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ELECTRIC LINEAR MOTION PRODUCTS

MSS Controller/Microstepping Motor Drive

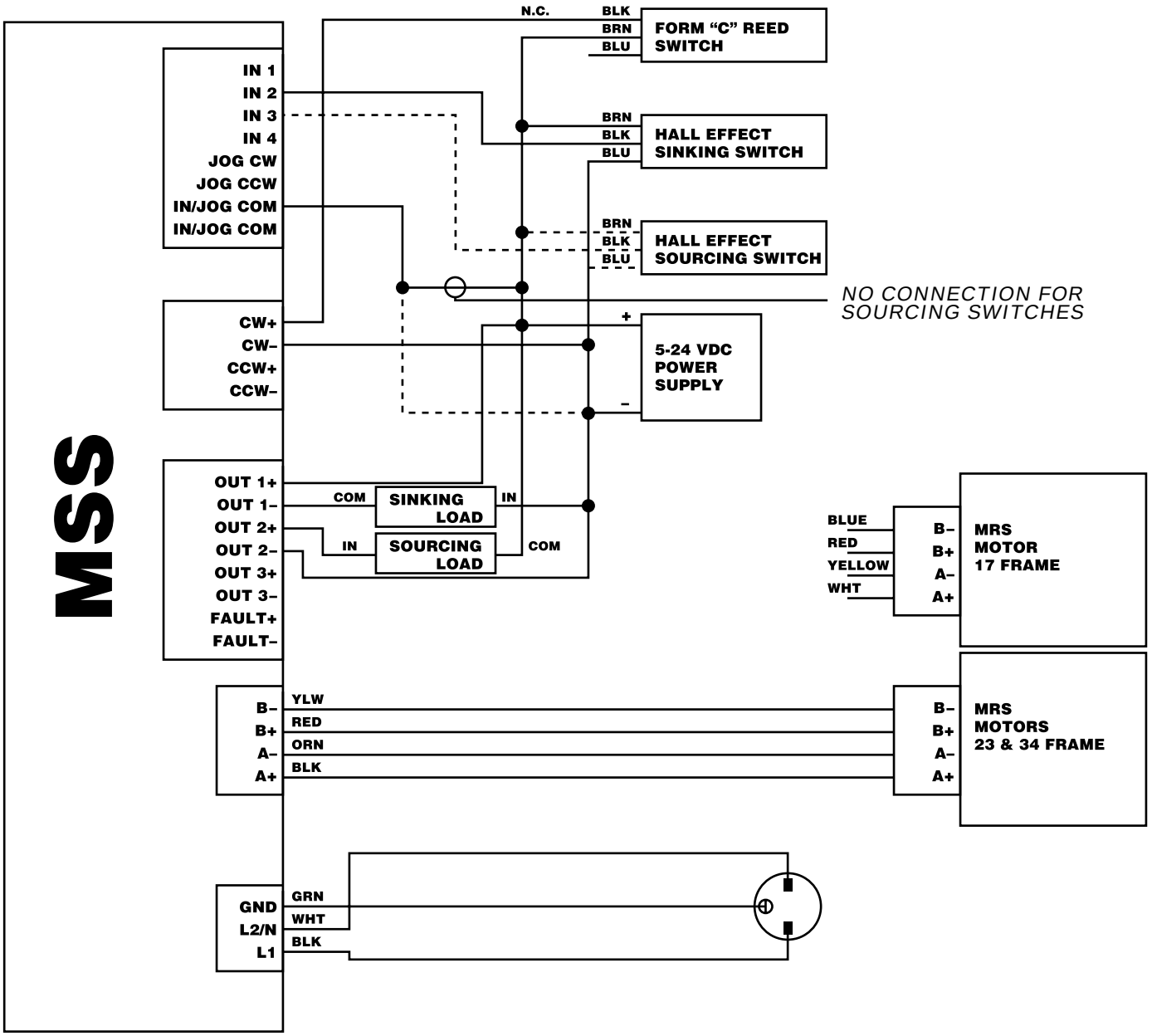
USER'S MANUAL



TOL-O-MATIC, INC
Excellence in Motion®

3600-4051E

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MSS
IN 1
IN 2
IN 3
IN 4
JOG CW
JOG CCW
IN/JOG COM
IN/JOG COM
CW+
CW–
CCW+
CCW–
OUT 1+
OUT 1–
OUT 2+
OUT 2–
OUT 3+
OUT 3–
FAULT+
FAULT–
B–
B+
A–
A+
GND
L2/N
L1
N.C.
BLK
BRN
BLU
FORM "C" REED SWITCH
BRN
BLK
BLU
HALL EFFECT SINKING SWITCH
BRN
BLK
BLU
HALL EFFECT SOURCING SWITCH
NO CONNECTION FOR SOURCING SWITCHES
+
–
5-24 VDC POWER SUPPLY
COM
SINKING LOAD
IN
IN
SOURCING LOAD
COM
BLUE
RED
YELLOW
WHT
B–
B+
A–
A+
MRS MOTOR 17 FRAME
YLW
RED
ORN
BLK
B–
B+
A–
A+
MRS MOTORS 23 & 34 FRAME
GRN
WHT
BLK

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About This Manual

This manual provides the information necessary to configure and install the Tol-O-Matic MSS Controller/Micro Stepping Drive for use with any of the Tol-O-Matic MRS stepper motors.

If difficulty is encountered while configuring, installing, or programming the system, please contact the nearest distributor for help, or call Tol-O-Matic at 1-800-328-2174.

This manual includes software features available with MSS units 3600-0038 and software 1.40 or later. Programs developed with prior software can be loaded and run on these units.

SAFETY SYMBOLS

The following symbols are used throughout this manual to alert the user to potential safety hazards.

⚠ **Caution!** When this symbol appears, exercise care to avoid the possibility of sustaining slight operator injury or equipment damage.

⚠ ***WARNING! When this symbol appears, exercise extreme caution to avoid an IMMEDIATE DANGER of sustaining severe operator injury or irreparable equipment damage.***

NOTE: Failure to comply with cautions, warnings and requirements in this manual, may result in damage to equipment not covered under Tol-O-Matic warranties.

CW, CCW DEFINITION

For all references in this manual, clockwise or counterclockwise rotation of the motor shaft is as viewed when looking at the motor mounting face with the shaft protruding toward you.

If the motor is direct-coupled to a right-hand screw actuator, CCW rotation will move the carrier toward the motor.

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Features

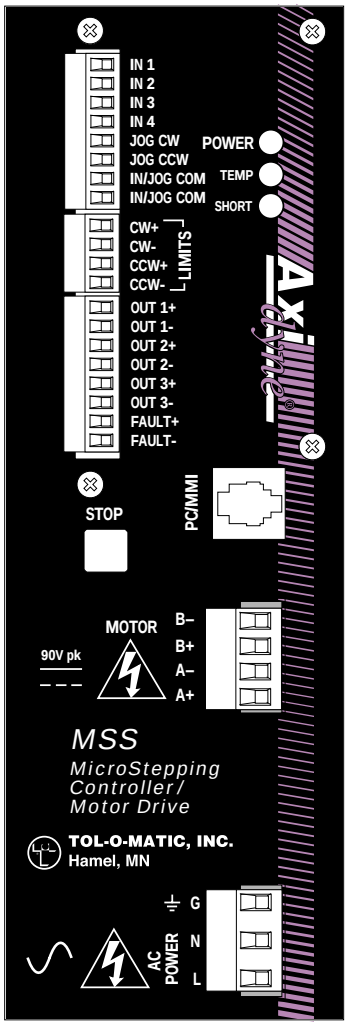


Figure 1

- ***Powerful, precise and efficient MOSFET driver providing up to 5.5 amps peak per phase and microstepping to 50,800 steps per revolution.***
- ***Reliable, efficient, low noise 80 VDC linear, toroidal power supply.***
- ***Powerful, flexible, easy to use indexer.***
- ***Separate programmable acceleration and deceleration.***
- ***Automatic homing function.***
- ***Connects by a simple cable to a PC for programming (cable included).***
- ***Tol-O-Motion MSS Microsoft Windows®-based software for set up and programming.***
- ***Eight inputs for interacting with the user and other equipment.***
- ***Four outputs for coordinating external equipment.***
- ***Accepts 110 or 220 volt AC power (switch selectable, factory preset for 110 volts).***
- ***Sturdy 3 x 8 x 5.3 inch metal case with integral heat sink. Mounting brackets included.***
- ***Pluggable screw terminal connectors for I/O, motor and ac power (all mating connectors included).***
- ***Three LEDs indicating power, drive and indexer status.***
- ***Drive overcurrent (short circuit) and drive over temperature protection.***
- ***Optional Panel-mount Interface (PIT) allows operator to enter distances, speeds, loop counts and more***
- ***UL and CE Recognized***

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Connections and Adjustments

Refer to Figure 2 for important connection and adjustment points. All mating connectors are included.

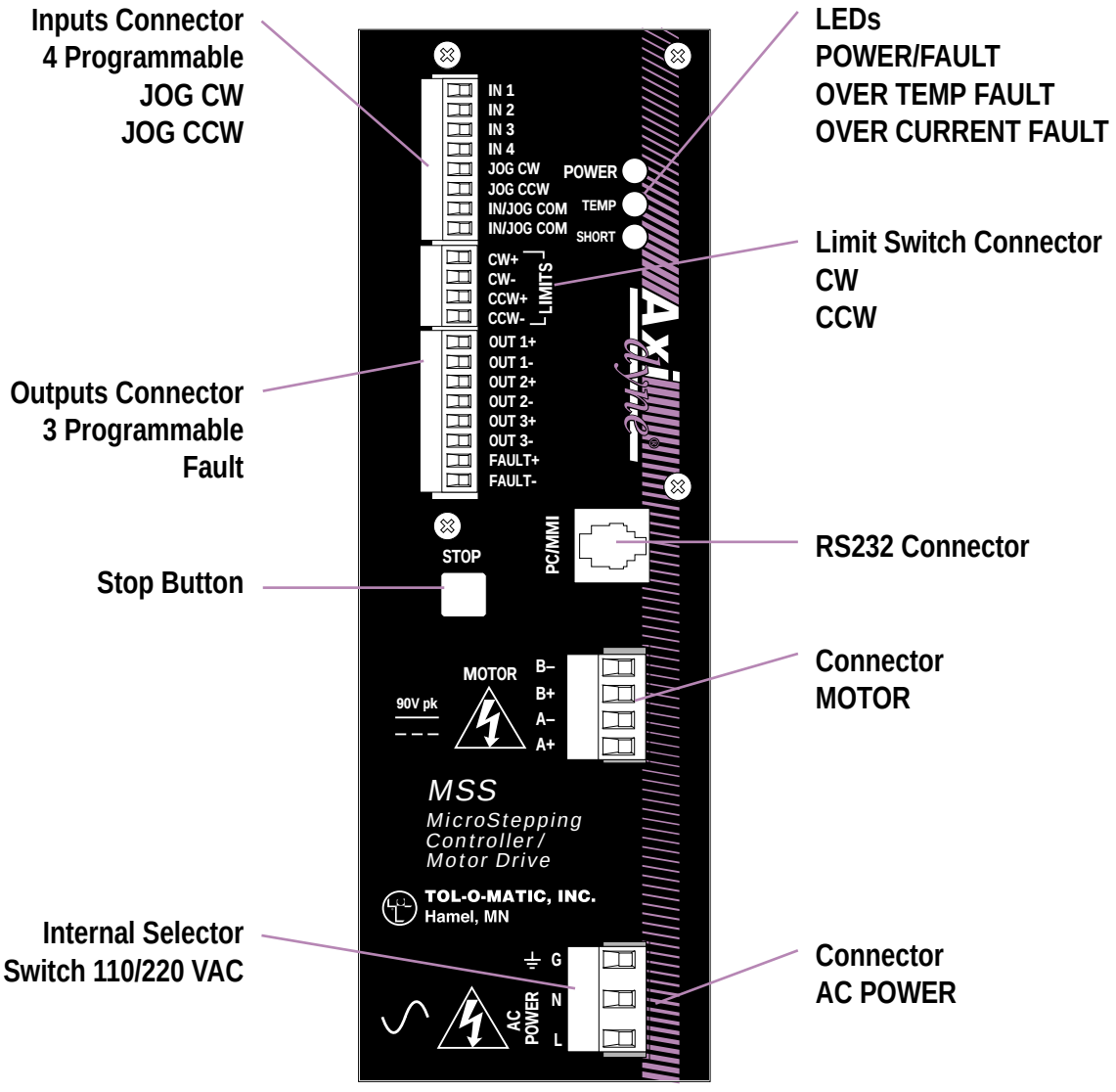


Figure 2 - CONNECTION AND ADJUSTMENT POINTS

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Connecting the Ac Line

110 Volts

The MSS is set for 110 volt operation at the factory. Before direct wiring the MSS to ac power, consult a qualified electrician and observe all building and electrical codes. Follow the instructions "Installing an ac line cord".

WARNING! Ac power can be dangerous. Use extreme caution when installing the ac cord.

220 Volts

The MSS is set for 110 Volt operation at the factory. In order to use 220 Volts, a switch setting must be changed inside the case and the correct fuse must be installed.

1. Remove all mating connectors from the drive.
2. Set the drive on its side, with the aluminum heat sink fins up.
3. With a medium-sized Phillips screwdriver, remove the eight screws at the perimeter of the case and the three screws that connect the heat sink to the internal heat bar, keeping track of which screws go where. See Figure 3.

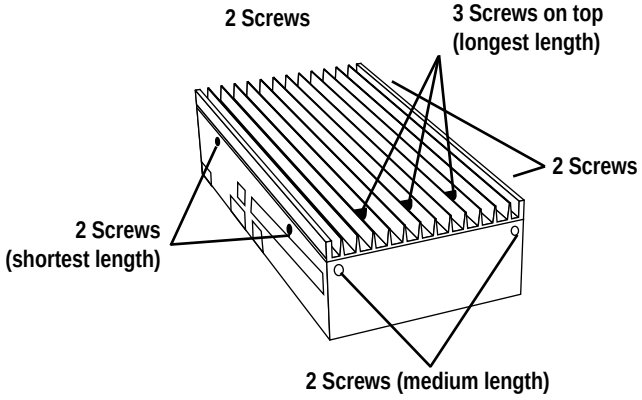


Figure 3 - CASE SCREWS

NOTE: Do not remove the 1/4-20 Allen head screw that connects the heat sink to the internal transformer.

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4. Separate the heat sink assembly from the cover and note how the wires are routed to the PC board. There are labels on the PC board to assist you.
5. Disconnect the two sets of wires connecting the heat sink/ transformer assembly to the chassic/PC board. The 110/220 Vac SWITCH is located on the PC board, near the ac power connector. See Figure 4.

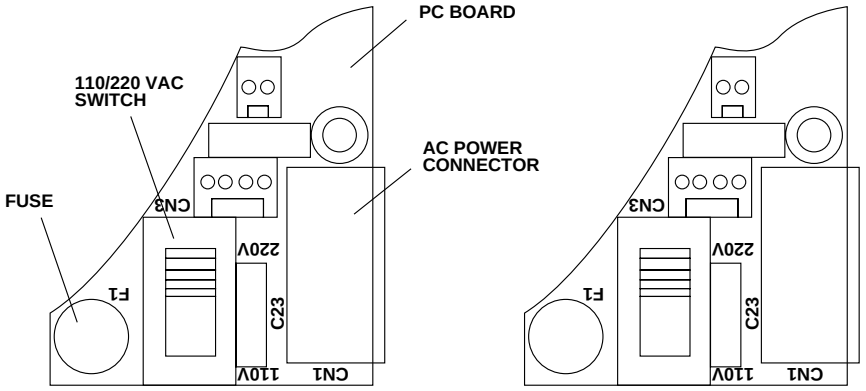


Figure 4 - INPUT VOLTAGE SWITCH

6. Remove the 110 Vac fuse and install the 220 Vac fuse that came with your drive. There is a label inside the drive that gives the correct fuse values.
7. Place the voltage selector switch in the correct position according to the labels on the printed circuit board near the switch. See the Figure 4.
8. Re-assemble the chassic/PC board assembly to the heat sink/ transformer assembly by following steps 4 & 5 in reverse. Again, pay close attention to the correct orientation of the two sets of wires connecting these assemblies.
9. Install and tighten the screws removed in step 3. Use the correct length screw according to the hole location.

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INSTALLING AN AC LINE CORD

WARNING! Always use a three-wire power cord when working with ac power. Failure to do so could result in damage to the MSS and/or personal injury or death.

WARNING! Always disconnect the line cord from the source before attaching it to the MSS.

Thread the cord through the insulating rubber boot provided. Remove approximately 5 mm ($^{3}/_{16}$ inches) of insulation from each of the three wires of the line cord. Depending on its source, the power cord may have black, white and green wires or brown/blue/green.

Connections

Refer to Figure 5.

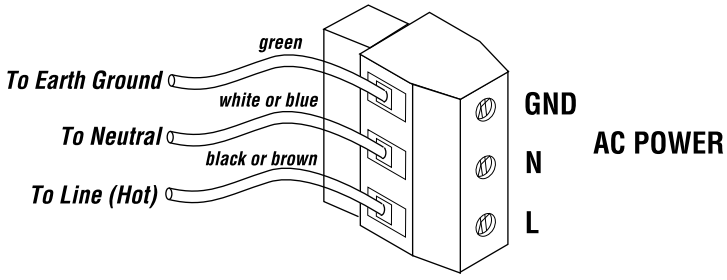


Figure 5 - AC LINE CORD INSTALLATION

1. Connect the black or brown wire to the MSS “L” (line or “hot” terminal of the ac power connector.
2. Connect the white or blue wire to neutral. That’s the “N” terminal.
3. Finally, and most importantly, connect the green wire to the GND terminal. This connects the MSS metal enclosure and dc power supply ground to earth ground.
4. Follow code-approved practices if a switch or relay is to be included in the power line cord.

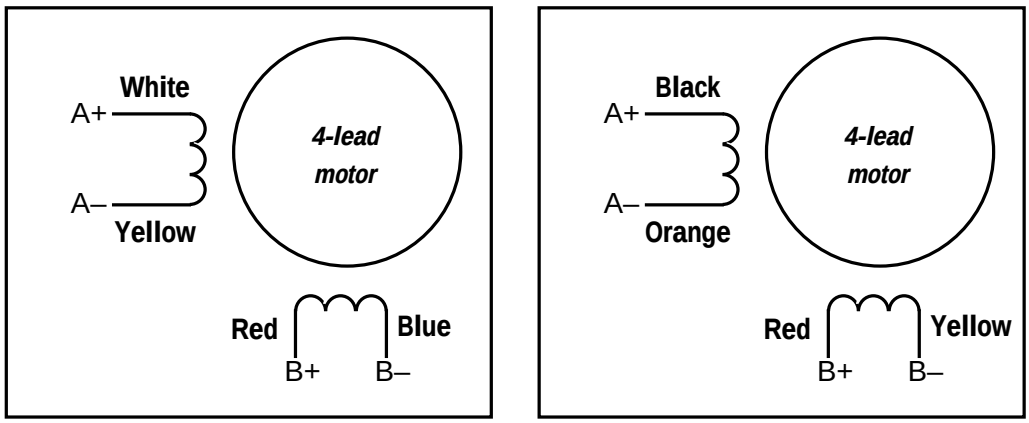
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Connecting the Motor

Caution! To avoid personal injury and/or damage to the MSS:

- Never connect the motor to the driver when the ac power is on.
- Never disconnect the motor while the ac power is on.
- Never connect motor leads to ground or to a power supply.

Tol-O-Matic MRS stepper motors are all four-lead, parallel connected. Four-lead motors should be connected as shown in Figure 6. See page 68 for Tol-O-Matic recommended motors.



MRS 17 FRAME MOTOR *MRS 23 AND 34 FRAME MOTORS*

Figure 6 - MOTOR CONNECTION

To reverse the rotation at the motor (rather than in programming), reverse the + and - connections of one phase.

(Full Stepping)

Step	A+	A-	B+	B-
0	+	–	+	–
1	+	–	–	+
2	–	+	–	+
3	–	+	+	–
4	+	–	+	–

DIR=1 cw

DIR=0 ccw

(Step 2 is the Power Up State)

Figure 7 - STEP TABLE

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Computer Connection

To Connect to the Computer for Programming:

1. Locate the MSS within 6 feet of the computer.

2. The MSS was shipped with a black adapter plug. It has a telephone-style jack at one end and a larger 9-pin connector at the other. Plug the large end into the computer's (COM1) serial port. Secure the adapter with the screws on the sides. If the COM1 port is already allocated, use of the COM2 port will be suggested. On some computers, COM2 will have a 25-pin connector that does not fit the black adapter plug. If this is the case and COM2 must be used, a 25-to-9 pin serial adapter will be required.

3. The MSS was also shipped with a 7-foot telephone line cord. Plug one end into the adapter just attached to the computer, and the other end into the RS232 jack on the MSS.

Caution! Never connect the MSS to a telephone circuit. The MSS uses the same connectors and cords as telephones and modems, but the voltages are not compatible.

4. When the software is loaded, it looks for COM port 1. If COM port 1 is already allocated, the software will prompt to allow trying the other ports.

   If the port is not already in use, the programming software will use it to communicate with the MSS, and will display the COM port used by the MSS.



Figure 8 - COM PORT

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Overview

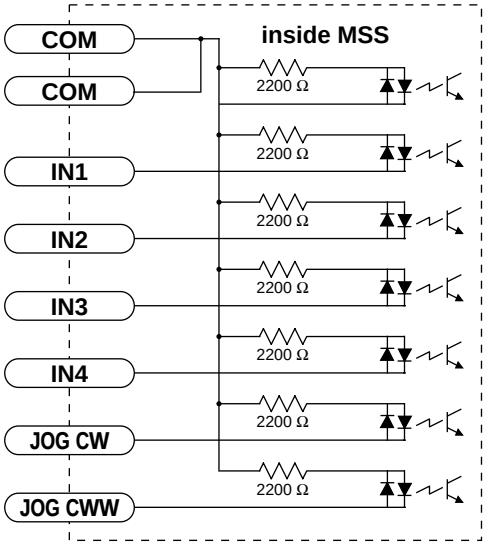


Figure 9 - INPUT CIRCUIT SCHEMATIC

Caution! The maximum voltage that can be applied to an input terminal is 24 Vdc.

The MSS input circuits can be used with sourcing or sinking signals, 5 to 24 Volts. This allows connection to TTL circuits, PLCs, replays and mechanical switches. Because the input circuits are isolated, they require a source of power. If connecting to a TTL circuit or to a PLC, power should be available from the PLC or TTL power supply. If using relays or mechanical switches, a separate power supply must be used.

NOTE: If **current is flowing** into or out of an MSS input, the logic state of that **input is low**. If **no current** is flowing, or the input is not connected, the **logic state is high**.

The diagrams onthe following pages show how to connect MSS inputs to various devices.

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Connecting an Input to a Switch or Relay

When connecting an input to a switch or relay, use a ***normally open momentary contact switch*** to trigger the MSS using a *WAIT INPUT* instruction. A ***single throw switch*** may be used for parameter selection using an *IF INPUT* instruction. A normally open momentary switch can be used for jogging. This connection is appropriate for Tol-O-Matic Reed Switches.

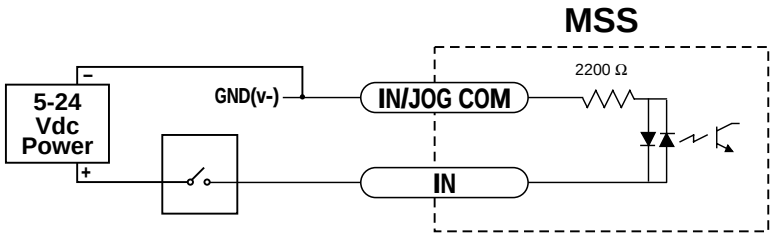


Figure 10 - INPUT SWITCH CONNECTION

Connecting an NPN-Type Proximity or Hall Effect Sensor to an Input

When the proximity sensor or Hall Effect sensor activates (closes), the input will go active (“low”). This connection is appropriate for Tol-O-Matic Hall Effect Sinking Switches.

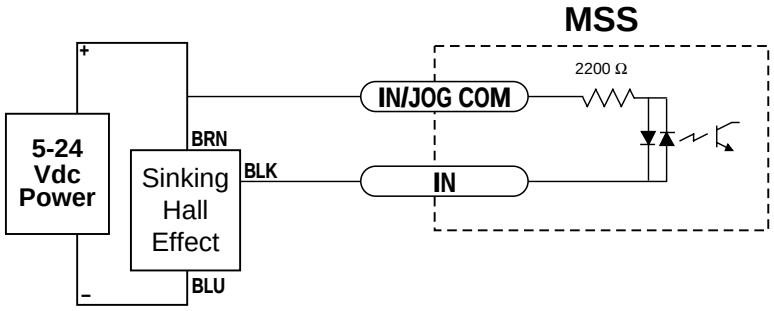


Figure 11 - NEW “SINKING” HALL EFFECT CONNECTION

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Connecting PNP-Type Proximity or Hall Effect Sensors to an Input

When the proximity sensor or Hall Effect sensor activates (closes), the input will be "low" (active). This connection is appropriate for Tol-O-Matic Sourcing Switches.

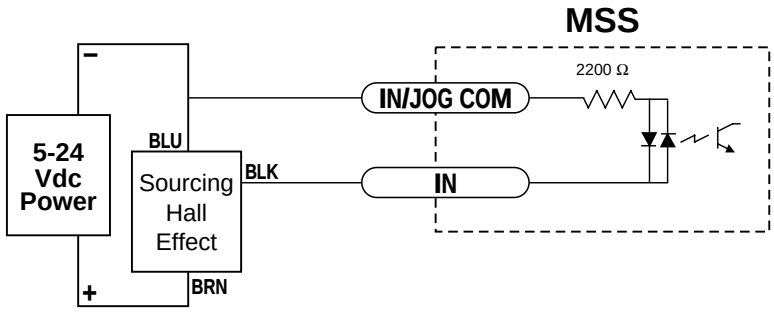


Figure 12 - PNP "SOURCING" HALL EFFECT CONNECTION

Jog Inputs

Two of the MSS input terminals are provided for jogging the motor from a jog switch or switches. The inputs are labeled "JOG CW" and "JOG CCW". Activating one of the inputs commands the drive to move the motor at a pre-designated speed until the contact is opened. A relay or mechanical switch can be used to activate the jog inputs. 5-24 volt circuitry can be used. The schematic diagram of the input circuit is shown below.

If a switch or relay is to be used, wire one end to the JOG input and the other to the power supply negative (-) terminal. Then connect the COM input to the power supply positive (+) terminal.

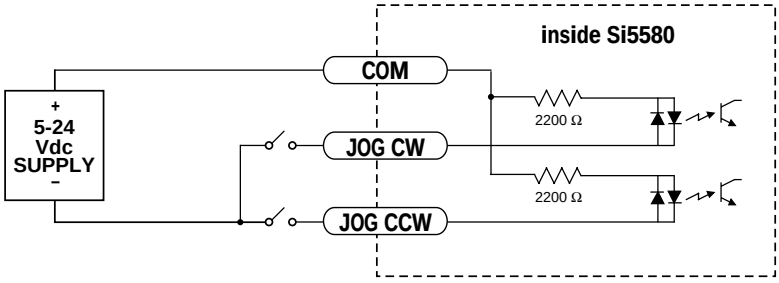


Figure 13 - JOG INPUT SCHEMATIC

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Jog CCW will drive the carrier toward the motor for a right-hand screw actuator with a direct coupled motor.

If the MSS is connected to a PC with the programming software running, the jog inputs will function under two conditions:

1. If the program is not executing
2. If the program is executing a *WAIT INPUT* command.

If the MSS is operating in stand alone mode (i.e. without a computer attached) then the jog inputs work when the program is executing the Wait Input instruction, or when waiting for a PIT (Interface Terminal) input. All other program execution modes inhibit the jog inputs.

Limit Switches

The MSS has two limit switch inputs, *LIMIT CW* and *LIMIT CCW*. By connecting switches or sensors that are triggered by the motion of the motor or load, the operating range of the MSS is limited. This is useful if a program error could cause damage to the system by exceeding the mechanical operating range.

The limit inputs are optically isolated. This allows a choice of voltage for the limit circuits of 5 to 24 Vdc. It also allows the use of long wires on limit sensors that may be far from the MSS with less risk of introducing noise to the MSS. The schematic diagram of the limit input circuit is shown in Figure 14.

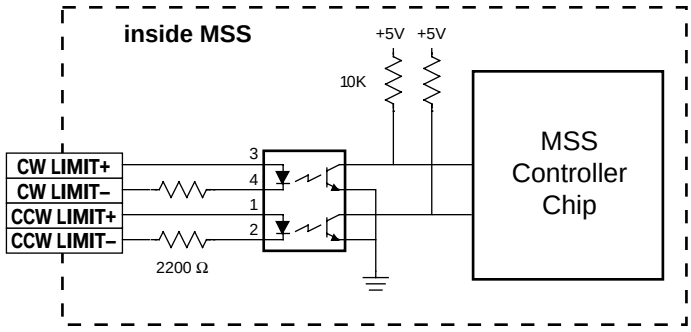


Figure 14 - LIMIT INPUT CIRCUIT

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WIRING A LIMIT SWITCH

Normally open or normally closed limit switches may be used. Either is wired as shown in Figure 15.

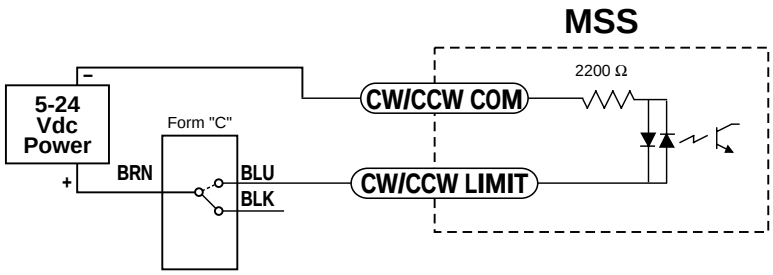


Figure 15 - FORM "C" LIMIT SWITCH SCHEMATIC

Limit Sensors

Some systems use active limit sensors that produce a voltage output rather than a switch or relay closure. These devices must be wired differently from switches.

If the sensor has an ***open collector*** output or a ***sinking*** output, wire it as shown in Figure 16.

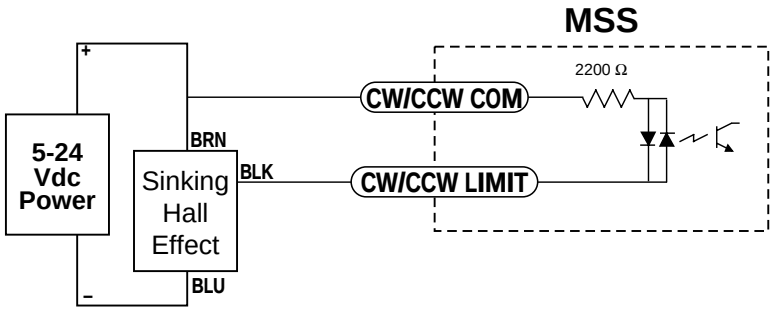


Figure 16 - NPN OR "SINKING" HALL EFFECT CONNECTION

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If the sensor output goes low (current flows) at the limit, select the option "Closed." If the output is open, (or high voltage), choose "Open" (no current flows).

Other sensors have ***sourcing*** outputs. That means that current can flow out of the sensor output, but not into it. In that case, wire the sensor as shown in Figure 17.

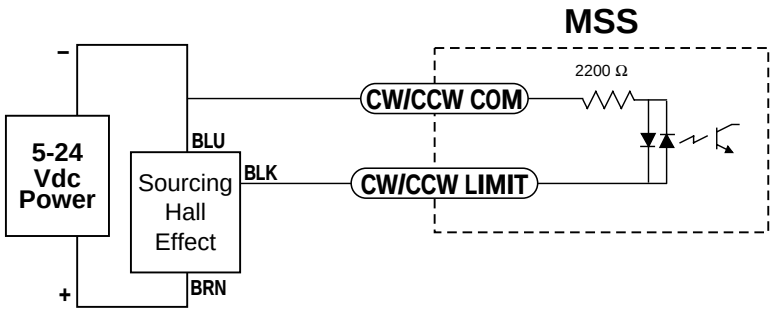


Figure 17 - PNP "SOURCING" HALL EFFECT CONNECTION

If the sensor output goes high (current flows) at the limit, choose the program option "Closed." If the output is low (open) at the limit, select "Open."

Caution! The current through the MSS limit switch inputs must not exceed 20 mA. Do not use voltages higher than 24 Vdc.

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SETTING FOR NORMALLY OPEN, NORMALLY CLOSED

The main window of the MSS programming software (see page 28) contains a panel for selecting the type of limit switches or sensors being used (see Figure 18).

If the limit switch closes when reached, select the option button marked “Closed.” This is often referred to as a *normally open* switch. If the limit switches are closed when the motor is not at a limit, and will open when reached, select the option button “Open.” This type of switch is frequently called *normally closed*.



Figure 18 - LIMIT SWITCH SELECTION PANEL

If limit switches are not required (caution: beware of potential for actuator damage) choose “not used”. With this selection, the limit switch inputs may be used as programmable inputs.

MSS Operation When a Limit Switch is Activated.

If a limit is reached during a *FEED TO LENGTH*, *FEED TO SENSOR*, *FEED & RETURN* or *FEED TO SENSOR & RETURN* move, the MSS will immediately stop the motor (with no deceleration) and turn off the motor current. The red *POWER* LED on the front panels will flash, and no future motion is possible. Ac power must be removed from the drive to reset this condition. If the drive is connected to a computer, the programming software will alert the user to this condition. Reset can be from the computer (instead of removing ac power).

If a limit is reached while jogging (using the *JOG CW* or *JOG CCW* inputs), motion will be disabled in the direction of travel. Jog can be activated in the reverse direction to back away from the limit.

During a *SEEK HOME* instruction, the motor will reverse direction when a limit is encountered, and continue seeking the home sensor.

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Wiring Outputs

Overview

The MSS provides three programmable ouputs (OUT 1, 2, 3) and a Fault output.

All four outputs are optically isolated, meaning there is no electrical connection between the indexer-drive and the output terminals. The signal is transmitted to the output circuit as light. This signal drives a transistor (NPN type) that closes, or conducts current, when the output is low. When the output is high, the transistor is open.

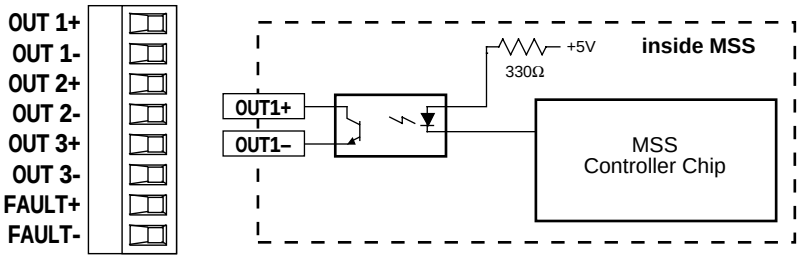


Figure 19 - OUTPUT CIRCUIT SCHEMATIC

Caution! The maximum permissable voltage between any pair of + and - output terminals is 24 Vdc. Never connect ac voltages to the MSS output terminals. Maximum current is 100 mA per output.

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Programmable Outputs

IMPORTANT NOTE: At power-up, the MSS sets all three programmable outputs high (open circuit).

Since there is no electrical connection to the MSS, current and voltage must be sourced from a PLC (programmable logic controller) or from a separate power supply. The current must be limited to less than 100 mA so that the output transistor is not damaged. A resistor is normally used for this, but some loads (such as PLC inputs) limit the current automatically.

Figure 20 shows how to connect an MSS output to an optically-isolated PLC input.

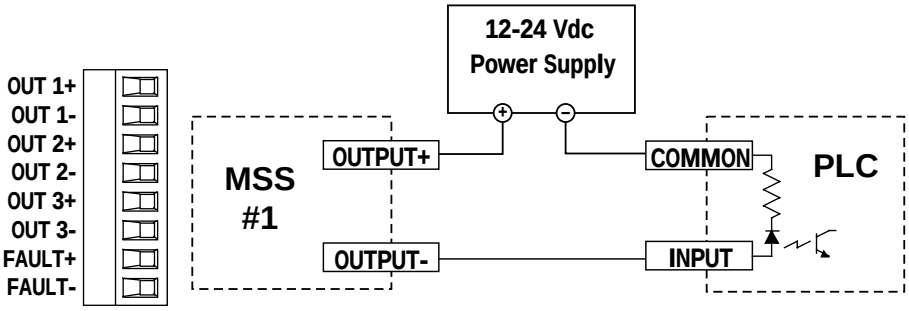


Figure 20 - CONNECTING AN MSS OUTPUT TO AN ISOLATED PLC INPUT

Fault Output

The fault output should be connected using the same considerations as the Programmable outputs.

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STOP Button, Fault Protection

Front Panel STOP Button

There is a button marked “STOP” on the front panel of the MSS. This button can be used to interrupt motion at any time. After pressing the *STOP* button, the motor will stop. No motor current will flow and the motor will not provide holding torque. The front panel *POWER* LED will then flash until the MSS is reset by removing and restoring the power. If the MSS is connected to a computer running the *Tol-O-Motion MSS Software*, the software will alert the user on screen to the condition, and provide the option to reset the drive from the computer.

Fault Protection

The MSS provides protection against motor short circuits and excessive drive temperature.

If the *OVERTEMP* light is on, the MSS has detected a thermal problem and has shut down the amplifiers. The first thing to do is unplug the drive from the power source. Next, touch the heat sink with the fingers. If it is very hot, the drive has probably overheated. This usually means more air flow is needed around the drive.

If the *SHORT (overcurrent)* light is on the MSS has detected a short circuit and has shut down the amplifiers. Unplug the drive from the power source. Check the motor wiring carefully. Make sure that the connections to the drive are secure and that any unused motor leads are insulated from the drive and power supply and from each other. Check the motor leads for shorts between phases or to ground.

Each Fault condition drives the fault output (Figure 20) to an “on” condition. The fault output is not activated by the limit switch circuits.

Reset requires removal of ac power unless the MSS is connected to the computer which allows software reset.

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Overview

The MSS is designed to be both configured and programmed through software. There is only the *STOP* button on the front panel and there are no jumpers inside. Virtually all the MSS's functions are controlled by software. The Tol-O-Motion MSS programming software that comes with the drive provides for setting the motor current, the step resolution, jogging parameters and limit switch polarity. It also allows the writing of complex motion control and machine interaction programs.

Installing the Programming Software

The MSS comes with two 3.5" software diskettes containing the software used in programming. This software requires a computer configured as follows:

- IBM compatible 386, 486, or higher CPU
- Microsoft Windows 3.1, Windows 95, 98 or NT
- At least 8 MB memory (16 MB will make the software run much faster)
- 4 MB available hard drive space
- VGA monitor, or better (16 bit color setting recommended)
- Mouse or other input device
- 3.5" floppy disk drive
- A 9-pin serial port

Like most Windows-based programs, installing the MSS software is highly automated.

To Install the Software:

1. Put Disk 1 in the 3.5" drive.
2. From the Windows Program Manager, select *RUN* from the *FILE* menu. (In Windows 95, 98 and NT 4.0, choose *RUN* from the *START* menu.)
3. If the 3.5" drive is drive A, enter the command line "A:\SETUP". If the 3.5" drive is B, type "B:\SETUP."
4. The *SETUP* program will provide screen prompts needed to finish the installation.

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If errors are encountered during installation, it is usually due to lack of memory or conflicts with other programs already running on the computer. If an error occurs while installing the programming software, quit all other Windows applications and try again. Holding down the *ALT* key and repeatedly pressing *TAB* will show all the programs currently running on the computer.

NOTE: Laptop computers generally present the biggest challenge to installation as they often come preloaded with programs that automatically execute on startup such as Microsoft Office and battery managers. Furthermore, laptops usually have the least memory.

The programming software will install more easily and run much faster with more memory. Eight megabytes of RAM on a Windows 3.1 system is recommended (16 megabytes with Windows 95).

IMPORTANT NOTE: Several example programs are installed with the programming software. It's a good idea to load some of the examples and look at them; they may help with the planned application.

Upon successful installation of the software, an icon is created in Windows. Double-click this icon to initiate the software. The MAIN PROGRAMMING WINDOW will appear as in Figure 28, page 28.

Programming Note: Always apply power to the MSC after the programming software is running on the computer.

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Using the Software to Input System Settings

SETTING THE MOTOR CURRENT

The drive current of the MSS must be set to match the motor. First, determine the rated current for the motor. Current settings for Tol-O-Matic MRS motors are shown in Figure 21. Motors can be operated at less than the rated current, but they will have less torque than at the rated current. However, they will also run cooler and make less audible noise.

MOTOR	MAX. PERMISSABLE DRIVE CURRENT SETTING AMPS (PEAK)
MRS171	1.4
MRS231	2.20
MRS232	3.60
MRS341	5.50
MRS342	5.50
MRS343	5.50

Figure 21 -TOL-O-MATIC CATALOG MOTOR CURRENT SETTINGS

In the Tol-O-Motion MSS programming software, the current is controlled in the main window (Figure 28) by the panel on the upper left side of the screen (see Figure 22). To adjust the current setting, just slide the scroll bar left or right. Precise adjustments can be made by clicking on the arrows at each end of the scroll bar.

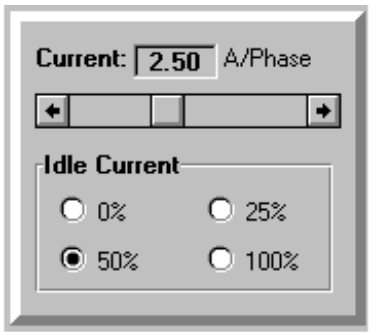


Figure 22 - CURRENT CONTROL PANEL

NOTE: The MSS current setting is for peak amps/phase. Other manufacturers' 4-lead parallel-connected motors can be used. Multiply the rms or dc Amps/phase current rating by 1.414 to find the value for setting the MSS. For other motors, consult the factory.

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IDLE CURRENT REDUCTION

The MSS is equipped with a feature that automatically reduces the motor current any time the motor is not moving. This reduces motor and drive heating. For example, setting the *IDLE CURRENT* to 50% reduces drive heating by about 50% and lowers motor heating by 75%. This feature can be set at any of four levels: 0%, 25%, 50% and 100%. The *100%* setting is useful when a high holding torque is required, as the drive does not reduce the current at all. The *0%* setting is for applications in which no holding torque is required.

Use of this feature is highly recommend. The *IDLE CURRENT* setting is chosen using the *OPTION* buttons in the *MOTOR CURRENT PANEL*.

SETTING THE MICROSTEPPING RESOLUTION

Most non-microstep step motor drives offer a choice between full-step and half-step resolutions. In full-step mode, both motor phases are used all the time. Half-stepping divides each step into two smaller steps by alternating between both phases ON and one phase ON.

Microstepping drives like the MSS precisely control the amount of current in each phase at each step position as a means of electronically subdividing the steps even further. The MSS offers a choice of 13 step resolutions, starting at 2000 steps per revolution. The highest setting divides each full step into 254 microsteps, providing 50,800 steps per revolution when using a 1.8° motor. The default resolution is 20,000 steps/revolution.

In addition to providing precise positioning and smooth motion, microstep drives can be used for motion conversion between different units. The *25,400 STEPS/REV* setting is provided for ease of converting motion from metric to English. (There are 25.4 mm per inch.) Another setting provides step angles that are decimal degrees (*36,000 STEPS/REV* makes the motor take 0.01° steps.) Some settings are used with lead screws. When the drive is set to *2000 STEPS/REV* and used with a 5 pitch lead screw, the result is .0001 inches/step. If User Units are inches, then Steps/User Unit are 10,000 steps/inch.

Choose a resolution that is convenient for the User Unit scaling ratio and which gives smooth motor operation.

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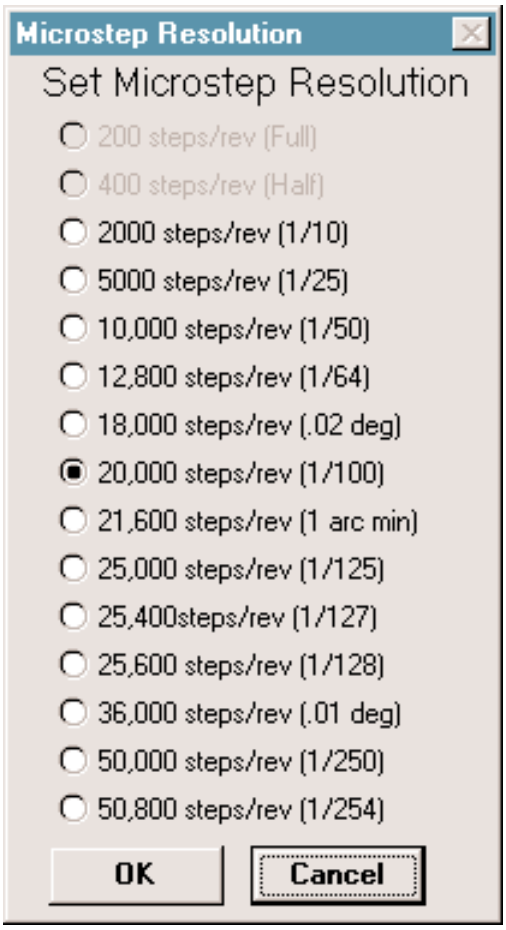


Figure 21 - CHANGE RESOLUTION DIALOG BOX

If in doubt, choose *20000 STEPS/REV*. The motor will run more smoothly and quietly at 20000 steps/rev than at lower resolutions.

The microstep resolution of the MSS is set using the programming software. The resolution appears at all times in the *STEPS/REVOLUTION PANEL* on the left side of the *MAIN WINDOW* (see Figure 23).



Figure 23 - STEP/REVOLUTION PANEL

To change the resolution, click on the *CHANGE* button to access a dialog box with *OPTION* buttons for each resolution (see Figure 21). Click the resolution required, then click the *OK* button.

If the step resolution is changed, the software will ask if user units are also to be changed. If not, it will automatically scale the distances so that the program distances in user units remain the same. Note that the maximum steps for a move are 16,000,000.

SETTING THE USER UNITS

The main programming window (see Figure 28) allows selection of User Units. This selection is used in conjunction with the Microstep Resolution selection of steps/revolution to set a scaling factor which allows move requirements to be entered (whether in programming or via the PIT) in the user's preferred units. Default steps/rev are 20,000 and user units are inches with a default of 40,000 steps/inch. These defaults correspond to a 2 turn per inch screw.

To make a new selection click the cursor on the Change box for User Units name (Figure 25) and enter a one to four digit description (mm, inch, feet, stps, revs, ????). Using the selected steps/resolution calculate the steps/unit (using screw pitch or belt wheel diameter and gear ratio) and enter in the user unit box.

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Figure 25 - SETTING USER UNITS

The units for the Jog Parameters will be seen to change, as will the units for all other screens for move data entry.

User units for PIT entries and values for entered PIT move limits will be changed automatically. Entries in the PIT display screen will not be changed.

NOTE: All max speeds will be subject to the 50 rev/sec maximum motor rotation speed limit set within the software.The steps/ user unit must be an integral number. Decimals will be rounded up or down to the nearest integral. Using high values for the steps per revolution will reduce the error. For programming metric user units with inch lead screws, it is helpful to use 25,400 steps/ revolution for the resolution.

SETTING THE JOG PARAMETERS

To set the *JOG SPEED* and *JOG ACCEL/DECEL RATE*, adjust the *SCROLL BARS* in the *MAIN PROGRAMMING WINDOW* (see Figure 26).

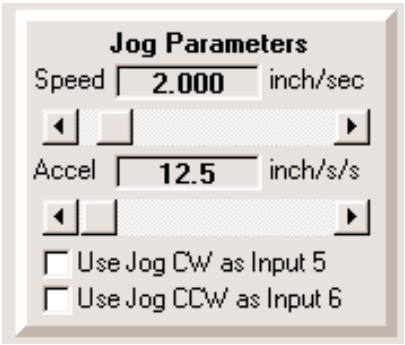


Figure 26 - SETTING JOG PARAMETERS

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Modest accel/decel rates are appropriate for jogging. Twenty-five rev/s/s usually works well except for very high inertial loads, in which case choose a lower rate. The range of jog accel is 1 to 3000 rev/s/s.

The range of jog speed is .025 to 50 rev/sec. The selection will depend on the application.

If jogging is not required in the clockwise direction, the *CW JOG* input can be used as a general purpose input by checking the box marked "Use Jog CW as Input 5." The same is true for the *JOG CCW* input. These selections can be implemented after system set-up.

SETTING FOR LIMIT SWITCHES

The main window of the MSS programming software (see page 28) contains a panel for selecting the type of limit switches or sensors being used (see Figure 18).

If the limit switch closes (conducts current) when reached, select the option button marked "Closed." This is often referred to as a *normally open* switch. If the limit switches are closed when the motor is not at a limit, and will open (no current) when reached, select the option button "Open." This type of switch is frequently called *normally closed*.



Figure 18 - LIMIT SWITCH SELECTION PANEL

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Using the Tol-O-Motion Software for Programming Motion

OVERVIEW

The Tol-O-Motion MSS software has a user program capacity of 100 lines. In this space, multiple motion and machine control programs can be designed. Sixteen high-level commands, or *instructions*, are available for this purpose.

Seven of the instructions involve pure motion: *FEED TO LENGTH* and *FEED & RETURN* are fixed distance moves. *FEED TO SENSOR* and *FEED TO SENSOR & RETURN* move relative to a sensor that is wired to one of the inputs. *FEED TO POSITION* moves to an absolute position relative to a previously set absolute reference position. *FEED/SET OUTPUT* allows an output to be set at any point during a move. *SEEK HOME* searches for a home sensor, "bouncing off" the limits if necessary to find it.

SET ABS POSITION allows the present position to be defined as any absolute position, at any point in the program.

Two instructions handle timing. *WAIT TIME* causes the program to stop for a specified amount of time. *WAIT INPUT* waits for one of the inputs to reach a specified state before continuing the program.

Four instructions control program flow. *GO TO* causes the program to jump to a particular line. *IF INPUT* jumps to a line if one of the inputs meets a specified condition. Otherwise, the program goes on to the next line. *REPEAT* and *END REPEAT* set up a loop wherein the same instructions can be repeated many times.

The *SET OUTPUT* instruction can be used to signal other equipment that a particular place in the program has been reached.

Using the *PIT PROMPT* instruction with the optional Panel-mount Interface (PIT), (or operator panel), the operator can enter distances, speeds and repeat loop counts on a keypad. The drive can also display messages for the operator, pause the program until the operator presses the *ENTER* button, or ask the user to make a decision and respond by pressing the *YES* key or *NO* key.

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A *COMMENT* tool allows notes to be inserted in the program so that it is easier to understand.

By combining the 16 instructions in different ways, a nearly infinite variety of useful programs and motion profiles can be constructed. Planning the objectives and sequence prior to entering instructions eases the programming process.

There are actually two software programs associated with the MSS. The first is the Windows program installed on the computer from the floppy disks. After the program is loaded, click on the Tol-O-Matic logo to see the software version and Tol-O-Matic's phone, fax and website numbers.

A second software program resides in a chip inside the MSS. Software in a chip is usually called ***firmware.*** It is the MSS firmware that runs the drive and executes the program. The drive firmware version is displayed near the top of the screen when the MSS is connected to the computer and turned on (see Figure 27). Make sure that the MSS software is selected in the drop box.



Figure 27 - FIRMWARE VERSION DISPLAY

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Entering The Program

To activate the MSS software, go into Windows and locate the *PROGRAMMER* icon. Double-click on the icon to run the software. The *MAIN PROGRAMMING WINDOW* will soon appear, as shown in Figure 28. If COM 1 is used by the computer, the software will prompt for use of COM 2.

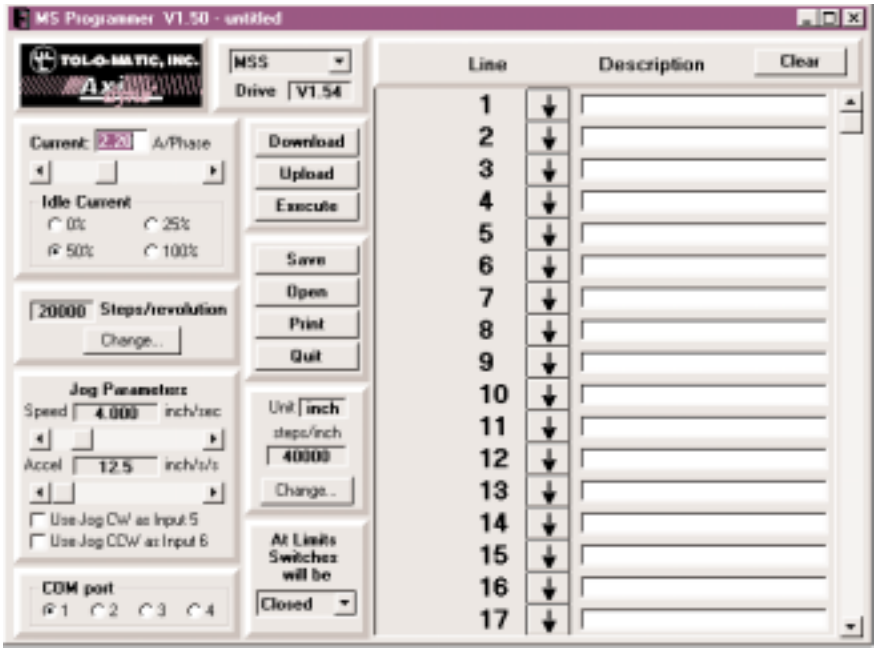


Figure 28 - MAIN PROGRAMMING WINDOW

If an MSS is connected to the computer, turn it on now. After applying power, the computer should beep. The *VERSION* box will display the version number of the MSS firmware that is in the drive. Parameter setup is described on page 35.

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INSTRUCTIONS & TOOLS

Refer to Figure 29. The programming software provides 16 easy-to-use high-level instructions for building programs. In addition, there are five tools.

INSTRUCTION SET ***TOOL SET***

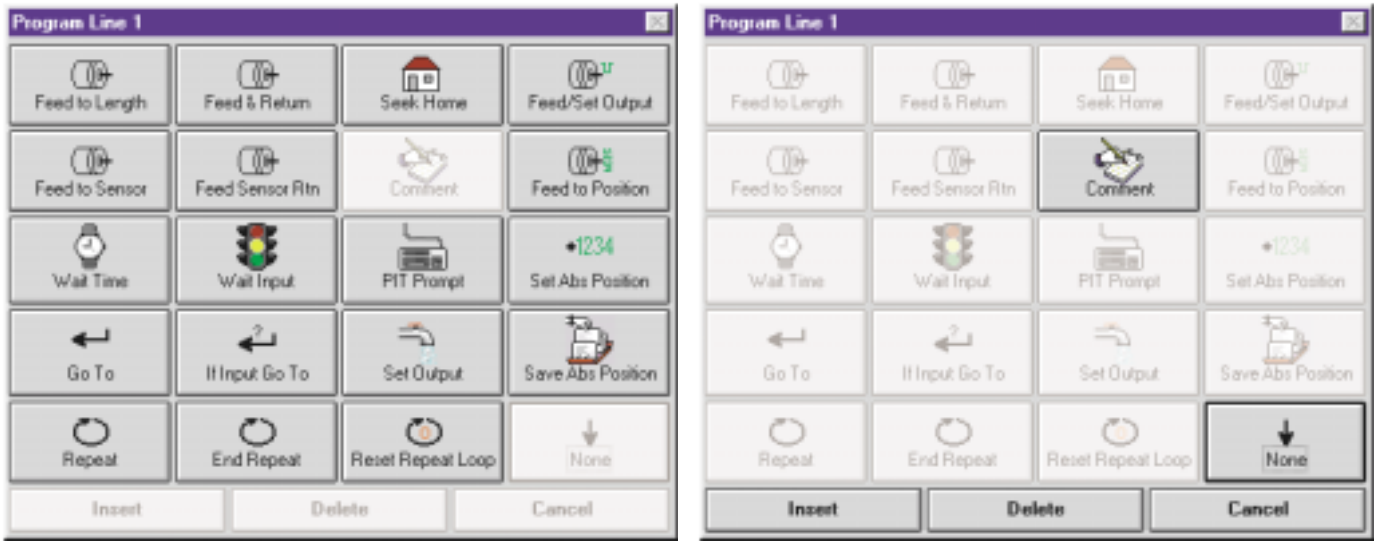


Figure 29 - INSTRUCTION/TOOL MENU

Instructions

NAME .....PAGE REF.	NAME .....PAGE REF.
Feed to Length 49	Feed & Return 51
Feed to Position 56	Feed/Set Output 54
Seek Home 59	Feed to Sensor 52
Feed to Sensor & Return 53	Set Abs Position 57
Wait Input 61	Wait Time 61
Go To 63	PIT Prompt 47
Set Output 68	If Input Go To 70
End Repeat 64	Repeat 64

Tools

NAME .....PAGE REF.	NAME .....PAGE REF.
Comment 45	None 44
Insert 44	Delete 44
Cancel 45	

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Most programs will begin with the instruction *WAIT INPUT* or a *PIT PROMPT*. This ensures that when power is applied to the MSS, it doesn't do anything until instructed to do so. It is easy to put a *WAIT INPUT* instruction on the first line.

Next to the large number 1 in the *PROGRAM WINDOW* is a button showing the *NONE* icon which indicates there is no instruction for that line. Whenever the MSS encounters a "None" program line, it simply moves on to the next line, as the icon implies with a downward pointing arrow. After the MSS executes the instruction on line 100, it automatically jumps to line 1, unless the instruction on line 100 makes it jump somewhere else.

To enter *PROGRAM LINE 1*, click once on the *PROGRAM* icon. The *PROGRAM LINE...* dialog box will appear (see Figure 30), displaying the programming instructions and tools.

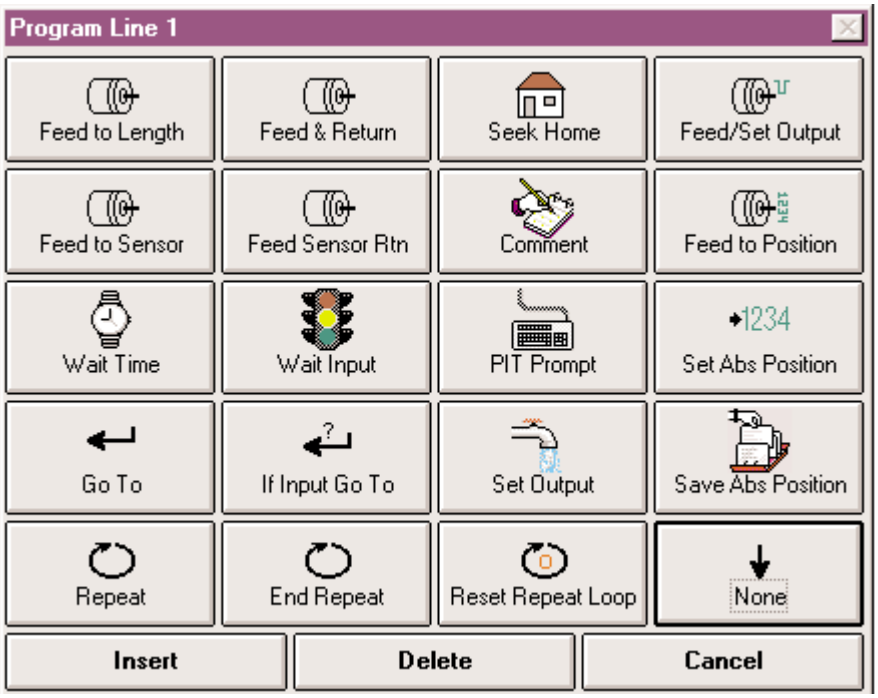


Figure 30 - "PROGRAM LINE" DIALOG BOX

Click on the button marked "Wait Input". The *WAIT INPUT* dialog box will appear. Click on the option button marked "Low" (in the "Condition" group), then click *OK*.

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The first line of the program should now display the *WAIT INPUT* icon, and the description "Wait for input 1 low."

Click on the icon button for *PROGRAM LINE 2*. When the *PROGRAM LINE...* dialog box appears, click on *FEED TO LENGTH*. In the *FEED TO LENGTH* dialog box, enter the distance as "5 inch," then slide the speed bar to "10 in/sec." Click *OK*.

The second program line should now show the motor icon and the caption "CW 5.0 inch, 10.0 inch/s."

Click on the *PROGRAM LINE 3* and repeat the same steps on *PROGRAM LINE 2*. Only change directions to CCW. The third program line should now show the motor icon and the caption CCW 5.0 inch, 10.0 inch/s.

Click on the *PROGRAM LINE 4* icon. Choose *GO TO*. When the *GO TO* dialog appears, the line number will already be set to "1." Click *OK*. The program should now look like the program shown in Figure 31.

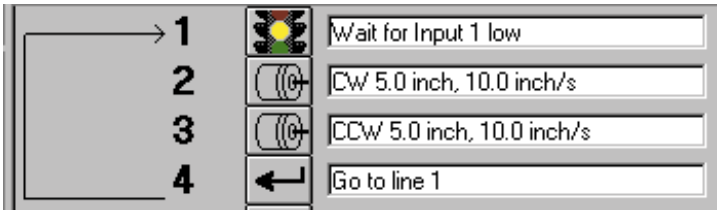


Figure 31

More complex programs are entered in the same manner, with more lines and more concern about the exact parameters and their importance in the application.

NOTE: To copy a line to a different program line, drag the program line, to be copied, to the program line it is to be copied to. For example: drag line 2 to line 3 and edit to change to CCW.

NOTE: To edit an instruction that is already in the program, hold down the shift key while clicking on the instruction icon. This is a shortcut to the instruction dialog box.

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DOWNLOAD, UPLOAD & EXECUTE

The MSS is designed to operate without a host computer once the program is finished and tested. However, running it from the computer makes it easy to quickly make changes in the program to fix errors or conduct experiments.

The programming software provides four command buttons for interacting with the indexer-drive: *DOWNLOAD, UPLOAD, EXECUTE*, and *STOP*.



DOWNLOAD - transfers the program from the Windows software to the MSS plugged into the serial port. The transfer takes about 3 seconds. The program must be downloaded before it can be executed. **NOTE:** If the *EXECUTE* button is pressed before downloading, the program previously loaded in the indexer-drive will execute and the results may not match what is shown on the computer screen.

Set the current to match the motor's rated current. Then, press the *DOWNLOAD* button near the middle of the screen. If the drive is on and connected properly, the *DOWNLOAD* dialog box will appear and show the progress of the download, which takes 1-3 seconds. (The transfer time is governed by the speed at which the MSS can rewrite its internal, nonvolatile memory, and by the size of the program.) Once the download has been completed, the program is ready to execute.



UPLOAD - allows extraction of whatever program is in the MSS memory and display it on the screen. To modify a program already in the MSS but never saved to the hard drive, use the *UPLOAD* command to bring it back from the MSS.



EXECUTE - tells the MSS to begin running the program currently in its internal memory, starting on line 1. After pressing the *EXECUTE* button, a box Figure 32 will appear with options for the mode of execution, and status indicators for inputs and outputs.

If your MSS has firmware prior to 1.40, the Execute box will be simpler than this and some commands will not be available. If the program to be executed contains any PIT instructions (see page 37) then a different Execute box with a PIT emulation will appear (page 38).

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STOP - interrupts the indexer-drive at any point in the program and closes the Execute box. This feature is useful when the drive starts doing things not intended for it to do. **NOTE:** Remember that the MSS is a small computer and computers do not do what the operator wants them to do, they do what the operator tells them to do.

If a motor and 2 turn per inch actuator is connected to the drive, the program can be tested. A normally-open-type momentary contact switch is required. Connect one end of the switch to *INPUT 1*. Connect the other end to any of the *GND* terminals.

Jog to the motor end of the actuator. Press the *EXECUTE* button. The *EXECUTE* dialog box will appear (see Figure 32).

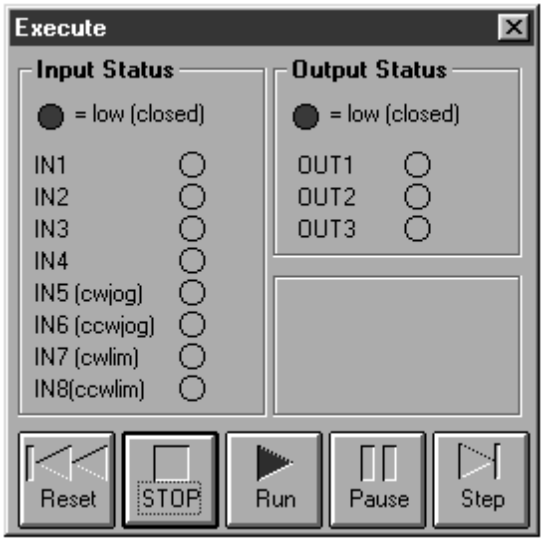


Figure 32 - EXECUTE DIALOG BOX

RUN - The *RUN* button is lighted green (ready) and the active line of program is highlighted.

Each time the switch is closed the motor should move 5 inch and return. (If the switch remains closed, the program will continually repeat.)

I/O STATUS - The execute box displays the status of the I/O during program execution.

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PAUSE - The *PAUSE* button halts the program but does not close the Execute box. While paused the display of inputs is continuously updated in response to the source status.

STEP - When in Pause, clicking on Step will execute the highlighted program line, then automatically pause again. Clicking on Run will make the program run again from where paused.

RESET - Clicking Reset sends the program back to line 1 in either Pause or Run mode.

The MSS will run its stored program immediately on application of power when not connected to a computer with MSC Programmer Software open. Starting the program with a *WAIT PROMPT* or a *PIT PROMPT* will prevent unintended moves.

COPYING INSTRUCTIONS

There may be occassions where it would be useful to make an exact copy of an instruction, or perhaps a copy with only one or two parameter changes. The fastest way to copy an instruction from one line to another is to point the mouse at an instruction icon that is to be copied and drag the icon onto another one elsewhere in the program. This is referred to as “Drag and Drop.”

For example, if there is a *SET OUTPUT* instruction on line 5 of your program, and an identical *SET OUTPUT* is required on line 11. Position the mouse over the *SET OUTPUT* icon on line 5, then click and hold the mouse button. Move the mouse until the icon is over the line 11 icon. let go of the button, and the instruction with all of its parameters will be copied to line 11.

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Setting Program Parameters From the Computer

The Windows-based programming makes it easy to enter data into the program.

TEXT BOXES



Large numbers that must be entered precisely, such as the number of steps to move, are entered in ***text boxes***. This is much like using a word processor, but only one word is being edited. Just click in the box and type in the number. If a mistake is made, select all or part of the number and type something else instead. When a dialog box containing text boxes is first encountered, the text inside one box is automatically selected. This allows typing in the number without having to click at all.

If a number is entered that is too large, the MSS Programmer will change the entry so that it is "in bounds" when it moves to the next entry in the dialog box. This prevents asking the indexer-drive to do something beyond its capabilities.

SCROLL BARS



Many parameters are set using ***scroll bars.*** Scroll bars work like the temperature controls in many cars. Sliding the small box to the right increases the value of the parameter. Sliding the box all the way to the right provides the maximum number. As the slider moves, the numerical value is shown in a box next to the scroll bar.

Refer to Figure 33. To make precise adjustments, try clicking next to the ***slider*** (on the bar, between the sliding box and the arrow). To make even more precise adjustments, click on the ***arrow*** at either end of the scroll bar.

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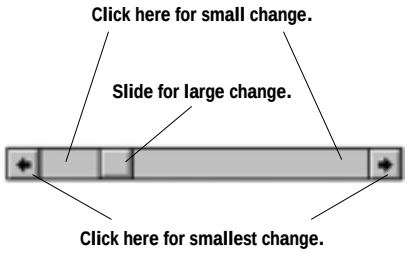


Figure 33 - PRECISE SCROLL BAR ADJUSTMENT

OPTION BUTTONS

Option buttons are very common in Windows. They are normally used to pick one item from a group, such as *CW* or *CCW* direction. To pick an item that is controlled by option buttons, click on the circle so it shows a black dot inside as shown in Figure 34.



Figure 34 - OPTION BUTTON

SPIN BUTTONS

Some parameters have a limited number of possible values, all numerical, but too many for option buttons. For example, there are 100 possible values in setting the line number in a *GO TO* instruction. For each, use the ***spin button.*** If the down arrow part of the button is clicked (see Figure 35), the value goes down by one. Clicking the ***up arrow*** makes it go up by one. Clicking and holding down the mouse button will cause the parameter value to "spin up" quickly.



Figure 35 - SPIN BUTTON

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Overview

The MSS is available with an optional Panel-mount Interface (PIT), sometimes called an ***operator panel.*** The optional *PIT INTERFACE* can be used to change parameters such as *MOVE DISTANCES, MOVE SPEED* or *REPEAT COUNT NUMBER.*

Using the Optional PIT

The PIT attaches to the same RS232 port used to connect to the computer, using the same cable. The PIT has a four-line liquid crystal display (LCD) and 20 keys for entering data. There are eight primary functions of the PIT:

1. ***Display a message*** on the LCD. *Examples:* Identify the machine ("ABC Bottle Filling Co. Model 20"), or display a status message ("Machine Running - Status OK").

2. ***Pause the program until the user presses*** **ENTER.** *Example:* Halt the process of applying preprinted labels while a new roll of labels is loaded.

3. ***Prompt the user to make a decision.*** *Example:* Offer the user an option such as changing set up parameters, that can be responded to by pressing the *YES* or *NO* keys.

4. ***Prompt the user to enter a move distance***. *Example:* Specify how long the material will be when used in a machine that feeds out material and then cuts it off.

5. ***Prompt the user for a move speed.*** *Example:* Adjust a feed rate, flow rate or other motor speed related setting.

6. ***Prompt the user for a repeat count.*** *Example:* The user sets the number of parts that are processed or combines a repeat loop with a *WAIT TIME* instruction to adjust dwell time.

7. ***Multiply branching using keys 1-8.*** Offer the user a choice of jumping to eight different sub-routines, within the overall program.

8. ***Perform jogging.*** Use the left and right arrow keys for jogging while in waiting for ENTER.

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To run a program (which includes PIT instructions) from the computer, press the *EXECUTE* button. The PIT *EXECUTE* dialog box looks and acts like the real PIT (see Figure 36). It will display messages, and clicking on the buttons will enter data. The PIT emulator *EXECUTE* box has all the display, run and step functions of the basic *EXECUTE* box (page 33).



Figure 36 - ON-SCREEN PIT EMULATION

TO DISPLAY A MESSAGE ON THE PIT (see Figure 37)

1. Click on the program line arrow icon.
2. Select the *PIT PROMPT* instruction.
3. Type a message (“Machine Running Status OK”) in the text box.
4. Select the *DISPLAY TEXT ONLY* option button.
5. Click the *OK* button. The message will stay on the LCD until another instruction uses the PIT.

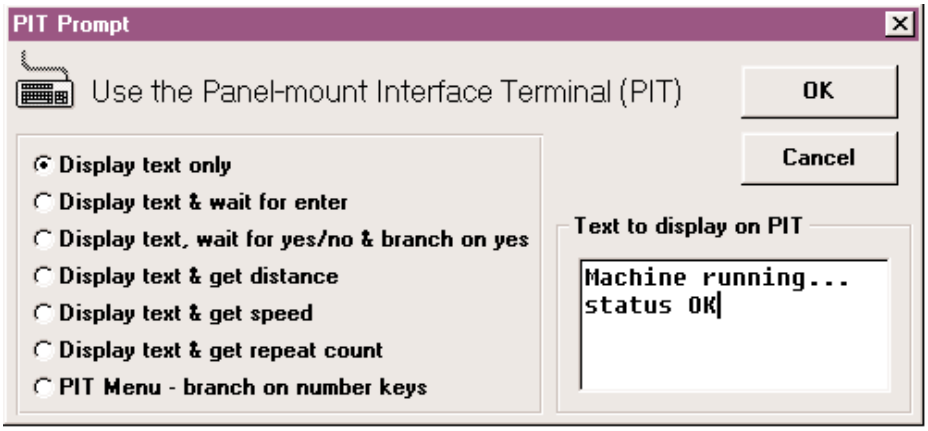


Figure 37 - DISPLAYING A MESSAGE ON PIT

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TO PAUSE UNTIL USER PRESSES ENTER (see Figure 38)

1. Click on the program line arrow icon.
2. Select the *PIT PROMPT* instruction.
3. Type a message ("Please reload labels, then press ENTER") in the text box.
4. Select the *DISPLAY TEXT & WAIT FOR ENTER* option button.
5. To allow jogging using the PIT arrow keys, check the "Allow jogging" box.
6. Click *OK*.

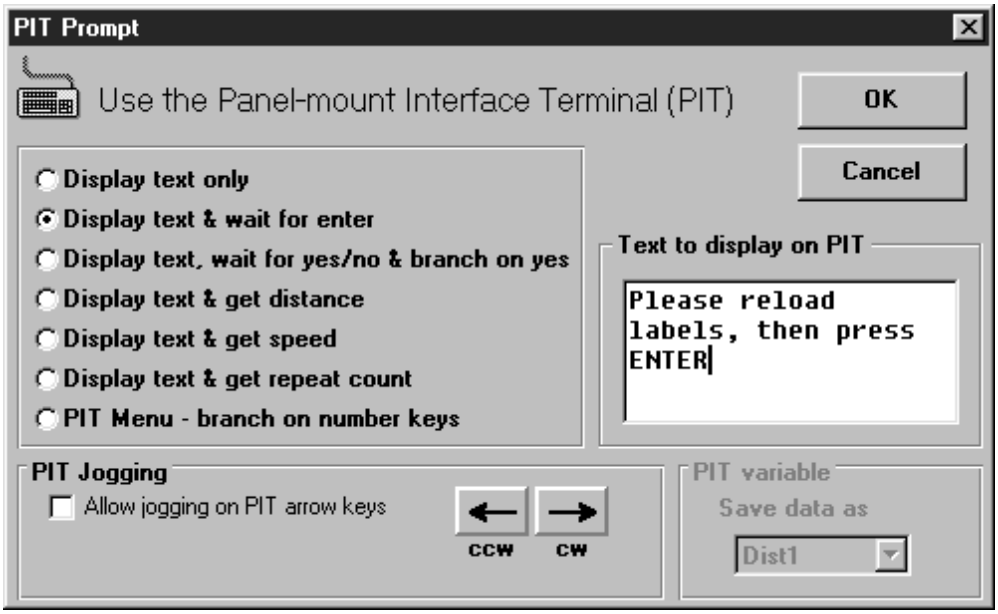


Figure 38 - PAUSING UNTIL USER PRESSES ENTER

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TO LET USER MAKE A DECISION (PIT BRANCHING) (see Figure 39)

1. Select the *PIT PROMPT* instruction for the program line.
2. Type a message ("Change setup parameters? (press yes or no)") in the text box.
3. Select the option button *DISPLAY TEXT, WAIT FOR YES/NO & BRANCH ON YES*.
4. Type the Program Line # ("12") to go to on *YES* in the line # box.
5. Click *OK*.
6. Enter program or comment(s) (parameter setting instructions), starting on Program Line # ("12").
7. If required, place a *GO TO LINE #* instruction at the end of the parameter-setting instructions.

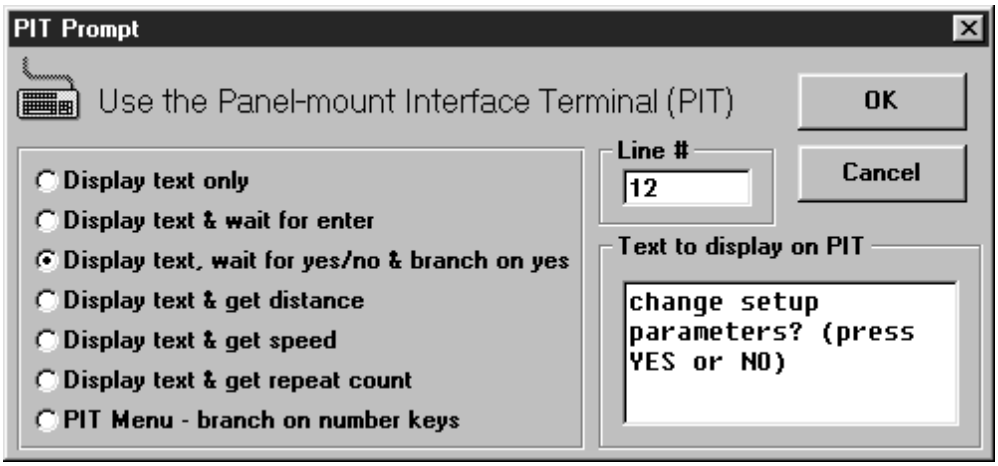


Figure 39 - PIT BRANCHING

TO ASK THE USER FOR A MOVE DISTANCE (see Figure 40)

1. Select the *PIT PROMPT* instruction for the program line.
2. Type a message ("Enter part length, in inches") in the text box.
3. Select the option button *DISPLAY TEXT AND GET DISTANCE*.
4. Enter upper and lower limits (this example allows the operator to enter distances between 0.5 and 12 inches).
5. Select a PIT variable to store the distance in (choose *Dist1* this time, but any of the eight PIT variables is acceptable for storing any type of data).
6. Later in the program, provide a feed instruction (*FEED TO LENGTH, FEED & RETURN*, etc.) that uses the *Dist1* variable for distance.

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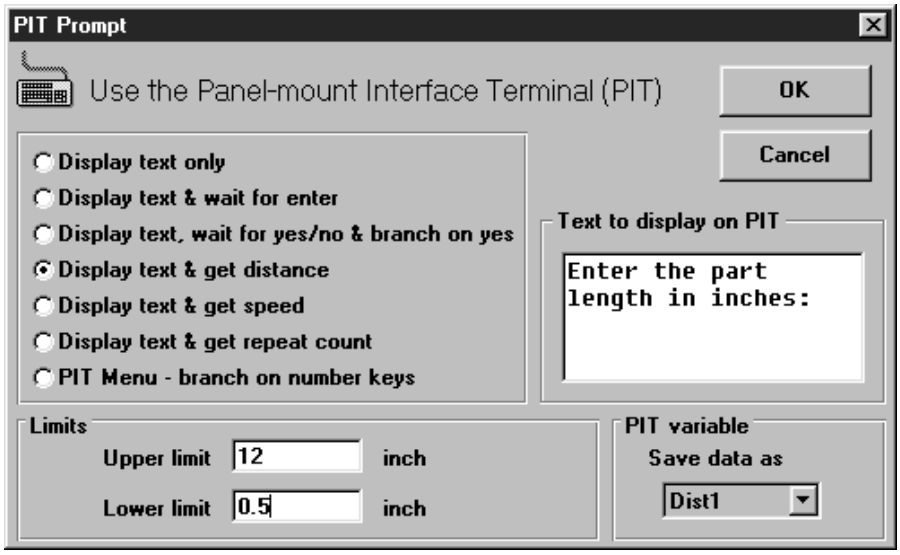


Figure 40 - PROMPT USER FOR MOVE DISTANCE

TO GET A SPEED FROM THE USER (see Figure 41)

1. Select the *PIT PROMPT* instruction for the program line.
2. Type a message ("Enter the speed, in mm/sec") in the text box.
3. Select the option button *DISPLAY TEXT AND GET SPEED.*
4. Enter upper and lower limits (this example allows the operator to enter speeds between 0.5 and 50 mm/sec).
5. Select an PIT variable in which to store the speed (choose *Speed1*).
6. Later in the program, provide a feed instruction (*FEED TO LENGTH*, *FEED & RETURN*, etc.) that uses the *Speed1* variable for speed.

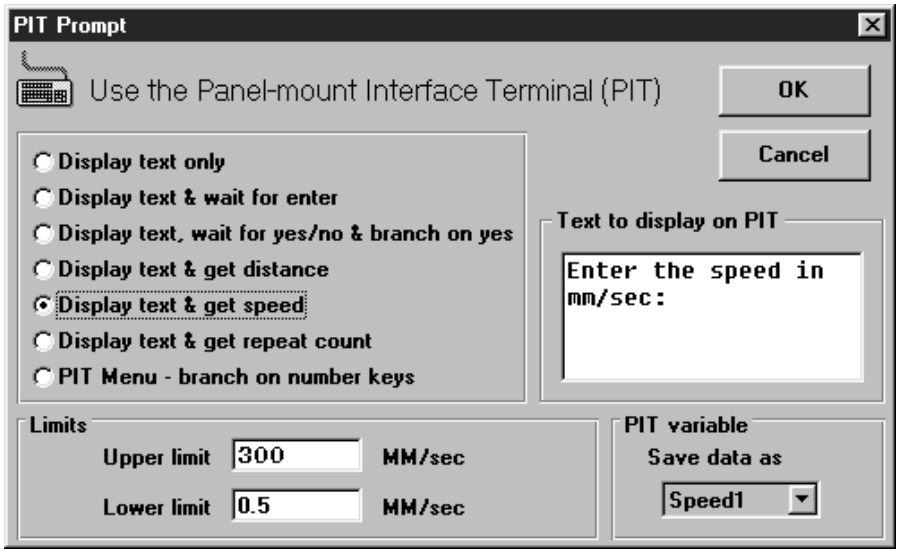


Figure 41 - PROMPT USER FOR SPEED

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TO GET A REPEAT COUNT FROM THE USER (see Figure 42)

1. Select the *PIT PROMPT* instruction for the program line.
2. Type a message (“How many parts should we run?”) in the text box.
3. Select the option button *DISPLAY TEXT AND GET REPEAT COUNT.*
4. Enter upper and lower limits (this example allows the operator to enter a number between 1 and 200).
5. Select an PIT variable to store the count in (choose *Count1*).
6. Later in the program, there must be a *REPEAT* instruction that uses the *Count1* variable for the repeat count.

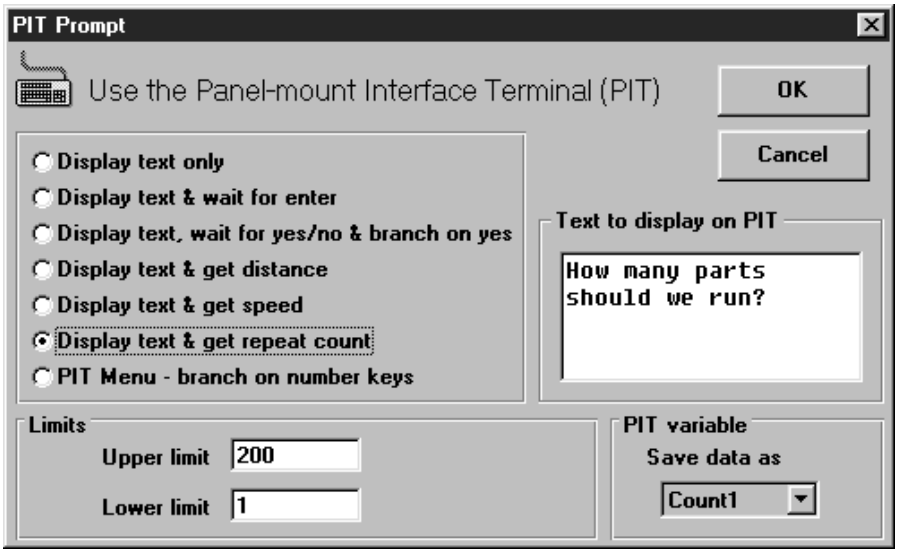


Figure 42 - PROMPT USER FOR REPEAT COUNT

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TO CREATE A PIT MENU (see Figure 43)

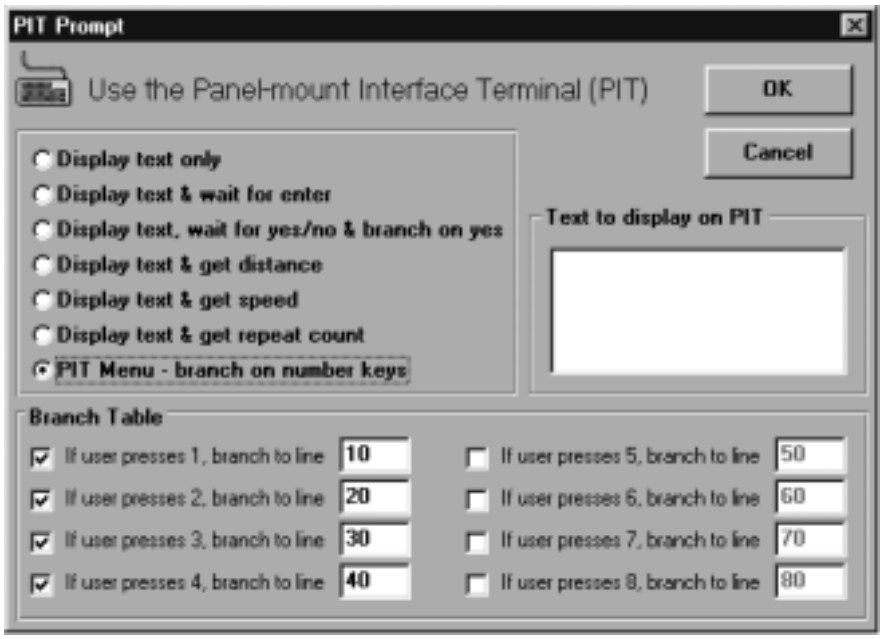


Figure 43 - PROMPT USER FOR SUBROUTINE SELECTION

1. Select the *PIT PROMPT* instruction for the program line.
2. Select the option button “PIT Menu…”
3. Type a message in the text box.
4. Check the boxes indicating which numeral keys are to be used (in this example, 1, 2, 3 and 4).
5. Assign a program line number to each key (10, 20, 30 and 40).
6. Later in your program, there must be instructions at each of the lines you’ve specified. These are the instructions that will execute if the user presses the appropriate key on the MMI. For example, when the user presses ‘1’, the program will branch to line 10.

   NOTE: If you add extra spaces to your display text to get the look “just right”, watch out: sometimes the *MSS Programmer* removes those spaces when you re-open the instruction dialog. It is safer to format your text using other characters, like ‘.’ (period) or ‘_’ (underscore).

   NOTE: You need firmware version 1.41 or later to execute the PIT Menu function.

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Programming Tools

Overview

These are five programming tools which appear in the Program Line dialog box (page 27). In addition the CLEAR button of at the top right of the main programming window provides an additional tool function.

Programming Tools

INSERT NEW STEP



This command is used to insert a new instruction anywhere in the program.

To insert a new step:

1. Click on the program icon where the new instruction is to go. The *PROGRAM LINE...* dialog box will appear.
2. Click on the command button marked “Insert”. The instructions are re-ordered, and the line needed for the new program line is available.
3. Click on the *OPEN* line and select an instruction.

DELETE STEP



In addition to inserting a line in the program, deletions can be made to make room for other lines farther down. For example, space exists in the middle of the program, but additional instruction is needed near the end.

To delete a step:

1. Click on a program line that is not needed. The *PROGRAM LINE...* dialog box will appear.
2. Click on *DELETE* to remove the selected line and move the other lines up one position. A blank spot will be created at the end of the program.

NOTE: By combining insertions and deletions, program lines can be placed wherever and whenever needed.

NONE



This tool on the *PROGRAM LINE* dialog box leaves a blank program line for future use without the need to Insert later.

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CANCEL



This tool exits from programming without saving or downloading the program.

COMMENT



This tool provides for insertion of notes into the program. Comments help organize the program and make future changes easier.

Whether the program is saved to disk or downloaded to the drive, comments stay with it. They do not affect the way the program runs. When the MSS executes a program, it simply skips over the comments.

Refer to Figure 44. Placing a comment on the first line of the program lets future programmers know who wrote the program, when it was written, and what it does. Adding comments to the program may save a great deal more time later on, when program steps are no longer obvious.

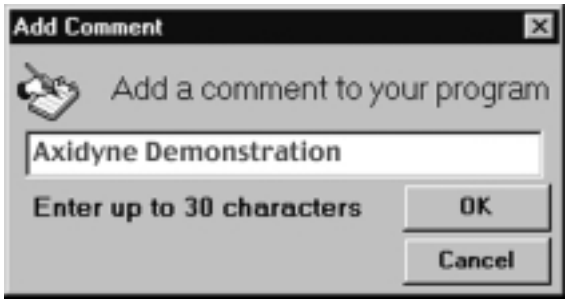


Figure 44 - COMMENT DIALOG BOX

There is a limit to the number of comments the program can have. The MSS has a ***string pool*** of 400 characters. All *PIT PROMPTS* text goes into the string pool, as any *COMMENT*, *WAIT INPUT* or *IF INPUT* instructions whose strings exceed 12 characters.

CLEAR

Clicking on the *CLEAR* button at the top right of the programming screen and then confirming *OK* will erase all the program stored and displayed in the active main programming window Lines 1-100. *CLEAR* does not clear the program stored in a connected MSS.

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COPYING INSTRUCTIONS

The fastest way to make an exact copy of an instruction or perhaps a copy with small changes is to point the mouse at the instruction icon to be copied, click and hold and drag the icon to the copy location. Release the mouse button. This is “Drag and Drop”.

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Overview

There are 16 Programming Instructions which appear in the *PROGRAM LINE* dialog box. Each icon, (except End Repeat) accesses an individual dialog box in which the instruction is fully defined.

Programming Instructions

PIT PROMPT



The *PIT PROMPT* instruction is used with the optional PIT (Man Machine Interface). *PIT PROMPTs* allow the program to display messages on the PIT screen, and can gather data from the operator to be used by other instructions (see Figure 45). The PIT can also pause the program until the user presses the *ENTER* button. It can allow the user to make a decision, then press the *YES* or *NO* button. If the user presses *YES*, the program branches to another program line. If the user presses *NO*, the program goes to the next line. If authorized the PIT can be used as a jog switch, while waiting for enter.

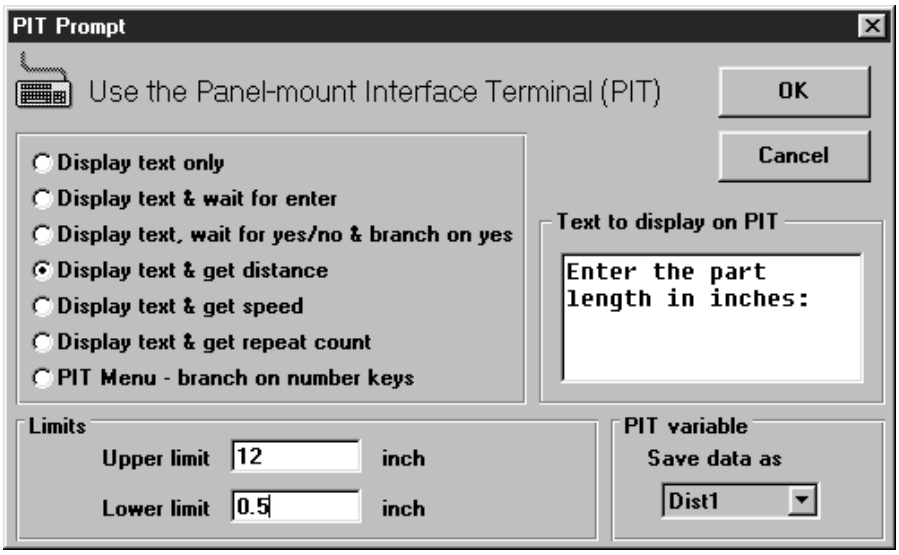


Figure 45 - PIT PROMPT DIALOG BOX

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To display a message (such as “Machine Running - Status OK”), put an *PIT PROMPT* instruction in the program at the point where the message is to appear. Check the option button marked “Display Text Only” and type in the message. Once the *PIT PROMPT* instruction has been executed, the message will stay on the screen until changed by another instruction that uses the PIT display.

If it is required that the operator be able to change parameters like *DISTANCE, SPEED* or *REPEAT COUNT*, an *PIT PROMPT* is required to ask the user for data and to store it in nonvolatile memory. In this case, click on the option button for the type of required: *DISTANCE, SPEED* or *REPEAT COUNT.*

Upper and lower limits must be set. The *PIT PROMPT* instruction will check the data entered against the limits specified and tell the user if a value is out of range. For example, if the *PIT PROMPT* is set to gather a *REPEAT COUNT*, and the upper and lower limits are set to 100 and 1, the operator will not be able to enter any value bigger than 100 or smaller than 1. The PIT will not accept limits greater than the MSS can allow.

The *PIT PROMPT* instruction must be told where to store the data in nonvolatile memory. There are eight locations to choose from. They are named *DIST1, DIST2, DIST3, SPEED1, SPEED2, COUNT1, COUNT2* and *COUNT3.* Remember where the *PIT PROMPT* was instructed to put the data. When an instruction is set up to use data from an PIT variable, that instruction must be told which variable to use (*DIST1, DIST2,* etc.). Any location can be used for any variable (i.e. distances could be put in speed or count locations).

For example, if the operator is to be able to set the number of parts the machine produces in a given run, put an *PIT PROMPT* instruction in the program to ask for a *REPEAT COUNT* and to save it as *COUNT1*. Set up a *REPEAT* loop somewhere else in the program to process the parts. The loop will start with a *REPEAT* instruction configured to get its repeat count from the PIT variable *COUNT1*.

If a *PIT PROMPT* instruction is to get distance or speed data, User Units will be as selected on the Main Programming window.

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To pause the program until the user presses the *ENTER* key on the PIT, choose the option marked “Display text & wait for enter.”

To allow the user to make a decision, select *DISPLAY TEXT,* wait for "Yes/No & branch on yes.” Be sure to enter a line number in the *LINE # BOX*. The program will jump to that line if the user presses *YES*. If the user presses NO, the program will execute the next line after the *PIT PROMPT.*

FEED TO LENGTH



This instruction is used for point-to-point incremental moves. This is the instruction to use to move the motor a fixed number of user units. Speed or distance data previously gathered by an *PIT PROMPT* instruction can also be used.

Clicking on the *FEED TO LENGTH* button in the *PROGRAM LINE...* dialog box causes the *FEED TO LENGTH* dialog box appear (see Figure 46). This is where the parameters for the move are entered.

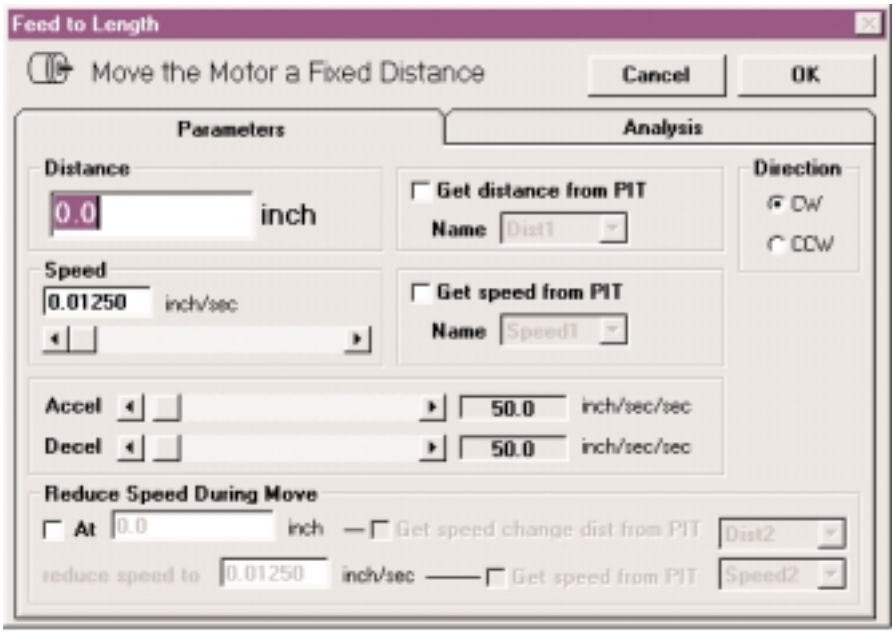


Figure 46 - FEED TO LENGTH DIALOG BOX

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DISTANCE - the number of user units to move. (The maximum number of steps is 16,000,000.) Selecting the check box marked "Get distance from PIT" allows a choice of one of the eight PIT variables as the distance. **NOTE:** Checking "Get distance from PIT" does not automatically make the MSS stop and ask the user for an entry. A *PIT PROMPT* instruction is needed elsewhere else in the program for that.

SPEED - the maximum speed the motor is to go, in user units. (The speed can be set anywhere between .025 and 50 rev/sec, in increments of .025 rev/sec.) Selecting the check box marked "Get speed from PIT" allows a choice of one of the eight PIT variables as the speed.

The Feed to Length instruction also allows for reducing speed during the move. Check the option box and enter the required values, or choose to enter the values via the PIT.

ACCEL - step motors cannot achieve a high speed instantly. The indexer-drive must gradually accelerate the motor to speed. The acceleration rate depends on the inertia of the motor and load, the torque available from the motor, and how fast it is to go. For trapezoidal move profiles (speed vs time), MSS accel and decel rates are limited to 3000rev/sec/sec. (For triangular move profiles, where the target speed is never reached, the sume of the accel and decel rates must not exceed 4000 rev/sec/sec. Thus, the fastest profile is achieved with accel and decel at 3000 rev/sec/sec and speed at the trapezoidal limit. This profile may not be possible in the application because of mechanical limitations.)

DECEL - this is the rate at which the drive decelerates to a stop at the end of the move. The range is the same as for acceleration. Because friction encourages a motor to stop, decel can often be set higher than accel.

DIRECTION - Choose *CW* or *CCW* as the direction for the move. Simply dot the appropriate circle by clicking on it.

ANALYSIS - This button presents a speed-time and a speed-distance graph of the move along with a calculation of the move duration and the times and distances spent accelerating and decelerating. Peak speed is also displayed.

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FEED & RETURN



The *FEED & RETURN* instruction (Figure 47) is used for point-to-point moves with return to the starting point (e.g. a motor driving a cut-off knife is to retract the knife after cutting).

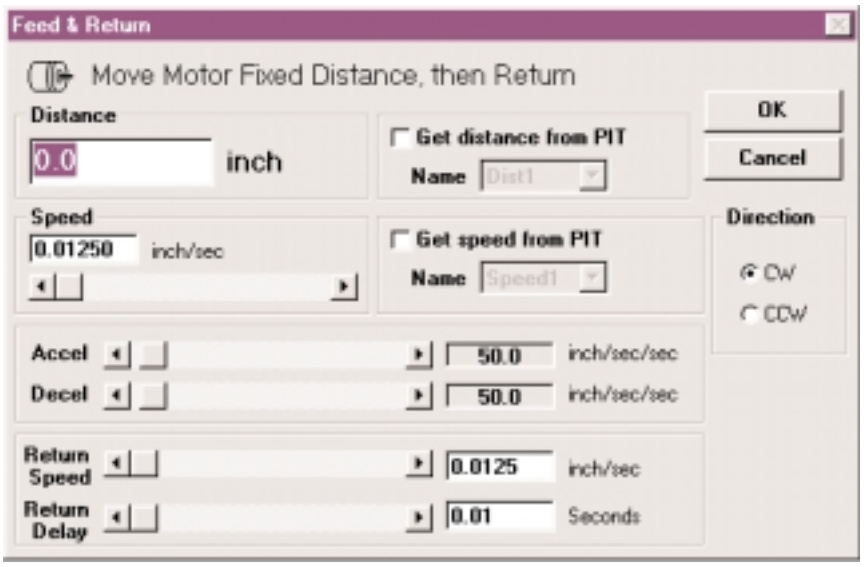


Figure 47 - FEED & RETURN DIALOG BOX

FEED & RETURN requires many of the same parameters as *FEED TO LENGTH*: *DISTANCE*, *SPEED*, *ACCEL*, *DECEL* and *DIRECTION*. For explanations of these, see "Feed to Length" on pages 00–00.

RETURN SPEED must also be set. In the case of the cut-off knife, set to feed slowly as the knife is cutting, then retract quickly. Thus, the return speed would be higher than the forward speed.

RETURN DELAY determines how long the MSS waits between the end of the feed move and the start of the return. This could, for example, give the machine time to remove a part before retracting. Since a motor and load need time to "settle out" after moving, do not set return delay to less than 0.2 seconds unless it is certain that the motor and load settle more quickly than normal.

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FEED TO SENSOR



This instruction (Figure 48) allows the motor to move until an external event changes the state of an input.

One useful application for *FEED TO SENSOR* is when the motion distance varies. An example of this is using a step motor to dispense labels that come on a roll. The spacing of the labels is not exact, so it is not practical to simply feed out the same number of steps each time. Instead, use a sensor on the feed mechanism that "sees" the edge of each label and signals one of the MSS inputs to stop motion.

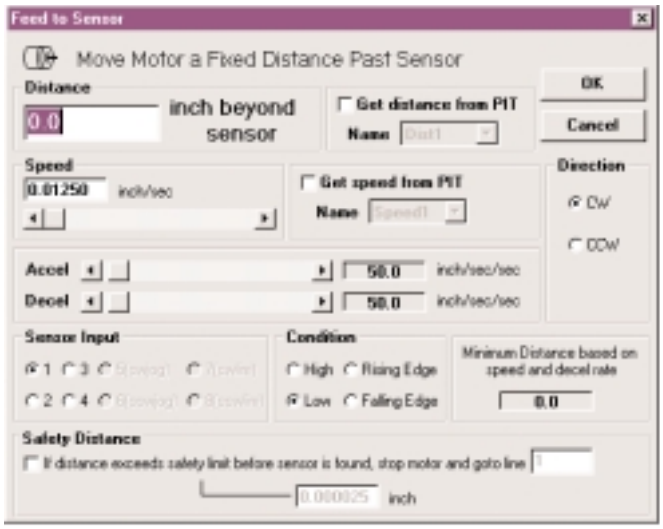


Figure 48 - FEED TO SENSOR DIALOG BOX

FEED TO SENSOR will ask for many of the same parameters as the other feed programs: *SPEED, ACCEL, DECEL* and *DIRECTION*. It is also necessary to specify a distance since the MSS must have enough space to decelerate to a stop once the sensor is tripped. The higher the speed, the longer it will take to stop. If the decel rate is increased, the motor can stop in fewer steps. The *MINIMUM DISTANCE* box tells how many steps must be allowed based on the speed and decel rate that is set. The distance cannot be set to less than this minimum.

The MSS must also be told which input the sensor is wired to and what input condition to look for. The four input conditions are:

HIGH - move until the specified input reaches a high voltage (no current) state. This is the default state of an input if nothing is connected to it.

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LOW - move until specified input is at a low voltage (closed) state.
RISING EDGE - move until the signal goes from low (current flowing) to high (no current flowing). This is similar to the high condition, but the difference is important. Assume a sensor is wired to the MSS, that will go high when motion is to stop. However, the sensor signal stays high after motion is complete, going low at a later time. This often happens in labeling applications where there isn't much space on the roll between labels. By choosing high as the input condition, the MSS will complete the motion, then refuse to start again because the input signal is still high. If a rising edge is chosen, the MSS can be restarted with the input voltage high and stop again when the sensor signal again goes from low to high.
FALLING EDGE - the opposite of rising edge. The MSS only recognizes the high to low transition (no current to current flow).
SAFETY DISTANCE - A safety distance and program line can be entered such that if the system does not see or reach the sensor, then, at the safety distance, motion (feed instruction) will stop and the program will go to the referenced line.

FEED TO SENSOR & RETURN



This instruction is the same as *FEED TO SENSOR*, except the motor returns to the starting point after the move.

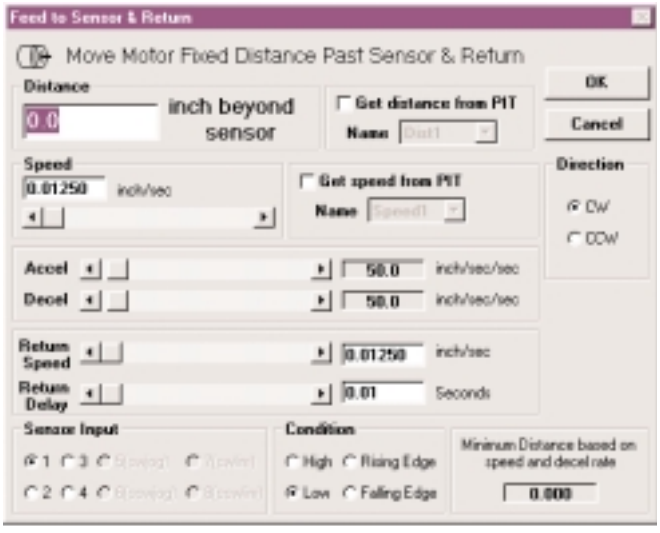


Figure 49 - FEED TO SENSOR & RETURN DIALOG BOX

Most of the parameters are the same as *FEED TO SENSOR*, except two new ones are added: *RETURN SPEED* and *RETURN DELAY.*

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A useful application of *FEED TO SENSOR & RETURN* is a variable distance application. If a machine cuts fabric of different sizes and the MSS is driving the cutoff knife, it is appropriate to set a sensor at the end of the cut off stroke. That way, manual adjustment can be for the width of material being used on a particular day without having to reprogram the MSS.

The indexer-drive feeds each time it is triggered until the knife trips the sensor, then returns to the starting point.

NOTE: The maximum distance for any program is 16,000,000 steps, the longest distance the MSS can track. If a move of more than 16 million steps is made before reaching the sensor, the MSS will not return to the correct position. If this is a problem, consider selecting a lower microstep resolution. At 50,000 steps/rev, the 16 million step limit is exceeded after 320 revolutions. At 2000 steps/rev, 8000 revs can be made before exceeding the limit.

FEED & SET OUTPUT



The *FEED & SET OUTPUT* instruction (Figures 50, 51, 52) allows combination of a Feed to Length instruction with a Set Output instruction, making the program shorter. Feed to Length and Set Output are frequently used in combination to make the MSS signal another device when it finishes a move.

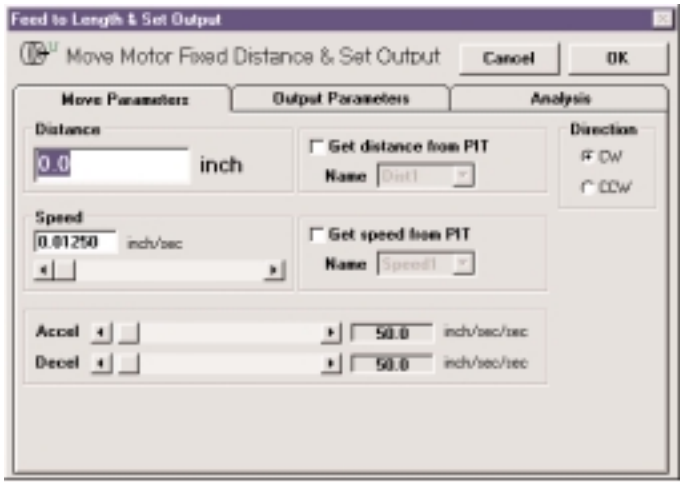


Figure 50 - MOVE PARAMETER DIALOG BOX

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Figure 51 - OUTPUT PARAMETER DIALOG BOX

Also the Feed & Set Output feature can improve manufacturing throughput. The MSS may be advancing a part which will then be processed by another device; for example feeding material to be cut off by a blade. If the blade requires some time to approach the material, it helps to trigger the blade before the material is fully advanced. That way, more pieces in the same amount of time.

Feed & Set Output allows an output to be set high or low at any point during the move. The Output Parameter Dialog Box allows flexible setting of the output timing and condition.

The analysis display (Figure 52) shows the motion profile and the transition of the output in either speed vs time or spread vs distance format.

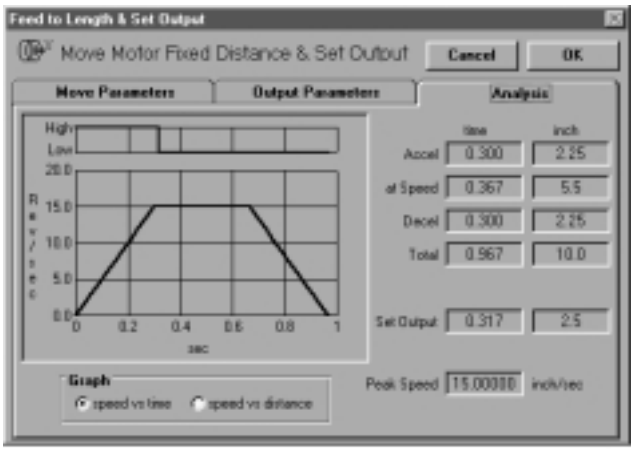


Figure 52 - ANALYSIS DISPLAY

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FEED TO POSITION



This instruction moves the motor and load from wherever they are to an absolute position. For example, if the load is at the 4 inch position and the program executes a Feed to Position 6 inches, the motor will move two inches clockwise. If the load was at the 10 inch position and a Feed to Position 6 inches was commanded, the move would be 4 inches counter clockwise.

Feed to Position requires the usual move parameters: speed, accel & decel rates. Like other move instructions, speed can be recalled from a PIT variable, allowing it to be entered by the operator on the PIT panel.

Position can be a positive or negative number, Position can be entered on the PIT, but note that the PIT has no minus (-) key, so a negative number cannot be entered on the PIT. Avoid using negative absolute positions by using the Set Position instruction.

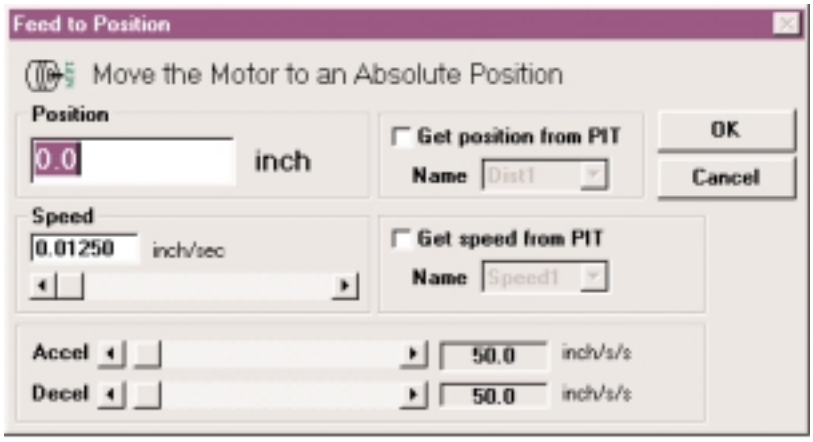


Figure 53 - FEED TO POSITION DIALOG BOX

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SET ABS POSITION



This instruction (Figure 54) allows the present motor position to be defined as any absolute position. The Seek Home instruction automatically clears the absolute position counter when it's finished, defining the home position as 0. However, it may be preferable to define the home sensor as the 8 inch position, or 90 degrees, or whatever. Simply put a Set Position instruction after the Seek Home instruction, or anywhere else in your program where appropriate to define the absolute position.

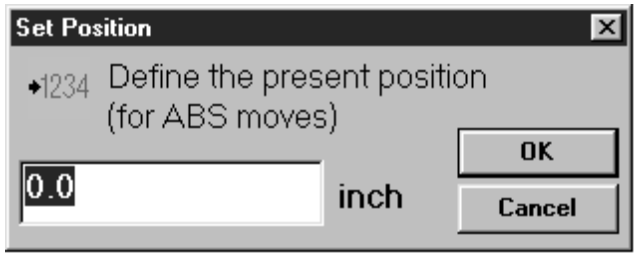


Figure 54 - SET POSITION DIALOG BOX

If the PIT is to be used for entering Absolute Positions, choose the position setting to allow PIT entries to be positive values.

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SAVE ABS POSITION



This instruction (Figure 55) allows the present absolute position to be saved to a PIT variable. This is useful if an operator is to visually position the load, and then be able to return to that position later in the program.

For a material handling application, a program could be created using the Wait Input command to allow the operator to move the load into position. The operator would then press an ENTER button to exit the Wait Input instruction. If the next instruction was Save Abs Position, the load position that the operator carefully obtained would be recorded in nonvolatile memory. Elsewhere in your program a Feed to Position instruction to return the load to the saved position could be used.

The MSS supports up to 8 PIT variables, so as many as eight different positions can be saved.

Even though the positions that the indexer has "learned" are still remembered after shutdown (because they are stored in nonvolatile memory), it is necessary to "home" the system each time it's powered up. Otherwise, the saved absolute positions don't make any sense.

NOTE: You need MSS with firmware version 1.52 or later to use the Save Abs Position instruction.

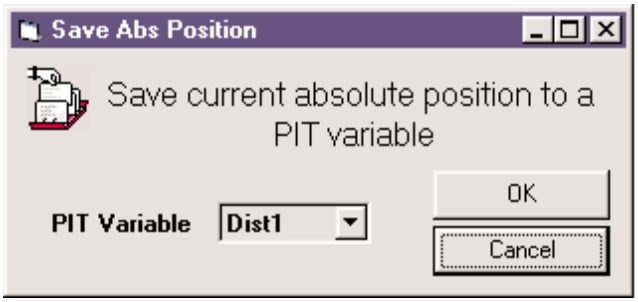


Figure 55 - SAVE ABS POSITION DIALOG BOX

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SEEK HOME



This instruction allows the motor to move until a home sensor is found. The home sensor can be wired to any of the general purpose inputs.

Some applications require the motor to start from a certain position each time the power is turned on, but can't guarantee where it was left at the last power down. The solution is to wire a sensor to one of the MSS inputs and place a *SEEK HOME* command at or near the beginning of the program.

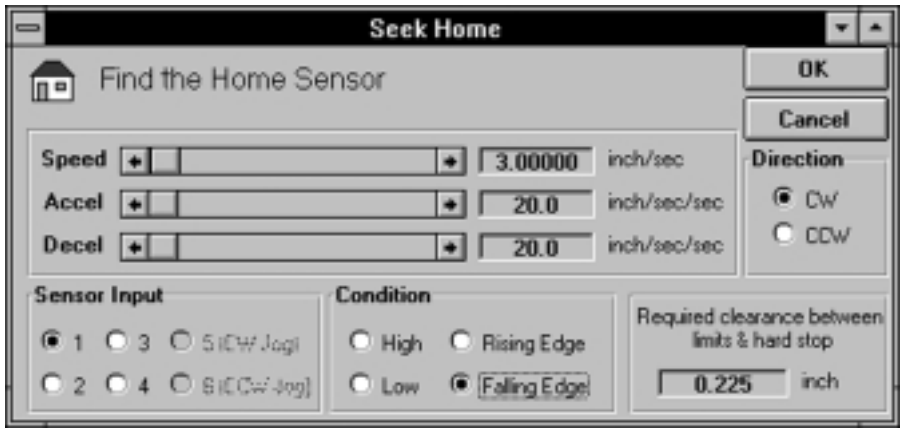


Figure 56 - SEEK HOME DIALOG BOX

SEEK HOME will ask for many of the same parameters as the other feed programs: *SPEED, ACCEL, DECEL* and *DIRECTION*. The MSS must also be told which input the sensor is wired to and what input condition to look for. The four input conditions are:

HIGH - move until the specified input reaches a high voltage (no current) state. This is the default state of an input if nothing is connected to it.
LOW - move until the specified input is at a low voltage (current flowing) state.
RISING EDGE - move until the signal goes from low (current flowing) to high (no current). This is similar to the high condition, but the difference is important. With a *SEEK HOME* command to a high input and the load already on the home sensor (causing the input to be high), the load will not move. Instead, choose "rising edge" and the MSS will move the load off and back to the home sensor.

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FALLING EDGE - the opposite of rising edge. MSS waits for input voltage to go from high, to low (no current to current flowing). If the input is already low at the start of the home instruction, it is ignored. It must go high, then go low to be recognized.

The MSS begins a *SEEK HOME* command by moving the motor in the direction specified. If the home sensor is found, the motor decelerates to a stop, then backs up to the position at which it found the switch edge. If a limit is encountered before the home sensor is found, the MSS reverses the direction of motion, then proceeds to the home sensor. That way it always ends up at the sensor no matter which side of the home sensor the load is started on.

For more precise homing and to be sure the home position is on the same edge of the home sensor a double home move is required, with a short move in between to go off the sensor. This allows a slow speed move with very small decel distance for the final homing. The first home instruction can be faster.

Tol-O-Matic Application Engineers can provide recommendations.

Always use a Hall Effect switch for the home sensor.

There is a box in the lower right-hand corner of the *SEEK HOME* dialog box. This tells how many steps the MSS needs to decelerate to a stop. The *REQUIRED CLEARANCE* box tells how much distance must be allowed between the limit sensors and any hard stop, based on the speed and decel rate that is set. If enough clearance is not allowed, the load may crash into something as it decelerates past a limit while seeking home.

The higher the speed, the longer it will take to stop. If the decel rate is increased, then the motor can stop in fewer steps.

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WAIT TIME



This is the simplest instruction. Simply enter an amount of time, and the MSS will pause for that time before proceeding to the next line in the program. The range is 0.01 to 300 seconds.



Figure 57 - WAIT TIME DIALOG BOX

The *WAIT TIME* instruction can be made to last longer (than 300 seconds) by placing a repeat loop around it. First factor the 3 minute delay into two parts. The most delay in one *WAIT TIME* instruction is 300 seconds. Therefore, six times 300 seconds results in 1800 seconds or 30 minutes. The program is shown in Figure 58.

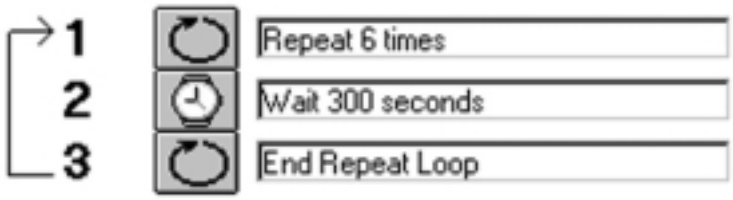


Figure 58 - WAIT TIME INSTRUCTION

Loops can be nested to provide very long delays.

WAIT INPUT



Rarely does a motion controller operate completely on its own with no input from the outside world. The *WAIT INPUT* command is used to cause the MSS to wait before it starts a motion.

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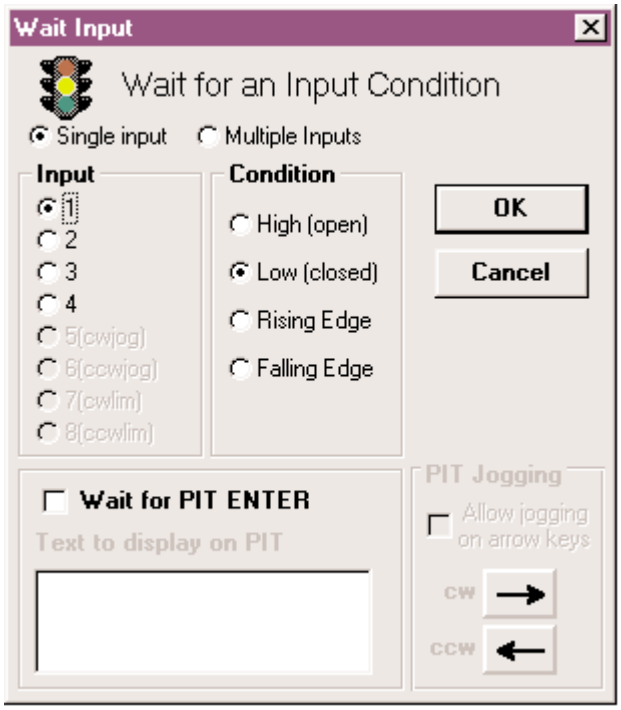


Figure 59 - WAIT INPUT DIALOG BOX

The *WAIT INPUT* instruction has two parameters (see Figure 59). The first is to specify the input. The second parameter is what kind of voltage condition to expect. The choices are:

HIGH - Wait until the specified input is at a high voltage (no current) state. This is the state an input will be in if nothing is connected to it, so be careful using this condition. If a wire comes loose, it could cause an undesired motion.
LOW - Wait until specified input is at a low voltage (current flowing) state. This is the most popular configuration. A momentary contact switch (normally open type) connected between an input and ground creates this condition when the button is pressed.
RISING EDGE - Wait until the signal goes from low (current flowing) to high (no current). This is similar to the high condition, but the difference is important. For example: a signal into the MSS is one that will go high when motion is to occur. However, the signal remains high after the motion is complete, going low sometime later. Choosing high as the input

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condition will cause the MSS to complete the motion and start again because the input signal is still high when it finishes the first move. If *RISING EDGE* is chosen, the MSS will wait for the input voltage to go low, then high (current flowing to no current) before moving.
FALLING EDGE - The opposite of *RISING EDGE*. MSS waits for input voltage to go high, then low (no current to current flowing).

Figure 60 illustrates a simple program that can be executed with the switch wired between *INPUT 1* and *GND*. Pressing the button will cause the actuator to move 5 inches and back 5 inches.

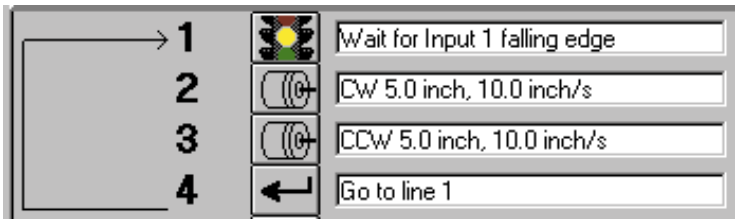


Figure 60

With the optional Panel-mount Interface (PIT), the *WAIT INPUT* instruction can be used to display a message on the PIT screen and wait until the operator presses the *ENTER* button on the PIT keypad. Simply check the box marked “Wait for PIT ENTER” and type the message in the box marked “Text to display on PIT.”

GO TO



The *GO TO* instruction is used to make the indexer-drive jump to another line in the program. To jump back to the beginning, place a *GO TO* instruction at the end of the program.

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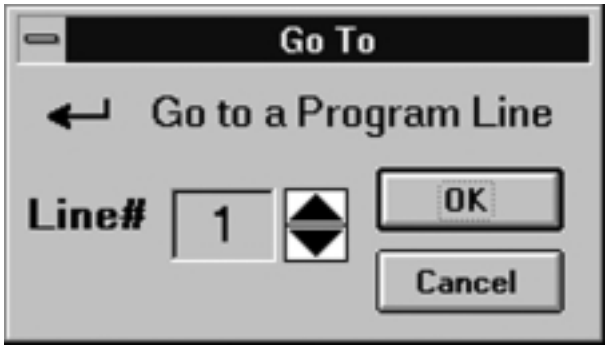


Figure 61 - GO TO DIALOG BOX

There is only one parameter to enter in a *GO TO* instruction: the line number to jump to. Click on the *SPIN* button to increase or decrease the line number.

REPEAT/END REPEAT



Sometimes the same thing is required several times. If that number is known in advance, Repeat loops allow the instructions inside the loop to be repeated up to 65535 times.

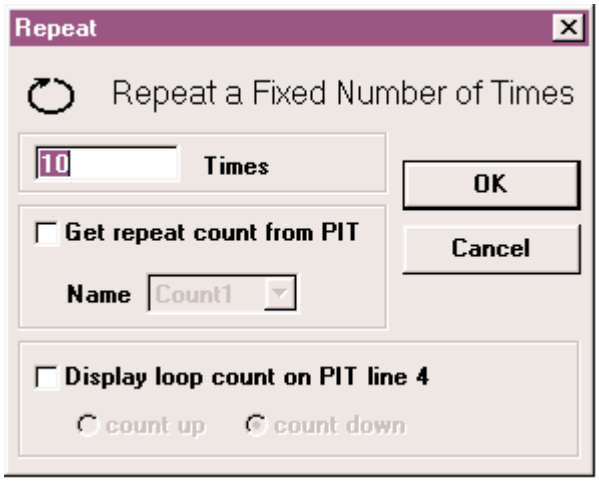


Figure 62 - REPEAT/END REPEAT DIALOG BOX

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Consider a system dispensing fluids into an array of containers. There are five rows and five columns of containers, each 1 inch away from the next. Each trigger command is to cause a move to the next position. After the fifth container is full, return to the first, 4 inches back.

A MSS controlling the X axis, or motion between columns, would be programmed as follows:

Refer to Figure 63. The program begins on line 1, entering the repeat loop. The next four times, the MSS will wait for the voltage at Input 1 to fall, then move 1 inch, taking the dispenser to the next container. After the fourth time, the MSS drops out of the loop into line 5. This time when Input 1 falls, the actuator is moved 4 inches back, returning to the original position.

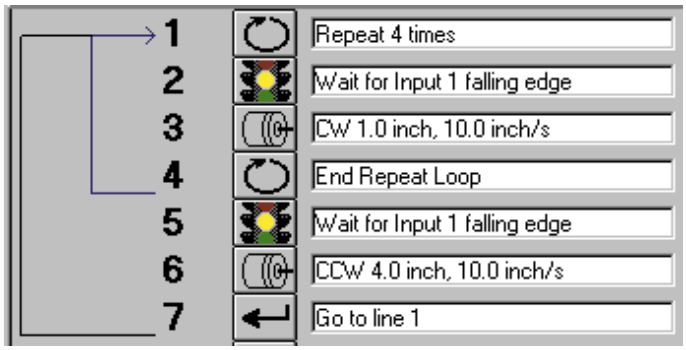


Figure 63

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Sometimes, it may be necessary to repeat something more than 65,535 times. For example, material is to be fed into a cut off knife and 100,000 pieces are to be created. The best solution is to set up 2 loops, one inside the other. The total number of cycles will be the number of repeats in the two loops multiplied together. 100,000 is 10,000 x 10, so one loop could be set for 10 and the other for 10,000 as shown in Figure 64.

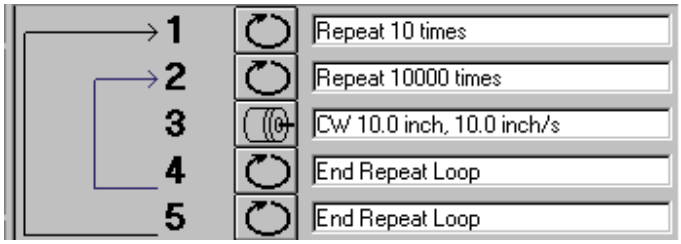


Figure 64

The *REPEAT* instruction can also use data gathered and stored by an *PIT PROMPT* instruction as the loop count. Check the box marked "Get repeat count from PIT" and select a variable from the list. For example, put an *PIT PROMPT* in the program to ask for the number of parts to be processed and save that data as *COUNT1*. Then set up the *REPEAT* instruction to get the repeat count from the PIT variable *COUNT1*.

The PIT can also display the loop count. Check Display on the dialog box and select Count up or Count down.

NOTE: If an input instruction is used to exit a Repeat Loop a Reset Repeat Loop instruction should be used to reset the loop. Otherwise the loop resumes where it left off.

RESET REPEAT LOOP



Forces a Repeat Loop to reset its counter if it's been terminated by an If Input or Feed to Sensor with Safety Distance instruction.

Sometimes it is necessary to leave a repeat loop before it is completed. If, for example, a repeat loop is set up to fill 100 bottles

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with fluid. If the reservoir runs dry, the loop is exited by putting an ***IF INPUT*** instruction inside the loop, triggered by a fluid sensor. The If Input could branch outside the loop, to a PIT Prompt telling the machine operator to refill the reservoir.

Suppose that 60 bottles have been filled, with 40 remaining. For the loop to "pick up where it left off", simply branch back to the beginning of the loop (to the Repeat instruction) after the operator finishes re-filling, and the loop will automatically fill the remaining 40 bottles.

On the other hand, consider a program to drill holes in parts, and each part gets five holes. The step motor is used to advance the part by 1 inch for each hole. So, there is a repeat loop with a count of 5. Along comes a bad part, detected after the 3rd hole is drilled. The loop is exited with 2 counts remaining.

If for the next part the program re-enters the loop again without reset, the next part will only get two holes drilled into it. What is wanted is for the loop to reset itself. For this, use the Reset Repeat Loop instruction as shown below.

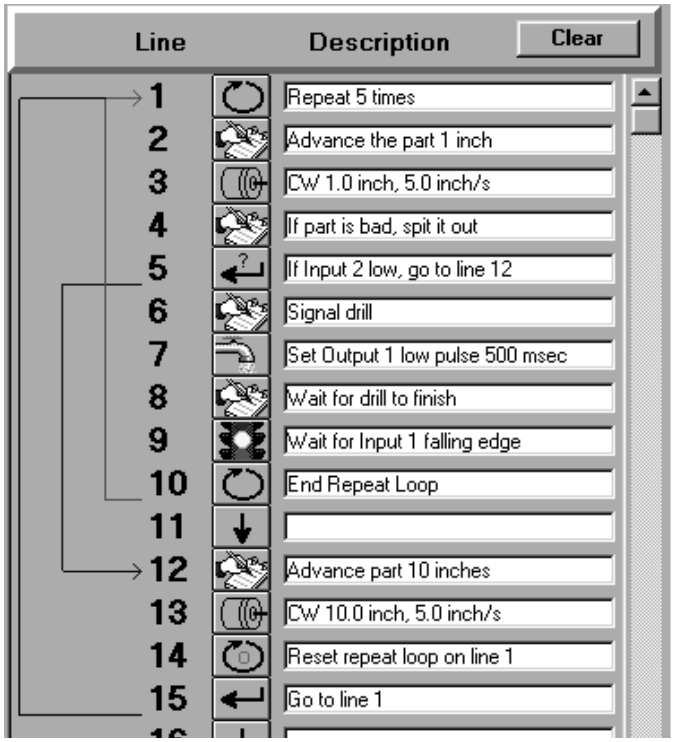


Figure 65

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SET OUTPUT



This command allow the choice of one of the three outputs and to put a voltage signal on it. For a detailed description of the circuitry and connections, see “Wiring Inputs" and "Wiring Outputs” sections of this manual.

There are four choices of output conditions (see Figure 66).

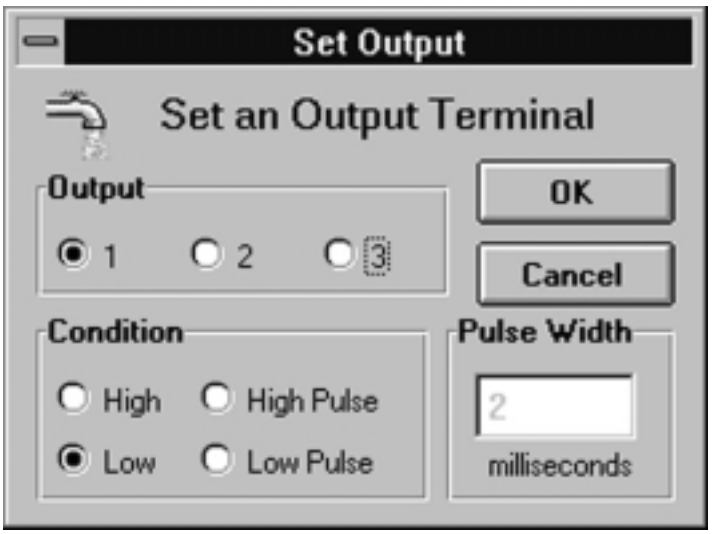


Figure 66

HIGH - Makes the photo transistor open. In circuits where the “-” output pin is grounded, and the “+” pin is pulled up, this causes a high voltage to appear on the “+” pin.
LOW - Makes the photo transistor close. In circuits where the “-” output pin is grounded, this causes a low voltage to appear on the “+” pin.
HIGH PULSE - Makes the photo transistor open for a specified amount of time (2 to 500 milliseconds)
LOW PULSE - Makes the photo transistor close for a specified amount of time (2 to 500 milliseconds)

At power-up, the MSS sets all 3 programmable outputs high (open circuit).

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As an example of the appropriate use of the *SET OUTPUT* instruction, consider a system dispensing fluids into an array of containers. Each time the MSS moves to a new position, it should tell the dispenser it has arrived. This can be accomplished with a high pulse, but the choice would depend on the kind of signal the dispenser wants to see in order to be activated.

There are five rows and five columns of containers, each 1 inch away from the next. Each trigger command is to cause a move to the next position. After the fifth container is full, return to the first, 4 inches back. After adding a *SET OUTPUT* instruction after each *FEED TO LENGTH*, the program is as shown in Figure 67.

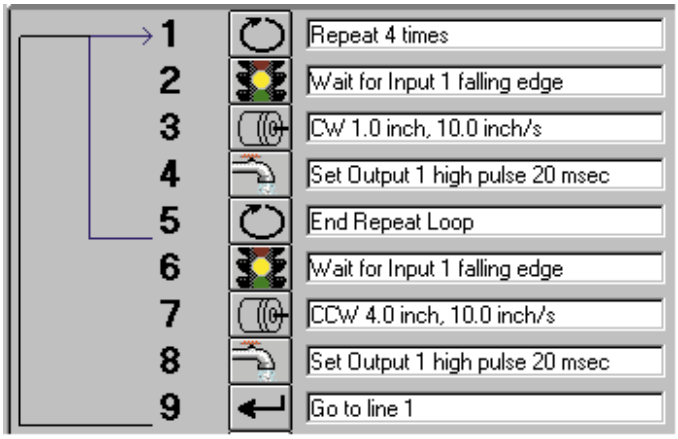


Figure 67

There may be occasions when a long pulse is required. This can be done by combining two Set Output commands with a Wait Time. The instructions shown in Figure 68 will produce a high pulse of 5 seconds on Output 3.



Figure 68

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IF INPUT GO TO



This instruction allows the MSS to make decisions based on input signals.

Refer to Figure 69. Choose an input terminal for the instruction to check. The MSS must also be told what signal condition to look for. Finally, the line number that the instruction will jump to must be set if the input condition occurs.

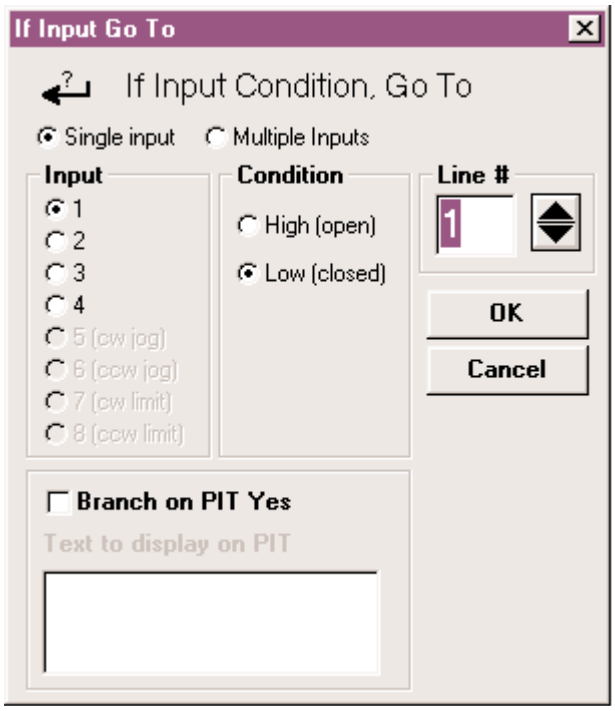


Figure 69 - IF INPUT DIALOG BOX

The *IF INPUT* instruction is included for three reasons:

1. It allows skipping part of the program based on an external condition. For example, the MSS's task is to feed parts. Normally the MSS waits only a half second before feeding the next part, because that's how long it takes for the saw to cut the part. However, parts are sometimes made of a different material that takes longer to cut (aluminum vs. steel, maybe). On the days steel parts are run, it would be advantageous to be able to flip a switch and change the delay between parts to 1.5 seconds. Figure 70 shows the program required to accomplish this.

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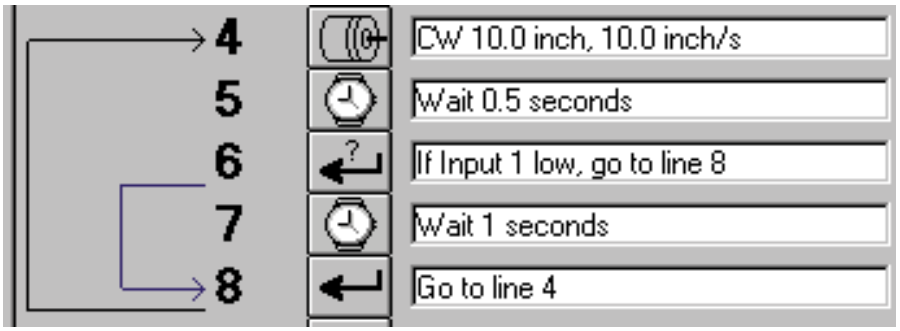


Figure 70

The program feeds a part during Step 4. Step 5, then makes it wait a half second. If the switch connected to *INPUT 1* is closed (low voltage signal state), the program jumps to Step 8, skipping the extra 1 second of delay. If the switch is open, the delay occurs. The switch's open circuit position can then be marked as "Steel" and the closed position as "Aluminum."

2. It allows a parameter to be changed such as distance or speed based on an input. Consider the example above. How will the cut-off saw know how fast to go when the switch is set for "Aluminum" or "Steel?" The same switch that controls the movement of the saw could be wired to the MSS. This time, the program is written as shown in Figure 71.

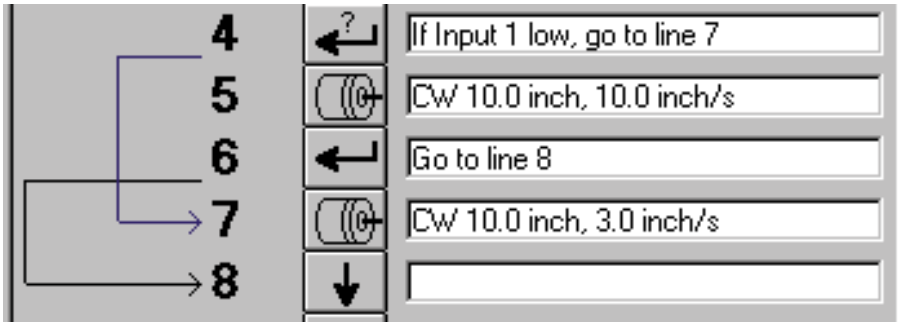


Figure 71

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When the MSS gets to Step 4, it will look at the "Steel/Aluminum" switch. If the signal is low (Aluminum), it jumps to the *FEED TO LENGTH* program at Step 7, which moves the saw at 3 inches/sec. If the switch is high, the program does not jump, but instead executes the *FEED TO LENGTH* at Step 5, which feeds at 1.0 inch/sec. The MSS then jumps past the second feed because of the *GO TO* instruction in Step 5. **NOTE:** To prevent moving the saw twice, do not forget the *GO TO*.

3. It allows the use of multiple programs within the 100 line program space. It may be that the system is to do is two completely different things depending on an input. If each of these tasks requires 4 instructions, the program should look like Figure 72.

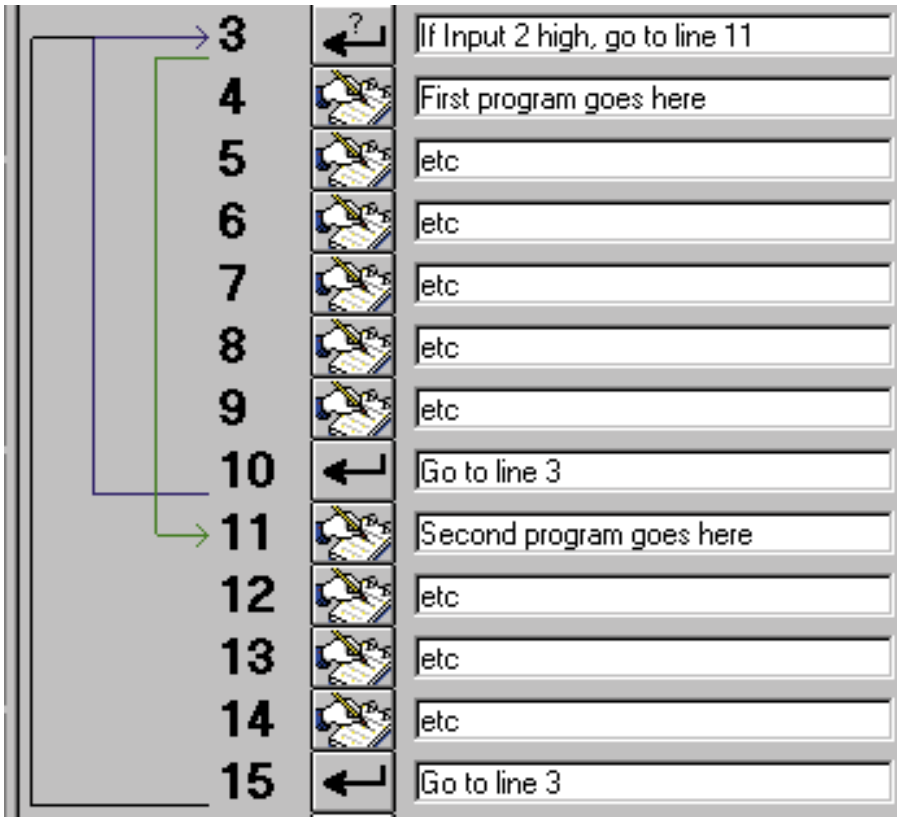


Figure 72

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Depending on the state of Input 2, the program will either execute lines 4–9 or lines 11–15. Either way, the program ultimately returns to line 3 to check the condition of the switch again.

The optional Panel-mount Interface (PIT) can be used as the decision making input of an *IF INPUT* instruction. Simply check the box marked “Branch on PIT YES” and type in the message the operator is to see. If the operator presses the *YES* button, the drive will jump to the line specified in the line number box. If the operator presses *NO*, the program moves on to the next line.

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Program Documentation

SAVE, LOAD, PRINT & QUIT

In addition to exchanging programs with the MSS, the programming software can also save & load programs using the hard drive, and can print hard copies of programs using the printer.



SAVE - allows saving a program to the hard drive. A file dialog box asks for a name for the program. Enter up to 8 characters, not including the suffix ".SI5". If a suffix is not added, the software will automatically add ".SI5" to the file name. The characters in the filename must conform to the usual DOS/Windows 3.1 rules. The safest approach is to use only letters and numbers in the filename, and to avoid special characters like "?" or "\".



OPEN - provides a dialog box showing all the ".SI5" files on the drive. Click to select one, then click OK to load it. .



PRINT - makes a hard copy of the program on any printer attached to the computer and installed in Windows.



QUIT - exits the MSS programming software and returns to the Windows Program Manager.

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Specifications

Amplifiers	Dual, MOSFET H-bridge, 3 state, pulse width modulated switching at 20 kHz. 0.5-5.5 peak Amps/phase output current, switch selectable in 0.2 increments. 340 watts maximum output power. Overcurrent and overtemperature protection. Automatic idle current reduction (defeatable), reduces current to 50% of setting after one second. Minimum motor inductance is 0.8 mH.
Power Supply	Linear, toroidal transformer based for high reliability and low noise. 110 or 220 Vac input, switch selectable (Max. ac inrush: 25 amps). 50-60 Hz. 340 W max. Dc voltage at nominal line voltage: 75 Vdc full load, 90 Vdc no load.
Inputs	Optically isolated. 5-24 Vdc, 20 mA max. 2200 Ω internal resistance. Can be configured for sinking (NPN) or sourcing (PNP) signals.
Outputs	Optically isolated. 12-24 Vdc, 100 mA max., per output.
Microstepping	13 switch selectable resolutions: 2000, 5000, 10000, 12800, 18000, 20000, 21600, 25000, 25400, 25600, 36000, 50000, 50800 steps/rev. Waveform: pure sine.
Motion Update	12800 Hz.
Physical	Constructed with black anodized aluminum heat sink and heavy gauge steel housing. 3 x 5.3 x 8 inches overall. 7.8 lbs. Ambient temperature range: 0-70 deg C. Power, over temp, and motor short circuit LEDs. Mounting brackets and switch cover included. See page 00 for detailed drawing.
Connectors	European style, pluggable screw terminal blocks. Motor: 4 position (A+, A-, B+, B-). Signal Input/Output: 18 position (8 input, 6 output, 4 limit). AC input: 3 position (L, N, G).
Agency Approvals	CE: complies with EN55011A, EN50082-1(1996), EN50178(1997); TUV.
Fuses	Wickman TR-5 style.Order from Digikey (1-800-DIGIKEY) 110V: P/N WK4258BK-ND (2.5 A IEC, slow) 220V: P/N WK4250BK-ND (1.25 A IEC, slow)
Maximum Case Temperature	75°C
Ambient temperature range	0 - 45°C

Use and Care

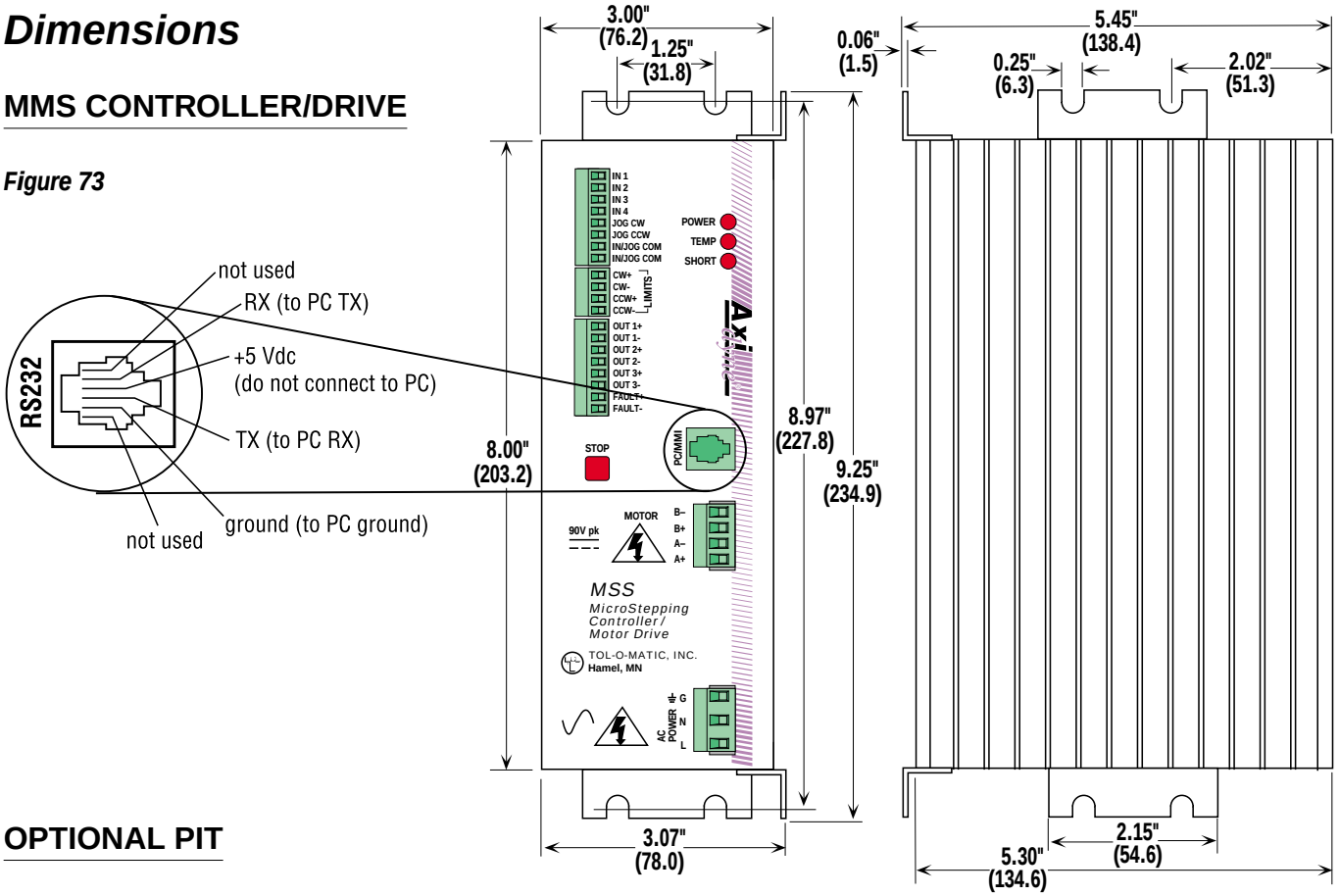
- Never allow metal particles near the drive.
- Never put the drive where it can get wet.
- Never block the fins of the heat sink or the vent holes.
- Never use the drive in a space where there is no air flow, or where the ambient temperature exceeds 50°C.

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Dimensions

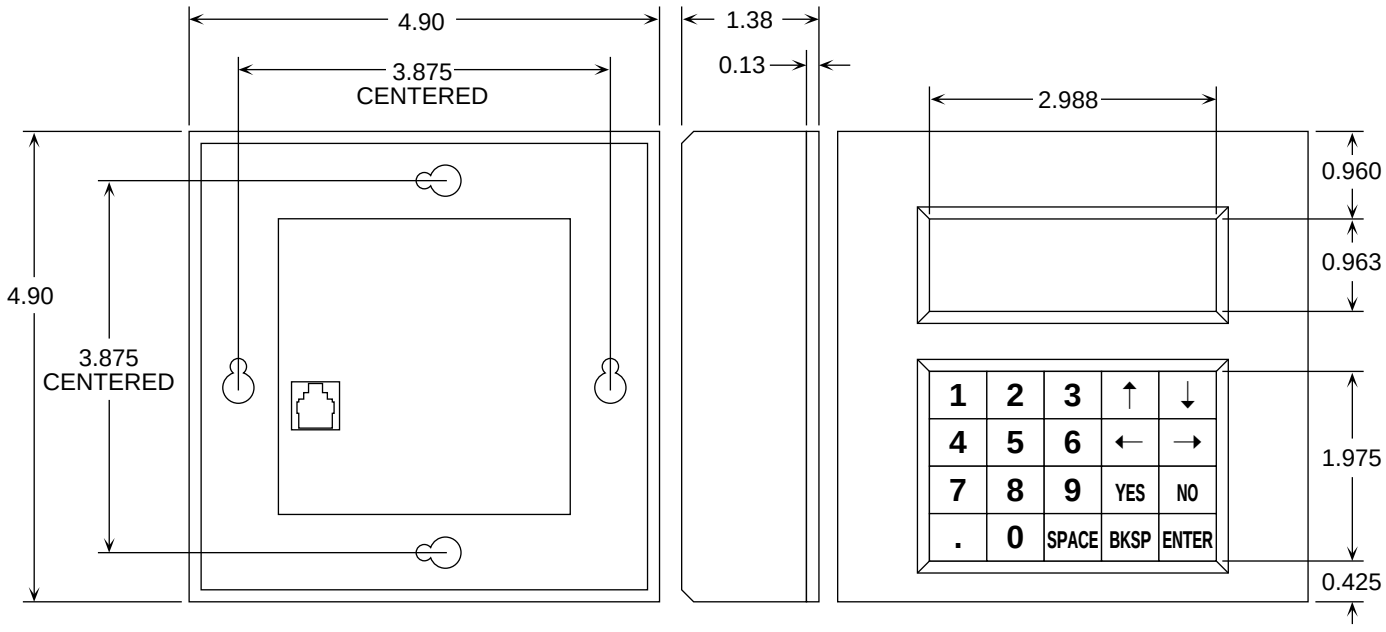
MMS CONTROLLER/DRIVE

Figure 73



OPTIONAL PIT

Figure 74



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Mounting Information

Mounting the MSS

The MSS can be mounted on the wide or the narrow side of the case. In either case, get the brackets and screws out of the accessory bag and bolt them onto the MSS. If mounting on the narrow side, first remove one of the screws from the heat sink, then put it back with the bracket in place, as shown in the Figure 75.

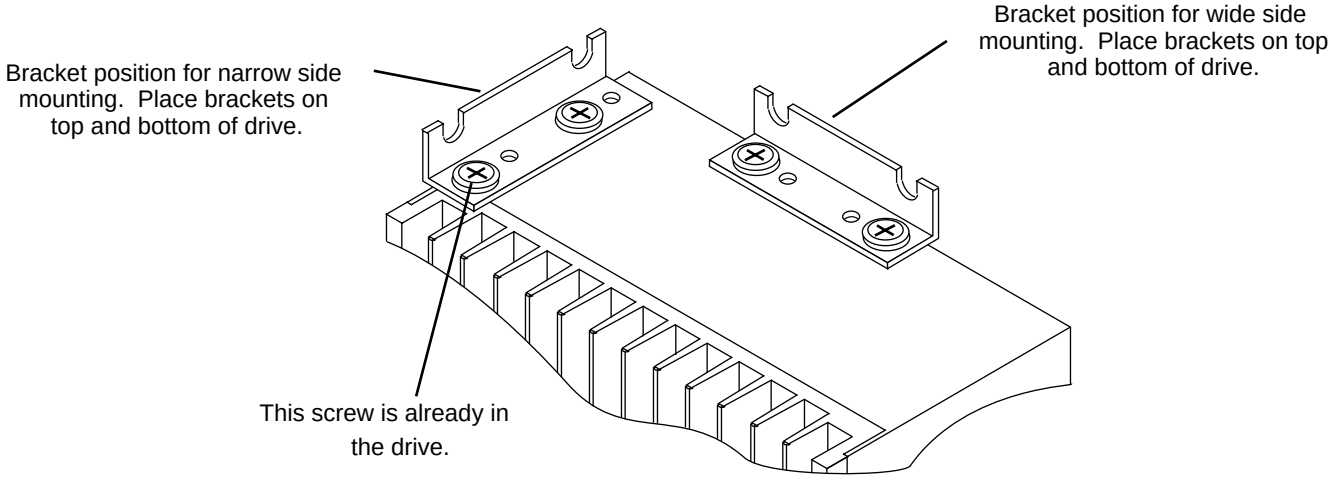


Figure 75 - MOUNTING THE MSS

Mounting the Optional PIT

There are two ways to mount the PIT in the application. In either case, connect the PIT to the MSS with the programming cable. **NOTE:** The adapter plug is not needed. The PIT has the same telephone style connector as the MSS.

Depending on how the PIT and cable are mounted, it may be difficult to remove the cable from the back of the PIT. If this is the case and it is necessary to reprogram the MSS, any telephone line cord can be used as a programming cable. Be careful not to lose the adapter plug that connects the telephone cord to the *COM* port of the computer. The adapter is only available from the factory.

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FLUSH MOUNTING

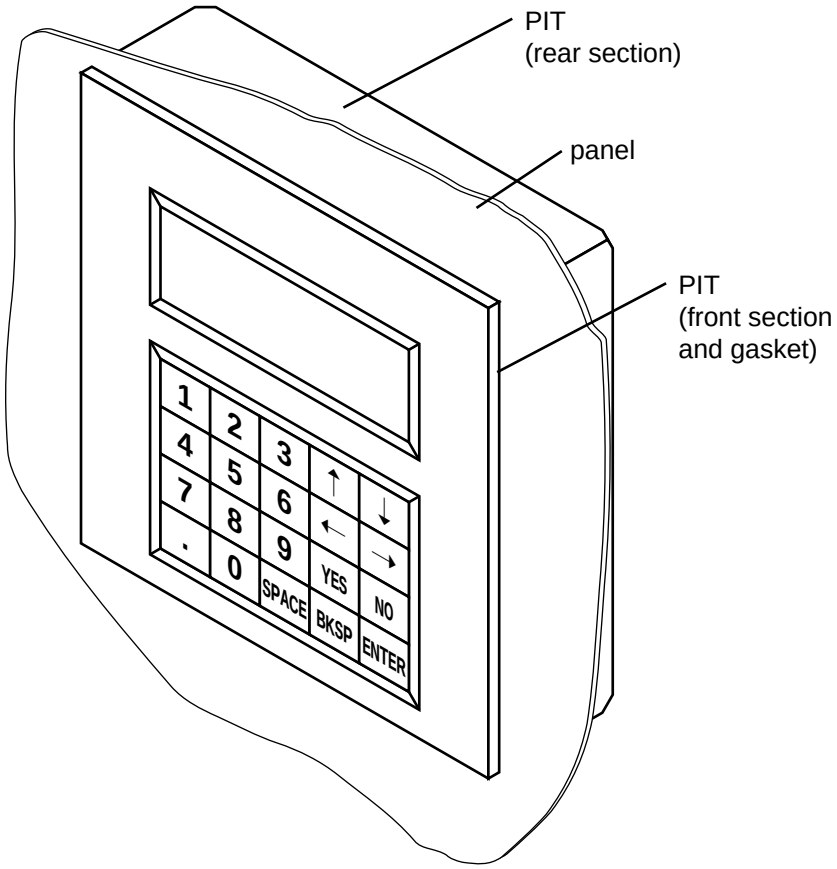


Figure 76 - FLUSH MOUNTING THE PIT

Fefer to Figure 75. After removing the PIT from the shipping carton, notice that it has two parts. The first is a fairly thin section that contains the keypad, display and some circuit boards. The other part is thicker and contains the telephone jack and a cable that connects to the thin part.

When flush mounting the PIT in a panel, only the thin section will stick out from the panel - the large portion mounts behind the panel. It is necessary to cut a precise section from the panel. A cardboard template is included in the box for this purpose.

If the PIT is to be dust proof and watertight, the black rubber gasket must be placed between the thin part of the PIT and the panel. Assemble the two halves using the eight small screws.

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SURFACE MOUNTING

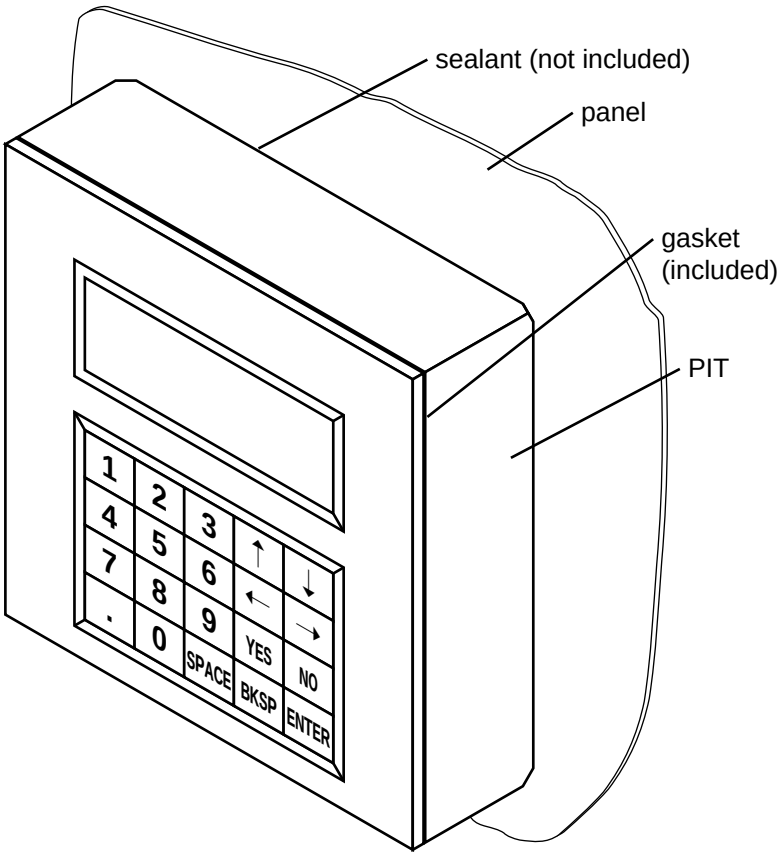


Figure 77 - SURFACE MOUNTING THE PIT

An easier way to mount the PIT is to bolt the two halves together ahead of time, using the eight small screws. If the PIT is to be dust proof and watertight, put the black rubber gasket between the two halves before screwing them together.

Next, cut a hole in the panel for the cable that runs between the PIT and the MSS. The hole must be at least 5/8" in diameter for the connector to fit through. There must be two holes that line up with the big mounting holes in the PIT. Figure 74 shows the location of the big mounting holes.

When mounting the PIT to the panel, some kind of sealant will be required to keep dust and liquid out. Silicone or latex caulking is appropriate, or make a gasket from a sheet of compliant material such as rubber or RTV.

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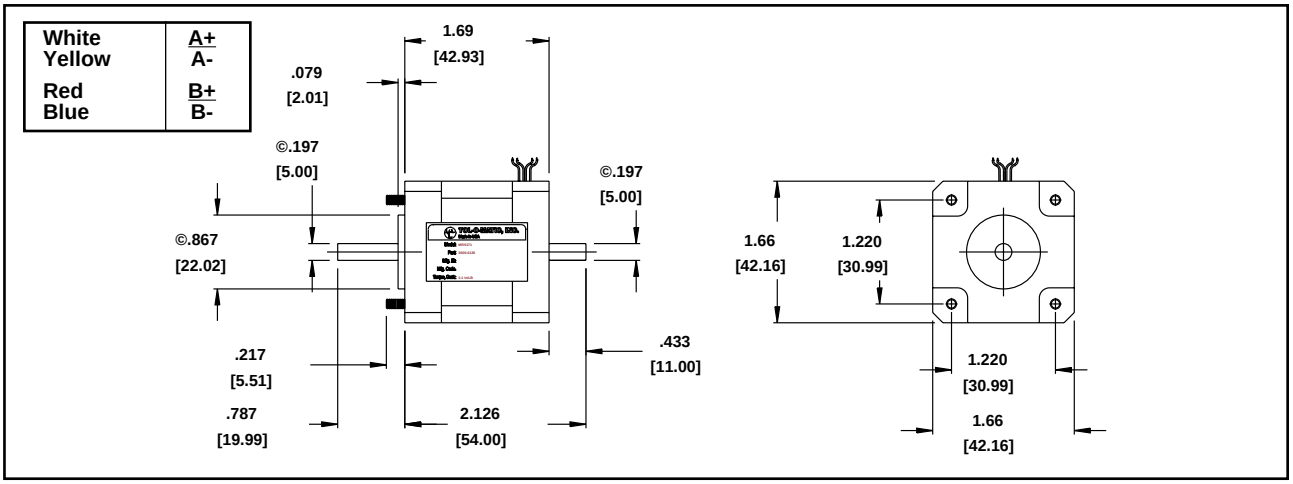
Recommended Motors

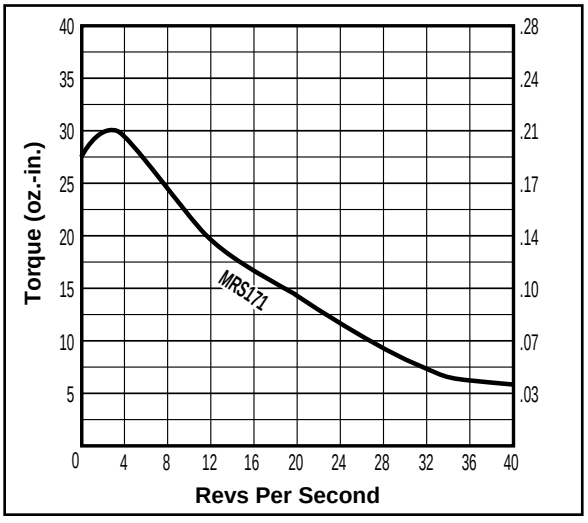
Motor Data and Dimensions

Tol-O-Matic catalog motor current settings (Figure 78).

MOTOR	WINDING CONNECTION	MAX. PERMISSABLE DRIVE CURRENT SETTING AMPS (PEAK)	ROTOR INERTIA (oz-in^2)	WEIGHT (lbs)
MRS171	parallel	1.4	0.17	0.66
MRS231	parallel	2.20	0.66	1.5
MRS232	parallel	3.60	1.39	2.5
MRS341	parallel	5.50	3.21	3.2
MRS342	parallel	5.50	6.56	5.3
MRS343	parallel	5.50	9.66	7.6

Tol-O-Matic 17 frame motor dimensions (Figure 79).

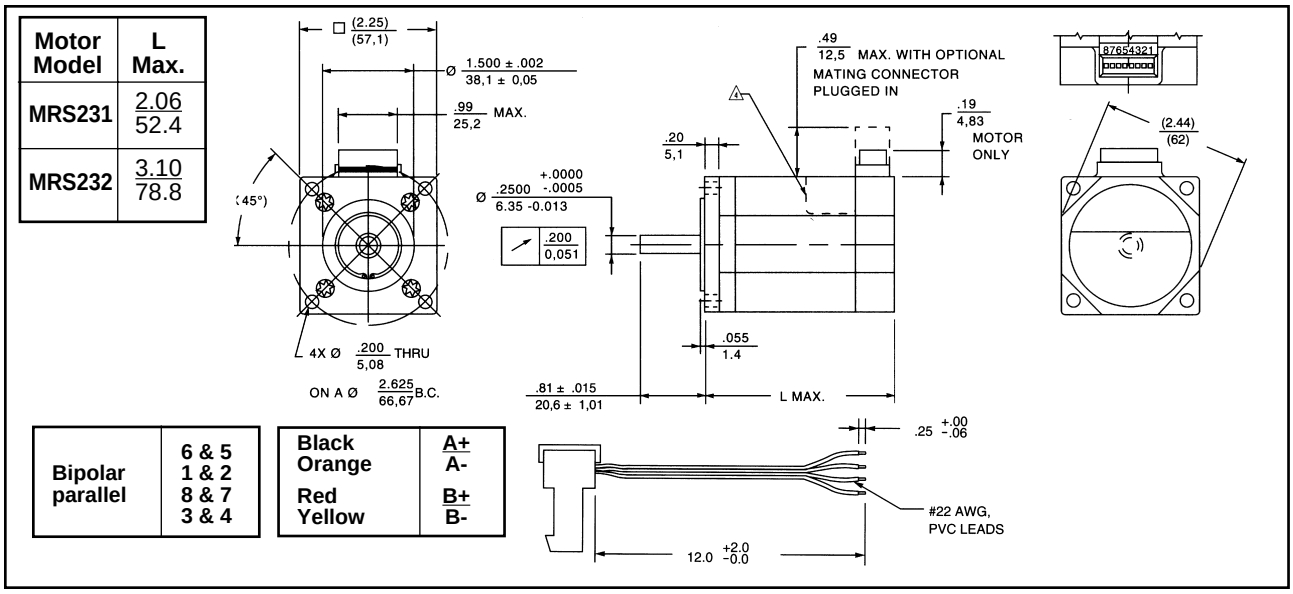




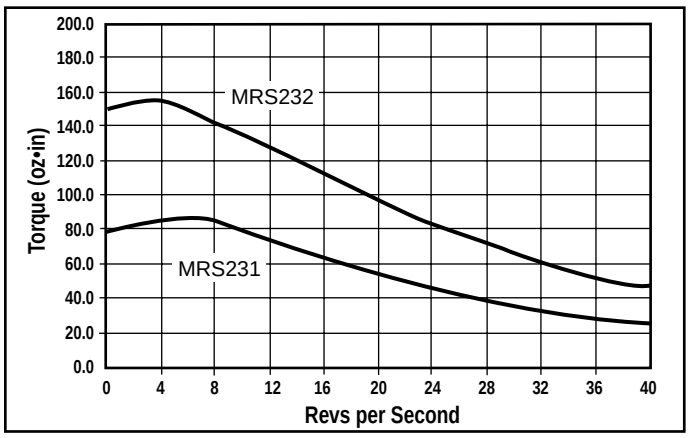
17 frame motor speed/torque characteristics (Figure 80).

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Tol-O-Matic 23 frame motor dimensions (Figure 81).



23 frame motor speed/torque characteristics (Figure 82).

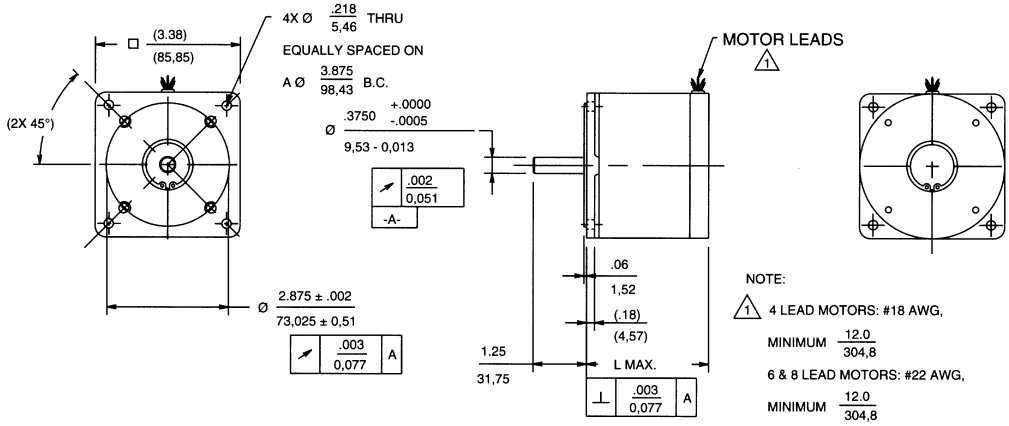


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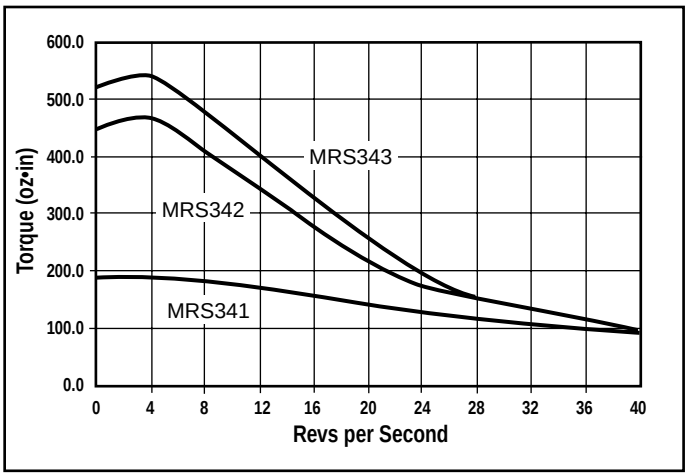
Tol-O-Matic 34 frame motor dimensions (Figure 83).

Motor Model	L Max.
MRS341	2.58 65.54
MRS342	3.76 95.51
MRS343	3.76 95.51

A+	Black
A-	Orange
B+	Red
B-	Yellow



34 frame motor speed/torque characteristics (Figure 84).



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