio	512 = 1:1	5120 = 10:1	512
QTX	Pulse input format	PD = pulse, dir Q1 = encoder quadrature x1 Q2 = encoder quadrature x2 Q4 = encoder quadrature x4		PD
VB10	Control mode	0 = pulse	1 = analog	1
VB11	Direction	0 = CW	1 = CCW	0
VF10	Analog input zero	-10.0	+10.0	0.0
VF11	Analog input full scale	+2.0	+10.0	+10.0
VF12	Pump speed scale factor, rpm/volt	10.0	25.0	15.0
VF13	Accel time constant, milliseconds	2	100	22
VF14	Max. motor current, amps	0.5	3.0	3.0
VF15	Control stiffness, %	25	200	125
VF16	Torque to Inertia ratio	330	60000	2700
VF17	Resolver transformation ratio	1.0	2.0	1.0
VF18	Maximum pump speed, rpm	10	255	255

Table 4.1 Programmable Parameters

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4.2 OPERATION WITH A PULSE SOURCE

Complete the motor, power, and I/O wiring to the IMC-3. Wire the pulse source to the Auxiliary Position Feedback connector on the bottom of the IMC-3. When wiring for pulse and direction, Channel A is the pulse input, and Channel B is the direction input. Note that these are differential inputs. If the source of the pulse and direction signals is single-ended, wire the A- and B- inputs to a voltage source whose voltage is near the mid point of the signal voltages. Apply a source of 115 vac to the IMC-3 and set parameters PLA and QTX to correspond to the required gear ratio and pulse input type. Set VB10 = 0. Set VF14 through VF18 to appropriate values. (The factory-supplied default values should work for most applications.) To start the motor, cycle the Enable input from false to true. The IMC-3 will rotate the motor in synchronization with the input pulse source. In this mode, motor displacement is proportional to the number of pulses received, and the motor speed is proportional to the frequency of the pulse train.

4.3 OPERATION WITH AN ANALOG INPUT VOLTAGE

Complete the motor, power, and I/O wiring to the IMC-3 and wire the analog control voltage to analog input terminals 8, 9, and 10 on the bottom of the IMC-3. Apply a source of 115 vac to the IMC-3 and set VB10 = 1. Set PLA, VB11, and VF10 through VF18 to appropriate values. (The factory-supplied default values should work for most applications.) Cycle the Enable input from false to true. When the Run input on I/O terminal 1 is true, the IMC-3 will accelerate and rotate the motor at a speed proportional to the analog input voltage.

4.3.1 Serial Port

The IMC-3 includes a serial port which is used to set the operational parameters. The serial port is an RS-232 port designed to operate at 7 data bits, 1 stop bit, and odd parity. Refer to the Hardware Manual for baud rate DIP switch settings.

4.3.2 Analog Input Calibration Sequence

1. Connect the IMC-3 analog input to the device producing the motor speed control voltage. If the rest of the system wiring is not in place, connect the IMC-3 power input terminals to a source of 90 to 130 vac. Disable (turn off) the Enable input.

2. Connect the IMC-3 serial port to a personal computer or other serial terminal device. Refer to the IMC-3 Hardware Manual for serial port wiring. Configure your serial terminal for 9600 baud, 7 data bits, 1 stop bit, and odd parity. Verify that the serial port is working by typing **1FC?<Enter>** and observing the response.

3. Set the motor speed control voltage to 0.00 volts. Type **1AI?<Enter>** to read the analog input. Type **1VF10=AI<Enter>** to set the analog input zero offset. The current value of the zero offset is reported by typing **1VF10?<Enter>**.

4. Set the motor speed control voltage to full scale. Type **1AI?<Enter>** to read the analog input. Type **1VF11=AI<Enter>** to set the full scale voltage. The current value of the full scale voltage is reported by typing **1VF11?<Enter>**.

5. Set the acceleration ramp time constant from 2 to 100 milliseconds by loading the time constant value into VF13. For example **1VF13=22<Enter>** sets the time constant to 22 ms. The current value of the acceleration time constant is reported by typing **1VF13?<Enter>**.

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6. Set the velocity scale factor of the output shaft in rpm/volt into VF12. Note this is the velocity scale factor of the output shaft. The IMC-3 automatically multiplies it by the gear ratio to compute the motor velocity scale factor. For example type **1VF12=15<Enter>** to set the output shaft velocity scale factor to 15 rpm/volt. The current value of the velocity scale factor is reported by typing **1VF12?<Enter>**.

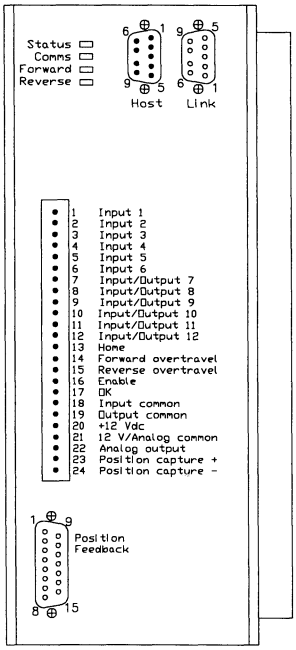
7. This completes the analog input calibration sequence. All of the parameters are automatically saved to memory as soon as they are entered.

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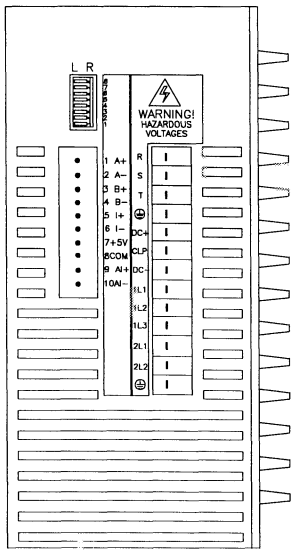
User Connections

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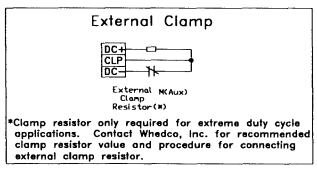
IMC-78005832
(IMC-313E-X-D)
USER CONNECTIONS AND SWITCH SETTINGS



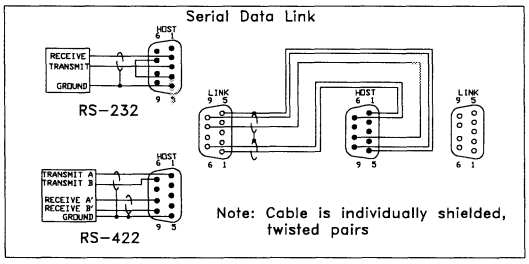
FRONT VIEW

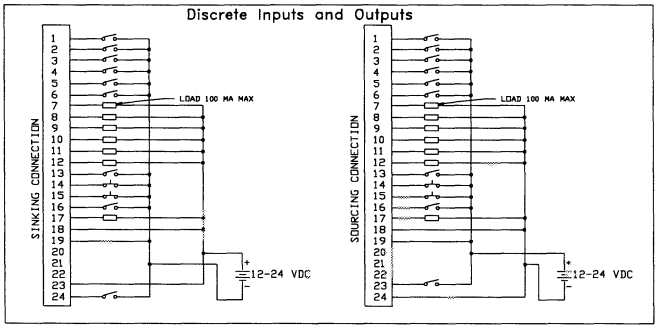


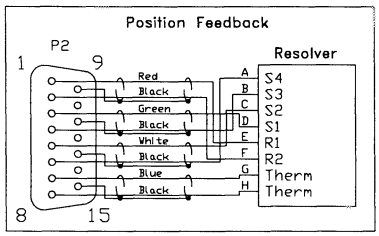
BOTTOM VIEW

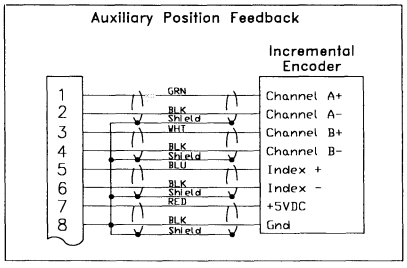


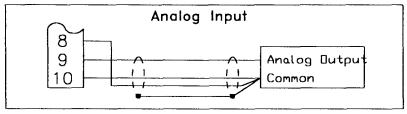
*Clamp resistor only required for extreme duty cycle applications. Contact Whedco, Inc. for recommended clamp resistor value and procedure for connecting external clamp resistor.

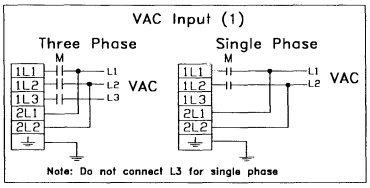










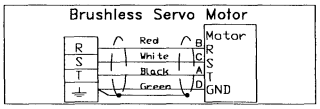


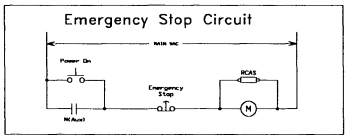
DIP Switch Positions (2)

Unit Address	1	2	3	4	5
0	R	R	R	R	R
1	L	R	R	R	R
2	R	L	R	R	R
3	L	L	R	R	R
4	R	R	L	R	R
5	L	R	L	R	R
6	R	L	L	R	R
7	L	L	L	R	R
8	R	R	R	L	R
9	L	R	R	L	R
A	R	L	R	L	R
B	L	L	R	L	R
C	R	R	L	L	R
D	L	R	L	L	R
E	R	L	L	L	R
F	L	L	L	L	R
G	R	R	R	R	L
H	L	R	R	R	L
I	R	L	R	R	L
J	L	L	R	R	L
K	R	R	L	R	L
L	L	R	L	R	L
M	R	L	L	R	L
N	L	L	L	R	L
O	R	R	R	L	L
P	L	R	R	L	L
Q	R	L	R	L	L
R	L	L	R	L	L
S	R	R	L	L	L
T	L	R	L	L	L
U	R	L	L	L	L
V	L	L	L	L	L

Serial Baud Rate	6	7
1200	R	R
9600	L	R
19200	R	L
38400	L	L

Switch 8 is Reserved





REMARKS:
(1) Input power 90 to 250 VAC
1 or 3 phase 50-440 Hz @ 15 Amps
(2) Must turn off power before changing settings.
R= right (closed)
L= left (open)

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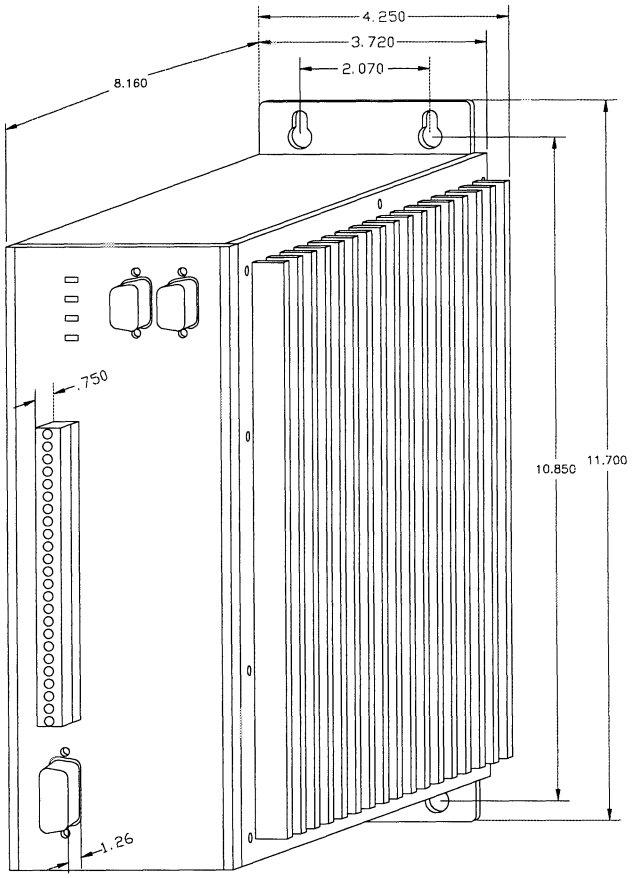
Mechanical

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Mechanical

Dimensions are shown in inches, weight in pounds

Model	Weight
IMC-313E-X-D	8



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