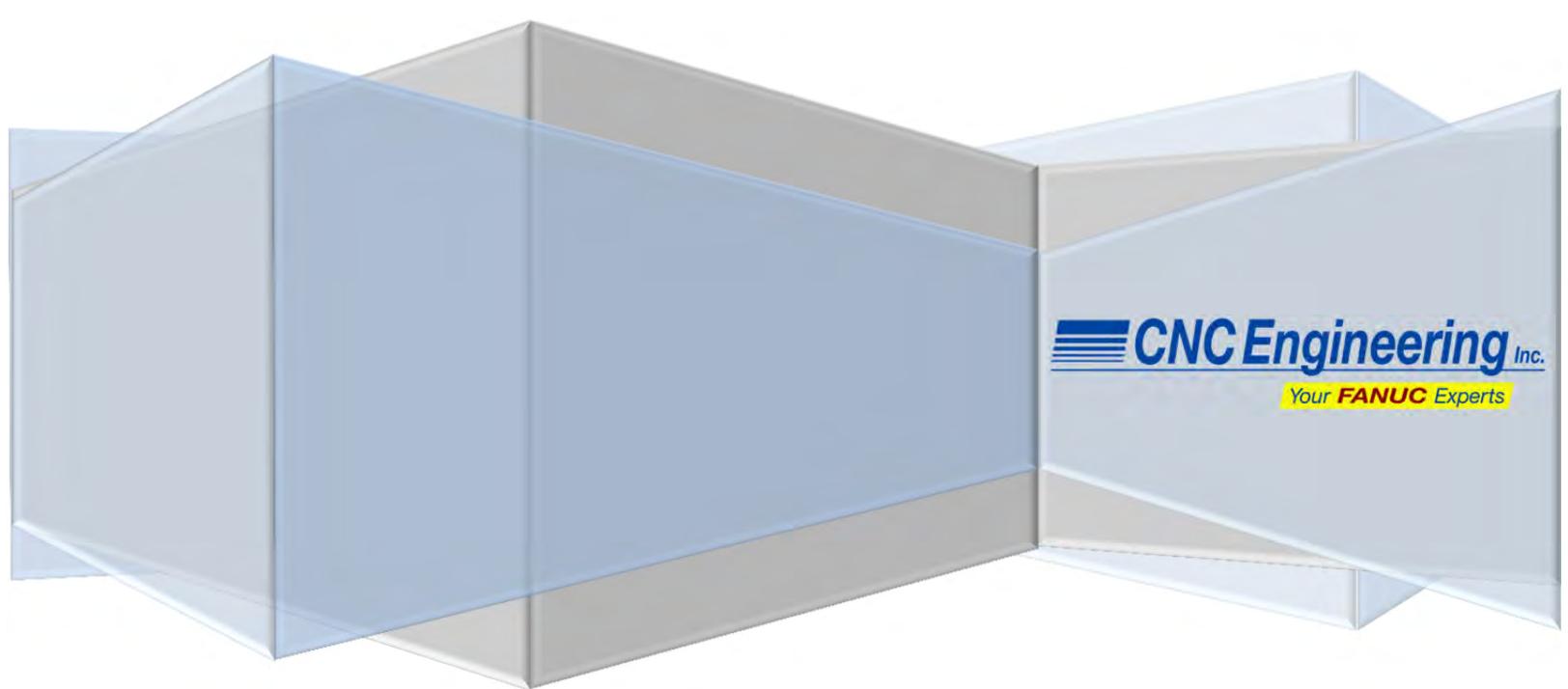


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CNC Engineering Retrofits for Makino Cell Control

Operation Manual



 **CNC Engineering** Inc.
Your **FANUC** Experts

Benefits of CNC Engineering's Cell Control System

User-friendly HMI

The graphical user interface of the Cell Control system from CNC Engineering allows the operator to easily set and view the status of any of the pallets and/or pallet stations. Pallets can easily be marked as "Ready to Load". Additionally, their load priority can be easily set or changed to alter the order in which pallets are processed.

Improved Pallet Placement

In the original system, it was necessary to move a pallet to one of the workstations prior to marking it as "Ready to Load" and making it available to a machine. This is no longer necessary, as any pallet can be moved directly to the machine from any pallet station.

Flexible Workstation Settings

In the original nine-station configuration, two pallet stations were designated as workstations. The functionality of those two stations can now be determined by the operator and set through an easy click of the mouse. These two stations can be designated, individually, as either a pallet station or a workstation. Determination of pallet placement is altered depending upon the current setting for these stations.

Home / Random Pallet Placement

A configuration setting allows the operator to specify whether pallets must be returned only to their "Home Station" or to any station that is available. If set to "Random", a pallet can be moved to any available pallet station, rather than having to be moved to its specific, dedicated station. This allows faster operation times of the pallet system, such as when a pallet is being unloaded from the machine.

Direct Machine-to-Workstation Pallet Placement

A configuration setting allows the operator to specify that pallets should be moved directly to an available workstation upon being removed from the machine. This allows the operator to more easily access the processed pallet to perform any post-machining functions.

Manual Machine Functions

The Cell Control Operator Panel allows the operator to move the shuttle in MPG and Jog modes. It also allows raising and lowering of the pallet on the shuttle. These functions provide a way of manually moving pallets from station to station, including the load station, without being in Auto mode. They also aid in the setup of the machine.

Improved Setup Procedure

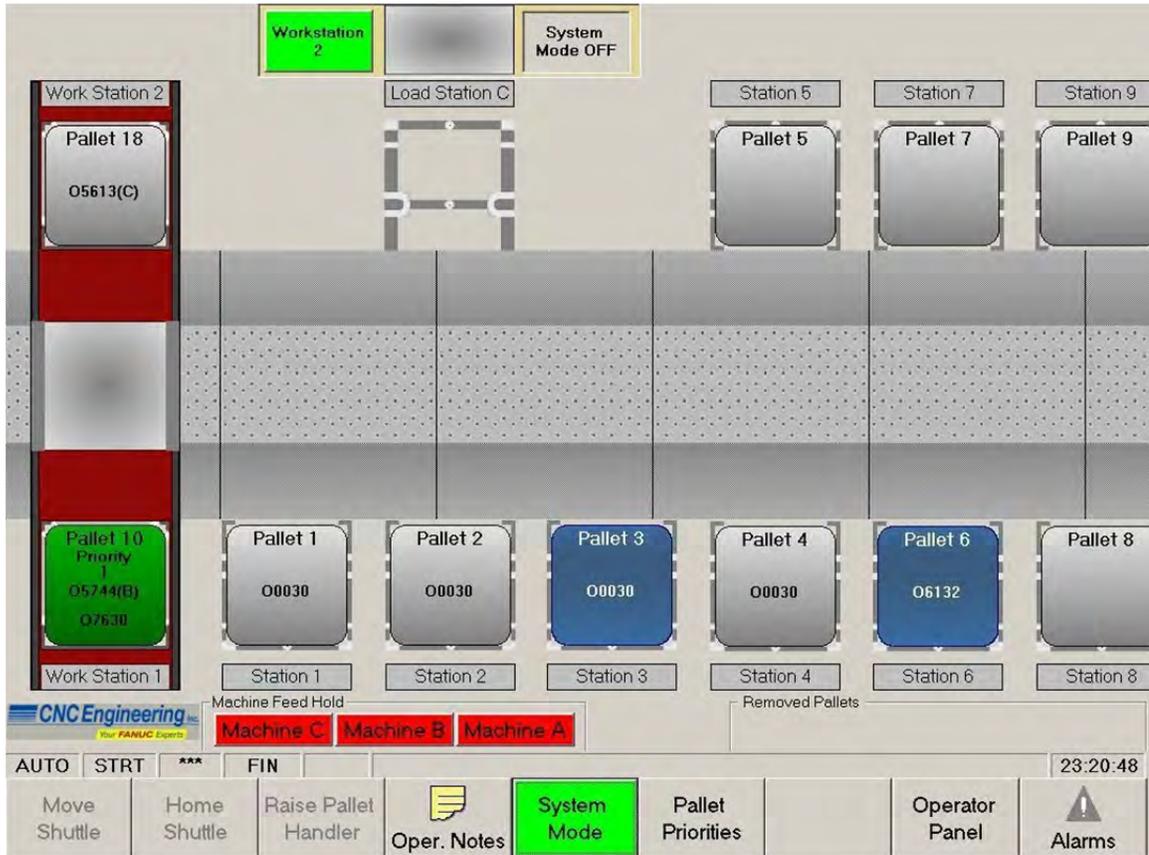
Using the manual modes of the Operator Panel, the system's setup screen allows capturing the shuttle's position at the press of a button. This allows quick and easy establishment of the shuttle position at each of the pallet stations, should a change be necessary due to mechanical changes or repositioning of the stations.

Diagnostics / Troubleshooting

Access to the Fanuc control's ladder, settings, and other diagnostic tools is provided through the use of Fanuc HSSB-based software, including the Ladder Editing Package and CNC Screen Display. This access will help in any problem resolution or changes that may be required in the future.

CNC Cell Control System Operation Manual

The CNC Cell control system by CNC Engineering provides an updated, easy-to-use interface for older Makino MMC automated cell controls. The functionality of the cell control, and its integration with existing Makino machines, is essentially the same as that provided by the older Makino cell control. While use of the HMI has been extensively improved and simplified, upgrading to CNC Engineering's cell control does not introduce any loss of functionality. Those familiar with the use of the old Makino system should have no problem learning CNC Engineering's improved system.

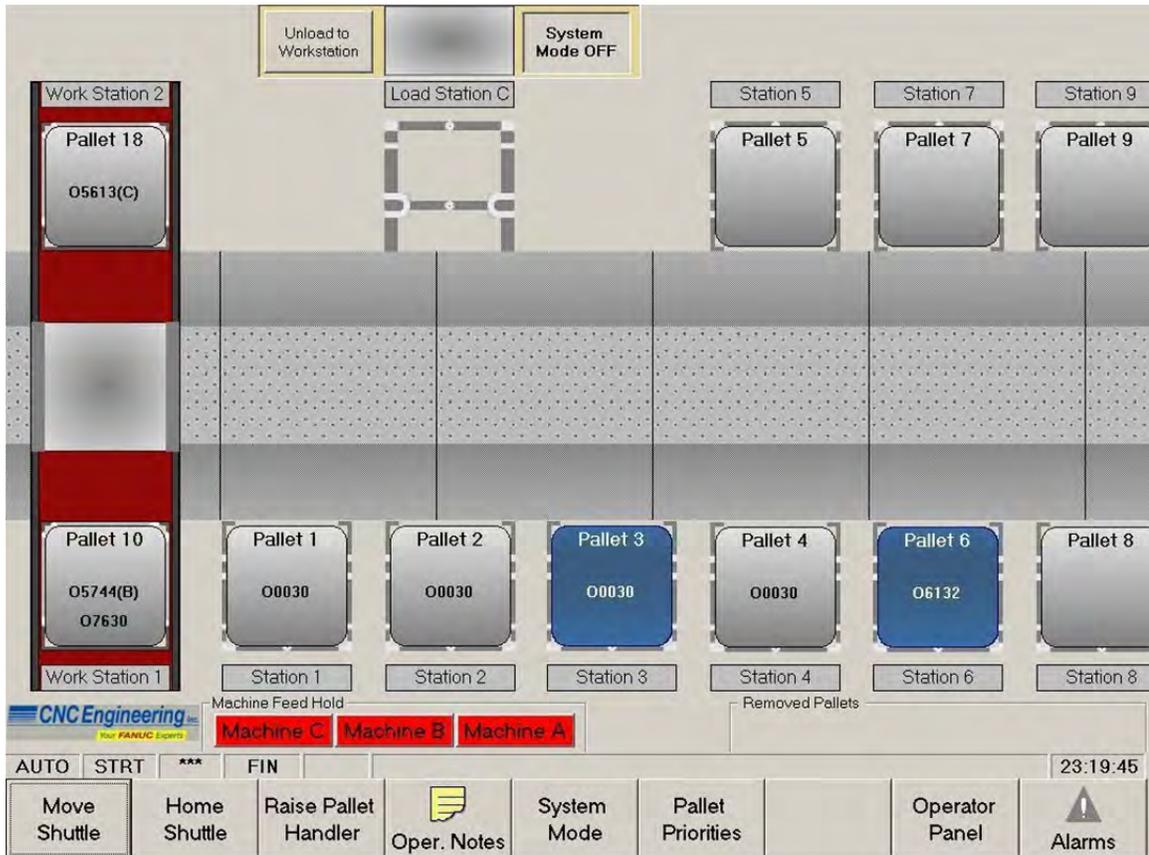


As can be seen from the above display, the interface for the cell control is entirely graphical. Each component of the actual cell, including the machines being serviced by the cell, is represented on the display. Operator functions are easily accessible using the touch screen interface and, where necessary, an on-screen keyboard. Any function normally performed by an operator is accessed with just one click on the main screen. This greatly reduces the amount of time that an operator spends to find the appropriate screen for the function.

Main Cell Control View

Shown below is the main screen used to perform the various operations of the cell control. This screen is used to move pallets between the various pallet stations, work stations, and machine(s) serviced by the cell control. The cell control system can service any number of machines, pallets and pallet stations.

All pallets, pallet stations, and machines are depicted in a graphical format and are laid out in the same orientation and configuration as the actual cell control. The image below shows that the work stations are situated at the left end of the cell, with the machines located on the same side of the cell as WorkStation 2.



The machine visible in the above image, Machine C, is identified by the corresponding Load Station and is one of three machines serviced by this cell. Machines A and B are not shown in this image since they are positioned to the right of Pallet Station 9. Since the computer used for the cell control uses a touch screen display, the operator simply needs to drag the screen to the left with his finger to view the pallets and machines located to the right. In this way, any portion of the cell can be viewed at any time.

Main Screen Components

Machine(s)

Any number of machines can be supported by the cell control. Each machine is represented by its load station (buffer) and an image of the machine itself. For clarification, the name of the load station identifies the machine. An alert area for each machine indicates if the machine is currently in System Mode or if an alarm is currently present on the machine.

If a pallet is currently located within the machine, the machine image will show the pallet number that is being processed.

The 'Unload to Workstation' button shown above is present only if the 'Enable Unload to Workstation' option on the Setup screen has been selected. Pressing this button will allow the operator to select whether pallets unloaded from this machine should be brought directly to Workstation 1, Workstation 2, or either workstation (if there is no pallet currently located on the workstation).

Note: The 'Machine Feed Hold' area located toward the bottom of the display is made up of one button for each machine configured in the cell. Pressing this button on the cell control screen places the respective machine into feed hold. This button is typically used for emergency purposes when something appears to be wrong with processing on a machine.

Shuttle

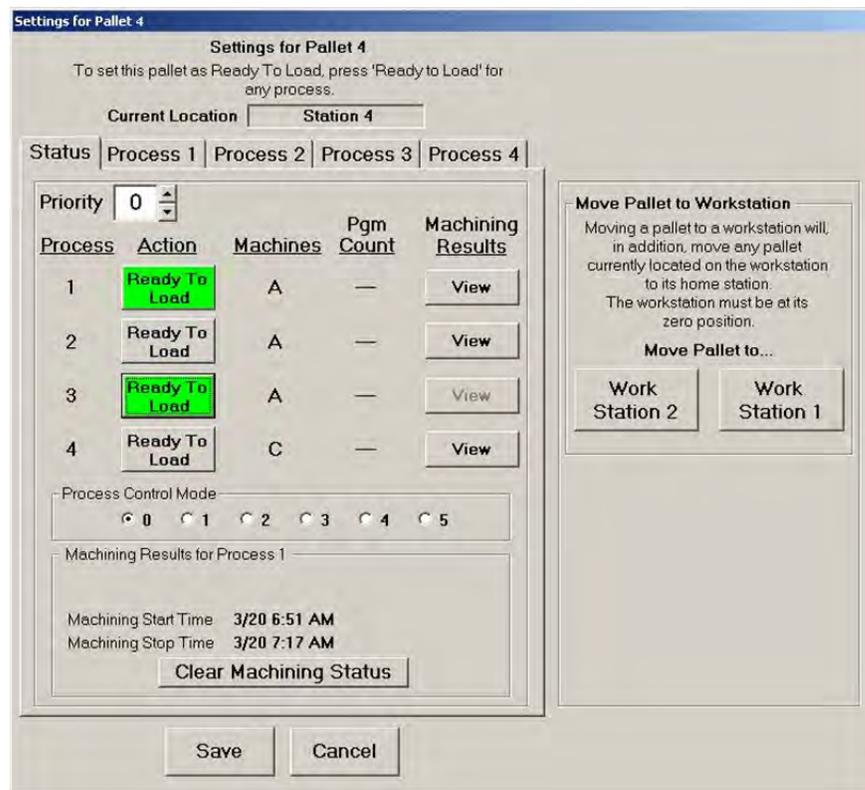
The shuttle is shown in its current position and its location is constantly updated to reflect its actual position within the cell. Any pallet that is located on the shuttle is also shown in the image. If the shuttle moves to a location outside of the current cell view, dragging the cell view to that area will again show the shuttle.

Pallets

Each pallet in the cell is represented by an image shown in the position where the actual pallet is located, typically on a workstation or the pallet's 'home station'. The color of the pallet represents the pallet's condition, such as ready-to-load or already machined.

If information has been specified for any machining process on the pallet, the NC program number for that process is shown on the pallet image. In addition, if the process has been marked as ready-to-load, the machine(s) that can be used for that process are shown next to the processes NC program number. The pallet color is also changed to green for a pallet that is ready to load.

Clicking on any pallet displays the 'Pallet Settings' screen for the pallet, as shown below.

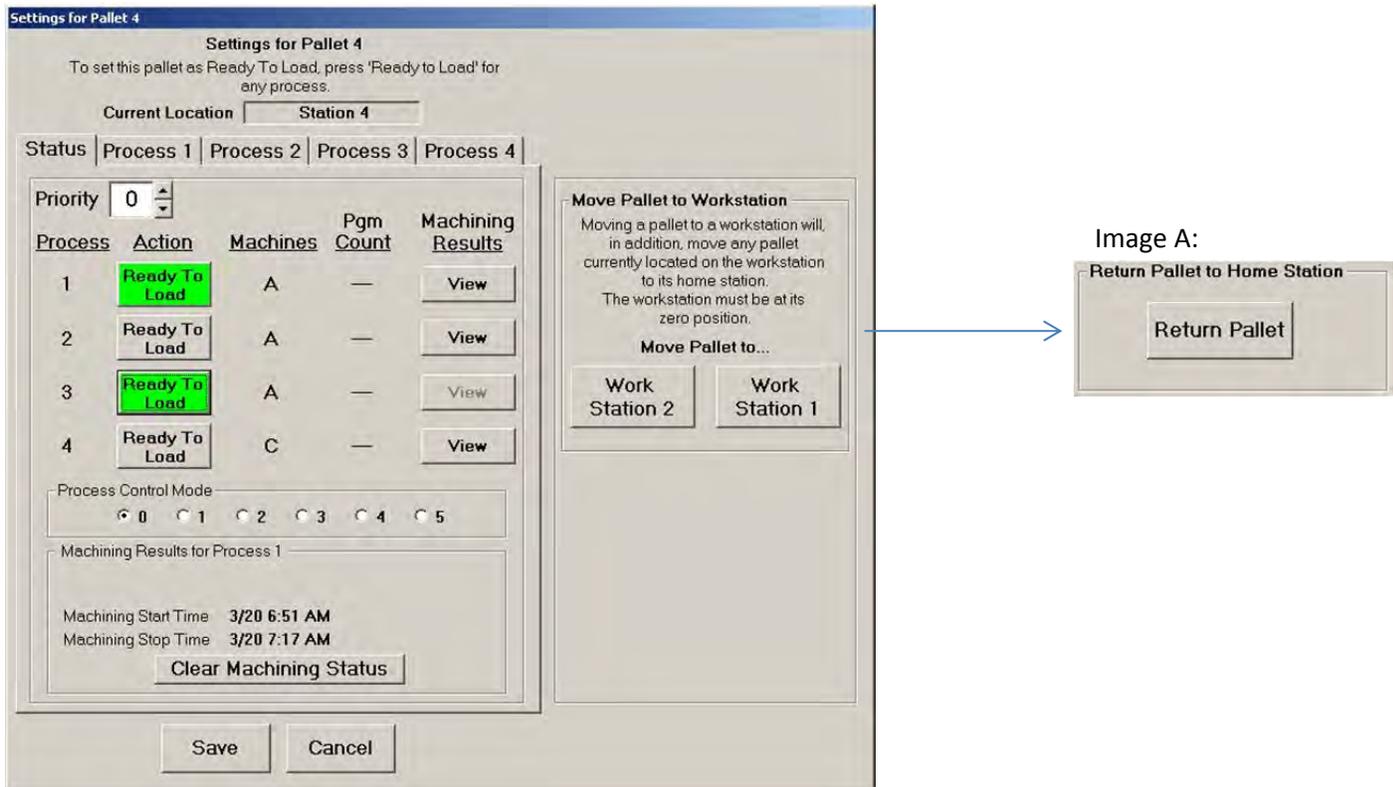


This Pallet Settings screen is made up of five main sections (tabs) and, possibly, a pallet movement button. The main 'Status' tab shows whether or not any of the processes is currently marked as ready-to-load, the machine(s) on which each process can be performed, the current program count, and information about any previous machining results for each process. Once machining information has been entered for any process, that process can then be marked as ready-to-load which will, in turn, mark the pallet as ready-to-load. Any pallet that is ready-to-load will then be available to be supplied to a machine when the cell control is in system mode.

The Process tab(s) allow entry of information for each machining process. The specific information for these tabs is described in a following section, 'Machine Process Information'.

Move Pallet Selection

The 'Move Pallet' area on the right of the Pallet Settings screen is shown when the pallet is located on a workstation or a pallet station.



In the screen image above, the pallet is on its home station, as shown by the 'Current Location' shown at the top of the screen. In this case, the operator can click one of the buttons to move the pallet to Workstation 1 or Workstation 2, if present. If no pallet is currently on the selected workstation, this pallet will be moved directly to that workstation. However, if a pallet is currently located on the requested workstation, the cell control will first remove that pallet and return it to its 'home' station. Once the workstation has been emptied, the original pallet will then be moved to the workstation.

Note: If a pallet must be removed from the workstation before the selected pallet can be moved there, it will automatically be removed. Therefore, care should be taken that it is safe to remove the pallet on the workstation.

If, however, the pallet is located on a workstation, this area of the screen will offer the ability to return the pallet to its home station (see Image A above).

Assuming that no machine is calling for a pallet, the pallet will be moved to its home station. If, however, a machine is calling for a pallet, and this pallet has been marked as ready-to-load for that machine, the pallet will be brought directly to the machine, instead of its home station. This provides more efficient movement of pallets than returning the pallet to its home station and then loading it to the machine.

Machine Process Information

Each pallet can have up to four machine processes defined, depending upon the option set on the Setup screen. Each process defines the information required to load the pallet to a specified machine(s), when requested.

Settings for Pallet 19

To set this pallet as Ready To Load, press 'Ready to Load' for any process.

Current Location: Work Station 1

Status: Process 1 | Process 2 | Process 3 | Process 4

Allowable Machines:

- Machine C
- Machine B
- Machine A

Pallet Face (degrees): 0 90 180 270

Program Number: 5940

Description: 59393-4002

Block Delete:

- /2 /3 /4 /5 /6 /7 /8 /9

Program Count:

- Enable Program Count
- Increment Count
- Decrement Count

Starting/Current Count: [] Initialize

Target Count: []

Clear Info

Return Pallet to Home Station

Return Pallet

Save Return

Allowable Machines

If more than one machine is being serviced by the cell control, these fields allow selection of the machines on which this process can be performed. If more than one machine is selected, this indicates that the process can be processed on any of the selected machines and the pallet will be loaded to the first available machine.

Pallet Face

This selection is used to indicate the side of the pallet, (the 0, 90, 180, or 270 degree face), that contains the part to be processed on the selected machine. Although only one face can be specified for each process, if more than one process is being used on a pallet, each process can specify a different face.

Program Number

This field specifies the name of the NC program that will be run by the machine when it begins to perform this process. This NC program must, therefore, be present in the selected machine's program memory.

Description (optional)

This is a free-form description used by the operator to better identify the process that will be performed. Any characters may be entered in this area.

Block Delete (optional)

If the NC program to be run on the machine for this process contains block delete codes, selecting any of these Block Delete indicators can be used to cause specific processing to be executed or skipped when the NC program executes on the machine.

Program Count (optional)

These settings can be used to keep count of the number of times this process has been performed on any machine. Whether the count is being incremented or decremented each time the process is performed, the process will not be able to be marked as ready-to-load once the target count has been reached.

If a pallet is present on the shuttle it can only be moved to a station which is not currently holding a pallet. In this case, if the 'Automatically Lower Pallet at Station' option has been selected on the Setup screen, the shuttle will lower the pallet once it reaches the station and back off to its center, home position.

'Home Shuttle' Button (available only in Manual mode)

Pressing this button will cause the shuttle to return to its Z-axis home position, roughly centered between the pallet stations on each side of the cell.

'Raise/Lower Pallet Handler' Button (available only in Manual mode)

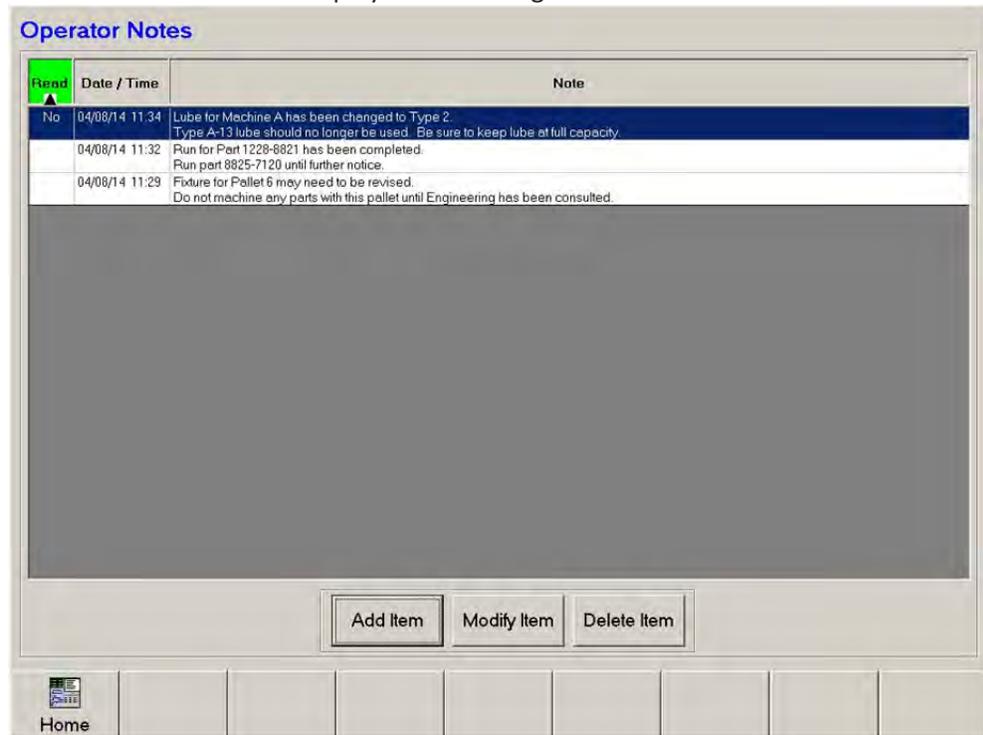
The use of this button changes depending upon the current state of the pallet handler (the mechanism used to raise and lower the pallets on the shuttle).

When the handler is raised, pressing this 'Lower Pallet Handler' button will cause the handler to lower. When the handler is lowered, pressing this 'Raise Pallet Handler' button will cause the handler to lower.

Note: Care should be taken that no pallets or stations are in the path of the pallet handler when using this function.

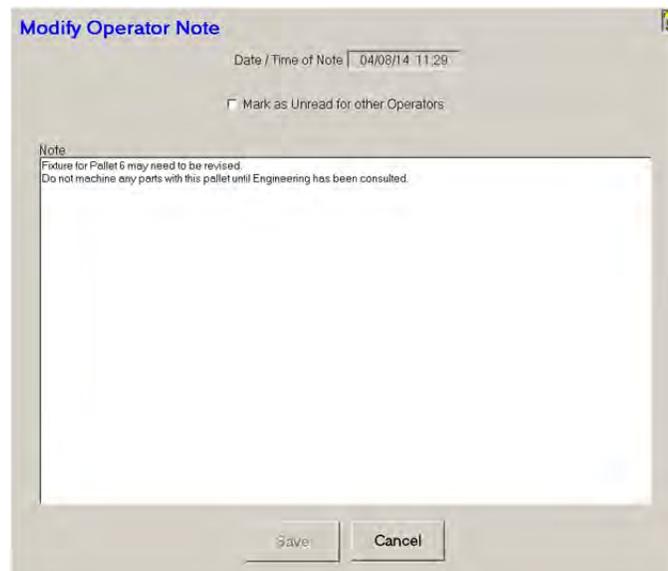
Operator Notes

Pressing the 'Operator Notes' button will display the following screen.



This screen shows all operator notes that have been entered by various operators. It can be used for any purpose, but is especially convenient for communication between operators working different shifts.

As can be seen above, there are currently three notes that have been entered. The list of notes provides a quick way to preview the notes. This list can be sorted by whether or not the note has already been read or by the date and time the note was created. By double-clicking on any note, or pressing the 'Add Item' button, the following screen is displayed.



After entering the desired note, the operator may select the 'Mark as Unread for other Operators' checkbox. Doing so will cause the 'Operator Notes' button on the main screen to flash, alerting other operators that there is an important note to be read. Once the other operators have read the note, and unchecked the 'Mark as Unread for other Operators' checkbox, the button on the main screen will stop flashing, assuming that there are no other notes that are marked in this same fashion.

Pallet Priorities Screen

Pressing the 'Pallet Priorities' soft key on the main screen displays the following screen:

Pallet Priorities

All pallets are shown below, listed in order of Priority and Pallet Number.
Change the Priority for any pallet(s) and press 'Save'
or
press 'Cancel' to return without making changes.

Priority	Pallet No.	Machines	Priority	Pallet No.	Machines
1	Pallet 1	B		Pallet 10	B, A
1	Pallet 5	C		Pallet 11	B
1	Pallet 6	A		Pallet 12	A
2	Pallet 3	A		Pallet 13	A
3	Pallet 7	B		Pallet 15	C
3	Pallet 8	B		Pallet 16	B
3	Pallet 9	A		Pallet 18	C
4	Pallet 14	B		Pallet 19	C
4	Pallet 17	B		Pallet 20	A
4	Pallet 22	B		Pallet 21	A
4	Pallet 23	A		Pallet 24	C
	Pallet 2	C		Pallet 25	C
	Pallet 4	C, A			

Save Cancel

This screen displays a list of all pallets in the system. It allows the operator to assign a priority to each pallet. The priority is used by the cell control to determine the order in which to load pallets to a machine that is calling for a ready-to-load pallet in system mode.

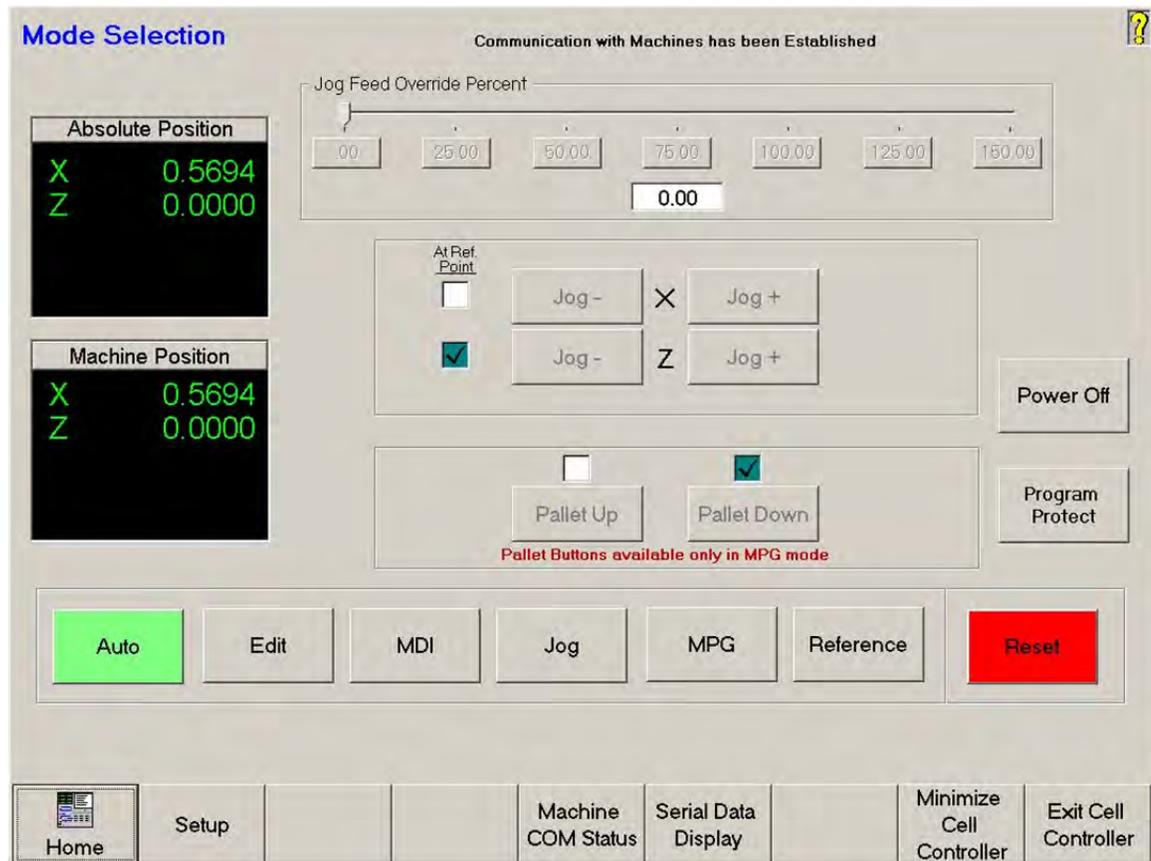
The list is shown in priority order and then, within that, pallet number order. Pallets with a lower number receive the highest priority when the system searches for the next ready-to-load pallet to load to a machine. Pallets with no priority (or a priority of zero) have the lowest priority. If more than one pallet has been assigned the same priority number, the pallets are given priority within that number based upon pallet number.

In addition to the pallet's priority, each item also shows the machine(s) that have been specified on any of the processes being used on the pallet. This should allow for easier assignment of priorities by the operator.

Note: Pallet priorities are not required. If no priorities are assigned to any pallets, they are all treated as equal and will be selected to be loaded to the machine(s) in pallet number order.

Operator Panel

The operator panel, shown below, provides access to functions that are not used during normal operation of the cell control.



These functions include changing the operating mode of the control to be able to reference and manually move the axes. These functions are normally used only during initial installation of the cell control system, such as when the station coordinates are being set.

The 'Program Protect' button, however, may be used on a regular basis. When Program Protect is on, the 'Program Protect' button will be highlighted. In this mode, operators will not be able to change the machining process information for any pallets. They will only be able to select the desired processes as ready-to-load. Turning program protect off, (requires an operator password), will provide full access to all pallet settings.

The 'Power Off' button will power down the cell control system as soon as it has completed any active processes. While waiting to power down the cell control, certain functionality, such as editing pallet information, will be disabled.

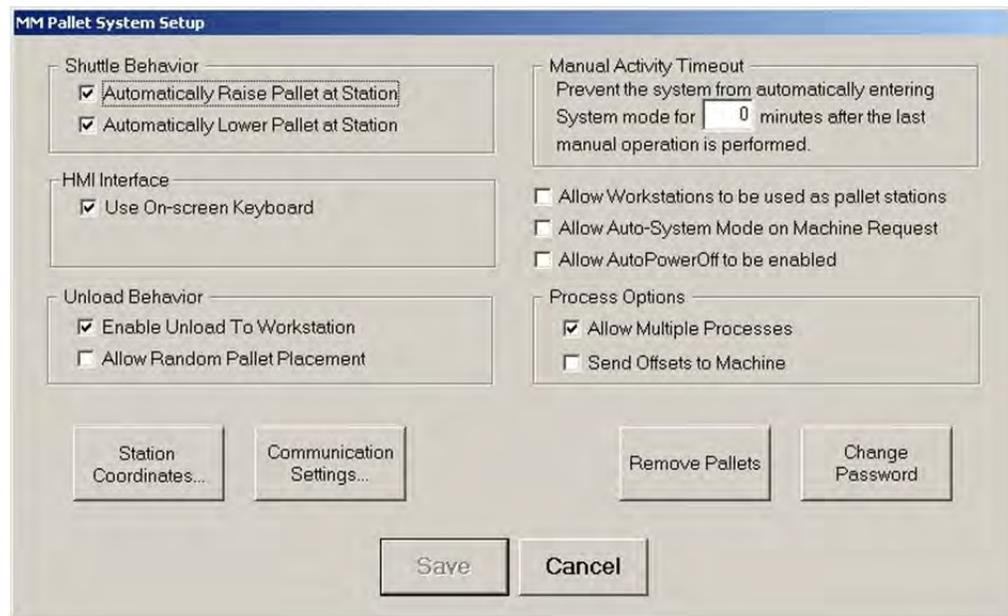
The 'Minimize Cell Controller' and 'Exit Cell Controller' buttons on the above screen affect the Cell Control software application. Pressing the 'Minimize' button will remove the HMI display from the computer and show it as an icon in the normal Windows task bar on the computer. To restore the display, simply click this icon in the task bar.

Pressing the 'Exit Cell Controller' button will cause the HMI software to end immediately. This should never be done, but is available for diagnostic purposes only. To restart the Cell Control software, double-click the desktop icon or power the cell control system down completely and restart it.

Note: The screen shown above shows all buttons active, since the cell control is in manual mode. When the cell control is in system mode, access to the Jog, Pallet Up, Pallet Down, Mode Selection, Setup, and Exit buttons will be disabled.

Setup Screen

The setup screen shown below provides a way to set options that affect how the cell control functions. These settings are typically set according to customer preferences during installation of the cell control system. However, they can be changed at any time should the customer decide that they would prefer different options.



Shuttle Behavior

These settings determine the shuttle behavior when the shuttle is manually moved to a pallet station, work station, or machine load station.

Automatically Raise Pallet at Station

If this option is selected, the shuttle will automatically pick up a pallet that is located on a station to which the shuttle has been manually moved.

If this option is not selected, the shuttle will move to the station, but will not raise the pallet off of the station.

Automatically Lower Pallet at Station

If this option is selected, and a pallet is currently located on the shuttle, the shuttle will automatically lower the pallet when the shuttle is manually moved to a station.

If this option is not selected, the shuttle will move to the station, but will not lower the pallet onto the station.

HMI Interface

Use On-screen Keyboard

The Cell Control HMI is installed on a touch screen computer. All 'mouse' actions can be performed with a touch of the screen. In addition, an on-screen keyboard is normally presented whenever keyboard input is required, such as when assigning a program number to a pallet process.

If the customer prefers to use a hardware keyboard, rather than the on-screen keyboard, deselecting this option will not present the on-screen keyboard when an entry field is clicked.

Unload Behavior

Each pallet in the cell is assigned a number and is assigned a 'home' station that coincides with its number. This 'home' station is the station on which the pallet is normally located when it is not in a machine or on a work station.

Enable Unload to Workstation

The normal behavior when unloading a pallet from a machine in system mode is to bring the pallet to its home station. However, selecting this option allows the operator to specify, for each machine, that a pallet unloaded from that machine should be brought directly to a work station, if the workstation is empty. The operator may specify that the pallet should be brought to only Workstation 1, only Workstation 2, or either. If the selected work station is not empty when the pallet is unloaded from the machine, it will be brought to its home station, unless 'Allow Random Pallet Placement' is selected.

Allow Random Pallet Placement

Normally, when a pallet is unloaded from a machine in system mode, it is brought to its home station – the station normally reserved for that pallet in the cell. However, if this option is selected, a pallet will be brought from the machine to the closest, empty pallet station. This will help to reduce the time it takes for a pallet to be put away after being unloaded from a machine and, therefore, to load the next pallet to a waiting machine.

Manual Activity Timeout

If the 'Allow Auto-System Mode on Machine Request' option is selected, the cell control will automatically enter system mode upon receiving a request for a pallet from a machine. This 'Manual Activity Timeout' setting will postpone the automatic switching to system mode for the specified number of minutes after the last manual move has been performed by the operator. This will allow the operator enough time to finish all desired manual moves, within that timeframe, before the cell control enters system mode and manual moves will no longer be possible.

Allow Workstations to be used as pallet stations

Each pallet in the cell is assigned a 'home' station – the station normally reserved for that pallet in the cell. In addition, there are normally two work stations reserved for the loading and unloading of parts on the pallet fixture by the operator. These work stations are not, therefore, used for permanent storage of pallets.

However, if this option is selected, the work stations can be used to permanently store pallets. Although this will provide storage for up to two additional pallets, selecting this option is not recommended since it will eliminate the normal functionality of the work stations.

Allow Auto-System Mode on Machine Request

Normally, the operator must select 'System Mode' on the cell control for it to honor load and unload requests from the machines. However, if this option is selected, and there is no manual activity being performed in the cell, the cell control will automatically enter system mode if it receives a load or unload request from a machine. This will ensure that machine requests are serviced if the operator has forgotten to place the cell control in system mode.

Allow AutoPowerOff to be Enabled

AutoPowerOff is a feature that is normally used for 'lights-out' operation of the cell control in system mode. Once a number of pallets are set as ready-to-load, the cell control will continue to load and unload pallets to the machines without operator intervention. When all ready-to-load pallets have been processed by the machine(s), and the cell control is in AutoPowerOff mode, the cell control will send signals to the machines that will cause them to power down. In addition, the cell control itself will power down. Setting this option on this setup screen enables this AutoPowerOff feature to be activated by the operator.

Process Options

Allow Multiple Processes

This option is normally turned on. When selected, four processes (normally one for each face on a fixture) can be specified for each pallet when setting the machining information to be supplied to the machine(s). If this option is not selected, only one process will be available for each pallet. This selection simplifies entry of machining information for those customers that use just one process at a time.

Send Offsets to Machine

This option is not currently supported. At this time, the ability to enter fixture offset information for a pallet does not exist. Once this option is supported, it will be possible to enter offsets for each face of a fixture and have this information sent to the machine to be used when processing the face.

Station Coordinates Screen

Pressing the 'Screen Coordinates' button from the Setup screen displays the following screen.

Station Coordinate Settings

To make a change to a coordinate setting for any station:
Enter the coordinates for the desired station and axis
OR
Move the shuttle to the desired station and press 'Capture'
for that station.

To return without making changes, press "Cancel".

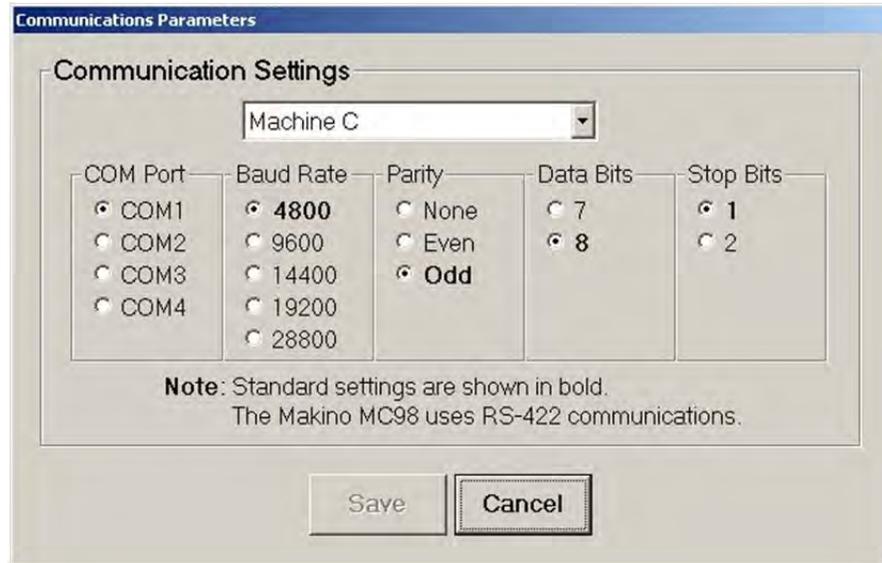
Station	X Setting	Z Setting	
Work Station 1	0.5694	41.2865	Capture
Work Station 2	0.4014	-41.1010	Capture
Station 1	-36.8933	41.3940	Capture
Station 2	-70.4993	41.3380	Capture
Load Station C	-70.4614	-41.0288	Capture
Station 3	-103.9109	41.3790	Capture
Station 4	-137.5069	41.4120	Capture
Station 5	-137.5931	-41.1000	Capture
Station 6	-170.9809	41.4120	Capture
Station 7	-171.1931	-41.1000	Capture

Save Cancel

The position of each pallet station, work station, and machine load station is determined by an X- and Z-axis coordinate. This screen, normally accessed only during initial system installation, identifies the precise position of each of these stations. Although the positions can be manually entered, using the 'Capture' button makes setup of the stations easier. After moving a pallet to each station in Jog or MPG mode, and fine-tuning its position over the station, pressing the 'Capture' button will capture the current position of the axes for that station.

Communication Settings Screen

Pressing the 'Communication Settings' button from the Setup screen displays the following screen.



The screenshot shows a dialog box titled "Communications Parameters" with a sub-section "Communication Settings". At the top, there is a dropdown menu labeled "Machine C". Below this, there are five columns of settings, each with a radio button and a label:

COM Port	Baud Rate	Parity	Data Bits	Stop Bits
<input checked="" type="radio"/> COM1	<input checked="" type="radio"/> 4800	<input type="radio"/> None	<input type="radio"/> 7	<input checked="" type="radio"/> 1
<input type="radio"/> COM2	<input type="radio"/> 9600	<input type="radio"/> Even	<input checked="" type="radio"/> 8	<input type="radio"/> 2
<input type="radio"/> COM3	<input type="radio"/> 14400	<input checked="" type="radio"/> Odd		
<input type="radio"/> COM4	<input type="radio"/> 19200			
	<input type="radio"/> 28800			

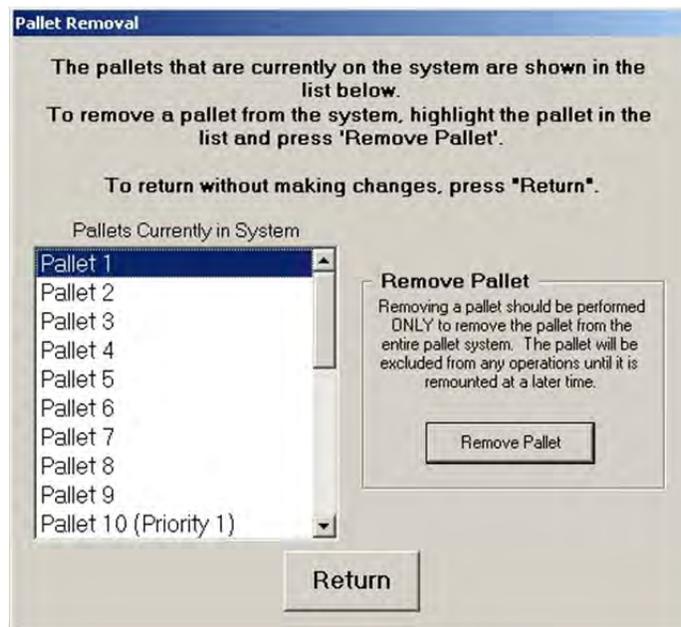
Below the settings, there is a note: "Note: Standard settings are shown in bold. The Makino MC98 uses RS-422 communications." At the bottom of the dialog box, there are two buttons: "Save" and "Cancel".

This screen allows designation of the communications settings required to communicate, serially, with each connected machine. The serial port used for each machine must be unique for that machine. The default selections for all other settings are shown in bold font. These are the normal settings, but can be overridden for any machine that may use different communications settings.

Once the correct settings have been established for each machine, these settings should never be changed.

Remove Pallets Screen

There may be instances when a pallet is no longer able to be used in the cell. Pressing the 'Remove Pallets' button from the Setup screen displays the following screen.



This screen displays a list of all pallets that are currently being used in the system. To remove a pallet from the system, highlight the pallet in the list and click the 'Remove Pallet' button. The pallet will no longer be defined as useable and will be shown on the main screen in the 'Removed Pallets' area, as shown below.



To add the removed pallet back into the cell, simply click on the small pallet showing in the Removed Pallets area. This will present a screen allowing the pallet to be 'added' back to the cell on any empty station.

Change Password Screen

Certain functionality within the cell control system is password protected.

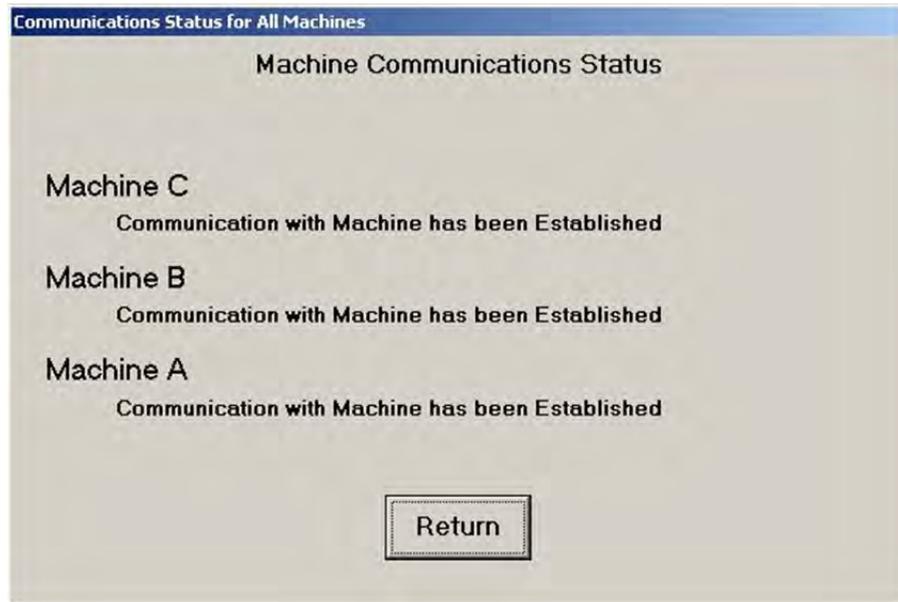
The protected functions include:

- Access to the Setup screen itself
- Changing the system to Edit or MDI mode
- Turning Program Protect off

Although multiple user names are not supported on the system, the password for accessing these functions can be changed. This will allow an administrator of the system to prevent unauthorized access to functions that should not be required by operators.

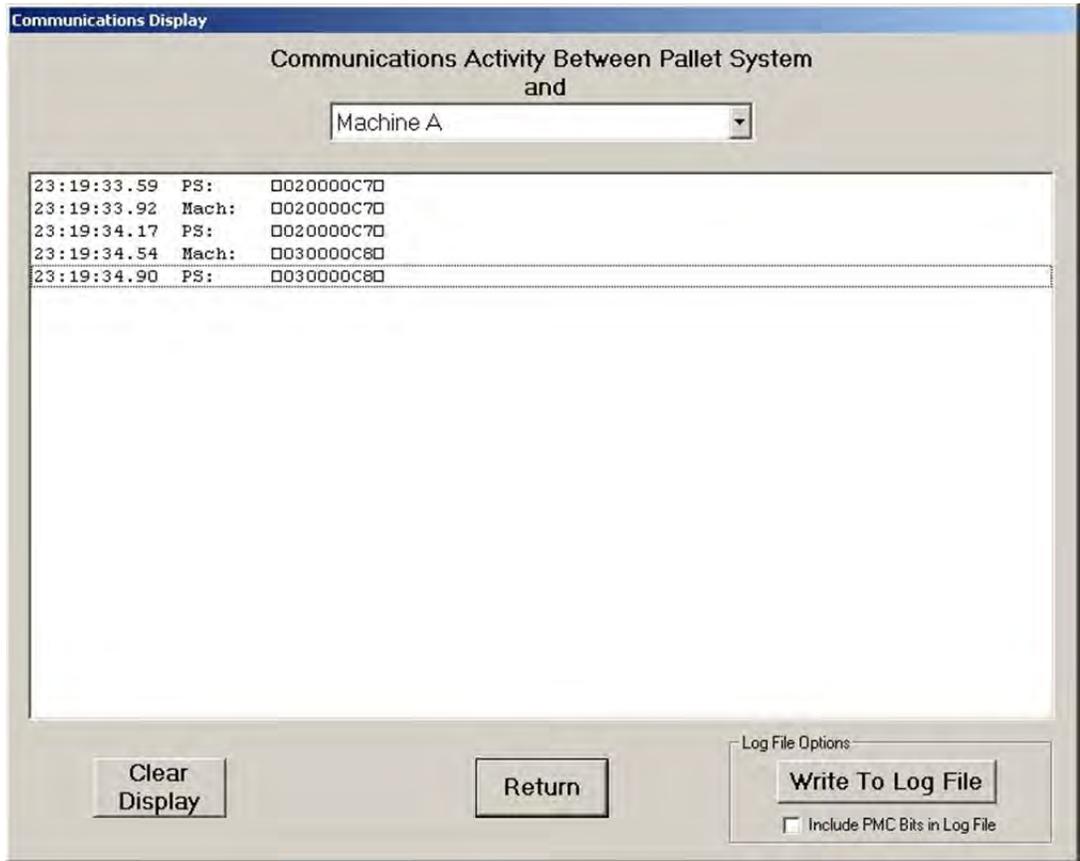
Machine COM Status Screen

The cell control system communicates with each machine using I/O signals and serial communications messages. This COM Status screen, shown below, provides a high-level status of the cell control's serial communication with each machine. Should an error occur in the serial communications, this screen can be used for diagnostic purposes.



Serial Data Display Screen

The cell control system communicates with each machine using I/O signals and serial communications messages. The serial data display screen shows the messages that are being sent to and received from each of the connected machines. This screen, shown below for Machine A, is used for diagnostic purposes only.



This display will show the last 50 messages between the cell control and the selected machine. Once a new message, beyond the 50 is transmitted, the oldest message(s) will be removed from the display. If it is necessary to maintain a full list of messages for diagnostic purposes, the 'Write To Log File' may be pressed. The button will be highlighted and the current contents of the display will be written to a text file on the computer's disk. This file will be then updated with every new message transmitted between the cell control and the selected machine. In addition, if the 'Include PMC Bits in Log File' selection has been made, the I/O signals between the cell control and the selected machine will also be written to the log file.

The log file for each machine will be located on the computer's disk in the 'CNC Cell Controller Logs' folder. The name of each log is:

'Machine nn Communication.log', where nn is the number of the selected machine (01 – 04).

Pressing the 'Clear Display' button will clear the current contents of the display, as well as any information that may be in the present log file for the machine.