

FANUC America Corporation

PMC Ladder Maintenance Course

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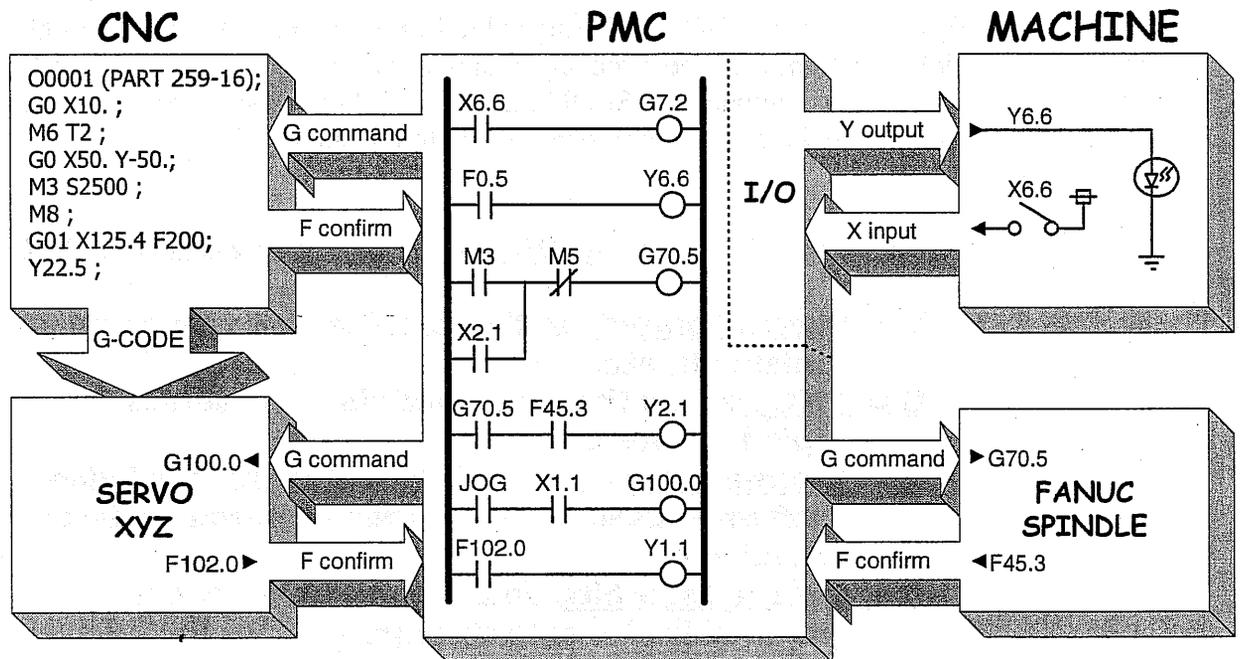
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1. Introduction to PMC Ladder

The machine control system consists of 3 general sections, the **CNC**, the **PMC**, and the **MACHINE**. PMC stands for *Programmable Machine Controller*, other manufacturers use PLC or *Programmable Logic Controller*. PMC or PLC, both perform the same function which is to interface between the CNC and the MACHINE side physical world.

The PMC is the **MASTER CONTROLLER** of the entire machine. The PMC software program is called the LADDER. The ladder program is written by the machine builder, and is customized per each machine type. It is the interface between the CNC control and the physical machine. The CNC will not do anything without first being commanded by the PMC. The ladder program is software, which replaces what used to be physical relay contacts and coils on the older machines of yesteryear. Today if we want to change a machines operation, we can just change the ladder program software, instead of rewiring the machines physical relays.



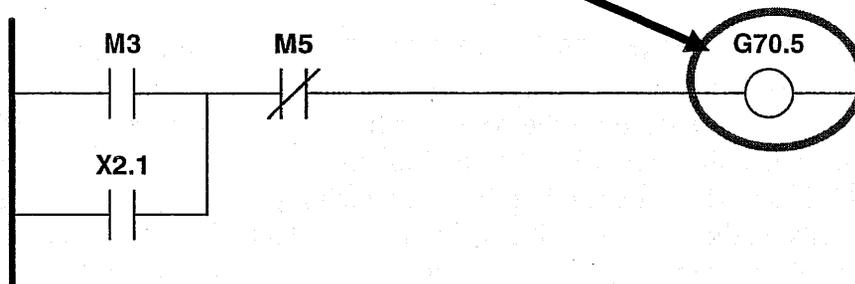
1.1. The PMC function

The PMC uses **G addresses** to **COMMAND** the CNC, SERVO, and SPINDLE systems, and **F addresses** are returned to the PMC, to **CONFIRM** the CNC, SERVO, SPINDLE has done what it was commanded to do. The G and F addresses are fixed software addresses and exist only in the memory of the PMC.

The physical world is connected to the PMC through the I/O modules, using X and Y addresses. The X addresses are inputs to the PMC, the Y addresses are outputs from the PMC. The I/O board simply converts the signal from +24V to digital signals.

1.1.1. Ladder Output Coils

The outputs from the PMC ladder are called coils. These coils output to the MACHINE, CNC, SERVO, or SPINDLE systems to command actions. In the ladder diagram, the coils are represented by circles.



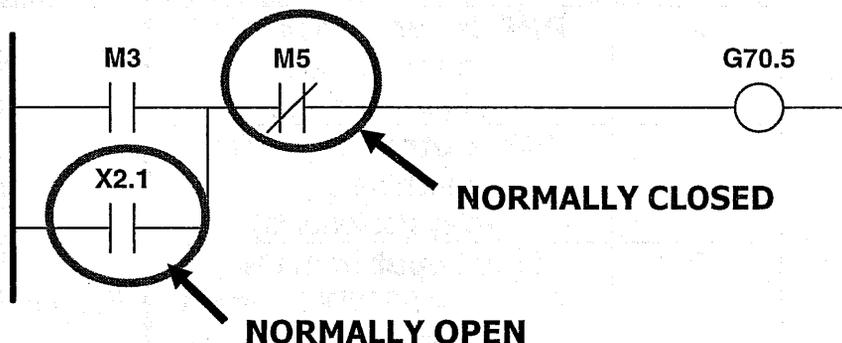
Each coil has an ADDRESS assigned to it. Here is the coil for address G70 bit 5. The address determines where the signal output will go. G70.5 is a dedicated address for the PMC to command the SPINDLE to go clockwise (M3). When the coil becomes active in the ladder, the command is sent to the spindle drive.

Here are some of the ladder ADDRESSES that can be assigned to PMC COILS.

- Y = Physical outputs to the machine that turn on relays, solenoids, etc.**
- G = PMC outputs that command the CNC, servos, or spindle systems.**
- R = Internal relays, relays that exist within the ladder software, used for the purpose determined by the ladder developer.**
- D = Data register bits, data registers are used for internal ladder data storage.**
- A = Alarm/Operator message display, used to display custom machine builder alarms on the CNC message display screen.**

1.1.2. Ladder Input Contacts

The inputs to the PMC ladder are called contacts. These contacts are input from the MACHINE, CNC, SERVO, SPINDLE, or INTERNAL PMC signals, to tell the PMC the status of those signals. In the ladder diagram, the contacts can be either normally closed or normally open.



The NORMALLY OPEN contact conducts when the signal is ACTIVE.

The NORMALLY CLOSED contact conducts when the signal is NOT ACTIVE.

When the signal X2.1 is ACTIVE, and signal M5 is NOT ACTIVE, the net conducts and the coil G70.5 is turned ON. If M5 becomes active, or X2.1 becomes not active, the coil G70.5 is turned OFF.

Here are some of the ladder ADDRESSES that can be assigned to INPUTS.

X = Physical inputs from the machine I/O, such as limit switches, proximity switches, or other relay contacts.

F = System inputs that confirm the CNC, servos, or spindle system status to the PMC.

K = Keep relays that are used to set ladder options, controlled by a parameter screen.

R = Internal relays, relays that exist within the ladder software, used for the purpose determined by the ladder developer.

D = Data register bits, data registers are used for internal ladder data storage.

A = Alarm/Operator message display, used to display custom machine builder alarms on the CNC message display screen.

1.1.3. PMC Address Table

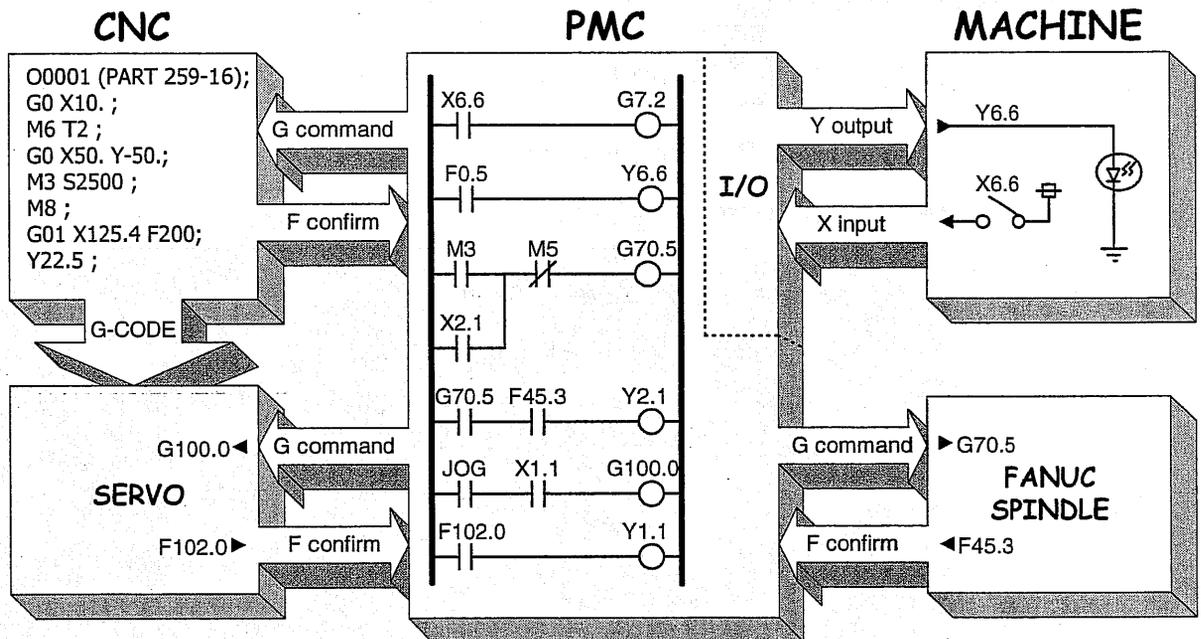
The address table varies between PMC types. Generally what varies is the number of I/O points between the different systems. The table below shows the difference between RB5 and RB6 PMC types.

Address	Description	PMC-RB5	PMC-RB6
X	PMC Input from physical machine side (limit switches)	X0 ~ X127 X1000 ~ X1019 X1020 ~ X1039	
Y	PMC Output to physical machine side (relays/solenoids)	Y0 ~ Y127 Y1000 ~ Y1014 Y1020 ~ Y1034	
F	PMC Input from CNC, SERVO, or SPINDLE system (confirmation)	F0 ~ F255 F1000~F1255	F0 ~ F255 F1000~F1255 F2000~F2511
G	PMC Output to CNC, SERVO, or SPINDLE system (command)	G0 ~ G255 G1000~G1255	G0 ~ G255 G1000~G1255 G2000~G2511
R	PMC Internal Relays contacts and coils found only within the ladder	R0 ~ R1499 R9000~R9117	R0 ~ R2999 R9000~R9199
A	PMC Output to CNC message display	A0 ~ A24	A0 ~ A124
C	PMC Counters	C0 ~ C79	C0 ~ C199
K	PMC Keep relays	K0 ~ K19	K0 ~ K39 K900 ~ K909
T	PMC Timers	T0 ~ T79	T0 ~ T299
D	PMC Data register	D0 ~ D2999	D0 ~ D7999
L	PMC Labels	L1 ~ L9999	L1 ~ L9999
P	PMC Subprogram number	P1 ~ P512	P1 ~ P2000

1.2. The CNC function

G-Code - The primary function of the CNC is to read the G-Code program which move the servo axis accordingly. Any miscellaneous codes (M, S, or T) read in the program are passed to the PMC (F addresses), and it is up to the PMC to process and confirm that they are executed. **When the PMC confirms the M, S, or T code has been processed, it returns the FIN signal** to the CNC (G4.3). The FIN signal allows the CNC to continue on to the next line of the G-Code program.

Parameters - The parameters are settings in the CNC memory. These settings tell the CNC what the machine is capable of, for example one parameter setting tells the CNC the travel distance for the X servo axis, in the + and - directions. Fanuc makes controllers that will work on any size machine. The parameters describe the machine capabilities to the CNC controller.



1.3. The Machine function

The MACHINE side has PMC inputs and outputs. The PMC inputs (X address) are physical switches, contacts, or sensors. The PMC outputs (Y address) are physical relay coils, solenoids, or contactors. **LED**

A typical scenario for interaction, is the use of the **CYCLE START** button.

- 1) The physical cycle start button is pressed, **input to PMC** through a X6.6
- 2) The ladder uses X6.6 to activate a G7.2, **commanding the CNC** to cycle start.
- 3) The CNC starts processing the current G-Code program, and then **returns F0.5 confirmation to the PMC**, to tell the PMC that it is cycle started.
- 4) The address **F0.5 energizes the physical output Y6.6**, that is used to turn on the lamp in the cycle start button.

A similar interaction of **command** and **confirmation** occurs with every PMC operation.

2. FS16 PMC Screen Review

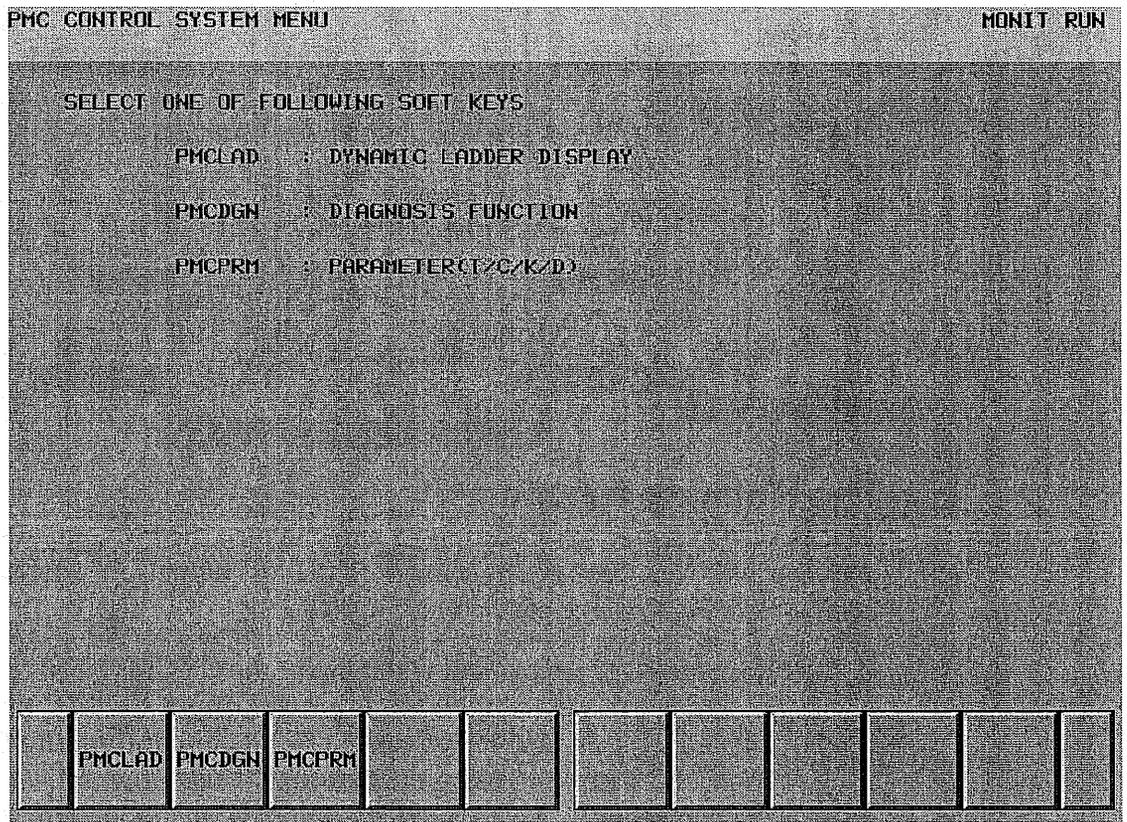
There are several screens that relate to PMC operation and status. This section reviews the screens available on the FS16 control with a RB6 PMC type. There are several types of PMC available on each control series. The type of PMC determines the number of ladder steps, the types of function blocks available, and the amount of counters and data registers. Different PMC types may have slightly different screen displays.

As shown in the previous section, the CNC and PMC are 2 separate entities. To view the PMC side screens, follow the instructions below.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.

The initial PMC screen appears ...



You are now viewing the PMC side of the control.
 Three choices appear, PMCLAD, PMCDGN, and PMCPRM.
 They are LADDER, DIAGNOSE, and PARAMETER.

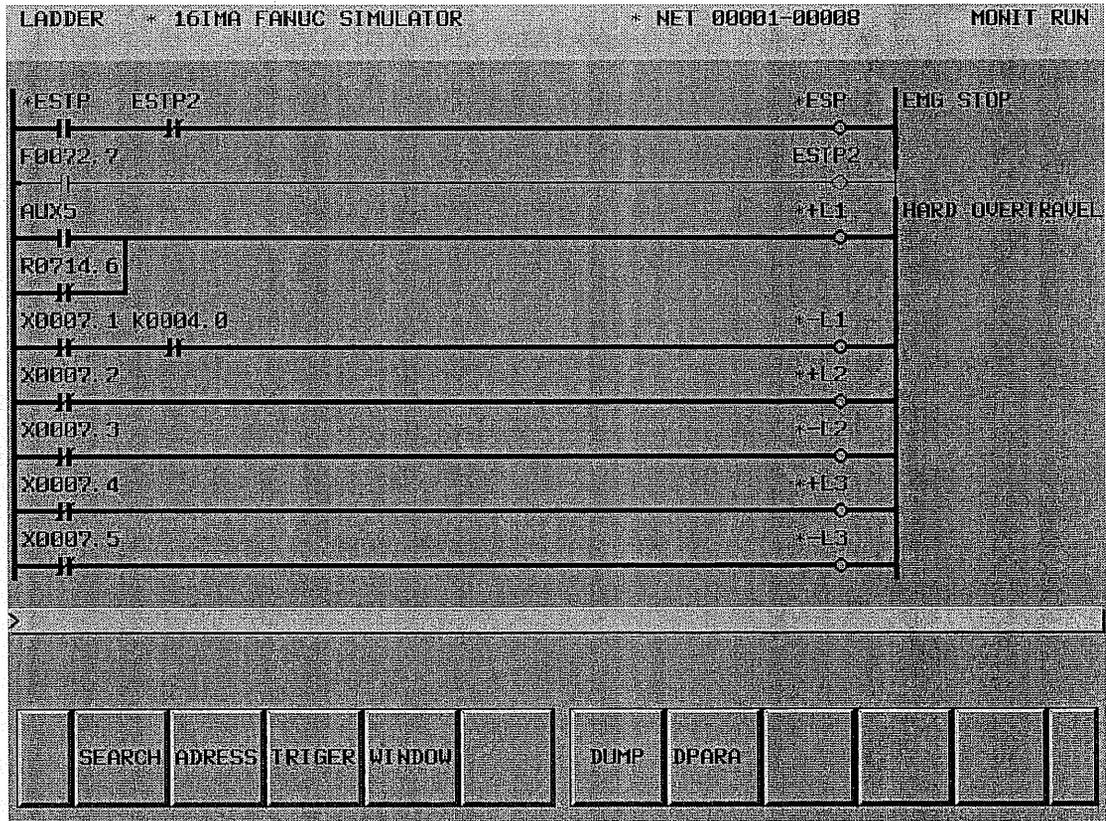
2.1. PMCLAD Ladder Display

The PMCLAD display allows you to see the ladder logic written by the machine builder. You also have the ability to search for a specific address, view the current status of a signal, or freeze the ladder display on a specific event.



1) Press the  soft key on the CRT menu.

The ladder diagram will appear ...



2) Press the  soft key on the CRT menu, it will change to 

This button toggles the display. The SYMBOLS are comments, which may be entered by the machine builder as they write the ladder. They can be the Fanuc dedicated signal name abbreviations, or custom abbreviations decided by the machine builder.

Think of the ladder diagram as an electrical circuit. The **CONDUCTING** contacts are highlighted bold, and they allow current to flow. The **NON-CONDUCTING** contacts are green and do not allow current to flow.

In the first ladder rung above, the **X0008.4** and **R707.3** contacts are **conducting**, so the coil **G8.4** is **ON** or activated.

PMCLAD Ladder Display

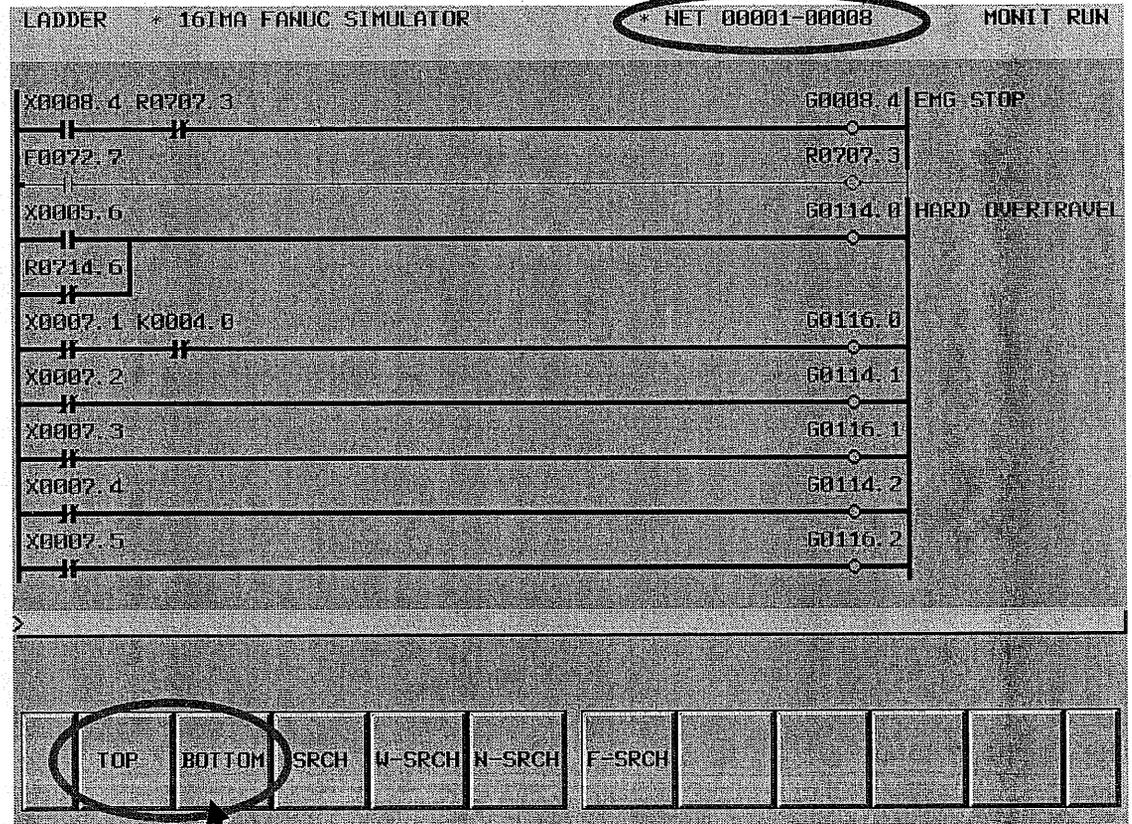
2.1.1. SEARCH Menu

By pressing the SEARCH soft key, the search menu is displayed. The choices on the search menu are TOP, BOTTOM, SRCH, W-SRCH, N-SRCH, and F-SRCH.



1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.

The ladder NET numbers are displayed at the top of the page



2) Press the  soft key on the CRT menu.

The display jumps to the BOTTOM of the ladder diagram. Notice the NET numbers at the top of the screen change accordingly.

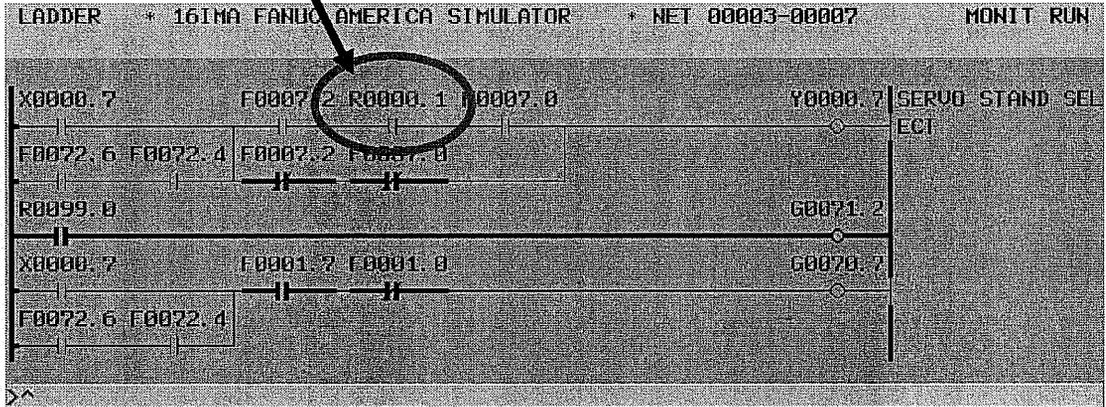
3) Press the  soft key on the CRT menu.

The display jumps to the TOP of the ladder diagram.

SEARCH Menu

- 4) Enter address **R0.1**, then press the  soft key.

The contact for R0.1 should appear on the top line of the display.

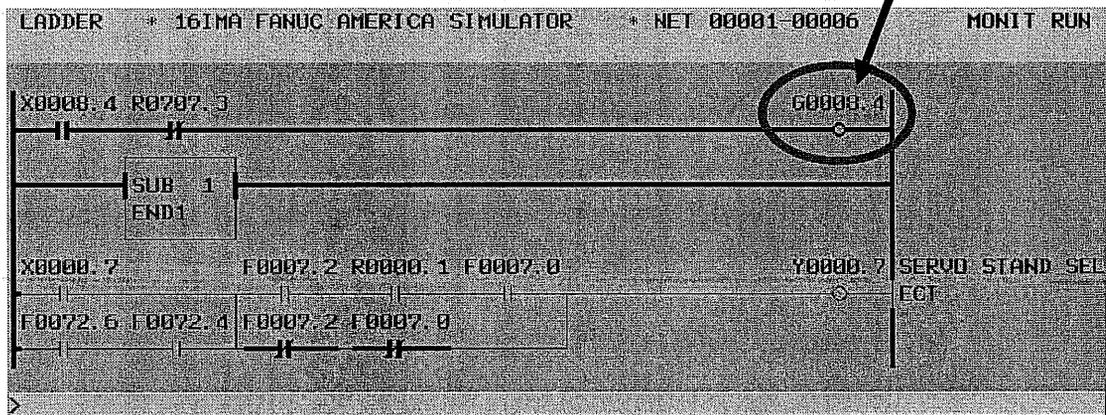


- 5) Repeat step 4, until the coil for address **R0.1** is found.

- 6) Enter symbol ***ESP**, then press the  soft key.

The coil G8.4 should appear at the top of the screen. This coil has the symbol *ESP assigned to it in this simulator ladder.

SYMBOLS (*ESP) can be searched as well as **ADDRESSES** (G8.4)



- 7) Press the  soft key on the CRT menu, it will change the menus' selections.

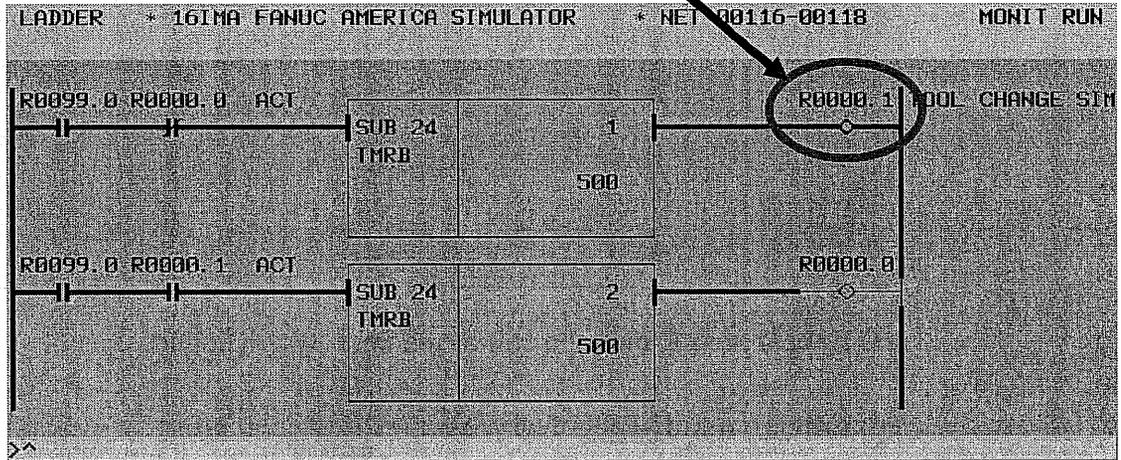
- 8) Press the  soft key on the CRT menu, it will change to 

SEARCH Menu

9) Press the  soft key on the CRT menu. The SEARCH soft menu appears.

10) Enter address R0.1, then press the  soft key.

The coil for R0.1 should appear on the top line of the display.
The W-SRCH soft key searches for COILS ONLY, not contacts.



11) Press the  soft key on the CRT menu.

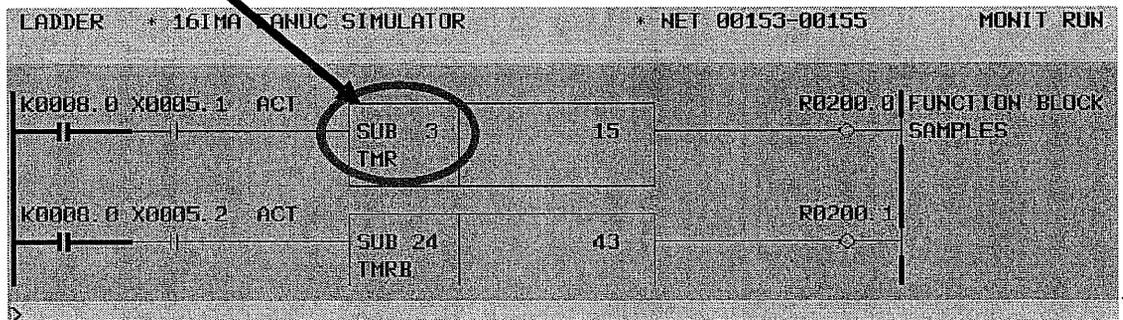
The display jumps to the TOP of the ladder diagram.

12) Enter NET number 126, then press the  soft key.

The coil for R0.1 should appear on the top line of the display.
The N-SRCH soft key searches for the NET LINE NUMBER which appear on the top of the display.

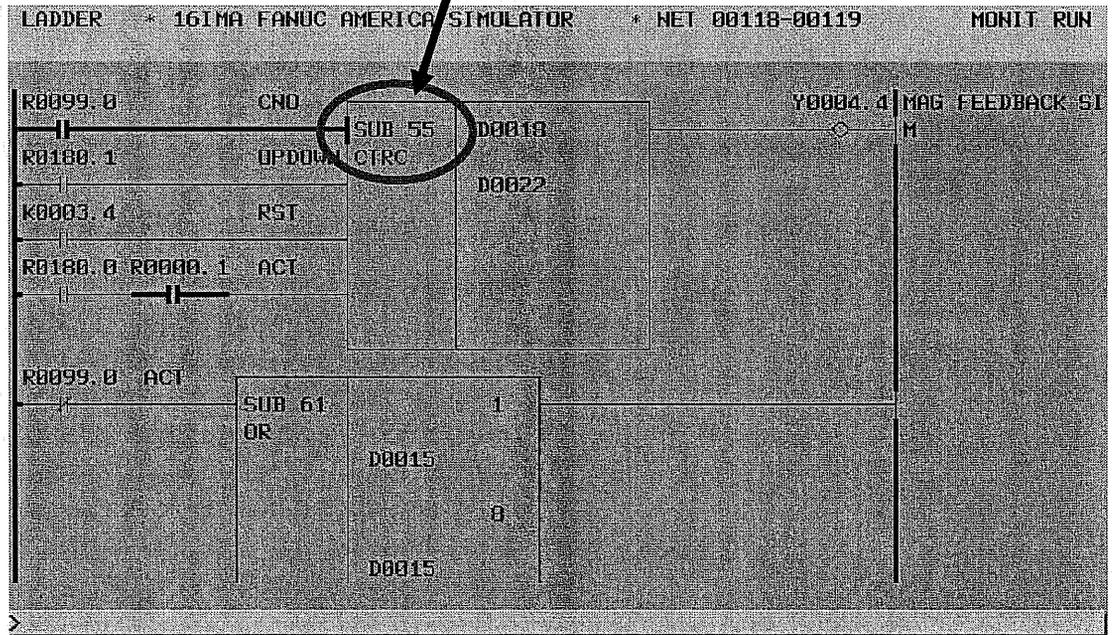
13) Enter FUNCTION number 3, then press the  soft key.

The boxes in the ladder are called **FUNCTION BLOCKS**. Each function is assigned a **SUB number**. A timer function block is assigned **SUB 3**.
The F-SRCH soft key searches for function blocks using their sub number.



SEARCH Menu

14) Enter FUNCTION number **55**, then press the  soft key.



The **SUB number 55**, is a counter. The function blocks are described in more detail later in this manual. There is also a complete listing of all the SUB functions.

15) Press the  soft key on the CRT menu, to the TOP of the ladder diagram.

16) Press the  soft key on the CRT menu, to return to the **PMCLAD** menu.

2.1.2. TRIGGER Menu

The trigger function can freeze the ladder display so you can look at what happened at a specific moment in time. This is useful when an event happens quickly, and you are unable to see the changes because of screen update time.



1) Press the  soft key on the CRT menu. The TRIGGER soft menu appears.

At the bottom of the screen a message appears. **ADR; POINT(0-3);COUNT**

ADR = the ADDRESS you want to trigger on

POINT = At which stage of ladder processing, do you want the TRIGGER event to freeze the display.

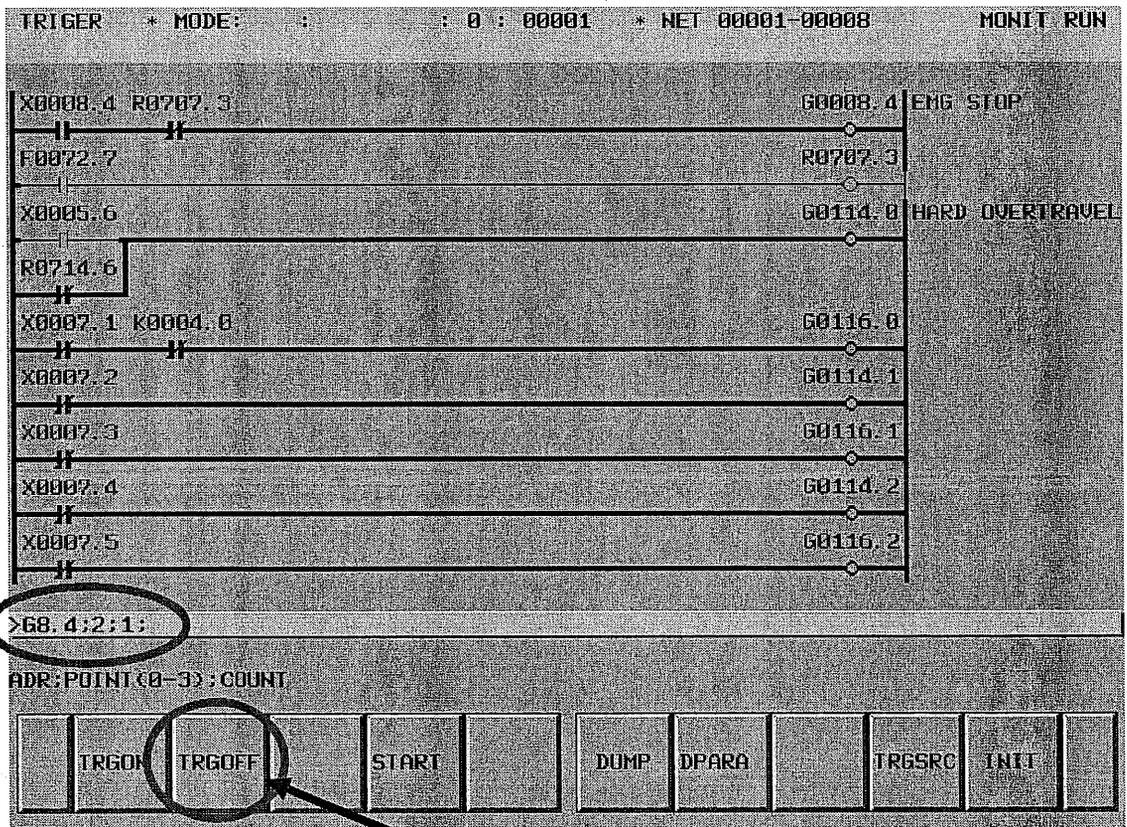
0 = When processing reaches the top of the ladder

1 = After END 1 function block executes

2 = After END 2 function block executes

3 = After END 3 function block executes

COUNT = how many times must the address trigger, before freezing the screen display. (1~65535 is valid)



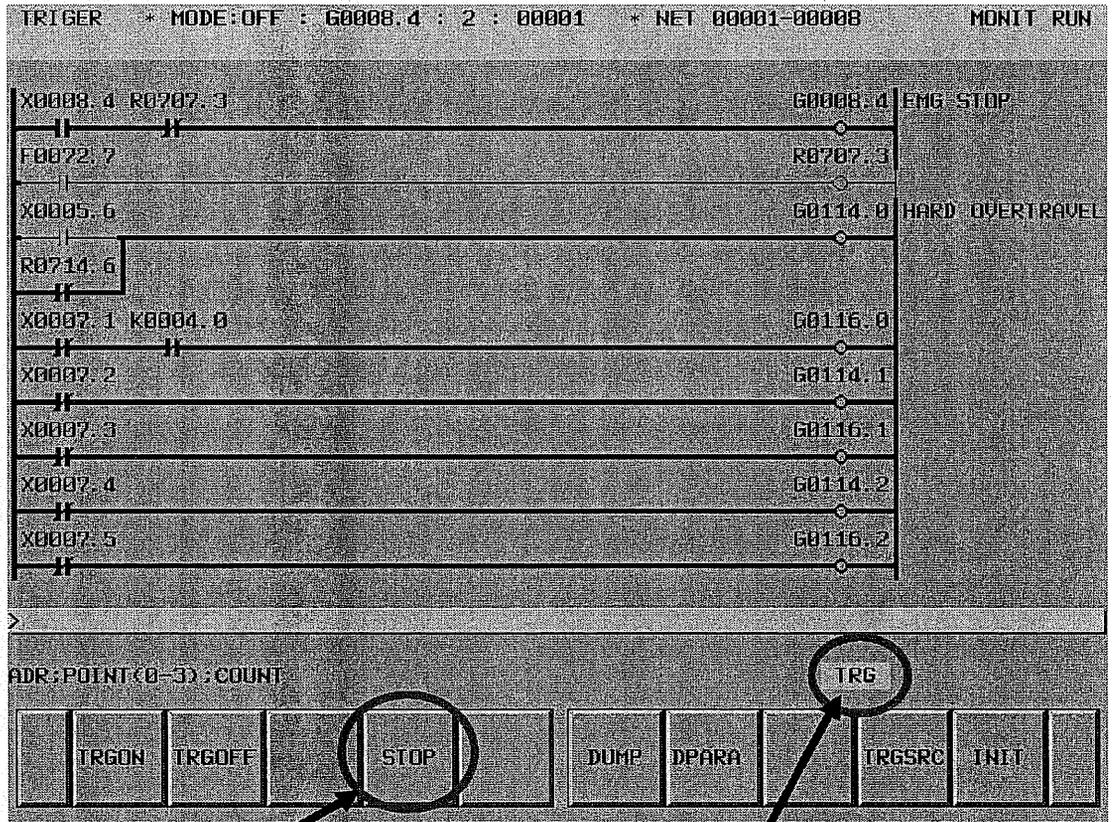
2) Enter "G8.4 ; 2 ; 1:" then press  soft key. Notice the entered data appears across the top of the display screen.

TRIGGER Menu

The  function, triggers on the **NEGATIVE EDGE**, when the signal status **changes from ON to OFF**



The  function, triggers **POSITIVE EDGE**, when the signal status **changes from OFF to ON**



3) Press the  soft key on the CRT menu,  will begin to flash at the bottom of the screen. This indicates the system is waiting for the trigger to occur.

4) Press the **EMERGENCY STOP** button. The  will stop flashing and the display screen should be frozen.

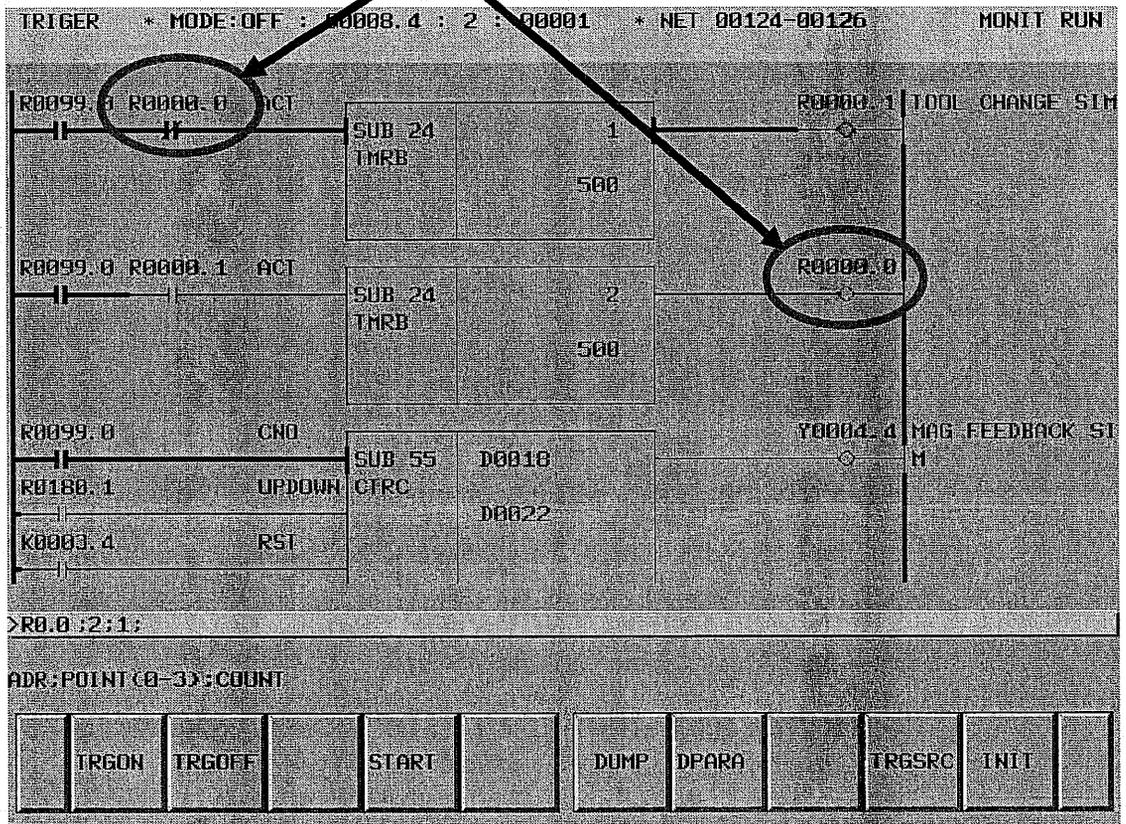
5) Release the **EMERGENCY STOP** button, notice the G8.4 coil does not highlight on the screen since the display is frozen.

6) Press the  left menu soft key on the CRT menu, you will return to the PMCLAD menu, and the screen will be active again.

7) Press the  soft key on the CRT menu, the frozen trigger screen re-appears.

TRIGGER Menu

- 8) Press the  soft key on the CRT menu.
- 9) Press the  soft key on the CRT menu,  will begin to flash at the
- 10) Press the **EMERGENCY STOP** button. How has the trigger changed?
- 11) Press the  left menu soft key on the CRT menu
- 12) **SEARCH** to find the coil R0.1, notice on the next line is the coil R0.0.
 Maybe you can see the R0.0 coil highlight? This is due to the screen update time. Since the coil is only on for 1 ladder scan, the display does not always update quickly enough to see the change. Also notice that it is difficult to see the changing state of the normally close R0.0 contact in the top line. The R0.0 contact should change states whenever the R0.0 coil changes, since they are related.

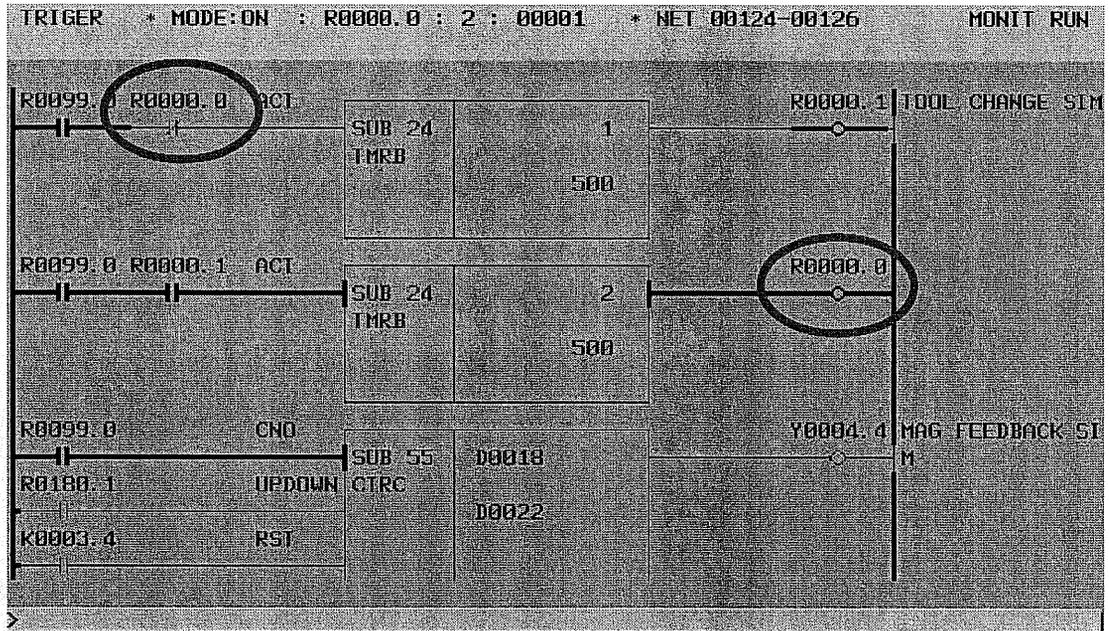


- 13) Press the  soft key on the CRT menu. The TRIGGER soft menu appears.
- 14) Enter `"R0.0 ; 2 ; 1 ;"` then press  soft key.

TRIGGER Menu

15) Press the  soft key on the CRT menu, it will trigger immediately.

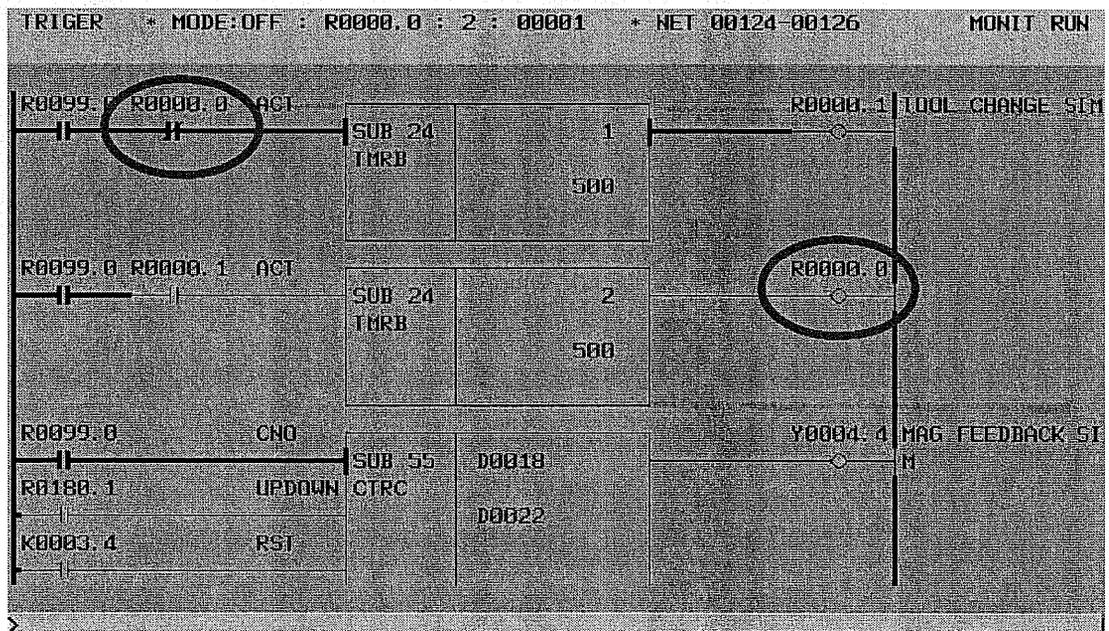
Notice you can now see the true state of the R0.0 contact when the coil is active.



16) Press the  soft key on the CRT menu.

17) Press the  soft key on the CRT menu,

You can now see the true state of the R0.0 contact when the coil is in-active.



TRIGGER Menu

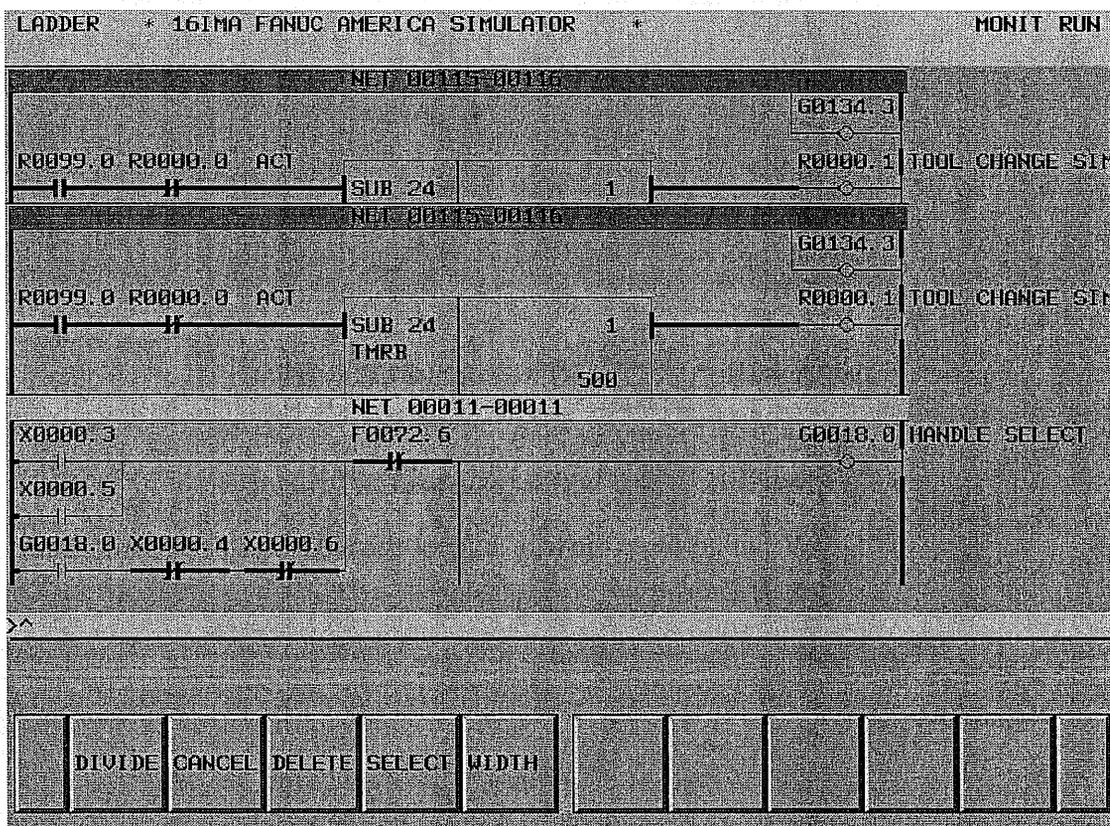
18) Press the  left menu soft key to return to the PMCLAD menu.

2.1.3. WINDOW Menu

The window function allows you to split the screen, so you can see different parts of the ladder diagram at the same time. The screen can be split into 6 different windows. The more windows you create, the smaller each window becomes.

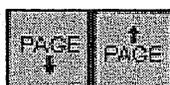


1) Press the  soft key on the CRT menu. The WINDOW soft menu appears.



2) Press the  soft key 2 times, 3 windows should be visible.

The highlighted window is currently selected.

3) Press the  buttons on the MDI keypad.

Notice the ladder changes only in the currently selected window.

WINDOW Menu

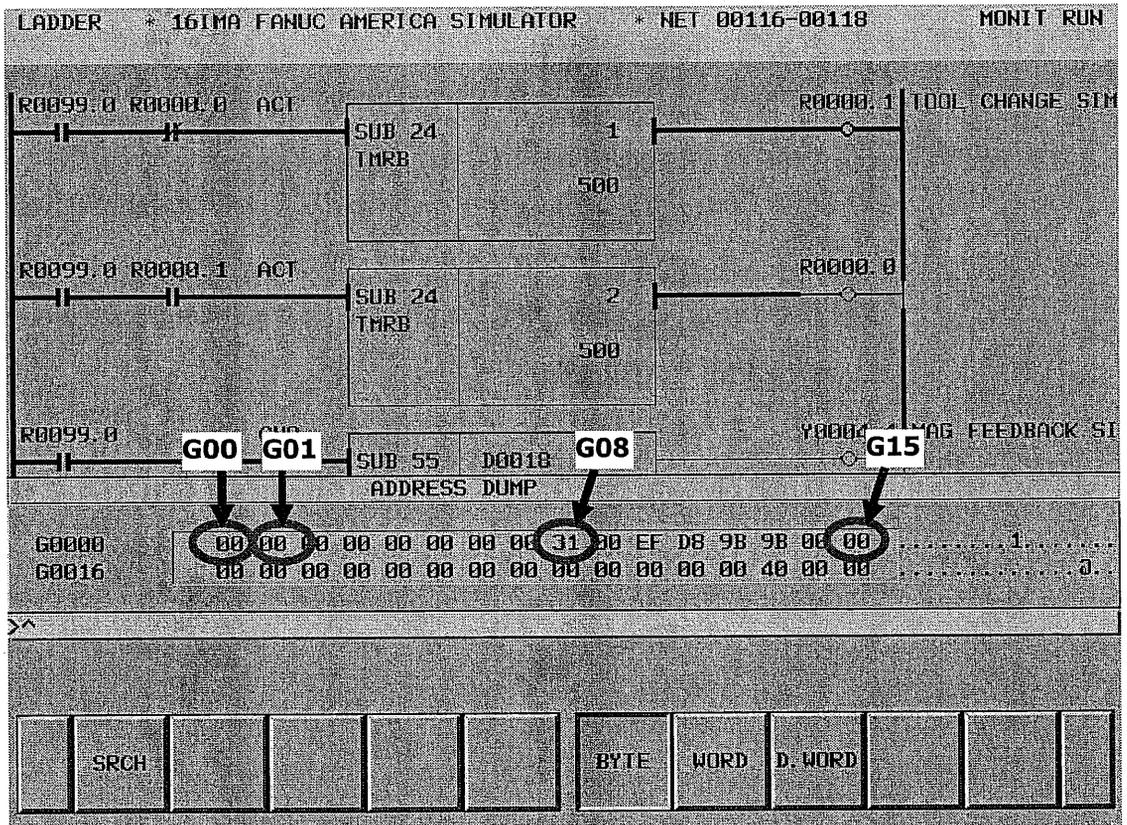
- 4) Press the  soft key, the other window will highlight.
- 5) Press the   buttons on the MDI keypad.
- 6) Press the  soft key.
- 7) Press the   soft keys, to change the size of the selected window.
- 8) Press the  soft key, to remove the selected window from the display.
- 9) Press the  soft key, to remove all windows from the display and return to the PMCLAD menu.

2.1.4. DUMP Function

The DUMP function allows you to view multiple addresses in a HEXADECIMAL format instead of binary format. From a maintenance perspective, this screen has limited value.



1) Press the **DUMP** soft key on the CRT menu. The HEX DUMP window appears.



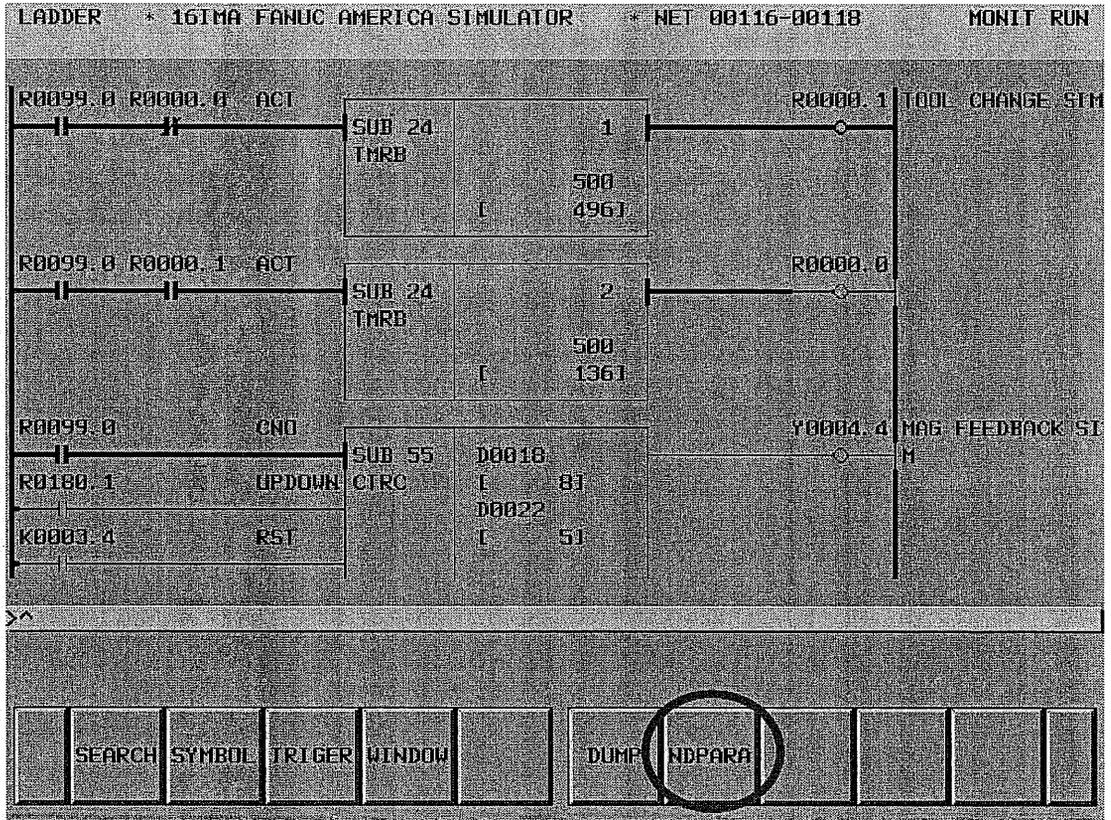
- 2) Press the **EMERGENCY STOP** button. Watch the value of address G08.
- 3) Release the **EMERGENCY STOP** button, Watch the value of address G08.
- 4) Press the  left menu soft key to return to the PMCLAD menu.

2.1.5. DPARA Function

The **DPARA** function allows you to DISPLAY PARAMETERS of the function blocks in real time. With this function on, you can see the actual count of timers, real-time values of D data register addresses, or current counter values. When the button is pressed, the text on the button changes to **NDPARA**, which stands for NOT DISPLAY PARAMETERS.



1) Press the  soft key on the CRT menu. The function block parameters appear.



2) Press the  soft key, the function block parameters are not displayed.

2.2. PMCDGN Diagnostic Display

The PMC diagnostic display allows you view information about the PMC, and monitor the status of all aspects of the PMC. The trace function allows you to monitor changes in any PMC address.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  soft key on the CRT menu.

2.2.1. TITLE Display

The title display is split in half, the top half of the screen is machine builder information like who wrote the ladder, when it was written, and the machine builders version. The bottom half of the screen is status information from the Fanuc PMC processor.

PMC TITLE DATA (LADDER) MONIT RUN

MACHINE TOOL BUILDER NAME	FANUC AMERICA CORP
MACHINE TOOL NAME	F5161MA SIMULATOR
CNC & PMC TYPE NAME	F5161MA / RB6
PMC PROGRAM NO.	4161
EDITION NO.	02
PROGRAM DRAWING NO.	OPERATOR PANEL REV G + S/W OP
DATE OF PROGRAMING	12/12/2002
PROGRAM DESIGNED BY	GARY THOMAS
RDM WRITTEN BY	
REMARKS	161MA FANUC AMERICA SIMULATOR
PMC CONTROL PROGRAM	SERIES : 006A EDITION : 11

PMC TYPE	CONTROL : RB6	PROGRAM : RB6
MEMORY USED : 005.2 KB	SCAN TIME : 008 MS	
LADDER : 003.2 KB	SCAN MAX : 008 MS	MIN : 008 MS
SYMBOL : 001.8 KB		
MESSAGE : 000.2 KB		

MACHINE BUILDER INFO

FANUC PROCESSOR INFO

Navigation bar: TITLE, STATUS, ALARM, TRACE, M. SRCH, I/OCHK

Typically the most important information on this screen is the **PMC PROGRAM NO.** and **EDITION NO.** This is the machine builder version information that is added at the time when they write the ladder. If the need arises to call the machine builder about the machine operation, they will most likely ask for this information.

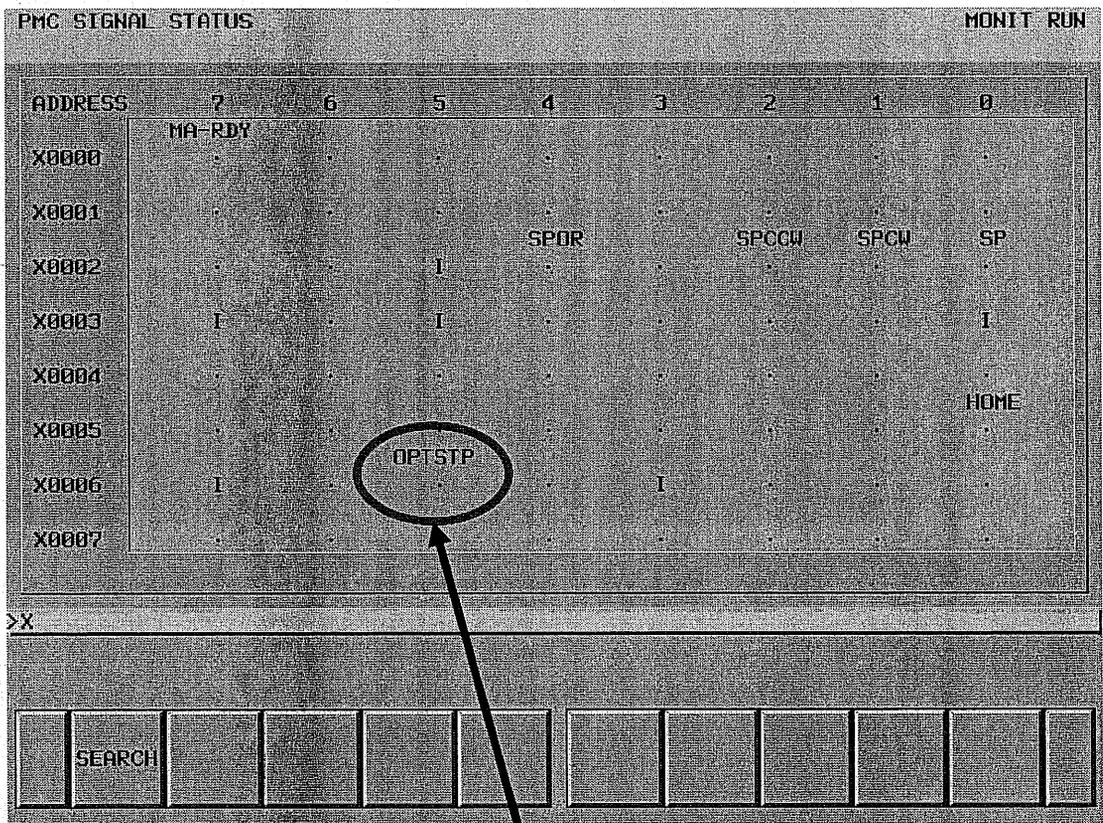
2.2.2. STATUS Display

The status display is where you can quickly see the status of any PMC address. This is useful when checking to see if an input address is working or to check if an output has been turned on. The status screen always updates, even if the PMC is not running.



- 1) Press the  soft key on the CRT menu.
- 2) Press the  button on the MDI key pad.
- 3) Press the  soft key on the CRT menu.

The status of the physical inputs (X addresses) appears on the display. Up and down the left side are the addresses, across the top are the bit numbers.



Address X6 bit 5 is wired to the OPTION STOP button on the operator panel.

- 4) Press the  button on the operator panel.

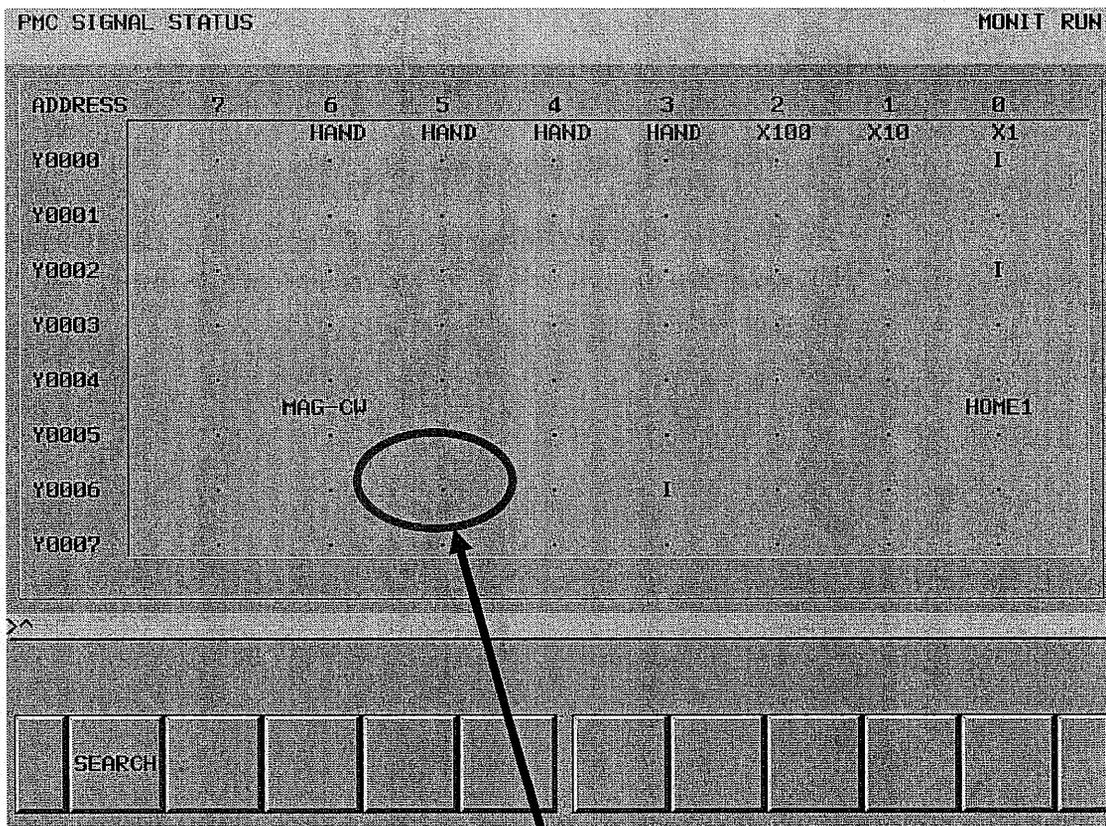
Watch the status bit change on the screen.

Status Display

5) Press the  button on the MDI key pad.

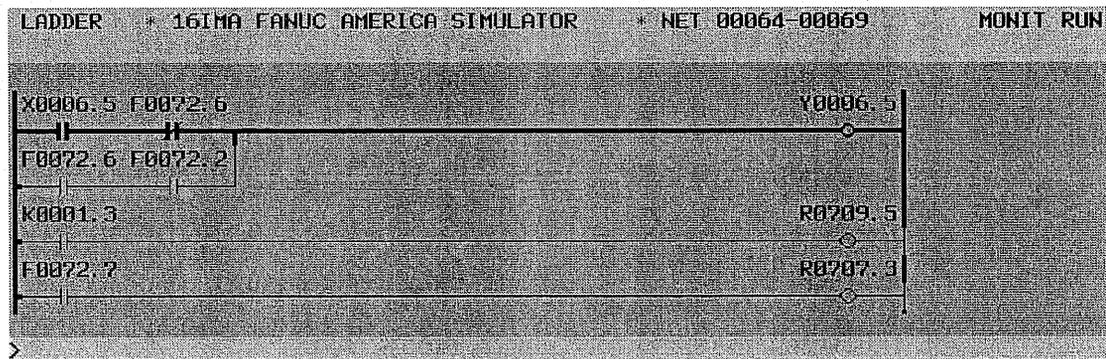
6) Press the  soft key on the CRT menu.

The status of the physical outputs (Y addresses) appears on the display.



Address Y6 bit 5 is wired to the OPTION STOP lamp inside the button.

The ladder logic which supports this action can be seen on the **PMCLAD** screen.



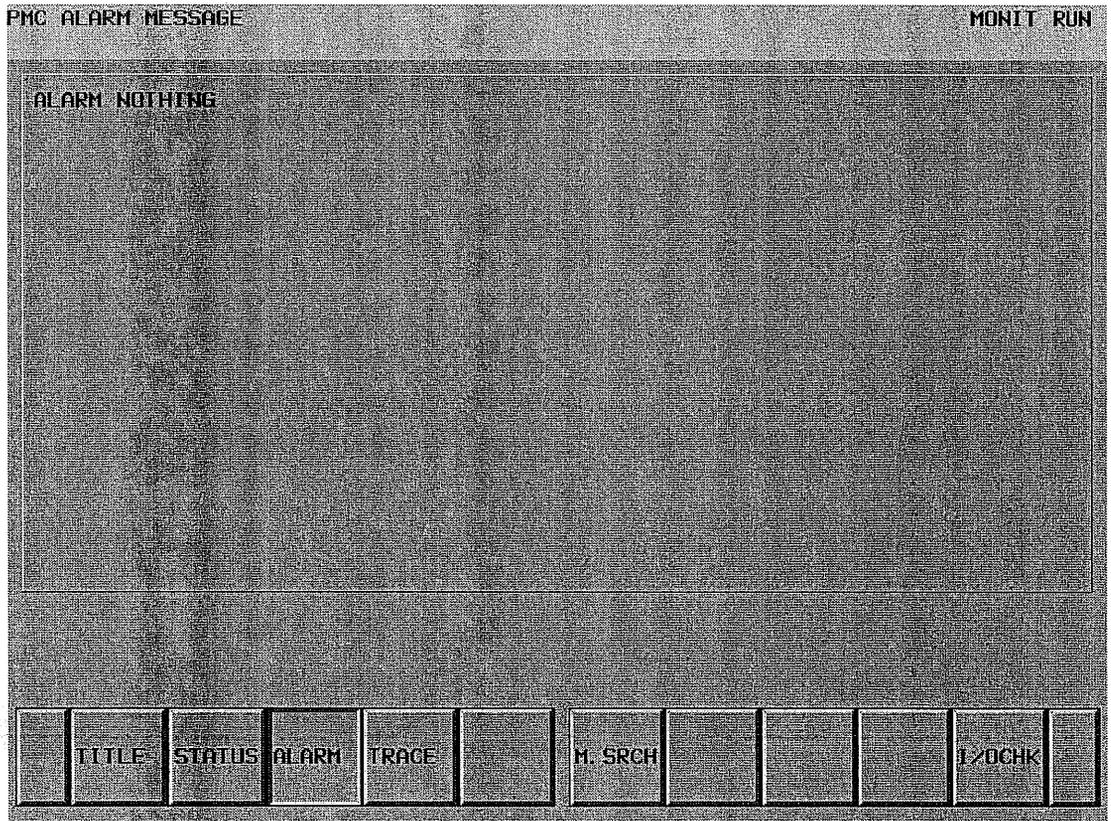
2.2.3. ALARM Display

The alarm display shows faults that occur during ladder processing. In most cases you will never see an alarm on this screen. It is mainly for the person writing the ladder logic. If there are any mistakes in their logic, a fault message will explain the problem. In the rare case that the ladder memory area should become corrupted, this may be the place to look.



1) Press the  left menu soft key to return to the PMCDGN menu.

2) Press the  soft key on the CRT menu. The PMC ALARM screen appears.



If all is good on the PMC side of the control, the message ALARM NOTHING will appear.

If a PMC alarm does occur, no alarm is present on the CNC MESSAGE display. The only indication you may see is the CNC will be stuck in an EMG-STOP condition. This is a good time to check the PMCDGN ALARM screen.

Disconnect the I/O Link cable, then power on the CNC to see this condition.

2.2.4. Binary to Hexadecimal Conversion

The purpose of hexadecimal is to be able **to count to 15 using 1 digit**. When starting at 0 and counting to 9, hexadecimal is the same as a decimal. When you reach 9 in decimal, the next numbers are **10, 11, 12, 13, 14, 15**. These numbers are 2 digits each. Since hexadecimal needs to count using 1 digit, we use **letters instead of these 2 digit numbers**. The count is shown below.

<u>DECIMAL</u>		<u>HEXADECIMAL</u>
15	=	F
14	=	E
13	=	D
12	=	C
11	=	B
10	=	A
9	=	9
8	=	8
7	=	7
6	=	6
5	=	5
4	=	4
3	=	3
2	=	2
1	=	1
0	=	0

The **PURPOSE OF HEXADECIMAL** is to count from 0 to 15 using 1 digit.

Binary to Hexadecimal Conversion

All computers use binary. Binary is a code that uses 1's and 0's. Each 1 or 0 is called a bit. Eight bits together is called a byte. The bits are numbered from left to right starting with 0 on the left. Bit 0 has a decimal value of 1. The value of each bit doubles as you move to the left, so bit 1 has a value of 2, bit 2 has a value of 4 and so on

BIT#	7	6	5	4	3	2	1	0
BINARY	0	0	0	0	1	0	0	1
VALUE	128	64	32	16	8	4	2	1

The byte shown above has a value of 9. Just add the bit values together to determine the value of the byte, 8+1=9. Then convert these binary patterns to hexadecimal.

First, split the byte into two groups of 4 bits. Each group of 4 bits will represent 1 hexadecimal digit. When you do this the value of bits 4 to 7 change to the same as bits 0 to 3.

BIT#	7	6	5	4	3	2	1	0
BINARY	0	0	0	0	1	0	0	1
VALUE	8	4	2	1	8	4	2	1

Second, add up the bit values for each 4 bit section, and those numbers become the hexadecimal value. For example...

BINARY	=	0	0	0	0	1	0	0	1
HEXADECIMAL	=	↓				↓			
		0				9			

Therefore a binary 0000 1001 is equal to hexadecimal 09. Then logically the binary pattern 0010 0001 is equal to hexadecimal 21.

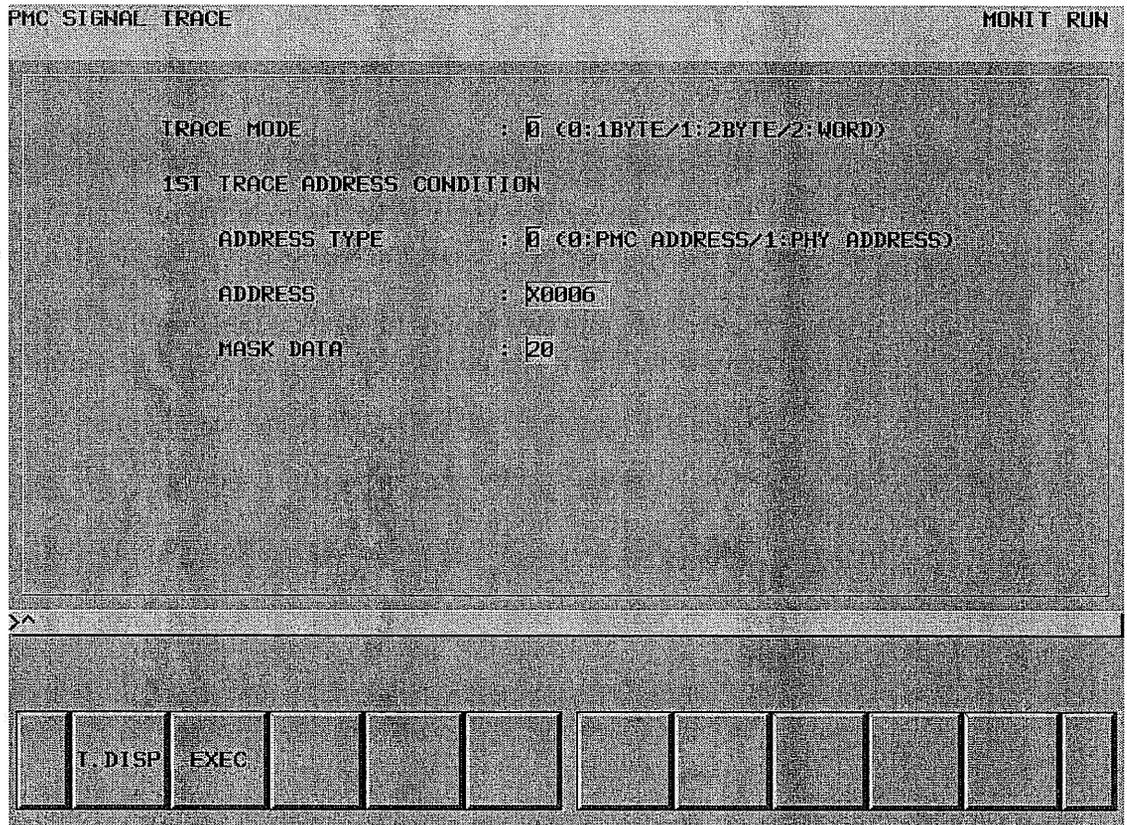
- BINARY 1000 0010 = HEX ?
- BINARY 0010 0100 = HEX ?
- BINARY 0100 1000 = HEX ?

2.2.5. TRACE Display

The trace display allows you to monitor changes in status of any PMC address.



- 1) Press the  left menu soft key to return to the PMCDGN menu.
- 2) Press the  soft key on the CRT menu. The TRACE setup screen appears.



- 3) Arrow down  to each field, enter the information as shown as above.
- 4) Press the  soft key on CRT menu. The **TRACE DISPLAY** screen appears.
- 5) Press the  soft key on CRT menu. The display begins recording events.
- 6) Press the  button on the operator panel 3 times, see the status of bit 5 change on the screen each time you press it.
- 7) Press the  button on the operator panel, notice nothing changes.

TRACE Display

Notice that the signal history shows you all bits in address X6, but traces only when the masked bit is activated. The **FEED HOLD** button is **X6 bit 7**.

PMC SIGNAL TRACE		MONIT RUN							
		ADDRESS = X0006 (20)							
NO.		7	6	5	4	3	2	1	0
0000	.	.	.	.	.	.	.	.	.
0001	I	.	.	I	.	.	.	.	.
0002	I	.	.	.	.	.	.	.	.
0003	I	.	.	I	.	.	.	.	.
0004	I	.	.	.	.	.	.	.	.
0005	I	.	.	I	.	.	.	.	.
0006	I	.	.	.	.	.	.	.	.
0007	I	.	.	I	.	.	.	.	.
0008	I	.	.	.	.	.	.	.	.
0009	I	.	.	I	.	.	.	.	.
0010	.	.	.	.	.	.	.	.	.
0011	.	.	.	.	.	.	.	.	.
0012	.	.	.	.	.	.	.	.	.
0013	.	.	.	.	.	.	.	.	.
0014	.	.	.	.	.	.	.	.	.
0015	.	.	.	.	.	.	.	.	.

TRCPRM	STOP									
--------	------	--	--	--	--	--	--	--	--	--

8) Press the  soft key on CRT menu, TRACE PARAMETER screen appears.

9) Arrow down  to each field, change the MASK DATA to 80

PMC SIGNAL TRACE		MONIT RUN	
TRACE MODE	:	0	(0:1BYTE/1:2BYTE/2:WORD)
1ST TRACE ADDRESS CONDITION	:	0	(0:PMC ADDRESS/1:PHY ADDRESS)
ADDRESS	:	X0006	
MASK DATA	:	80	

TRACE Display

10) Press the  soft key on CRT menu. The **TRACE DISPLAY** screen appears.

11) Press the  soft key on CRT menu. The display begins recording events.

12) Press the  button on the operator panel, a few times.

13) Press the  button on the operator panel.

14) Press the  button on the operator panel, again.

Notice you can see X6 bit 5 changed, but traces only when the masked signal changes.

PMC SIGNAL TRACE										MONIT RUN
		ADDRESS = X0006 (800)								
NO.		7	6	5	4	3	2	1	0	
0000	.	.	.	.	.	.	.	.	.	.
0001	1	.	.	.	.	.	.	.	.	.
0002	.	.	.	.	.	.	.	.	.	.
0003	1	.	.	.	.	.	.	.	.	.
0004	.	.	.	.	.	.	.	.	.	.
0005	1	.	.	.	.	.	.	.	.	.
0006	.	.	.	1	.	.	.	.	.	.
0007	1	.	.	1	.	.	.	.	.	.
0008	.	.	.	1	.	.	.	.	.	.
0009	1	.	.	1	.	.	.	.	.	.
0010	.	.	.	1	.	.	.	.	.	.
0011	1	.	.	1	.	.	.	.	.	.
0012	.	.	.	.	.	.	.	.	.	.
0013	.	.	.	.	.	.	.	.	.	.
0014	.	.	.	.	.	.	.	.	.	.
0015	.	.	.	.	.	.	.	.	.	.

TRCPRM	STOP									
--------	------	--	--	--	--	--	--	--	--	--

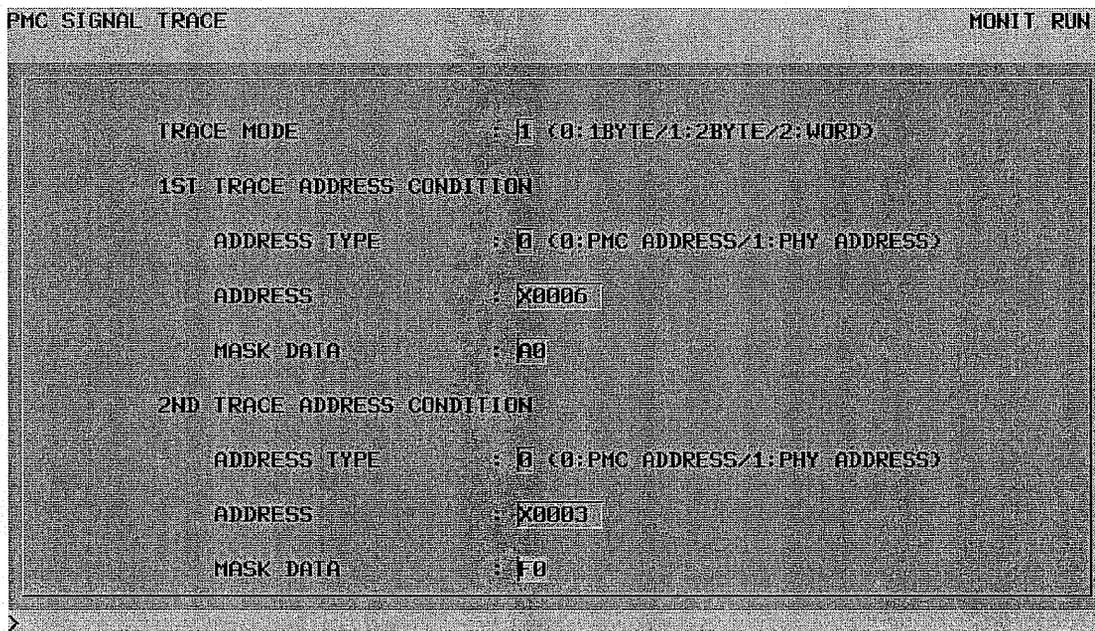
What **MASK DATA** would you enter to trace activity of both signals ?

15) Press the  soft key on CRT menu, **TRACE PARAMETER** screen appears.

TRACE Display

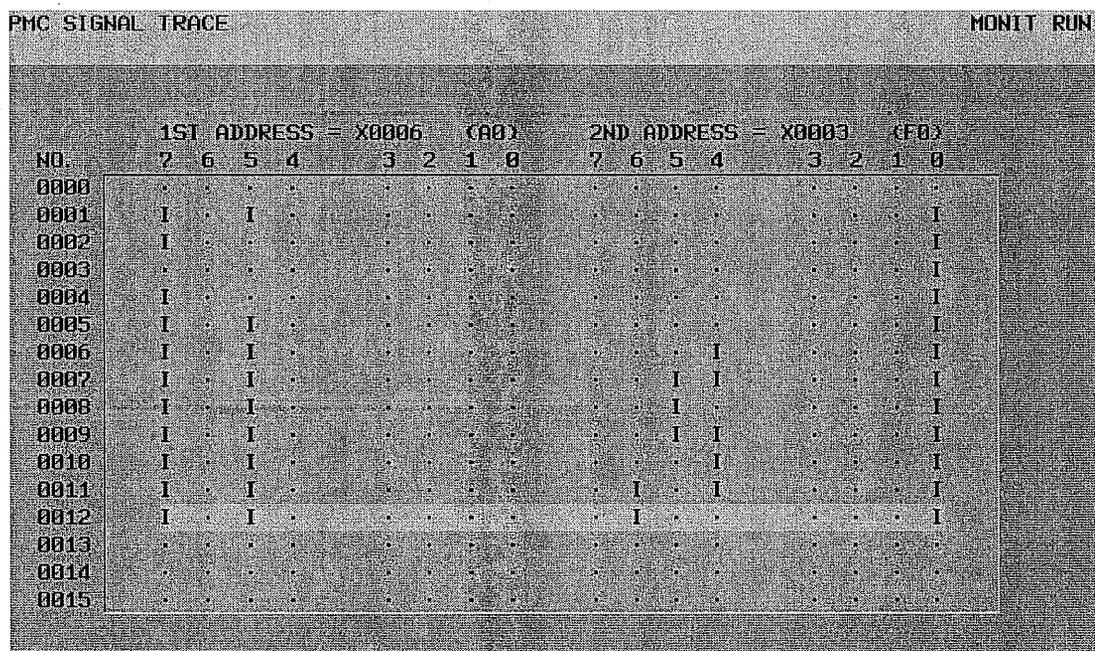
16) Change the **TRACE MODE** setting to a value of **1**, a second trace setting appears.

17) Arrow down  to each field, enter the information as shown as below.



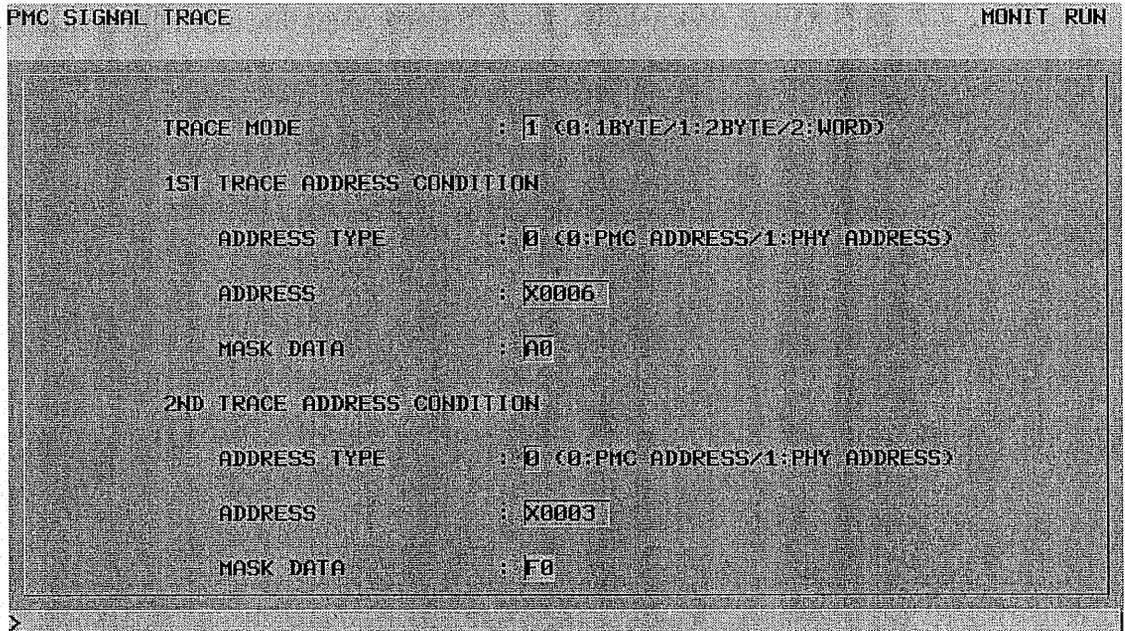
18) Press the  soft key on CRT menu. The **TRACE DISPLAY** screen appears.

19) Press the  soft key on CRT menu. The display begins recording events.



TRACE Display

The other **TRACE MODE** is **2:WORD**. This mode traces 2 consecutive address. A BYTE is 8 bits, a WORD is 16 bits, so X0006 and X0007 will be traced.



The other **ADDRESS TYPE** is **1:PHY ADDRESS** which is used to monitor the PMC memory addresses. This is the physical memory that the PMC runs in. Not very useful to the average troubleshooter, but may be useful to a PMC developer. Change ADDRESS TYPE to 1 to see the physical address where X6 resides.

20) Press the  left menu soft key to return to the PMCDGN menu.

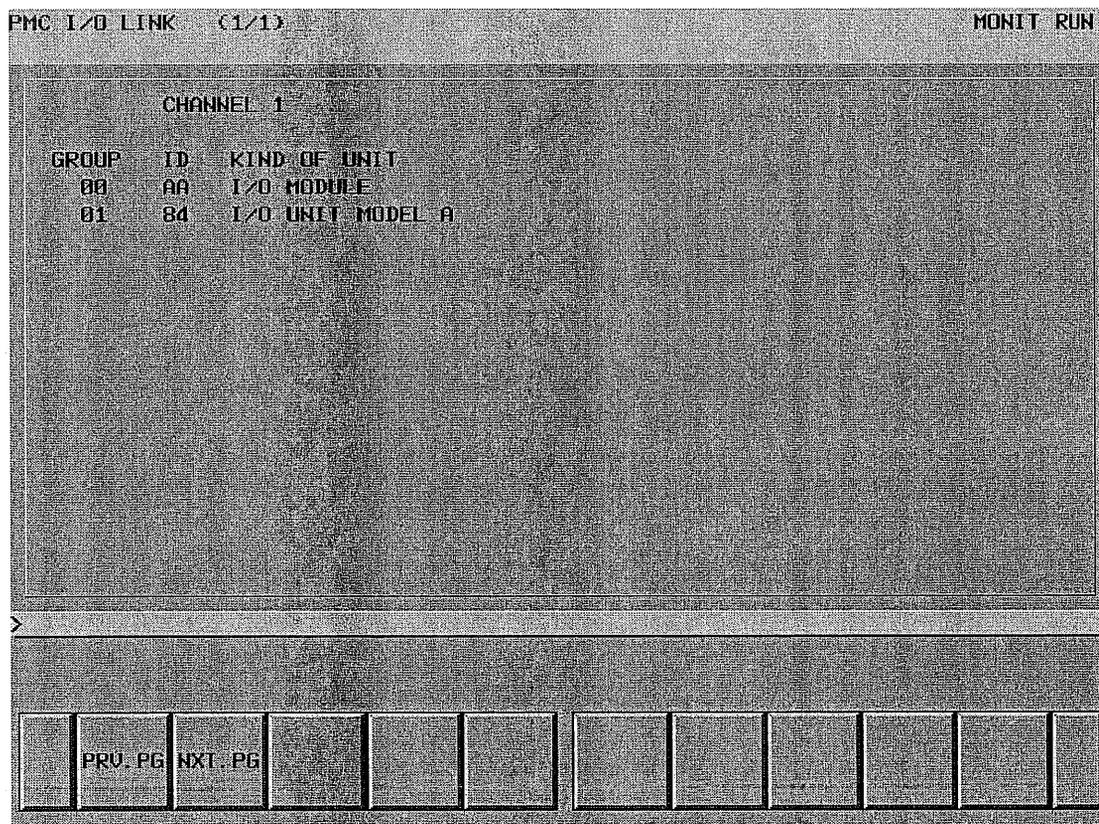
2.2.6. I/O CHECK Display

The I/O check display shows which I/O devices are connected to the CNC I/O LINK connector. The I/O link is a serial communication that connects to remote I/O devices. The status of the INPUT and OUTPUT devices is fed back to the PMC ladder in the form of X and Y addresses (physical inputs and outputs).

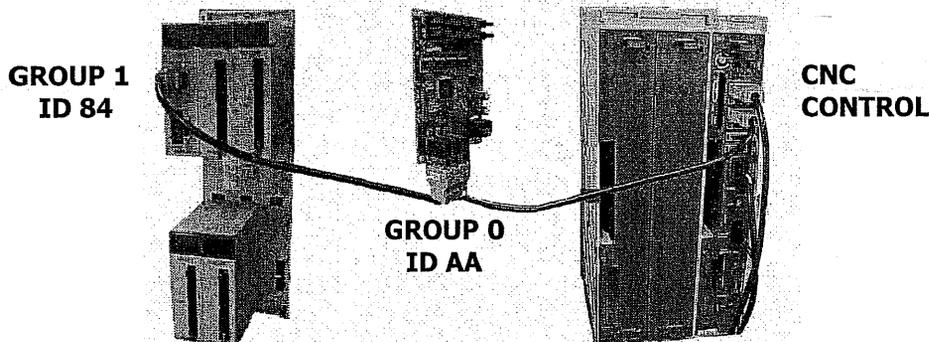


1) Press the  soft key on the CRT menu. The I/O CHECK screen appears.

2) Press the  soft key on CRT menu. The I/O LINK configuration appears.



The machine builder assigns X and Y addresses to each I/O module connected to the I/O link communication cable. The addressing is specified by GROUP, BASE and SLOT. This screen shows you the different groups of I/O connected.



I/O Check Display

- 3) Press the  left menu soft key 3 times to return to the original PMC menu.

2.3. PMCPRM Parameter Display

The PMC parameters tell the PMC how it will operate. They set time intervals for timers, keep track of current counts in counters, turn on machine side options, and store data to remember machine conditions like which tools are in which magazine pots. Their purpose is determined by the machine builder at the time the ladder is written.

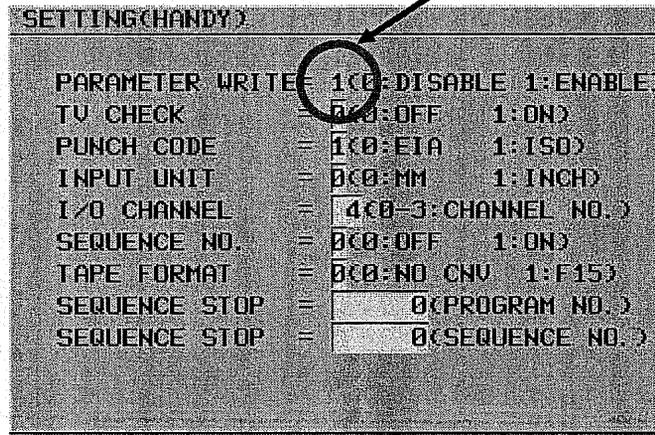
To change PMC parameter settings, the CNC must be in MDI mode (or EMG-STOP) and PARAMETER WRITE enable must be set to 1.

2.3.1. Setting Parameter Write Enable

If the PMC parameters need to be changed, the **PARAMETER WRITE** enable bit must be set before changes can be made. Here are the steps to enable parameter write.



- 1) Select  mode on the operator panel.
- 2) Press the  button on the MDI panel.
- 3) Press the  soft key on the CRT menu.
- 4) Use the **arrow** keys to highlight the PARAMETER WRITE setting.



- 5) Press  then press the  key on the MDI key panel.

Alarm "100 PARAMETER WRITE ENABLE" will appear on the screen.

Press the  and  buttons at the same time, to clear this alarm.

- 6) Now press the  key on the MDI key panel.

- 7) Press the  soft key on the CRT menu.

2.3.2. TIMER Setting Display

The timers are used for delay purposes. The timer function blocks labeled SUB3 can be adjusted on this page. Contact the machine builder to determine the timers purpose.



1) Press the  soft key on the CRT menu.

2) Press the  soft key on CRT menu. The TIMER setting screen appears.

There are 3 columns on this screen, NO., ADDRESS, and DATA.

3) Arrow down  to NO. 15, enter 2000 then press .

PMC PRM (TIMER) #001 MONIT RUN

NO.	ADDRESS	DATA	NO.	ADDRESS	DATA	NO.	ADDRESS	DATA
001	T000	0	016	T030	0	031	T060	0
002	T002	0	017	T032	0	032	T062	0
003	T004	0	018	T034	0	033	T064	0
004	T006	0	019	T036	0	034	T066	0
005	T008	0	020	T038	0	035	T068	0
006	T010	0	021	T040	0	036	T070	0
007	T012	0	022	T042	0	037	T072	0
008	T014	0	023	T044	0	038	T074	0
009	T016	0	024	T046	0	039	T076	0
010	T018	0	025	T048	0	040	T078	0
011	T020	0	026	T050	0	041	T080	0
012	T022	0	027	T052	0	042	T082	0
013	T024	0	028	T054	0	043	T084	0
014	T026	0	029	T056	0	044	T086	0
015	T028	2000	030	T058	0	045	T088	0

TIMER	COUNTR	KEEPRL	DATA	SETING					
-------	--------	--------	------	--------	--	--	--	--	--

NO. = Refers to the TIMER NUMBER in the SUB3 function block



Then, 2 seconds after K8.0 and X5.1 conduct, the coil R200.0 becomes active.

TIMER Setting Display

ADDRESS = Used by any other function block, to reference this timer.

DATA = The timer delay in milliseconds, 1000=1 second.

- 4) Press the  left menu soft key to return to the PMC main menu.
- 5) Press the  soft key on the CRT menu.
- 6) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 7) Enter **FUNCTION** number 3, then press the  soft key.
- 8) Press the  left menu soft key to return to the PMC main menu.
- 9) Press the  soft key on the CRT menu. The function block parameters appear.
- 10) Press the  button on the operator panel, and watch the timer count.
When the count reaches 2000, the R200.0 coil will turn ON
- 11) Press the  left menu soft key to return to the PMC main menu.
- 12) Press the  soft key on the CRT menu.

2.3.3. COUNTER Setting Display

The counters can be used by the machine builder to count any occurrence they choose. A common use for a counter would be to count tool pots on the tool magazine. The counter function blocks SUB5 can be adjusted on this screen.

1) Press the  soft key on CRT menu. The PMCPRM menu appears.

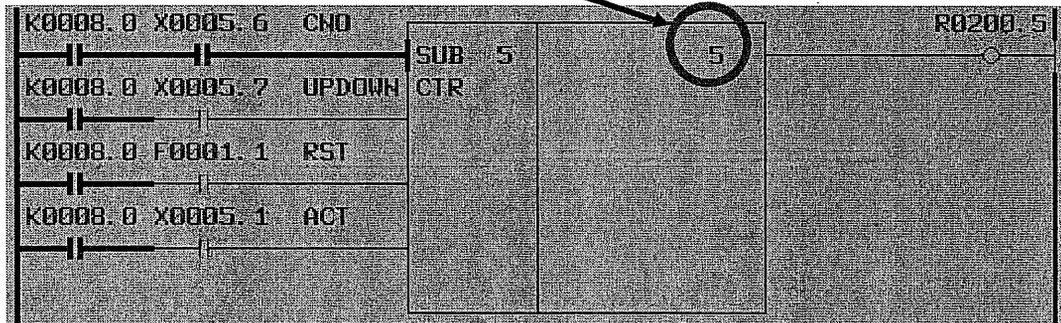
2) Press the  soft key on CRT menu. The COUNTER setting screen appears.

PMC PRM (COUNTER) #001 MONIT RUN

NO.	ADDRESS	PRESET	CURRENT	NO.	ADDRESS	PRESET	CURRENT
001	C000	0	0	016	C060	0	0
002	C004	0	0	017	C064	0	0
003	C008	0	0	018	C068	0	0
004	C012	0	0	019	C072	0	0
005	C016	10	1	020	C076	0	0
006	C020	0	0	021	C080	0	0
007	C024	0	0	022	C084	0	0
008	C028	0	0	023	C088	0	0
009	C032	0	0	024	C092	0	0
010	C036	0	0	025	C096	0	0
011	C040	0	0	026	C100	0	0
012	C044	0	0	027	C104	0	0
013	C048	0	0	028	C108	0	0
014	C052	0	0	029	C112	0	0
015	C056	0	0	030	C116	0	0

TIMER	COUNTR	KEEPRI	DATA	SETTING					
-------	---------------	--------	------	---------	--	--	--	--	--

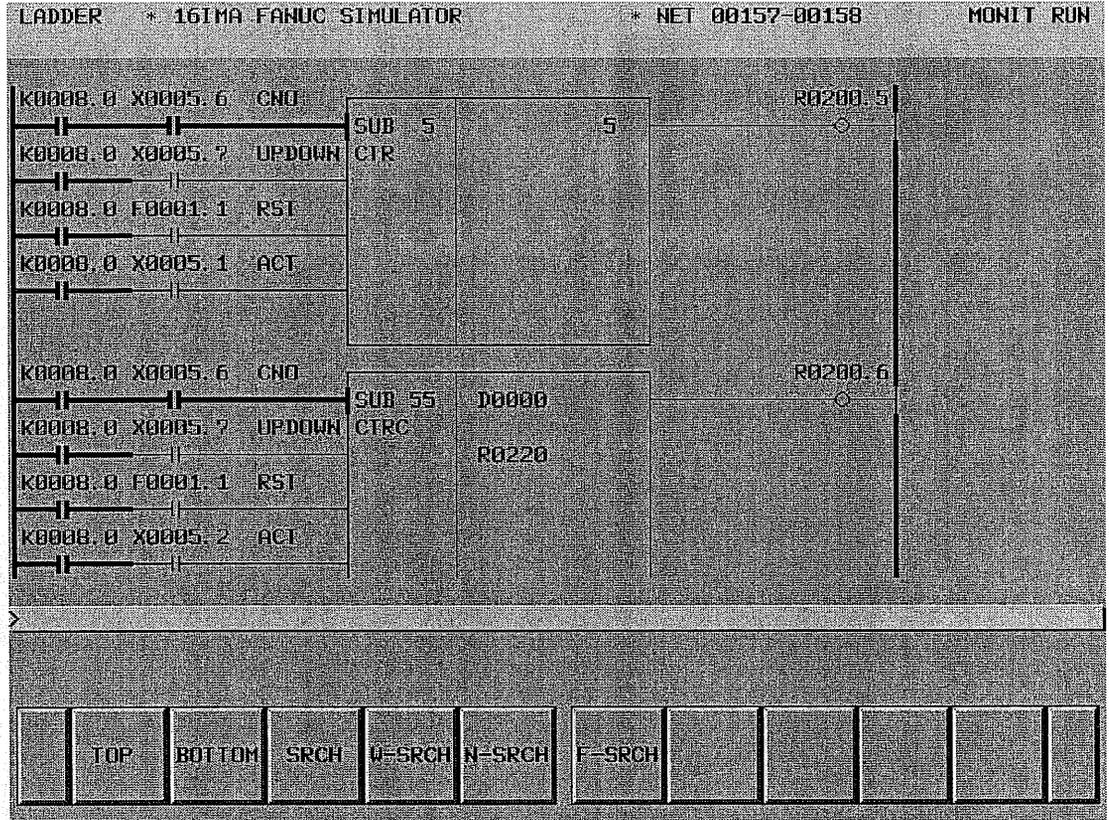
NO. = Refers to the COUNTER NUMBER in the SUB5 function block



COUNTER Setting Display

The **ACT** input (**X5.1**) is the action that will be counted. When the **current** count reaches the **preset** value (10), the output coil (**R200.5**) becomes active. The next **ACT** input will return the counter to the beginning value (0 or 1).

3) Find **COUNTER 5** in the ladder diagram.



4) Press the  button on the operator panel, and watch the counter count.

5) Press the  left menu soft key to return to the PMC main menu.

6) Press the  soft key on the CRT menu.

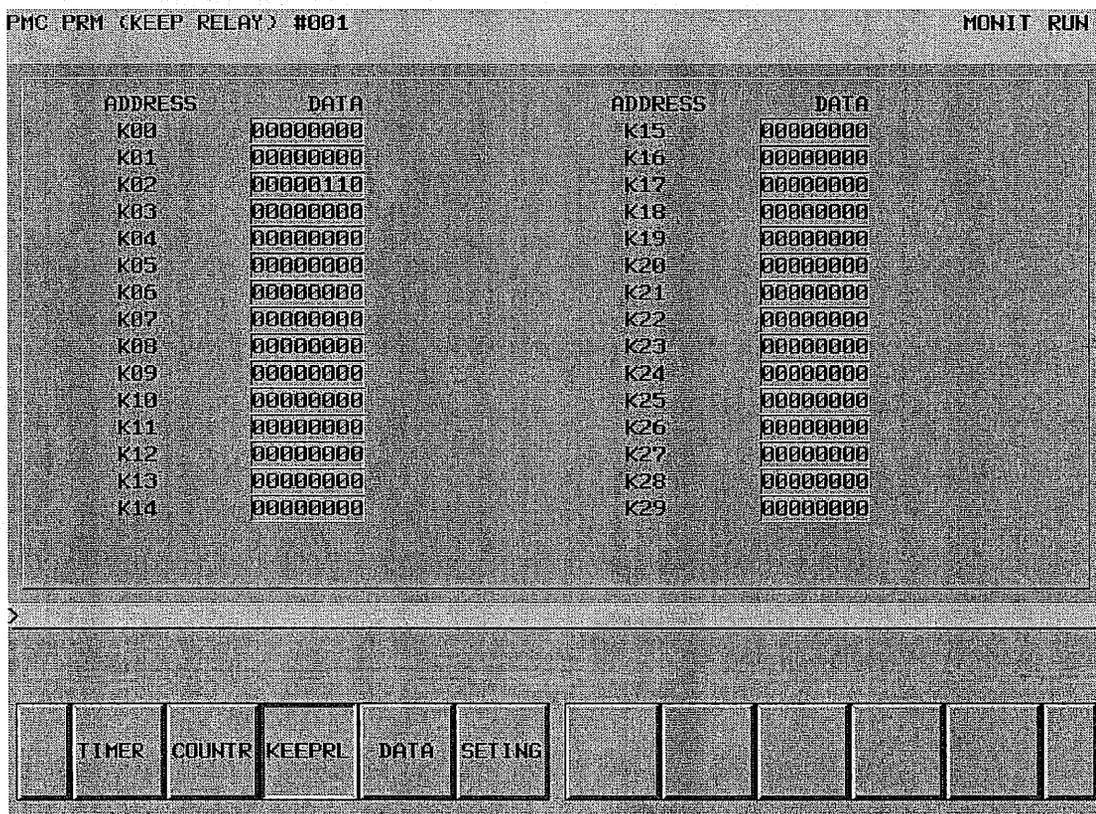
2.3.4. KEEP RELAY Setting Display

The keep relays are used to enable machine builder options in the ladder. For example, the machine builder may include 4th axis control in the ladder, even though the machine does not have the axis. If the end user decides to add a 4th axis later, a keep relay will enable that portion of the ladder. This allows the machine builder to add all machine functions, so they don't need to re-write the ladder if the user decides to upgrade the machine.



1) Press the  soft key on the CRT menu.

2) Select  mode on the operator panel.



3) Turn ON K4 bit 0 on this display.

4) Find K4 bit 0 in the ladder diagram, what does it do ?

You will not find any **K COILS** in the ladder. The only way to turn ON/OFF the K addresses in the ladder, is on this parameter screen.

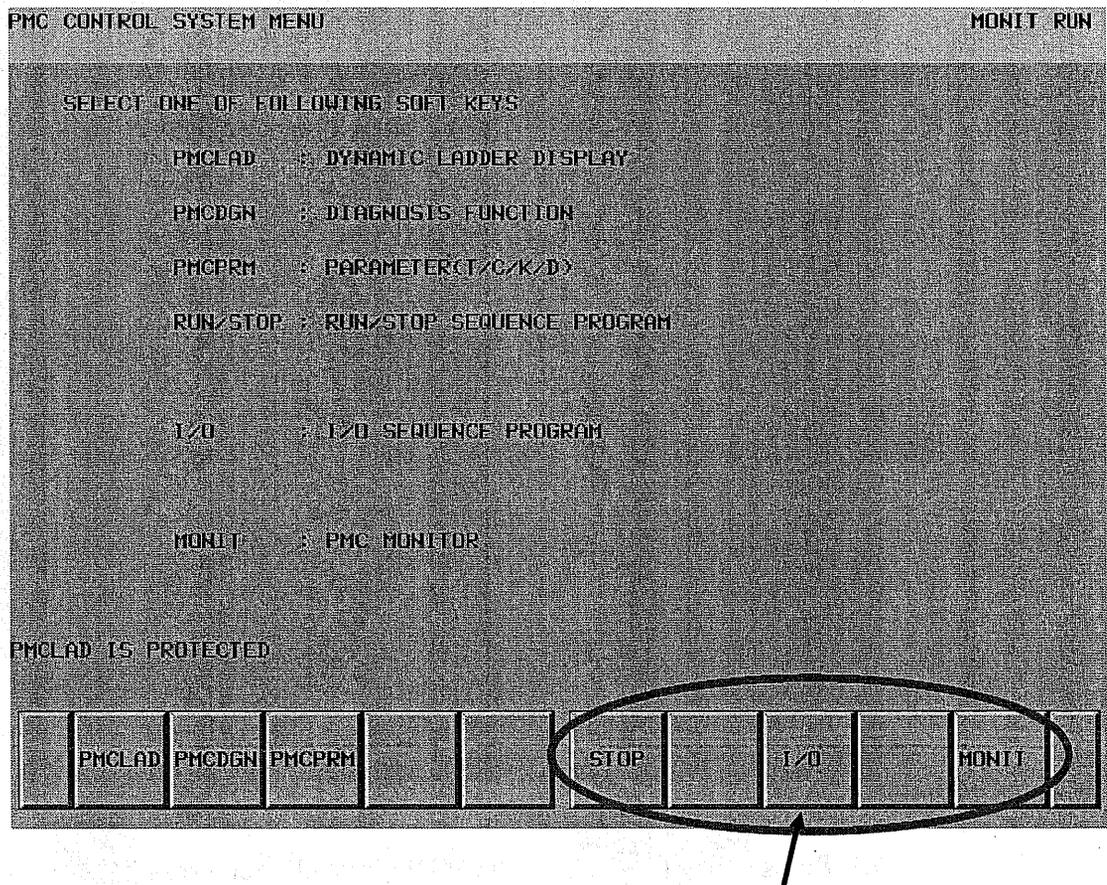
KEEP RELAY Setting Display

Keep relays K16 through K19 are reserved for Fanuc PMC functions. If the control has a SB6 type PMC, K900 through K902 are used in place of K17 through K19. The most commonly used keep relay bits are K17/K900 bits 0 and 1.

K17/K900 bit 0 – 0=PMCLAD display is available
 1=PMCLAD display cannot be seen
 (Alarm = **PMCLAD IS PROTECTED**)

K17/K900 bit 1 - 0=STOP, I/O, and MONITOR soft keys are not visible
 1=STOP, I/O, and MONITOR soft keys are seen

5) Set K17/K900 bit 0 to 1, what happens when you try to view the ladder ?



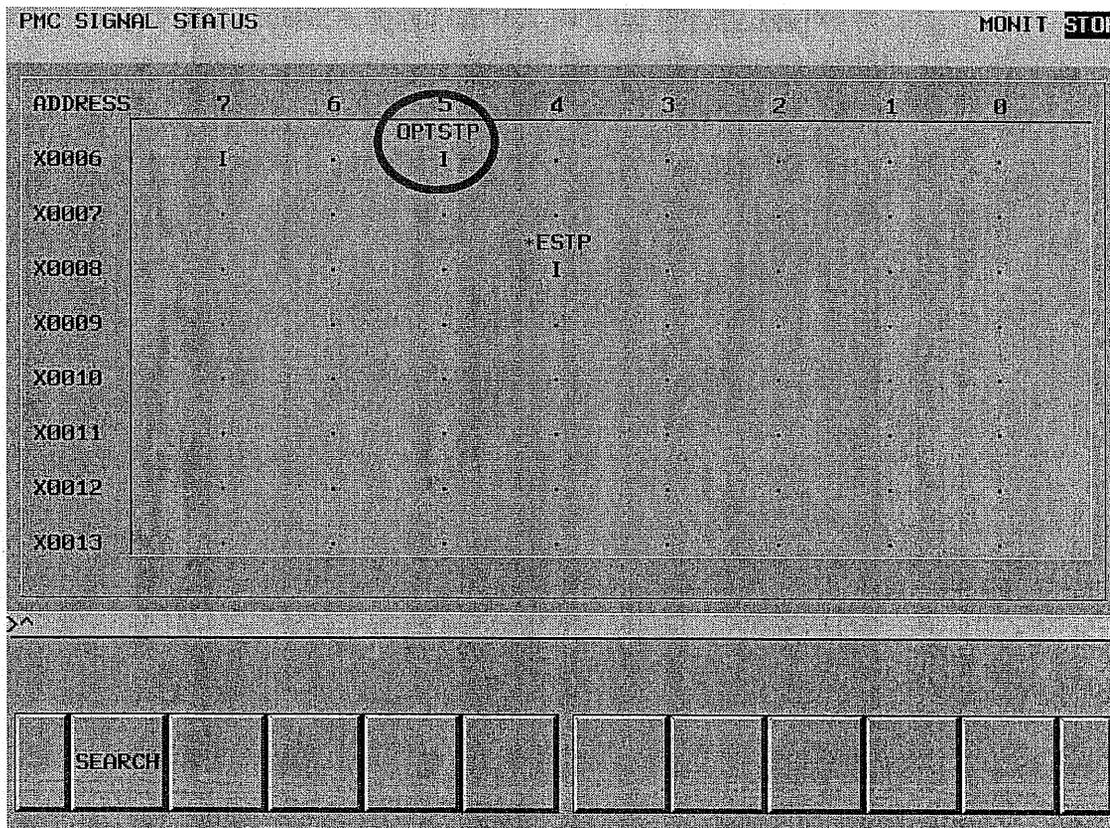
6) Set K17/K900 bit 1 to 1, notice the soft keys **STOP**, **I/O**, and **MONIT** appear. These soft keys are used for ladder editing and backup. The STOP key can also be used to provide SAFETY during the troubleshooting process.

7) Press the  button on the operator panel, so it is lit.

8) Press the  soft key on CRT menu. STOP appears in the top right corner.

KEEP RELAY Setting Display

- 9) Press the  soft key on the CRT menu.
- 10) Press the  soft key on the CRT menu.
- 11) Press   on the MDI key pad, then press .
- 12) Press the  button on the operator panel, watch the status change.



- 13) Press   on the MDI key pad, then press .

The output to the lamp, Y6.5 does not change because the ladder is stopped. When you stop the ladder, **the outputs retain their current status.**

- 14) Find the coil Y6 bit 5 in the ladder diagram, and watch the circuit as you press the OPTION STOP button. The coil does not change states. Depending on the PMC type, the X6.6 contact may not change either, on the ladder screen. The true status is always shown on the PMCDGN -> STATUS screen.

- 15) Press the  left menu soft key to return to the PMC main menu.

2.3.5. DATA Table Display

The data table is a place to store numbers. The numbers can be used for any purpose the PMC developer wants. They could be used to store tool numbers in a random tool changer, to keep track of which tool is in which pocket, or they may be used to vary the data in a counter.



1) Press the  soft key on the CRT menu.

2) Press the  soft key on the CRT menu. The DATA TBL CONTROL screen appears. This screen is used to select the format of the data registers. The user typically does not make changes here, it is set up by the machine builder.

PMO DATA TBL CONTROL MONIT RUN

to increase enter 10 and Press G. CONT

GROUP TABLE COUNT 5

NO.	ADDRESS	PARAMETER	TYPE	NO. OF DATA	NO.	ADDRESS	PARAMETER	TYPE	NO. OF DATA
001	00000	00000000	0	100	016				
002	00100	00000100	0	1000	017				
003	01100	00000100	0	200	018				
004	01300	00000000	0	200	019				
005	01500	00000001	0	6500	020				
006					021				
007					022				
008					023				
009					024				
010					025				
011					026				
012					027				
013					028				
014					029				
015					030				

>

G. DATA	G. CONT	NO. SRH	INIT						
---------	---------	---------	------	--	--	--	--	--	--

The DATA TBL CONTROL parameters should only be changed by the ladder author. Below is a brief description of their meanings...

ADDRESS = The starting address of the group

PARAMETER = Selects data display type, DECIMAL (bit0 and 2=0), BCD (bit0=1), HEX (bit2=1), and also protection (bit1)

TYPE = Data length, 0=BYTE(8bit), 1=WORD(16bit), 2=LONG WORD(32bit)

NO. OF DATA = number of registers in this group

DATA Table Display

3) Press the  soft key on the CRT menu. The **DATA** table screen appears.

PMC PRM (DATA) 01/001 BIN MONIT RUN

NO.	ADDRESS	DATA	NO.	ADDRESS	DATA	NO.	ADDRESS	DATA
0000	D0000	0	0015	D0015	0	0030	D0030	0
0001	D0001	10	0016	D0016	0	0031	D0031	0
0002	D0002	0	0017	D0017	0	0032	D0032	0
0003	D0003	1	0018	D0018	8	0033	D0033	0
0004	D0004	0	0019	D0019	0	0034	D0034	0
0005	D0005	0	0020	D0020	9	0035	D0035	0
0006	D0006	0	0021	D0021	0	0036	D0036	0
0007	D0007	0	0022	D0022	1	0037	D0037	0
0008	D0008	0	0023	D0023	0	0038	D0038	0
0009	D0009	0	0024	D0024	0	0039	D0039	0
0010	D0010	1	0025	D0025	0	0040	D0040	0
0011	D0011	0	0026	D0026	0	0041	D0041	0
0012	D0012	0	0027	D0027	0	0042	D0042	0
0013	D0013	0	0028	D0028	0	0043	D0043	0
0014	D0014	0	0029	D0029	0	0044	D0044	0

>

C. DATA	G-SRCH	SEARCH							
---------	--------	--------	--	--	--	--	--	--	--

4) Arrow down  to D0008, enter 10 then press 

5) Press the  left menu soft key 2 times to return to the PMC main menu.

6) Press the  soft key on the CRT menu.

7) Press the  soft key on the CRT menu. The SEARCH soft menu appears.

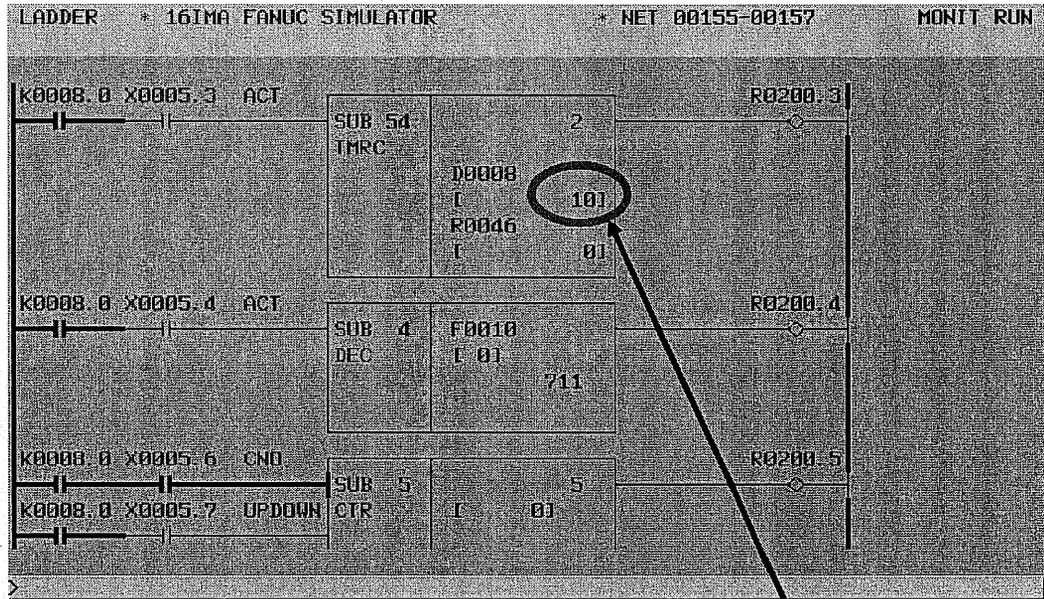
8) Enter address D8, then press the  soft key.

The function block containing D0008 should appear.

DATA Table Display

The function block containing D0008 should appear.

- 9) Press the  left menu soft key to return to the PMCLAD menu.



- 10) Press the  soft key on the CRT menu. The setting in D8 should appear.

- 11) Return to the PMCPRM screen and change the setting for D0008 to 22.

- 12) Then view the change on the PMCLAD screen.

2.3.6. SETTING Display

The setting display has parameters that determine how the ladder special functions will work. These functions are described below.

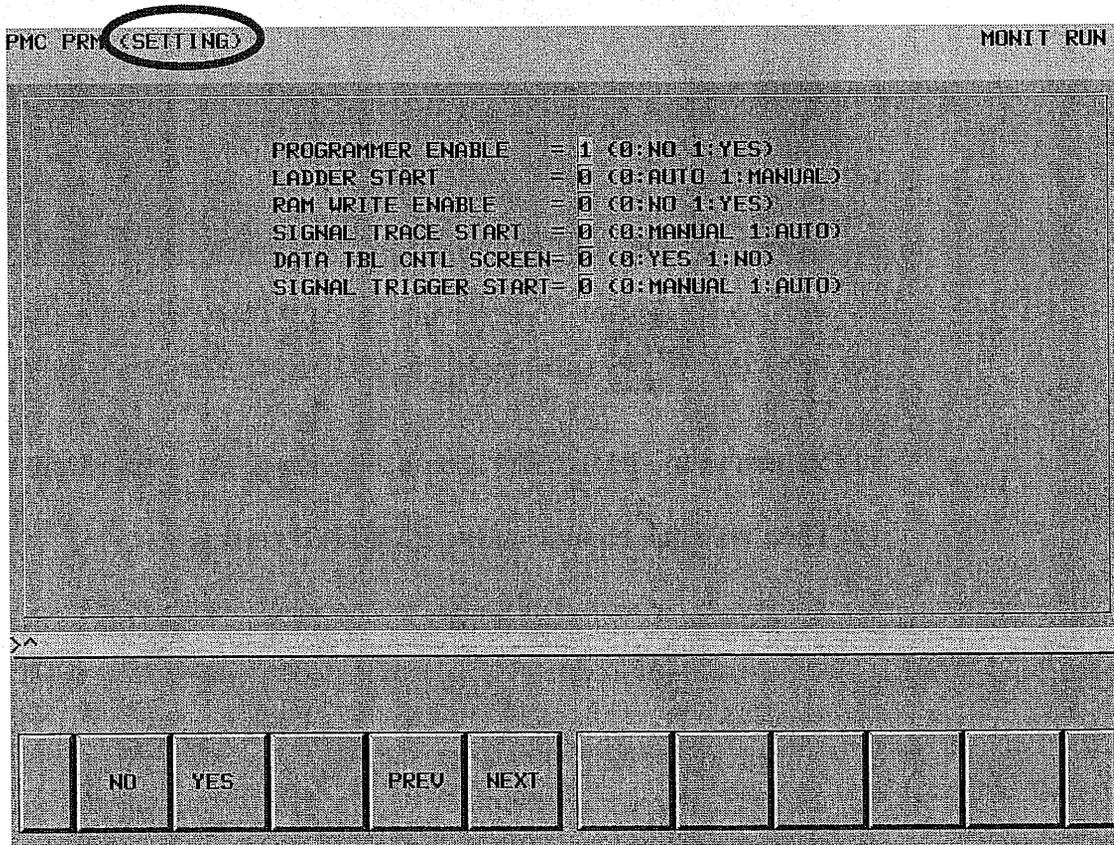


1) Press the  key on the MDI key panel.

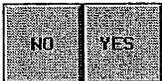
2) Press the  soft key on CRT menu.

3) Press the  soft key on the CRT menu.

4) Press the  soft key on the CRT menu.

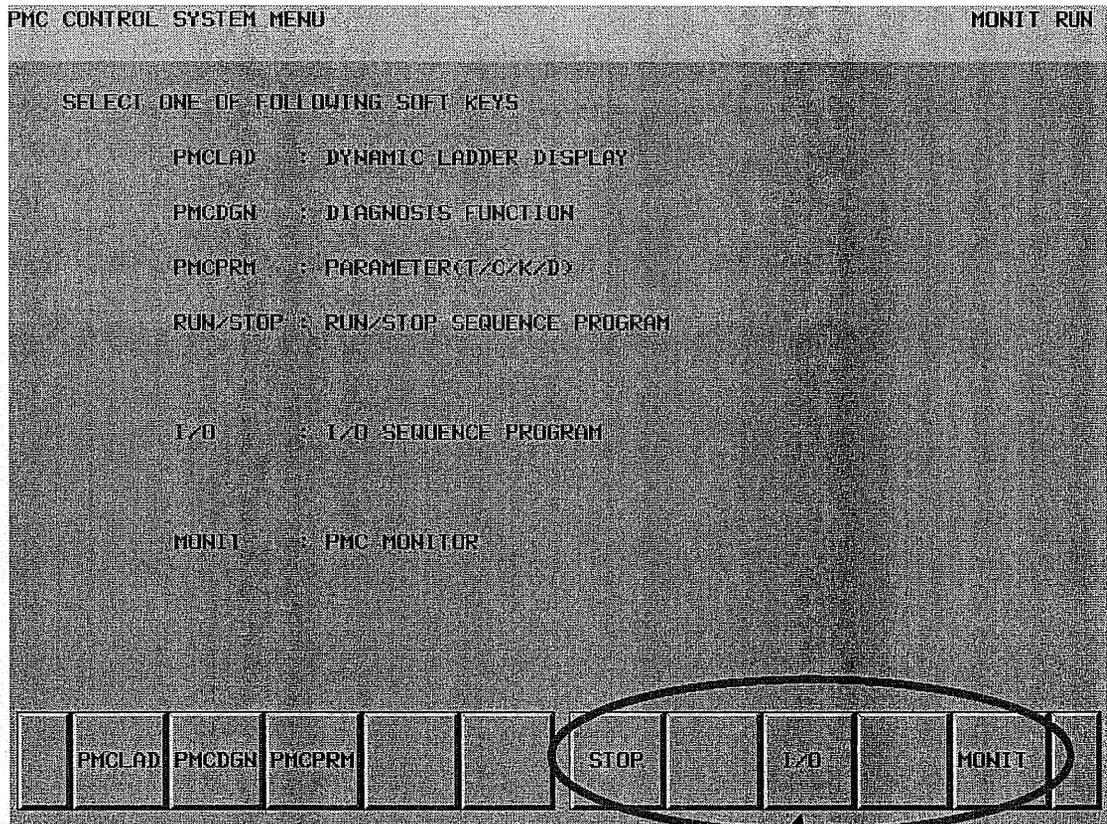


The **PROGRAMMER ENABLE** setting corresponds to the **K17 / K900** keep relay setting. If you change this setting, the value of K17 / K900 bit 1 will also change.

5) Press the  soft keys to change the **PROGRAMMER ENABLE** setting.

SETTING Display

- 9) Press the  left menu soft key 2 times, to return to the PMCLAD menu.



If **PROGRAMMER ENABLE=1**, notice the soft keys **STOP**, **I/O**, and **MONIT** appear. If programmer enable = 0 then the soft keys are not present. These soft keys are used for ladder editing and ladder backup.

- 10) Press the  soft key on the CRT menu.

- 11) Press the  soft key on the CRT menu, the setting screen appears.

- 12) Change the **PROGRAMMER ENABLE** setting to **0:NO**.

- 13) Arrow down  to **LADDER START**, notice the soft keys change.

This setting decides if the ladder is automatically starts running when the CNC power is turned ON. You probably noticed the ladder was automatically started last time you powered the CNC ON.

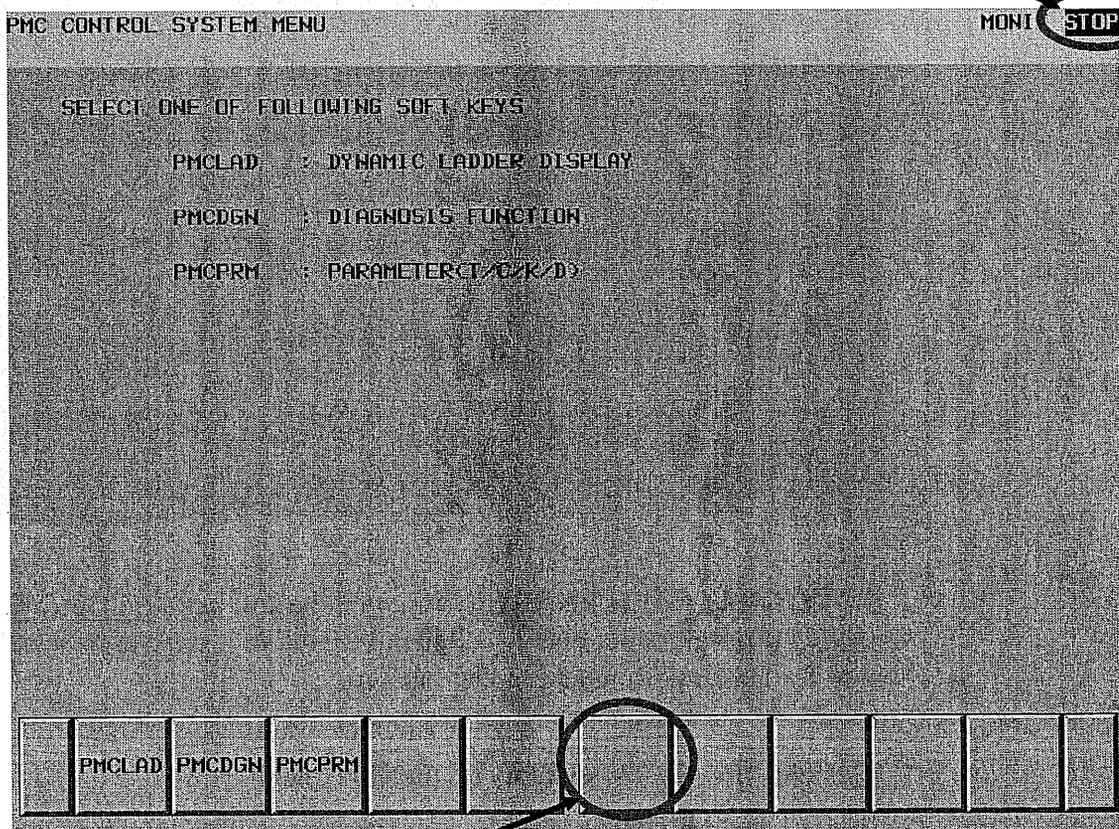
SETTING Display

14) Press the  soft key on the CRT menu, notice the setting changes to 1.

15) Power the CNC OFF/ON.

16) Press the  key on the MDI key panel.

17) Press the  soft key on CRT menu, notice the PMC is stopped.



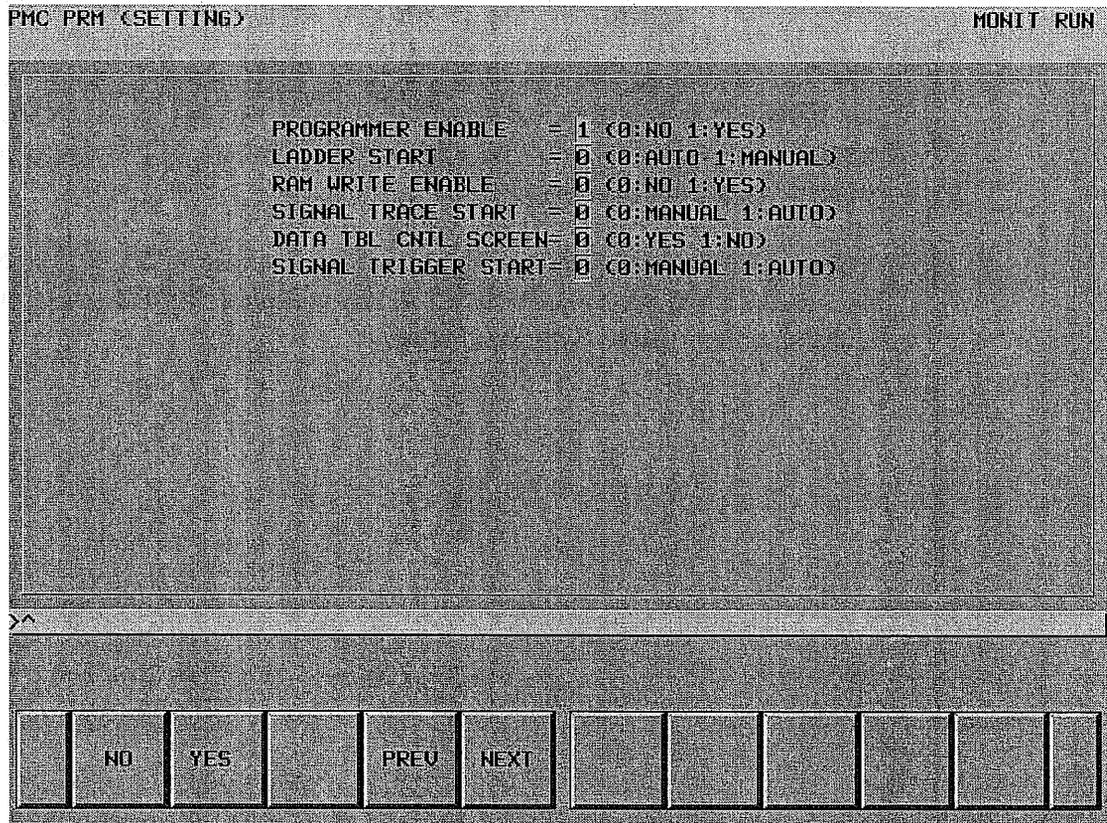
Also notice that the RUN button is **not present**. This is a good way to ensure nobody will accidentally operate the machine while maintenance is being performed. No outputs can change while the ladder is stopped.

18) Take the necessary steps to make the ladder RUN.

19) Press the  soft key on the CRT menu, the setting screen appears.

SETTING Display

The next setting on this screen is **SIGNAL TRACE START**. This setting decides if the **TRACE** screen automatically starts tracing at CNC power ON. Earlier in this manual, the trace function was described. It allows you to monitor the status of a PMC signal, and record if the status changes.



DATA TBL CNTL SCREEN is a setting that will hide the data table control screen when the  soft key is pressed on the PMCPRM display.

20) Change the **DATA TBL CNTL SCREEN** setting to **1:NO**.

21) Press the  left menu soft key, to return to the PMCPRM menu.

22) Press the  soft key, notice the **DATA TABLE** screen appears directly.

Previously, when the **DATA** soft key was pressed a control screen was displayed. The control screen is where the ladder author setup the types of data registers. Since you should not change the control screen settings anyway, it is probably better to leave the **SETTING** screen set to **DATA TBL CNTL SCREEN = 1:NO**

SETTING Display

23) Press the  left menu soft key, to return to the PMCPRM menu.

24) Press the  soft key on the CRT menu, the setting screen appears.

The final setting on this screen is **SIGNAL TRIGGER START**. This setting decides if the **TRIGGER function automatically starts at CNC power ON**. Earlier in this manual, the trigger function was described. It allows you to freeze the ladder display when a certain event occurs.

You may have more or less settings on your specific SETTING screen. This depends on the type of PMC processor your CNC has installed. Refer to the proper Fanuc manual to understand how those functions work.

2.4. DGNOS CNC Diagnose Screen

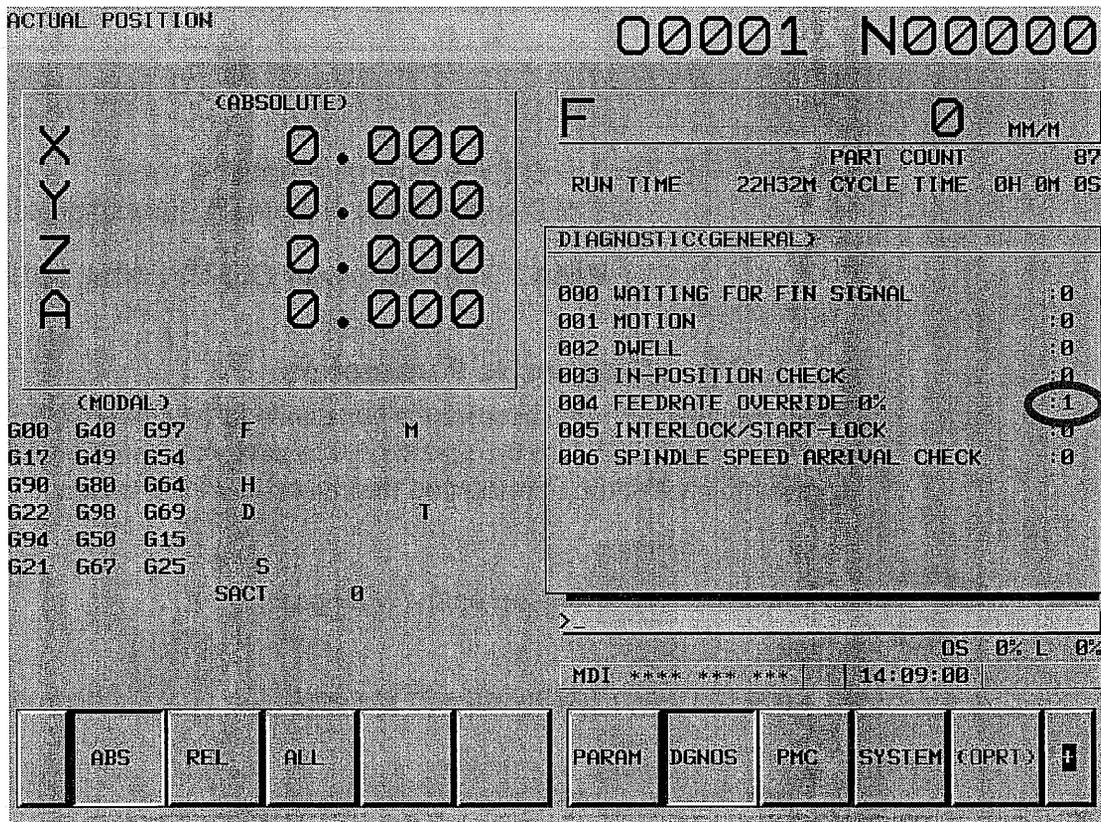
The CNC diagnostic screen shows the status of several operating factors. If the machine will not run, but there are no alarms, this screen will help diagnose the problem.



1) Press the  button on the MDI panel.

2) Press the  soft key on CRT menu.

The DIAGNOSTIC (GENERAL) window will appear.



Here is a list of things that the CNC will wait for while running a G-code program. On the right side of the window is a row of 0's, the number 1 will appear next to the item that the CNC is waiting for.

3) Turn the FEEDRATE switch to 0, on the operator panel.

4) Select **MEMORY** mode on the operator panel mode select switch.

5) Press the  button, the program will execute.

Notice a 1 appears next to the label **004 FEEDRATE OVERRIDE 0%**

2.5. WDGN Wave Diagnostic Screen

The wave diagnostic screen is similar to having a digital oscilloscope built in to the CNC control. The main purpose of the screen is servo/spindle tuning, however you can also look at PMC signal addresses.

It was added to the, FS16/18B, FS16/18C, FS15B and the FS15/16/18 i-Series controls. This function is **only available if the graphic trace option** is installed in the control unit. More information can be found in the control maintenance manual. The parameter **3112.0 = 1** enables the wave diagnostic screen.

FS0C	--	7	6	5	4	3	2	1	0
FS15	--								SGD
FS16	3112								
PM-E	--								

- Bit 0 = SGD=0 = Display normal graphic screen
- 1 = Display servo waveform diagnostic screen

Note: Turn NC power OFF/ON after setting the bit.

2.5.1. Wave Diagnostic Parameters

The parameter settings determine when data will be captured, how long, at what trigger, and the type of data. Use the arrow keys to navigate from field to field, help information specific to each setting appears on the right side of the screen.



- 1) Press the  button on the MDI panel.
- 2) Press the  right menu soft key, until the  button appears.
- 3) Press the  soft key on CRT menu.

The wave diagnostic parameter screen will appear.

WAVE DIAGNOS. (PARAMETER)			
GRP CONDITION	1	GRP CONDITION	
SAMPLING TIME	8000MS	(ONE-S TYPE)	
TRIGGER	X0006.6	0: START	
	(CH-1) (CH-2)	1: START&TRG ↑	
		2: START&TRG ↓	
		(MEMORY TYPE)	
DATA NO.	99 99	100: DATA OF	
UNIT	10 10	MEMORY	
SIGNAL	G0007.2 F0007.0		

Wave Diagnostic Parameters

The GROUP CONDITION parameter determines how the capture cycle of the Wave Diagnostic tool will trigger.

WAVE DIAGNOS. (PARAMETER)		
GRP CONDITION	1	GRP CONDITION
SAMPLING TIME	8000MS	(ONE-S TYPE)
TRIGGER	X0006.6	0: START
	(CH-1) (CH-2)	1: START&TRG ↑
		2: START&TRG ↓
		(MEMORY TYPE)
		100: DATA OF
DATA NO.	99	MEMORY
UNIT	10	
SIGNAL	G0007.2 F0007.0	

3) Press  then  on the MDI key pad.

This will trigger on the positive edge of the trigger signal.

4) Press the  button, on the MDI key pad, to highlight SAMPLING TIME

5) Enter “8000” then press  on the MDI key pad

This is the capture time in milliseconds, 8000 = 8 seconds

6) Press the  button, on the MDI key pad, to highlight TRIGGER

This is the PMC address you want to start the capture with.

7) Enter “X6.6” then press  on the MDI key pad

This is the address for the CYCLE START button.

8) Press the  button, on the MDI key pad, to highlight DATA NO.

This is the type of data you want to view on channel 1.

9) Enter “99” then press  on the MDI key pad

The setting 99 means you want to look at PMC addresses.

10) Press the  button, on the MDI key pad, to highlight SIGNAL

This is the PMC address you want to monitor on the scope.

Wave Diagnostic Parameters

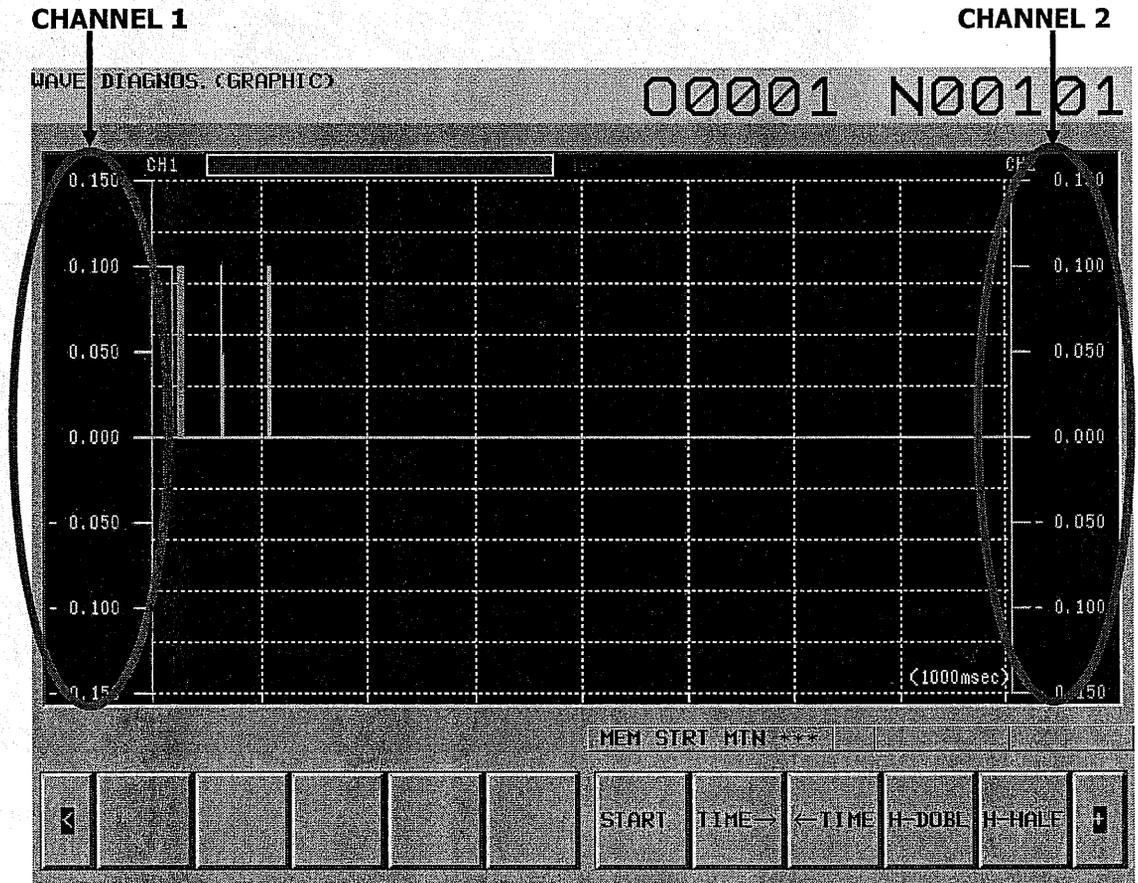
- 11) Enter "G7.2" then press  on the MDI key pad
G7.2 is the PMC command to tell the CNC to CYCLE START
- 12) Press the  button, on the MDI key pad, to highlight DATA NO.
This is the type of data you want to view on channel 2.
- 13) Enter "99" then press  on the MDI key pad
The setting 99 means you want to look at PMC addresses.
- 14) Press the  button, on the MDI key pad, to highlight SIGNAL
This is the PMC address you want to monitor on the scope.
- 15) Enter "F7.0" then press  on the MDI key pad
F7.0 is the M-Code flag, it turns ON while M-codes are being processed.

2.5.2. Capturing the Signal Waveform

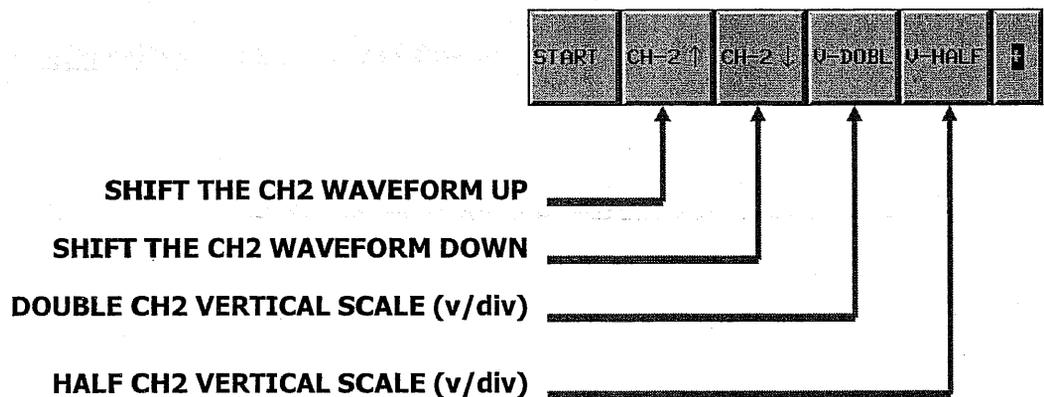
- 16) Press the  soft key on CRT menu.
The wave diagnostic graph screen will appear.
- 17) Press the  soft key on CRT menu.
The wave diagnostic is now waiting for the TRIGGER address to occur.
- 18) Select **MEMORY** mode on the operator panel mode select switch.
- 19) Press the  button, the program will execute.
The message SAMPLING will flash on the screen for 8 seconds.
At the end of the sample the signal trace will appear on the screen.

2.5.3. Viewing the Capture Waveform

When the sampling time has ended, the waveform automatically appears on the display. The graduations for CH1 appears vertically on the left (volts per division) and the graduations for CH2 appears vertically on the right. In this case, since we are looking at PMC addresses, 0.000=OFF and 0.100=ON.

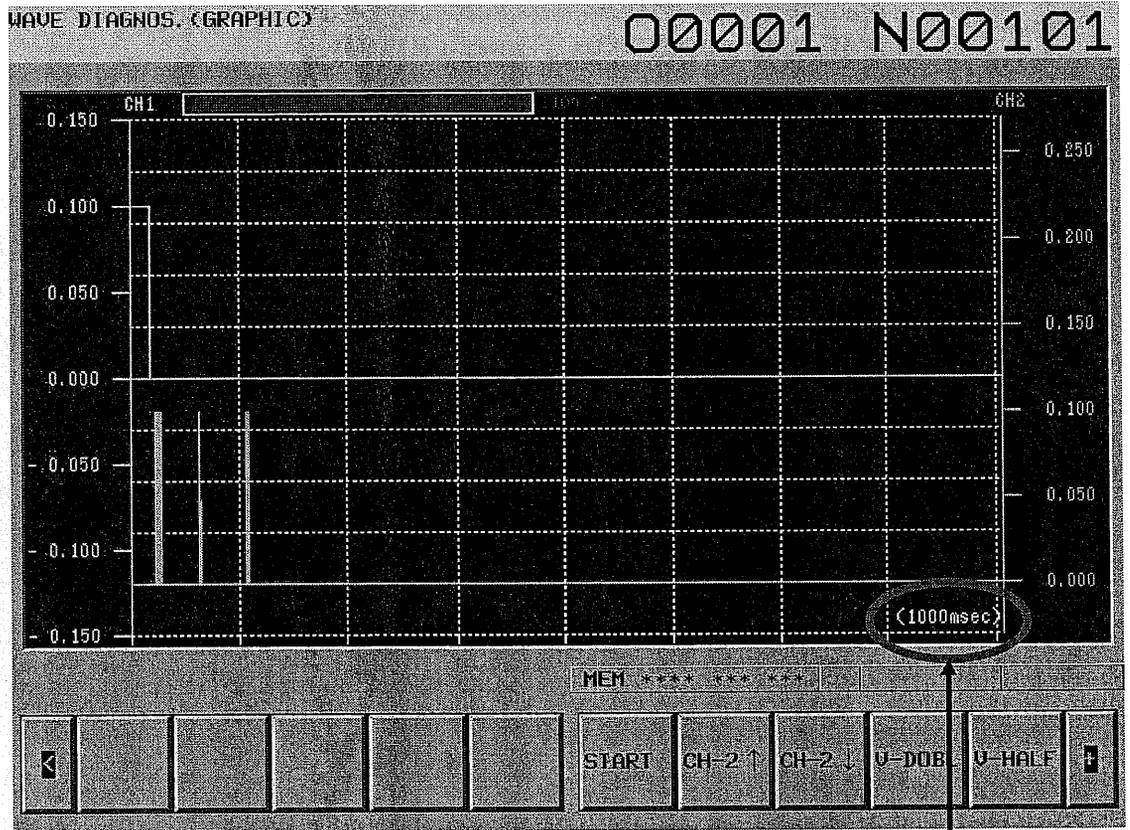


20) Press the  right menu soft key 2 times, the CHANNEL 2 menu will appear.



Viewing the Capture Waveform

21) Press the  soft key on CRT menu, a few times to separate the waveforms.



TIME PER DIVISION

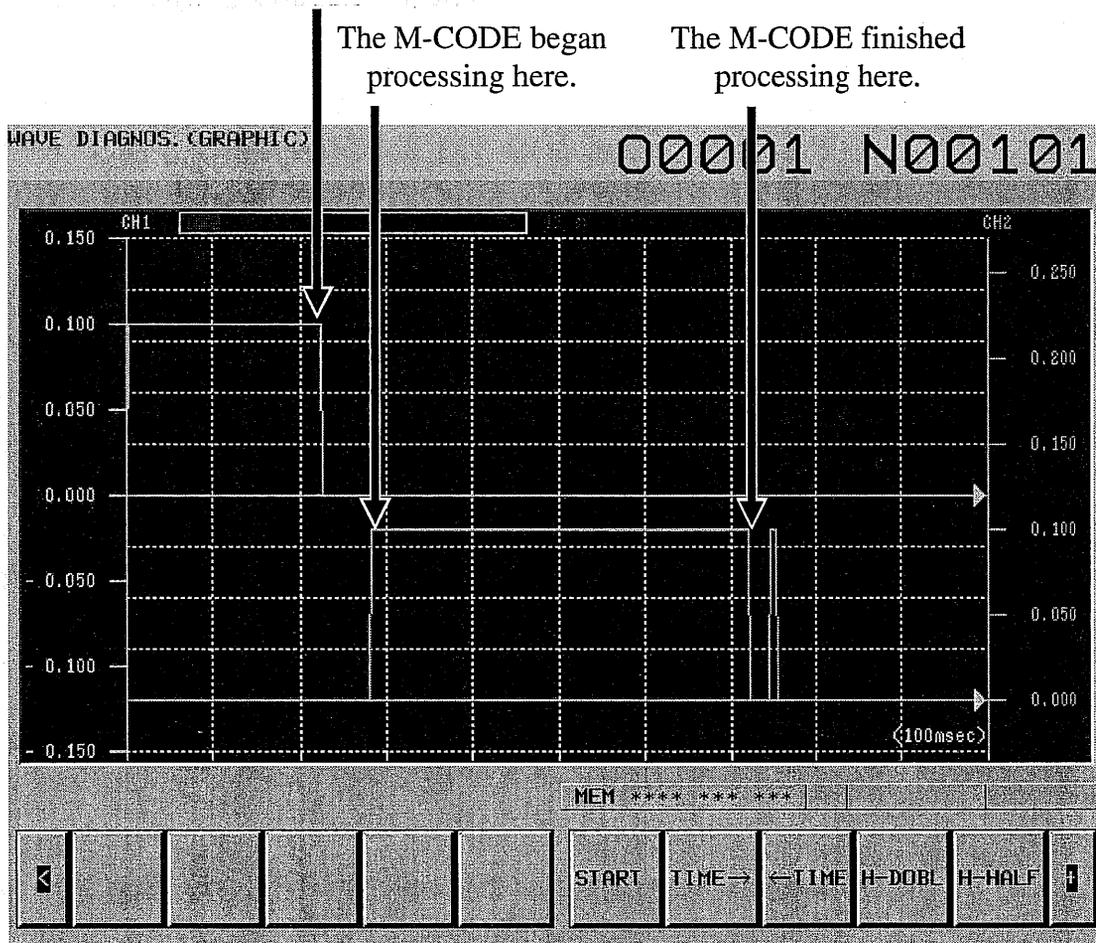
22) Press the  right menu soft key, to display the original GRAPH menu.

23) Press the  menu soft key, until the time per division reads (100msec).

23) Press the  menu soft key, until the negative edge of the channel 1 signal is visible..

Viewing the Capture Trace

The CYCLE START button was released here.



From this waveform we can see that the first M-Code (M6 T1) began processing about **50mSec** after the cycle start button was released.

It is also seen that it took approximately **450mSec** to actually perform the tool change.

2.6. Exercise 1 – PMC Screen Review

- 1) Search the ladder for R0.1, how many contacts are in the ladder ?
how many coils are in the ladder ?

- 2) What is the purpose of the TRIGGER function ?

- 3) How many ladder windows can be displayed on the screen at 1 time ?

- 4) Search the ladder for SUB 5, what is the current count of counter 5 ?

- 5) What is the current ladder version in your simulator ?

- 6) Using the PMCDGN STATUS screen, what is the status of address R0.1 ?

- 7) Setup the TRACE screen to monitor F7.0 (M-code Flag), then run program O0001
From the trace screen view, how many M-codes were processed in that program.

- 8) What mode must the CNC be in, to allow you to change PMC parameters ?

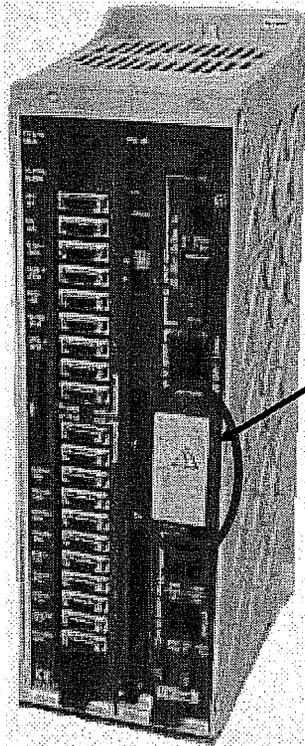
- 9) On the PMCPRM SETTING screen, what is the purpose of the
PROGRAMMER ENABLE setting ?

- 10) When troubleshooting the machine side switches, what should you do to the ladder
before toggling the switches ?

3. PMC Ladder Backup

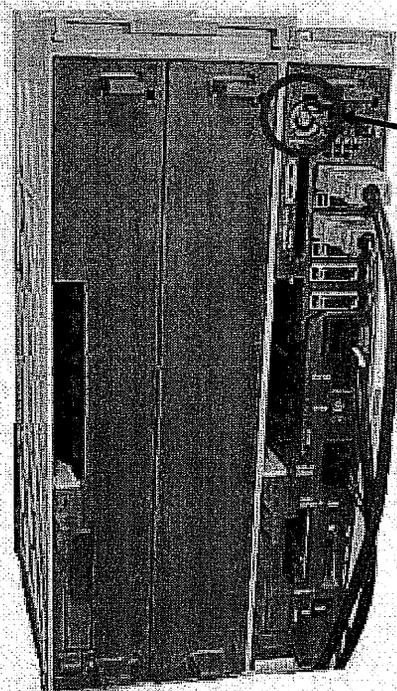
It is important to have a backup of your PMC LADDER and PMC PARAMETERS. Since the ladder and parameters were setup by the machine builder, if the information is lost you will have to contact them to get the data reloaded. **If you have a backup on hand, it is simple to restore the data and get the machine running quickly.** On modern CNC's, the ladder is stored in FLASH ROM. This type of memory typically does not fail, but it is possible. The parameters are stored in SRAM, battery backed-up memory, and if the battery voltage becomes low, the data may be lost. The battery is located on the control unit.

16 Model C



The battery is located under the yellow cover on the power supply unit.

16/Model A/B



The battery is located at the top of the CPU card.

Typically a BATTERY LOW alarm will appear on the CNC display when it is time to change the battery. **We recommend the battery is changed every 5 years.** The battery part number is listed in the maintenance manual for your specific control. As long as you **leave the CNC power ON**, until the battery is changed, the parameter data should not be lost. The battery is only used when the CNC power is OFF.

There is 2 ways to make a backup of the ladder and parameters.

- 1) **By RS232** using a laptop computer.
- 2) **By SRAM** memory card

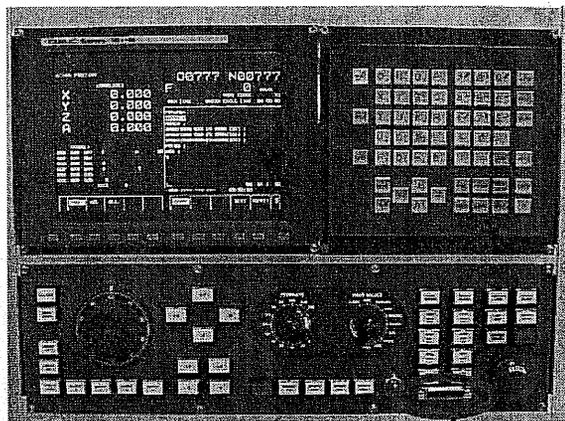
Both methods are described in this chapter.

3.1. Backup by RS232

The 16 control has 2 RS232 serial communication ports. Typically the machine builder makes port 1 available on the machine operator panel.



- 1) Connect the CNC and PC with the RS232 cable.

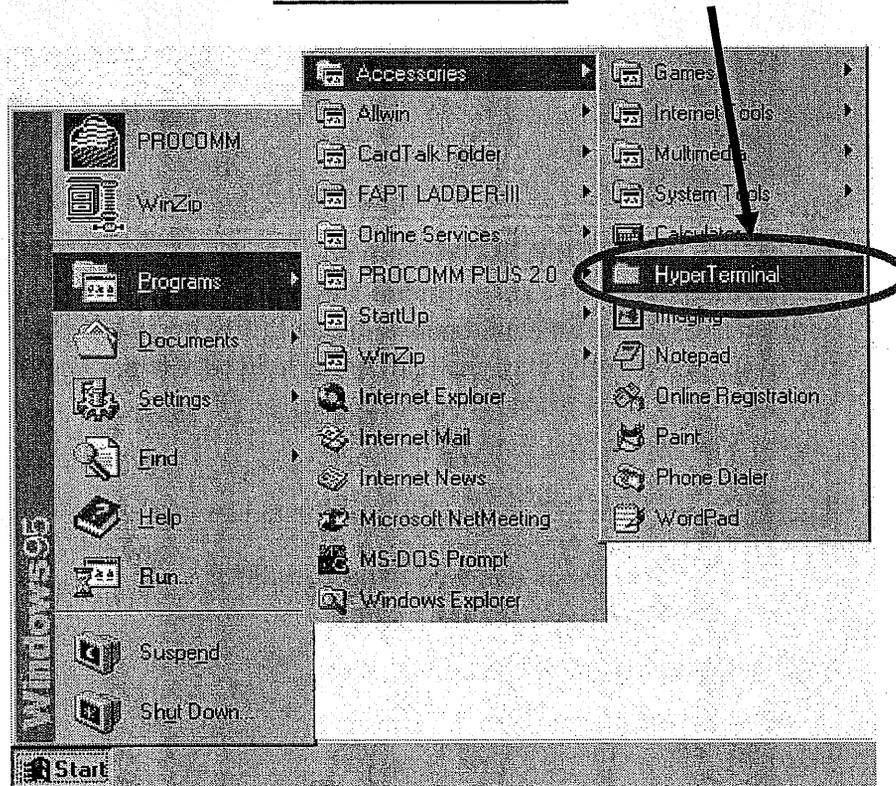


RS232 PORT 1

3.1.1. Laptop PC Setup

In this example, hyperterminal will be used to communicate between the PC and CNC. Hyperterminal is software that comes free with the Windows operating system.

- 1) Turn ON the PC and run HYPERTERMINAL on the START menu ...



Computer Setup

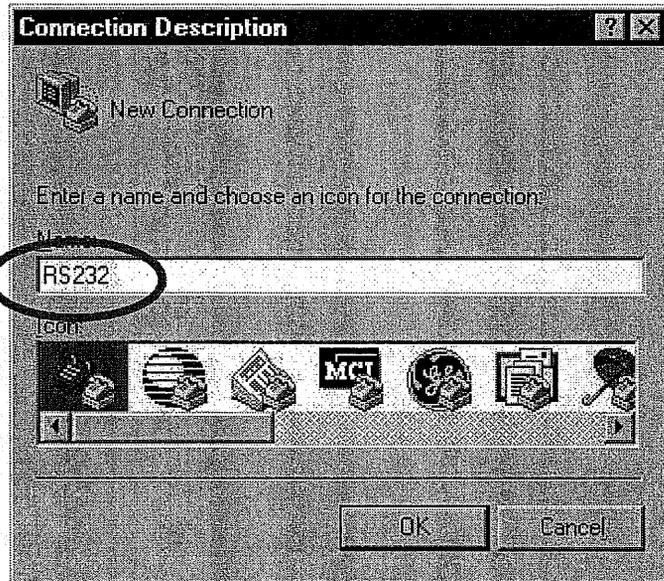
2) Double-Click the  HYPER-TERMINAL icon

Hypertm.exe

The connection description window appears...

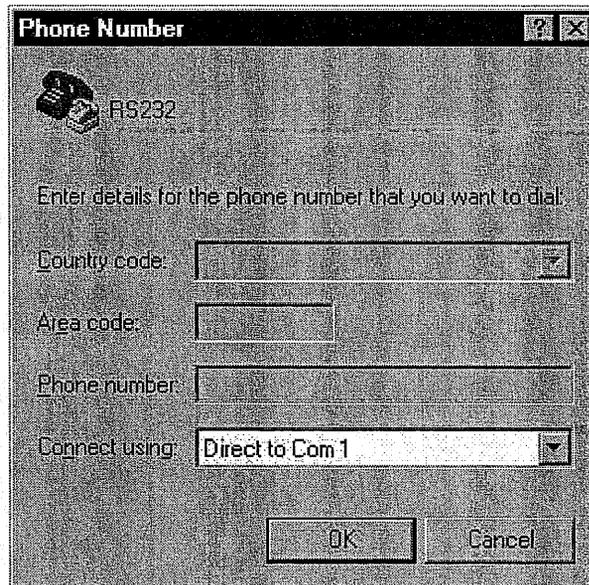
3) Type the connection name, RS232, then click 

The phone number window will appear.



4) On the PHONE NUMBER window select DIRECT to COM 1 then

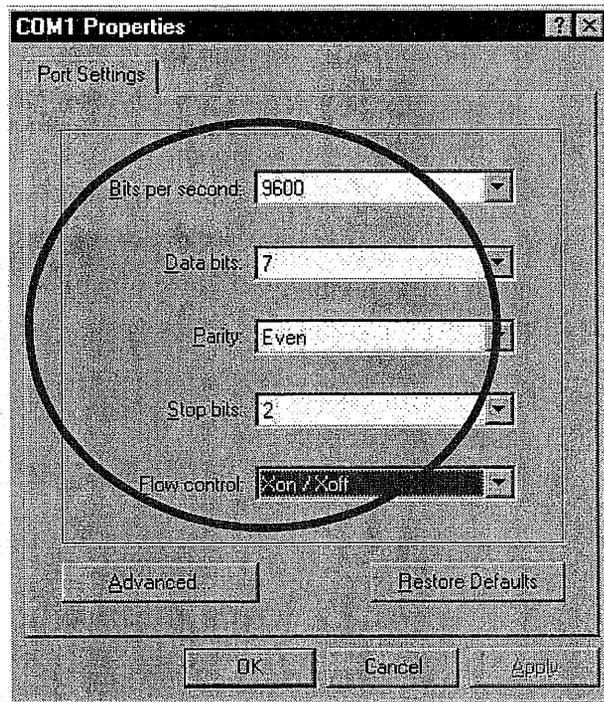
click 



Computer Setup

5) On the **COM1 PROPERTIES** window, select the settings shown below, then

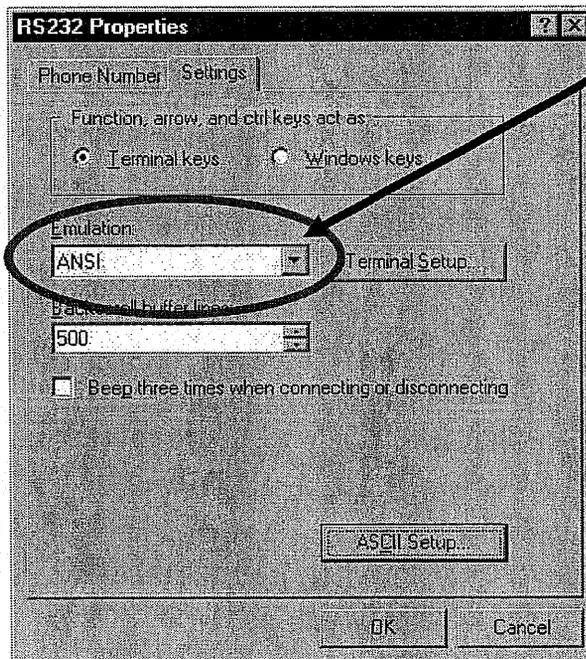
click 



6) The **RS232-HyperTerminal** window should now be visible. In the lower left corner of the window, **CONNECTED** should be displayed with the connection time.

7) Click the **PROPERTIES** icon  on top of the HyperTerminal window.

8) Click the **SETTINGS** tab, then in the **EMULATION** drop down box select **ANSI**



Computer Setup

9) Click the **ASCII Setup...** button.

Make sure the check boxes

"Send line ends with line feeds"

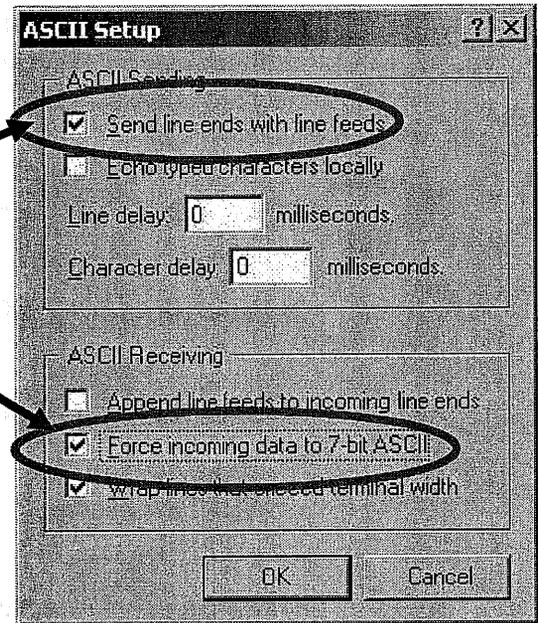
and

"Force incoming data to 7 bit ASCII"

are both checked.

10) Click the **OK** button.

11) Click the **OK** button.



3.1.2. PMC Parameter Setup

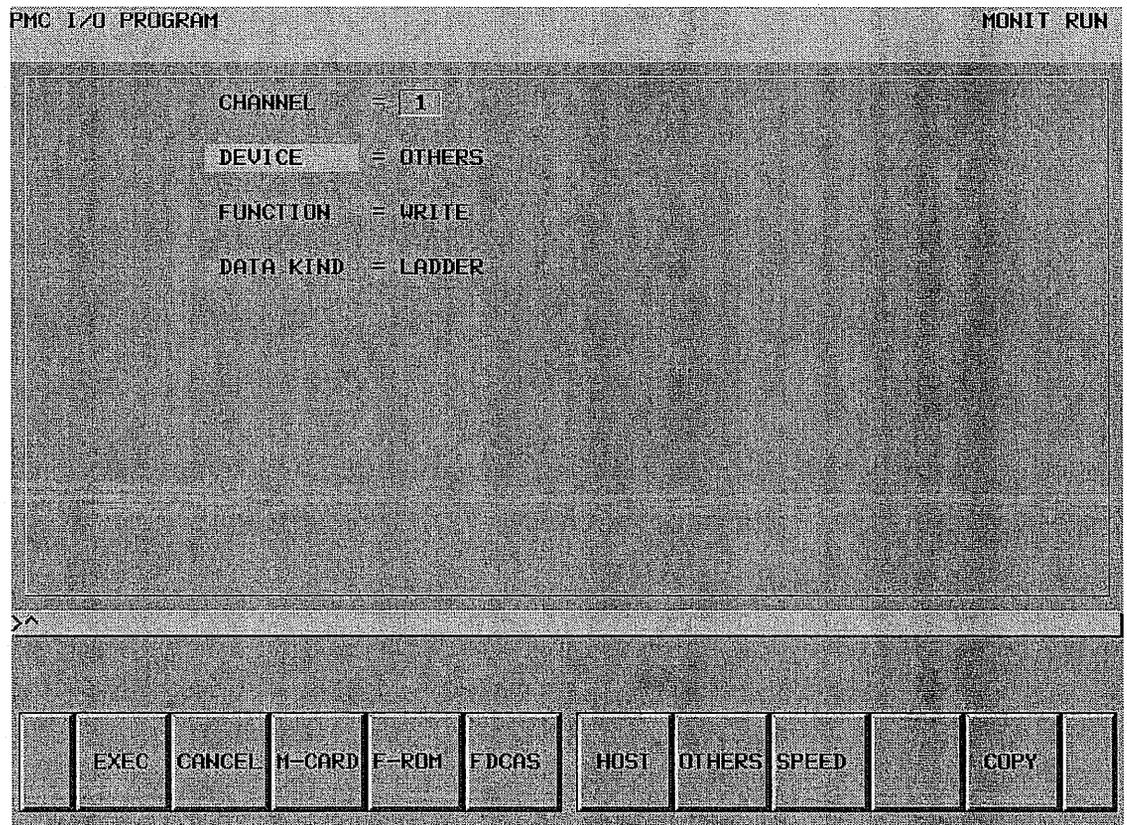
Confirm the setting of the following PMC communication parameters. The PMC communication parameters are different than the CNC communication parameters since they are considered to be separate entities.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  soft key on the CRT menu, the PMC I/O screen appears.

If the I/O soft key is not visible, set PROGRAMMER ENABLE on the PMCPRM SETTING screen.

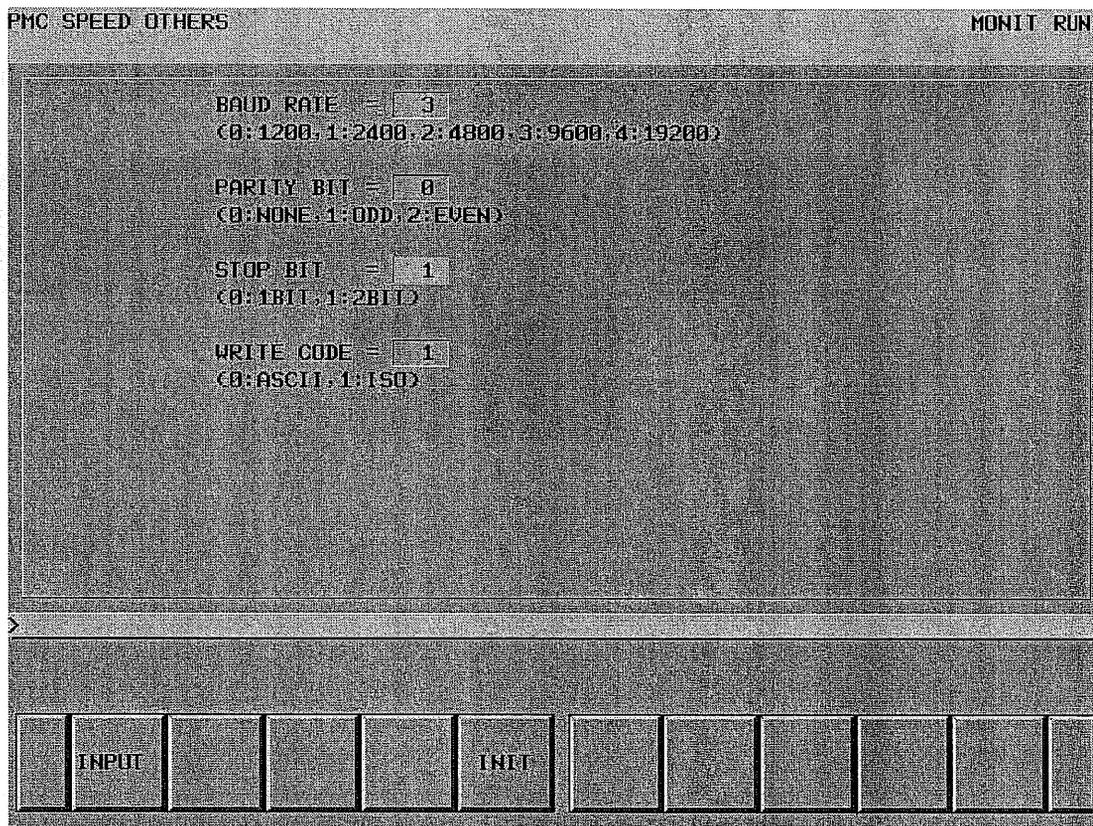
- 4) Use the  arrow key on the MDI panel, to highlight DEVICE on the CRT.



- 5) Press the  soft key on the CRT menu.

PMC Parameter Setup

6) Press the  soft key on the CRT menu, the communication settings appear.



7) Use the  arrow key on the MDI panel, change the settings as shown above.

BAUD RATE = 3, PARITY BIT = 0, STOP BIT = 1, WRITE CODE = 1

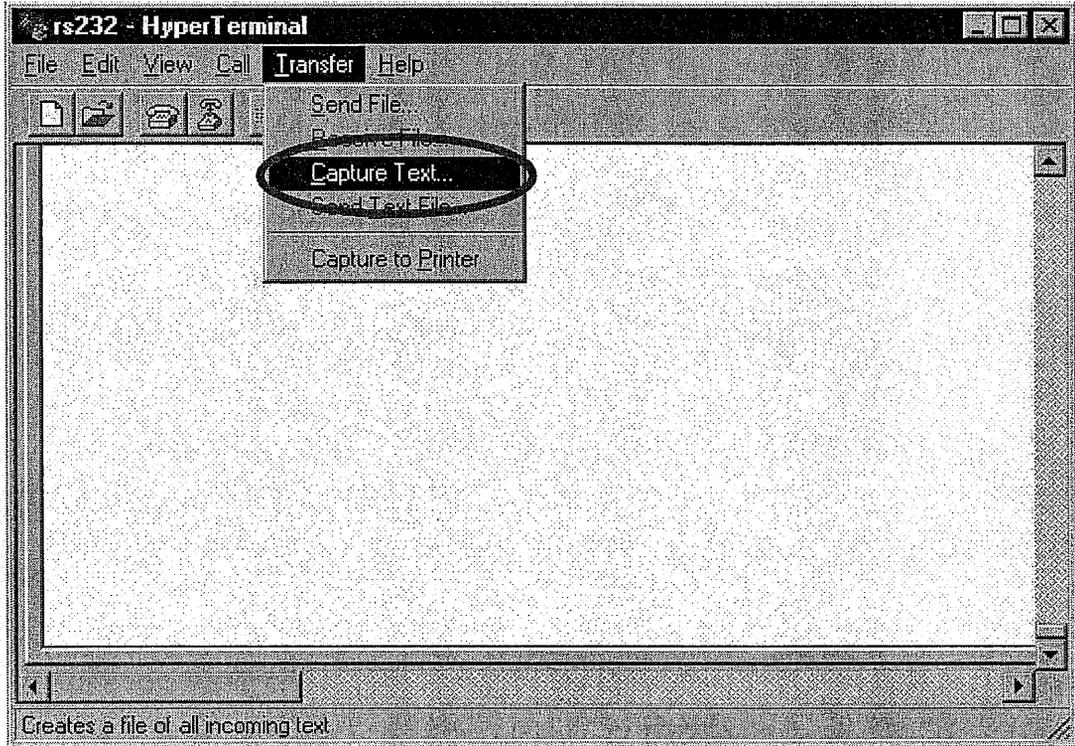
8) Press the  left menu soft key, to return to the PMC I/O screen.

3.1.3. PMC Ladder Backup

Now that the PC and CNC are ready, the ladder file can be transferred to the PC. Follow the steps below to make the ladder backup file.

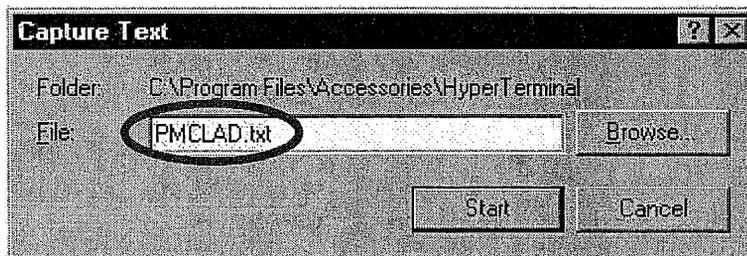


- 1) On the PC, across the top of the Hyperterminal window click on **TRANSFER** then select **CAPTURE TEXT**



- 2) On the PC, a window appears that ask you to **enter the file name**, for the capture.

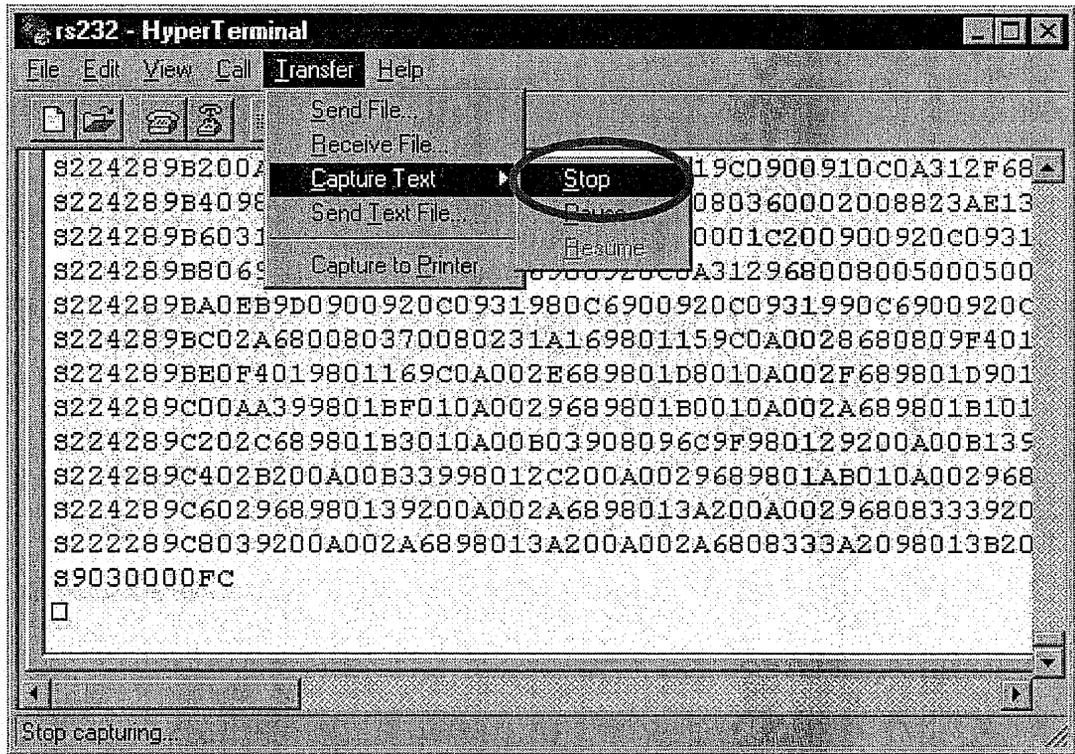
Enter **PMCLAD.txt**, then click the **Start** button.



The PC is now ready to receive the file.

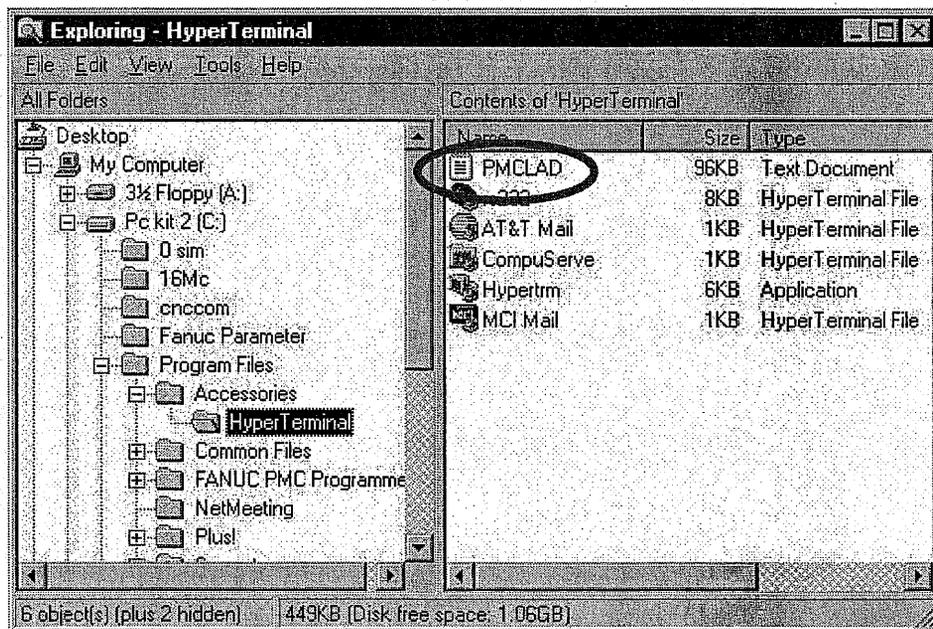
PMC Ladder Backup

- 4) On the PC, across the top of the Hyperterminal window click on **TRANSFER** then select **CAPTURE TEXT**, then select **STOP**



The file is now saved. You should confirm the file was saved correctly.

- 5) On the PC, double-click the  icon, to open windows explorer.

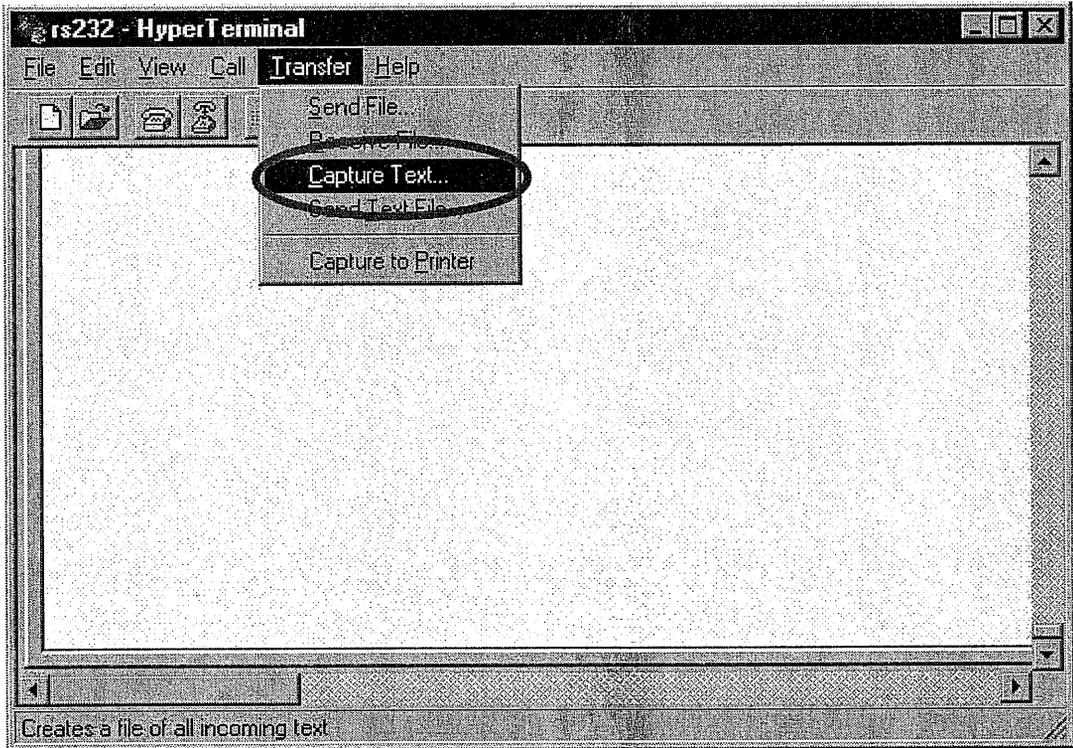


3.1.4. PMC Parameter Backup

The parameter backup is the same as the ladder backup procedure, except on the PMC I/O screen the DATA KIND will be PARAMETER instead of LADDER. Follow the steps below to complete the parameter backup.

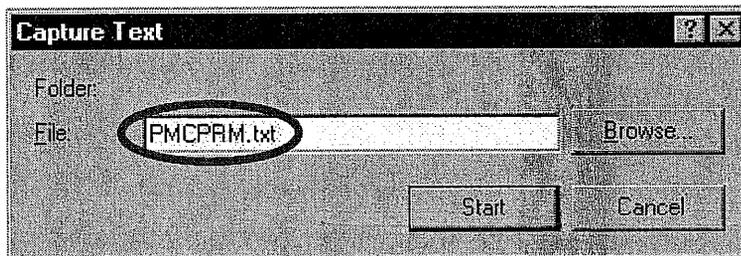


- 1) On the PC, across the top of the Hyperterminal window click on **TRANSFER** then select **CAPTURE TEXT**



- 2) On the PC, a window appears that ask you to **enter the file name**, for the capture.

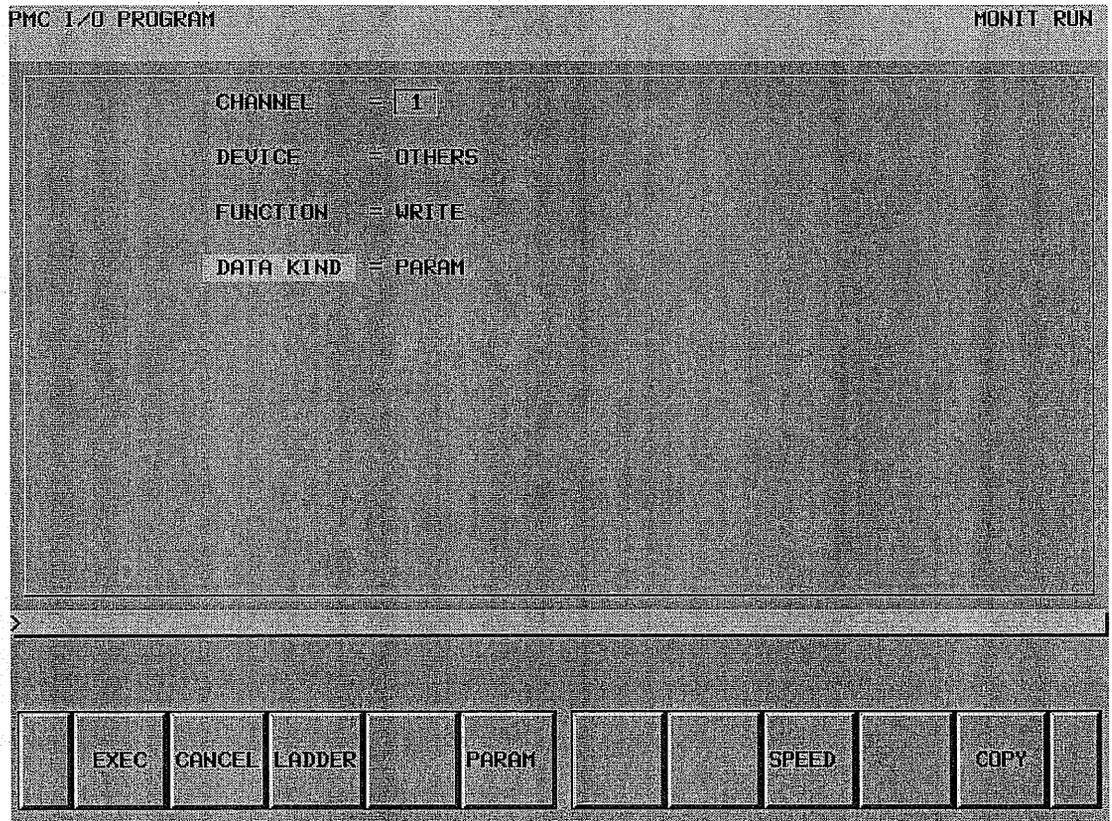
Enter **PMCPRM.txt**, then click the **Start** button.



The PC is now ready to receive the file.

PMC Parameter Backup

- 3) On the CNC, use the  arrow key on the MDI panel, to arrow down to the **DATA KIND** setting.



- 4) On the CNC, press the  soft key on the CRT menu.

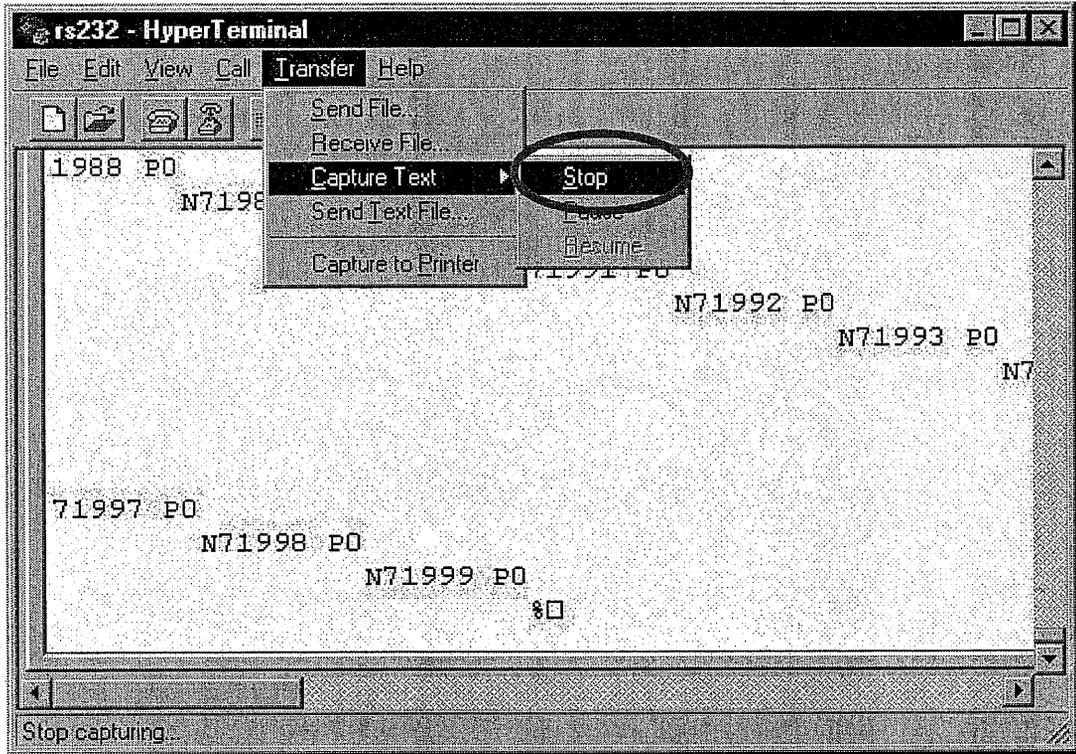
- 5) On the CNC, press the  soft key on the CRT menu.

The PMC will begin outputting the ladder parameters to hypertext. You should see readable characters on the PC window. If not, re-check the PC and PMC setup.

When the CNC is done outputting **COMPLETE** will appear in the bottom left corner of the **CNC screen**.

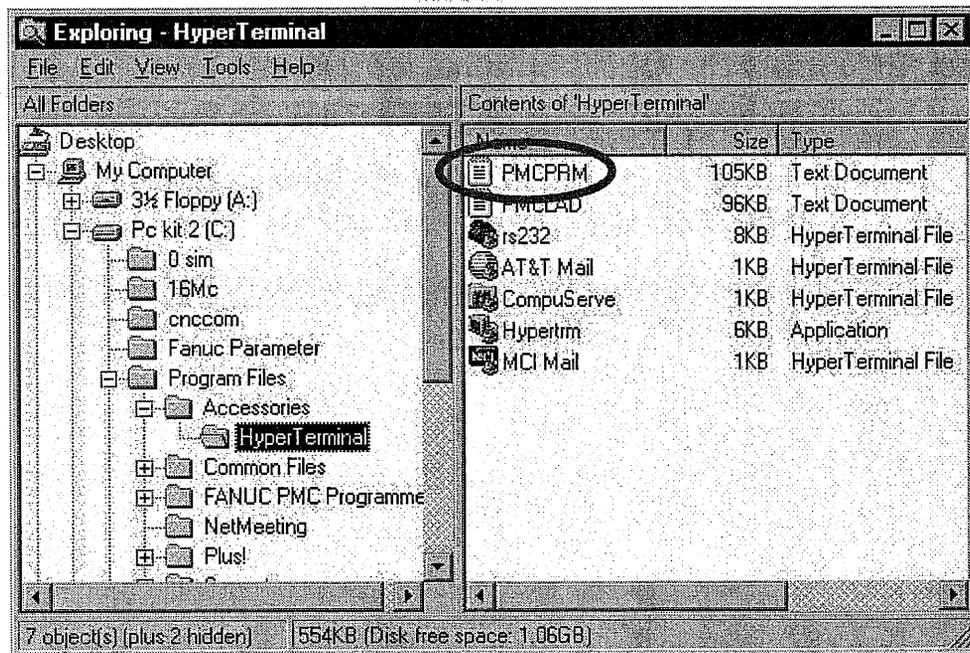
PMC Parameter Backup

- 6) On the PC, across the top of the Hyperterminal window click on **TRANSFER** then select **CAPTURE TEXT**, then select **STOP**



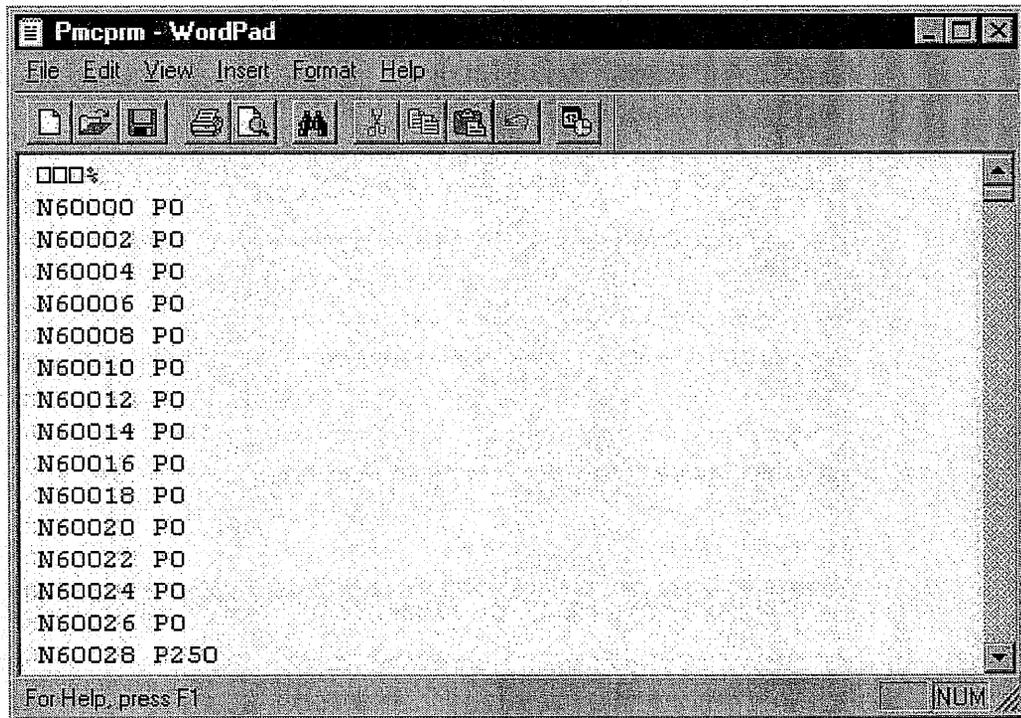
The file is now saved. You should confirm the file was saved correctly.

- 7) On the PC, double-click the  icon, to open windows explorer.



PMC Parameter Backup

- 8) On the PC, double-click the  PMCPRM parameter file icon, to open the file using WORDPAD



The file should appear as **readable english characters**. The N number is the parameter number, the P number is the setting of that parameter. If you see arrows and smiley faces, the communication settings were not correct, either on the PC or PMC side.

- 9) Close the file window, and Windows Explorer.

3.2. Backup by Memory Card

Backup using a memory card is obviously easier. There is no cable, computer, or PC software to concern yourself with. The cards can be purchased from a local computer supplier, which simplifies replacement or upgrading. There are 2 types of memory cards, **SRAM** and **FLASH** memory. The **SRAM cards work with all controls** that have a card slot. The **FLASH cards only work with the i-series controls** that have the proper hardware/software versions. Here is a list of memory cards that have been verified on Fanuc CNC controls.

ATA Flash Card				
Maker	Item	Capacity	Fanuc Authorized	Price
SanDisk	SDP3B-4	4MB	YES	\$37.00
	SDP3B-20	20MB	YES	\$72.00
	SDP3B-40	40MB	YES	\$143.00
Hitachi	HB289016A4	16MB	YES	\$64.50
	HB289032A4	32MB	YES	\$93.50
	HB289048A4	48MB	YES	\$144.00
Panasonic	BN-012AB	12MB	YES	
	BN-020AB	20MB	YES	
	BN-040AB	40MB	YES	
SRAM Card				
Maker	Item	Capacity	Fanuc Authorized	Price
Panasonic	BN-512HSRC	512KB	YES	\$85.00
	BN-01MHSRC	1MB	YES	\$120.00
	BN-02MHSRC	2MB	YES	\$188.00

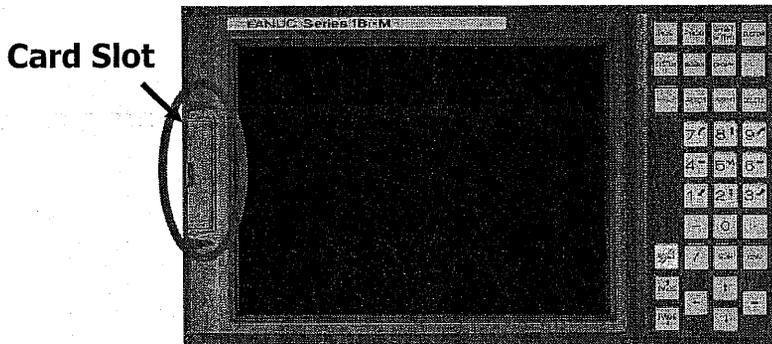
The pricing varies on a weekly basis, contact your local distributor for current pricing.



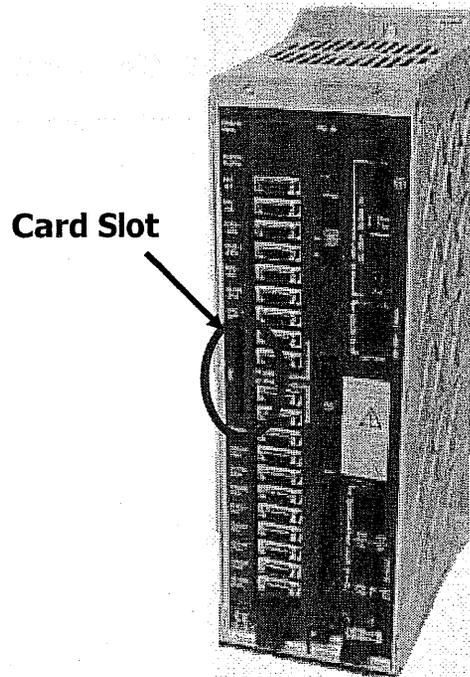
- 1) Insert the **MEMORY** card into the CNC, for **model C** controls the card slot is located on the MAIN pcb,

For **i-series** controls, the slot next to the display screen can be used.

16i Model A



16 Model C



Backup by Memory Card

2) Turn ON the CNC, and wait for the system to come up ready.

3) Press the  button on the MDI panel.

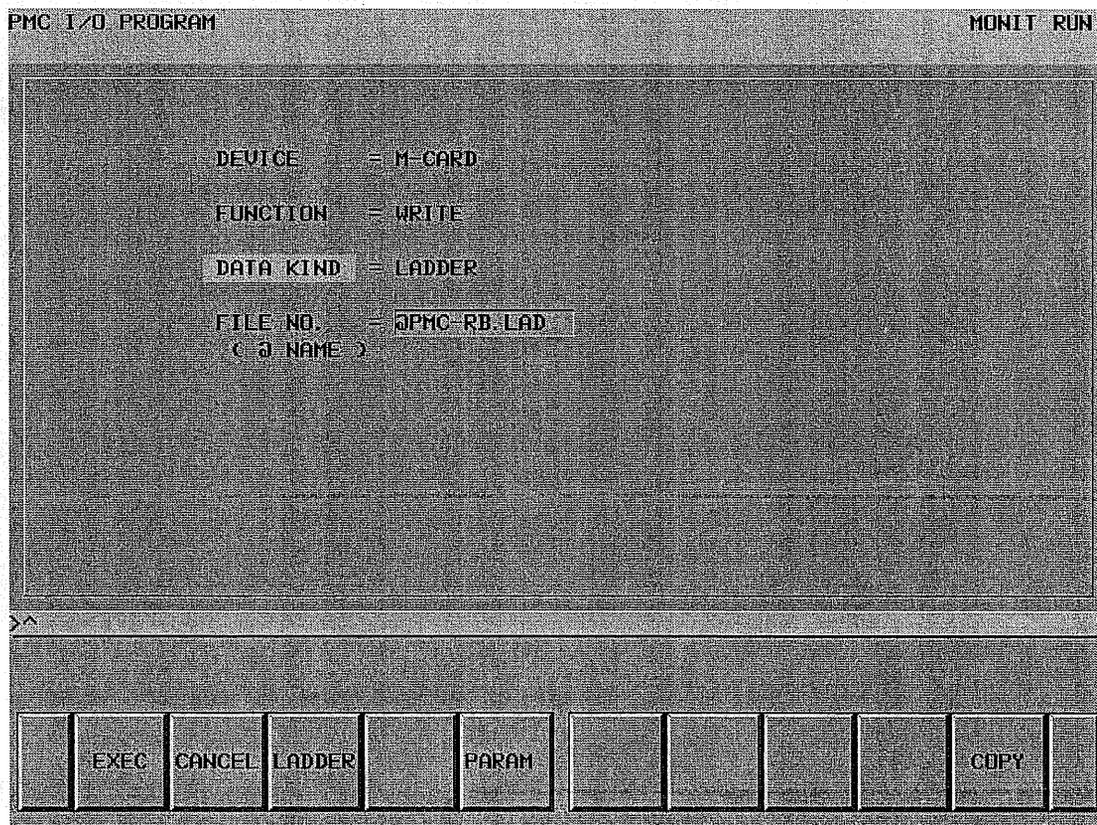
4) Press the  soft key on the CRT menu.

5) Press the  soft key on the CRT menu, the PMC I/O screen appears.

If the I/O soft key is not visible, set PROGRAMMER ENABLE on the PMCPRM SETTING screen.

6) Use the  arrow key on the MDI panel, to highlight DEVICE on the CRT.

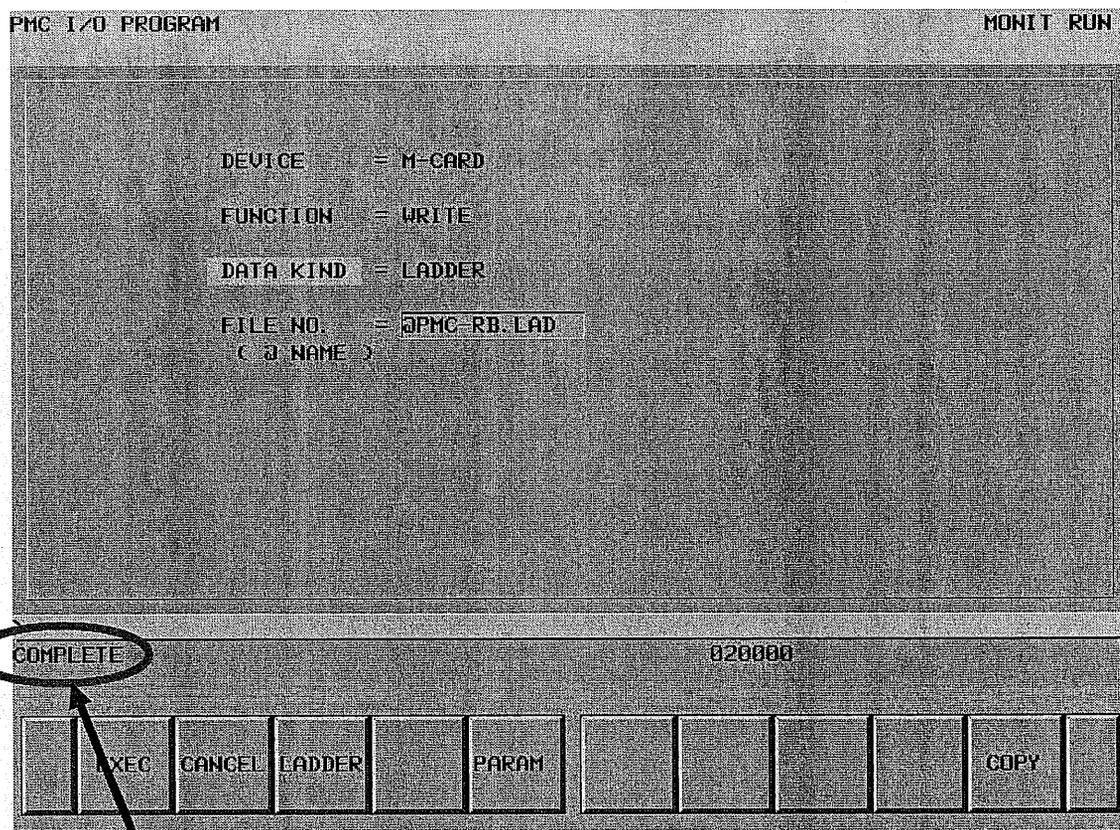
7) Press the  soft key on the CRT menu.



8) Use the  arrow key on the MDI panel, to FUNCTION on the CRT.

Backup by Memory Card

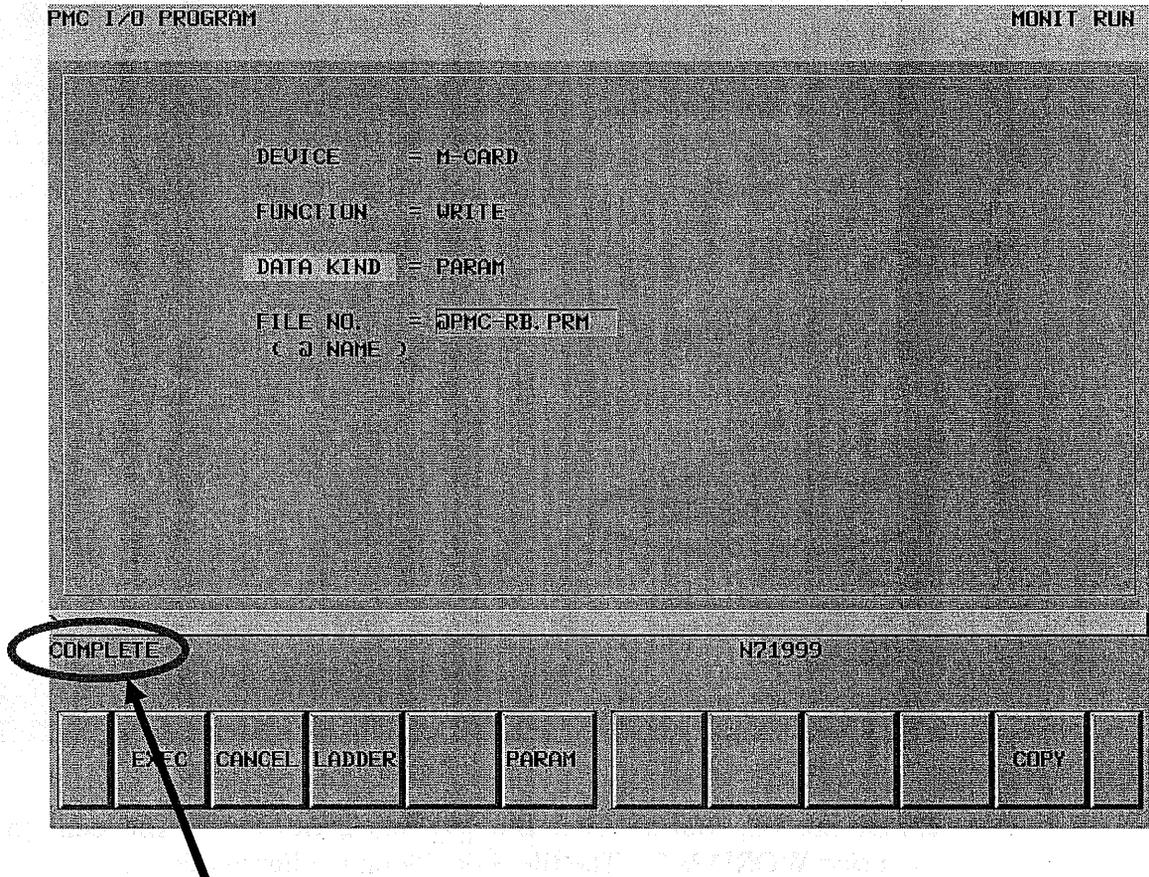
- 9) Press the  soft key on the CRT menu.
- 10) Use the  arrow key on the MDI panel, to **DATA KIND** on the CRT.
- 11) Press the  soft key on the CRT menu. The **FILE NO** field will automatically be set to “@PMC-RB.LAD” which will be the file name.
- 12) On the CNC, press the  soft key on the CRT menu.



- 13) **COMPLETE** appears at the bottom of the display, when the file is saved.
- 14) Use the  arrow key on the MDI panel, to **DATA KIND** on the CRT.
- 15) Press the  soft key on the CRT menu. The **FILE NO** field will automatically be set to “@PMC-RB.PRM” which will be the file name.

Backup by Memory Card

16) On the CNC, press the  soft key on the CRT menu.



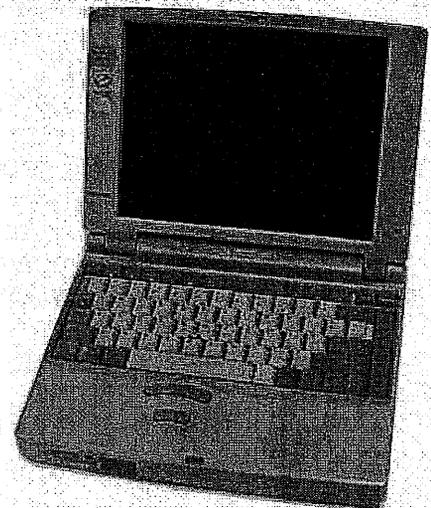
17) COMPLETE appears at the bottom of the display, when the file is saved.

18) Turn OFF the CNC, and remove the memory card.

19) Insert memory card into PC,
this can be done with PC power ON.

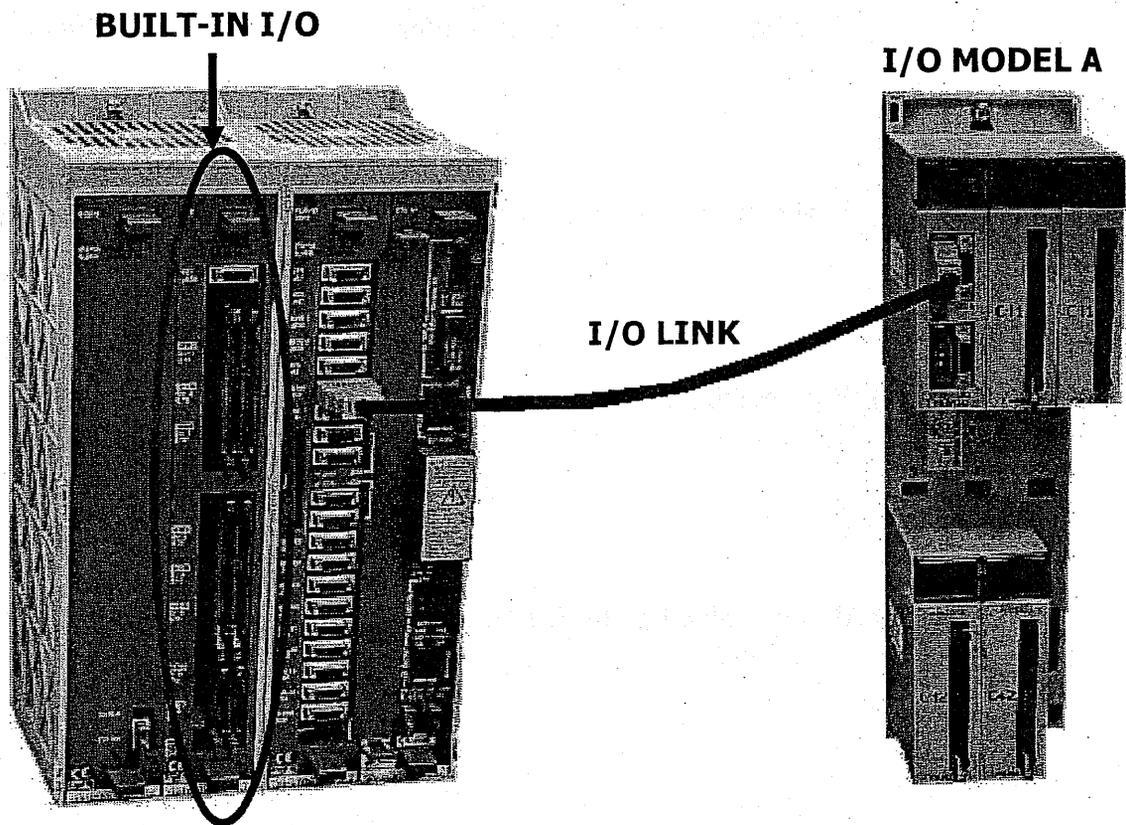
20) On the PC, double-click the  icon,
to open windows explorer.

Windows Explorer



4. Input/Output Connection

Fanuc offers 3 different types of I/O connection. They are **BUILT-IN I/O**, **I/O MODEL A**, and **I/O MODEL B**. The built-in I/O is mounted inside the CNC card rack. The I/O model A and I/O model B are connected to the CNC by an electrical serial communication link which is referred to as the **I/O LINK**.



All three types of I/O are available in **SINKING** (ground activated) or **SOURCING** (+24VDC activated) style connection. **The inputs are selectable** (sinking or sourcing) by a pin on the connector, **the outputs are fixed** (either sinking or sourcing) by the I/O board part number. More detail about this connection is shown in the following sections, but generally the I/O style is determined by the area where the machine was manufactured.

**USA Made = SOURCING INPUTS (+24V)
SOURCING OUTPUTS (+24V)**

**Japanese Made = SINKING INPUTS (Ground)
SOURCING OUTPUTS (+24V)**

**European Made = SINKING INPUTS (Ground)
SINKING OUTPUTS (Ground)**

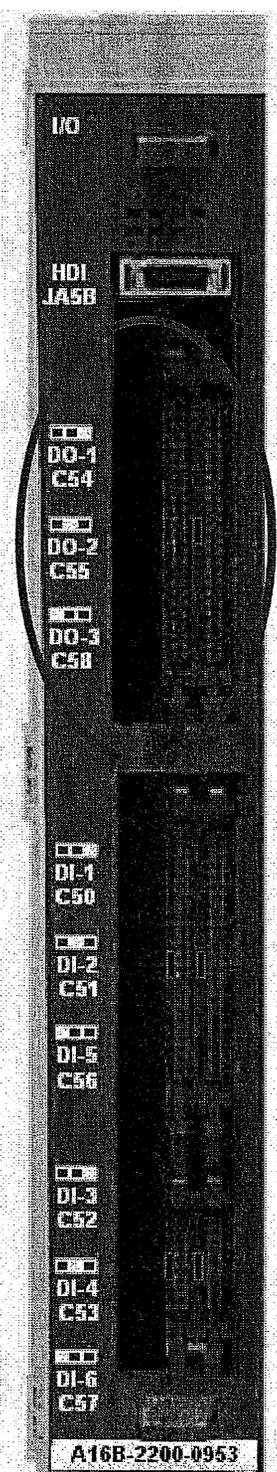
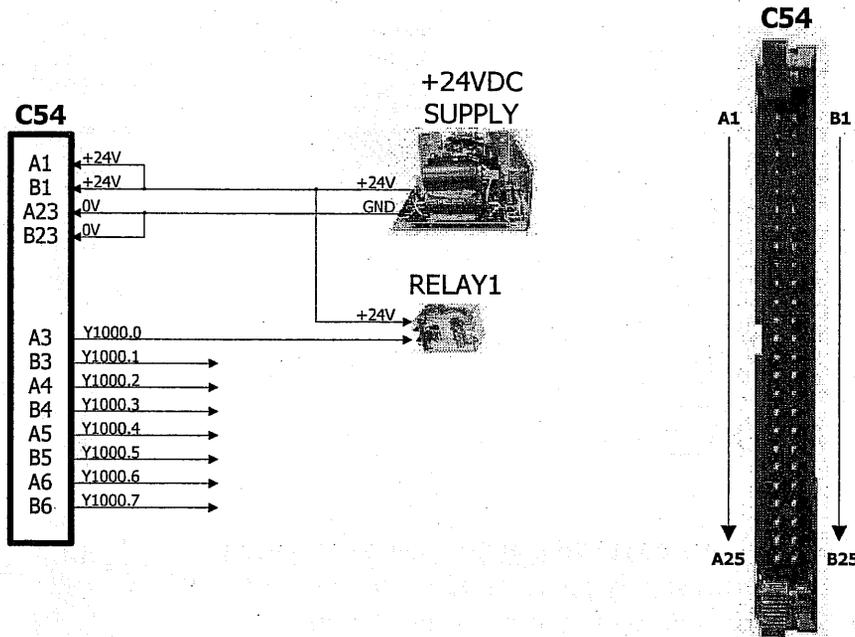
3.3. Exercise 2 – Ladder Backup

- 1) Where is the SRAM memory battery located ?
- 2) If the battery runs down, what information may be lost ?
- 3) In what type of memory is the LADDER stored ? Can it be lost if the battery is low?
- 4) When making a backup through RS232. what software is used on the PC side ?
How much does it cost ?
- 5) After downloading the ladder to you laptop through RS232, how can you confirm the file is correct ?
- 6) How often should you make a backup, of the LADDER ?
of the LADDER PARAMETERS ?

4.2.2. Sinking Output Connections

The sinking (GND active) output board has connectors labeled **C54**, **C55**, and **C58**. A maximum of 200ma per output is allowed. An external power supply is required to power the outputs, with an allowable output tolerance of $\pm 10\%$

Below is an example of sinking type output, where ground is switched out the output Y1000.0



The connections for sinking type outputs are shown below ...

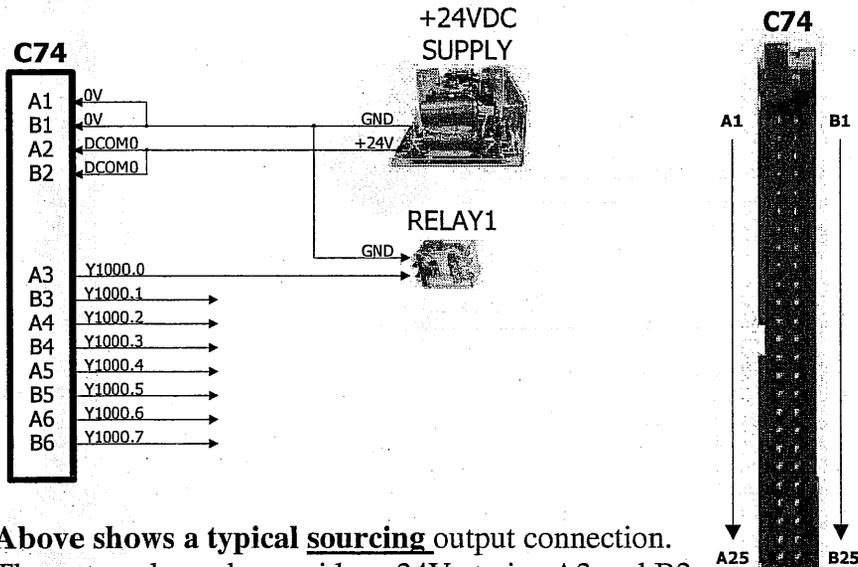
CONNECTOR C54			CONNECTOR C55			CONNECTOR C58		
	A	B		A	B		A	B
1	+24V	+24V	1	+24V	+24V	1	+24V	+24V
2			2			2		
3	Y1000.0	Y1000.1	3	Y1005.0	Y1005.1	3	Y1010.0	Y1010.1
4	Y1000.2	Y1000.3	4	Y1005.2	Y1005.3	4	Y1010.2	Y1010.3
5	Y1000.4	Y1000.5	5	Y1005.4	Y1005.5	5	Y1010.4	Y1010.5
6	Y1000.6	Y1000.7	6	Y1005.6	Y1005.7	6	Y1010.6	Y1010.7
7	Y1001.0	Y1001.1	7	Y1006.0	Y1006.1	7	Y1011.0	Y1011.1
8	Y1001.2	Y1001.3	8	Y1006.2	Y1006.3	8	Y1011.2	Y1011.3
9	Y1001.4	Y1001.5	9	Y1006.4	Y1006.5	9	Y1011.4	Y1011.5
10	Y1001.6	Y1001.7	10	Y1006.6	Y1006.7	10	Y1011.6	Y1011.7
11	Y1002.0	Y1002.1	11	Y1007.0	Y1007.1	11	Y1012.0	Y1012.1
12	Y1002.2	Y1002.3	12	Y1007.2	Y1007.3	12	Y1012.2	Y1012.3
13	Y1002.4	Y1002.5	13	Y1007.4	Y1007.5	13	Y1012.4	Y1012.5
14	Y1002.6	Y1002.7	14	Y1007.6	Y1007.7	14	Y1012.6	Y1012.7
15	Y1003.0	Y1003.1	15	Y1008.0	Y1008.1	15	Y1013.0	Y1013.1
16	Y1003.2	Y1003.3	16	Y1008.2	Y1008.3	16	Y1013.2	Y1013.3
17	Y1003.4	Y1003.5	17	Y1008.4	Y1008.5	17	Y1013.4	Y1013.5
18	Y1003.6	Y1003.7	18	Y1008.6	Y1008.7	18	Y1013.6	Y1013.7
19	Y1004.0	Y1004.1	19	Y1009.0	Y1009.1	19	Y1014.0	Y1014.1
20	Y1004.2	Y1004.3	20	Y1009.2	Y1009.3	20	Y1014.2	Y1014.3
21	Y1004.4	Y1004.5	21	Y1009.4	Y1009.5	21	Y1014.4	Y1014.5
22	Y1004.6	Y1004.7	22	Y1009.6	Y1009.7	22	Y1014.6	Y1014.7
23	0V	0V	23	0V	0V	23	0V	0V
24	0V	0V	24	0V	0V	24	0V	0V
25	0V	0V	25	0V	0V	25	0V	0V

4.2. Built-in I/O

The built-in I/O card is available on the model A, B, and C controls.

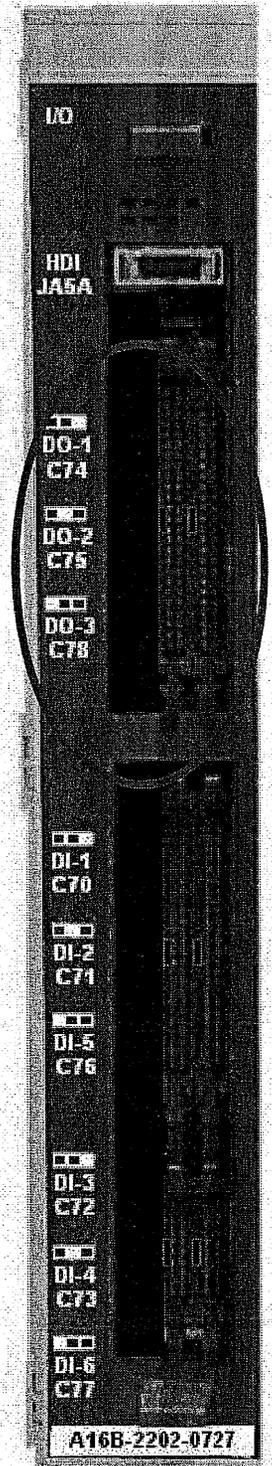
4.2.1. Sourcing Output Connections

The digital outputs are used to control relays, solenoids, or other machine side devices. A maximum of 200ma per output is allowed. On the sourcing (+24V active) output board the connectors are labeled C74, C75, and C78.



Above shows a typical sourcing output connection. The external supply provides +24V at pins A2 and B2 which is switched out pin A3 when Y1000.0 is active. The other side of the relay coil is grounded. The connections for sourcing type outputs are shown below.

CONNECTOR C74			CONNECTOR C75			CONNECTOR C78		
	A	B		A	B		A	B
1	0V	0V	1	0V	0V	1	0V	0V
2	DCOM0	DCOM0	2	DCOM5	DCOM5	2	DCOM10	DCOM10
3	Y1000.0	Y1000.1	3	Y1005.0	Y1005.1	3	Y1010.0	Y1010.1
4	Y1000.2	Y1000.3	4	Y1005.2	Y1005.3	4	Y1010.2	Y1010.3
5	Y1000.4	Y1000.5	5	Y1005.4	Y1005.5	5	Y1010.4	Y1010.5
6	Y1000.6	Y1000.7	6	Y1005.6	Y1005.7	6	Y1010.6	Y1010.7
7	Y1001.0	Y1001.1	7	Y1006.0	Y1006.1	7	Y1011.0	Y1011.1
8	Y1001.2	Y1001.3	8	Y1006.2	Y1006.3	8	Y1011.2	Y1011.3
9	Y1001.4	Y1001.5	9	Y1006.4	Y1006.5	9	Y1011.4	Y1011.5
10	Y1001.6	Y1001.7	10	Y1006.6	Y1006.7	10	Y1011.6	Y1011.7
11	Y1002.0	Y1002.1	11	Y1007.0	Y1007.1	11	Y1012.0	Y1012.1
12	Y1002.2	Y1002.3	12	Y1007.2	Y1007.3	12	Y1012.2	Y1012.3
13	Y1002.4	Y1002.5	13	Y1007.4	Y1007.5	13	Y1012.4	Y1012.5
14	Y1002.6	Y1002.7	14	Y1007.6	Y1007.7	14	Y1012.6	Y1012.7
15	Y1003.0	Y1003.1	15	Y1008.0	Y1008.1	15	Y1013.0	Y1013.1
16	Y1003.2	Y1003.3	16	Y1008.2	Y1008.3	16	Y1013.2	Y1013.3
17	Y1003.4	Y1003.5	17	Y1008.4	Y1008.5	17	Y1013.4	Y1013.5
18	Y1003.6	Y1003.7	18	Y1008.6	Y1008.7	18	Y1013.6	Y1013.7
19	Y1004.0	Y1004.1	19	Y1009.0	Y1009.1	19	Y1014.0	Y1014.1
20	Y1004.2	Y1004.3	20	Y1009.2	Y1009.3	20	Y1014.2	Y1014.3
21	Y1004.4	Y1004.5	21	Y1009.4	Y1009.5	21	Y1014.4	Y1014.5
22	Y1004.6	Y1004.7	22	Y1009.6	Y1009.7	22	Y1014.6	Y1014.7
23	DCOM	DCOM	23	DCOM	DCOM	23	DCOM	DCOM
24	DCOM	DCOM	24	DCOM	DCOM	24	DCOM	DCOM
25	DCOM	DCOM	25	DCOM	DCOM	25	DCOM	DCOM

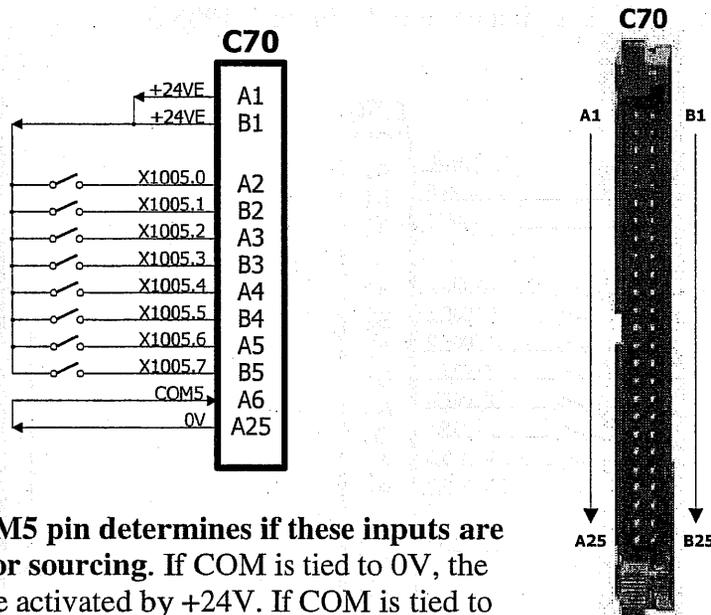


4.2.3. Sourcing Input Connections

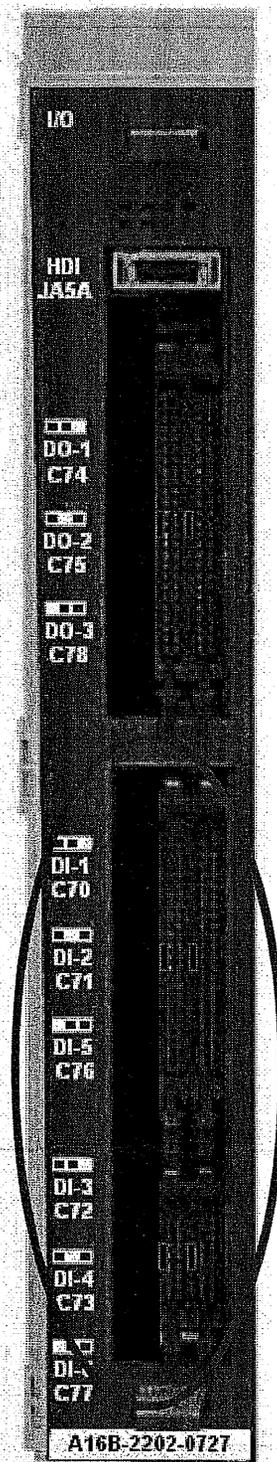
The digital inputs are used to read the status of limit switches and proximity switches that tell the PMC the machines' condition.

The **CNC power supply outputs +24V** on pins A1, B1, and also provides ground at pins A25, B24, and B25. On the board, the input connectors are labeled **C70, C71, C76, C72, C73, C77**.

Below is an example of **sourcing** type input, where +24V is switched into the input X1005.0



The **COM5** pin determines if these inputs are **sinking** or **sourcing**. If COM is tied to 0V, the inputs are activated by +24V. If COM is tied to +24V, the inputs are activated by ground.



CONNECTOR C70

	A	B
1	+24V	+24V
2	X1005.0	X1005.1
3	X1005.2	X1005.3
4	X1005.4	X1005.5
5	X1005.6	X1005.7
6	COM5	COM6
7	X1006.0	X1006.1
8	X1006.2	X1006.3
9	X1006.4	X1006.5
10	X1006.6	X1006.7
11	X1007.0	X1007.1
12	X1007.2	X1007.3
13	X1007.4	X1007.5
14	X1007.6	X1007.7
15	COM7	COM8
16	X1008.0	X1008.1
17	X1008.2	X1008.3
18	X1008.4	X1008.5
19	X1008.6	X1008.7
20	X1009.0	X1009.1
21	X1009.2	X1009.3
22	X1009.4	X1009.5
23	X1009.6	X1009.7
24	COM9	0V
25	0V	0V

CONNECTOR C71

	A	B
1	+24V	+24V
2	X1000.0	X1000.1
3	X1000.2	X1000.3
4	X1000.4	X1000.5
5	X1000.6	X1000.7
6	COM0	COM1
7	X1001.0	X1001.1
8	X1001.2	X1001.3
9	X1001.4	X1001.5
10	X1001.6	X1001.7
11	X1002.0	X1002.1
12	X1002.2	X1002.3
13	X1002.4	X1002.5
14	X1002.6	X1002.7
15	COM2	COM3
16	X1003.0	X1003.1
17	X1003.2	X1003.3
18	X1003.4	X1003.5
19	X1003.6	X1003.7
20	X1004.0	X1004.1
21	X1004.2	X1004.3
22	X1004.4	X1004.5
23	X1004.6	X1004.7
24	COM4	0V
25	0V	0V

CONNECTOR C76

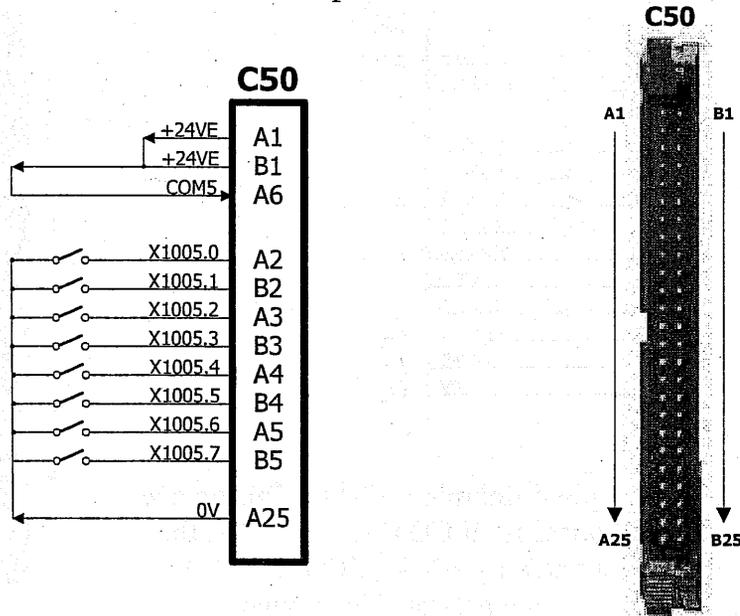
	A	B
1	+24V	+24V
2	X1010.0	X1010.1
3	X1010.2	X1010.3
4	X1010.4	X1010.5
5	X1010.6	X1010.7
6	COM13	COM14
7	X1011.0	X1011.1
8	X1011.2	X1011.3
9	X1011.4	X1011.5
10	X1011.6	X1011.7
11	X1012.0	X1012.1
12	X1012.2	X1012.3
13	X1012.4	X1012.5
14	X1012.6	X1012.7
15	COM15	COM16
16	X1013.0	X1013.1
17	X1013.2	X1013.3
18	X1013.4	X1013.5
19	X1013.6	X1013.7
20	X1014.0	X1014.1
21	X1014.2	X1014.3
22	X1014.4	X1014.5
23	X1014.6	X1014.7
24	COM17	0V
25	0V	0V

4.2.4. Sinking Input Connections

As described in the previous section, the inputs can be configured sinking or sourcing on all I/O boards. The type of input is determined by the connection of the COM pin.

The CNC power supply outputs +24V on pins A1, B1, and also provides ground at pins A25, B24, and B25. On the board, the input connectors are labeled C50, C51, C56, C52, C53, C57. Approximately 15ma of current flows per input.

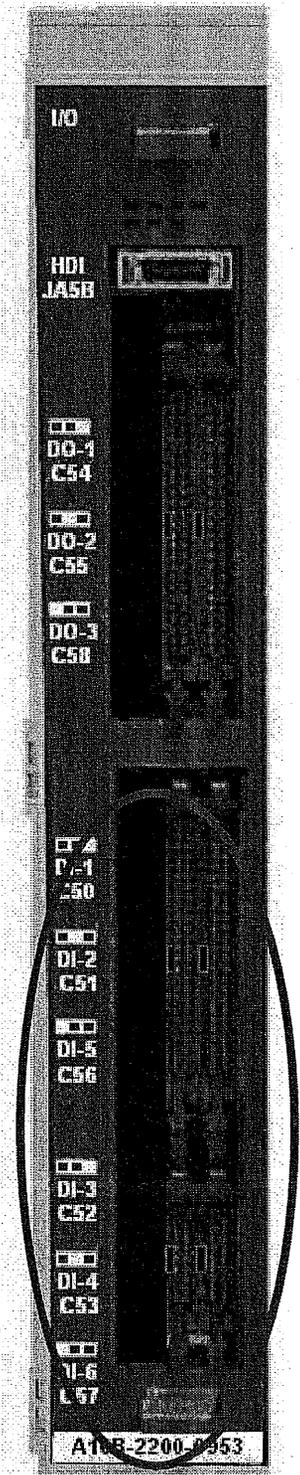
Below is an example of sinking type input, where GROUND is switched into the input X1005.0



The connection points for C50, C51, and C56 are the same as C70, C71, and C76 which are shown on the previous page. The connection points for C52, C53, C57 are shown below ...

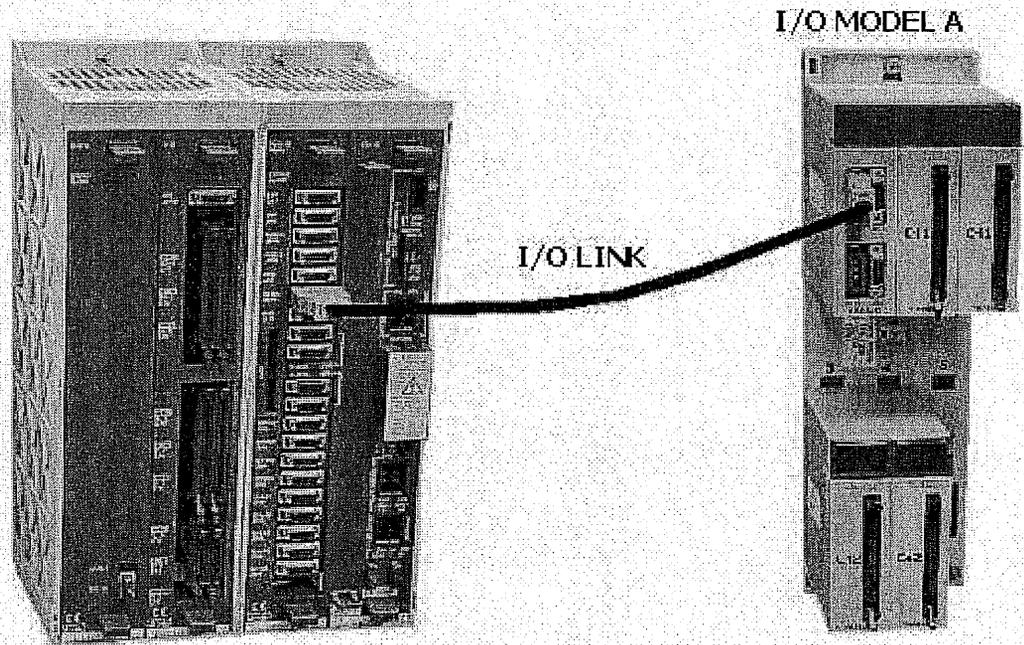
CONNECTOR C52			CONNECTOR C53			CONNECTOR C57		
	A	B		A	B		A	B
1	+24V	+24V	1	+24V	+24V	1	+24V	+24V
2	X1015.0	X1015.1	2	X1017.0	X1017.1	2	X1018.0	X1018.1
3	X1015.2	X1015.3	3	X1017.2	X1017.3	3	X1018.2	X1018.3
4	X1015.4	X1015.5	4	X1017.4	X1017.5	4	X1018.4	X1018.5
5	X1015.6	X1015.7	5	X1017.6	X1017.7	5	X1018.6	X1018.7
6	COM10	+5V	6	COM10	+5V	6	COM10	+5V
7	X1016.0	X1016.1	7	X1016.4	X1016.5	7	X1019.0	X1019.1
8	X1016.2	X1016.3	8	X1016.6	X1016.7	8	X1019.2	X1019.3
9	+15V	0V	9	+15V	0V	9	+15V	0V
10	0V	-15V	10	0V	-15V	10	0V	-15V

NOTE: The +15V, -15V, and +5V connection pins should NOT be used.



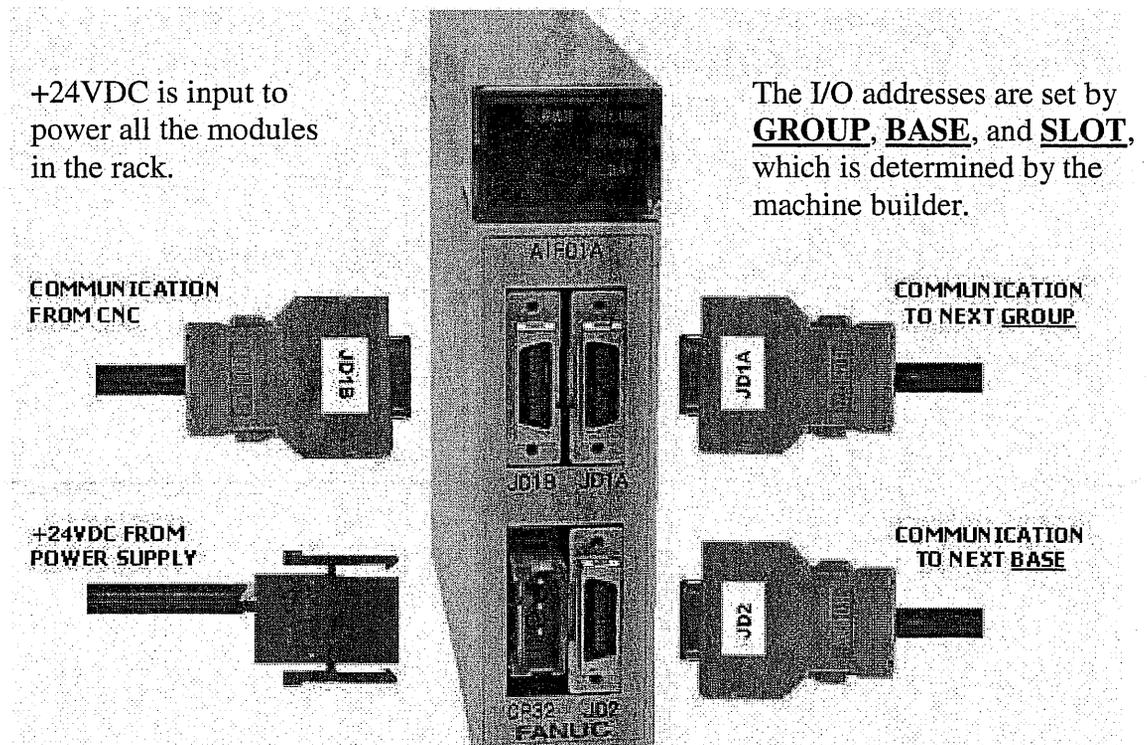
4.3. I/O Model A

The I/O model A is a PLC rack style I/O, which connects to the CNC via electrical serial communication cable (I/O LINK). The status of the inputs and outputs is transferred through the serial cable between the CNC and I/O rack. The I/O Model A connection manual, is part number B-61813E.



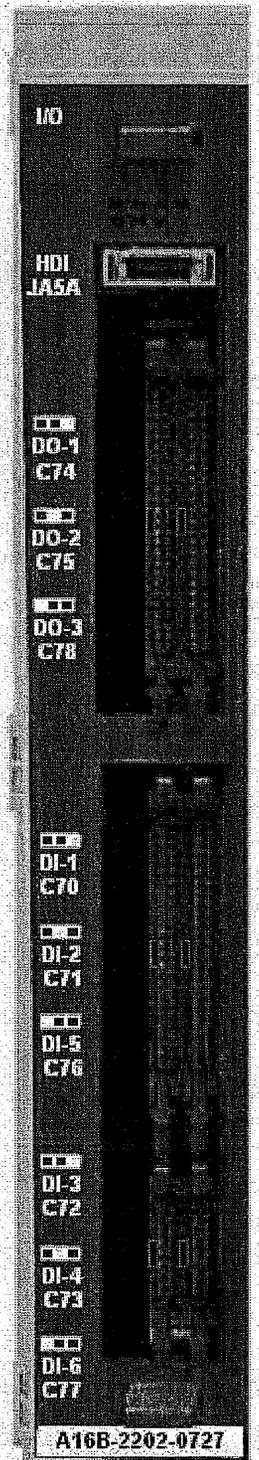
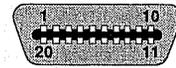
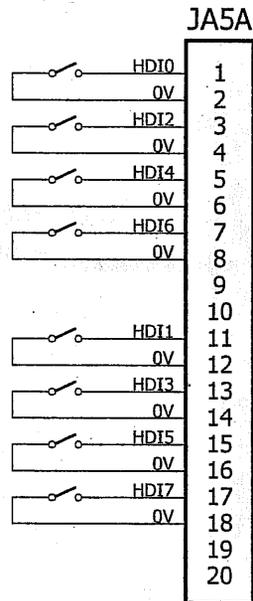
4.3.1. I/O Configuration

There are 5 slot and 10 slot racks available. The first module in slot 0 is a communication module. Several different communication modules are available.



4.2.5. High Speed Skip Inputs

The high speed skip inputs are used for tool measurement or part probing. They are connected directly to the CNC and have dedicated X addresses in the PMC.



I/O Configuration

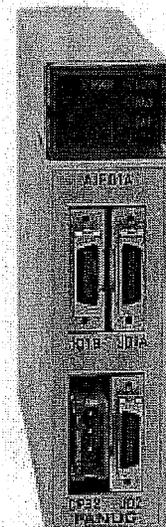
At the top of the communication module are four LED's to indicate current communication status.

PWR = indicates +24VDC is input on connector **CP32**

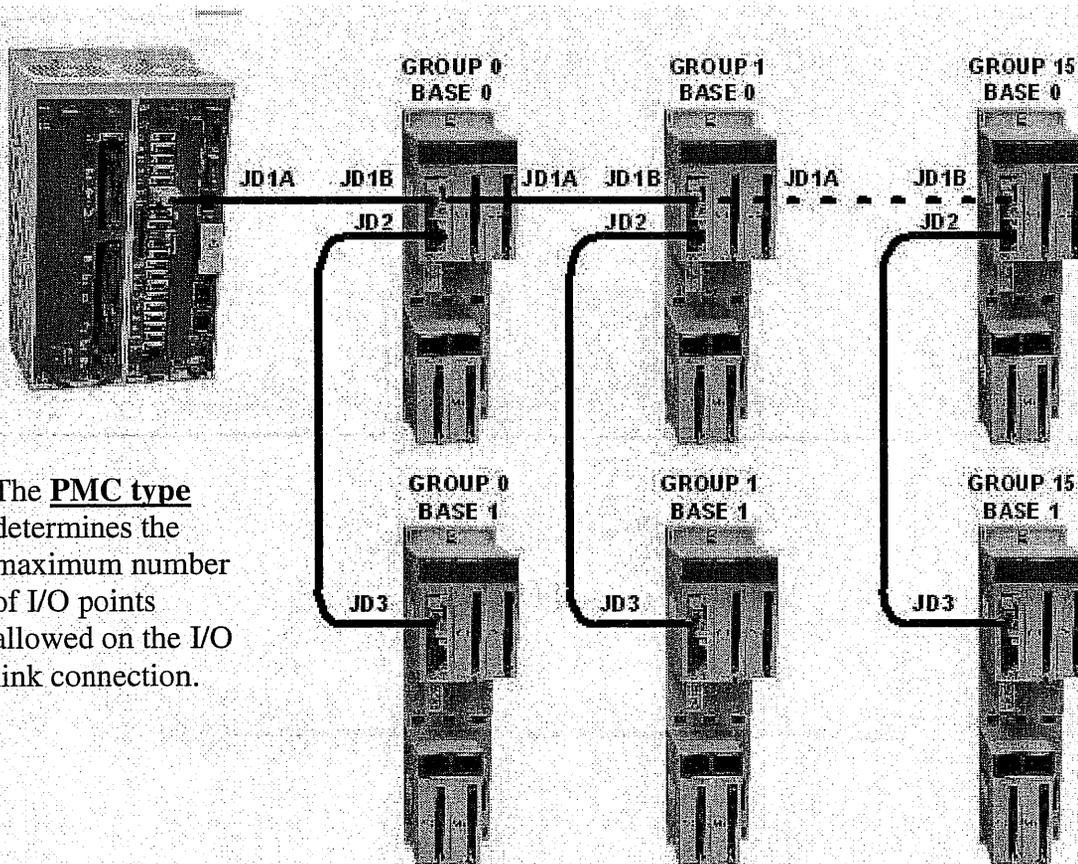
LINK = indicates the serial communication to the CNC, in the I/O Link cable is active. (**JD1B**)

BA0 = indicates communication to BASE 0 is active.

BA1 = indicates communication to BASE 1 is active. (**JD2**)



The I/O addresses are set by **GROUP**, **BASE**, and **SLOT**. The first connection from the CNC is always **GROUP 0**. From that communication module, **JD2** goes to **BASE 1**, **JD1A** goes to the next **GROUP**. Each group can have 2 bases, there can be up to 15 groups connected on a single I/O LINK.

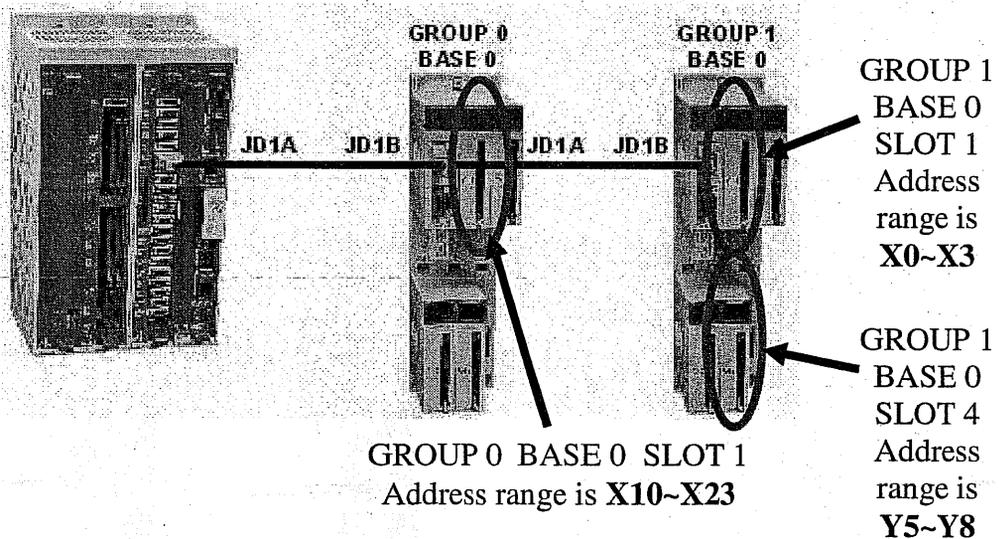


The **PMC type** determines the maximum number of I/O points allowed on the I/O link connection.

I/O Configuration

When the machine builder writes the ladder they assign X and Y addresses to each module mounted. This screen is not available on the standard CNC, however the information is documented in the machine electrical drawings.

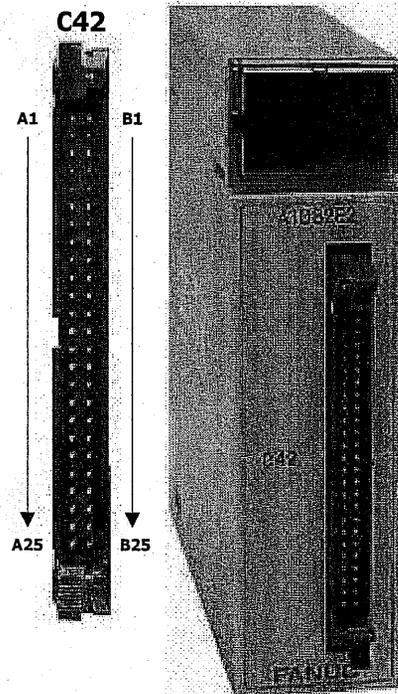
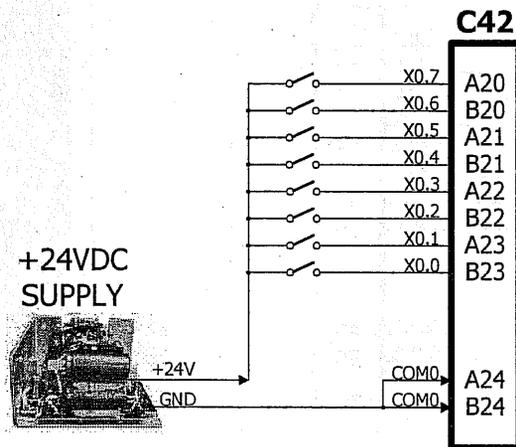
Input					Output				
Address	Group	Base	Slot	Module	Address	Group	Base	Slot	Module
X0000	1	0	01	ID32E	Y0000	1	0	03	DD32D
X0001	1	0	01	ID32E	Y0001	1	0	03	DD32D
X0002	1	0	01	ID32E	Y0002	1	0	03	DD32D
X0003	1	0	01	ID32E	Y0003	1	0	03	DD32D
X0004					Y0004				
X0005	1	0	02	ID32E	Y0005	1	0	04	DD32D
X0006	1	0	02	ID32E	Y0006	1	0	04	DD32D
X0007	1	0	02	ID32E	Y0007	1	0	04	DD32D
X0008	1	0	02	ID32E	Y0008	1	0	04	DD32D
X0009					Y0009				
X0010	0	0	01	CM14I	Y0010				
X0011	0	0	01	CM14I	Y0011				
X0012	0	0	01	CM14I	Y0012				
X0013	0	0	01	CM14I	Y0013				
X0014	0	0	01	CM14I	Y0014				
X0015	0	0	01	CM14I	Y0015				
X0016	0	0	01	CM14I	Y0016				
X0017	0	0	01	CM14I	Y0017				
X0018	0	0	01	CM14I	Y0018				
X0019	0	0	01	CM14I	Y0019				
X0020	0	0	01	CM14I	Y0020				
X0021	0	0	01	CM14I	Y0021				
X0022	0	0	01	CM14I	Y0022				
X0023	0	0	01	CM14I	Y0023				
X0024					Y0024				



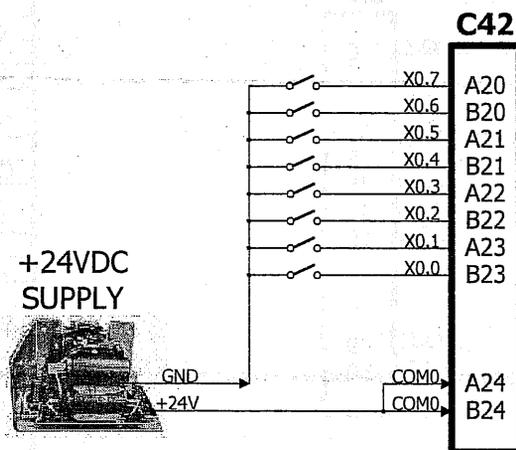
4.3.2. Input Module Connections

The input modules are available with ribbon cable, Honda connector, or terminal block style connection. An external +24V supply is required to power the inputs. They can be configured as **sinking** or **sourcing** inputs. The **AID32E2** module is shown below. The typical input current is 4.5mA

SOURCING – has the **GROUND** connected to the **COM** pins for the inputs. +24V is switched to the inputs.



SINKING – has the **+24V** connected to the **COM** for the inputs. **GROUND** is switched to the inputs.



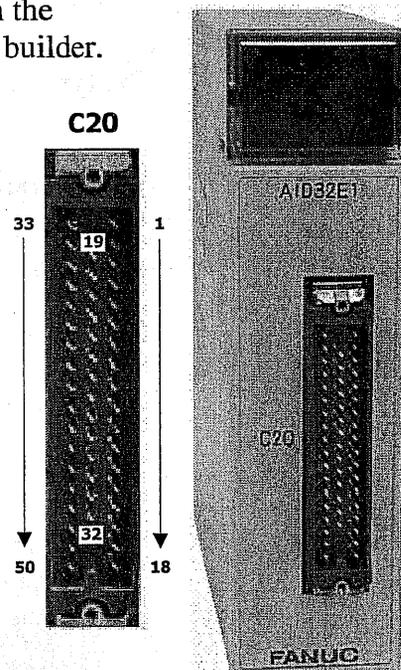
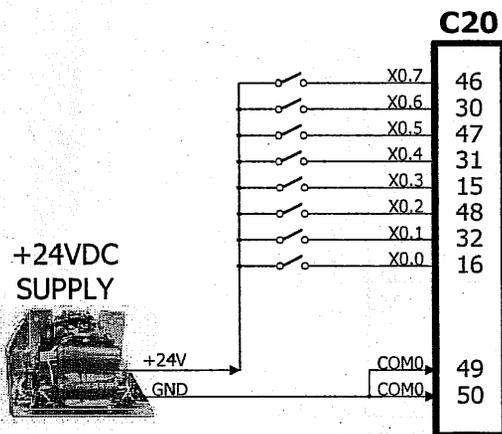
CONNECTOR C42

	A	B
1		
2	X3.7	X3.6
3	X3.5	X3.4
4	X3.3	X3.2
5	X3.1	X3.0
6	COM3	COM3
7		
8	X2.7	X2.6
9	X2.5	X2.4
10	X2.3	X2.2
11	X2.1	X2.0
12	COM2	COM2
13		
14	X1.7	X1.6
15	X1.5	X1.4
16	X1.3	X1.2
17	X1.1	X1.0
18	COM1	COM1
19		
20	X0.7	X0.6
21	X0.5	X0.4
22	X0.3	X0.2
23	X0.1	X0.0
24	COM0	COM0
25		

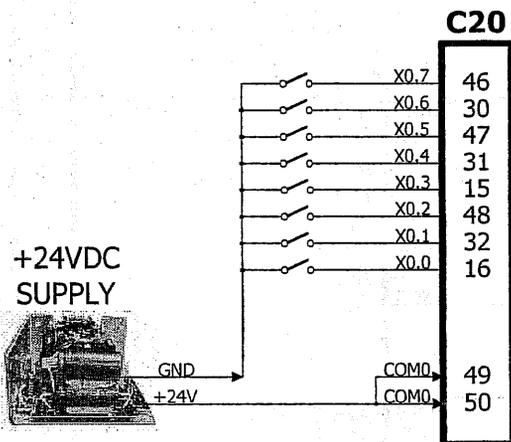
Input Module Connections

The **AID32E1 HONDA connector** input module is shown here. The typical input current is 4.5mA and the inputs can be wired **sinking** or **sourcing**. The start address is dependent on the I/O configuration settings, determined by the machine builder.

SOURCING – has the **GROUND** connected to the **COM** pins for the inputs. +24V is switched to the inputs.



SINKING – has the +24V connected to the **COM** for the inputs. **GROUND** is switched to the inputs.



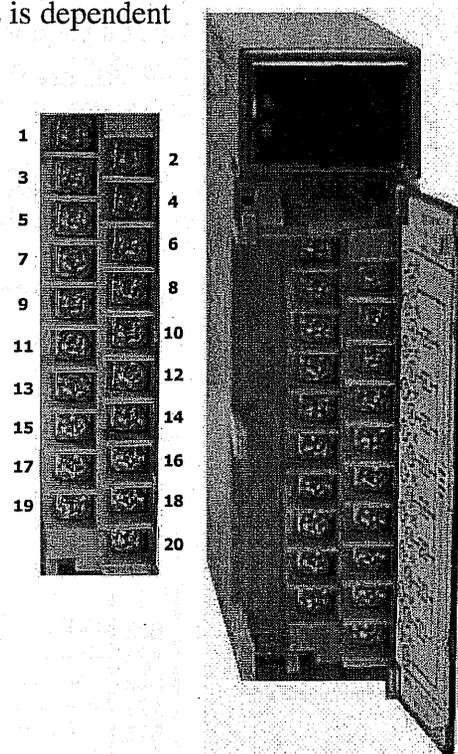
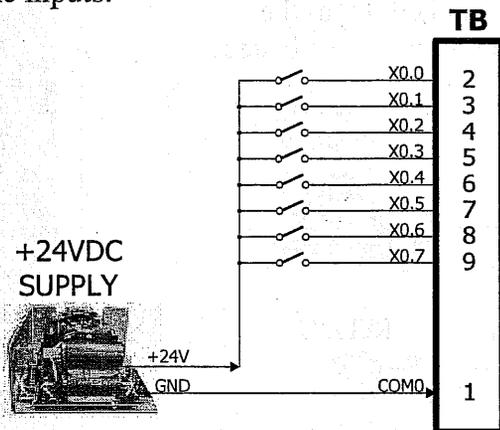
CONNECTOR C20

33		1
X3.7		X3.6
34		2
X3.5	19	X3.3
35	X3.4	3
X3.2	20	X3.0
36	X3.1	4
COM3	21	
37	COM3	5
X2.7	22	
38	X2.6	6
X2.5	23	X2.3
39	X2.4	7
X2.2	24	X2.0
40	X2.1	8
COM2	25	
41		9
COM2	26	
42		10
X1.7	27	X1.6
43	X1.4	11
X1.5	28	X1.3
44	X1.1	12
X1.2	29	X1.0
45	COM1	13
COM1	30	
46	X0.6	14
X0.7	31	
47	X0.4	15
X0.5	32	X0.3
48	X0.1	16
X0.2		X0.0
49		17
COM0		
50		18
COM0		

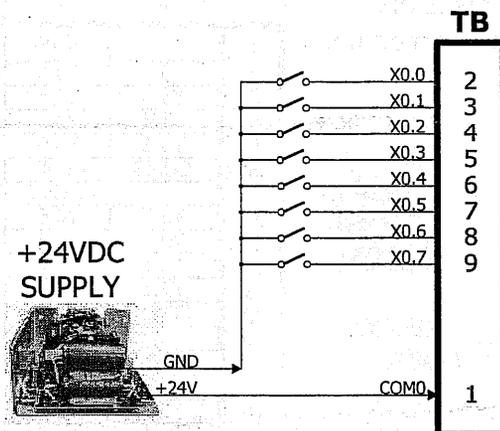
Input Module Connections

The **AID16D TERMINAL BLOCK** connection input module is shown here. The typical input current is 4.0mA and the inputs can be wired **sinking** or **sourcing**. The start address is dependent on the configuration settings.

SOURCING – has the **GROUND** connected to the **COM** pin for the inputs. +24V is switched to the inputs.



SINKING – has the **+24V** connected to the **COM** for the inputs. GROUND is switched to the inputs.



TERMINAL BLOCK

1	COM0		
3	X0.1	X0.0	2
5	X0.3	X0.2	4
7	X0.5	X0.4	6
9	X0.7	X0.6	8
11	X1.1	X1.0	10
13	X1.3	X1.2	12
15	X1.5	X1.4	14
17	X1.7	X1.6	16
19	NC	NC	18
		NC	20

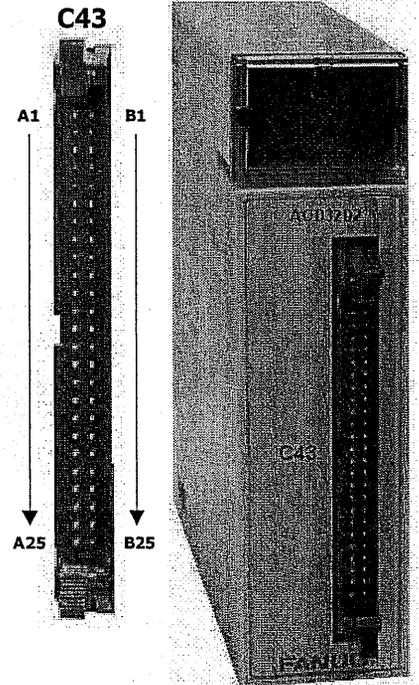
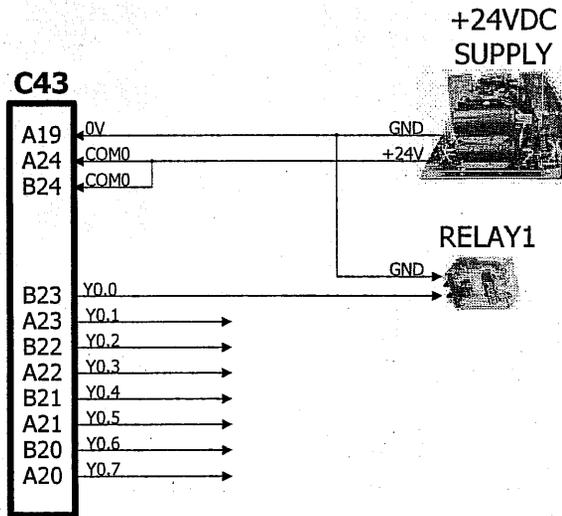
Terminals 18, 19, and 20 are for factory use **ONLY**.

DO NOT make any connections on those terminals.

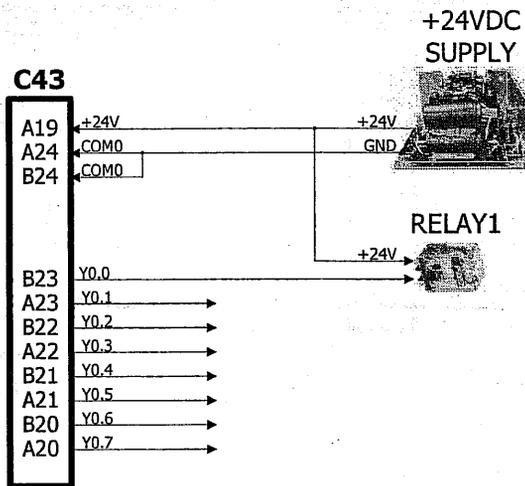
4.3.3. Output Module Connections

The output modules are available with ribbon cable, Honda connector, or terminal block style connection. An external +24V supply is required to power the outputs. The **sinking** or **sourcing** configuration is determined by the module part number. Both types of module have a maximum output current of 300mA per output.

AOD32D2 SOURCING – C43 has the **GROUND** connected to the **0V** pin. **+24V is connected to the COM** pin, which will be switched out of the individual outputs, when the output is activated.



AOD32C2 SINKING – This is the equivalent **sinking** type output module.



AOD32C2 C43

AOD32D2 C43

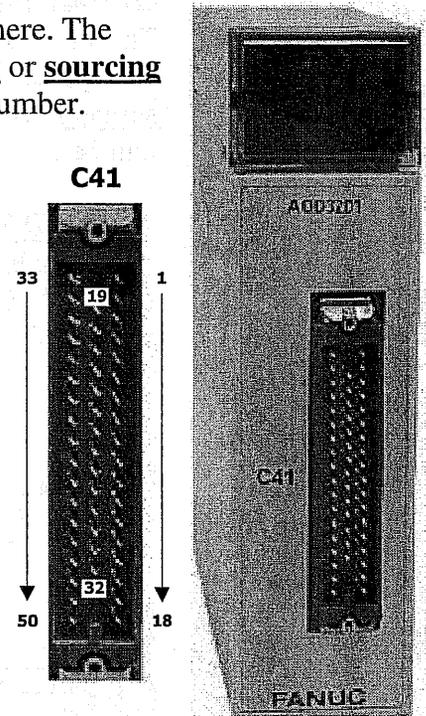
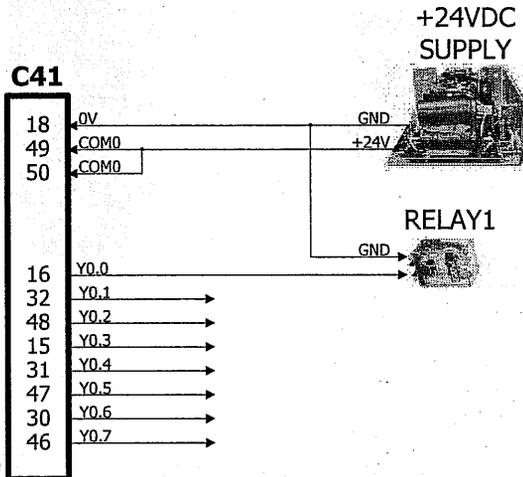
	A	B
1		+24V3
2	Y3.7	Y3.6
3	Y3.5	Y3.4
4	Y3.3	Y3.2
5	Y3.1	Y3.0
6	COM3	COM3
7		+24V2
8	Y2.7	Y2.6
9	Y2.5	Y2.4
10	Y2.3	Y2.2
11	Y2.1	Y2.0
12	COM2	COM2
13		+24V1
14	Y1.7	Y1.6
15	Y1.5	Y1.4
16	Y1.3	Y1.2
17	Y1.1	Y1.0
18	COM1	COM1
19		+24V0
20	Y0.7	Y0.6
21	Y0.5	Y0.4
22	Y0.3	Y0.2
23	Y0.1	Y0.0
24	COM0	COM0
25		

	A	B
1		0V3
2	Y3.7	Y3.6
3	Y3.5	Y3.4
4	Y3.3	Y3.2
5	Y3.1	Y3.0
6	COM3	COM3
7		0V2
8	Y2.7	Y2.6
9	Y2.5	Y2.4
10	Y2.3	Y2.2
11	Y2.1	Y2.0
12	COM2	COM2
13		0V1
14	Y1.7	Y1.6
15	Y1.5	Y1.4
16	Y1.3	Y1.2
17	Y1.1	Y1.0
18	COM1	COM1
19		0V0
20	Y0.7	Y0.6
21	Y0.5	Y0.4
22	Y0.3	Y0.2
23	Y0.1	Y0.0
24	COM0	COM0
25		

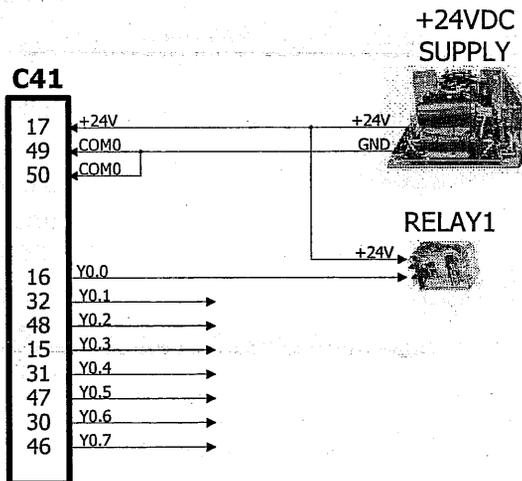
Output Module Connections

The **HONDA connector** style output module is shown here. The typical output current is 300mA per output. The **sinking** or **sourcing** configuration is determined by the output module part number.

AOD32D1 SOURCING – C41 has the **GROUND** connected to the **0V** pin. **+24V** is connected to the **COM** pin, which will be switched out of the individual outputs, when the output is activated.



AOD32C1 SINKING – C41 has the **+24V** connected to the **+24V** pin. **GROUND** is connected to the **COM** pin, which will be switched out of the individual outputs, when the output is activated.



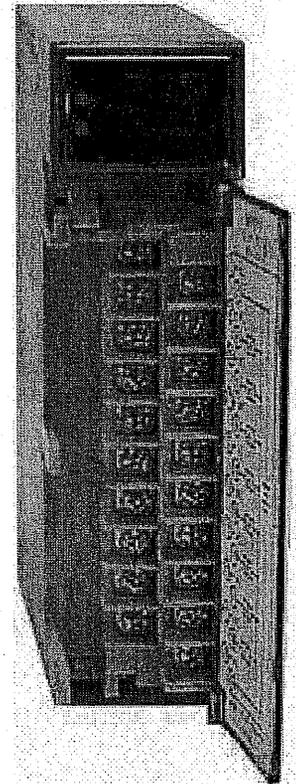
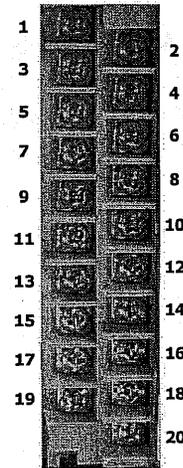
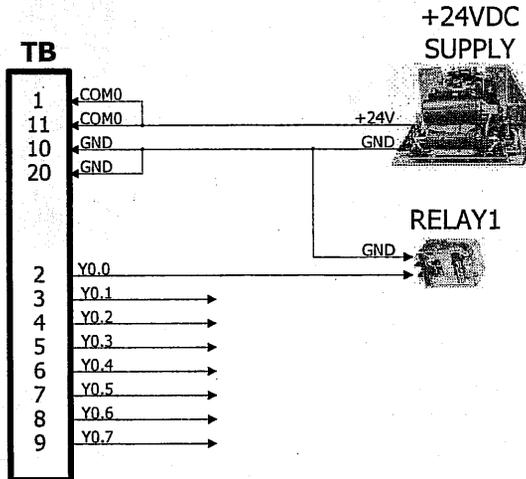
SOURCING C41

33		1
Y3.7		Y3.6
34		2
Y3.5	19	Y3.3
35	Y3.4	3
Y3.2	20	Y3.0
36	Y3.1	4
COM3	21	
37	COM3	5
Y2.7	22	OV3
38	Y2.6	6
Y2.5	23	Y2.3
39	Y2.4	7
Y2.2	24	Y2.0
40	Y2.1	8
COM2	25	
41		9
COM2	26	OV2
42		10
Y1.7	27	Y1.6
43	Y1.4	11
Y1.5	28	Y1.3
44	Y1.1	12
Y1.2	29	Y1.0
45	COM1	13
COM1	30	
46	Y0.6	14
Y0.7	31	OV1
47	Y0.4	15
Y0.5	32	Y0.3
48	Y0.0	16
Y0.2		Y0.0
49		17
COM0		
50		18
COM0		OV0

Output Module Connections

The **TERMINAL BLOCK** style output module is shown here. The typical output current is 500mA per output. The **sinking** or **sourcing** configuration is determined by the output module part number.

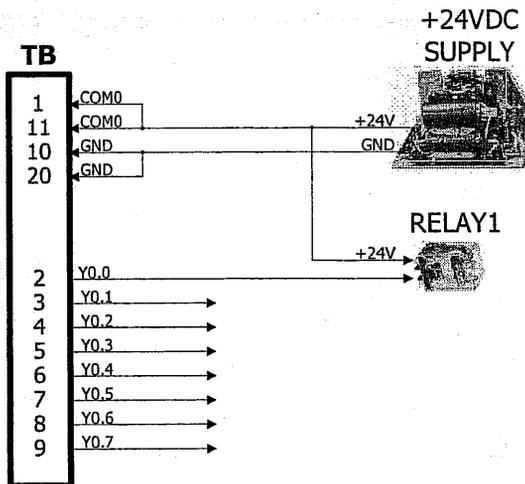
AOD16D SOURCING – **GROUND** is connected to terminals 10 and 20. **+24V is connected to terminals 1 and 11**, which will be switched out of the individual outputs, when the output is activated.



TERMINAL BLOCK

1	COM0	Y0.0	2
3	Y0.1	Y0.2	4
5	Y0.3	Y0.4	6
7	Y0.5	Y0.6	8
9	Y0.7	OV0	10
11	COM1	Y1.0	12
13	Y1.1	Y1.2	14
15	Y1.3	Y1.4	16
17	Y1.5	Y1.6	18
19	Y1.7	OV1	20

AOD16C SINKING – **+24V** is connected to terminals 1 and 11. **GROUND** is connected to terminals 10 and 20., which will be switched out of the individual outputs, when the output is activated.



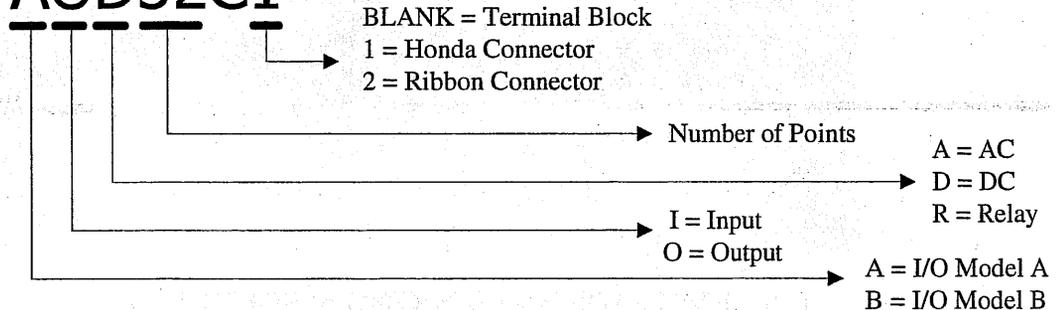
The terminal block connections are the same on source and sink. The difference is where the other side of the load is connected.

4.3.4. I/O Module List

Below is a list of all the I/O modules available for Model A I/O. More details and connection information for each module can be found in the manual **B61813E**, **FANUC I/O MODEL A CONNECTION and MAINTENANCE MANUAL**.

TYPE	MODULE	VOLTAGE	CURRENT	SINK/ SOURCE	RESPONSE	POINTS	CONN	LED
DC Input	AID32A1	24VDC	7.5mA	Both	20mSec	32	Honda	N
	AID32B1	24VDC	7.5mA	Both	2mSec	32	Honda	N
	AID32H1	24VDC	7.5mA	Both	2mSec	8	Honda	N
DC Opto-isolated Input	AID16C	24VDC	7.5mA	Sink	20mSec	16	TB	Y
	AID16K	24VDC	7.5mA	Sink	2mSec	16	TB	Y
	AID16D	24VDC	7.5mA	Source	20mSec	16	TB	Y
	AID16L	24VDC	7.5mA	Source	2mSec	16	TB	Y
	AID32E1	24VDC	7.5mA	Both	20mSec	32	Honda	N
	AID32E2	24VDC	7.5mA	Both	20mSec	32	Ribbon	N
	AID32F1	24VDC	7.5mA	Both	2mSec	32	Honda	N
AID32F2	24VDC	7.5mA	Both	2mSec	32	Ribbon	N	
AC Input	AIA16G	100V~ 120V	10.5mA 120AC	AC	45mSec	16	TB	Y
DC Output	AOD32A1	5~24VDC	300mA	Sink	2mSec	32	Honda	N
DC Opto-isolated Output	AOD08C	12~24VDC	2.0A	Sink	2mSec	8	TB	Y
	AOD08D		2.0A	Source		8	TB	Y
	AOD16C		500mA	Sink		16	TB	N
	AOD16D		500mA	Source		16	TB	N
	AOD32C1		300mA	Sink		32	Honda	N
	AOD32C2		300mA	Sink		32	Ribbon	N
	AOD32D1		300mA	Source		32	Honda	N
	AOD32D2		300mA	Source		32	Ribbon	N
AC Output	AOA05E	100~	2.0A	-	1mSec	5	TB	Y
	AOA08E	240VAC	1.0A	-	1mSec	8	TB	Y
	AOA12F	100~120	500mA	-	1mSec	12	TB	Y
Relay Output	AOR08G	250VAC /	4A	-	15mSec	8	TB	Y
	AOR16G	30VDC	2A	-	15mSec	16	TB	Y
	AOR16H2	30VDC	2A	-	15mSec	16	Ribbon	Y

AOD32C1



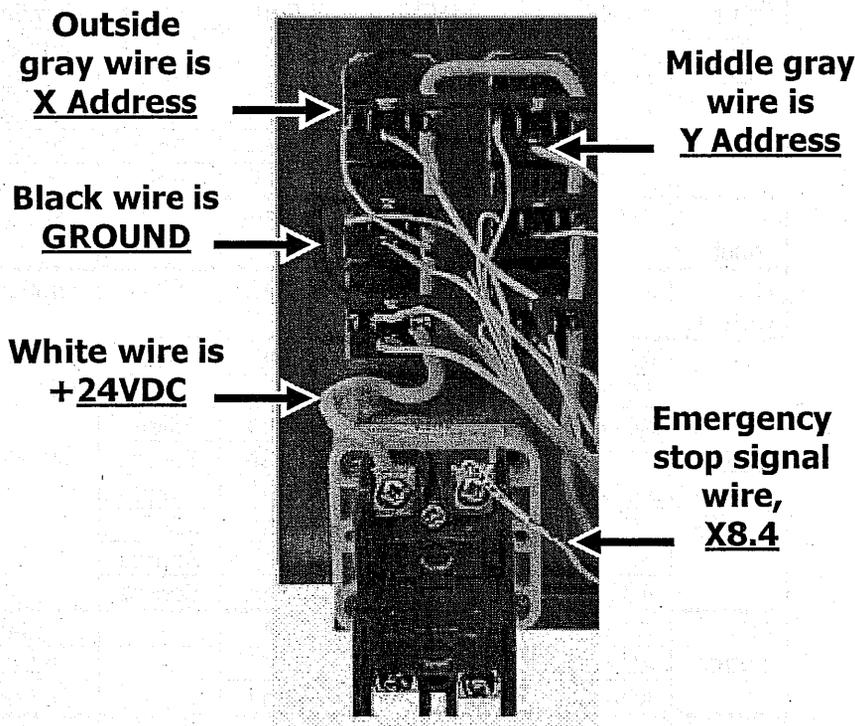
4.3.5. I/O Confirmation

The PMCDGN STATUS screen is the best place to confirm an I/O point is working. If it appears to be functioning there, you will need to use a voltmeter to physically check the device that is connected. You will need the machine wiring diagrams.

In this example we will confirm the operation of the EMERGENCY STOP and SINGLE BLOCK switches on the operator panel.



- 1) LOOK on the back of the operator panel, behind the emergency stop switch.



- 2) Connect a volt-meter between GROUND and EMG-STOP signal wire.

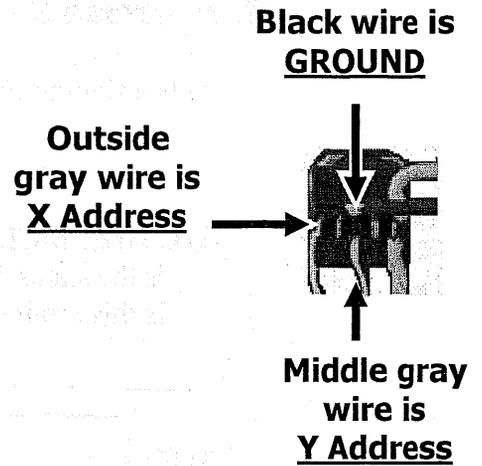
- 3) Push IN the EMG-STOP button, is the signal wire +24V or 0V ?
How does that relate to the status bit on the PMCDGN screen ?

PMC SIGNAL STATUS								MONIT	RUN
ADDRESS	7	6	5	4	3	2	1	0	
X0008	.	.	.	+	
X0009	
X0010	1	

Is the EMG-STOP input SINKING or SOURCING ?

I/O Confirmation

- 4) Connect a volt-meter between GROUND and the SINGLE BLOCK X address wire.
- 5) Turn ON the SINGLE BLOCK switch. What is the voltage when the switch is turned ON ?

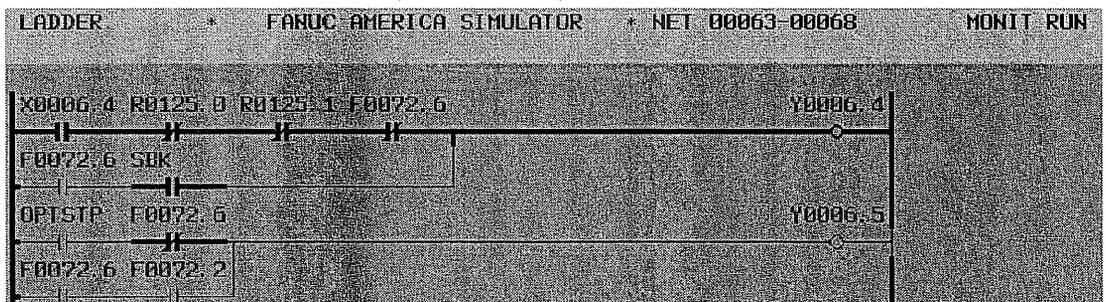


How does that relate to the status bit X6.4 ?

Is the X address sinking or sourcing ?

PMC SIGNAL STATUS		MONIT RUN							
ADDRESS	7	6	5	4	3	2	1	0	
X0006	I	.	.	I	.	.	.	.
X0007	
X0008	.	.	.	*ESTP	.	.	.	.
X0009	.	.	.	I	.	.	.	.
X0010	I	
X0011	
X0012	
X0013	

The Y address Y6.4 is used to turn ON the lamp inside the SINGLE BLOCK button. Connect the meter and watch the output change states with the ladder.



4.4. Exercise 3 – Physical Input/Output

- 1) Is a sinking input activated by GROUND or +24V ?

- 2) On the PMCDGN STATUS screen search for address X8.4.
Is the status 1 or 0 ?
Is this input sinking or sourcing ?

- 3) How is it decided whether an input will be SINKING or SOURCING ?

- 4) Using the BUILT-IN I/O card, where is the +24V supply for the X inputs ?

- 5) Using I/O Model A, where is the +24V supply for the X inputs ?

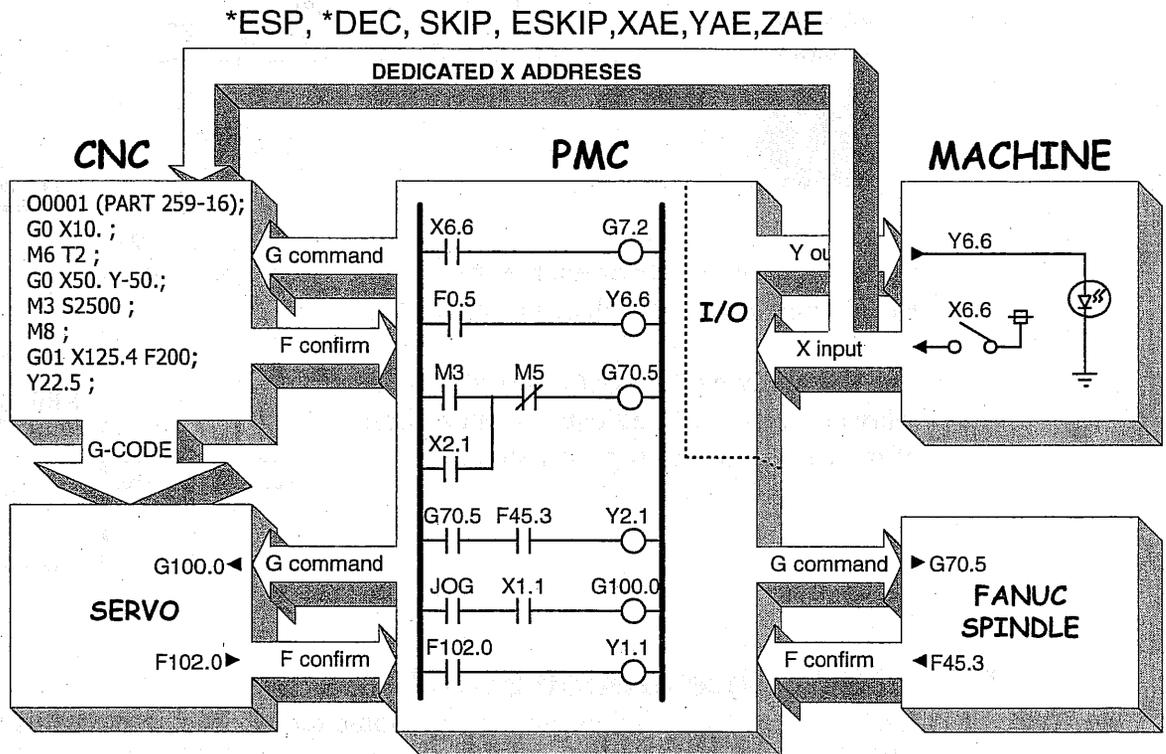
- 6) Using I/O Model A, if a new output connection requires 750mA of current, which output module should be used ?

- 7) How is the module address specified ?

- 8) If you swap I/O modules between slots does the starting addressing change ?

5. Dedicated X Addresses

Normally the X addresses are determined by the machine builder, because they decide how the machine will be wired to the I/O module. There are a few X addresses that are fixed by Fanuc. These addresses, are for time critical signals like emergency stop. This chapter explains the function of the dedicated addresses.



5.1. *ESP - Emergency Stop

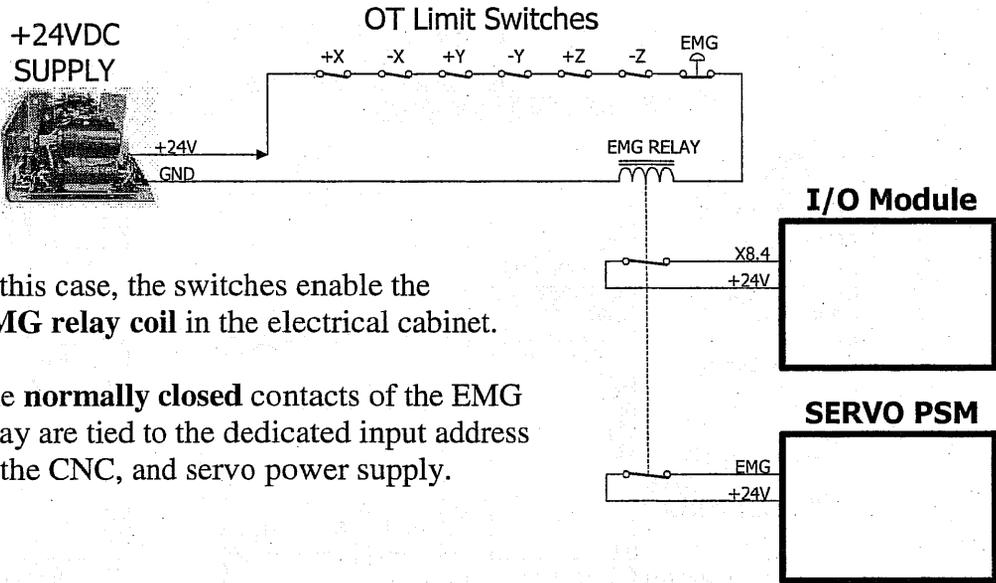
The emergency stop signal is used to stop the machine immediately. Address **X8.4** is used for the **MACHINE** to tell the CNC there is an emergency. Address **G8.4** is used for the **PMC** to tell the CNC there is an emergency. Address X8.4 may appear in the PMC, but whether it is or not, the CNC will still monitor the address.

Control Type	EMG - MACHINE to CNC (built-in I/O)	EMG - MACHINE to CNC (I/O Link)	EMG - PMC to CNC
15	na	X6.4	G0.4
16 / 18	X1008.4	X8.4	G8.4
0	X21.4	na	G121.4

The asterisk * in the signal name indicates the emergency stop signal is **active low**. This means that when the signal is 1 on the status screen, there is no emergency. When the signal **changes from 1 to 0, emergency stop becomes active**.

*ESP - Emergency Stop

Some machine builders choose to tie all of the hard over-travel switches in series with the emergency stop switch. If the machine hits a hard over-travel or someone presses the EMG-STOP button, the CNC displays EMG.



In this case, the switches enable the **EMG relay coil** in the electrical cabinet.

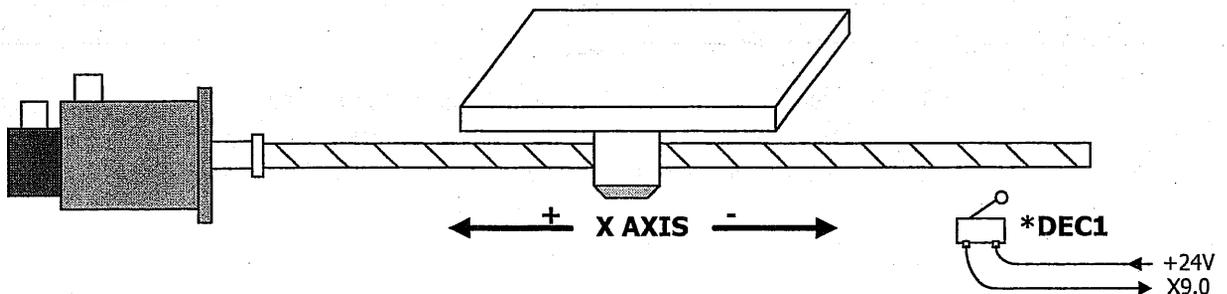
The **normally closed** contacts of the EMG relay are tied to the dedicated input address of the CNC, and servo power supply.

5.2. *DEC - Deceleration Switch

The deceleration switches are used for home return. They are commonly referred to as DOG switches, they tell the CNC when the servo axis is near home. These switches are wired normally closed as indicated by the * asterisk. When the CNC sees the switch status change from 1 -> 0 -> 1 it stops at the next Z pulse, which is home position.

Control Type	DEC - MACHINE to CNC (built-in I/O)	DEC - MACHINE to CNC (I/O Link)
15	na	
16 / 18	X1009	X9
0	X16.5, X17.5, X18.5, X19.5	na

There is a separate address for each axis. **The 16 control** uses address X9. Address X9.0 is used for the 1st axis (X axis), X9.1 is used for the 2nd axis (Y on mill or Z on lathe), X9.2 is used for the 3rd axis (Z on mill, C on lathe) and X9.3 is used for the 4th axis.



5.3. SKIP1 - Skip Input

The skip input function is used when the machining end point is not programmed, but instead the part dimension is probed by a fixed dimension measuring instrument during cutting. The skip input is wired to the measuring instrument. When the correct part dimension is sensed, the skip input activates, and the remaining G-code command (G31) is skipped. The program moves to the next block.

Control Type	SKIP - MACHINE to CNC (built-in I/O)	SKIP - MACHINE to CNC (I/O Link)
15	na	X11.6
16 / 18	X1004.7	X4.7
0	X8.7	na

There is also a dedicated G address, G06.6 (SKIPP) which can be used as an auxiliary skip input. Parameter 6200 bit 0 determines if this address is used (1) or not (0).

5.4. SKIPx - Multi-Step Skip Input

The multi-skip function works the same as the SKIP INPUT function, except you have 8 dedicated inputs. This allows for multiple dimension measuring instruments.

5.5. XAE, YAE, ZAE - Measuring Point Reached

The measuring point signals are used for **Automatic Tool Length Measurement** (mill) and **Automatic Tool Offset** (lathe) option functions. These signals are wired to the tool setter arm switches to sense the tool tip. The G37 command is issued by the macro program to move the tool tip toward the tool setter arm. When the switch activates, the difference between the current coordinates and the setter arm position is used to measure and adjust the active tool offset.

Control Type	xAE - MACHINE to CNC (built-in I/O)	xAE - MACHINE to CNC (I/O Link)
15	na	X8.3, X8.4, X8.5
16 / 18	X1004.0, X1004.1, X1004.2	X4.0, X4.1, X4.2
0	X8.0, X8.1, X8.2	na

5.6. +MIT1, -MIT1 - Manual Feed Interlock

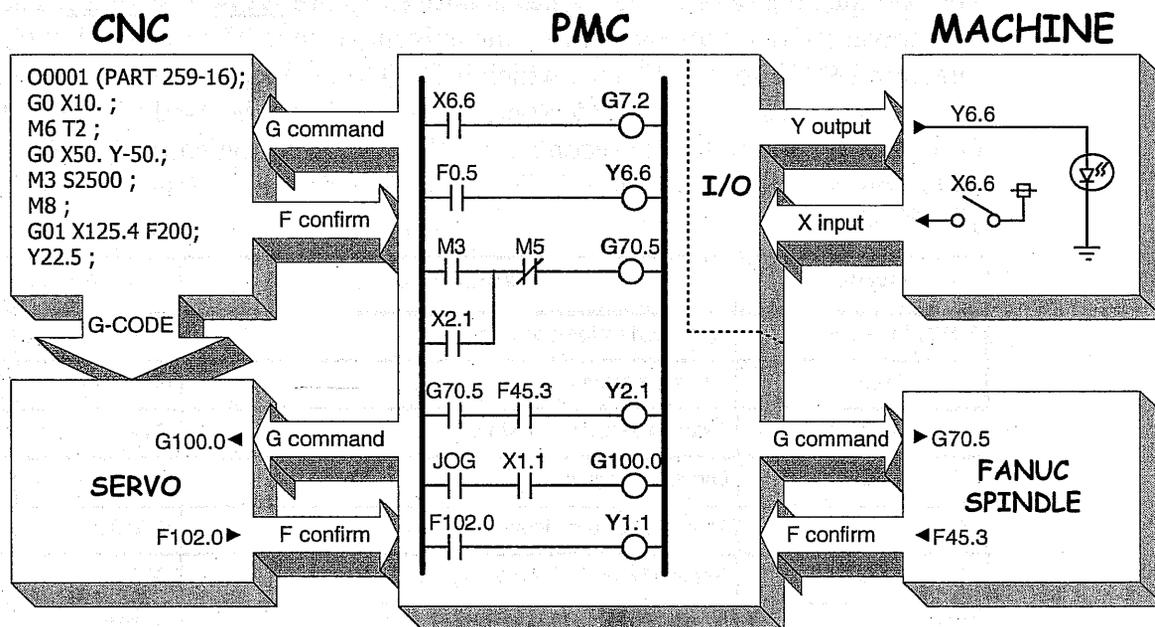
These signals are used when **manual tool length measurement** is performed. These signals are wired to the tool setter arm switches. The tool is manually moved to touch the setter arm switches. When activated, the axis cannot continue moving in the same direction. The signal +MIT1 is the +X direction, -MIT1 = -X, +MIT2 = +Z, and -MIT2 = -Z direction. The dedicated X addresses are used on **LATHE** controls only. The MILL control has the same function, however it uses addresses G132/G134.

Control Type	MIT - MACHINE to CNC (built-in I/O)	MIT - MACHINE to CNC (I/O Link)
15T	na	
16T / 18T	X1004.2, X1004.3, X1004.4, X1004.5	X4.2, X4.3, X4.4 X4.5
0T		na

The addresses for MIT are the same addresses used for multi-step skip function. Use caution when both functions are enabled. When parameter 3003 bit 3 (DIT) is set to 1, the manual interlock addresses are disabled.

6. Dedicated G and F Addresses

All of the G and F addresses are set by Fanuc. The machine builder interfaces to them with X and Y (physical inputs/outputs) in the PMC ladder. The G and F addresses Interface between the PMC and CNC, SERVO system, and SPINDLE system (if Fanuc spindle is used)



The dedicated addresses are listed in tables in the appendix of this manual. There are separate tables for each control model, 16/18, 15, and 0. This information is typically given in the Maintenance manual for the control. The following examples are from the 16iA maintenance manual, B63005EN / 02. The **16iA CONNECTION (FUNCTION) manual B63003EN-1**, has more details on how the dedicated signals function.

The information is given in more than one way. On **page 478**, the table **LIST OF INPUT/OUTPUT SIGNALS** is shown. This is an **alphabetical listing by SYMBOL** name. Each of the G and F addresses has an assigned mnemonic called the symbol. If you know the **SYMBOL** for a signal, this is a good place to find its' description.

Symbol	Signal name	Address	T-series	M-series
*+ED1 to *+ED8	External deceleration signal	G118	○	○
*+L1 to *+L8	Overtravel signal	G114	○	○
*-ED1 to *-ED8	External deceleration signal	G120	○	○
*-L1 to *-L8	Overtravel signal	G116	○	○
*ABSM	Manual absolute signal	G006#2	○	○
*AFV0 to *AFV7	Second feedrate override signal	G013	○	○
*REFLD	R-axis clamp completion signal	G038#7	○	○

Dedicated G and F Addresses

In the table **LIST OF INPUT/OUTPUT SIGNALS**, the first group of signals has asterisk in front of the symbol name. The **asterisk means the signal is active when status is 0** on the PMCDGN status screen. A status of 1 is its' normal state.

For example, the **over travel signal is addresses are G114 and G116**. These are the hard over travel switches for each end of the axis movement. The symbol ***+L1** is the + direction LIMIT for the 1st axis, which is X. The symbol ***-L1** is the - direction LIMIT for the 1st axis. It assumed you understand that G116.0 will be used for the first axis -X, and G116.1 will be used for the second axis -Y. There fore, logically G116.2 = -Z, G116.3 = -A and so on, up to 8 axis of control. The PMC doesn't know about X Y Z axis, it just knows 1st, 2nd, 3rd axis.

Symbol	Signal name	Address	T series	M series
*+ED1 to *+ED8	External deceleration signal	G118	<input type="radio"/>	<input type="radio"/>
*+L1 to *+L8	Overtravel signal	G114	<input type="radio"/>	<input type="radio"/>
*-ED1 to *-ED8	External deceleration signal	G120	<input type="radio"/>	<input type="radio"/>
*-L1 to *-L8	Overtravel signal	G116	<input type="radio"/>	<input type="radio"/>
*ABSM	Manual absolute signal	G006#2	<input type="radio"/>	<input type="radio"/>
*AFV0 to *AFV7	Second feedrate override signal	G013	<input type="radio"/>	<input type="radio"/>
*RECI0	R-axis clamp completion signal	G038#7	<input type="radio"/>	<input type="radio"/>

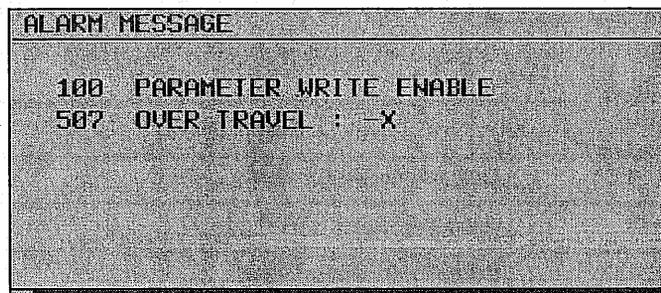


1) On the **PMCDGN STATUS** screen, look at the status of address G116.0
Is it ON or OFF ?

2) Turn ON keep relay **K4.0**, on the **PMCPRM KEEPRL** screen.

3) Press the  button on the MDI key pad.

The following error message should appear...



4) Return to the **PMCDGN STATUS** screen, look at the status of address G116.0
Is it ON or OFF ? This is how signals with **ASTERISK** in the symbol name function.

Dedicated G and F Addresses

The second way information is provided in the maintenance manual is on page 497, by G and F address. These pages give you addresses in sequential order, so if you only know the address this is the better place to look.

When you look up G116 on this table, it just tells you the SYMBOL name...

	#7	#6	#5	#4	#3	#2	#1	#0
G114	*+L8	*+L7	*+L6	*+L5	*+L4	*+L3	*+L2	*+L1
G116	*-L8	*-L7	*-L6	*-L5	*-L4	*-L3	*-L2	*-L1
G118	*+ED8	*+ED7	*+ED6	*+ED5	*+ED4	*+ED3	*+ED2	*+ED1
G120	*-ED8	*-ED7	*-ED6	*-ED5	*-ED4	*-ED3	*-ED2	*-ED1

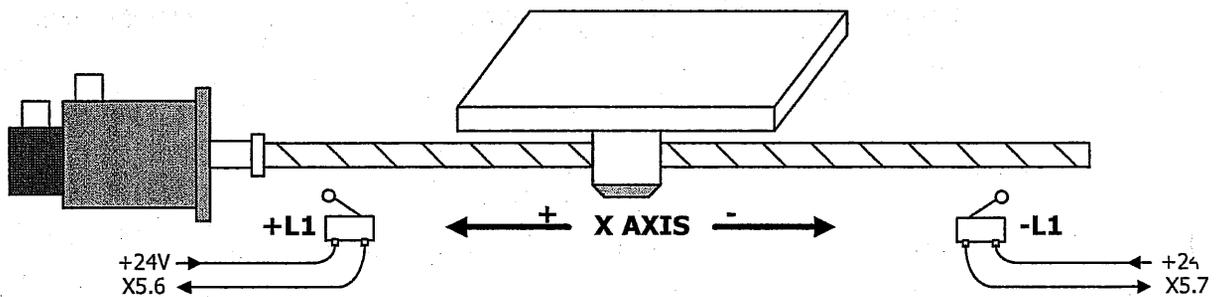
Look up that **SYMBOL** name on the previous table on page 478 to see the signal description. The 16iA CONNECTION (FUNCTION) manual B63003EN-1 / 02, has more details on how the signal can be used and if any parameters are related.

6.1. Active Low Signals *

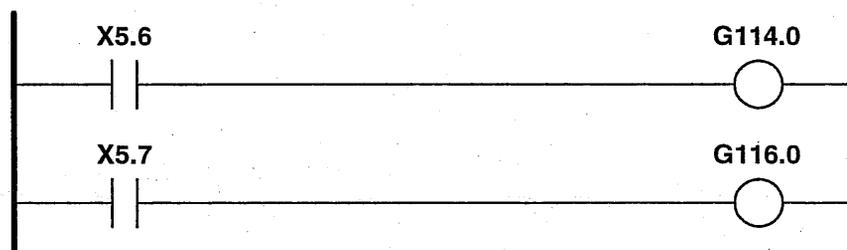
As shown in the previous pages, the signals with asterisks in their SYMBOL name are active low signals. These signals are considered to be operation critical signals and are designed active low to provide enhanced machine safety. The EMG-STOP signal X8.4 is an active low signal. It is this way, in case the wiring from the switch should become open it will cause the machine to stop and present an emergency stop alarm. If the signal was not active low, you would not realize the wiring was open until you pressed the EMG button in and found it didn't work. This may be the worst time to find out the wiring is broken. This section reviews the commonly used active low signals.

6.1.1. *+L1~*+L8 G114/G116 - Hard Over travel

The hard over travel limits are physical switches at the end of travel for each axis. The switches are wired to X inputs on the I/O module. The machine builder decides which X address will be used. The switches are usually wired normally closed for safety, so the input is active (1) until the switch is pressed (0).



The ladder logic for this physical wiring may look like this ...



Because the physical switches are wired normally closed, as long as the switch is not pressed, the X5.6 input is active (1) and the coil G114.0 is ON. When the machine table moves over and touches the switch, the X5.6 input becomes inactive (0) and the coil G114.0 goes OFF, causing alarm 506 / 507 on the message screen.

**CNC Alarms 506 OVERTRAVEL +
 507 OVERTRAVEL -**

NOTE1 : On machines with ABSOLUTE type motor pulse coders, the overtravel signals may not be used. Software overtravel limits are employed.

NOTE2 : The hard over travel function is ignored if parameter 3004 bit 5 (OTH) is 1.

6.1.2. *ESP X8.4/G8.4 - Emergency Stop

The emergency stop signal stops the machine immediately. Address **X8.4** is used for the **MACHINE** to tell the CNC there is an emergency. Address **G8.4** is used for the **PMC** to tell the CNC there is an emergency. Address X8.4 may appear in the PMC, but whether it is or not, the CNC will still monitor the address. More information about emergency stop can be found in the previous chapter.

6.1.3. *ESPA G71.1 - Spindle Emergency Stop

The spindle emergency stop signal commands the spindle to stop immediately. The CNC emergency stop (X8.4) will also cause this. **This signal is from PMC to SPINDLE.** The other signals *ESPB (G75.1) and *ESPC (G205.1) are used for the second and third spindle

6.1.4. *FV0~FV7 G12 - Feedrate Override

The feedrate override signal overrides the feedrate commanded by the G-code program (F command). This signal uses all of the bits in address G12 to create a binary pattern of the override amount. The override amount can be from 0% to 25%. Because this is an active low signal, the bits that have a status of 0 are the binary override amount.



- 1) On the PMCDGN STATUS screen, search for address G12
- 2) Turn the FEEDRATE rotary switch to 0, on the machine operator panel.
The status of all the bits in address **G12 should be 1.**

PMC SIGNAL STATUS								MONIT RUN			
ADDRESS	7	6	5	4	3	2	1	0			
G0012	1	1	1	1	1	1	1	1			
G0013	1	1	1	1	1	1	1	1			
G0014	.	.	.	.	.	.	.	.
G0015	.	.	.	.	.	.	.	.
G0016	.	.	.	.	.	.	.	.
G0017	.	.	.	.	.	.	.	.	HS1C	HS1B	HS1A
G0018	.	.	.	.	.	.	.	.
G0019	RT	.	MP2	MP1	.	.	.	.

SEARCH											
--------	--	--	--	--	--	--	--	--	--	--	--

***FV0~FV7 G12 - Feedrate Override**

3) Turn the FEEDRATE rotary switch to 10%, on the machine operator panel.
The status of G12 bits should change.

ADDRESS	7	6	5	4	3	2	1	0
G0012	I	I	I	I	.	I	.	I
G0013	I	I	I	I	.	I	.	I
G0014	.	.	.	.	.	.	.	.
G0015	.	.	.	.	.	.	.	.

The bit value of bit 1 = 2, and the bit value of bit 3 = 8, 2+8=10%

Address G13 is a secondary feedrate override and does not necessarily change with changes in G12. It only changes on this simulator because it is written into the ladder this way.

4) What will the status of the G12 bits be when 50% is commanded ?

NOTE : The feed rate override switch may be disabled by a M-Code, check the M-code list provided by the machine builder to see if your machine has this function.

6.1.5. *IT G8.0 - All Axis Interlock

If the interlock signal is active (0), it will lock ALL servo axis so they cannot move, in any mode. This is done when the machine is in a condition where it would be dangerous for it to move, for example during tool change. If parameter 3003 bit 0 (ITL) is set to 1, this signal is disabled.

6.1.6. *IT1~*IT8 G130 - Specified Axis Interlock

If the interlock signal is active (0), it will lock the specified servo axis so it cannot move, in any mode. The PMC recognizes 1st, 2nd, 3rd, axis so if this is a mill the *IT1 signal (G130.0) is used for X axis, *IT2 (G130.1) is for Y axis, and *IT3 (G130.2) is for the Z axis. This is done when the machine is in a condition where it would be dangerous for it to move, for example during tool change you may want to lock the Z axis. If parameter 3003 bit 2 (ITX) is set to 1, these signals are disabled.

6.1.7. *JV0~*JV15 G10~G11 - Manual Feedrate Override

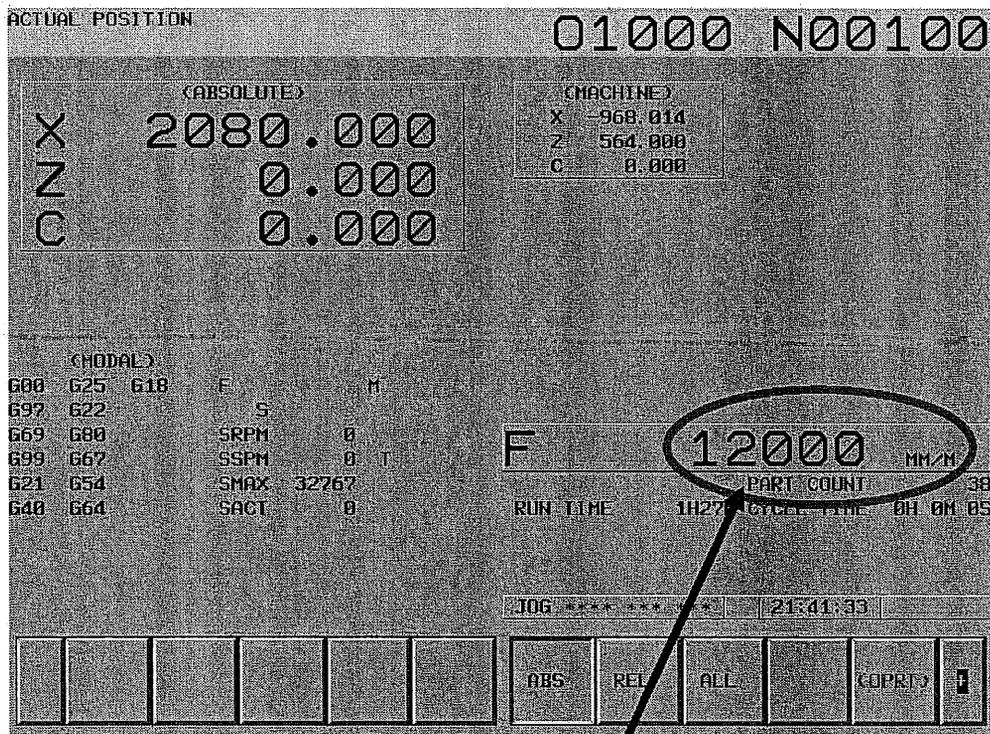
These signals override the **manual feedrate when in JOG mode**, and using the jog buttons on the operator panel (+X,-X,+Y,-Y,+Z,-Z). Normally the manual feedrate is set by **parameter 1423 MANUAL CONTINUOUS FEEDRATE**. These addresses override the parameter setting.

This is a 16bit command, the low bits are address G11 and the high bits are address G10, 8 bits each. The binary pattern sets the override amount in increments of 0.01%.

These signals also serve as the automatic feedrate override **when a program is run with DRYRUN activated**.



- 1) On the PMCDGN STATUS screen, search for address G10
- 2) Turn the FEEDRATE rotary switch to 100%, on the machine operator panel. What is the binary value of G10~G11 addresses ?
- 3) Select **JOG** mode, on the machine operator panel.
- 4) Press the  button, on the MDI keypad to view the POSITION screen.
- 5) Press the  jog button, on the machine operator panel.



Notice the actual feedrate changes as you rotate the FEEDRATE switch.

6.1.8. *SP/SPL G8.5/F0.4 - Feed Hold

The feed hold signal will stop the G-code program temporarily. It may stop immediately or at the end of the current command block, depending on the current G-code it is processing. The physical switch is typically wired normally closed. G8.5 must be in its' normal state (1) for the CYCLE START button to work.

The signal F0.4 (SPL) is the feed hold confirmation from CNC to PMC.

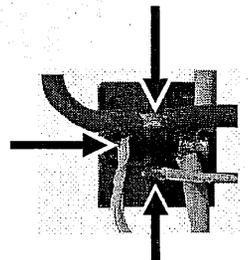


- 1) On the PMCDGN STATUS screen, search for address G8
Is the status 1 or 0 ?

- 2) Notice the wiring on the back of the switch,
Is it wired normally open or normally closed ?

- 3) Find the FEEDHOLD circuit in the PMC Ladder,
and watch it change when the switch is pressed.
What X address is assigned to this button ?

Outside
gray wire is
X Address



Black wire is
GROUND

Middle gray
wire is
Y Address

6.2. Axis Specific Signals + -

The next group of addresses on the LIST OF INPUT/OUTPUT SIGNALS table in the appendix is the + - group. These signals are related to the servo axis directions + and -

6.2.1. +J1/-J1 G100/G102 - Feed Axis Direction

These signals are used to JOG the axis in the + or - direction. The address G100 is used for the + direction of each axis. The PMC does not know X Y Z axis names, it does know 1st axis, 2nd axis, 3rd axis. The signal +J1 (G100.0) is used to jog the 1st axis in the + direction, and -J1 (G102.0) is used to jog the axis in the - direction. Likewise +J2/-J2 (G100.1/G102.1) jogs the 2nd axis, and +J3/-J3 (G100.2/G102.2) jog the 3rd axis. Address F102 (MV1~MV8) is the confirmation signals that the axis are moving and address F106 (MVD1~MVD8) indicates the direction of the movement.



- 1) On the PMCDGN STATUS screen, search for address G100
- 2) Turn the FEEDRATE rotary switch to 100%, on the machine operator panel.
What is the binary value of G10~G11 addresses ?
- 3) Select **JOG** mode, on the machine operator panel.
- 4) Press the  button, on the MDI keypad to view the POSITION screen.
- 5) Press the  jog button, on the machine operator panel.
- 6) Which X address is wired to the +X jog button ?
Find it on the PMCLAD ladder screen.

6.2.2. +MIT/-MIT G132/G134 - Interlock Each Axis Direction

These signals are used when manual tool length measurement is performed. These signals are wired to the tool setter arm switches. The tool is manually moved to touch the setter arm switches. When the signal is activated, the axis cannot continue moving in the same direction. The signal +MIT1 is the +X direction (G132.0), -MIT1 = -X (G134.0), +MIT2 = +Y (G132.1), and -MIT2 = -Y (G134.1) direction. The signals are used on MILL controls. Dedicated X addresses are used on LATHE controls (X4).

NOTE : When parameter 3003 bit 3 (DIT) is set to 1, the manual interlock addresses are disabled.

6.3. Commonly Used G and F Addresses

As you can see in the table of signals, there is a command (G) and confirmation (F) for almost every function the CNC can perform. Many of them are not used by the average machine. This section reviews the more commonly used G and F addresses. The **16iA CONNECTION (FUNCTION) manual B63003EN-1**, has details on all of the CNC functions and how the dedicated signals operate.

6.3.1. AFL/MAFL G5.6/F4.4 - Auxiliary Function Lock

The **M-Codes, S-Codes, and T-Codes** found in the G-code program are referred to as **auxiliary functions**. M-codes control machine side functions, such as coolant pumps (M8) or spindle commands (M3,M4,M5,M19). S-codes are used to control spindle speed or on a lathe control they may be used to specify part surface speed at the tool tip. T-code are used for tool magazine or turret control.

If you would like to run a G-code program without activating the M, S, or T codes, **this can be done by turning ON address G5.6**. This may be desirable if you want to perform a test run of the program without actually cutting a part. The **address F4.4 is a confirmation signal** from CNC to PMC, to let the PMC know that the CNC is performing this action.

6.3.2. AL F1.0 - Alarm In-Progress

This is a signal from CNC to PMC. The signal is **set to 1** by the CNC any time it has an alarm present on the [MESSAGE] screen.

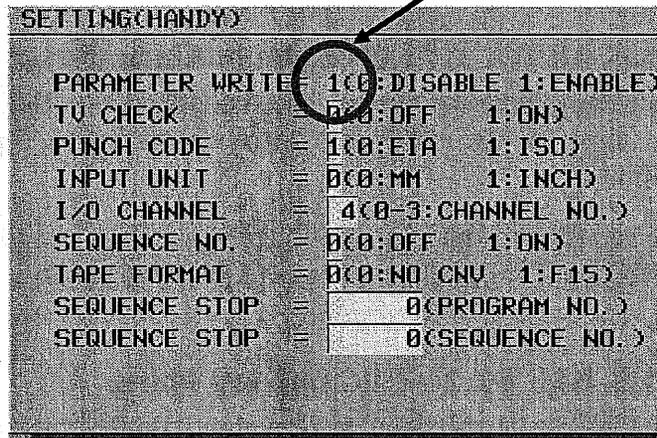


- 1) On the PMCDGN STATUS screen, search for address F1. Notice that F1.0 is now **OFF**, because there is no alarm present

PMC SIGNAL STATUS								MONIT RUN
ADDRESS	7	6	5	4	3	2	1	0
F0001	I	.	.	.	.	.	RST	.
F0002	I	.	.	.	.	.	.	I
F0003	.	.	I	.	.	.	.	.
F0004	.	.	.	.	.	I	.	.
F0005	.	.	.	.	.	.	.	.
F0006	.	.	.	.	.	.	.	.
F0007	.	.	.	.	IF	SF	.	MF
F0008	.	.	.	.	.	.	.	.

AL F1.0 - Alarm In-Progress

- 2) Select **MDI** mode on the operator panel.
- 3) Press the  button on the MDI panel.
- 4) Press the  soft key on the CRT menu.
- 5) Use the arrow keys to highlight the PARAMETER WRITE setting.



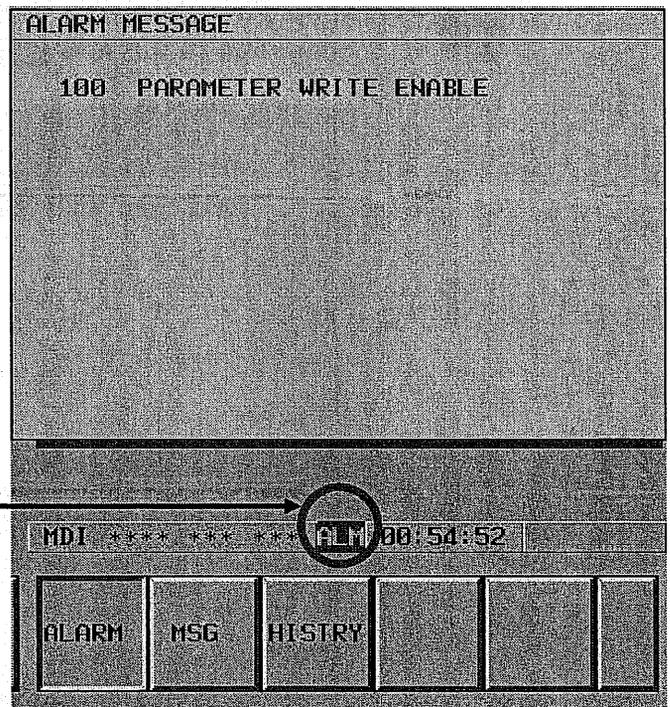
- 6) Press  then press the  key on the MDI panel.

Alarm 100 PARAMETER WRITE ENABLE will occur.

The CNC may automatically switch to the MESSAGE screen when the alarm occurs.

Parameter 3111 bit 7 (NPA) will decide if it does or not. **If bit 7 is 0, then it will change screens.** If bit 7 is 1, it will not change screens.

At the bottom of the screen is the status line. Any time F1.0 is 1, ALM flashes in the status line.



6.3.3. ALMA F45.0 - Spindle Alarm

The spindle is a stand alone controller. It processes the commands (G) received from the PMC and returns confirmation (F). It also has internal alarm detection circuits. **Any time the SPINDLE detects an alarm condition, it turns ON the ALMA signal (F45.0), to tell the PMC something is wrong.** The spindle then displays the alarm code on the 7 segment display, located on the front of the spindle module.

There are separate alarm addresses for the second (ALMB-F49.0) and third (ALMC-F168.0) spindles, if the machine is equipped with more than one spindle.

6.3.4. ARSTA G71.0 - Spindle Alarm Reset

Once the spindle detects an alarm condition, the PMC can command it to reset. This may clear the alarm, however some alarms require 3 phase power to be cycled OFF/ON.

The second and third spindles have separate reset addresses also. The second is (ARSTB-G75.0) and the third is (ARSTC-G205.0)

6.3.5. BAL F1.2 - CNC Battery Alarm

The CNC has a voltage detection circuit on the main PCB. The normal voltage of the battery is 3.0VDC. If the battery voltage drops below 2.6V, the message **BAT** will flash on the status line of the display. **The CNC will turn ON F1.2 to tell the PMC the battery is low.** The machine builder may use this address to force the CNC into a FEEDHOLD condition so the machine cannot be run until the battery is changed.



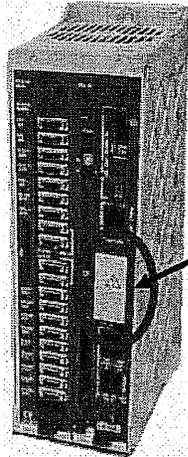
- 1) On the PMCDGN STATUS screen, search for address F1
Notice that F1.2 is now **OFF**, because there is no alarm present

PMC SIGNAL STATUS							MONIT RUN	
ADDRESS	7	6	5	4	3	2	1	0
F0001	I	.	.	.	.	.	R51	.
F0002	I	.	.	.	.	.	.	I
F0003	.	.	I	.	.	.	.	.
F0004	.	.	.	.	.	I	.	.
F0005	.	.	.	.	.	.	.	.
F0006	.	.	.	.	.	.	.	.
F0007	.	.	.	.	IF	SF	.	MF
F0008	.	.	.	.	.	.	.	.

BAL F1.2 - CNC Battery Alarm

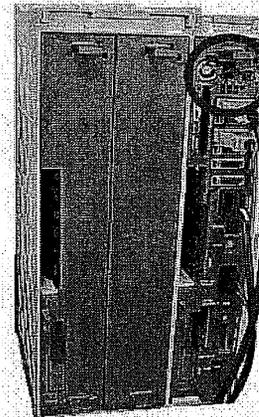
- 2) Make sure the CNC power is ON.
- 3) Locate the BATTERY on the CNC control.

16 Model C



The battery is located under the yellow cover on the power supply unit.

16/Model A/B



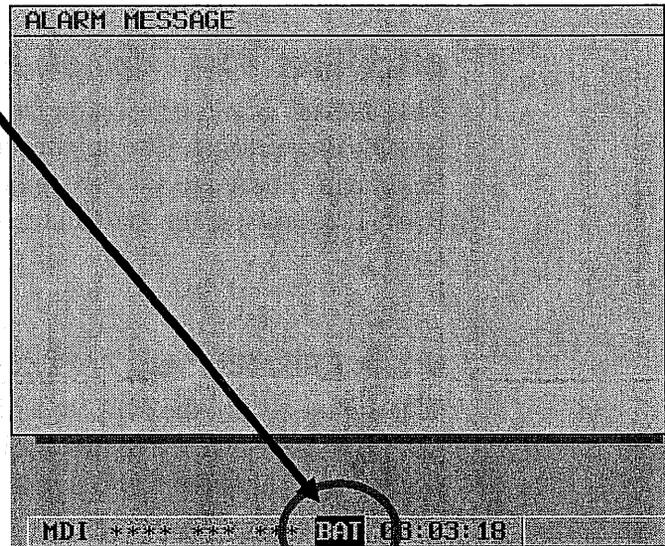
The battery is located at the top of the CPU card.

- 4) Disconnect the BATTERY, it is the brown plastic connector..

No alarm message appears but the word **BAT** flashes on the CNC status line.

The CNC uses a lithium battery that does not re-charge. Most CNCs use a SANYO battery, the Fanuc part number is **A98L-0031-0012**

Confirm this with the proper maintenance manual before replacing it.



- 5) Return to the **PMCDGN STATUS** screen, address F1 bit 2 should now be ON
- 6) Plug the **BATTERY** back into the CNC, then press  to clear the alarm.

6.3.6. DRN/MDRN G46.7/F2.7 - Dry Run

Dry allows you to check the G-code program movement, without actually cutting a part. This confirms the program has no errors also the tool path can be viewed on the graphic screen. When G46.7 is active (1), the tool is moved at the manual jog feedrate override speed, instead of the programmed feedrate from the G-code program (F command). The PMC commands the CNC to perform dryrun operation with G46.7, then the CNC sends confirmation back to the PMC using F2.7, to tell the PMC it is using dryrun.

1) Which X address is wired to the DRYRUN button ?

Find it on the PMCLAD ladder screen.

6.3.7. DTCH1/MDTCH1 G124/F110 - Controlled Axis Detach

This signal allows removal of a servo axis, without causing alarm on the CNC. The most common use is for a removable rotary table on a mill, or in the case of C-axis/spindle control on a lathe. In address G124, bit 0 corresponds to the 1st axis, bit 1 = 2nd axis, and so on. The address F110 is the CNC confirmation telling the PMC it knows an axis is detached.

6.3.8. ENB F1.4 - Spindle Enabled

This address is a confirmation from SPINDLE to PMC, to let the PMC know the spindle is operating. The spindle turns this signal ON after receiving the M3/M4/M19 command. There are similar signals for the second (ENB2-F38.2) and third (ENB3-F38.3) spindles, if the machine is equipped.

6.3.9. ERS/RST G8.7/F1.1 - External Reset

This signal allows the PMC to activate the CNC reset. It functions the same as if you had physically pressed the RESET button on the MDI keypad. Address F1.1 is a confirmation that the CNC is in a reset state, and is only active as long as the command (G8.7)



- 1) On the PMCDGN STATUS screen, search for address F1
Notice that F1.1 is now OFF, because there is no RESET present

- 2) Press the  button, on the MDI keypad.

Notice the status of F1.1 changes.

6.3.10. HROV G96.7 - Rapid Override 1% Select

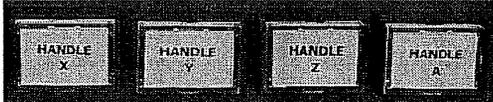
The rapid override command is typically controlled by address G14 bit 0 and 1. Using the G14 address the only choices for override are F0%, 25%, 50%, or 100%. If this address (G96.7) is turned ON (1) then G96 bit 0 through bit 6 can be used to command a rapid override in 1% increments, from 1% to 100%.

6.3.11. HS1A~HS1D G18.0~G18.3 - Manual Handle Feed Axis

These addresses select which axis will be moved when the manual handle is turned, when the CNC is in handle mode (MPG). The bits count up in binary to select the axis. The CNC has 3 handle inputs, these addresses are for the first, the second input uses HS2A~HS2D (G18.4~G18.7), and the third uses HS3A~HS3D (G19.0~G19.3)



- 1) On the PMCDGN STATUS screen, search for address G18
- 2) Select **HANDLE** mode on the operator panel.

- 3) Select  each axis, on the operator panel.

Watch the bits in address G18 change with each selection.

G18.3 HS1D	G18.2 HS1C	G18.1 HS1B	G18.0 HS1A	FEED AXIS
0	0	0	0	No axis moves
0	0	0	1	1 st axis
0	0	1	0	2 nd axis
0	0	1	1	3 rd axis
0	1	0	0	4 th axis
0	1	0	1	5 th axis
0	1	1	0	6 th axis
0	1	1	1	7 th axis
1	0	0	0	8 th axis

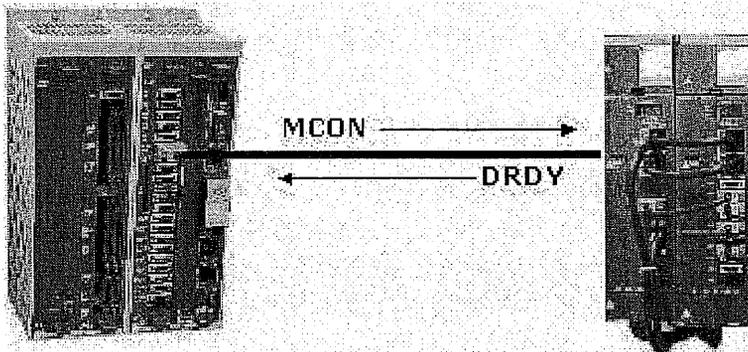
6.3.12. MP1~MP2 G19.4~G19.5 - Manual Handle Multiplier

These addresses determine how far the axis will move when the manual handle is turned 1 click. The bits count in binary to select the multiplier.

G19.5 MP2	G19.4 MP1	FEED AXIS
0	0	x1 = 0.001 per click
0	1	x10 = 0.010 per click
1	0	x100 = 0.100 per click (set by parameter 7113)
1	1	X1000 = 1.000 per click (set by parameter 7114)+

6.3.13. IGNVRY G66.0 - Ignore VRDY OFF Alarm All Axis

This signal ignores the servo alarm **401 DRDY OFF**. This alarm occurs whenever a alarm condition is detected by the servo drive unit.



In normal operation, when the CNC boots up, it sends a signal called **MCON** to the servo drive. The servo drive then checks itself internally and if no alarm conditions exist, it returns a signal called **DRDY**. This tells the CNC that the drive is ready.

If at any time during the servo operation, an alarm is detected by the servo drive, it turns off the DRDY signal to the CNC. This indicates to the CNC that there is a problem with the drive and the CNC stops, and alarm **401 DRDY OFF** is presented.

6.3.14. IGNVRY1~8 G192 - Ignore VRDY OFF Alarm

These addresses ignores the servo alarm **401 DRDY OFF**. This address (G192) provides individual bits per axis, so that you can choose which axis you want to ignore this alarm from. The previous section (G66.0) ignores 401 alarms from all of the axis. This alarm occurs whenever a alarm condition is detected by the servo drive unit

If G192.0 is 1 (ON) then the 401 alarm is ignored from the 1st axis. The individual axis can also be ignored by entering -128 in parameter 1023. If a dual or triple axis drive is used, a single axis cannot be ignored, all axis controlled by the drive must be ignored.

6.3.15. INCH F2.0 - Inch Input

This bit is indicating the current increment selection. The CNC can run in millimeter or inch. The selection can be made by G-code (G20=INCH, G21=mm) or by a setting on the SETTING screen.

6.3.16. INP1~INP8 F104 - In-Position Signal

These are confirmation bits that the CNC turns on when the servo axis reach the position commanded in the G-code program. The allowable tolerance is set by parameter **1826 IN-POSITION WIDTH FOR EACH AXIS**

6.3.17. KEY1~KEY4 G46.3~G46.6 - Memory Protect Key

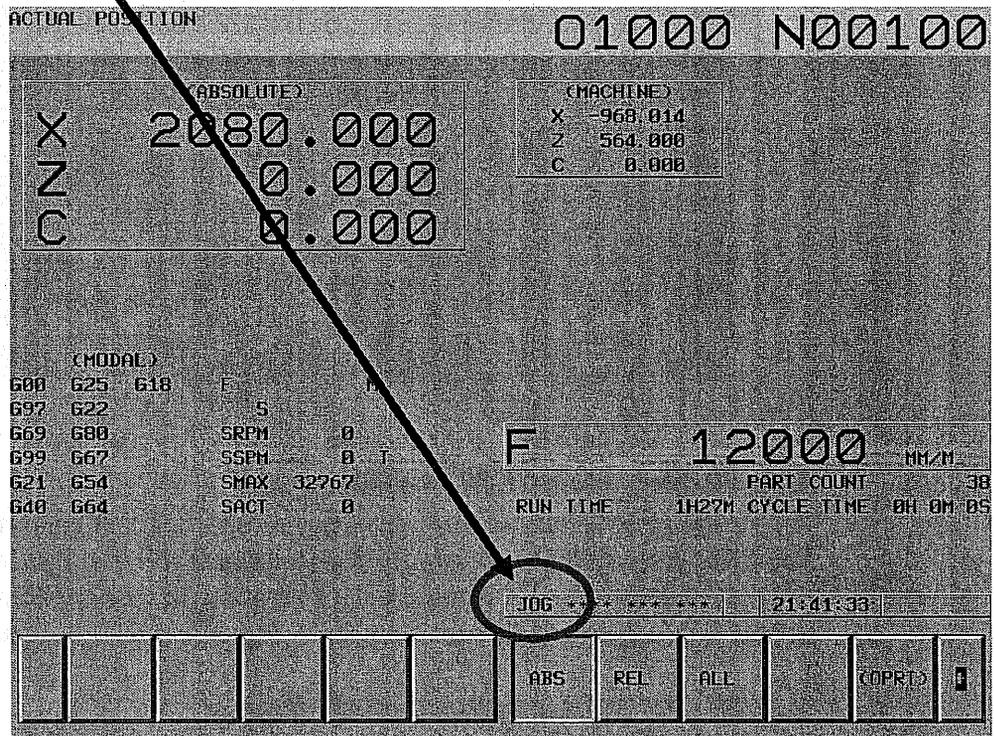
The KEY addresses protect data stored in the CNC memory. They are typically all wired to the same physical input, which is connected to the key switch on the operator panel. When the bit is 1 (ON), the memory area is not protected.

KEY	ADDRESS	MEMORY PROTECTED
KEY1	G46.3	Tool offset compensation and work offsets
KEY2	G46.4	Setting data and macro variables
KEY3	G46.5	G-code program loading and editing
KEY4	G46.6	(reserved)

Parameter 3290 also affects the operation of these signals. If 3290 bit 7 is 0, they are all valid. If 3290 bit 7 is 1, only KEY1 (G46.3) is valid, the other memory areas are not protected

6.3.18. MD1~MD4 G43.0~G43.2 - CNC Mode Selection

These signals select the CNC operation mode. The mode confirmation is displayed on the status line on the CNC screen.



The mode selections sometimes go by different names, this is dependent on the machine builder. For example, some machine builders call MEMORY mode AUTO on the operator panel switch. On the status line it will say MEM.

MD1~MD4 G43.0~G43.2 - CNC Mode Selection



- 1) On the PMCDGN STATUS screen, search for address G43
- 2) Rotate the **MODE SELECT** switch, then fill in the bit patterns on the chart below.

G19.7 RT	G43.7 ZRN	G43.5 DNC	G43.2 MD4	G43.1 MD2	G43.0 MD1	MODE SELECTED
0	1	0	1	0	1	Z-RTN (Zero Return)
0	0	0	0	0	0	MDI (Manual Data Input)
0	0	0	0	0	1	MEMORY (Auto operation)
0	0	0	0	1	1	EDIT
0	0	0	1	0	0	HANDLE
1	0	0	1	0	1	RAPID (Rapid manual jog)
0	0	0	1	0	1	JOG (Manual jog)
0	0	0	1	1	1	TEACH
0	1	0	0	0	1	DNC (Direct numeric control)

The mode confirmations can be found in address F3.

SYMBOL	ADDRESS	MODE CONFIRMATION
MINC	F3.0	Incremental Feed selection (INC)
MH	F3.1	Manual Handle selection (HND)
MJ	F3.2	Manual Jog Feed selection (JOG)
MMDI	F3.3	Manual Data Input selection (MDI)
MRMT	F3.4	Direct Numeric Control (RMT)
MMEM	F3.5	Automatic Operation (MEM)
MEDT	F3.6	Memory Edit mode (EDIT)
MTCH	F3.7	Teach-in selection (THND)
MREF	F4.5	Manual Reference Return (REF)

6.3.19. MA F1.7 - CNC Ready Signal

When the CNC is turned on it performs a self check. If no system alarms are generated, the CNC turns ON (1) address F1.7 to tell the PMC that it is ready for operation. This signal remains a 1 even if there is a CNC alarm on the MESSAGE screen or EMG-STOP is activated. Only system alarms (900 alarms) will cause this bit to change status.

6.3.20. SA F0.6 - Servo Ready Signal

When the CNC is ready, it sends MCON to the servo drive units to tell them to get ready. The servo drives perform an internal self check to see if any alarm conditions are present. If no alarms are present on the drives, the servos send back the DRDY signal to the CNC. The SA (F0.6) bit is a collective status of all the servo drives. If they are all ready, SA turns ON (1). Anytime a servo drive alarm occurs F0.6 turns OFF.

6.3.21. MI1~MI8 G106/F108 - Mirror Image Control

This function will cause the programmed positions in the specified axis to be inverted. If the program line is G01 X10.0 F2000 ; and X axis mirror image is ON, the axis will move to position X-10.0 This is especially useful when symmetrical parts must be machined, as in the automotive industry where a left and right part must be created for each side of the car. Mirror image control can be enabled in 3 ways.

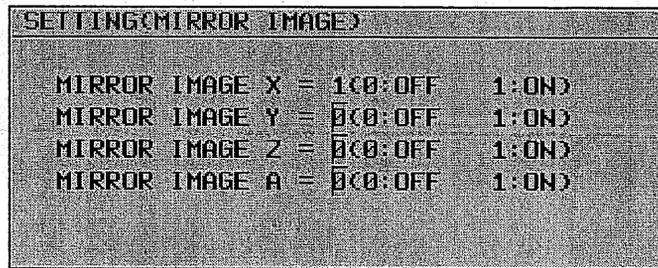
- ❶ By PMC address G106
- ❷ By manual entry on the [OFFSET SETTING] <SETTING> screen
- ❸ By G-Code command G51.1/G68 (programmable mirror image)

When mirror image is enabled by the PMC (G106) or by manual entry on the SETTING screen, address F108 reflects the status. If it is turned on by G-Code (G51.1/G68) then F108 does not reflect this status. In address G106, bit 0 corresponds to the 1st axis, bit 1 = 2nd axis, and so on.



- 1) On the PMCDGN STATUS screen, search for address G106
- 2) Select **MDI** mode on the operator panel.
- 3) Press the  button on the MDI panel.
- 4) Press the  soft key on the CRT menu.
- 5) Press the  down arrow, on the MDI key pad.

The mirror image screen should appear.



- 6) Press  then press the  key on the MDI panel.

The X axis mirror image bit should change to 1.

- 7) Press the  button, on the MDI keypad.

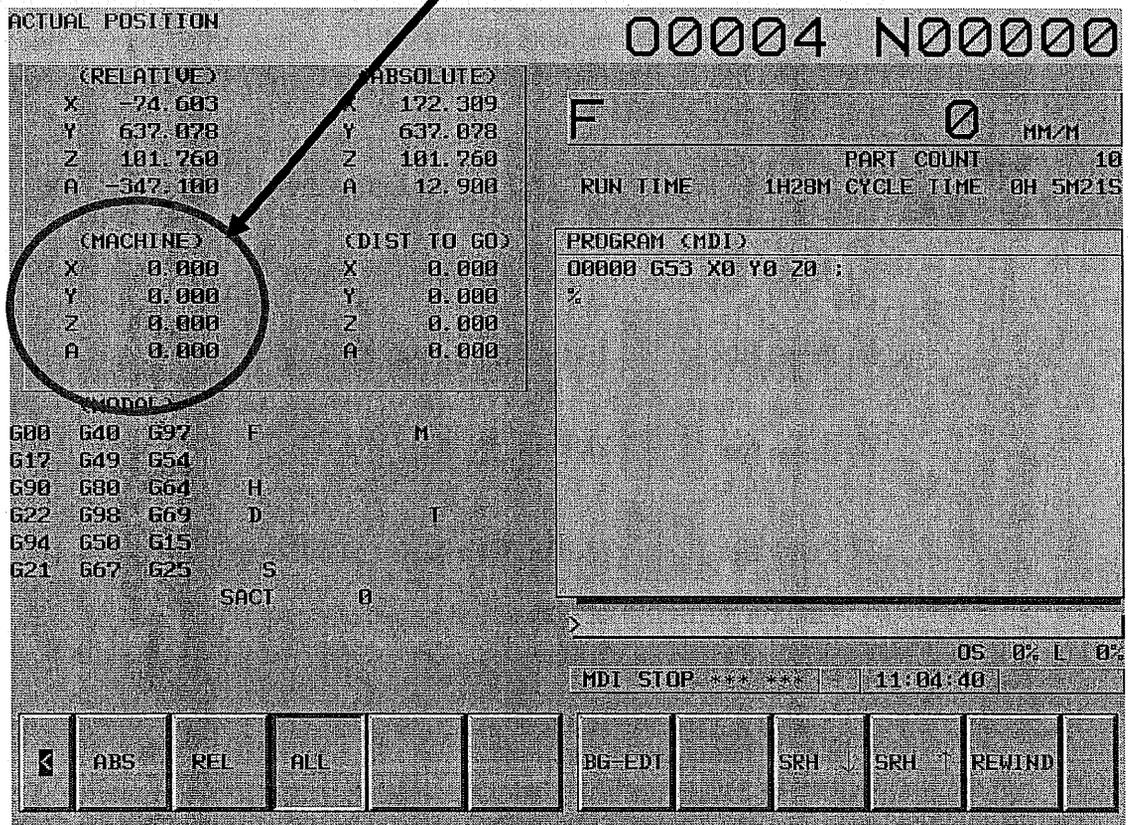
MI1~MI8 G106/F108 - Mirror Image Control

8) Press the  soft key on the CRT menu.

9) Press the  soft key on the CRT menu.

10) Enter “ G53X0Y0Z0 ; “ then press  , then press 

The axis should move to MACHINE position X0 Y0 Z0



11) Enter “ G92X0Y0Z0 ; “ then press  , then press 

The ABSOLUTE position display should change to X0 Y0 Z0

12) Enter “ G0X10. ; “ then press  , then press 

The ABSOLUTE position display should change to X10.000, however the MACHINE position display will display X-10.000. This is because the actual machine movement was negative.

6.3.22. MLK/MMLK G44.1/F4.1 - Machine Lock All Axis

The machine lock function stops all servo axis from movement. This allows you to check the G-code program movement on the graphic screen, without actually moving the machine. On the screen, the position display changes even though the axis are not moving. You should zero return the machine in manual zero return mode, after using this function.

6.3.23. MLK1~MLK8 G108 - Machine Lock Individual Axis

This works the same as Machine Lock All Axis, except you can choose the axis you want to lock instead of locking all axis. . In address G108, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on.

6.3.24. MV1~MV8 F102 - Axis Movement In-progress

This signal indicates that the servo axis is in motion. The signal becomes active (1) during motion. This signal operates the same in manual jog or automatic operation. In address F102, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on.

6.3.25. MVD1~MVD8 F106 - Axis Movement Direction

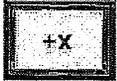
This signal indicates which direction the servo axis is moving. The signal turns OFF (0) when the axis is moving in the + direction, and ON (1) when moving in the – direction. The bit retains the value of the last movement when the axis stops. The signal operates the same in manual jog or automatic operation. In address F106, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on.



1) On the PMCDGN STATUS screen, search for address F102

2) Select **JOG** mode, on the machine operator panel.

3) Press the  button, on the MDI keypad to view the POSITION screen.

4) Press the   jog buttons, on the machine operator panel.

Watch the status of F102 and F106 bits.

5) Select **MEMORY** mode, on the machine operator panel.

6) Press the  button, on the machine operator panel.

Watch the status of F102 and F106 bits as the program runs.

6.3.26. OVC G6.4 - Override Cancel

This signal causes the FEED OVERRIDE signal to be ignored, which forces the G-code program to run at the programmed feed rate. This ensures a know chip load at the cutting tool. Often the machine builder will provide a M-Code to turn ON (1) this address.

6.3.27. ROV1~ROV2 G14.0~G14.1 - Rapid Override

The rapid override signal will allow the operator to slow the rapid traverse feed rate. These two addresses count in a binary pattern from 0 to 3, to select one of the four settings F0, 25%, 50%, or 100%. The F0 setting amount is determined by parameter number 1421, which is in millimeters per minute. These signal addresses are only used if address G96.7 (HROV) is OFF (0).

6.3.28. SBK/MSBK G46.1/F4.3 - Single Block

The single block signal is used to single step through the G-Code program. Each line of the program called a block, up to the END OF BLOCK symbol the semi-colon (;) This is recommended when running a new program for the first time.



1) Select **MEMORY** mode, on the machine operator panel.

2) Press the  button, on the MDI keypad to view the PROGRAM screen.

3) Press the  button, on the operator panel

4) Press the  button, on the machine operator panel.

The CNC will execute 1 line of the program each time you press CYCLE START.

The line that is highlighted in yellow was executed when cycle start was pressed. The next 2 lines are read by the CNC to prepare for their execution.

```

PROGRAM
00101 (MILL SAMPLE 1) ;
G90 G55 G40 G49 G80 G21 G17 ;
M06 T01 ;
M1 ;
G00 G43 Z20.0 H1 ;
G41 X-5.0 Y-15.0 D2 ;
G01 X0.0 Y-10.0 F4000.0 M8 ;
M03 S2000 ;
G01 Z-10.0 F2000.0 ;
G02 X20.0 R10.0 ;
G03 X25.0 Y-15.0 R5.0 ;
    
```

6.3.29. ST/STL G7.2/F0.5 - Cycle Start

The cycle start signal ST (G7.2) is used for the PMC to command the CNC to execute the currently selected G-code program. When the CNC begins the program execution, it returns the confirmation signal STL (F0.5) to the PMC. The confirmation address is typically used to turn on the lamp inside the cycle start switch.

The cycle start function will not work unless the FEED HOLD signal G8.5 is ON (1).



1) Find G7.2 and F0.5, in the LADDER diagram.

Which X and Y addresses are assigned to the switch and lamp ?

Does the G address stay active while the program is running ?

6.3.30. STLK G7.1 - Start Lock

When this signal is turned ON (1) the axis movement in the G-code program is not performed, the machine stops. If the signal is activated during other blocks, such as reading M, S, or T codes, those commands are executed normally. Only axis movement blocks cause the machine to stop program execution. When the signal turns OFF (0) the program execution is resumed.

6.3.31. SVF1~SVF8 G126 - Servo OFF

These signals turn OFF the servo amplifier output power to the motor windings. The status of the drive will change from 0 (ready) to – (not ready). If the amplifier is a multi-axis amp, all of the axis controlled by that amplifier will be turned OFF. In address G126, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on.

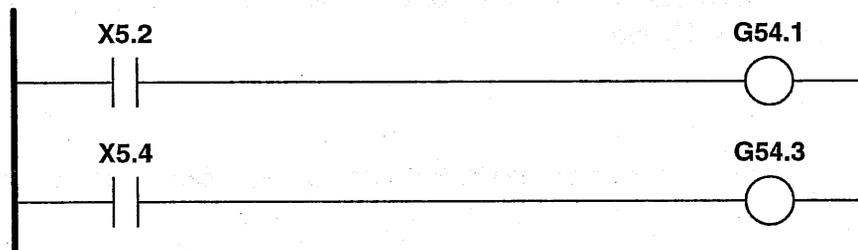
6.3.32. UI00~UI15 G54~G55 - User Input Custom Macro

The macro user inputs are used to make decisions in G-Code programs. The status of these addresses are read through macro variables #1000~#1015. These variables are used to read **PHYSICAL INPUTS** from the machine side. For example, a small proximity switch may be wired to the physical input, to sense if a part is loaded on a tombstone. The status of that switch can then be **READ** through a system variable. Because they use physical inputs, these signals are processed through the PMC ladder logic. The machine builder writes the ladder logic program, and decides which X addresses in the PMC will be used to activate these signals.

Each of these system variables are assigned to a specific G addresses by Fanuc. In the ladder logic, these G addresses are activated by a physical inputs X address, generally whatever the machine builder wants.

SYSTEM INPUT VARIABLES #1000~#1015 ASSIGNMENT					
Variable#	PMC Address	PMC Symbol	Variable#	PMC Address	PMC Symbol
#1000=	G54 bit 0	UI000	#1008=	G55 bit 0	UI008
#1001=	G54 bit 1	UI001	#1009=	G55 bit 1	UI009
#1002=	G54 bit 2	UI002	#1010=	G55 bit 2	UI010
#1003=	G54 bit 3	UI003	#1011=	G55 bit 3	UI011
#1004=	G54 bit 4	UI004	#1012=	G55 bit 4	UI012
#1005=	G54 bit 5	UI005	#1013=	G55 bit 5	UI013
#1006=	G54 bit 6	UI006	#1014=	G55 bit 6	UI014
#1007=	G54 bit 7	UI007	#1015=	G55 bit 7	UI015

A simplified example of the ladder logic the machine builder may write is shown below.



In the FIRST ladder rung ...

When the limit switch X5.2 (X5 bit 2) is activated, the coil G54.1 will turn ON. When G54.1 turns ON, the status of system variable #1001 changes from 0 to 1.

In the SECOND ladder rung ...

When the limit switch X5.4 is activated, the coil G54.3 will turn ON. When G54.3 turns ON, the status of system variable #1003 changes from 0 to 1.

The system variable #1032 reads all 16 bits together as a word, #1000~#1015.

6.3.33. U000~U015 F54~F55 - User Output Custom Macro

These variables are used to write **PHYSICAL OUPUTS** to the machine side. For example, during tool change, a door may need to be opened to allow the spindle access to the tool magazine. The system variable can be **WRITTEN** to 1, which activates the output to the door motor. Because they use physical outputs, these signals are processed through the PMC ladder logic. The machine builder writes the ladder logic program, and decides which Y addresses in the PMC will be activated by these signals.

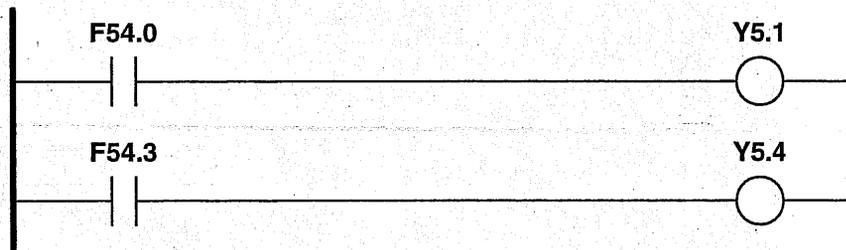
Each of these system variables are assigned to a specific F addresses by Fanuc. In the ladder logic, these F addresses are activated by whatever the machine builder wants.

SYSTEM OUTPUT VARIABLES #1100~#1115 ASSIGNMENT						
Variable#	PMC Address	PMC Symbol		Variable#	PMC Address	PMC Symbol
#1100=	F54 bit 0	U0000		#1108=	F55 bit 0	U0008
#1101=	F54 bit 1	U0001		#1109=	F55 bit 1	U0009
#1102=	F54 bit 2	U0002		#1110=	F55 bit 2	U0010
#1103=	F54 bit 3	U0003		#1111=	F55 bit 3	U0011
#1104=	F54 bit 4	U0004		#1112=	F55 bit 4	U0012
#1105=	F54 bit 5	U0005		#1113=	F55 bit 5	U0013
#1106=	F54 bit 6	U0006		#1114=	F55 bit 6	U0014
#1107=	F54 bit 7	U0007		#1115=	F55 bit 7	U0015

In the macro program, the following statement would cause #1100 to be set to 1.

#1100 = 1 ;

When #1100 changes from 0 to 1, this change is reflected in the ladder address F54.0. A simplified example of the ladder logic the machine builder writes is shown below.



When F54.0 activates, it conducts to the coil Y5.1 causing it to send +24VDC out of that physical output to the machine side, which activates a relay or solenoid.

#1100 = 0 ;

The command #1100=0; will cause the output Y5.1 to turn OFF.

6.3.34. UI/UO G54/F54 - Using Macro Inputs and Outputs

In this example we will write a small program that will use a macro input and output. This will demonstrate how decisions can be made in a G-code program.



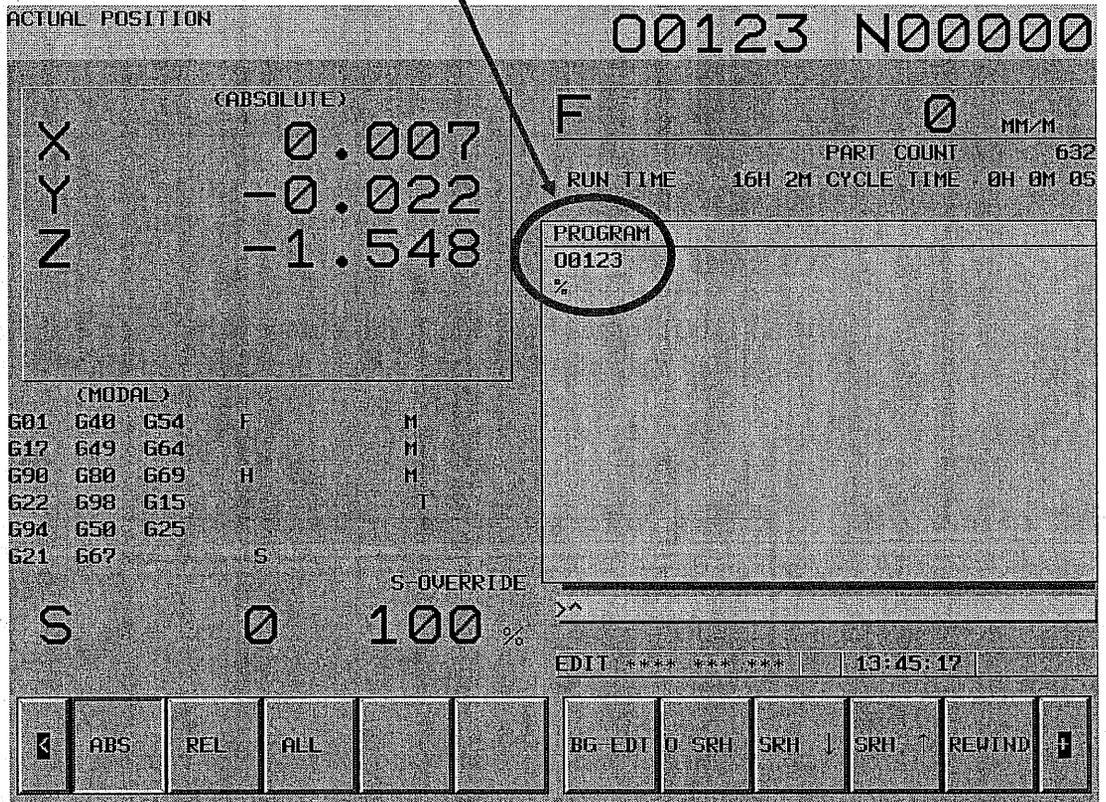
1) Select **EDIT** mode on the operator panel.

2) Press the **PROG** button on the MDI key pad.

3) Press the letter **O**, then enter the program number **1** **2** **3**

4) Press the **INSERT** button on the MDI key pad.

The program is now created, the program number should appear highlighted on the top left corner of the program window ...



5) Press the **EOB** then press **INSERT** button, now the program can be entered.

G54/F54 - Using Macro Inputs and Outputs

- 6) Enter the rest of the program, as shown below.

```

PROGRAM
O0123 ;
N10 G0 X10. ;
N20 IF [#1000 EQ 1] GOT080 ;
N30 G4 X1.0 ;
N40 G0 X11. ;
N50 #1100 =1 ;
N60 G0 X12. ;
N70 GOT020 ;
N80 #1100 =0 ;
M30 ;
%
```

- 7) Press the  soft key button on the CRT menu, and confirm the cursor is located at the top of the program

- 8) Select **MEMORY** mode on the operator panel, or (MEMORY) mode.

- 9) Press the  button, the program will execute.

- 10) The program will loop between lines N20 and N70 as long as #1000 is equal to 0. #1000 is assigned to G54.0, which is tied to a physical input in the ladder program. When #1000 changes to 1, the program will jump to line N80.

In this scenario #1100 could be an output from the CNC to tell the robot to load a part, and the input #1000 could be a robot loader output to tell the CNC the part has been loaded.

6.3.35. ZP1~ZP8 F94 - Zero Return Complete

When manual zero return is performed, or zero return by G28 in a G-code program, when the CNC realizes the axis are at home it turns on this address to tell the PMC that the zero return has been completed. In address F94, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on. Often these signals are used to turn ON the home position indicators on the operator panel.

6.3.36. ZP21~ZP28 F96 - Second Reference Point Return Complete

Second reference position return is performed by G30 in a G-code program, when the CNC realizes the axis are at the second home position, it turns on this address to tell the PMC that the zero return has been completed. In address F96, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on. **The second home position is often used as the tool change position.** Parameter 1241 determines where this position is located. The parameter is set in metric and assumes 3 decimal places. For example a setting of 234567 would be 234.567 millimeters from the G28 reference point.

6.3.37. ZP31~ZP38 F98 - Third Reference Point Return Complete

Third reference position return is performed by G30 P3 in a G-code program, when the CNC realizes the axis are at the third home position, it turns on this address to tell the PMC that the zero return has been completed. In address F98, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on. Parameter 1242 determines where this position is located. The parameter is set in metric and assumes 3 decimal places. For example a setting of 234567 would be 234.567 millimeters from the G28 reference point.

6.3.38. ZP41~ZP48 F100 - Fourth Reference Point Return Complete

Fourth reference position return is performed by G30 P4 in a G-code program, when the CNC realizes the axis are at the third home position, it turns on this address to tell the PMC that the zero return has been completed. In address F100, bit 0 corresponds to the 1st axis (X), bit 1 = 2nd axis (Y), bit 2 = 3rd axis (Z) and so on. Parameter 1243 determines where this position is located. The parameter is set in metric and assumes 3 decimal places. For example a setting of 234567 would be 234.567 millimeters from the G28 reference point.

6.4. Exercise 4 – Dedicated Addresses

- 1) There are 2 dedicated addresses for EMG-STOP, X8.4 and G8.4.
What is the difference between the two ?
- 2) What is the meaning of the asterisk * in the symbol name ?
- 3) Which PMC signal will cause all axis to not move, but the absolute position display will still change ?
- 4) Which PMC signal will cause all axis to not move, and the position displays will not change ?
- 5) Which PMC signal will cause the machine to move to X-10.0 when the program command reads GO X10. ?
- 6) On the MESSAGE display, alarm 506 OVER TRAVEL : +X is present.
Find the X address causing this alarm.
- 7) When you try to edit a G-Code program, alarm WRITE PROTECT occurs.
Find the X address causing this alarm.
- 8) Operator said the +X jog button does not work.
Find the X address causing this problem.
- 9) Operator said the CYCLE START button does not work.
Find the X address causing this problem?
- 10) Operator said the -Z jog button does not work.
Find the X address causing this problem?

7. Software Operator Panel

The software operator panel is displayed on CNC screens. Typically it is used by Fanuc for control testing and verification. Mode selection, feed override and other functions are displayed. There are general purpose switches that may be labeled and used by machine builder to add functions that are not on the physical operator panel.



1) Press the  button on the MDI key pad.

2) Press the  right menu button on the CRT soft keys.

3) Press the  button on the MDI key pad.

The software operator panel appears.

Each of the functions on this screen has a dedicated F address.

ACTUAL POSITION 00123 N00123

(ABSOLUTE)	
X	-10.000
Y	-20.000
Z	30.000
A	0.000

(MODAL)

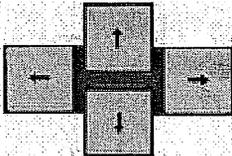
G00	G40	G97	F	M
G17	G49	G55		
G90	G80	G64	H	
G22	G98	G69	D	T
G94	G50	G15	S	
G21	G67	G25	SACT	0

OPERATOR'S PANEL

MODE : MDI MEM EDIT HND JOG REF
 HANDLE AXIS : HX HY HZ HA
 HANDLE MULT : +1 +10 +100
 RAPID OVRD. : 100% 50% 25% F0
 JOG OVRD. : 100%
 FEED OVRD. : 100%

05 0% L 0%
 EDIT **** * * * * 11:53:23

ABS REL ALL MACRO OPR

4) Use the  arrow buttons on the MDI key pad.

To navigate the screen and make selections.

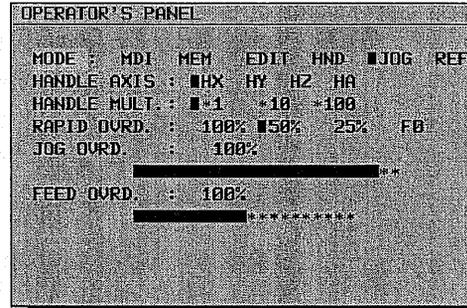
7.1. Mode Selection MDO1~MDO4 – F73.0~F73.2

The mode is the first selection displayed at the top of the window. Obviously you cannot use this mode select and the physical operator panel mode select at the same time, since it would not know which operator panel inputs to use. These F addresses will be used to activate the standard mode select G addresses in G43.



1) On the PMCDGN STATUS screen, search for address F73.

2) Use the   arrow buttons on the MDI key pad to select each mode.



3) Fill in the chart below, to show the pattern for each selection.

F73.2 MDO4	F73.1 MDO2	F73.0 MDO1	MODE SELECTED
0	0	0	MDI (Manual Data Input)
0	0	1	MEMORY (Auto operation)
0	1	1	EDIT
1	0	0	HANDLE
1	0	1	JOG (Manual jog)
1	0	1	Z-RTN (Zero Return)

7.2. Manual Handle Feed Axis HSA0~HSD0 – F77.0~F77.3

These addresses select which axis will be moved when the manual handle is turned, when the CNC is in handle mode (MPG). The bits count up in binary to select the axis. These F addresses will be used to activate the handle feed select G addresses in G18.

F77.3 HSD0	F77.2 HSCO	F77.1 HSBO	F77.0 HSA0	FEED AXIS
0	0	0	1	1 st axis
0	0	1	0	2 nd axis
0	0	1	1	3 rd axis
0	1	0	0	4 th axis

7.3. Manual Handle Multiplier MP10~MP20 – F76.0~F76.1

These addresses determine how far the axis will move when the manual handle is turned 1 click. The bits count in binary to select the multiplier. These F addresses will be used to activate the handle multiplier G addresses in G19.

F76.1 MP20	F76.0 MP10	FEED AXIS
0	0	x1 = 0.001 per click
0	1	x10 = 0.010 per click
1	0	x100 = 0.100 per click (set by parameter 7113)

7.4. Rapid Override ROV10~ROV20 – F76.4~F76.5

The rapid override signal will allow the operator to slow the rapid traverse feed rate. These two addresses count in a binary pattern from 0 to 3, to select one of the four settings F0, 25%, 50%, or 100%. The F0 setting amount is determined by parameter number 1421, which is in millimeters per minute. These signal addresses are only used if address G96.7 (HROV) is OFF (0). These F addresses will be used to activate the standard rapid override G addresses G14.0~G14.1.

7.5. Jog Feedrate Override *JV00~*JV150 - F79~F80

These signals override the **manual feedrate when in JOG mode**, and using the jog buttons on the operator panel (+X,-X,+Y,-Y,+Z,-Z). Normally the manual feedrate is set by **parameter 1423 MANUAL CONTINUOUS FEEDRATE**. These addresses override the parameter setting.

This is a 16bit command, the low bits are address G11 and the high bits are address G10, 8 bits each. The binary pattern sets the override amount in increments of 0.01%. These signals also serve as the automatic feedrate override **when a program is run with DRYRUN activated**.

These F addresses will be used to activate the standard jog override G addresses G10~G11.

7.6. Feedrate Override *FV00~*FV70 – F78

The feedrate override signal overrides the feedrate commanded by the G-code program (F command). This signal uses all of the bits in address F78 to create a binary pattern of the override amount. The override amount can be from 0% to 254%. Because this is an active low signal, the bits that have a status of 0 are the binary override amount. This F address will be used to activate the standard feedrate override G address G12.

7.7. Software Operator Panel Function Switches

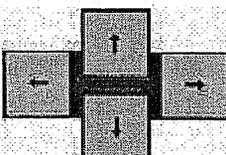


- 1) Press the  button on the MDI key pad.

The function switch screen appears ...

OPERATOR'S PANEL				
BLOCK SKIP	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F75.2 (BDTO)
SINGLE BLOCK	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F75.3 (SBKO)
MACHINE LOCK	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F75.4 (MLKO)
DRY RUN	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F75.5 (DRNO)
PROTECT KEY	:	<input type="checkbox"/> PROTECT	<input type="checkbox"/> RELEASE	F75.6 (KEYO)
FEED HOLD	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F75.7 (SPO)

The addresses of these switches are shown above. The functions that appear on this window are previously decided by Fanuc.

- 2) Use the  arrow buttons on the MDI key pad.

to navigate the screen and turn ON/OFF the switches.

7.8. General Purpose Switches

There are 8 general purpose switches that can be labeled anything you want. This is where the machine builder may add functions not normally found on the physical operator panel.



- 1) Press the  button on the MDI key pad.

The general purpose switch screen appears ...

OPERATOR'S PANEL				
CYCSTART	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.0 (OUT0)
FEEDHOLD	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.1 (OUT1)
OPT STOP	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.2 (OUT2)
DNC MODE	:	<input type="checkbox"/> OFF	<input checked="" type="checkbox"/> ON	F72.3 (OUT3)
SERVSTND	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.4 (OUT4)
	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.5 (OUT5)
USE SWOP	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.6 (OUT6)
EMG STOP	:	<input type="checkbox"/> OFF	<input type="checkbox"/> ON	F72.7 (OUT7)

General Purpose Switches

- 2) Arrow down  button to the switch that is labeled **USE SWOP**.
- 3) Then arrow  right button to turn it **ON**.

The software operator panel will now function instead of the physical operator panel. Change the mode selection and watch the mode change on the status line of the CNC display.

- 4) Notice the **OUT5 general purpose switch**, does not have a label. The label names are set in the parameters. Search for parameter 7260, then set the parameters as shown below...

PARAMETER(OPERATOR'S PANEL)	
7260 NAME OF SWITCH 6	84
7261	85
7262	82
7263	66
7264	79
7265	0
7266	0
7267	0

The ASCII value of the letters you want to display are set in the parameter.

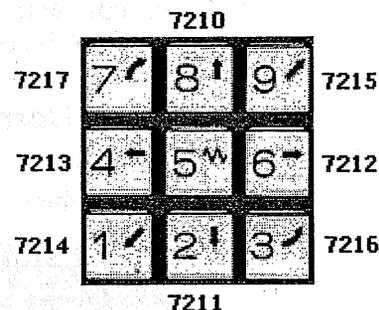
- 5) Return to the software operator panel screen, to see the new label.

OPERATOR'S PANEL		
CYCSTART	: OFF	ON
FEEDHOLD	: OFF	ON
OPT STOP	: OFF	ON
DNC MODE	: OFF	ON
SERVSTND	: OFF	ON
TURBO	: OFF	ON
USE SWOP	: OFF	ON
EMG STOP	: OFF	ON

7.9. Software Operator Jog Buttons

There are jog buttons on the MDI keypad number keys. Each key has a parameter assigned to it as shown on this diagram. Then a code is set in the parameter to tell the CNC which axis to move and in which direction. The codes are also shown here.

SET CODE	FEED AXIS
0	No movement
1	1 st axis, positive direction
2	1 st axis, negative direction
3	2 nd axis, positive direction
4	2 nd axis, negative direction
5	3 rd axis, positive direction
6	3 rd axis, negative direction
7	4 th axis, positive direction
8	4 th axis, negative direction



- 1) Select **JOG** mode, on the software operator panel.
- 2) Press the **SHIFT** button, on the MDI key pad.
- 3) Then press the **6** button, on the MDI key pad to jog X axis.

7.10. ASCII Code Chart

CHAR	CODE	CHAR	CODE	CHAR	CODE	CHAR	CODE
A	65	Q	81	6	54	,	44
B	66	R	82	7	55	-	45
C	67	S	83	8	56	.	46
D	68	T	84	9	57	/	47
E	69	U	85		32	:	58
F	70	V	86	!	33	;	59
G	71	W	87	"	34	<	60
H	72	X	88	#	35	=	61
I	73	Y	89	\$	36	>	62
J	74	Z	90	%	37	?	63
K	75	0	48	&	38	@	64
L	76	1	49	'	39	[	91
M	77	2	50	(	40		92
N	78	3	51	)	41	]	93
O	79	4	52	*	42	^	94
P	80	5	53	+	43	_	95

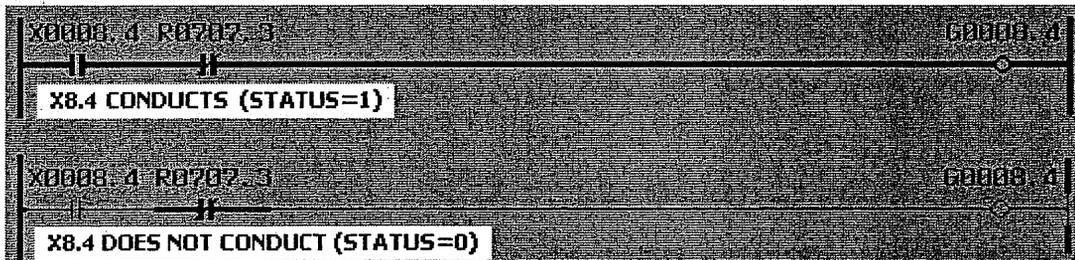
8. Ladder Instructions

8.1. Basic Ladder Symbols

The basic ladder symbols are the normally open, normally closed, output coils, inverted output coils, set coil, and reset coils. The set and reset coils are only available with certain PMC types. The other symbols are available with all PMC types.

8.1.1. Normally Open Input Contact

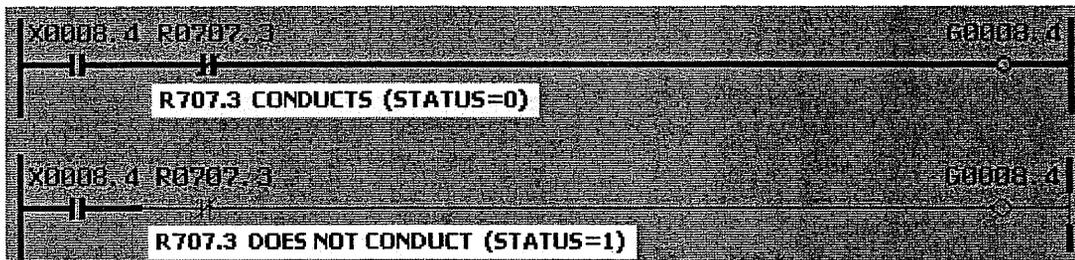
The normally open contact conducts when the input is activated (status=1), and does not conduct when the input is inactive (status=0).



The contact appears white or bold on the display when it is conducting (1).

8.1.2. Normally Closed Input Contact

The normally closed contact conducts when the input is inactive (status=0), and does not conduct when the input is activated (status=1).



The contact appears white or bold on the display when it is conducting (0).

8.1.3. Output Coil

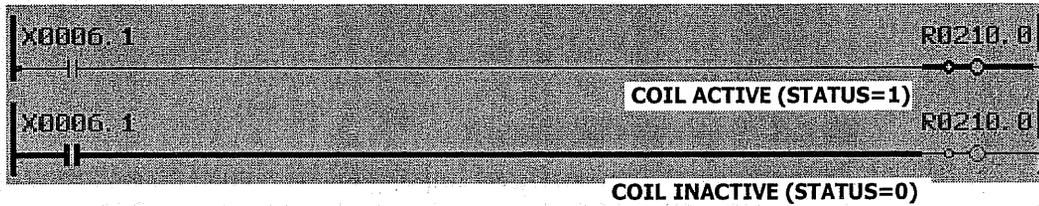
If the contacts before the output coil conduct, the output coil is activated (status=1). If any of the contacts before the coil are not conducting, the output coil is inactive (status=0).



The coil appears white or bold on the display when it is activated (1).

8.1.4. Inverted Output Coil

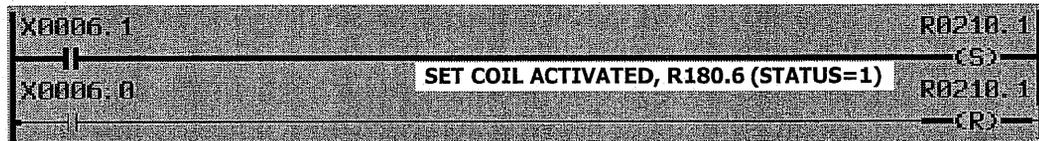
If any of the contacts before the coil are NOT conducting, the output coil is active (status=1). If the contacts before the output coil conduct, the output coil is activated (status=0).



The coil appears white or bold on the display when it is activated (1).

8.1.5. SET Output Coil

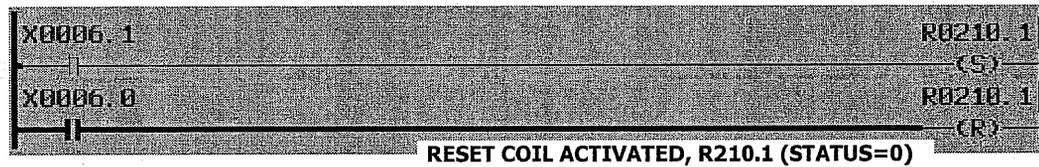
If the contacts before this coil conduct, even momentarily, the coil is LATCHED ON (status=1). The only way to turn it OFF is to use the RESET coil with the same address.



The coil appears white or bold on the display when it is activated (1).

8.1.6. RESET Output Coil

If the contacts before this coil conduct, even momentarily, the coil is LATCHED OFF (status=0). The only way to turn it ON is to use the SET coil with the same address.



The coil appears green or un-bold on the display when it is activated (0).

8.1.7. Logical AND Circuit

When contacts are **arranged in series** with each other, this is called **ANDing**. Both X5.1 **AND** X5.2 must conduct before the output R210.2 turns ON.



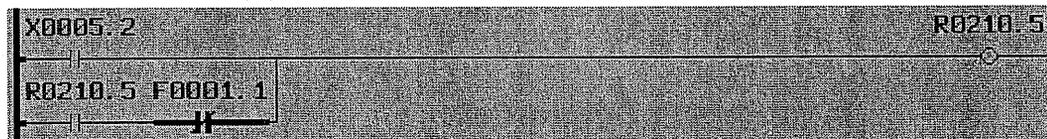
8.1.8. Logical OR Circuit

When contacts are **arranged in parallel** with each other, this is called **ORing**. Either X5.1 **OR** X5.2 must conduct before the output R210.3 turns ON.



8.1.9. Latch and Hold Circuit

A latch and hold circuit uses a contact of the same address as the coil, to latch the coil ON even if the input only turns ON momentarily. In this example, when X5.2 turns ON the coil R210.5 is ON. When the coil R210.5 is ON, the contact R210.5 then conducts, causing the coil to **LATCH and HOLD** the output ON, even if X5.2 stops conducting. The only way the circuit can turn OFF is for F1.1 to stop conducting. Address F1.1 is the RESET button on the MDI key pad.



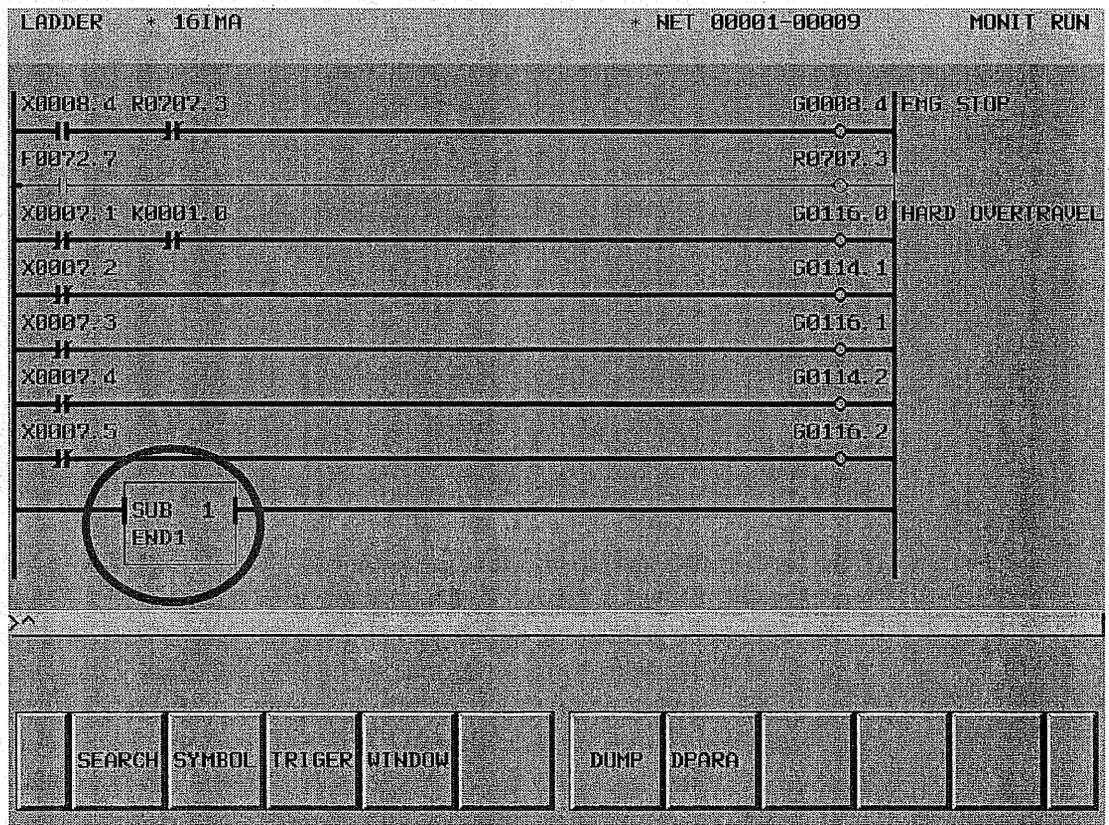
8.2. Function Block Instructions

The function block instructions perform complex operations. This section describes the most commonly used functions, which are available with the current PMC types.

Each function block is a subroutine, therefore each function block is assigned a SUB number. The more advanced PMC types have additional subroutine blocks added. Refer to the PMC PROGRAMMING MANUAL B61863E to find a complete listing of the subroutines available with your specific PMC type.

8.2.1. SUB1 - END1 Ladder 1st Level End

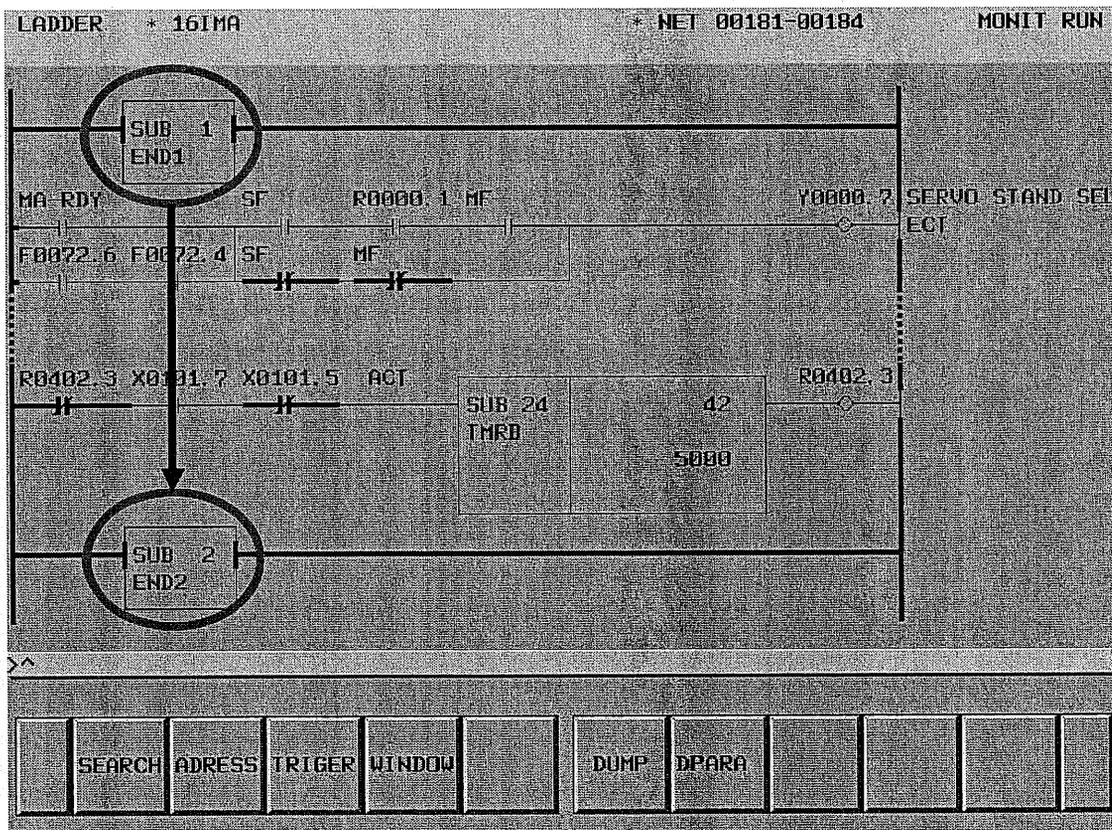
The 1st level is the high priority processing section. This section of ladder is guaranteed to be completely processed every 8 milliseconds. Signals that are time critical are typically inserted in this section, things like emergency stop and hard overtravels, signals that may have a negative affect if their processing is delayed. From NET00001, the ladder beginning, to this function block SUB1 is the 1st ladder level processing.



The remaining time, after the 1st level is processed, is used to process the second level. Therefore it is desirable to make the 1st level as small as possible. If it takes 2 mSec to process level 1, that leaves 6 mSec to process level 2, at the end of the total 8mSec the program must return to level 1 to process it again.

8.2.2. SUB2 – END2 Ladder 2nd Level End

The 2nd level is the medium processing section. This section of ladder is processed during the time remaining after level 1 processing has completed. Signals that are NOT time critical are typically inserted in this section, things like operator panel buttons and signal tower outputs. From the SUB1 END1 function block to the SUB2 END2 function block is all level 2 processing.



The time to process level 2 is not guaranteed. For example let's say it takes 10 mSec to process all of level 2. Level 1 gets processed first, this takes 2mSec, leaving 6mSec until level 1 must be processed again. Level 2 begins processing, and uses the remaining 6mSec of time. At this point there is still 4mSec of level 2 that has not been processed. The system returns to level 1 to process it again completely. When level 1 is completed this time, the system returns to where it left off in level 2 and processed the remaining 4mSec of ladder logic. At the end of level 2, there is 2mSec remaining. If the ladder has a 3rd level, the remaining 2mSec is used to process it. If not the system idles for 2mSec then returns to level 1.

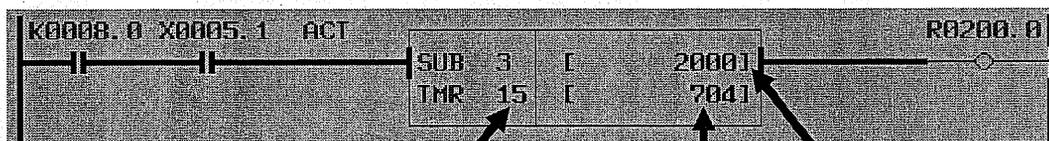
Because of this processing priority, a **contact address in level 1 may display a different status than the same contact address in level 2**, simply because during the processing delay of level 2 the contact had changed status.

8.2.3. SUB48 – END3 Ladder 3rd Level End

The third processing level of ladder logic is only processed with the remaining time after level 2 processing has completed. This section of the ladder contains logic with the lowest priority of processing. This level of processing is only available with a few ladder types. Generally only the highest speed processors perform this function.

8.2.4. SUB3 – TMR User Adjustable Timer

Timers are used as a delay in the ladder. When the contacts before the timer function block conduct, the timer begins timing. When the timer reaches its' preset value it turns on the output coil to the right. If the contact before the timer stops conducting, the timer resets back to zero.



Timer number from "NO." column on parameter screen.

Current timer count

Setting value on parameter screen.



1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.

2) Enter  on the MDI keypad, then press the  soft key.

3) Press the  soft key on the CRT menu, to display the parameter setting.

4) Press the  button on the operator panel, and watch the timer count.

When the count reaches 2000, the R200.0 coil will turn ON

5) Press the  left menu soft key to return to the PMC main menu.

6) Press the  soft key on the CRT menu.

7) Press the  soft key on CRT menu.

The **TIMER** setting screen appears.

NO.	ADDRESS	DATA
001	T000	0
002	T002	0
003	T004	0
004	T006	0
005	T008	0
006	T010	0
007	T012	0
008	T014	0
009	T016	0
010	T018	0
011	T020	0
012	T022	0
013	T024	0
014	T026	0
015	T028	2000

SUB3 – TMR User Adjustable Timer

The timer settings on the parameter screen can be set in increments of 48msec or 8msec depending on the timer number. The chart below shows the increment timer increments.

TYPE	PMC TYPE		
	PA1,PA3,SA1,SA2,SA3,SA5,SB,SB2,SB3,SB5,SC,NB	SB4,SB6,SC4,NB2,NB6	SB7
48 mSec	1 to 8	1 to 8	1 to 8
8 mSec	9 to 40	9 to 150	9 to 250

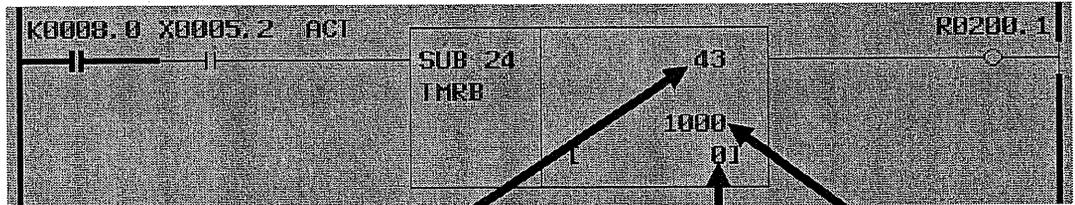
If you set 2000 in timer 015, the number 2000 is set because it is an even multiple of 8mSec. If you set 2000 in timer 001, the number automatically changes to 1968 because it is an even multiple of 48mSec.

TYPE	MAXIMUM SETTING	TIMER ERROR
48 mSec	48 msec to 1572.8 sec	0 to 48 msec
8 mSec	8 msec to 262.1 sec	0 to 8msec

NO.	ADDRESS	DATA
001	T000	0
002	T002	0
003	T004	0
004	T006	0
005	T008	0
006	T010	0
007	T012	0
008	T014	1968
009	T016	2000
010	T018	0

8.2.5. SUB24 - TMRB Fixed Timer

Timers are used as a delay in the ladder. When the contacts before the timer function block conduct, the timer begins timing. The delay time of TMRB is fixed in the ladder function block. When the timer reaches this fixed value it turns on the output coil to the right. If the contact before the timer stops conducting, the timer resets back to zero.

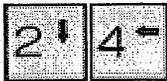


Timer number
1~100

Current timer
count

Fixed setting value
in milliseconds



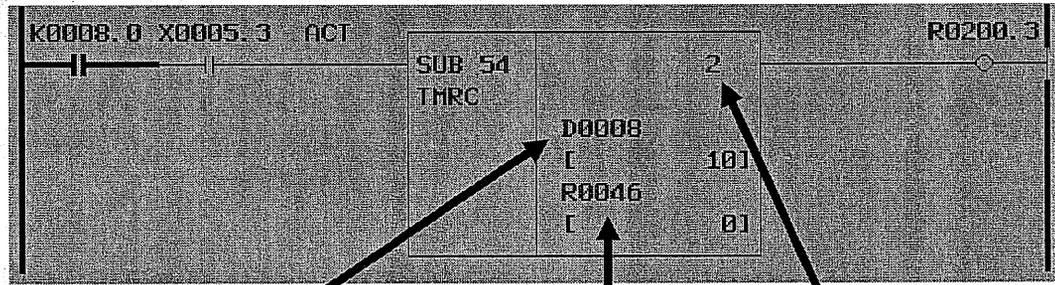
- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter  on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Press the  button on the operator panel, and watch the timer count.

When the count reaches 1000, the R200.1 coil will turn ON

8.2.6. SUB54 - TMRC Timer

Timers are used as a delay in the ladder. When the contacts before the timer function block conduct, the timer begins timing. When the timer reaches its' preset value it turns on the output coil to the right. If the contact before the timer stops conducting, the timer resets back to zero.

Timer C is defined by the ladder developer. They may make it fixed or variable depending on its' use. The place where the timer will count is also decided by the developer. This means the quantity of these timers is limited only by the number of registers that can be used to count.



Register to hold preset value

Register used to perform the count

Timer increments
 0 = 8 millisecond
 1 = 48 millisecond
 2 = 1 second
 3 = 10 second
 4 = 1 minute

In this example, data register D8 holds the value to count up to. Register R46 is the place where the timer will actually keep track of the time. The timer increment of 2 means this timer is using seconds. Since D8 is set to a value of 10, 10 seconds after X5.3 conducts the coil R200.3 will turn ON.



1) Press the  soft key on the CRT menu.

2) Press the  soft key on the CRT menu.

The DATA TBL CONTROL screen

3) Press the  soft key on the CRT menu.

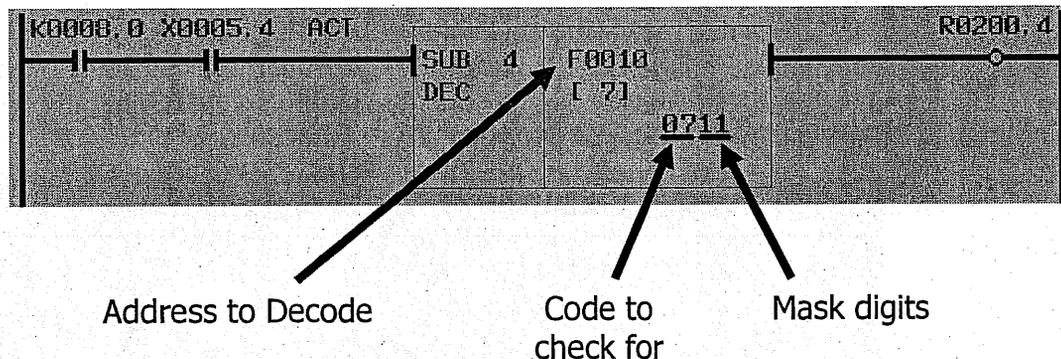
The DATA table screen appears.

4) Change the value in D0008 then return to the PMCLAD screen and view the timer change.

NO.	ADDRESS	DATA
0000	D0000	0
0001	D0001	10
0002	D0002	0
0003	D0003	1
0004	D0004	0
0005	D0005	0
0006	D0006	0
0007	D0007	0
0008	D0008	10
0009	D0009	0
0010	D0010	1
0011	D0011	0
0012	D0012	0
0013	D0013	0
0014	D0014	0

8.2.7. SUB 4 – DEC Decode

The decode function turns ON its' output when the decode address value and the two digit BCD value are equal. This instruction is mainly used to decode M-code or T-code values read in the G-code program.



In the example above, the **ADDRESS TO DECODE** is **F10**. This happens to be where the CNC puts M-codes when it reads them in a G-code program.

The BCD **CODE TO CHECK FOR** is **07**, when F10 = 07 the output R200.4 turns ON.

The **Mask digits decide which digits to look at** when checking F10. Since the mask digits are 11, the data at address F10 must be 07 for the output to turn ON. If the mask digits were 01, the output would turn on if the data at address F10 was 07, 17, 27, 37 etc. If the mask digits were 10, the output would turn on if the data at address F10 was 00, 01, 02, 03, 04, etc. The mask digits decide which digit positions must match in the address to decode and the code to check for.



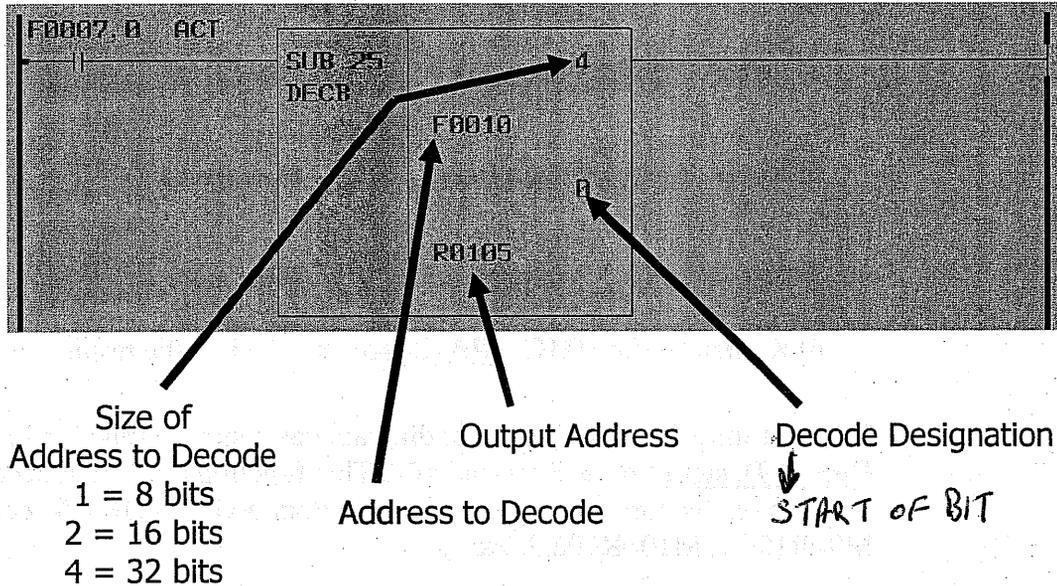
- 1) Select **MDI** mode on the operator panel.
- 2) Press the **PROG** button on the MDI key pad.
- 3) Press the **MDI** soft key on the CRT menu.
- 4) Enter “**MZ ;**” then press **INSERT** , then press **CYCLE START**
- 5) Return to the **PMCLAD** screen,
- 6) Press the **AUX4** button on the operator panel, and watch the timer count.

Notice the coil R200.4 turns ON. Try M17, then notice the coil is not ON.

8.2.8. SUB 25 – DECB Decode Binary

This function will decode 8bit, 16bit, or 32bit binary data. When the ADDRESS TO DECODE value is one of the DECODE DESIGNATION numbers, the decode function turns ON its' output. The code to check for can be any of eight consecutive numbers starting with the DECODE DESIGNATION value. When the address to decode is within this range, the DECB function turns ON the bit in the OUTPUT ADDRESS, which corresponds with the code found in the ADDRESS TO DECODE.

This instruction is mainly used to decode M-code or T-code values read in the G-code program.



In the example above, **32 bits starting at address F10 are decoded**. Address F10 is where the CNC puts M-codes when it reads them in a G-code program.

The **Designation Data** determines which codes this function block is looking for. **Since it is 0, this function block will decode m-codes M0~M7**. If it were 8, the function block would decode M8~M15.

The **Output Address** is where the resultant bit will be set. For example, if 3 is read in address F10, that means the G-code program read M3. The decode block will turn on output address R105.3. If a M5 code was read in the G-code program, output address R105.5 would turn ON.

Realistically the M-codes are processed too quickly to see the bits in R105 change on the PMCDGN STATUS screen.

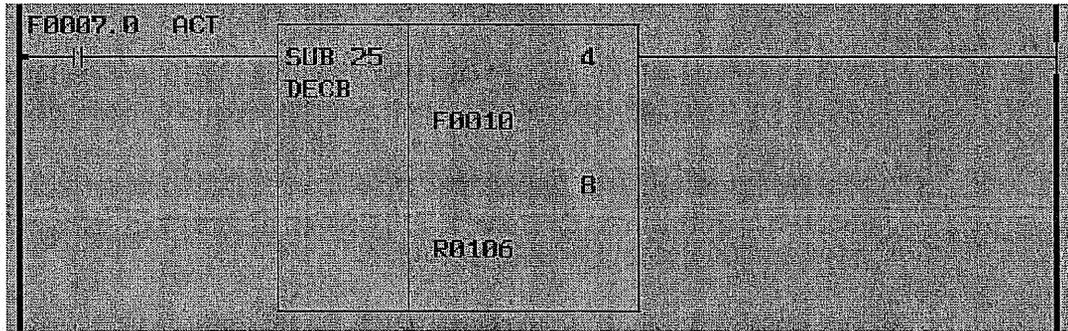
What other PMC screen can be used to see if the bits are turning ON ?

SUB 25 – DECB Decode Binary



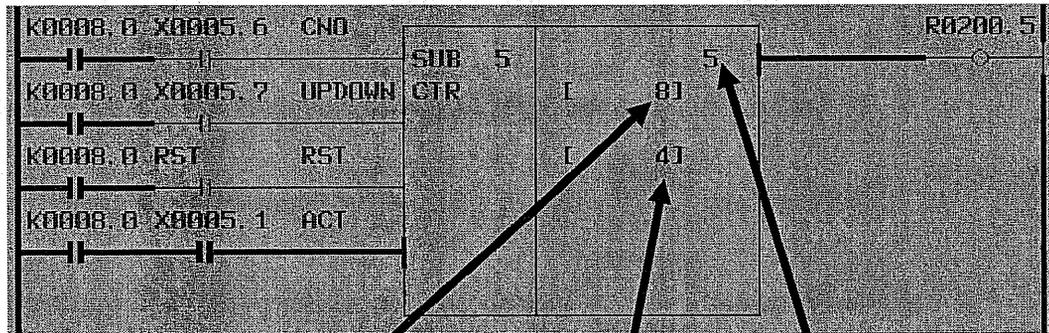
- 1) Setup the TRACE function, to trace all bits in address R105.
- 2) Select **MDI** mode on the operator panel.
- 3) Press the  button on the MDI key pad.
- 4) Press the  soft key on the CRT menu.
- 5) Enter “ **M3 ;** “ then press  , then press  .
- 5) Enter “ **M4 ;** “ then press  , then press  .
- 5) Enter “ **M5 ;** “ then press  , then press  .
- 6) Return to the PMC TRACE screen, to view the result.

The next rung down in the ladder diagram has a similar function block, except the Decode Designation is 8 instead of 0. This function block will decode M8 through M15 and turn on the corresponding bit in the output address R106. M-code M8=R106.0, M9=R106.1, M10=R106.2, etc...



8.2.9. SUB 5 – CTR Counter

The counter function block is used to count events. The counters act as a ring counter, when the counter reaches its' maximum count the output coil R200.5 turns ON. The next count action (X5.1) will change the count back to the start count and turn OFF the coil.



Maximum Count from "**PRESET**" column on parameter screen.

Current Count

Counter number from "**NO.**" column on parameter screen

The inputs to the counter function block are described below...

CNO = Counter start number
 0 = Start with 0
 1 = Start with 1

UPDOWN = The counter counts up or down
 0 = count UP
 1 = count DOWN

RST = counter RESET
 0 = normal operation
 1 = RESET to-0 or 1 depending on CNO

ACT = counter ACTION causes the counter to increment
 0 = no change
 1 = increment current count

The table below shows the number of counters available with each PMC type.

COUNTERS AVAILABLE			
PMC TYPE	PA1,PA3,SA1,SA2,SA3,SA5,SB,SB2,SB3,SB5,SC,NB	SB4,SB6,SC4,NB2,NB6	SB7
COUNTERS	1 to 20	1 to 50	1 to 100

SUB 5 – CTR Counter

From the PMCLAD screen



- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter  on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Press the  button on the operator panel, and watch the timer count.

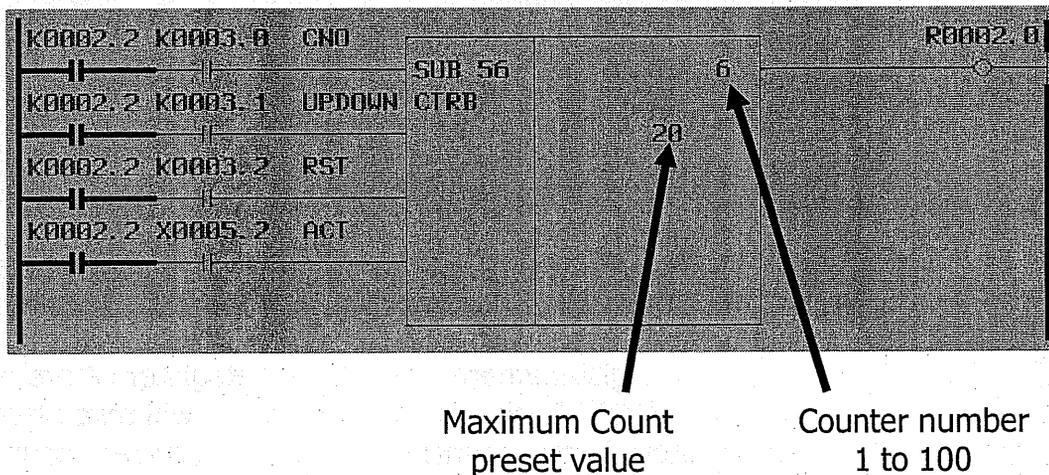
Watch the count change each time you press the button.

- 5) Press the  left menu soft key to return to the PMC main menu.
- 6) Press the  soft key on the CRT menu.
- 7) Press the  soft key on CRT menu.

NO.	ADDRESS	PRESET	CURRENT
001	C000	0	15
002	C004	0	0
003	C008	0	0
004	C012	0	0
005	C016	0	2
006	C020	0	0
007	C024	0	0
008	C028	0	0
009	C032	0	10
010	C036	0	0
011	C040	0	0
012	C044	0	0
013	C048	0	0
014	C052	0	0
015	C056	0	0

8.2.10. SUB 56 – CTRB Fixed Counter

The fixed counter function block is used to count events. The maximum count of this counter is fixed in the function block. The machine builder will use this type of counter when they know the count should not be changed. These counters also act as a ring counter, when the counter reaches its' maximum count the output coil R2.0 turns ON. The next count action will change the count back to the start count and turn OFF the output coil.



The inputs to the counter function block are described below...

CNO = Counter start number

0 = Start with 0

1 = Start with 1

UPDOWN = The counter counts up or down

0 = count UP

1 = count DOWN

RST = counter RESET

0 = normal operation

1 = RESET to 0 or 1 depending on CNO

ACT = counter ACTION causes the counter to increment

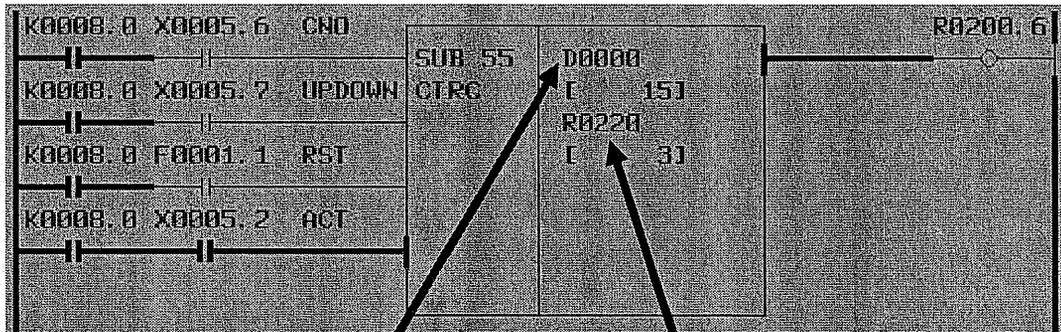
0 = no change

1 = increment current count

Counter B is only available on SA1 and SB7 PMC types. It is always a binary count. The current count can be accessed at address C5000 as a 2 byte word. Counter 1 corresponds to C5000, and counter 2 corresponds to C5002 etc.

8.2.11. SUB 55 - CTCR Counter C

Counter C is a developer defined counter, this means the ladder developer decides where the preset and current count values will be stored. Otherwise it acts as a regular SUB 5 counter and is used to count events. The counters act as a ring counter, when the counter reaches its' maximum count the output coil R200.5 turns ON. The next count action will change the count back to the start count and turn OFF the output coil.



Register where
PRESET value is
stored (max count)

Register where count
will take place
(current count)

The inputs to the counter function block are described below...

CNO = Counter start number
 0 = Start with 0
 1 = Start with 1

UPDOWN = The counter counts up or down
 0 = count UP
 1 = count DOWN

RST = counter RESET
 0 = normal operation
 1 = RESET to 0 or 1 depending on CNO

ACT = counter ACTION causes the counter to increment
 0 = no change
 1 = increment current count

The counter **PRESET register is a 16 bit register**. In the example above D0000 is used. Since D registers are 8 bits, 2 registers will be used by the counter D0000 and D0001.

The counter **CURRENT COUNT register is a 32 bit register**. In the example above R0666 is used. Since R registers are 8 bits, 4 registers will be used by the counter R0666~R0669. If a R register is used the value is cleared to 0 at power on. If a D register is used, it will retain it's value at power off.

SUB 55 - CTRC Counter C

From the PMCLAD screen



1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.

2) Enter   on the MDI keypad, then press the  soft key.

3) Press the  soft key on the CRT menu, to display the parameter setting.

4) Press the  button on the operator panel, and watch the timer count.
Watch the count change each time you press the button.

5) Press the  left menu soft key to return to the PMC main menu.

6) Press the  soft key on the CRT menu.

7) Press the  soft key on the CRT menu.

The DATA TBL CONTROL screen appears.

8) Press the  soft key on the CRT menu.

The DATA table screen appears.
Adjust register D0000 then return to the ladder screen to view the change.

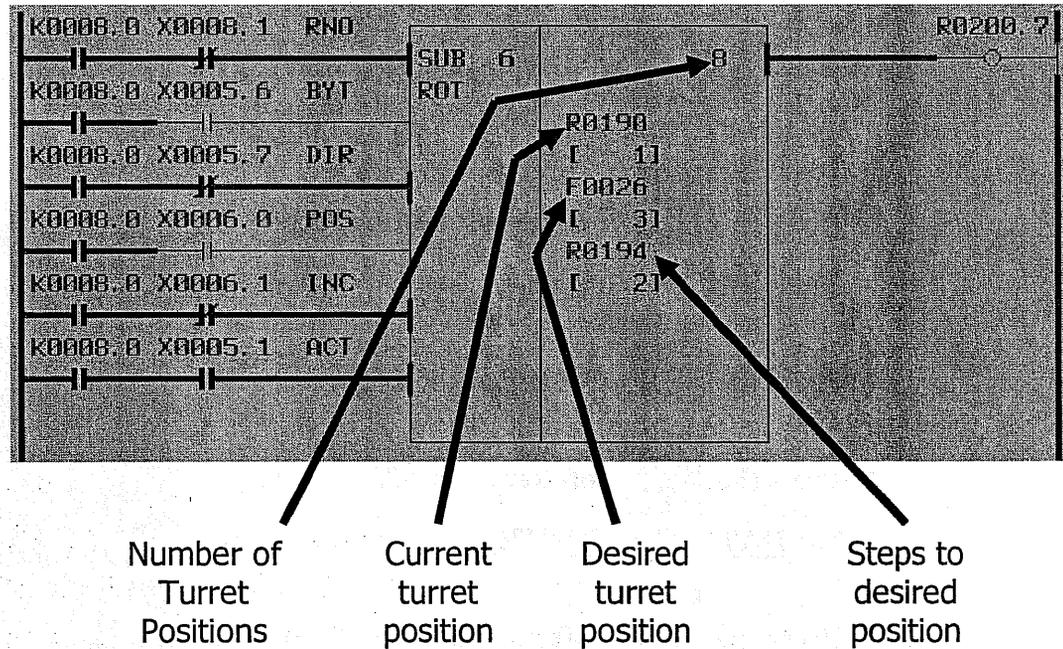
NO.	ADDRESS	DATA
0000	D0000	15
0001	D0001	0
0002	D0002	0
0003	D0003	0
0004	D0004	0
0005	D0005	0
0006	D0006	0
0007	D0007	0
0008	D0008	10
0009	D0009	0
0010	D0010	1
0011	D0011	0
0012	D0012	0
0013	D0013	0
0014	D0014	0

8.2.12. SUB 6 – ROT Rotation Control

The rotation control function block is typically used to control a tool changer or turret but could also control a PMC controlled rotary axis. This function just performs the calculation, other ladder functions will be used to actually rotate the control axis. It performs 3 functions ...

- ❶ To select rotation direction for shortest path
- ❷ Calculates the number of steps between current position and the goal position.
- ❸ Calculates the position, or number of steps to position, to one position before goal

The data processed by this function is in BCD format. The ROTB instruction is binary.



The inputs to the ROT function block are described below...

RNO = Rotary Axis beginning position

0 = First position is 0

1 = First position is 1

BYTE = The number of BCD digits to process

0 = Two BCD digits

1 = Four BCD digits

DIR = Calculate shortest direction to goal position

0 = No, always rotate forward

1 = Yes, output shortest direction

POS = Position calculation is ...

1 = Calculate goal position

0 = Calculate number of steps to goal position

SUB 6 – ROT Rotation Control

INC = Calculate goal position or number of steps to goal position
 0 = Calculate goal position (POS=1)
 1 = Calculate number of steps to goal (POS=0)

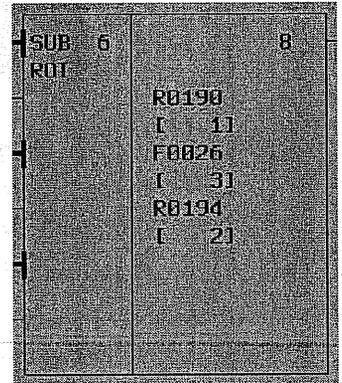
ACT = Activate command, causes calculation to perform
 0 = No calculation is done
 1 = Perform calculation

OUTPUT COIL = If DIR=1 then the output coil will determine rotation direction.
 0 = Rotate CW
 1 = Rotate CCW

From the **PMCLAD** screen



- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter  on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Rotate the **FEEDRATE** override switch.
 Notice R190 value changes. In this example this switch will serve as the turret feedback. Turn the switch to **10%**
- 5) Select **MDI** mode on the operator panel
- 6) Press the  button on the MDI key pad.
- 7) Press the  soft key on the CRT menu
- 8) Enter “**M6 T3 ;**” then press  , then press 
- 9) Return to the **PMCLAD** screen, notice F26 holds the T-code you entered.
- 10) Press the  button on the operator panel, and watch calculation occur.



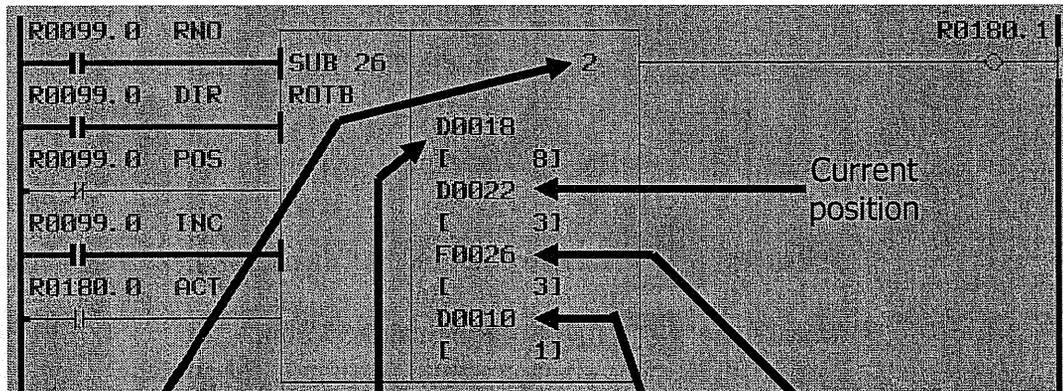
The result, number of steps to goal, will be placed into R194.

8.2.13. SUB 26 – ROTB Rotation Control Binary

The rotate binary function block used the same as the ROT function block. The primary difference is that the **NUMBER OF POSITIONS** can be specified in an address, instead of being fixed in the function block. Also the calculation addresses are treated as **BINARY** instead of BCD.

This function block is typically used to control a tool changer or turret but could also control a PMC controlled rotary axis. This function just performs the calculation, other ladder functions will be used to actually rotate the control axis. It performs 3 functions ...

- ❶ To select rotation direction for shortest path
- ❷ Calculates the number of steps between current position and the goal position.
- ❸ Calculates the position, or number of steps to position, to one position before goal



Format
 1 = 8 bits (byte)
 2 = 16 bits (word)
 4 = 32 bits (long)

Number of positions

Steps to desired position

Desired position

The inputs to the **ROTB** function block are described below...

RNO = Rotary Axis beginning position
 0 = First position is 0
 1 = First position is 1

DIR = Calculate shortest direction to goal position
 0 = No, always rotate forward
 1 = Yes, output shortest direction

POS = Position calculation is ...
 1 = Calculate goal position
 0 = Calculate number of steps to goal position

SUB 26 – ROTB Rotation Control Binary

INC = Calculate goal position or number of steps to goal position

0 = Calculate goal position (POS=1)

1 = Calculate number of steps to goal (POS=0)

ACT = Activate command, causes calculation to perform

0 = No calculation is done

1 = Perform calculation

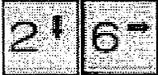
OUTPUT COIL = If DIR=1 then the output coil will determine rotation direction.

0 = Rotate CW

1 = Rotate CCW

From the **PMCLAD** screen

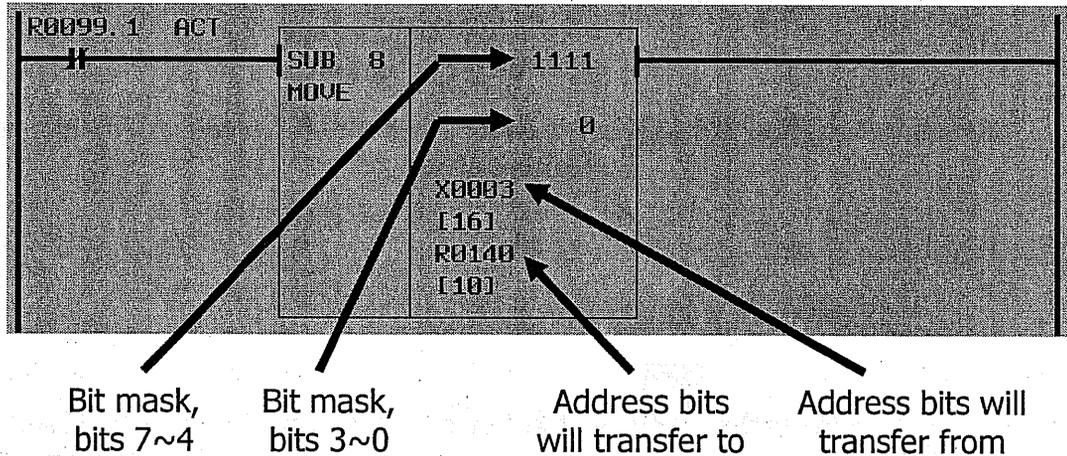


- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter  on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Select **MDI** mode on the operator panel
- 5) Press the  button on the MDI key pad.
- 7) Press the  soft key on the CRT menu
- 8) Enter “**M6 T6** ; “ then press  but do not press cycle start.
- 9) Return to the **PMCLAD** screen, to see the function block.
- 10) Press the  button on the operator panel..

Watch the rotate command function.

8.2.14. SUB 8 – MOVE Logical Product Transfer

The **MOVE** command allows you to COPY data bits from one address to another. This allows you to check to see if specific bits are turned ON. A bit mask is provided so you can select the bits you want to check. The name implies that the data will be moved, but it is actually copied, and remains in the original address after the command executes.



In this example bits 7~4 are masked, so only those bits that are 1 in the mask data transfer to address R140.

<u>BIT#</u>	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>	
<u>X3</u>	0	0	0	1	0	1	0	1	=15
<u>MASK</u>	1	1	1	1	0	0	0	0	=F0

<u>R140</u>	0	0	0	1	0	0	0	0	=10

Bits 0 ~ 3 are the MODE SELECT switch on the operator panel, and bits 4 ~ 7 are the FEEDRATE switch. Rotate each of the switches and watch the data change.

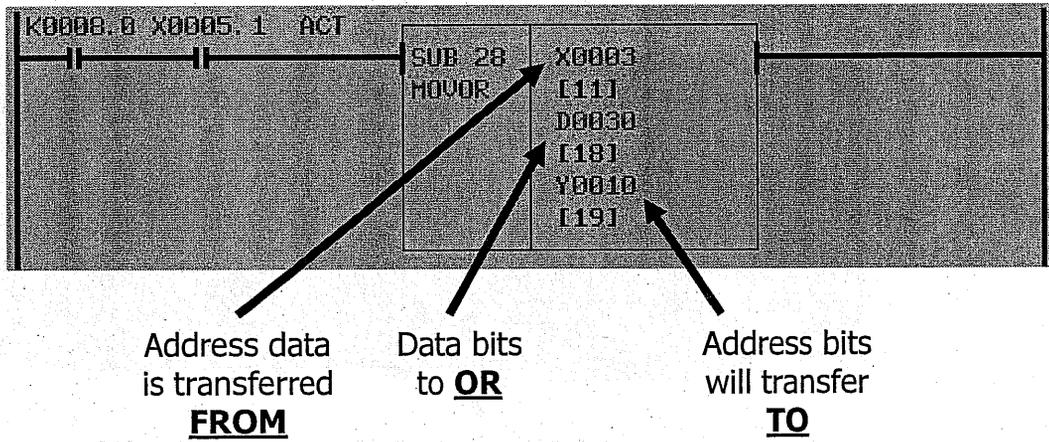
This process is called LOGICAL ANDING with a move...



INPUT A	INPUT B	OUTPUT
0	0	0
1	0	0
0	1	0
1	1	1

8.2.15. SUB 28 – MOVOR Data Transfer After Logical Sum

The MOVOR command allows you to SET selected data bits ON in a specific address. As the name implies the data will be ORed, then the result will be moved to the output address.

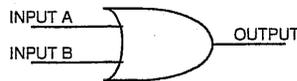


In this example bits address X3 is ORed hexadecimal 18 and the result is transferred to address Y10. Notice the bits that are ON in the result address are those that are ON in address X3, or the OR data, or both.

<u>BIT#</u>	7	6	5	4	3	2	1	0
<u>X3</u>	0	0	0	1	0	0	0	1 =11
<u>OR</u>	0	0	0	1	1	0	0	0 =18
<u>Y10</u>	0	0	0	1	1	0	0	1 =19

Also notice the data set in register D30 is in decimal on the PMCPAR screen, even though it is treated as hexadecimal in the function block.

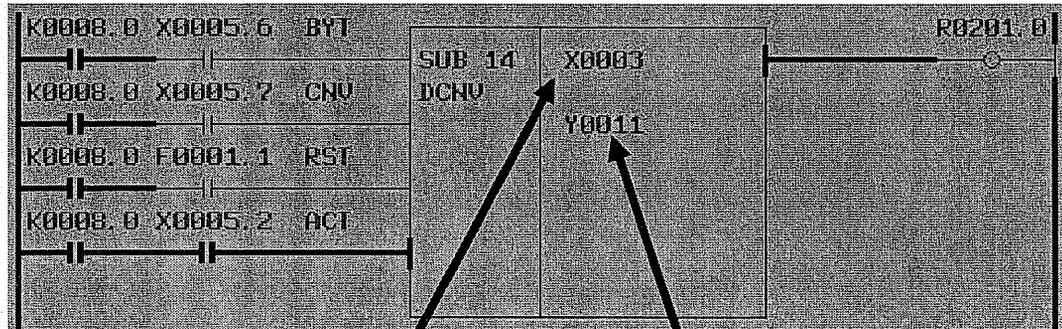
This process is called LOGICAL ORing with a move...



INPUT A	INPUT B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	1

8.2.16. SUB 14 – DCNV Data Conversion

This function block converts BINARY into BCD, or BCD into BINARY depending on the status of the CNV input. Typically **BCD** is used for human interface, where seven segment displays or thumbwheels are used. The **PMC processes everything in binary**, humans use binary coded decimal.



Address where data
to be converted is
FROM

Address where
converted data will
transfer **TO**

The inputs to the DCNV function block are described below...

BYT = Data size specification

0 = 8 bits (byte)

1 = 16 bits (word)

CNV = Conversion type

0 = Binary to BCD (write to Seven Segment Display)

1 = BCD to Binary (read from thumbwheel)

RST = Reset input

0 = Not reset, normal operation

1 = Reset, resets error output coil

ACT = Activate command, causes calculation to perform

0 = No conversion is done

1 = Perform conversion

OUTPUT COIL = If an error occurs during the conversion process

0 = Conversion was normal

1 = Error occurred during conversion

an error occurs if the converted data will not fit into the commanded byte/word size (BYT input)

SUB 14 – DCNV Data Conversion



- 1) Setup the TRACE screen, to monitor addresses X3 and Y11.
- 2) Rotate the **FEEDRATE** override switch, turn the switch to 10%
- 3) Select **MEMORY** mode on the operator panel
- 4) Press the  button on the operator panel.
- 5) Return to the TRACE screen, did the data convert properly ?

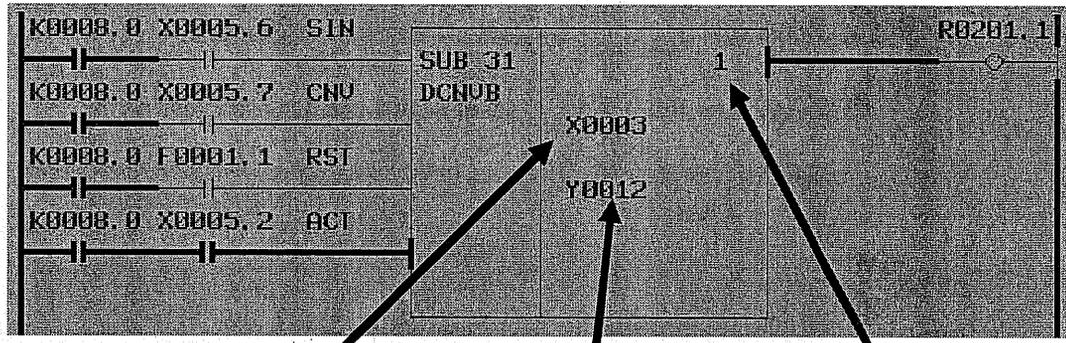
PMC SIGNAL TRACE															MONIT RUN	
NO.	1ST ADDRESS = X0003 (FF)								2ND ADDRESS = Y0011 (FF)							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0000
0001	.	.	.	I	.	.	I	.	.	.	.	.	.	I	I	.
0002	.	.	.	I	.	.	I	.	.	.	I	I	.	.	.	.
0003
0004
0005
0006
0007
0008
0009
0010
0011
0012
0013
0014
0015

TRCPRM	STOP															
--------	------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

8.2.17. SUB 31 – DCNVB Extended Data Conversion

This function works the same way as the DCNV except this command allows you to convert 1, 2, or 4 byte information and also signed \pm BCD to binary.

This function block converts BINARY into BCD, or BCD into BINARY depending on the status of the CNV input. Typically **BCD** is used for **human interface**, where seven segment displays or thumbwheels are used. The **PMC processes everything in binary**, humans use binary coded decimal.



Address where data to be converted is **FROM**

Address where converted data will transfer **TO**

Format Specification
 1 = 8 bits (byte)
 2 = 16 bits (word)
 4 = 32 bits (long)

The inputs to the DCNVB function block are described below...

SIN = Data size specification, used when converting BCD to BINARY
 0 = BCD input data is positive
 1 = BCD input data is negative

CNV = Conversion type
 0 = Binary to BCD
 1 = BCD to Binary

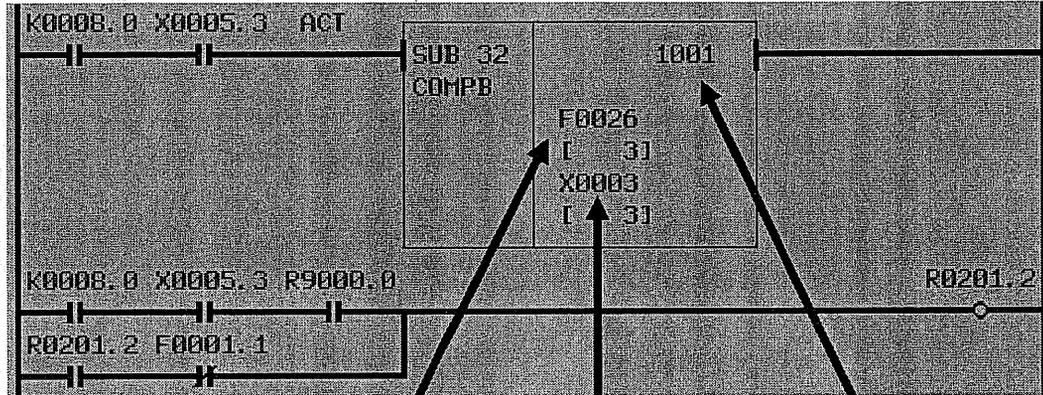
RST = Reset input
 0 = Not reset, normal operation
 1 = Reset, resets error output coil

ACT = Activate command, causes calculation to perform
 0 = No conversion is done
 1 = Perform conversion

OUTPUT COIL = If an error occurs during the conversion process
 0 = Conversion was normal
 1 = Error occurred during conversion
 an error occurs if the converted data will not fit into the commanded byte/word/long data size (format specification)

8.2.18. SUB 32 – CMPB Comparison Between Binary Data

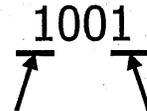
The CMPB function compares binary data. When the input activated (X5.3), the result of the comparison is output to address R9000.



Address where data compared is **FROM**

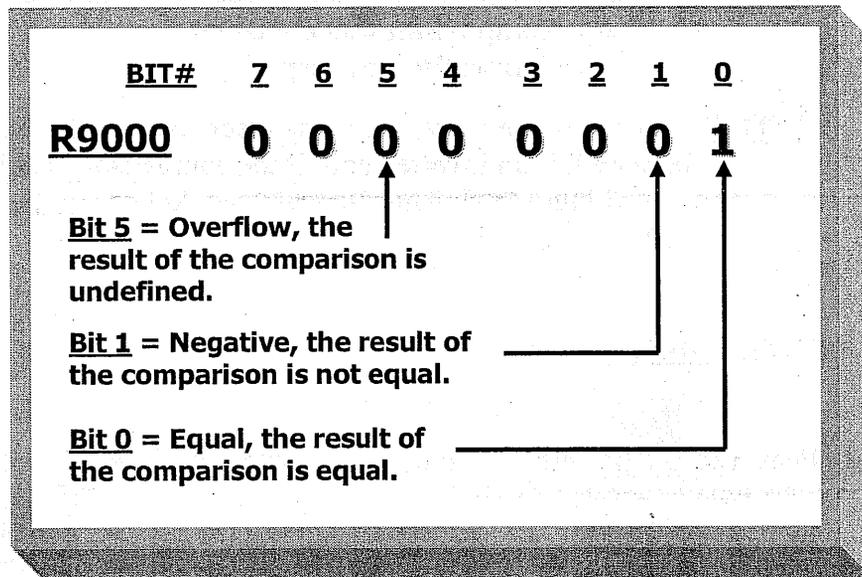
Data to be compared **TO**

Format Specification



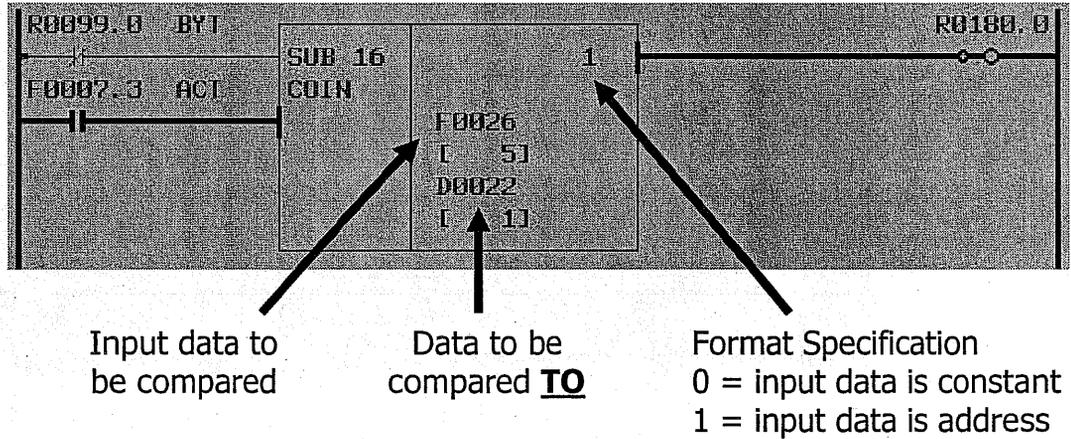
- 0 = Constant
- 1 = Address
- 1 = 8 bit
- 2 = 16 bit
- 4 = 32 bit

R9000 must appear in the next ladder rung after the comparison function block. It is a common address used by several other mathematical function blocks. A single bit in address R9000 will turn ON to indicate the result of the comparison.



8.2.19. SUB 16 – COIN Coincidence Check

The COIN function compares the input address with the comparison address, if they are equal the output latches ON until the next comparison which has a not equal result.



The inputs to the COIN function block are described below...

BYT = Data size specification
 0 = 8 bits (byte), two BCD digits
 1 = 16 bits (word), four BCD digits

ACT = Activate command, causes calculation to perform
 0 = No coincidence check is done
 1 = Perform coincidence check

OUTPUT COIL = The result of the coincidence check is reflected in the coil status
 0 = Comparison was not equal
 1 = Comparison was equal

NOTE : In the example above the comparison data is different. The coil is active because it is an inverted coil. If the comparison data is equal the inverted coil will turn OFF. This operation would be opposite with a standard relay coil.

From the PMCLAD screen



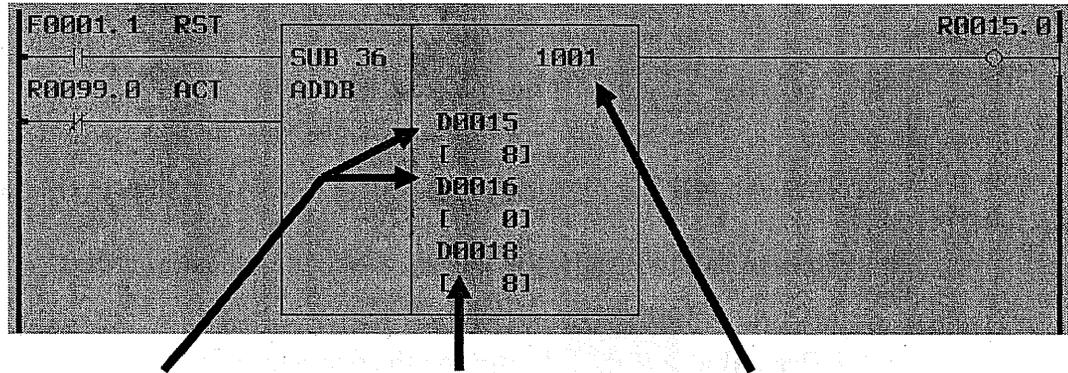
- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter  on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.

SUB 16 – COIN Coincidence Check

- 4) Select  mode on the operator panel
- 5) Press the  button on the MDI key pad.
- 7) Press the  soft key on the CRT menu
- 8) Enter “M6 T2 ; “ then press  but do not press cycle start.
- 9) Return to the PMCLAD screen, to see the function block.
- 10) Press the  button on the operator panel..
Watch the COIN command function.

8.2.20. SUB 36 – ADDB Binary Addition

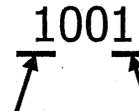
Binary addition simply adds the first address to the second address and puts the result into the third address in the function block. The second address may be either a constant or address, as specified in the format specification. If an error occurs in the addition process, the output coil will turn ON, in this example R15.0



Data to be added together

Address where result will be stored

Format Specification



In the example above, R99.0 is not conducting. Find the coil for R99.0.

When will this addition occur ?

Change the value in D16 and watch the result address data change.

0 = Constant
1 = Address

1 = 8 bit
2 = 16 bit
4 = 32 bit

RST = Reset input

- 0 = Not reset, normal operation
- 1 = Reset, resets error output coil

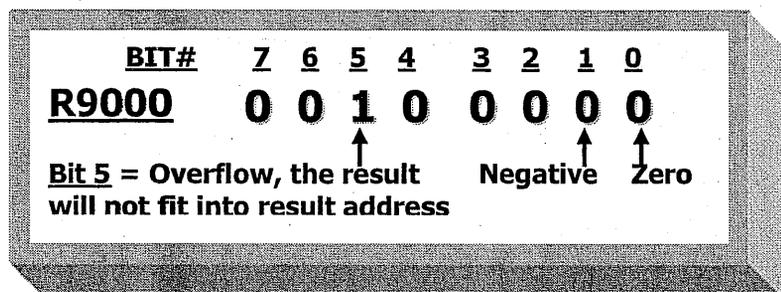
ACT = Activate command, causes calculation to perform

- 0 = No addition is performed
- 1 = Perform addition

OUTPUT COIL = If an error occurs during the addition of the addresses

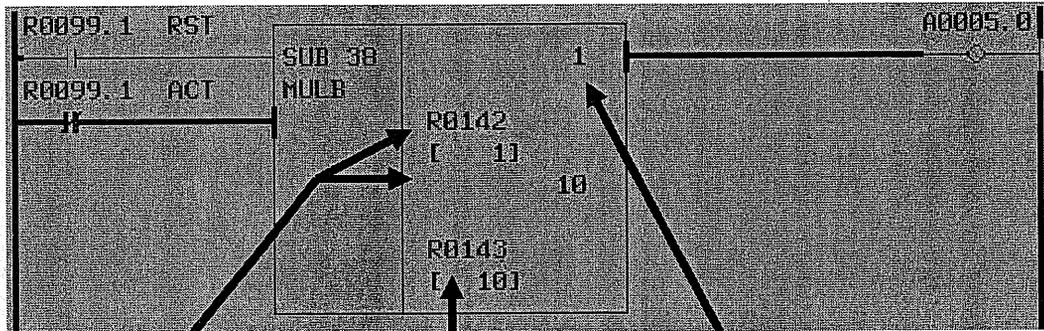
- 0 = Addition was normal
 - 1 = Error occurred during addition
- an error occurs if the addition result data will not fit into the commanded byte/word/long data size (format specification)

Address R9000 will also indicate if an error occurs during the addition process.



8.2.21. SUB 38 – MULB Binary Multiplication

Binary multiplication simply multiplies the first address by the second address and puts the result into the third address in the function block. The second address may be either constant or address, as specified in the format specification. If an error occurs in the addition process, the output coil will turn ON, in this example A5.0

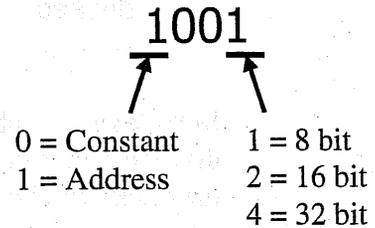


Data to be multiplied together

Address where result will be stored

Format Specification

In the example above, R142 will be multiplied by the constant 10, then the result will be stored in R143.



RST = Reset input

0 = Not reset, normal operation

1 = Reset, resets error output coil

ACT = Activate command, causes calculation to perform

0 = No multiplication is performed

1 = Perform multiplication

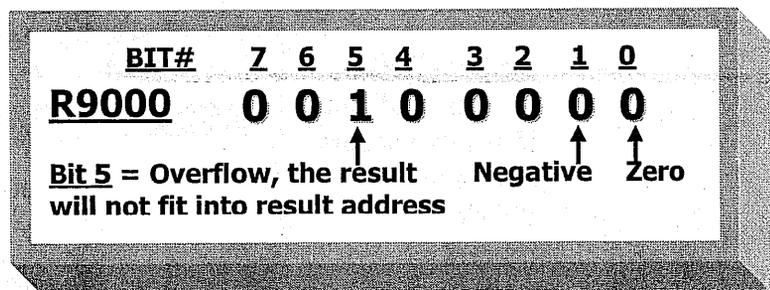
OUTPUT COIL = If an error occurs during the multiplication of the data

0 = Multiplication was normal

1 = Error occurred during multiplication

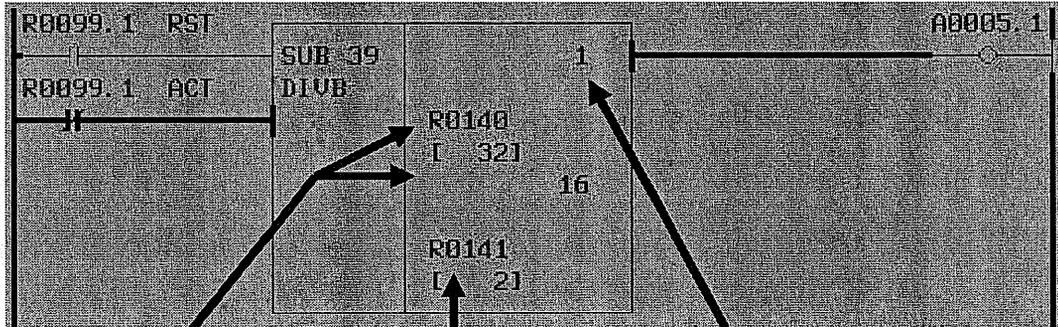
an error occurs if the multiplication result data will not fit into the commanded byte/word/long data size (format specification)

Address R9000 will also indicate if an error occurs during the multiplication process.



8.2.22. SUB 39 – DIVB Binary Division

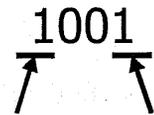
Binary division simply divides the first address by the second address and puts the result into the third address in the function block. The second address may be either a constant or address, as specified in the format specification. If an error occurs in the division process, the output coil will turn ON, in this example A5.1



Data to be divided

Address where result will be stored

Format Specification



In the example above, R140 will be divided by the constant 16, then the result will be stored in R141.

- 0 = Constant
- 1 = Address
- 1 = 8 bit
- 2 = 16 bit
- 4 = 32 bit

RST = Reset input

- 0 = Not reset, normal operation
- 1 = Reset, resets error output coil

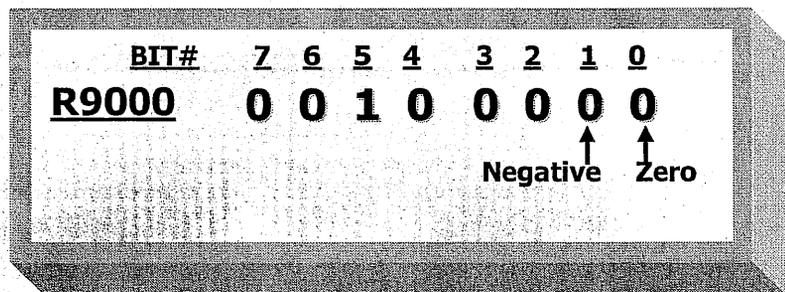
ACT = Activate command, causes calculation to perform

- 0 = No division is performed
- 1 = Perform division

OUTPUT COIL = If an error occurs during the division of the data

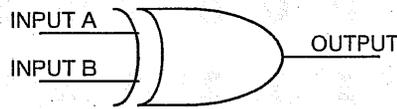
- 0 = division was normal
 - 1 = Error occurred during division
- an error occurs if the division result data will not fit into the commanded byte/word/long data size (format specification)

Address R9000 will also indicate if an error occurs during the division process.



8.2.23. SUB 59 – EOR Logical Exclusive OR

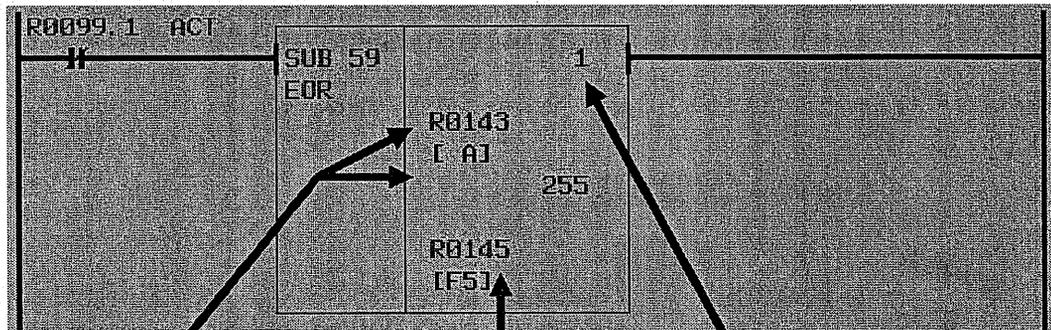
The EOR function can be used to **toggle a bit** or **invert bits**. It works like the digital logic gate. If a **SINGLE** input is ON between the two inputs, the output is ON. If **BOTH** inputs are ON or OFF between the two inputs, then the output is OFF.



XOR LOGIC TABLE

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	0

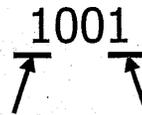
The bits from the first address are EXCLUSIVE ORed with the bits of the second address and the result is stored into the third address in the function block. The second address may be a either constant or address, as specified in the format specification.



Data to be EORed

Address where result will be stored

Format Specification



0 = Constant
1 = Address

1 = 8 bit
2 = 16 bit
4 = 32 bit

ACT = Activate command, causes **exclusive OR** to perform

0 = No process is performed

1 = Perform exclusive OR process

SUB 59 – EOR Logical Exclusive OR

In this example bits address R143 is exclusive-ORed with decimal 255 and the result is transferred to address R145. Notice the bits that are EXCLUSIVE to each of the input operators are turned ON in the result address. The bits that are ON in both the first and second addresses are ignored.

BIT#	7	6	5	4	3	2	1	0	
R143	0	0	0	0	1	0	1	0	=0A
255	1	1	1	1	1	1	1	1	=FF
—————									
R145	1	1	1	1	0	1	0	1	=F5

The result of this operation is the inverse of the value in R143. This is a valuable function when you are dealing with the *asterisk signals that are active low. The above action shows we can take an active high signal (R143) and convert it to active low (R145).

From the PMCLAD screen



- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter   on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Rotate the **FEEDRATE** override switch, watch the value of R145 change.
- 5) Enter     on the MDI keypad, then press the  key.

What happens next to the data in R145 ?

What function does that address perform ?

Why did the bits need to be inverted ?

8.2.24. SUB 60 – AND Logical AND

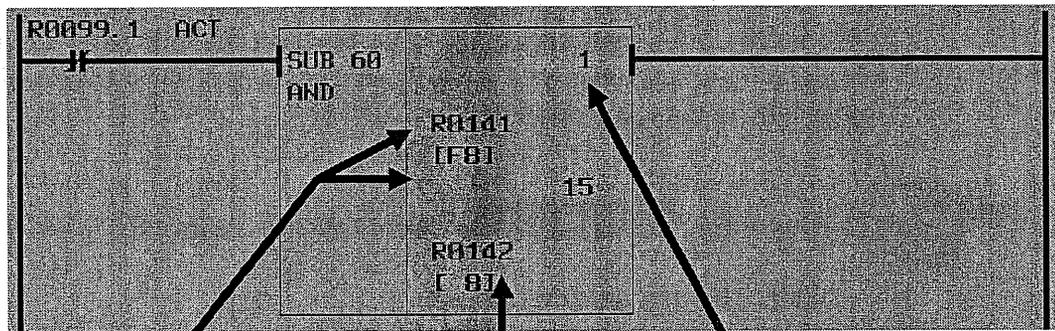
The AND function can be used to **check the status of a bit** or **turn a bit OFF**. It works like the digital logic gate. If both input bits are ON, the output is ON. The same theory is applied to binary data on a bit by bit basis.



LOGIC TABLE

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	0
0	1	0
1	1	1

The bits from the first address are ANDed with the bits of the second address and the result is stored into the third address in the function block. The second address may be a either constant or address, as specified in the format specification.



Data to be ANDed

Address where result will be stored

Format Specification

1001

0 = Constant

1 = Address

1 = 8 bit

2 = 16 bit

4 = 32 bit

ACT = Activate command, causes AND operation to perform

0 = No process is performed

1 = Perform AND process

SUB 60 – AND Logical AND

In this example bits address R141 is ANDed with decimal 15 and the result is transferred to address R142. Notice only the bits that are ON in both the **first AND second** address are turned ON in the result address. The second address acts as a bit mask to filter the result.

BIT#	7	6	5	4	3	2	1	0	
<u>R141</u>	1	1	1	1	1	0	0	0	=F8
<u>15</u>	0	0	0	0	1	1	1	1	=0F
—————									
<u>R142</u>	0	0	0	0	1	0	0	0	=08

The result of this operation allows you to select the bits you want to transfer. This is a valuable function when you want to act upon a specific group of bits while ignoring other bits in the same address

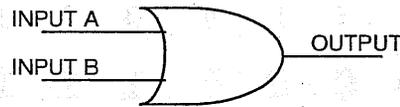


- 1) Rotate the **FEEDRATE** override switch, watch the value of **R142** change.

Notice bits 4~7 are filtered out.

8.2.25. SUB 61 – OR Logical OR

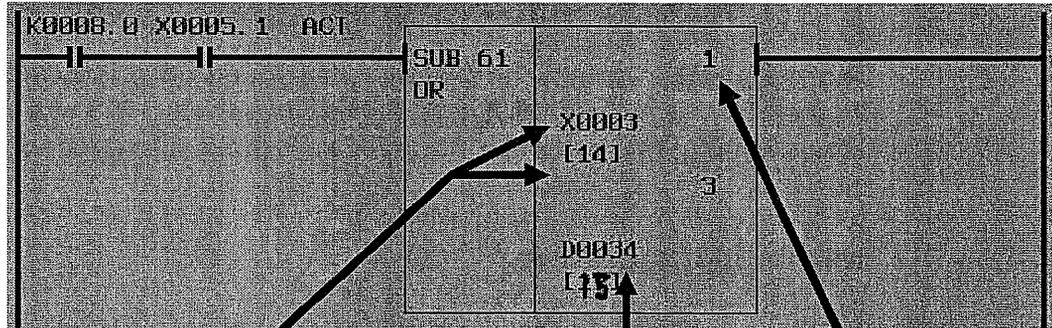
The OR operator can be used to **turn ON a bit**. It works like the digital logic gate. If either input OR both inputs are ON the output is ON.



OR LOGIC TABLE

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	1

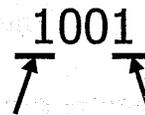
The bits from the first address are ORed with the bits of the second address and the result is stored into the third address in the function block. The second address may be a either constant or address, as specified in the format specification.



Data to be ORed

Address where result will be stored

Format Specification



0 = Constant
1 = Address

1 = 8 bit
2 = 16 bit
4 = 32 bit

ACT = Activate command, causes OR operation to perform

0 = No process is performed

1 = Perform OR process

SUB 61 – OR Logical OR

In this example bits address X3 is ORed with hexadecimal 3 and the result is transferred into address D34. Notice the bits that are ON in both the **first OR second** address are turned ON in the result address. The second address ensures at least that bit will be turned ON.

<u>BIT#</u>	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>	
<u>X03</u>	0	0	0	0	1	1	1	0	=14
<u>03</u>	0	0	0	0	0	0	1	1	=03
<hr/>									
<u>D34</u>	0	0	0	0	1	1	1	1	=15

The result of this operation is to ensure a minimum value is moved to the result address. If no bits are on in the first address, the minimum value of 3 will be transferred to D34. This is a useful function when you want to be sure a minimum value is used.

From the PMCLAD screen



- 1) Press the  soft key on the CRT menu. The SEARCH soft menu appears.
- 2) Enter   on the MDI keypad, then press the  soft key.
- 3) Press the  soft key on the CRT menu, to display the parameter setting.
- 4) Rotate the **FEEDRATE** override switch, watch the value of R145 change.
- 5) Press the  button on the operator panel, and watch the OR function occur.

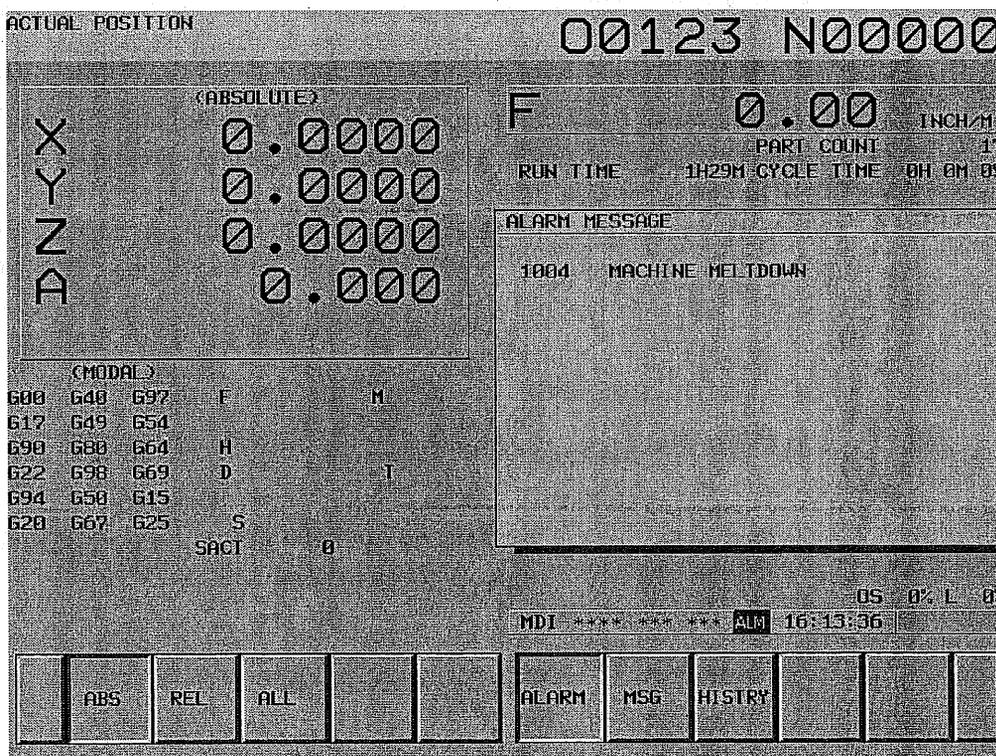
8.3. Machine Alarms

The machine builder can create custom alarm messages for their machine. The custom alarms are generated from the PMC and appear on the MESSAGE display the same as the Fanuc alarms. The PMC alarms can be distinguished by the alarm number.

- 000~999** Fanuc alarms, stop machine operation and can be cleared by RESET on the CNC MDI key pad or by power OFF/ON. The descriptions can be found in the back of the yellow Fanuc manuals
- 1000~1999** Machine builder alarms, generated in the PMC. These alarms cause the machine to stop operation and can be cleared by RESET on the CNC MDI key pad. The descriptions for these faults can be found in the machine builders OPERATOR manual.
- 2000~2999** Machine builder messages. These messages do not stop machine operation when they occur. The message appears and the machine continues to run. The descriptions for these faults can be found in the machine builders OPERATOR manual. Messages numbered **2100~2999** display the message without the message number.
- 3000~3124** G-Code programs generated alarms. Typically they come from macro programs, which can be written by the machine builder or the end user.

To view the alarm screen press the  button on the MDI key pad.

Parameter 3111 bit 7 determines if the CNC will change to this screen automatically when an alarm is present.



8.3.1. A Address Alarm Coils

The A coils in the ladder cause the alarm messages to appear on the MESSAGE screen. When the coil turns ON (1), the message is sent to the CNC message screen. Typically the alarm circuit is a latch and hold type circuit that will latch itself ON. In this example the RESET button (F1.1) will unlatch the circuit.



In the PMC memory a table exists, where the actual message that appears is entered.

No.	AD	Message
1	A0.0	1000 CALL MAINTENANCE
2	A0.1	1001 PLEASE WORK HARDER
3	A0.2	1002 CABINET OVERHEAT
4	A0.3	1003 LUBE TANK EMPTY
5	A0.4	1004 MACHINE MELTDOWN
6	A0.5	1005 TOOL CODE FAULT [I220,F26]
7	A0.6	
8	A0.7	
9	A1.0	2001 CABINET TEMPERATURE HIGH
10	A1.1	2002 LUBE LEVEL LOW
11	A1.2	
12	A1.3	
13	A1.4	
14	A1.5	

No.10 - 22 Byte

This message table cannot be seen unless you have ladder editing software. The machine builder usually provides a list of the PMC alarm messages they have added.

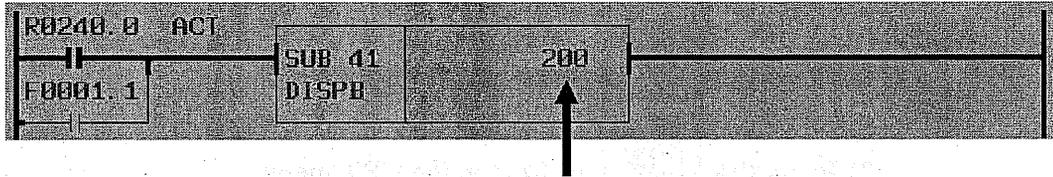
The **alarm number** itself determines if the message appears on the ALARM screen or the MESSAGE screen. 1000~1999=ALARM, 2000~2999=MESSAGE.



- 1) Press the  and  buttons on the operator panel, at the same time.
- 2) Press the  button, on the MDI keypad if the CNC did not automatically change screens. Alarm 1004 should be present.
- 3) Press the  button, on the MDI keypad to clear the alarm.

8.3.2. SUB 41 - DISPB Display Alarm Message

The DISPB function block causes the alarm messages to appear using A coils in the ladder. Even if an A coil is activated, the alarm doesn't appear unless the DISPB function block is activated.



Total number of messages

The total number of messages possible to display is determined by the PMC type.

MAXIMUM MESSAGES AVAILABLE			
PMC TYPE	PA1,PA3,SA1,SA2,SA3,SA5,SB,SB2,SB3,SB4,SB5,SC,NB	SB6,SC4,NB2,NB6	SB7
MESSAGES	1 to 200	1 to 1000	1 to 2000

8.3.3. Troubleshooting Messages with DISPB SUB41

Since you cannot see the message table, troubleshooting is performed by first finding which A address coil is activated, then second search for that coil in the ladder diagram.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  soft key on the CRT menu.
- 4) Press the  soft key on the CRT menu.
- 5) Press the   buttons on the MDI key pad.
- 6) Press the  soft key on the CRT menu.

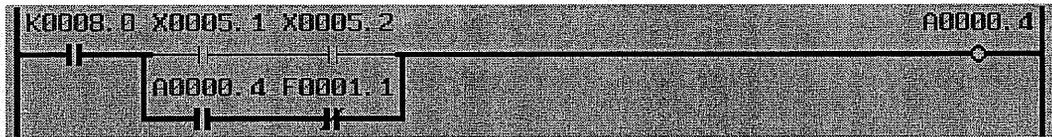
On this screen you can see which A coil is currently activated. Then return to the PMCLAD screen and search for the active coil (A0.4) using WSRCH.

PMC SIGNAL STATUS		MONIT RUN							
ADDRESS	7	6	5	4	3	2	1	0	
A0000				1					
A0001									
A0002									
A0003									
A0004									
A0005									
A0006									
A0007									

SEARCH

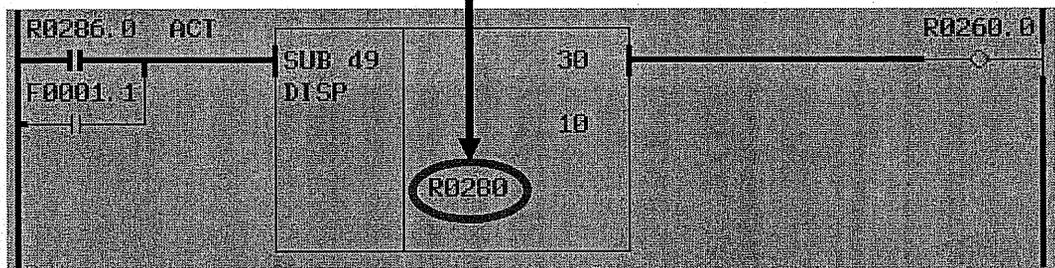
Troubleshooting Messages with DISPB SUB41

By searching the active coil, you can see that X5.1 and X5.2 had to be active to cause this alarm to appear. Also you can see that F1.1 (RESET) will clear the alarm.



8.3.4. SUB 49 – DISP Display Alarm Message

The DISP function block causes the alarm messages to appear on the CNC screen. Each SUB49 function block can control up to **8 alarm** messages. The messages are activated by **the specified R address within the function block**.



In this example, 30bytes are allocated, each message is allowed 10bytes, calculating from this 3 messages are assigned to R280. Address R280.0 will be the first alarm, R280.1 will be the second, and R280.2 will be the third.

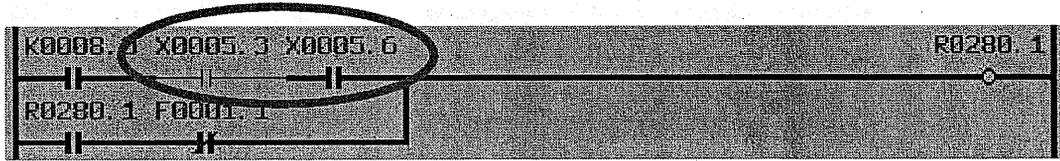
8.3.5. Troubleshooting Messages with DISP SUB49

Troubleshooting when the DISP function is used is similar to the DISPB function except with DISP you need to search the ladder for each SUB49 to see which R registers are being used. Once you know which registers are used, search for them on the PMCDGN STATUS screen to see which bit is ON. In this example we know R280 is being used.

ADDRESS	7	6	5	4	3	2	1	0
R0280							1	
R0281								
R0282							1	
R0283								
R0284								
R0285								
R0286								1
R0287								

Troubleshooting Messages with DISP

Once you know which address bit is ON (R280.1) then search for that coil in the ladder program to see what inputs could cause the alarm.

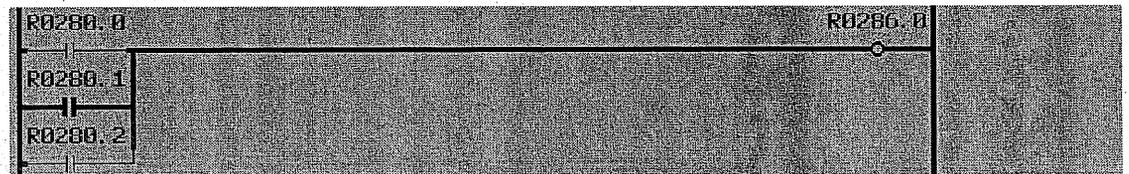


8.3.6. Master Alarm Circuit

Most machine builders include a master alarm circuit in their ladder. If **DISPB SUB41** is used, this circuit turns ON a common coil when any of the alarm coils (A) are activated. The common coil address can be used as a contact in any circuit that may be affected by alarms.

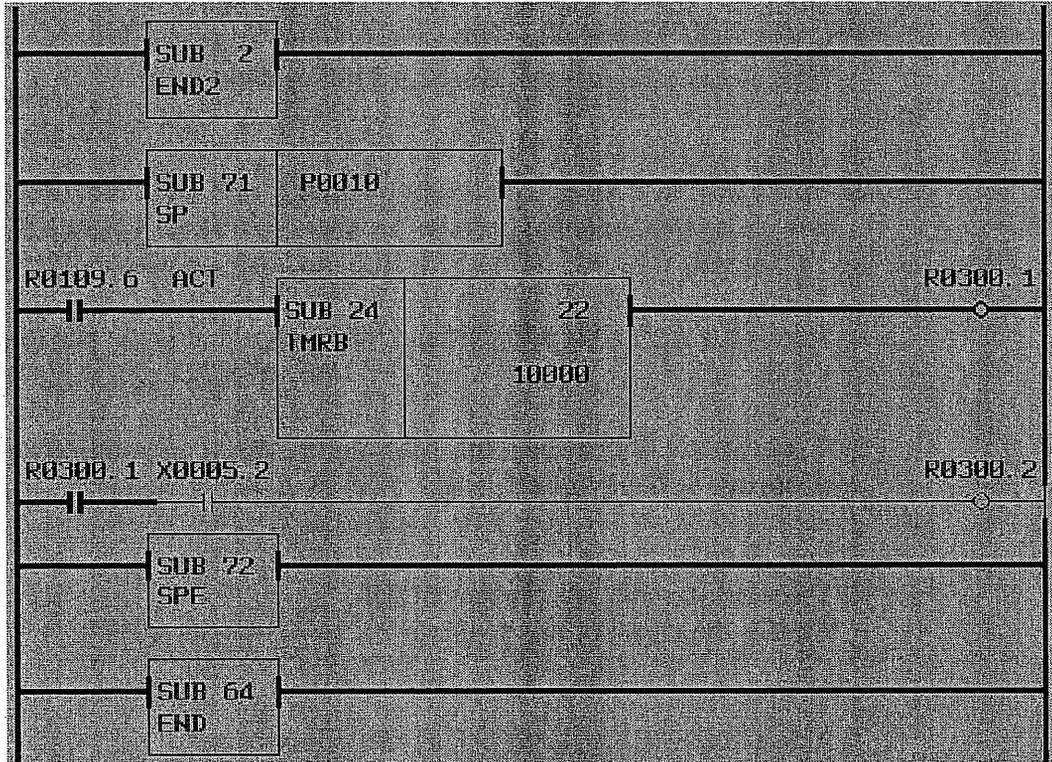


If **DISP SUB49** is used the master alarm circuit will turn ON a common coil address that will have input contacts that reflect the R addresses that are being used.



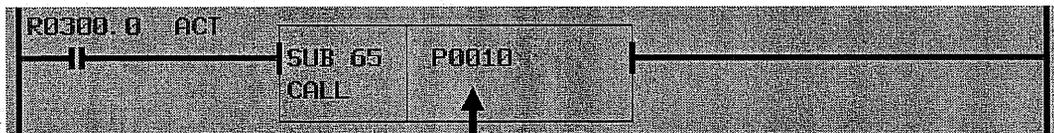
8.4. Ladder Subroutines

A sub-routine is a machine function that is performed outside of the typical machine operation. Sub-routines can only be called from the second ladder level. The sub-routine is located after the END2 function block, then starts at the designated function block SP SUB71, and ends with the SPE SUB72 function block. A SUB64 END function block is used at the end of the subroutines.



Operations like loading a pallet, loading a workpeice, or performing tool changes are good candidates to be separated into a sub-routine. Placing this logic in a sub-routine, reduces the amount of logic the PMC has to process during its' regular scan cycle.

In LEVEL 2 of the ladder a **SUB65 CALL** function block is what makes the ladder processing jump to the sub-routine.



Call sub-routine
P0010

When the ACT input turns OFF in level2, the sub-routine stops processing. For this reason the input must stay active until the sub-routine logic has been satisfied.

8.5. Exercise 5 – PMC Function Blocks

- 1) Which type of timer can be adjusted on the PMCPRM screen ?
SUB3 TMR SUB24 TMRB SUB54 TMRC

- 2) If you input 2100 on the parameter screen, for Timer 001, the value changes to 2064.
Why doesn't the parameter accept 2100 as valid input ?

- 3) How many M-codes are decoded by each SUB4 DEC function block ?
How many M-codes are decoded by each SUB25 DECB function block ?

- 4) Search for the SUB8 MOVE function block, what is the purpose of the mask bits ?

- 5) If A coils are not used for machine alarms, how can you find out which other addresses is being used ?

- 6) The machine will not change MODE
What is the cause of this problem ?

- 7) Alarm 1001 PLEASE WORK HARDER occurs.
What coil is used for this alarm, and which X input is used ?

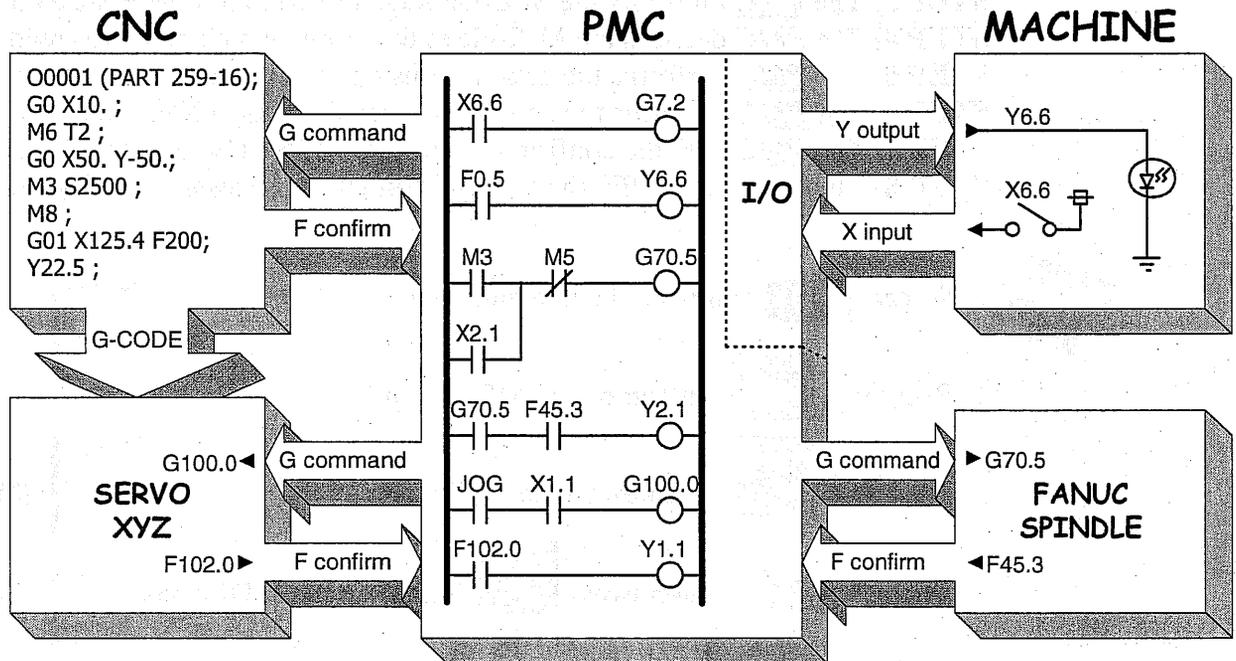
- 8) Switch to MEMORY mode, message MACHINE DOOR NOT CLOSED occurs.
What coil is used for this alarm, and which X input is used ?

- 9) Run program O0001, after 5 seconds alarm 1103 LUBE LEVEL EMPTY occurs.
What coil is used for this alarm, and which X input is used to sense the tank level ?

- 10) Run program O0001, after 5 seconds alarm 1002 CABINET OVERHEAT occurs.
What coil is used for this alarm, and which X input is used to sense the cabinet temperature ?

9. Auxiliary Functions – MSTB Codes

The AUXILIARY functions control machine side functions. These codes are read in the G-Code program by the CNC, however it is the PMCs' responsibility to process them. When the PMC has confirmed the auxiliary function was completed, it sends the "FIN" signal to the CNC, which allows the CNC to continue processing the G-Code program.



9.2. M-Codes

M-Codes are used to control machine side functions. The M-codes are specific to each machine and are determined by the machine builder. Depending on the functionality of the machine, the M-codes can vary widely. Some common M codes are listed below.

- M00 = Program STOP
- M01 = Option STOP
- M02 = Program RESET
- M03 = Spindle CW
- M04 = Spindle CCW
- M05 = Spindle Stop
- M06 = Tool Change
- M08 = Coolant ON
- M09 = Coolant OFF
- M19 = Spindle Orient
- M30 = Program RESET and REWIND

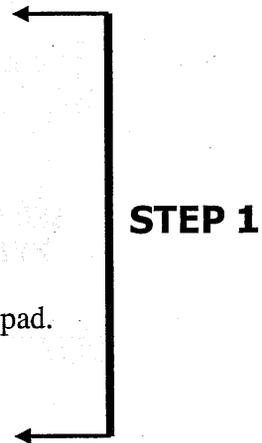
9.2.1. M-Code Processing

The **8 steps** for processing a M-Code are listed below. The CNC and PMC each have different tasks, but the PMC holds the primary responsibility for processing the code.

- STEP 1) The **CNC** reads the M-CODE in the G-CODE program
- STEP 2) The **CNC** puts the binary code into a known register, (F10)
- STEP 3) The **CNC** turns ON the M-Code flag, (F7.0) to tell the PMC a code is waiting.
- STEP 4) The **PMC** decodes the M-Code to determine which code was read. (F10)
- STEP 5) The **PMC** performs the action (turns on command Y or G address)
- STEP 6) The **PMC** confirms the action (reads confirmation X or F address)
- STEP 7) The **PMC** uses the confirmation to send "FIN" (G4.3) to the CNC
- STEP 8) The **CNC** turns OFF the flag and continues processing the G-Code program

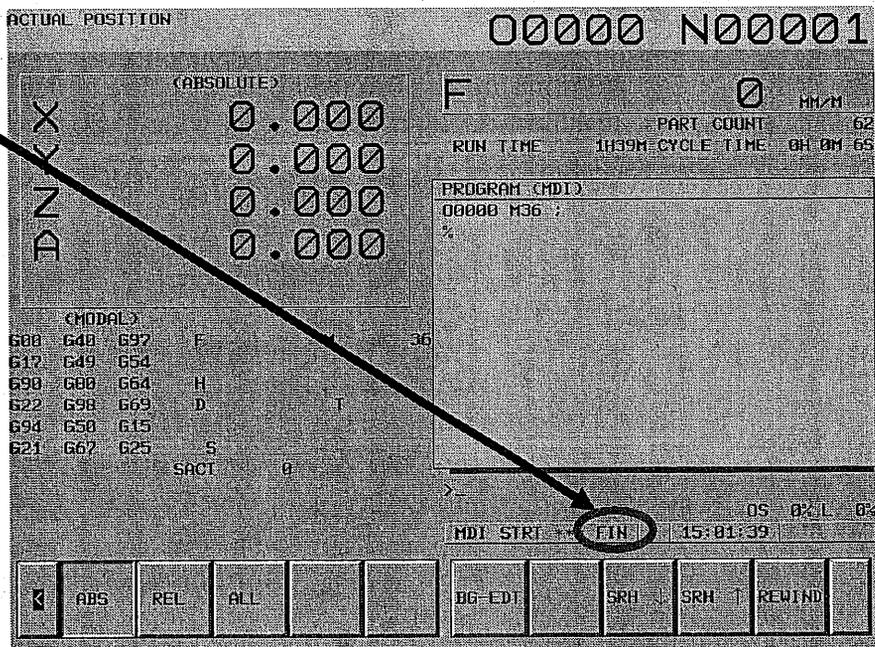


- 1) Select **MDI** mode on the operator panel
- 2) Press the **PROG** button on the MDI key pad.
- 3) Press the **MDI** soft key on the CRT menu
- 4) Enter "**M36** ; " then press **INSERT** button on the MDI keypad.
- 5) Press the **CYCLE START** button on the operator panel..



Notice that "**FIN**" appears on the status line.

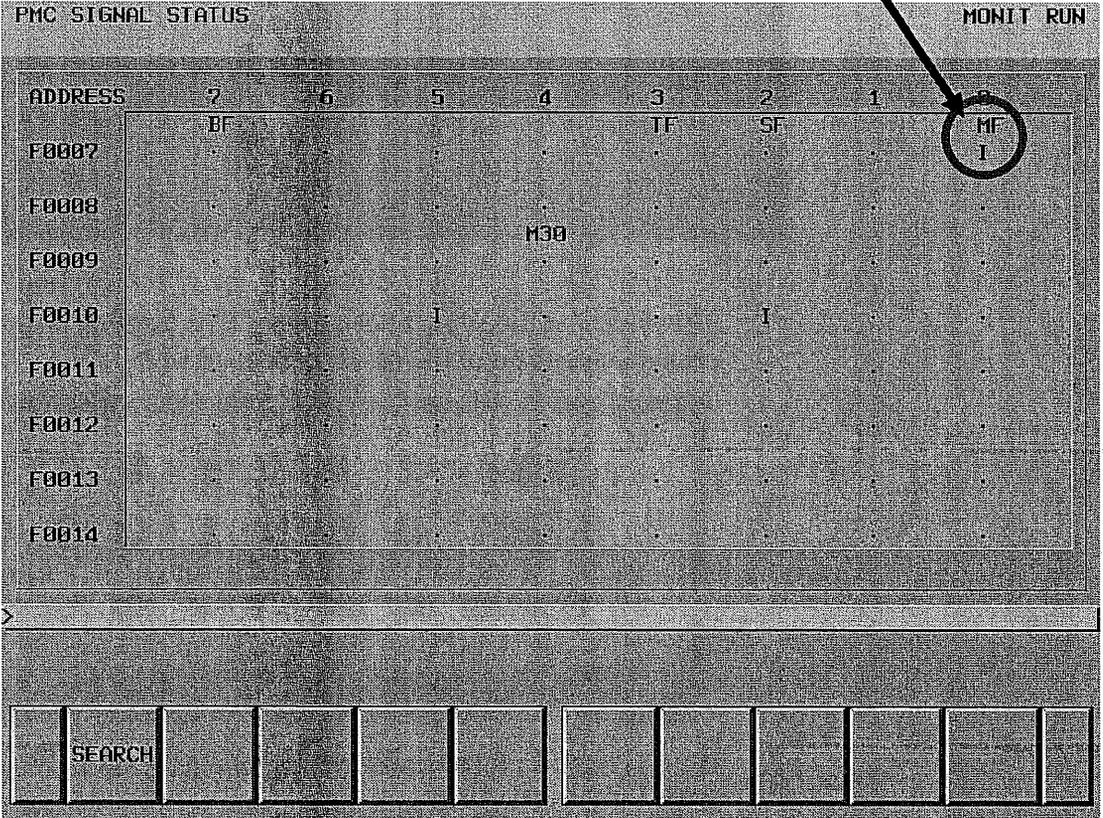
This indicates the CNC is waiting for the PMC to activate the FIN signal so it can continue processing the G-code program.



M-Code Processing

- 6) Press the  button on the MDI panel.
- 7) Press the  soft key on the CRT menu.
- 8) Press the  soft key on the CRT menu.
- 9) Press the  soft key on the CRT menu.
- 10) Enter "F7" on the MDI key pad.
- 11) Press the  soft key on the CRT menu.

Notice that F7.0 is ON. This is the M-Code Flag bit. The CNC turns it ON to tell the PMC that a M-Code needs to be processed.



ADDRESS	7	6	5	4	3	2	1	0
F0007	BF				TF	SF		MF I
F0008								
F0009				M30				
F0010			I			I		
F0011								
F0012								
F0013								
F0014								

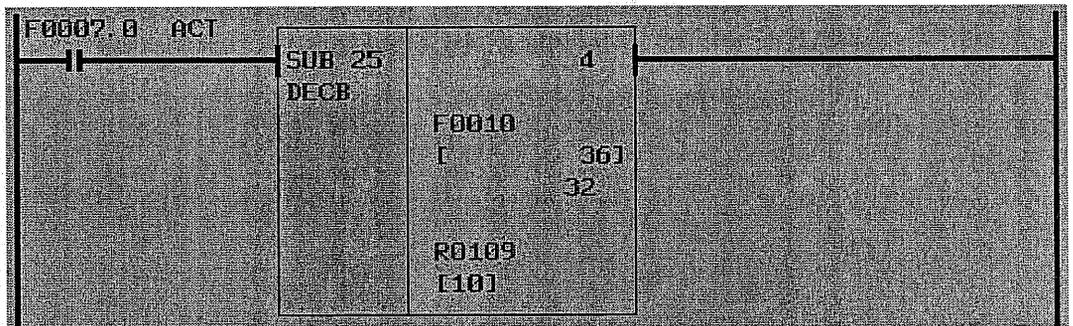
The CNC puts the M-Code into address F10, in binary code to tell the PMC which M-Code it read in the program.

M-Code Processing

The CNC read **M36** in the G-code program. Looking at address F10, bits 5 and bit 2 are ON. If you add the values of the bits, $32 + 4 = 36$.

BIT#	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>
BINARY	0	0	1	0	0	1	0	0
VALUE	<u>128</u>	<u>64</u>	<u>32</u>	<u>16</u>	<u>8</u>	<u>4</u>	<u>2</u>	<u>1</u>

STEP 4) The PMC uses address F10 to decode the M-code. This can be done with a DECB function block ...



This function block decodes address F10, starting with code 32, and sets the corresponding bit in the result address R109.

BIT#	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>0</u>
R109	0	0	0	1	0	0	0	0
M-Code	<u>M39</u>	<u>M38</u>	<u>M37</u>	<u>M36</u>	<u>M35</u>	<u>M34</u>	<u>M33</u>	<u>M32</u>

Bit 4 in address R109 corresponds with M-code M36. Viewing address R109 on the STATUS screen, you can see bit 4 is turned ON. This address will be used to perform the action.

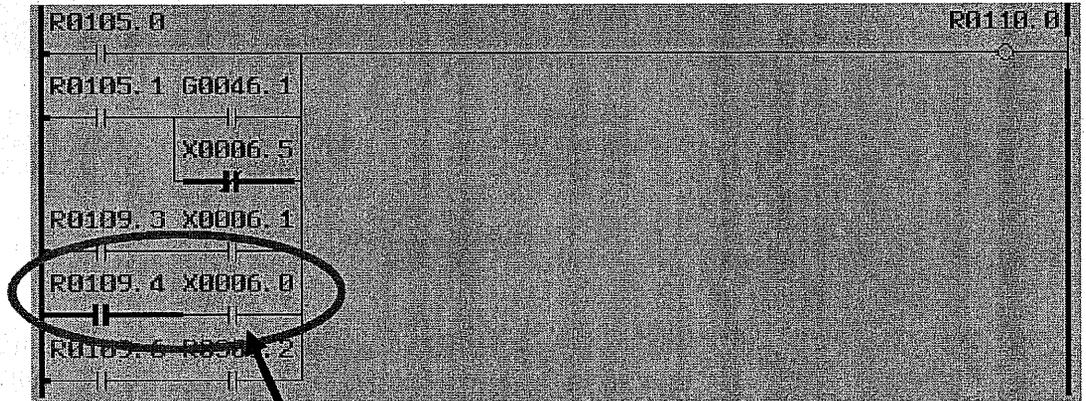
M-Code Processing

STEP 5) PMC performs the action. In this case M36 is used as a DOOR CLOSE command. Search the ladder for **R109.4** contacts.



R109.4 turns ON Y6.0 Address Y6.0 is wired to the air valve that enables the air ram which is used to close the door.

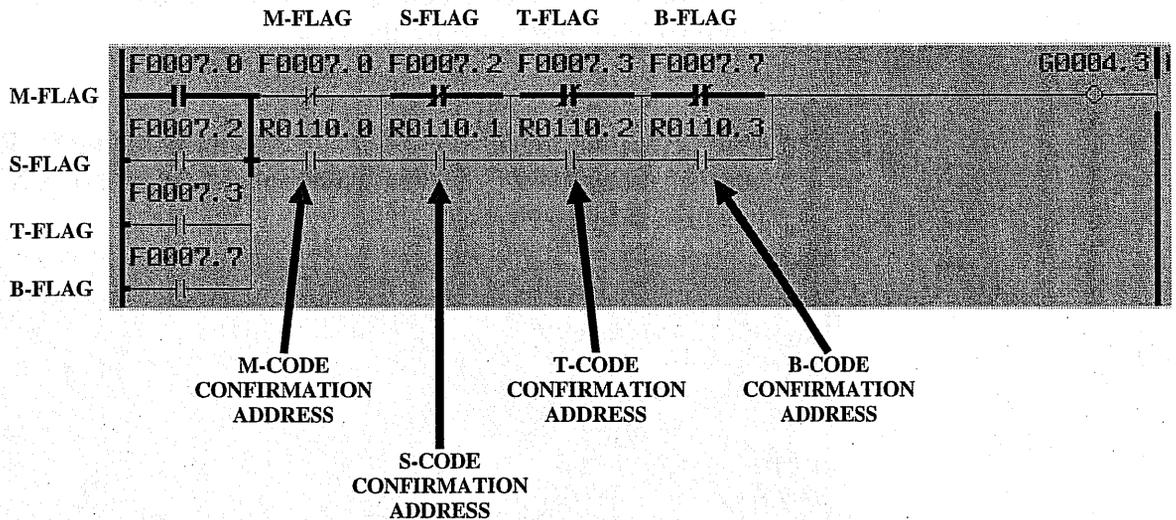
STEP 6) PMC confirms action took place. Continue searching for R109.4 in the confirmation circuit. The confirmation address will be a X address for machine side functions.



Here you can see that input address X6.0 will be used to confirm the door is closed. When X6.0 turns ON, the coil R110.0 will turn ON. This address will be used in the master FIN circuit, to send the FIN signal to the CNC.

M-Code Processing

STEP 7) The master FIN circuit is completed, causing “FIN” (G4.3) to be turned ON. Below is the recommended master FIN circuit. When the CNC turns ON the M-Code flag, the normally open F7.0 contact begins to conduct. The normally closed F7.0 contact will not conduct, so the only way for the circuit to complete is through the m-code confirmation address contact R110.0 below.



The confirmation addresses are determined by the machine builder and will vary from ladder to ladder, but the flag addresses will always be the for 16/18/21 controls.

STEP 8) When the CNC receives “FIN” (G4.3), it turns OFF the flag bit “MF” (F7.0), then continues processing the G-code program.

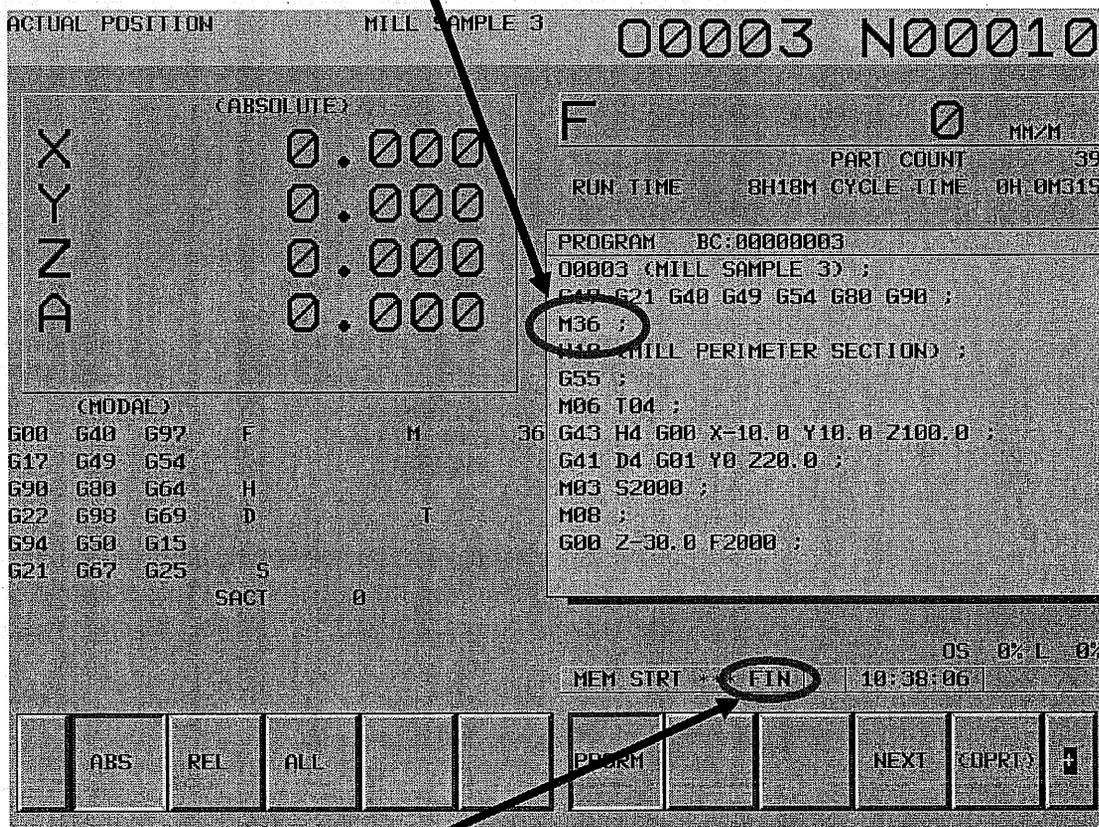
9.2.2. M-Code Troubleshooting

When troubleshooting a M-Code problem, it is often easier to follow the m-code processing steps backward to find the cause of a failure. It is also necessary to have the machine electrical diagrams, to determine which X and Y addresses are used to perform the function.



1) Press the  button on the MDI key pad.

This screen will show you the currently running program. The line highlighted in yellow is the command currently being executed.



Also notice that **“FIN”** is displayed on the status line of the screen. This indicates the CNC is waiting for the PMC to turn ON the “FIN” address (G4.3).

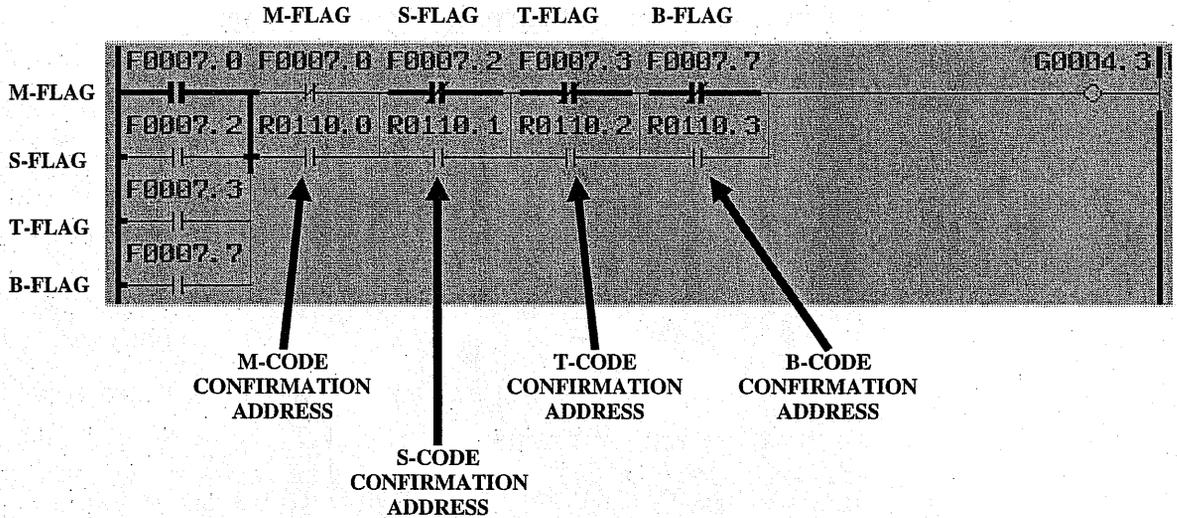
2) Press the  button on the MDI panel.

3) Press the  soft key on the CRT menu.

4) Press the  soft key on the CRT menu.

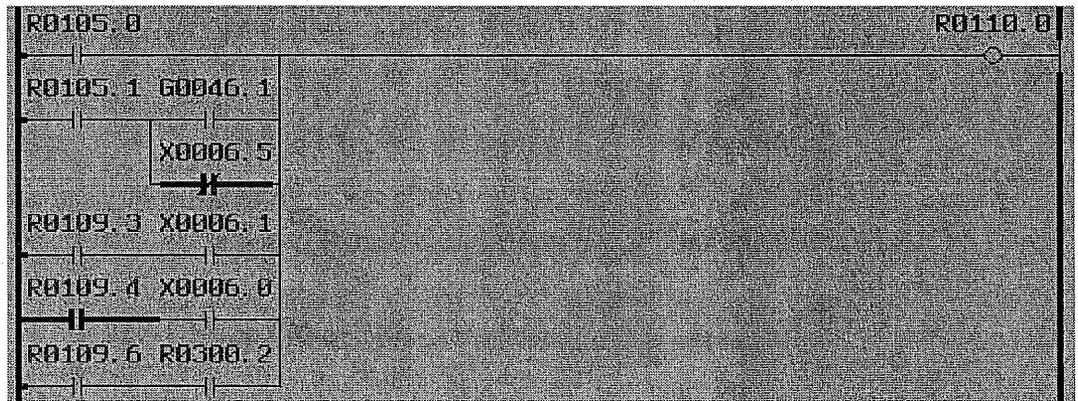
M-Code Troubleshooting

- 5) Press the  soft key on the CRT menu.
- 6) Enter “G4.3” on the MDI key pad.
- 7) Press the  soft key on the CRT menu.



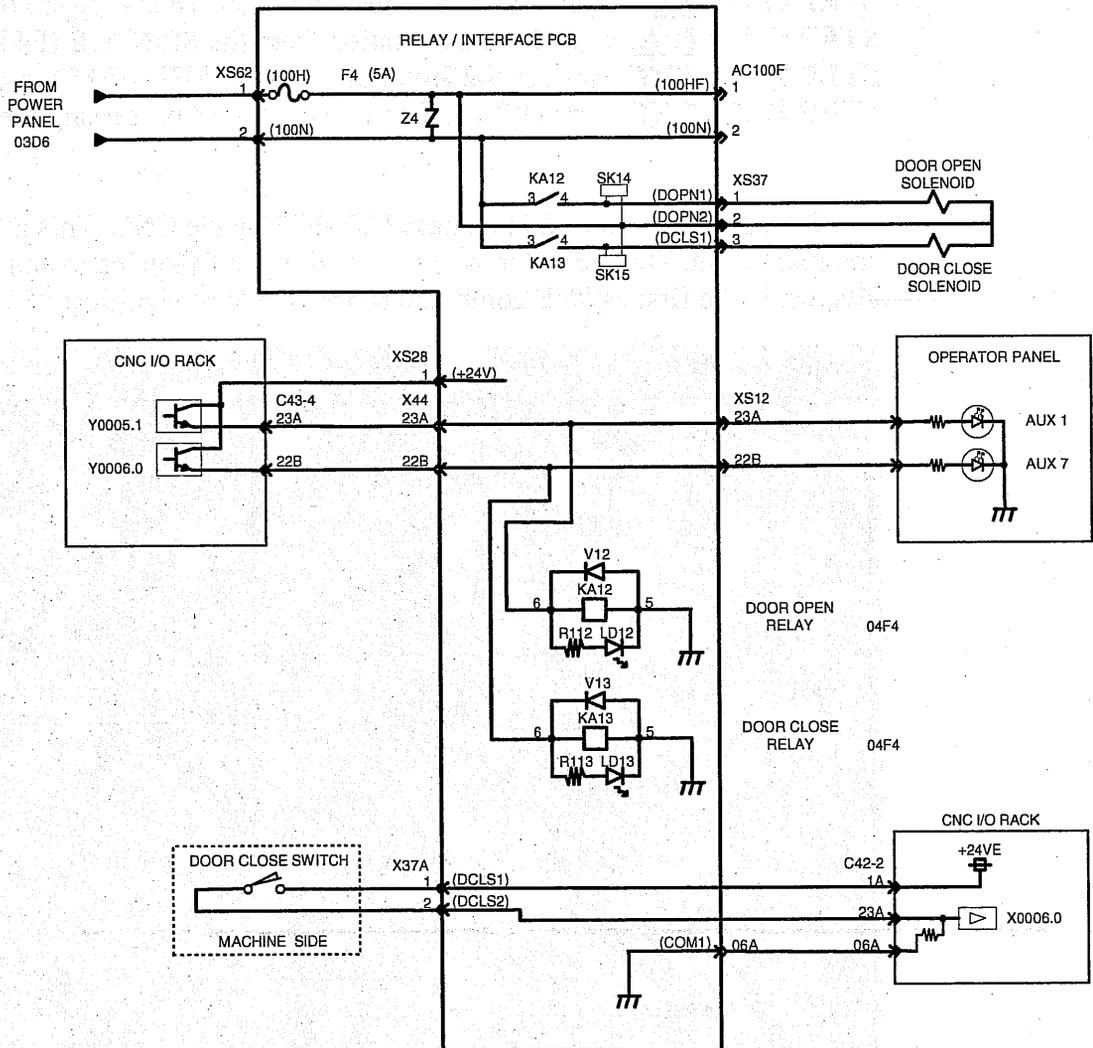
From this circuit you can see which flag is ON (MF=F7.0) and you can also see what address the machine builder has chosen for the confirmation address, (in this case R110.0). Search for the confirmation address coil.

- 8) Enter “R110.0” on the MDI key pad.
- 9) Press the  soft key on the CRT menu.



M-Code Troubleshooting

Here you can see only one R address contact is active. This contact is the M-Code address. Right next to the R109.4 contact is the confirmation address X6.0 This is what the PMC is waiting for. Search for the confirmation address in the electrical drawings for the machine, there should be a reference to the output address for this function.



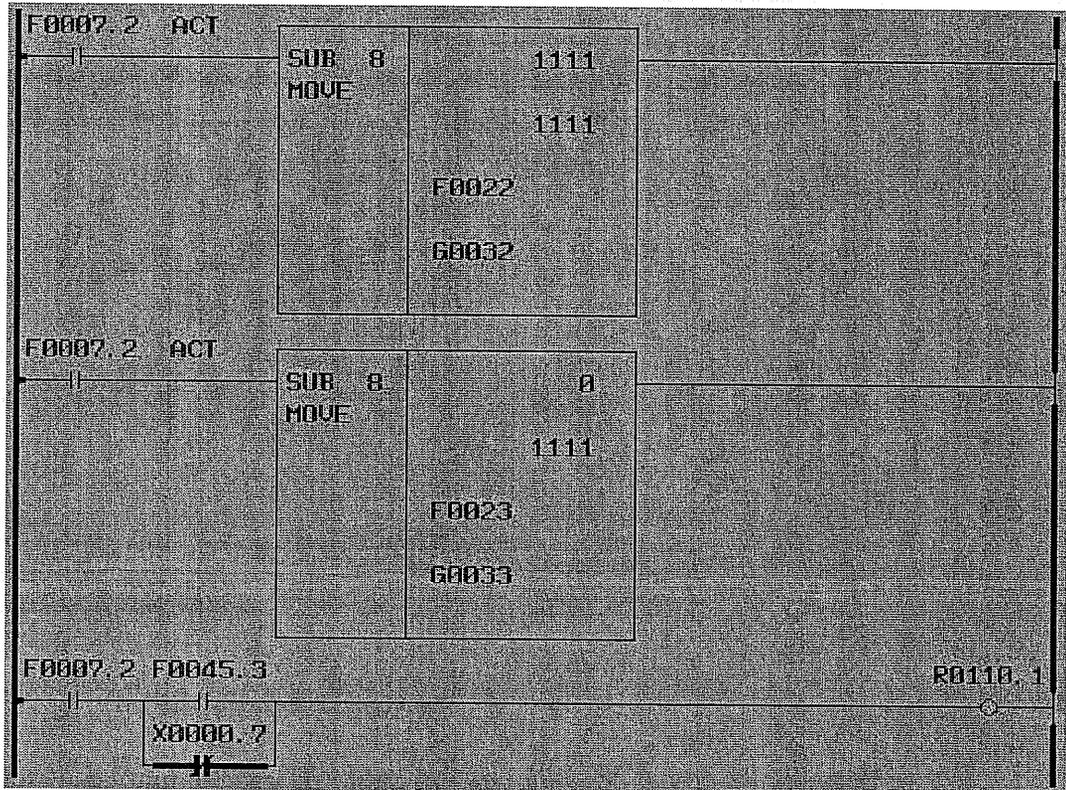
From the electrical drawing you can see Y6.0 is the output, and X6.0 is the input. Check to see the relay KA13 is ON, then check the status of the input X6.0

9.3. S-Code Processing

S-Codes are used to command spindle speed. Like M-Codes they are read by the CNC, but processed by the PMC.

- STEP 1) The **CNC** reads the S-CODE in the G-CODE program
- STEP 2) The **CNC** puts the binary code into a known register, (F22)
- STEP 3) The **CNC** turns ON the S-Code flag, (F7.2) to tell the PMC a code is waiting.
- STEP 4) The **PMC** transfers the S-Code from CNC (F22~F25) to the SPINDLE (G32)
- STEP 5) The **PMC** waits for confirmation from the SPINDLE (F45.3=SARA)
- STEP 6) The **PMC** uses the confirmation to send "**FIN**" (G4.3) to the CNC
- STEP 7) The **CNC** turns OFF the flag and continues processing the G-Code program

The S-Code data is placed in address F22~F25 by the CNC. This allows 32 bits for the command data. The second move command in the following example is only moving 4 bits, while the first MOVE command moves the least significant 8 bits.



The confirmation is performed with F7.2 (SF=S-Code flag from CNC, and the address F45.3 (SARA=Speed Arrival). Then address R110.1 is used in the master FIN circuit to confirm completion to the CNC.

9.4. T-Code Processing

T-Codes control the tool magazine (mill) or turret (lathe). They are used to call the tool number that is desired for machining. The process is very similar to M-code processing. **The 8 steps for processing a T-Codes are listed below.** The CNC and PMC each have different tasks, but the PMC holds the primary responsibility for processing the code.

- STEP 1) The CNC reads the T-CODE in the G-CODE program
- STEP 2) The CNC puts the binary code into a known register, (F26)
- STEP 3) The CNC turns ON the T-Code flag, (F7.3) to tell the PMC a code is waiting.
- STEP 4) The PMC compares the T-Code with the current tool number to determine if the magazine needs to rotate, and which direction. (ROTB function)
- STEP 5) The PMC performs the action (turns on command Y to rotate magazine)
- STEP 6) The PMC confirms the action (compares current magazine tool with desired)
- STEP 7) The PMC uses the confirmation to send "FIN" (G4.3) to the CNC
- STEP 8) The CNC turns OFF the flag and continues processing the G-Code program

Below each of the steps in this process are described in more detail ...

STEP 1) The CNC reads the T-CODE in the G-CODE program.

```

PROGRAM BC:00000005
00003 (MILL SAMPLE 3) :
G17 G21 G40 G49 G54 G80 G90 :
N10 (MILL PERIMETER SECTION) :
G33 :
M06 T04 :
G40 G41 G00 X-10.0 Y10.0 Z100.0 :
G41 D4 G01 Y0 Z20.0 :
M03 S2000 :
M08 :
G00 Z-30.0 F2000 :
G01 X10.0 :
    
```

STEP 2) The CNC puts the binary code into a known register, (F26)

ADDRESS	7	6	5	4	3	2	1	0
F0026						1		
F0027								
F0028								
F0029								
F0030								
F0031								
F0032								
F0033								

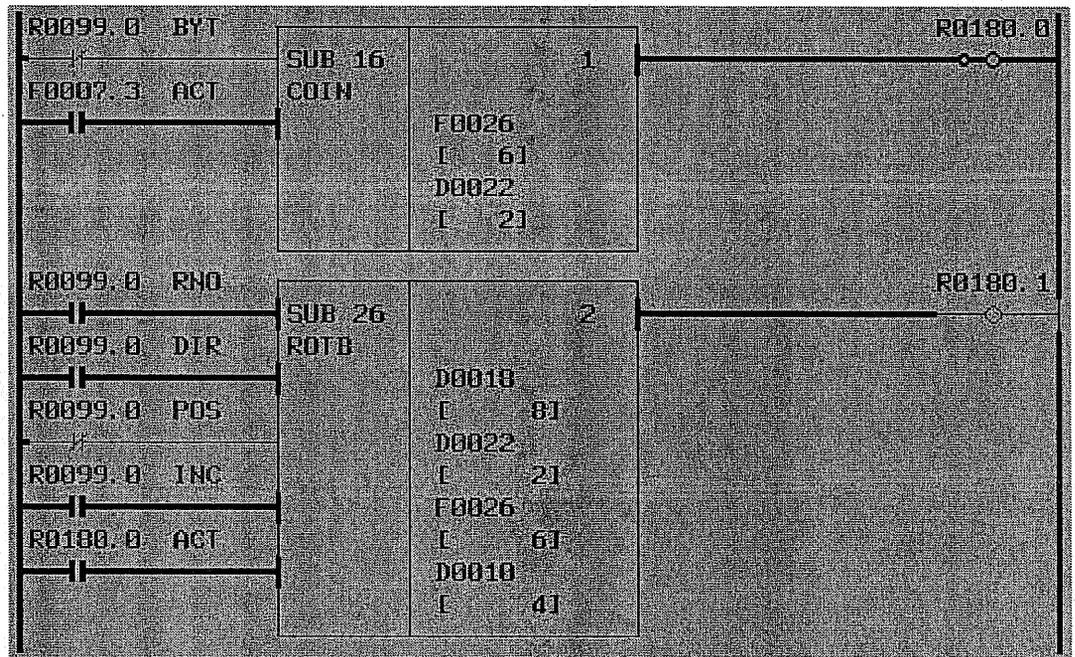
T-Code Processing

STEP 3) The CNC turns ON the T-Code flag, (F7.3) to tell the PMC a code is waiting.

ADDRESS	7	6	5	4	3	2	1	0
F0007	BF				TF I	SF		MF I
F0008								
F0009				M30				
F0010						I	I	
F0011								
F0012								
F0013								
F0014								

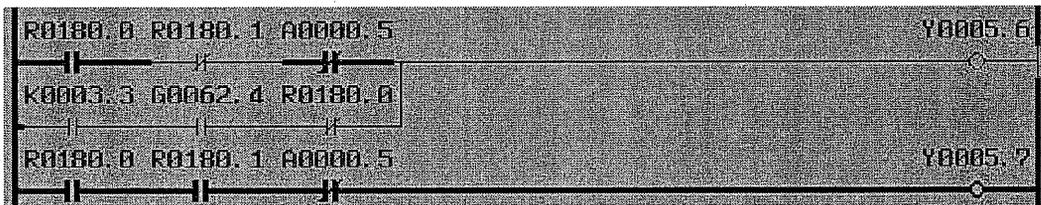
Notice the M-Code Flag is ON also (F7.0), because a M and T code were both read in the same G-code program line.

STEP 4) The PMC compares the T-Code with the current tool number to determine if the magazine needs to rotate (COIN function), and which direction it needs to rotate to get to the desired tool. (ROTB function)



T-Code Processing

STEP 5) The PMC turns ON the Y output to rotate the tool magazine. In this example Y5.6 rotates the magazine CW, and Y5.7 rotates the magazine CCW. The address R180.0 indicates that the magazine needs to rotate, and the address R180.1 determines which direction it should rotate.



STEP 6) The PMC confirms the magazine is at the correct tool, if F7.3 (T-Flag) is ON, and the address R180.0 is OFF (magazine does not need to rotate) then R180.2 turns ON to activate the FIN to the CNC.



STEP 7) The PMC uses the confirmation R180.2 to send “FIN” (G4.3) to the CNC. Address R110.2 is used in the master FIN circuit to confirm T-Code processing is finished.

STEP 8) The CNC turns OFF the T-Flag (F7.2) and continues processing the G-Code program.

9.5. PMC Controlled Axis

The typical axis on a CNC are the X Y and Z. These axis appear on the position display screen. It is possible for the PMC to control servo axis also. These axis typically do not appear on the CNC position display screen. Typically PMC controlled axis are used to control a tool magazine (T-Code) or some other device on the machine side (B-Code).

10. Ladder Editing

With the 16/18 model B, C, and *i*-series controls, ladder editing is possible by using a LADDER EDIT CARD or by using Windows based software on a laptop PC called FAPT LADDER III. These ladder edit devices can be purchased through the machine builder. At the time of purchase, most machine builders will request that you sign a legal agreement stating you are responsible for the machines operation since the ladder logic determines how the machine will function.

10.1. 16/18 Ladder Edit Card

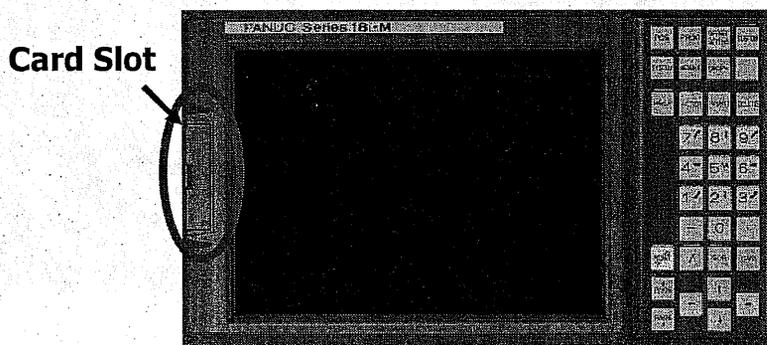
The ladder edit card is a FLASH memory card which contains software that allows the ladder logic to be changed. This software can only be executed by the CNC, not in a PC.



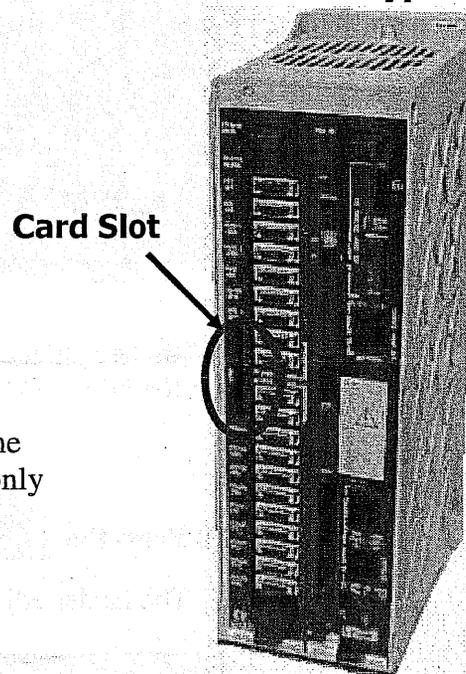
10.1.1. Installing the Ladder Edit Card

The ladder edit card is installed in the memory card slot on the MAIN CPU board if the standalone type CNC is used. If the CNC is a LCD mounted type *i*-series then the edit card can be installed into the card slot next to the LCD display.

LCD Mounted



Stand-alone type



In the case of the *i*-series stand-alone control unit, there is a card slot on the LCD display and also one on the main CPU card. The ladder edit card can only be used in the main CPU card slot.

Press **SYSTEM** **PMC** **PMCPRM** then **SETTING** keys.

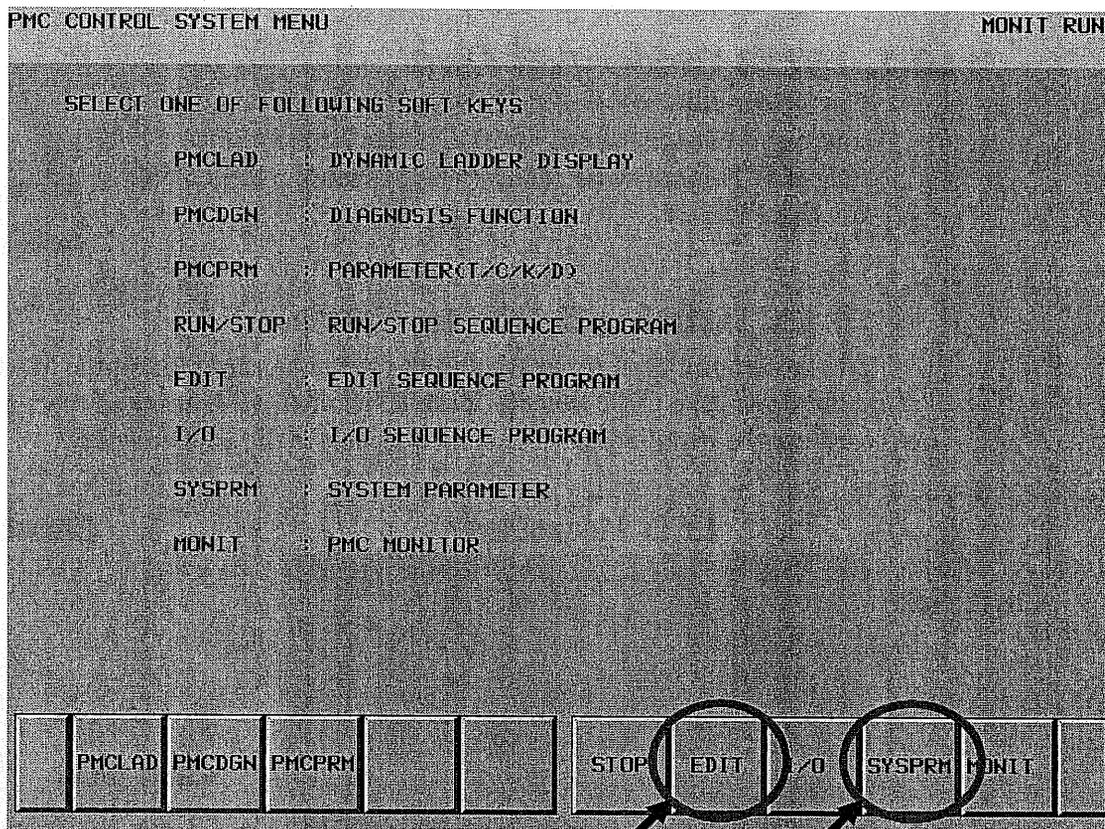
And confirm that the **PROGRAMMER ENABLE** setting is set to "1".

Installing the Ladder Edit Card



1) Press the  button on the MDI panel.

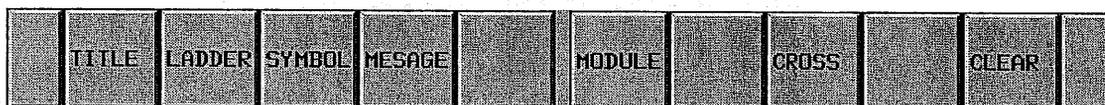
2) Press the  soft key on the CRT menu.



With the ladder edit card installed, the EDIT and SYSPRM buttons should appear on the initial PMC menu.

3) Press the  button on the CRT menu.

The ladder edit menu should appear ...

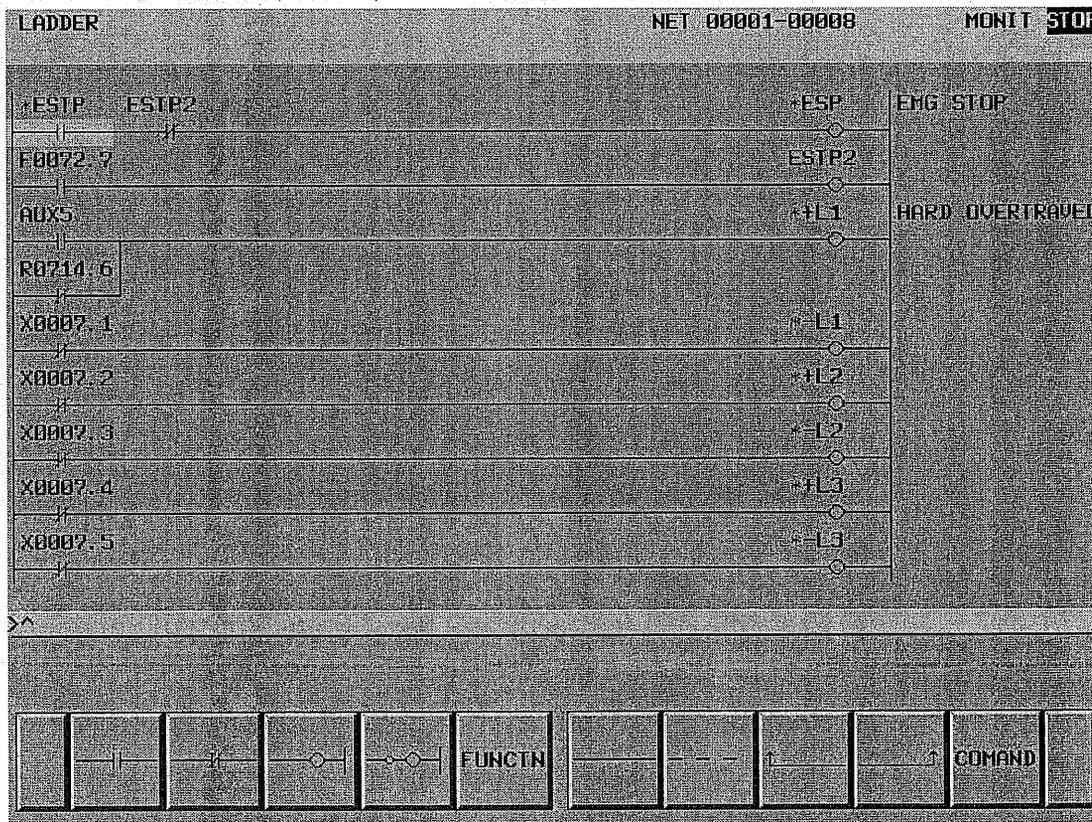


10.1.2. Altering Existing Ladder Logic

Once the ladder edit card is installed, ladder changes can be made on the control.



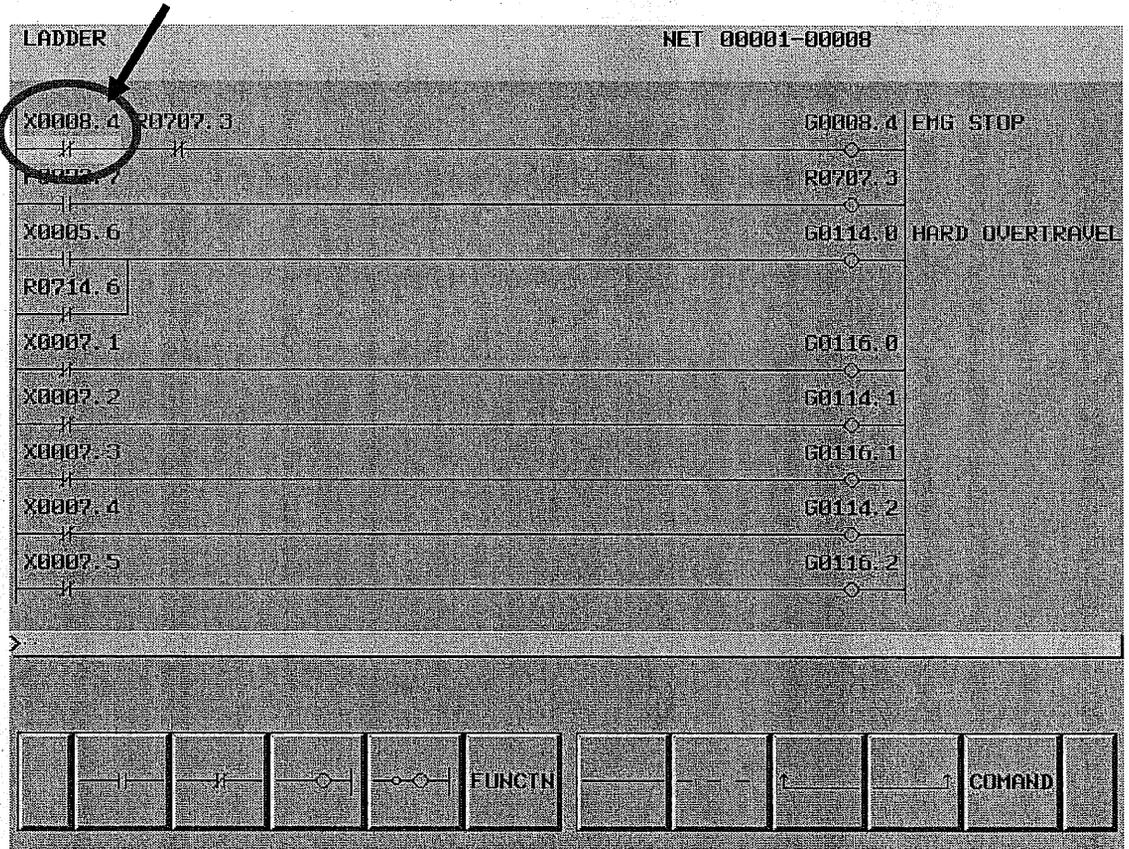
- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  button on the CRT menu.
- 4) Press the  button on the CRT menu.



- 5) Press the  soft key on the CRT menu, to change the EDIT menu.
- 6) Press the  soft key on the CRT menu, to change SYMBOL to ADDRESS

Altering Existing Ladder Logic

- 7) Press the  NORMALLY OPEN contact soft key on the CRT menu, to change X8.4 from a normally closed contact to a normally open contact.



- 8) Press the  left menu soft key 2 times, you will return to the main menu.

- 9) Press the  soft key, to begin execution of the ladder.

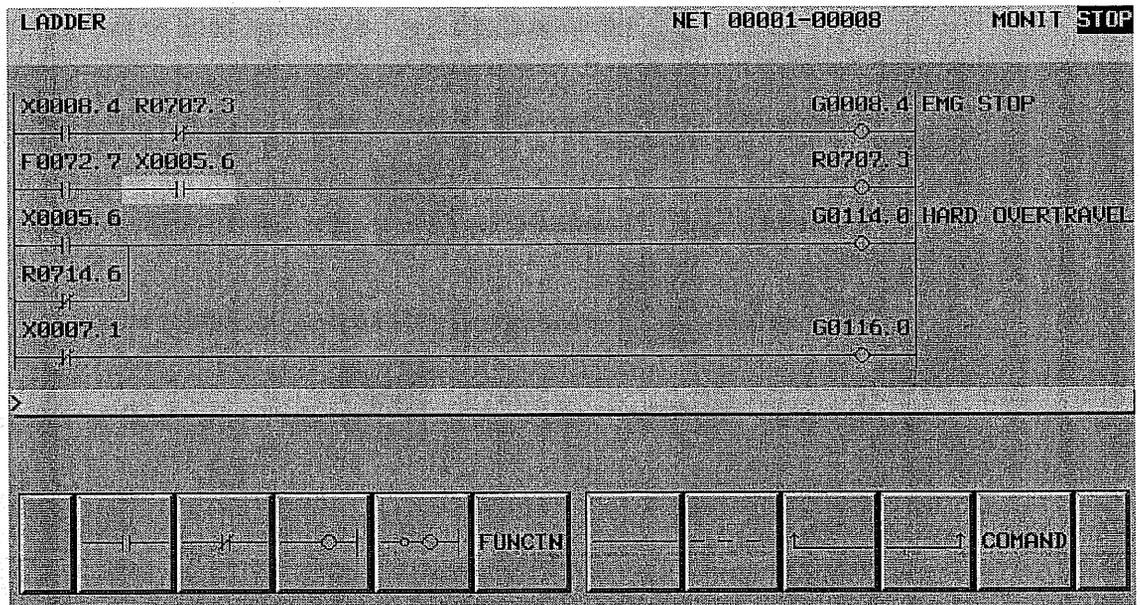
- 10) Press the  soft key, to view the change.

IMPORTANT NOTE : Do NOT turn off CNC power. The changes made are not saved until the ladder program is written to FLASH ROM. See the section about saving changes to flash-rom.

- 11) Press the  left menu soft key, you will return to the main menu.

Altering Existing Ladder Logic

- 12) Press the  button on the CRT menu.
- 13) Press the  button on the CRT menu.
- 14) Press the  button on the MDI panel.
- 15) Press the  button on the MDI panel.
- 16) Press the  NORMALLY OPEN contact soft key on the CRT menu,
- 17) Enter “X5.6” then press , this will change the contact address.

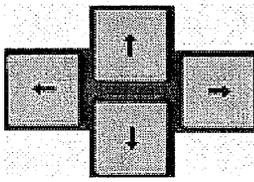


- 18) Press the  left menu soft key 2 times, you will return to the main menu.
- 19) Press the  soft key, to begin execution of the ladder.
- 20) Press the  soft key, to view the change.
- 21) Press the  button, on the operator panel.

10.1.3. INSNET - Adding New Ladder Logic

Then **INSNET** button allows you to add a space for a new line of ladder logic. You can insert a large space, then when the ladder is RUN, the extra space will automatically be removed.



1) Use the  button on the MDI panel, position the cursor on the line above where you would like to add some space for the new ladder line.

2) Press the  soft key on the ladder edit menu.

3) Press the  soft key a 3 times to enter a few line spaces.

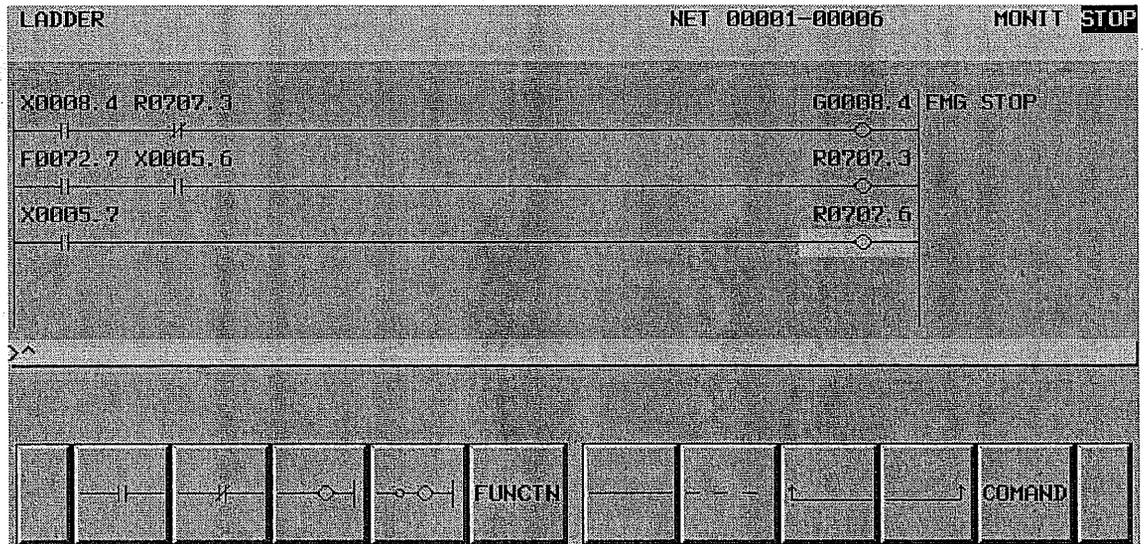
4) Press the  left menu soft key, to change back to the edit menu.

5) Press the  normally open contact soft key on the ladder edit menu.

6) Enter “X5.7” then press , the contact will be labeled.

7) Press the  output coil soft key on the ladder edit menu.

8) Enter “R707.6” then press , the contact will be labeled.



INSNET - Adding New Ladder Logic

9) Press the  left menu soft key 2 times, you will return to the main menu.

10) Press the  soft key, to begin execution of the ladder.

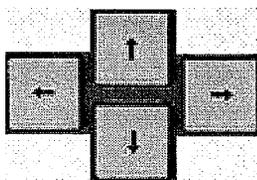
11) Press the  soft key, to view the change.

12) Press the  button, on the operator panel, watch the logic work.

10.1.4. INSNET - Adding a New Function Block

To insert a function block, first you must make space for the function block to fit into. Once the space is available, you must start by entering a contact. All function blocks have a contact before them.



1) Use the  button on the MDI panel, position the cursor on **the line above** where you would like to add some space for the new ladder line.

2) Press the  soft key on the ladder edit menu.

3) Press the  soft key a 4 times to enter a few line spaces.

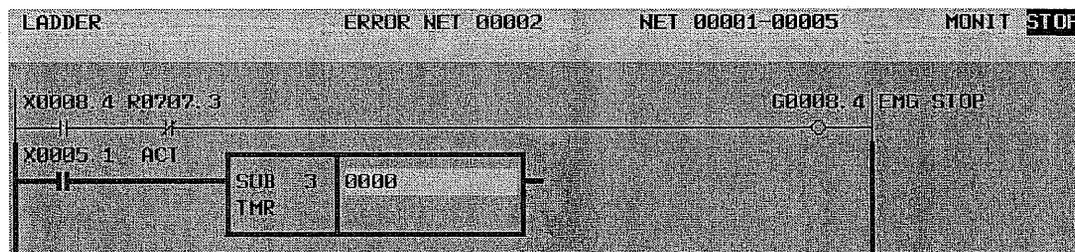
4) Press the  left menu soft key, to change back to the edit menu.

5) Press the  normally open contact soft key on the ladder edit menu.

6) Enter “X5.1” then press , the contact will be labeled.

The function block can be added now. If you know the SUB number of the function block, just enter it then press the FUNCTN soft key. If you do not know the SUB number then press the FUNCTN soft key and a list of all the sub functions will appear.

7) Enter “3” then press , the function block appears.



8) Enter “20” then press , to assign the timer number.

9) Press the  output coil soft key on the ladder edit menu.

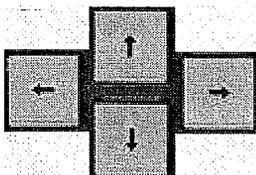
10) Enter “R212.0” then press , the contact will be labeled.

10.1.5. DELNET - Deleting Ladder Logic

Then **DELNET** button allows you to delete ladder nets. A single line or multiple lines can be deleted at one time.



1) Use the



arrow buttons on the MDI panel, position the cursor on the line you want to delete.

2) Press the

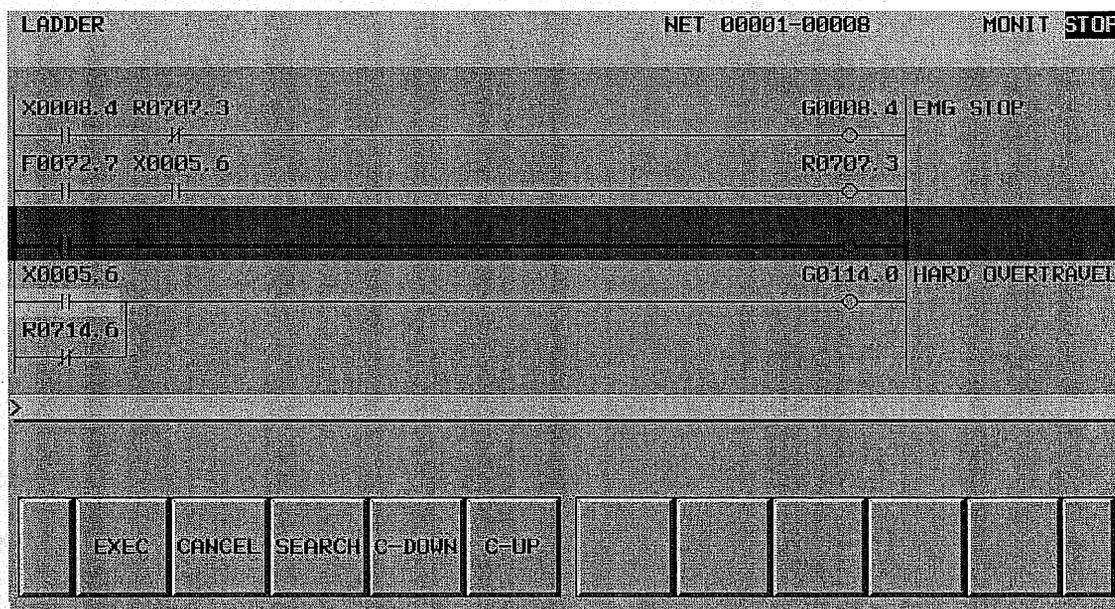


soft key on the ladder edit menu.

3) Press the



soft key, the ladder rung will turn RED.



4) Press the

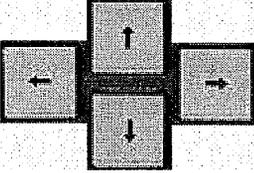


soft key on the ladder edit menu, the highlighted line is deleted.

10.1.6. Deleting a Single Contact

It is possible to delete a single contact or function block without deleting the entire ladder net.



1) Use the  arrow buttons on the MDI panel, position the cursor on the ladder element you want to delete.

LADDER NET 00001-00008 MONIT STOP

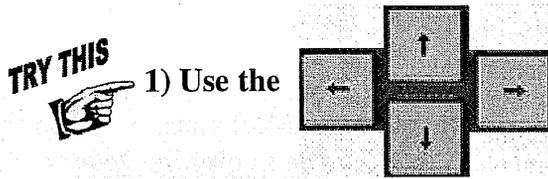
X0008.4	R0707.3	G0008.4	EMG STOP
F0072	X0005.6	R0707.3	
X0005.6		G0114.0	HARD OVERTRAVEL
R0714.6			
X0007.1		G0116.0	
X0007.2		G0114.1	
X0007.3		G0116.1	
X0007.4		G0114.2	
X0007.5		G0116.2	

Control Panel: 

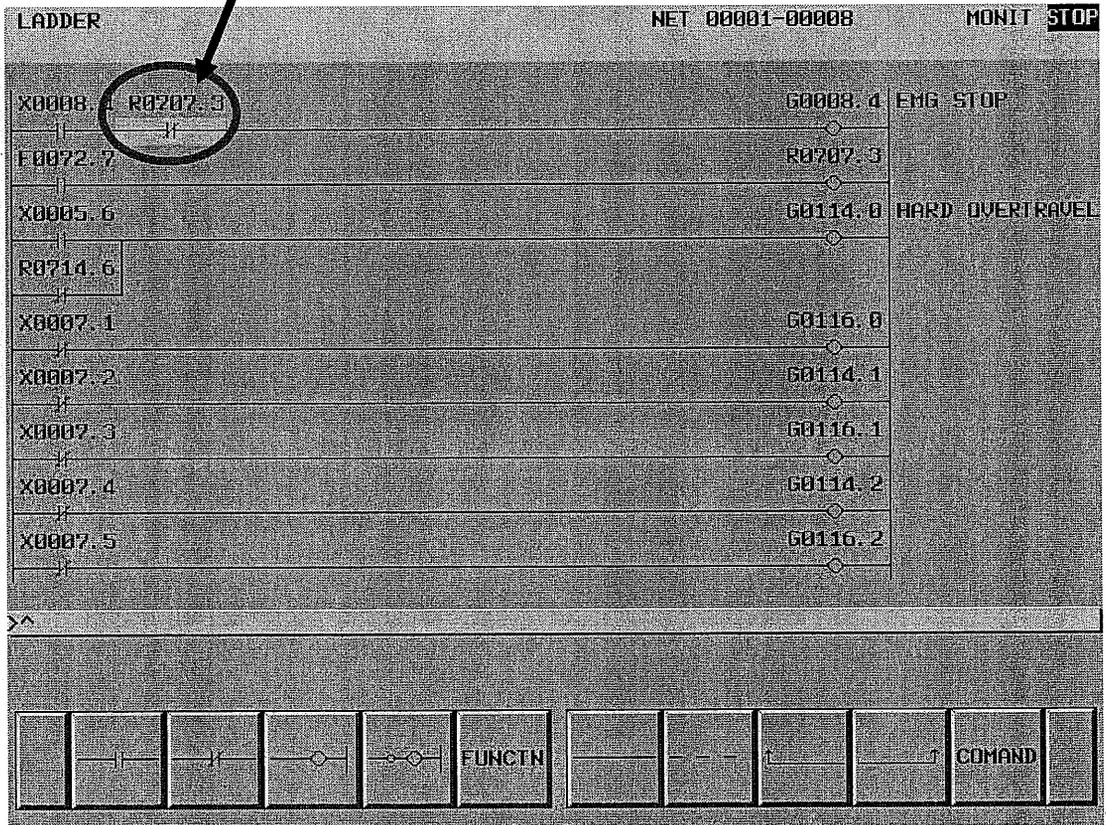
2) Press the  soft key to delete the contact, or press  to replace it.

10.1.7. INSERT – Inserting a Single Element

To insert a contact between exiting contacts, the INSERT button is used.



1) Use the arrow buttons on the MDI panel, position the cursor on the ladder element you want to SHIFT RIGHT.



2) Press the  soft key on the ladder edit menu.

3) Press the  soft key, the menu choices will change to   

INSNET = Insert network, INSLIN = Insert line, INSELM = Insert element

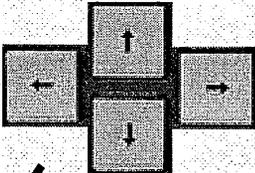
4) Press the  soft key, the R707.3 contact will shift to the right.

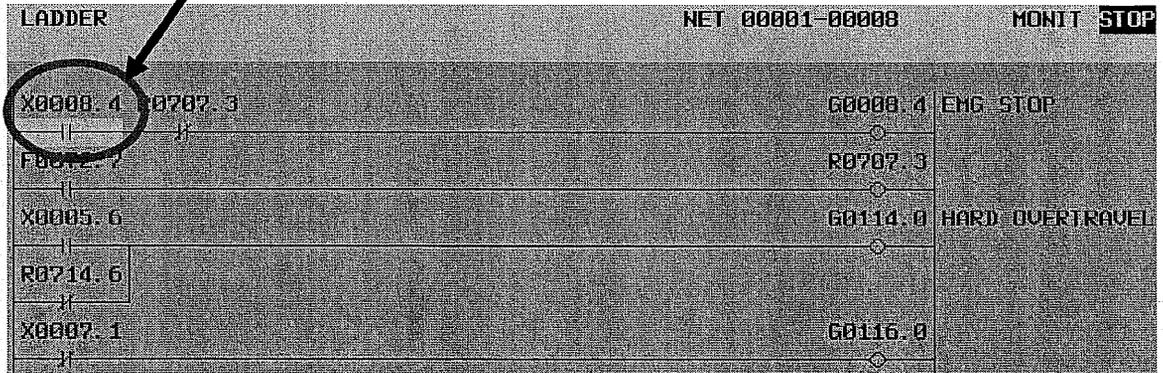
Now another contact can be added.

10.1.8. COPY – Copy and Paste Ladder Rungs

The **COPY** function allows you to copy ladder rungs then paste them to a different part of the ladder. This is useful when similar logic is used for parallel functions.



1) Use the  arrow buttons on the MDI panel, position the cursor on the beginning ladder rung.

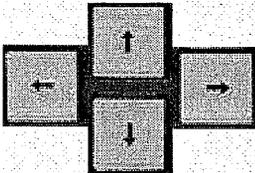


2) Press the  soft key on the ladder edit menu.

3) Press the  soft key, the ladder rung will highlight.

4) Press the  soft key, to select the next ladder rung also.

5) Press the  soft key, to end the ladder rung selection.

6) Use the  arrow buttons on the MDI panel, position the cursor where you would like to paste the logic.

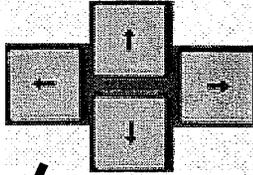
7) Press the  soft key, to paste the copied logic.

10.1.9. MOVE – Move Ladder Rungs

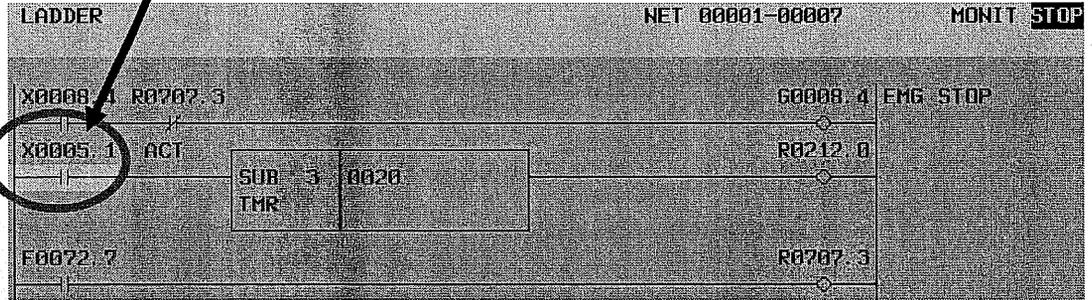
The **MOVE** function allows you to rearrange ladder rungs. This is useful to organize the ladder to have a logical flow. Suppose you want to move the timer that was added earlier to level 2 ...



1) Use the



arrow buttons on the MDI panel, position the cursor on the beginning ladder rung.



2) Press the



soft key on the ladder edit menu.

3) Press the



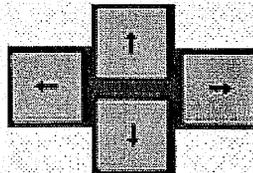
soft key, the ladder rung will highlight.

5) Press the

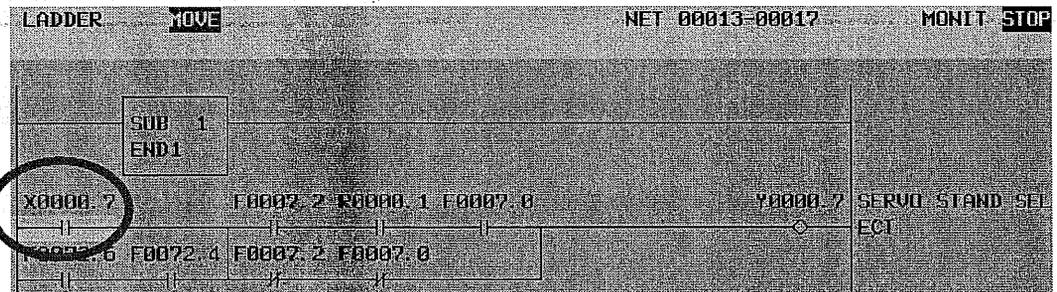


soft key, to end the ladder rung selection.

6) Use the



arrow buttons on the MDI panel, position the cursor where you would like to move the logic.



7) Press the



soft key, to move the logic.

10.1.10. Adding SYMBOL Comments

Ladder contact and coil comments can be added to easy ladder troubleshooting. The machine builder may or may not add these comments, they are not required.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  button on the CRT menu.
- 4) Press the  button on the CRT menu.

PMC SYMBOL & COMMENT MONIT STOP

ADDRESS	SYMBOL	COMMENT
G0004.3	FIN	MASTER FIN
G0007.2	ST	
G0008.0	*IT	INTERLOCKS
G0008.4	*ESP	EMG STOP
G0008.5	*SP	
G0008.6	RRW	
G0008.7	ERS	
G0018.0	HS1A	HANDLE SELECT
G0018.1	HS1B	
G0018.2	HS1C	
G0019.4	MP1	HANDLE MULTIPLIER
G0019.5	MP2	
G0019.7	RT	
G0029.6	*SSTP	
G0043.0	MD1	MODE SELECT

R212.0

- 5) Enter "R212.0" then press , the contact ADDRESS is added.
- 6) Enter "BTIME" then press , the contact SYMBOL is added.
- 7) Enter "BREAK TIME" then press , the contact COMMENT is added.
- 8) Press the  left menu soft key, to change back to the edit menu.
- 9) Press the  button on the CRT menu, to view the added comments.

10.1.11. Adding Machine Alarm Messages



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  button on the CRT menu.
- 4) Press the  button on the CRT menu.

PMC MESSAGE		MONIT STOP
NO.	MESSAGE	
A000.0	1000 CALL MAINTENANCE	
A000.1	1001 PLEASE WORK HARDER	
A000.2	1002 CABINET OVERHEAT	
A000.3	1003 LUBE LEVEL EMPTY	
A000.4	1004 MACHINE MELTDOWN	
A000.5	1005 TOOL CODE FAULT	
A000.6		
A000.7		
A001.0	2001 CABINET TEMPERATURE HIGH	
A001.1	2002 LUBE LEVEL LOW	
A001.2	2001 SPINDLE TOOL NO=[1220;F0026]	
A001.3		
A001.4		
A001.5		
A001.6		

>1015 BIG TROUBLE

- 5) Press the  button on the MDI panel, to highlight A001.5
- 6) Enter “1015 BIG TROUBLE” then press 

Now when the coil A1.5 is active in the ladder, and the DISPB function is activated, then the message will be displayed.

10.1.12. Adding I/O Link Modules



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  button on the CRT menu.
- 4) Press the  button on the CRT menu.

The I/O module configuration screen will appear ...

PMC I/O MODULE MONIT STOP

ADDRESS	GROUP	BASE	SLOT	NAME	ADDRESS	GROUP	BASE	SLOT	NAME
X009					Y009				
X010	0	0	1	CM141	Y010	0	0	1	CM040
X011	0	0	1	CM141	Y011	0	0	1	CM040
X012	0	0	1	CM141	Y012	0	0	1	CM040
X013	0	0	1	CM141	Y013	0	0	1	CM040
X014	0	0	1	CM141	Y014				
X015	0	0	1	CM141	Y015				
X016	0	0	1	CM141	Y016				
X017	0	0	1	CM141	Y017				
X018	0	0	1	CM141	Y018				
X019	0	0	1	CM141	Y019				
X020	0	0	1	CM141	Y020	1	0	5	OR16G
X021	0	0	1	CM141	Y021	1	0	5	OR16G
X022	0	0	1	CM141	Y022				
X023	0	0	1	CM141	Y023				

GROUP BASE SLOT NAME =

>1. 0. 5. OR16G

INPUT
SEARCH
DELETE
IOSTRT

- 5) Press the  button on the MDI panel, to highlight address Y020
- 6) Enter “1.0.5.OR16G” then press 

You have just added a I/O module. The control now believes there is a **AOR16G** module installed at **GROUP1, BASE0, in SLOT5**.

10.1.13. Saving Ladder Changes to FROM

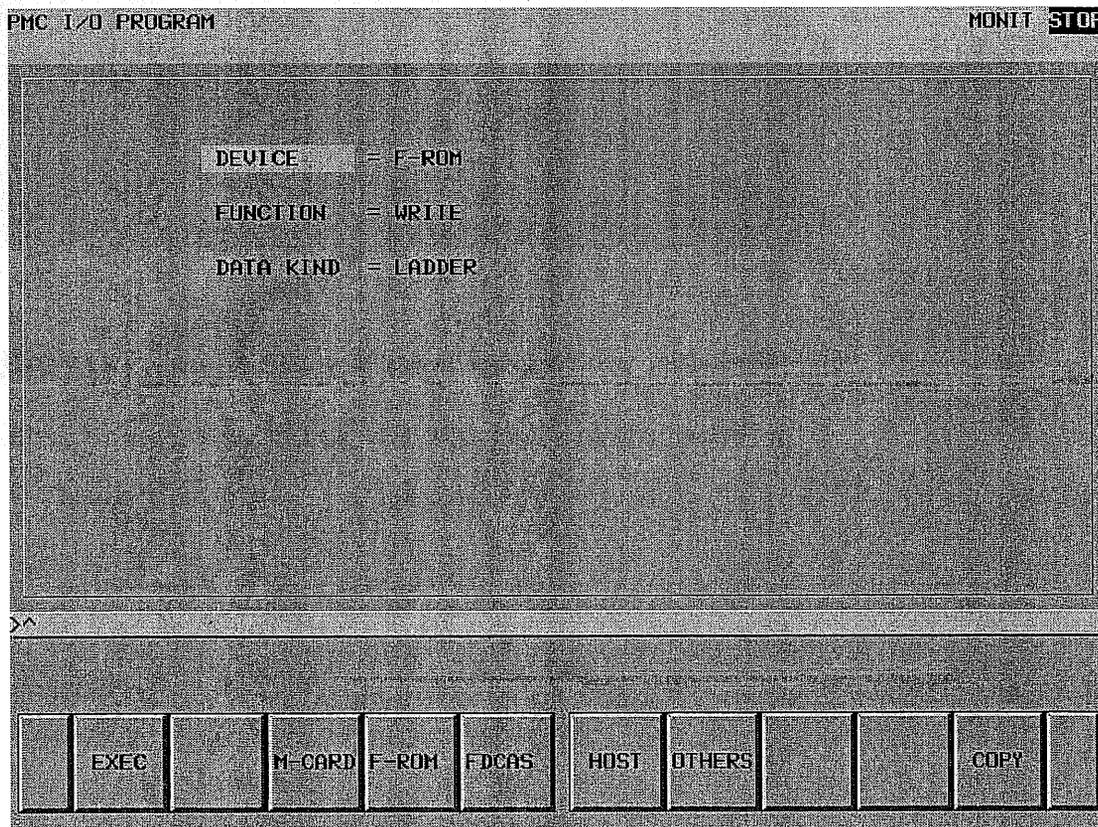
When ladder editing is completed and proper operation has been proven the **changes should be saved to FLASH ROM for permanent storage**. Each time the control powers ON, it transfers the ladder from FROM to DRAM memory where it runs from. Follow the steps below to save your changes.



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key on the CRT menu.
- 3) Press the  soft key on the CRT menu, the **PMC I/O** screen appears.

If the I/O soft key is not visible, set **PROGRAMMER ENABLE** on the PMCPRM SETTING screen.

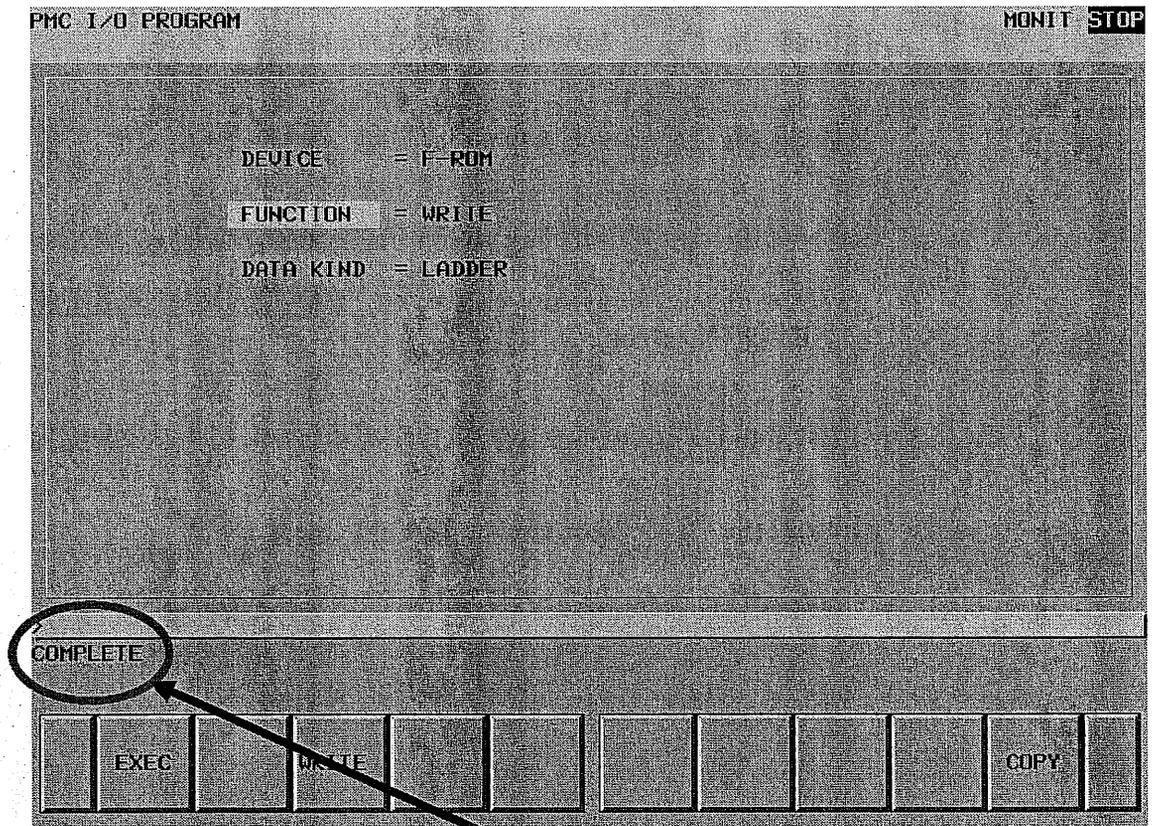
- 4) Use the  arrow key on the MDI panel, to highlight **DEVICE** on the CRT.
- 5) Press the  soft key on the CRT menu.



Saving Ladder Changes to FROM

6) Press the  soft key on the CRT menu.

7) On the CNC, press the  soft key on the CRT menu.



The ladder will be saved, when done the message **COMPLETE** will appear.

It is now safe to power OFF/ON the CNC control without loosing your changes.

10.2. Exercise 6 – Ladder Editing

- 1) What is the purpose of M-CODES ?
S-CODES ?
T-CODES ?
- 2) What addresses does the CNC use to tell the PMC a M-Code needs to be processed ?
- 3) What does “FIN” mean when it appears on the CNC status line of the display ?
- 4) Who can you purchase ladder edit software from ?
- 5) When editing ladder logic, what is the most important consideration ?
- 6) Add a machine alarm, X5.3 activates alarm **1016 HYDRAULIC PRESSURE LOW**
Make sure it latches ON, and can only be cleared by the RESET button.
- 7) Add symbols in the ladder diagram to LABEL the alarm coil created above.
- 8) Add logic to check the feed rate override switch. If it is set to any position other than 100% then generate an operator message (not alarm) **SET FEEDRATE TO 100%**
- 9) The message above will not cause the CNC to stop. Add logic to activate the FEED HOLD signal when the message occurs.
- 10) Add an M-Code to the ladder M63. This m-code will be used to control a conveyor system. When M63 is read, Y5.1 turns ON, 2 seconds later Y5.2 turns ON, 2 seconds later Y5.3 turns ON, 2 seconds later Y5.4 turns ON. After 5 seconds the conveyors turn OFF in reverse order with a 2 second delay between each action. (Y5.1, Y5.2, Y5.3 and Y5.4 already exist in the ladder. Add a parallel circuit)

THE UNIVERSITY OF CHICAGO

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IN CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF _____

CHICAGO, ILLINOIS

A. FS16/18 PMC Address List

This section contains the G and F address lists for the 16/18/21 controls. There are 3 lists, the first is a **LIST by FUNCTION**, the second is a **LIST by SYMBOL**, and the third is a **LIST by ADDRESS**. The same information is given in each of the 3 lists, they are just organized differently to make it easier to find what you are looking for.

A.1 List by Function

This table lists the PMC addresses by **FUNCTION** name and in alphabetical order.

○	: Available
●	: Available only with 2-path control
-	: Unavailable

Function	Signal name	Symbol	Address	T series	M series
Abnormal load detection	Servo axis abnormal load detected signal	ABTQSV	F090#0	○	○
	First-spindle abnormal load detected signal	ABTSP1	F090#1	○	○
	Second-spindle abnormal load detected signal	ABTSP2	F090#2	○	○
	Abnormal load detection for the third spindle	ABTSP3	F090#3	○	○
Actual spindle speed output	Actual spindle speed signal	AR0 to AR15	F040,F041	○	-
ALARM signal	Alarm signal	AL	F001#0	○	○
	Battery alarm signal	BAL	F001#2	○	○
Angular axis control / arbitrary angular axis control	Perpendicular/angular axis control disable signal	NOZAGC	G063#5	○	○
Automatic tool length measurement (M series)/Automatic tool offset (T series)	Measuring position reached signal	XAE	X004#0	○	○
		YAE	X004#1	-	○
		ZAE	X004#2	-	○
		ZAE	X004#1	○	-
Auxiliary function lock	Auxiliary function lock signal	AFL	G005#6	○	○
	Auxiliary function lock check signal	MAFL	F004#4	○	○
Butt-type reference position return setting	Torque limit reach signals for butt-type reference position setting	CLRCH1 to CLRCH8	F180	○	○
Canned cycle (M series)/Canned cycle for hole machining (T series)	Tapping signal	TAP	F001#5	○	○
Canned cycle (T series)/Multiple repetitive canned cycle (T series)	Chamfering signal	CDZ	G053#7	○	-
Chopping function	Chopping hold signal	*CHLD	G051#7	-	○
	Chopping start signal	CHPST	G051#6	-	○
	Chopping feedrate override signals	*CHP8 to *CHP0	G051#0 to #3	-	○
	Chopping-in-progress signal	CHPMD	F039#2	-	○
	Chopping cycle signal	CHPCYL	F039#3	-	○

Function	Signal name	Symbol	Address	T series	M series
Chuck/tailstock barrier (T series)	Tail stock barrier select signal	*TSB	G060#7	○	-
CNC ready signal	CNC Ready signal	MA	F001#7	○	○
	Servo ready signal	SA	F00#6	○	○
Constant surface speed control	Constant surface speed signal	CSS	F002#2	○	○
Controlled axes detach	Controlled axis detach signal	DTCH1 to DTCH8	G124	○	○
	Controlled axis detach status signal	MDTCH1 to MDTCH8	F110	○	○
Cs contour control	Cs contour control change signal	CON	G027#7	○	○
	Cs contour control change completion signal	FSCSL	F044#1	○	○
Custom macro	Input signal for custom macro	UI000 to UI015	G054,G055	○	○
	Output signal for custom macro	UO000 to UO015	F054,F055	○	○
		UO100 to UO131	F056 to F059	○	○
Cycle start/feed hold	Cycle start signal	ST	G007#2	○	○
	Feed hold signal	*SP	G008#5	○	○
	Automatic operation signal	OP	F000#7	○	○
	Cycle start lamp signal	STL	F000#5	○	○
	Feed hold lamp signal	SPL	F000#4	○	○
Data input/output functions based on the I/O Link	Power Mate read/write inprogress signal	BGION	G092#2	○	○
	Power Mate read/write alarm signal	BGIALM	G092#3	○	○
	Power Mate background busy signal	BGEN	G092#4	○	○
	I/O Link confirmation signal	IOLACK	G092#0	○	○
	I/O Link specification signal	IOLS	G092#1	○	○
	Group number specification signals	SRLNI0 to SRLNI3	G091#0 to #3	○	○
	Slave I/O Link selection signal	IOLNK	F177#0	○	○
	Slave external read start signal	ERDIO	F177#1	○	○
	Slave read/write stop signal	ESTPIO	F177#2	○	○
	Slave external write start signal	EWIO	F177#3	○	○
	Slave program selection signal	EPRG	F177#4	○	○
	Slave macro variable selection signal	EVAR	F177#5	○	○
	Slave parameter selection signal	EPARM	F177#6	○	○
	Slave diagnosis selection signal	EDGN	F177#7	○	○
	Group number output signals	SRLNO0 to SRLNO3	F178#0 to #3	○	○
External read start signal	EXRD	G058#1	○	○	

Function	Signal name	Symbol	Address	T series	M series
Data input/output functions based on the I/O Link	External punch start signal	EXWT	G058#3	○	○
	External read/punch stop signal	EXSTP	G058#2	○	○
	Background busy signal	BGEACT	F053#4	○	○
	Read/punch in-progress signal	RPBSY	F053#2	○	○
	Read/punch alarm signal	RPALM	F053#3	○	○
Direct operation by PMC/MMC	Direct operation select signal	DMMC	G042#7	○	○
DNC operation	DNC operation select signal	DNCI	G043#5	○	○
	DNC operation selection confirm signal	MRMT	F003#4	○	○
Dry run	Dry run signal	DRN	G046#7	○	○
	Dry run check signal	MDRN	F002#7	○	○
Emergency stop	Emergency stop signal	*ESP	G008#4	○	○
		*ESP	G008#4	○	○
Erase CRT screen display / Automatic erase CRT screen display	Automatic erase CRT screen display cancel signal	*CRTOF	G062#1	○	○
Error detect (T series)	Error detect signal	SMZ	G053#6	○	-
External data input	Data signal for external data input	ED0 to ED15	G000,G001	○	○
	Address signal for external data input	EA0 to EA6	G002#0 to #6	○	○
	Read signal for external data input	ESTB	G002#7	○	○
	Read completion signal for external data input	EREND	F060#0	○	○
	Search completion signal for external data input	ESEND	F060#1	○	○
External deceleration	External deceleration signal	*+ED1 to *+ED8	G118	○	○
		*-ED1 to *-ED8	G120	○	○
External I/O device control	External read start signal	EXRD	G058#1	○	○
	External punch start signal	EXWT	G058#3	○	○
	External read/punch stop signal	EXSTP	G058#2	○	○
	Background editing signal	BGEACT	F053#4	○	○
	Read/punch busy signal	RPBSY	F053#2	○	○
	Read/punch alarm signal	RPALM	F053#3	○	○

Function	Signal name	Symbol	Address	T series	M series
External key input	External key input mode selection signal	ENBKY	G066#1	○	○
	Key code signal	EKC0 to EKC7	G098	○	○
	Key code read signal	EKSET	G066#7	○	○
	Key code read completion signal	EKENB	F053#7	○	○
	Key input disable signal	INHKY	F053#0	○	○
	Program screen display mode signal	PRGDPL	F053#1	○	○
External motion function (M series)	External operation signal	EF	F008#0	-	○
Feedrate override	Feedrate override signal	*FV0 to *FV7	G012	○	○
External program input	External program input start signal	MINP	G058#0	○	○
External workpiece number search	Workpiece number search signal	PN1, PN2, PN4, PN8, PN16	G009#0 to 4	○	○
Floating reference position return	Floating reference position return end signal	FRP1 to FRP8	F116	○	○
Follow-up	Follow-up signal	*FLWU	G007#5	○	○
F1-digit feed (M series)	F1-digit feed select signal	F1D	G016#7	-	○
High-precision contour control by RISC (M series)	HPCC mode signal	MHPCC	F066#6	-	○
	HPCC operation signal	EXHPCC	F066#7	-	○
High-speed skip signal	High-speed skip status signal	HDO0 to HDO7	F122	○	○
High-speed M/S/T/B interface	Miscellaneous function completion signal	MFIN	G005#0	○	○
	Spindle function completion signal	SFIN	G005#2	○	○
	Tool function completion signal	TFIN	G005#3	○	○
	2nd auxiliary function completion signal	BFIN	G005#4	○	-
		BFIN	G005#7	-	○
	2nd M function completion signal	MFIN2	G004#4	○	○
	3rd M function completion signal	MFIN3	G004#5	○	○
	External operation signal for high-speed interface	EFD	F007#1	-	○
External operation function completion signal	EFIN	G005#1	-	○	
Inch/metric conversion	Inch input signal	INCH	F002#0	○	○
Index table indexing function (M series)	B-axis clamp signal	BCLP	F061#1	-	○
	B-axis clamp completion signal	*BECLP	G038#7	-	○
	B-axis unclamp signal	BUCLP	F061#0	-	○
	B-axis unclamp completion signal	*BEUCP	G038#6	-	○

Function	Signal name	Symbol	Address	T series	M series
In-position check	In-position signal	INP1 to INP8	F104	○	○
Input of offset value measured A (T series)	Position record signal	PRC	G040#6	○	-
Input of tool offset value measured B (T series)	Tool offset value write mode select signal	GOQSM	G039#7	○	-
	Tool offset value write signal	+MIT1,+MIT2	X004#2,#4	○	-
		-MIT1,-MIT2	X004#3,#5	○	-
	Tool offset number select signal	OFN0 to OFN5,OFN6	G039#0 to #5,G040#0	○	-
	Workpiece coordinate system shift value write mode select signal	WOQSM	G039#6	○	-
	Workpiece coordinate system shift value write signal	WOSET	G040#7	○	-
Interlock/start lock	Start lock signal	STLK	G007#1	○	-
	Interlock signal	*IT	G008#0	○	○
	Interlock signal for each axis	*IT1 to *IT8	G130	○	○
	Interlock signal for each axis and direction	+MIT1, +MIT2	X004#2,#4	○	-
		-MIT1,-MIT2	X004#3,#5	○	-
	Interlock signal for each axis and direction	+MIT1 to +MIT4	G132#0 to #3	-	○
-MIT1 to -MIT4		G134#0 to #3	-	○	
Interruption type custom macro	Interrupt signal for custom macro	UINT	G053#3	○	○
Jog feed/incremental feed	Feed axis and direction selection signal	+J1 to +J8	G100	○	○
		-J1 to -J8	G102	○	○
	Manual feedrate override signal	*JV0 to *JV15	G010,G011	○	○
	Manual rapid traverse selection signal	RT	G019#7	○	○
Look-ahead control	Lock-ahead control mode signal	G08MD	F066#0	-	○
Machine lock	All-axis Machine lock signal	MLK	G044#1	○	○
	Each-axis machine lock signal	MLK1 to MLK8	G108	○	○
	All-axis machine lock check signal	MMLK	F004#1	○	○
Manual absolute on/off	Manual absolute signal	*ABSM	G006#2	○	○
	Manual absolute check signal	MABSM	F004#2	○	○
Manual handle feed	Manual handle feed axis selection signal	HS1A to HS1D	G018#0 to #3	○	○
		HS2A to HS2D	G018#4 to #7	○	○
		HS3A to HS3D	G019#0 to #3	-	○
	Manual handle feed amount selection signal (incremental feed signal)	MP1,MP2	G019#4,#5	○	○

Function	Signal name	Symbol	Address	T series	M series
Manual handle interruption	Manual handle interrupt axis selection signal	HS1IA to HS1ID	G041#0 to #3	○	○
		HS2IA to HS2ID	G041#4 to #7	○	○
		HS3IA to HS3ID	G042#0 to #3	-	○
Manual linear/circular interpolation	Feed axis and direction selection signals	+Jg, -Jg, +Ja, -Ja	G086#0 to #3	○	○
Manual reference position return	Manual reference position return selection signal	ZRN	G043#7	○	○
	Manual reference position return selection check signal	MREF	F004#5	○	○
	Reference position return deceleration signal	*DEC1 to *DEC8	X009	○	○
	Reference position return end signal	ZP1 to ZP8	F094	○	○
	Reference position establishment signal	ZRF1 to ZRF8	F120	○	○
Memory protection key	Memory protection signal	KEY1 to KEY4	G046#3 to #6	○	○
Mirror image	Mirror image signal	MI1 to MI8	G106	○	○
	Mirror image check signal	MMI1 to MMI8	F108	○	○
Miscellaneous function/2nd auxiliary function	Miscellaneous function code signal	M00 to M31	F010 to F013	○	○
	Miscellaneous function strobe signal	MF	F007#0	○	○
	Decode M signal	DM00	F009#7	○	○
		DM01	F009#6	○	○
		DM02	F009#5	○	○
		DM30	F009#4	○	○
	Spindle speed code signal	S00 to S31	F022 to F025	○	○
	Spindle speed strobe signal	SF	F007#2	○	○
	Tool function code signal	T00 to T31	F026 to F029	○	○
	Tool function strobe signal	TF	F007#3	○	○
	2nd auxiliary function code signal	B00 to B31	F030 to F033	○	○
	2nd auxiliary function strobe signal	BF	F007#4	○	-
		BF	F007#7	-	○
	End signal	FIN	G004#3	○	○
Distribution end signal	DEN	F001#3	○	○	
Mode selection	Mode selection signal	MD1,MD2,MD4	G043#0 to #2	○	○
	Manual data input select check signal	MMDI	F003#3	○	○
	Automatic operation select check signal	MMEM	F003#5	○	○
	Memory edit select check signal	MEDT	F003#6	○	○
	Manual handle feed select check signal	MH	F003#1	○	○

Function	Signal name	Symbol	Address	T series	M series
Mode selection	Incremental feed select check signal	MINC	F003#0	○	○
	Jog feed select check signal	MJ	F003#2	○	○
	TEACH IN select check signal	MTCHIN	F003#7	○	○
Multi-spindle control (T series)	Spindle selection signal	SWS1	G027#0	○	-
		SWS2	G027#1	○	-
		SWS3	G027#2	○	-
	Individual spindle stop signal	*SSTP1	G027#3	○	-
		*SSTP2	G027#4	○	-
		*SSTP3	G027#5	○	-
	Gear select signal (input)	GR21	G029#0	○	-
		GR31	G029#2	○	-
	2nd position coder selection signal	PC2SLC	G028#7	○	-
Spindle enable signal	ENB2	F038#2	○	-	
	ENB3	F038#3	○	-	
Skip signal	Skip signal	SKIP2 to SKIP6,SKIP7,SKIP8	X004#2 to #6,#0,#1	○	○
Multiple M commands in a single block	2nd M function code signal	M200 to M215	F014 to F015	○	○
	3rd M function code signal	M300 to M315	F016 to F017	○	○
	2nd M function strobe signal	MF2	F008#4	○	○
	3rd M function strobe signal	MF3	F008#5	○	○
Optional block skip/addition of optional block skip	Optional block skip signal	BDT1,BDT2 to BDT9	G044#0,G045	○	○
	Optional block skip check signal	MBDT1,MBDT2 to MBDT9	F004#0,F005	○	○
Outputting the movement state of an axis	Axis moving signal	MV1 to MV8	F102	○	○
	Axis moving direction signal	MVD1 to MVD8	F106	○	○
Override cancel	Override cancel signal	OVC	G006#4	○	○
Overtravel signal	Overtravel signal	*+L1 to *+L8	G114	○	○
		*-L1 to *-L8	G116	○	○
Path selection	Path selection signal (Tool post selection signal)	HEAD	G063#0	●	●
PMC axis control/PMC axis speed control function	Control axis selection signal (PMC axis control)	EAX1 to EAX8	G136	○	○
	Axis control command signal (PMC axis control)	EC0A to EC6A	G143#0 to #6	○	○
		EC0B to EC6B	G155#0 to #6	○	○
		EC0C to EC6C	G167#0 to #6	○	○
		EC0D to EC6D	G179#0 to #6	○	○
	Axis control feedrate signal (PMC axis control)	EIF0A to EIF15A	G144,G145	○	○
		EIF0B to EIF15B	G156,G157	○	○
		EIF0C to EIF15C	G168,G169	○	○
		EIF0D to EIF15D	G180,G181	○	○

Function	Signal name	Symbol	Address	T series	M series
PMC axis control/PMC axis speed control function	Axis control data signal (PMC axis control)	EID0A to EID31A	G146 to G149	○	○
		EID0B to EID31B	G158 to G161	○	○
		EID0C to EID31C	G170 to G173	○	○
		EID0D to EID31D	G182 to G185	○	○
	Axis control command read signal (PMC axis control)	EBUFA	G142#7	○	○
		EBUFB	G154#7	○	○
		EBUFC	G166#7	○	○
		EBUFD	G178#7	○	○
	Axis control command read completion signal (PMC axis control)	EBSYA	F130#7	○	○
		EBSYB	F133#7	○	○
		EBSYC	F136#7	○	○
		EBSYD	F139#7	○	○
	Reset signal (PMC axis control)	ECLRA	G142#6	○	○
		ECLRB	G154#6	○	○
		ECLRC	G166#6	○	○
		ECLRD	G178#6	○	○
	Axis control temporary stop signal (PMC axis control)	ESTPA	G142#5	○	○
		ESTPB	G154#5	○	○
		ESTPC	G166#5	○	○
		ESTPD	G178#5	○	○
	Block stop signal (PMC axis control)	ESBKA	G142#3	○	○
		ESBKB	G154#3	○	○
		ESBKC	G166#3	○	○
		ESBKD	G178#3	○	○
	Block stop disable signal (PMC axis control)	EMSBKA	G143#7	○	○
		EMSBKB	G155#7	○	○
		EMSBKC	G167#7	○	○
		EMSBKD	G179#7	○	○
	Auxiliary function code signal (PMC axis control)	EM11A to EM48A	F132,F142	○	○
		EM11B to EM48B	F135,F145	○	○
		EM11C to EM48C	F138,F148	○	○
		EM11D to EM48D	F141,F151	○	○
Auxiliary function strobe signal (PMC axis control)	EMFA	F131#0	○	○	
	EMFB	F134#0	○	○	
	EMFC	F137#0	○	○	
	EMFD	F140#0	○	○	

Function	Signal name	Symbol	Address	T series	M series
PMC axis control/PMC axis speed control function	Auxiliary function completion signal (PMC axis control)	EFINA	G142#0	○	○
		EFINB	G154#0	○	○
		EFINC	G166#0	○	○
		EFIND	G178#0	○	○
	Servo off signal (PMC axis control)	ESOFA	G142#4	○	○
		ESOFB	G154#4	○	○
		ESOFB	G166#4	○	○
		ESOFD	G178#4	○	○
	Buffering disable signal (PMC axis control)	EMBUFA	G142#2	○	○
		EMBUFB	G154#2	○	○
		EMBUFC	G166#2	○	○
		EMBUFD	G178#2	○	○
	Control axis selection status signal (PMC axis control)	*EAXSL	F129#7	○	○
	In-position signal (PMC axis control)	EINPA	F130#0	○	○
		EINPB	F133#0	○	○
		EINPC	F136#0	○	○
		EINPD	F139#0	○	○
	Following zero checking signal (PMC axis control)	ECKZA	F130#1	○	○
		ECKZB	F133#1	○	○
		ECKZC	F136#1	○	○
		ECKZD	F139#1	○	○
	Alarm signal (PMC axis control)	EIALA	F130#2	○	○
		EIALB	F133#2	○	○
		EIALC	F136#2	○	○
		EIALD	F139#2	○	○
	Axis moving signal (PMC axis control)	EGENA	F130#4	○	○
		EGENB	F133#4	○	○
		EGENC	F136#4	○	○
		EGEND	F139#4	○	○
	Auxiliary function executing signal (PMC axis control)	EDENA	F130#3	○	○
		EDENB	F133#3	○	○
		EDENC	F136#3	○	○
		EDEND	F139#3	○	○
	Negative-direction overtravel signal (PMC axis control)	EOTNA	F130#6	○	○
		EOTNB	F133#6	○	○
		EOTNC	F136#6	○	○
		EOTND	F139#6	○	○

Function	Signal name	Symbol	Address	T series	M series
PMC axis control/PMC axis speed control function	Positive-direction overtravel signal (PMC axis control)	EOTPA	F130#5	○	○
		EOTPB	F133#5	○	○
		EOTPC	F136#5	○	○
		EOTPD	F139#5	○	○
	Feedrate override signal (PMC axis control)	*FV0E to *FV7E	G151	○	○
	Override cancellation signal (PMC axis control)	OVCE	G150#5	○	○
	Rapid traverse override signal (PMC axis control)	ROV1E,ROV2E	G150#0,#1	○	○
	Dry run signal (PMC axis control)	DRNE	G150#7	○	○
	Manual rapid traverse selection signal (PMC axis control)	RTE	G150#6	○	○
	Override 0% signal (PMC axis control)	EOV0	F129#5	○	○
	Skip signal (PMC axis control)	ESKIP	X004#6	○	○
	Distribution completion signal (PMC axis control)	EADEN1 to EADEN8	F112	○	○
	Buffer full signal (PMC axis control)	EABUFA	F131#1	○	○
		EABUFB	F134#1	○	○
		EABUFC	F137#1	○	○
EABUFD		F140#1	○	○	
Controlling signal (PMC axis control)	EACNT1 to EACNT8	F182	○	○	
Polygonal turning	Polygon synchronization under way signal	PSYN	F063#7	○	-
Polygonal turning with two spindles	Polygon spindle stop signal	*PLSST	G038#0	○	-
	Spindle polygon speed arrival signal	PSAR	F063#2	○	-
	Master axis not arrival signal	PSE1	F063#0	○	-
	Polygon synchronous axis not arrival signal	PSE2	F063#1	○	-
Position switch	Position switch signal	PSW01 to PSW10	F070#0 to F071#1	○	○
Position display neglect	Position display neglect signal	NPOS1 to NPOS8	G198	○	○
Program restart	Program restart signal	SRN	G006#0	○	○
	Program restart under way signal	SRNMV	F002#4	○	○

Function	Signal name	Symbol	Address	T series	M series
Rapid traverse override	Rapid traverse override signal	ROV1,ROV2	G014#0,#1	○	○
	1% step rapid traverse override select signal	HROV	G096#7	○	○
	1% step rapid traverse override signal	*HROV0 to *HROV6	G096#0 to #6	○	○
Remote buffer	Input signal for remote buffer	RMTDI0 to RMTDI7	G052	○	○
	Output signal for remote buffer	RMTDO0 to RMTDO7	F069	○	○
Reset and rewind	External reset signal	ERS	G008#7	○	○
	Reset & rewind signal	RRW	G008#6	○	○
	Resetting signal	RST	F001#1	○	○
	Rewinding signal	RWD	F000#0	○	○
Retrace (M series)	Retrace signal	RVS	G007#0	-	○
	Retrace-in-progress signal	RVSL	F082#2	-	○
Retreat and retry function (M series)	Retry start signal	RTNCY	G064#0	-	○
	Retry point selection signal	SLCSEQ	G064#1	-	○
	Retry complete signal	RCYO	F063#5	-	○
	Retry point signal	RTNMVS	F066#3	-	○
Rigid tapping	Rigid tapping signal	RGTAP	G061#0	○	○
	Spindle rotation direction signal	RGSP	F065#0	-	○
		RGSPM	F065#1	-	○
	Rigid tapping in-progress signal	RTAP	F076#3	○	○
Rigid tapping spindle selection signal	RGTSP1,RGTSP2	G061#4,#5	○	-	
Run hour and parts count display	Target part count reached signal	PRTSF	F062#7	○	○
	General-purpose integrating meter start signal	TMRON	G053#0	○	○
Second reference position return/crd, 4th reference position return	2nd reference position return end signal	ZP21 to ZP28	F096	○	○
	3rd reference position return end signal	ZP31 to ZP38	F098	○	○
	4th reference position return end signal	ZP41 to ZP48	F100	○	○
Second feedrate override	2nd feedrate override signal	*AFV0 to *AFV7	G013	○	○
Servo off (mechanical handle)	Servo off signal	SVF1 to SVF8	G126	○	○
Servo/spindle motor speed detection	Motor speed detection function enable signal	MSDFON	G016#0	○	○
	Servo motor speed detection signals	DSV1 to DSV8	Y(n+0)	○	○
	Spindle motor speed detection signals	DSP1, DSP2, DSP3	Y(n+1)#0 to #2	○	○
Single block	Single block signal	SBK	G046#1	○	○
	Single block check signal	MSBK	F004#3	○	○

Function	Signal name	Symbol	Address	T series	M series
Simultaneous input and output operations (M series)	Input and run simultaneous mode select signal	STRD	G058#5	-	○
	Output and run simultaneous mode select signal	STWD	G058#6	-	○
Simple electric gear box (M series)	Retract signal	RTRCT	G066#4	-	○
	Retract completion signal	RTRCTF	F065#4	-	○
	EGB mode signal	SYNMOD	F065#6	-	○
Simple spindle synchronous control	Simple spindle synchronous control signal	ESRSYC	G064#6	○	○
	First spindle synchronous control signal	PKESS1	G122#6 (G031#6)	○	○
	Second spindle synchronous control signal	PKESS2	G122#7 (G031#7)	○	○
	Phase error monitor signal	SYCAL	F044#4	○	○
Simple synchronous control	Simple synchronous axis select signal	SYNC1 to SYNC8	G138	○	○
	Simple synchronous manual feed axis select signal	SYNCJ1 to SYNCJ8	G140	-	○
Skip function	Skip signal	SKIP	X004#7	○	○
		SKIPP	G006#6	○	-
Small hole peck drilling cycle	Overload torque signal	SKIP	X004#7	-	○
	Small-diameter peck drilling in progress signal	PECK2	F066#5	-	○
Software operator's panel	Software operator's panel signal (MD1)	MD1O	F073#0	○	○
	Software operator's panel signal (MD2)	MD2O	F073#1	○	○
	Software operator's panel signal (MD4)	MD4O	F073#2	○	○
	Software operator's panel signal (ZRN)	ZRNO	F073#4	○	○
	Software operator's panel signal (+J1 to +J4)	+J1O to +J4O	F081#0,#2,#4,#6	○	○
	Software operator's panel signal (-J1 to -J4)	-J1O to -J4O	F081#1,#3,#5,#7	○	○
	Software operator's panel signal (RT)	RTO	F077#6	○	○
	Software operator's panel signal (HS1A)	HS1AO	F077#0	○	○
	Software operator's panel signal (HS1B)	HS1BO	F077#1	○	○
	Software operator's panel signal (HS1C)	HS1CO	F077#2	○	○
	Software operator's panel signal (HS1D)	HS1DO	F077#3	○	○
	Software operator's panel signal (MP1)	MP1O	F076#0	○	○

Function	Signal name	Symbol	Address	T series	M series
Software operator's panel	Software operator's panel signal (MP2)	MP20	F076#1	○	○
	Software operator's panel signal (*JV0 to *JV15)	*JV00 to *JV150	F079,F080	○	○
	Software operator's panel signal (*FV0 to *FV7)	*FV00 to *FV70	F078	○	○
	Software operator's panel signal (ROV1)	ROV10	F076#4	○	○
	Software operator's panel signal (ROV2)	ROV20	F076#5	○	○
	Software operator's panel signal (BDT)	BDT0	F075#2	○	○
	Software operator's panel signal (SBK)	SBK0	F075#3	○	○
	Software operator's panel signal (MLK)	MLK0	F075#4	○	○
	Software operator's panel signal (DRN)	DRN0	F075#5	○	○
	Software operator's panel signal (KEY1 to KEY4)	KEY0	F075#6	○	○
	Software operator's panel signal (*SP)	SPO	F075#7	○	○
	Software operator's panel general-purpose switch signal	OUT0 to OUT7	F072	○	○
	Spindle orientation	Spindle orientation external stop position command signal	SHA00 to SHA11	G078#0 to G079#3	○
SHB00 to SHB11			G080#0 to G081#3	○	○
SHC00 to SHC11			G208#0 to G209#3	○	○
Spindle output control by the PMC	Spindle motor speed command select signal	SIND	G033#7	○	○
		SIND2	G035#7	○	○
		SIND3	G037#7	○	○
	Spindle motor speed command signal	R011 to R121	G032#0 to G033#3	○	○
		R0112 to R1212	G034#0 to G035#3	○	○
		R0113 to R1213	G036#0 to G037#3	○	○
	Spindle motor command polarity select signal	SSIN	G033#6	○	○
		SSIN2	G035#6	○	○
		SSIN3	G037#6	○	○
	Spindle motor command polarity select signal	SGN	G033#5	○	○
		SGN2	G035#5	○	○
		SGN3	G037#5	○	○

Function	Signal name	Symbol	Address	T series	M series
Spindle positioning (T series)	Spindle stop complete signal	SPSTP	G028#6	○	-
	Spindle unclamp signal	SUCLP	F038#1	○	-
	Spindle unclamp completion signal	*SUCPF	G028#4	○	-
	Spindle clamp signal	SCLP	F038#0	○	-
	Spindle clamp completion signal	*SCPF	G028#5	○	-
	Spindle orientation completion signal	ZPX	F094	○	-
Spindle serial output/ spindle analog output	Torque limit command LOW signal (serial spindle)	TLMLA	G070#0	○	○
		TLMLB	G074#0	○	○
		TLMLC	G204#0	○	○
	Torque limit command HIGH signal (serial spindle)	TMHA	G070#1	○	○
		TMHB	G074#1	○	○
		TMHC	G204#1	○	○
	Clutch/gear signal (serial spindle)	CTH1A,CTH2A	G070#3,#2	○	○
		CTH1B,CTH2B	G074#3,#2	○	○
		CTH1C,CTH2C	G204#3,#2	○	○
	CCW command signal (serial spindle)	SRVA	G070#4	○	○
		SRVB	G074#4	○	○
		SRVC	G204#4	○	○
	CW command signal (serial spindle)	SFRA	G070#5	○	○
		SFRB	G074#5	○	○
		SFRC	G204#5	○	○
	Orientation command signal (serial spindle)	ORCMA	G070#6	○	○
		ORCMB	G074#6	○	○
		ORCMC	G204#6	○	○
	Machine ready signal (serial spindle)	MRDYA	G070#7	○	○
		MRDYB	G074#7	○	○
		MRDYC	G204#7	○	○
	Alarm reset signal (serial spindle)	ARSTA	G071#0	○	○
		ARSTB	G075#0	○	○
		ARSTC	G205#0	○	○
	Emergency stop signal (serial spindle)	*ESPA	G071#1	○	○
		*ESPB	G075#1	○	○
		*ESPC	G205#1	○	○
	Spindle select signal (serial spindle)	SPSLA	G071#2	○	○
		SPSLB	G075#2	○	○
		SPSLC	G205#2	○	○

Function	Signal name	Symbol	Address	T series	M series
Spindle serial output/ spindle analog output	Power line switch completion signal (serial spindle)	MCFNA	G071#3	○	○
		MCFNB	G075#3	○	○
		MCFNC	G205#3	○	○
	Soft start/stop cancel signal (serial spindle)	SOCNA	G071#4	○	○
		SOCNB	G075#4	○	○
		SOCNC	G205#4	○	○
	Signal for controlling velocity integration (serial spindle)	INTGA	G071#5	○	○
		INTGB	G075#5	○	○
		INTGC	G205#5	○	○
	Output switch request signal (serial spindle)	RSLA	G071#6	○	○
		RSLB	G075#6	○	○
		RSLC	G205#6	○	○
	Power line status check signal (serial spindle)	RCHA	G071#7	○	○
		RCHB	G075#7	○	○
		RCHC	G205#7	○	○
	Orientation stop position change signal (serial spindle)	INDXA	G072#0	○	○
		INDXB	G076#0	○	○
		INDXC	G206#0	○	○
	Rotation direction command while changing the orientation stop position signal (serial spindle)	ROTAA	G072#1	○	○
		ROTAB	G076#1	○	○
		ROTAC	G206#1	○	○
	Short-distant movement command while changing the orientation stop position signal (serial spindle)	NRROA	G072#2	○	○
		NRROB	G076#2	○	○
		NRROC	G206#2	○	○
	Differential mode command signal (serial spindle)	DEFMDA	G072#3	○	○
		DEFMDB	G076#3	○	○
		DEFMDC	G206#3	○	○
	Analog override command signal (serial spindle)	OVRIDA	G072#4	○	○
		OVRIDB	G076#4	○	○
		OVRIDC	G206#4	○	○
	Incremental command external setting type orientation signal (serial spindle)	INCMDA	G072#5	○	○
		INCMDB	G076#5	○	○
		INCMDC	G206#5	○	○
	Main spindle MCC status signal while changing spindles signal (serial spindle)	MFNHGA	G072#6	○	○
		MFNHGB	G076#6	○	○
		MFNHGC	G206#6	○	○
	High-output MCC status signal while a magnetic sensor (serial spindle)	RCHHGA	G072#7	○	○
		RCHHGB	G076#7	○	○
		RCHHGC	G206#7	○	○

Function	Signal name	Symbol	Address	T series	M series
Spindle serial output/ spindle analog output	Command for spindle orientaion with a magnetic sensor (serial spindle)	MORCMA	G073#0	○	○
		MORCMB	G077#0	○	○
		MORCMC	G207#0	○	○
	Slave operation command signal (serial spindle)	SLVA	G073#1	○	○
		SLVB	G077#1	○	○
		SLVC	G207#1	○	○
	Motor power stop signal (serial spindle)	MPOFA	G073#2	○	○
		MPOFB	G077#2	○	○
		MPOFC	G207#2	○	○
	Alarm signal (serial spindle)	ALMA	F045#0	○	○
		ALMB	F049#0	○	○
		ALMC	F168#0	○	○
	Speed zero signal (serial spindle)	SSTA	F045#1	○	○
		SSTB	F049#1	○	○
		SSTC	F168#1	○	○
	Speed detection signal (serial spindle)	SDTA	F045#2	○	○
		SDTB	F049#2	○	○
		SDTC	F168#2	○	○
	Speed arrival signal (serial spindle)	SARA	F045#3	○	○
		SARB	F049#3	○	○
		SARC	F168#3	○	○
	Load detection signal 1 (serial spindle)	LDT1A	F045#4	○	○
		LDT1B	F049#4	○	○
		LDT1C	F168#4	○	○
	Load detection signal 2 (serial spindle)	LDT2A	F045#5	○	○
		LDT2B	F049#5	○	○
		LDT2C	F168#5	○	○
	Torque limit signal (serial spindle)	TLMA	F045#6	○	○
		TLMB	F049#6	○	○
		TLMC	F168#6	○	○
	Orientation completion signal (serial spindle)	ORARA	F045#7	○	○
		ORARB	F049#7	○	○
		ORARC	F168#7	○	○
	Power line switch signal (serial spindle)	CHPA	F046#0	○	○
		CHPB	F050#0	○	○
		CHPC	F269#0	○	○
	Spindle switch completion signal (serial spindle)	CFINA	F046#1	○	○
		CFINB	F050#1	○	○
		CFINC	F169#1	○	○

Function	Signal name	Symbol	Address	T series	M series
Spindle serial output/ spindle analog output	Output switch signal (serial spindle)	RCHPA	F046#2	○	○
		RCHPB	F050#2	○	○
		RCHPC	F169#2	○	○
	Output switch completion signal (serial spindle)	RCFNA	F046#3	○	○
		RCFNB	F050#3	○	○
		RCFNC	F169#3	○	○
	Slave operation status signal (serial spindle)	SLVSA	F046#4	○	○
		SLVSB	F050#4	○	○
		SLVSC	F169#4	○	○
	Signal for approximate spindle orientation with a position coder (serial spindle)	PORA2A	F046#5	○	○
		PORA2B	F050#5	○	○
		PORA2C	F169#5	○	○
	Signal for completion of spindle orientation with a magnetic sensor (serial spindle)	MORA1A	F046#6	○	○
		MORA1B	F050#6	○	○
		MORA1C	F169#6	○	○
	Signal for approximate spindle orientation with a magnetic sensor (serial spindle)	MORA2A	F046#7	○	○
		MORA2B	F050#7	○	○
		MORA2C	F169#7	○	○
	Signal indicating the status of the detected one-rotation position coder signal (serial spindle)	PC1DEA	F047#0	○	○
		PC1DEB	F051#0	○	○
		PC1DEC	F170#0	○	○
Incremental method orientation signal (serial spindle)	INCSTA	F047#1	○	○	
	INCSTB	F051#1	○	○	
	INCSTC	F170#1	○	○	
Spindle speed control	Spindle stop signal	*SSTP	G029#6	○	○
	Spindle orientation signal	SOR	G029#5	○	○
	Spindle speed override signal	SOV0 to SOV7	G030	○	○
	Spindle speed arrival signal	SAR	G029#4	○	○
	Spindle enable signal	ENB	F001#4	○	○
	Gear selection signal (output)	GR10,GR20,GR30	F034#0 to #2	-	○
	Gear selection signal (input)	GR1,GR2	G028#1,#2	○	○
S12-bit code signal	R010 to R120	F036#0 to F037#3	○	○	
Spindle speed control for two-path lathe	Spindle command select signal	SLSPA,SLSPB	G063#2,#3	●	-
	Spindle feedback select signal	SLPCA,SLPCB	G064#2,#3	●	-
	Spindle command signal	COSP	F064#5	●	-
Spindle speed fluctuation detection	Spindle fluctuation detection alarm signal	SPAL	F035#0	○	○

Function	Signal name	Symbol	Address	T series	M series
Spindle synchronous control	Spindle synchronous control signal	SPSYC	G038#2	○	○
	Spindle phase synchronous control signal	SPPHS	G038#3	○	○
	Spindle synchronous speed control completion signal	FSPSY	F044#2	○	○
	Spindle phase synchronous control completion signal	FSPPH	F044#3	○	○
	Spindle synchronous control alarm signal	SYCAL	F044#4	○	○
Status output signal	Rapid traversing signal	RPDO	F002#1	○	○
	Cutting feed signal	CUT	F002#6	○	○
Stored stroke limit	Stored stroke limit select signal	EXLM	G007#6	○	○
	Stroke limit external setting signal	+LM1 to +LM8	G110	-	○
		-LM1 to -LM8	G110	-	○
Stroke limit release signal	RLSOT	G007#7	-	○	
Stored stroke check 2, 3	Stroke check 3 release signal	RLSOT3	G007#4	○	○
Synchronous control	Synchronous control axis selection signals	SYNC to SYNC8	G138	○	-
	Parking signals	PK1 to PK8	G122	○	-
	Synchronous control under way signals	SYN10 to SYN80	F118	○	-
	Synchronous control axis selection signals	SYNC to SYNC7	G138#0 to #6	●	-
	Synchronous/composite/superimposed control under way signals	SYN10 to SYN70	F118#0 to #6	●	-
Thread cutting	Thread cutting signal	THRD	F002#3	○	○
Tool axis direction handle feed function / tool axis direction handle feed function B (M series)	Tool axis direction handle feed mode signal	ALNGH	G023#7	-	○
	Tool axis perpendicular direction handle feed mode signal	RGHTH	G023#6	-	○
Tool post interface check (T series, two-path control)	Tool post interference check signal	TCHK	F064#6	●	-
	Tool post interference alarm signal	TIALM	F064#7	●	-
Tool retraction and return	Tool retraction signal	TRESC	G059#0	○	○
	Tool retraction mode signal	TRACT	F092#3	○	○
	Tool return signal	TRRTN	G059#1	○	○
	Tool return completion signal	TRSPS	F092#5	○	○

Function	Signal name	Symbol	Address	T series	M series
Tool life management	Tool change signal	TLCH	F064#0	○	○
	Tool change reset signal	TLRST	G048#7	○	○
	Individual tool change signal	TLCHI	F064#2	-	○
	Individual tool change reset signal	TLRST	IG048#6	-	○
	Tool skip signal	TLSKP	G048#5	○	○
	New tool select signal	TLNW	F064#1	○	○
	Tool group number select signal	TL01 to TL256	G047#0 to G048#0	-	○
		TL01 to TL64	G047#0 to #6	○	-
Tool life count override signal	*TLV0 to *TLV9	G049#0 to G050#1	-	○	
Torque limit skip (T series)	Torque limit reached signal	TRQL1 to TRQL8	F114	○	-
VRDY off alarm ignore signal	All-axis VRDY OFF alarm ignore signal	IGNVRY	G066#0	○	○
	Each-axis VRDY OFF alarm ignore signal	IGVRY1 to IGVRY8	G192	○	○
Waiting M code (two-path control)	No-wait signal	NOWT	G063#1	●	●
	Waiting signal	WATO	F063#6	●	●

A.2 List by Symbol

This table lists the PMC G and F addresses by **SYMBOL** name in alphabetical order. The first part of the table has the asterisk signals, which are all active low signals. The next part of the table is the plus/minus signals, which all are related to servo function.

Group	Symbol	Signal name	Address	T series	M series
	*+ED1 to *+ED8	External deceleration signal	G118	○	○
	*+L1 to *+L8	Overtravel signal	G114	○	○
	*-ED1 to *-ED8	External deceleration signal	G120	○	○
	*-L1 to *-L8	Overtravel signal	G116	○	○
	*ABSM	Manual absolute signal	G006#2	○	○
	*AFV0 to *AFV7	2nd feedrate override signal	G013	○	○
	*BECLP	B-axis clamp completion signal	G038#7	-	○
	*BEUCP	B-axis unclamp completion signal	G038#6	-	○
	*CHLD	Chopping hold signal	G051#7	-	○
	*CHP8 to *CHP0	Chopping feedrate override signals	G051#0 to #3	-	○
	*CRTOF	Automatic erase CRT screen display cancel signal	G062#1	○	○
	*DEC1 to *DEC8	Deceleration signal for reference position return	X009	○	○
	*EAXSL	Control axis selection status signal(PMC axis control)	F129#7	○	○
	*ESP	Emergency stop signal	X008#4	○	○
	*ESP		G008#4	○	○
	*ESPA	Emergency stop signal (serial spindle)	G071#1	○	○
	*ESPB		G075#1	○	○
	*ESPC		G205#1	○	○
	*FLWU	Follow-up signal	G007#5	○	○
	*FV0 to *FV7	Feedrate override signal	G012	○	○
	*FV0E to *FV7E	Feedrate override signal (PMC axis control)	G151	○	○
	*FV00 to *FV70	Software operator's panel signal(*FV0 to *FV7)	F078	○	○
	*HROV0 to *HROV6	1% step rapid traverse override signal	G096#0 to #6	○	○
	*IT	Interlock signal	G008#0	○	○
	*IT1 to *IT8	Interlock signal for each axis	G130	○	○
	*JV0 to *JV15	Manual feedrate override signal	G010,G011	○	○
	*JV00 to *JV150	Software operator's panel signal(*JV0 to *JV15)	F079,F080	○	○
	*PLSST	Polygon spindle stop signal	G038#0	○	-

Group	Symbol	Signal name	Address	T series	M series
.	*SCPF	Spindle clamp completion signal	G028#5	○	-
	*SP	Feed hold signal	G008#5	○	○
	*SSTP	Spindle stop signal	G029#6	○	○
	*SSTP1	Stop signal in each spindle	G027#3	○	-
	*SSTP2		G027#4	○	-
	*SSTP3		G027#5	○	-
	*SUCPF	Spindle unclamp completion signal	G028#4	○	-
	*TLV0 to *TLV9	Tool life count override signal	G049#0 to G050#1	-	○
*TSB	Tailstock barrier select signal	G060#7	○	-	
+	+J1 to +J8	Feed axis and direction selection signal	G100	○	○
	+J10 to +J40	Software operator's panel signal(+J1 to +J4)	F081#0,#2,#4,#6	○	○
	+Jg, -Jg, +Ja, -Ja	Feed axis and direction selection signals	G086#0 to #3	○	○
	+LM1 to +LM8	Stroke limit external setting signal	G110	-	○
	+MIT1,+MIT2	Manual feed interlock signal for each axis	X004#2,#4	○	-
	+MIT1,+MIT2	Tool offset write signal	X004#2,#4	○	-
	+MIT1 to +MIT4	Interlock signal for each axis and direction	G132#0 to #3	-	○
-	-J1 to -J8	Feed axis and direction selection signal	G102	○	○
	-J10 to -J40	Software operator's panel signal(-J1 to -J4)	F081#1,#3,#5,#7	○	○
	-LM1 to -LM8	Stroke limit external setting signal	G112	-	○
	-MIT1,-MIT2	Manual feed interlock signal for each axis	X004#3,#5	○	-
	-MIT1,-MIT2	Tool offset write signal		○	-
	-MIT1 to -MIT4	Interlock signal for each axis and direction	G134#0 to #3	-	○
A	ABTQSV	Servo axis abnormal load detected signal	F090#0	○	○
	ABTSP1	First-spindle abnormal load detected signal	F090#1	○	○
	ABTSP2	Second-spindle abnormal load detected signal	F090#2	○	○
	AFL	Miscellaneous function lock signal	G005#6	○	○
	AL	Alarm signal	F001#0	○	○
	ALMA	Alarm signal (serial spindle)	F045#0	○	○
	ALMB		F049#0	○	○
	ALMC		F168#0	○	○
	ALNGH	Tool axis direction handle feed mode signal	G023#7	-	○
	AR0 to AR15	Actual spindle speed signal	F040,F041	○	-
	ARSTA	Alarm reset signal (serial spindle)	G071#0	○	○
	ARSTB		G075#0	○	○
	ARSTC		G205#0	○	○

Group	Symbol	Signal name	Address	T series	M series
B	B00 to B31	2nd auxiliary function code signal	F030 to F033	○	○
	BAL	Battery alarm signal	F001#2	○	○
	BCLP	B-axis clamp signal	F061#1	-	○
	BDT1,BDT2 to BDT9	Optional block skip signal	G044#0,G045	○	○
	BDTO	Software operator's panel signal(BDT)	F075#2	○	○
	BF	2nd auxiliary function strobe signal	F007#4	○	-
	BF		F007#7	-	○
	BFIN	2nd auxiliary function completion signal	G005#4	○	-
	BFIN		G005#7	-	○
	BGEACT	Background busy signal	F053#4	○	○
	BGEN	Power Mate background busy signal	G092#4	○	○
	BGIALM	Power Mate read/write alarm signal	G092#3	○	○
	BGION	Power Mate read/write inprogress signal	G092#2	○	○
	BUCLP	B-axis unclamp signal	F061#0	-	○
C	CDZ	Chamferring signal	G053#7	○	-
	CFINA	Spindle switch completion signal (serial spindle)	F046#1	○	○
	CFINB		F050#1	○	○
	CFINC		F169#1	○	○
	CHPA	Power line switch signal (serial spindle)	F046#0	○	○
	CHPB		F050#0	○	○
	CHPC		F269#0	○	○
	CHPCYL	Chopping cycle signal	F039#3	-	○
	CHPMD	Chopping-in-progress signal	F039#2	-	○
	CHPST	Chopping start signal	G051#6	-	○
	CLRCH1 to CLRCH8	Torque limit reach signals for built-type reference position setting	F180	○	○
	CON	Cs contour control change signal	G027#7	○	○
	COSP	Spindle command signal	F064#5	●	-
	CSS	Constant surface speed signal	F002#2	○	○
C	CTH1A,CTH2A	Clutch/gear signal (serial spindle)	G070#3,#2	○	○
	CTH1B,CTH2B		G074#3,#2	○	○
	CTH1C,CTH2C		G204#3,#2	○	○
	CUT	Cutting feed signal	F002#6	○	○

Group	Symbol	Signal name	Address	T series	M series
D	DEFMDA	Differential mode command signal (serial spindle)	G072#3	○	○
	DEFMDB		G076#3	○	○
	DEFMDC		G206#3	○	○
	DEN	Distribution end signal	F001#3	○	○
	DM00	Decode M signal	F009#7	○	○
	DM01		F009#6	○	○
	DM02		F009#5	○	○
	DM30		F009#4	○	○
	DMMC	Direct operation select signal	G042#7	○	○
	DNCI	DNC operation select signal	G043#5	○	○
	DRN	Dry run signal	G046#7	○	○
	DRNE	Dry run signal (PMC axis control)	G150#7	○	○
	DRNO	Software operator's panel signal(DRN)	F075#5	○	○
	DSP1, DSP2, DSP3	Spindle motor speed detection signals	Y(n+1)#0 to #2	○	○
	DSV1 to DSV8	Servo motor speed detection signals	Y(n+0)	○	○
DTCH1 to DTCH8	Controlled axis detach signal	G124	○	○	
E	EA0 to EA6	Address signal for external data input	G002#0 to #6	○	○
	EABUFA	Buffer full signal (PMC axis control)	F131#1	○	○
	EABUFB		F134#1	○	○
	EABUFC		F137#1	○	○
	EABUFD		F140#1	○	○
	EACNT1 to EACNT8	Controlling signal (PMC axis control)	F182	○	○
	EADEN1 to EADEN8	Distribution completion signal(PMC axis control)	F112	○	○
	EAX1 to EAX8	Control axis select signal (PMC axis control)	G136	○	○
	EBSYA	Axis control command read completion signal (PMC axis control)	F130#7	○	○
	EBSYB		F133#7	○	○
	EBSYC		F136#7	○	○
	EBSYD		F139#7	○	○

Group	Symbol	Signal name	Address	T series	M series
E	EBUFA	Axis control command read signal(PMC axis control)	G142#7	○	○
	EBUFB		G154#7	○	○
	EBUFC		G166#7	○	○
	EBUFD		G178#7	○	○
	EC0A to EC6A	Axis control command signal (PMC axis control)	G143#0 to #6	○	○
	EC0B to EC6B		G155#0 to #6	○	○
	EC0C to EC6C		G167#0 to #6	○	○
	EC0D to EC6D		G179#0 to #6	○	○
	ECKZA	Following zero checking signal (PMC axis control)	F130#1	○	○
	ECKZB		F133#1	○	○
	ECKZC		F136#1	○	○
	ECKZD		F139#1	○	○
	ECLRA	Reset signal (PMC axis control)	G142#6	○	○
	ECLRB		G154#6	○	○
	ECLRC		G166#6	○	○
	ECLRD		G178#6	○	○
	ED0 to ED15	Data signal for external data input	G000,G001	○	○
	EDENA	Auxiliary function executing signal (PMC axis control)	F130#3	○	○
	EDENB		F133#3	○	○
	EDENC		F136#3	○	○
	EDEND		F139#3	○	○
	EDGN	Slave diagnosis selection signal	F177#7	○	○
	EF	External operation signal	F008#0	-	○
	EFD	External operation signal for high-speed interface	F007#1	-	○
	EFIN	External operation function completion signal	G005#1	-	○
	EFINA	Auxiliary function completion signal (PMC axis control)	G142#0	○	○
	EFINB		G154#0	○	○
	EFINC		G166#0	○	○
	EFIND		G178#0	○	○
	EGENA	Axis moving signal (PMC axis control)	F130#4	○	○
	EGENB		F133#4	○	○
	EGENC		F136#4	○	○
EGEND	F139#4		○	○	
EIALA	Alarm signal (PMC axis control)	F130#2	○	○	
EIALB		F133#2	○	○	
EIALC		F136#2	○	○	
EIALD		F139#2	○	○	

Group	Symbol	Signal name	Address	T series	M series
E	EID0A to EID31A	Axis control data signal (PMC axis control)	G146 to G149	○	○
	EID0B to EID31B		G158 to G161	○	○
	EID0C to EID31C		G170 to G173	○	○
	EID0D to EID31D		G182 to G185	○	○
	EIF0A to EIF15A	Axis control feedrate signal (PMC axis control)	G144,G145	○	○
	EIF0B to EIF15B		G156,G157	○	○
	EIF0C to EIF15C		G168,G169	○	○
	EIF0D to EIF15D		G180,G181	○	○
	EINPA	In-position signal (PMC axis control)	F130#0	○	○
	EINPB		F133#0	○	○
	EINPC		F136#0	○	○
	EINPD		F139#0	○	○
	EKC0 to EKC7	Key code signal	G098	○	○
	EKENB	Key code read completion signal	F053#7	○	○
	EKSET	key code read signal	G066#7	○	○
	EM11A to EM48A	Auxiliary function code signal (PMC axis control)	F132,F142	○	○
	EM11B to EM48B		F135,F145	○	○
	EM11C to EM48C		F138,F148	○	○
	EM11D to EM48D		F141,F151	○	○
	EMBUFA	Buffering disable signal (PMC axis control)	G142#2	○	○
	EMBUFB		G154#2	○	○
	EMBUFC		G166#2	○	○
	EMBUFD		G178#2	○	○
	EMFA	Auxiliary function strobe signal (PMC axis control)	F131#0	○	○
	EMFB		F134#0	○	○
	EMFC		F137#0	○	○
	EMFD		F140#0	○	○
	EMSBKA	Block stop disable signal (PMC axis control)	G143#7	○	○
	EMSBKB		G155#7	○	○
	EMSBKC		G167#7	○	○
	EMSBKD		G179#7	○	○
	ENB	Spindle enable signal	F001#4	○	○
	ENB2		F038#2	○	-
	ENB3		F038#3	○	-
ENBKY	External key input mode selection signal	G066#1	○	○	
EOTNA	Negative-direction overtravel signal (PMC axis control)	F130#6	○	○	
EOTNB		F133#6	○	○	
EOTNC		F136#6	○	○	
EOTND		F139#6	○	○	

Group	Symbol	Signal name	Address	T series	M series
E	EOTPA	Positive-direction overtravel signal (PMC axis control)	F130#5	○	○
	EOTPB		F133#5	○	○
	EOTPC		F136#5	○	○
	EOTPD		F139#5	○	○
	EOV0	Override 0% signal (PMC axis control)	F129#5	○	○
	EPARM	Slave parameter selection signal	F177#6	○	○
	EPRG	Slave program selection signal	F177#4	○	○
	ERDIO	Slave external read start signal	F177#1	○	○
	EREND	Read completion signal for external data input	F060#0	○	○
	ERS	External reset signal	G008#7	○	○
	ESBKA	Block stop signal (PMC axis control)	G142#3	○	○
	ESBKB		G154#3	○	○
	ESBKC		G166#3	○	○
	ESBKD		G178#3	○	○
	ESEND	Search completion signal for external data input	F060#1	○	○
	ESKIP	Skip signal (PMC axis control)	X004#6	○	○
	ESOFA	Servo off signal (PMC axis control)	G142#4	○	○
	ESOFB		G154#4	○	○
	ESOFC		G166#4	○	○
	ESOFD		G178#4	○	○
	ESRSYC	Simple spindle synchronous control signal	G064#6	○	○
	ESTB	Read signal for external data input	G002#7	○	○
	ESTPA	Axis control temporary stop signal (PMC axis control)	G142#5	○	○
	ESTPB		G154#5	○	○
	ESTPC		G166#5	○	○
	ESTPD		G178#5	○	○
	ESTPIO	Slave read/write stop signal	F177#2	○	○
	EVAR	Slave macro variable selection signal	F177#5	○	○
	EXHPCC	HPCC operation signal	F066#7	-	○
	EXLM	Stored stroke limit select signal	G007#6	○	○
EXRD	External read start signal	G058#1	○	○	
EXSTP	External read/punch stop signal	G058#2	○	○	
EXWT	External punch start signal	G058#3	○	○	
EWTI0	Slave external write start signal	F177#3	○	○	

Group	Symbol	Signal name	Address	T series	M series
F	F1D	F1-digit feed select signal	G016#7	-	○
	FIN	Completion signal	G004#3	○	○
	FRP1 to FRP8	Floating reference position return end signal	F116	○	○
	FSCSL	Cs contour control change completion signal	F044#1	○	○
	FSPPH	Spindle phase synchronous control completion signal	F044#3	○	○
	FSPSY	Spindle synchronous speed control completion signal	F044#2	○	○
G	G08MD	Lock-ahead control mode signal	F066#0	-	○
	GOQSM	Tool offset value write mode select signal	G039#7	○	-
	GR1,GR2	Gear selection signal (input)	G028#1,#2	○	○
	GR1O,GR2O,GR3O	Gear selection signal (output)	F034#0 to #2	-	○
	GR21	Gear selection signal (input)	G029#0	○	-
	GR31		G029#2	○	-
H	HDO0 to HDO7	High-speed skip status signal	F122	○	○
	HEAD	Path selection signal (Tool post selection signal)	G063#0	●	●
	HROV	1% step rapid traverse override select signal	G096#7	○	○
	HS1A to HS1D	Manual handle feed axis selection signal	G018#0 to #3	○	○
	HS1AO	Software operator's panel signal(HS1A)	F077#0	○	○
	HS1BO	Software operator's panel signal(HS1B)	F077#1	○	○
	HS1CO	Software operator's panel signal(HS1C)	F077#2	○	○
	HS1DO	Software operator's panel signal(HS1D)	F077#3	○	○
	HS1IA to HS1ID	Manual handle interruption axis select signal	G041#0 to #3	○	○
	HS2A to HS2D	Manual handle feed axis selection signal	G018#4 to #7	○	○
	HS2IA to HS2ID	Manual handle interruption axis select signal	G041#4 to #7	○	○
	HS3A to HS3D	Manual handle feed axis selection signal	G019#0 to #3	-	○
	HS3IA to HS3ID	Manual handle interruption axis select signal	G042#0 to #3	-	○

Group	Symbol	Signal name	Address	T series	M series
I	IGNVRY	All-axis VRDY OFF alarm ignore signal	G066#0	○	○
	IGVRY1 to IGVRY8	Each-axis VRDY OFF alarm ignore signal	G192	○	○
	INCH	Inch input signal	F002#0	○	○
	INCMDB	Incremental command external setting type orientation signal (serial spindle)	G072#5	○	○
	INCMDA		G076#5	○	○
	INCMDC		G206#5	○	○
	INCSTB	Incremental method orientation signal (serial spindle)	F047#1	○	○
	INCSTA		F051#1	○	○
	INCSTC		F170#1	○	○
	INDXB	Orientation stop position change signal (serial spindle)	G072#0	○	○
	INDXA		G076#0	○	○
	INDXC		G206#0	○	○
	INHKY	Key input disable signal	F053#0	○	○
	INP1 to INP8	In-position signal	F104	○	○
	INTGB	Signal for controlling velocity integration (serial spindle)	G071#5	○	○
	INTGA		G075#5	○	○
	INTGC		G205#5	○	○
	IOLACK	I/O Link confirmation signal	G092#0	○	○
IOLNK	Slave I/O Link selection signal	F177#0	○	○	
IOLS	I/O Link specification signal	G092#1	○	○	
K	KEY1 to KEY4	Memory protect signal	G046#3 to #6	○	○
	KEYO	Software operator's panel signal(KEY1 to KEY4)	F075#6	○	○
L	LDT1B	Load detection signal 1 (serial spindle)	F045#4	○	○
	LDT1A		F049#4	○	○
	LDT1C		F168#4	○	○
	LDT2B	Load detection signal 2 (serial spindle)	F045#5	○	○
	LDT2A		F049#5	○	○
	LDT2C		F168#5	○	○
M	M00 to M31	Miscellaneous function code signal	F010 to F013	○	○
	M200 to M215	2nd M function code signal	F014 to F015	○	○
	M300 to M315	3rd M function code signal	F016 to F017	○	○
	MA	CNC ready signal	F001#7	○	○
	MABSM	Manual absolute check signal	F004#2	○	○
	MAFL	Miscellaneous function lock check signal	F004#4	○	○
	MBDT1,MBDT2 to MBDT9	Optional block skip check signal	F004#0,F005	○	○

Group	Symbol	Signal name	Address	T series	M series
M	MCFNA	Power line switch completion signal (serial spindle)	G071#3	○	○
	MCFNB		G075#3	○	○
	MCFNC		G205#3	○	○
	MD1,MD2,MD4	Mode selection signal	G043#0 to #2	○	○
	MD1O	Software operator's panel signal(MD1)	F073#0	○	○
	MD2O	Software operator's panel signal(MD2)	F073#1	○	○
	MD4O	Software operator's panel signal(MD4)	F073#2	○	○
	MDRN	Dry run check signal	F002#7	○	○
	MDTCH1 to MDTCH8	Controlled axis detach status signal	F110	○	○
	MEDT	Memory edit select check signal	F003#6	○	○
	MF	Auxiliary function strobe signal	F007#0	○	○
	MF2	2nd M function strobe signal	F008#4	○	○
	MF3	3rd M function strobe signal	F008#5	○	○
	MFIN	Auxiliary function completion signal	G005#0	○	○
	MFIN2	2nd M function completion signal	G004#4	○	○
	MFIN3	3rd M function completion signal	G004#5	○	○
	MFNHGA	Main spindle MCC status signal while changing spindles signal (serial spindle)	G072#6	○	○
	MFNHGB		G076#6	○	○
	MFNHGC		G206#6	○	○
	MH	Manual handle feed select check signal	F003#1	○	○
	MHPCC	HPCC mode signal	F066#6	-	○
	MI1 to MI8	Mirror image signal	G106	○	○
	MINC	Incremental feed select check signal	F003#0	○	○
	MINP	External program input start signal	G058#0	○	○
	MIX1 to MIX7	Composite control axis selection signals	G128#0 to #6	●	-
	MJ	JOG feed select check signal	F003#2	○	○
	MLK	All-axis machine lock signal	G044#1	○	○
	MLK1 to MLK8	Each-axis machine lock signal	G108	○	○
MLKO	Software operator's panel signal(MLK)	F075#4	○	○	
MMDI	Manual data input select check signal	F003#3	○	○	
MMEM	Automatic operation select check signal	F003#5	○	○	
MMI1 to MMI8	Mirror image check signal	F108	○	○	

Group	Symbol	Signal name	Address	T series	M series
M	MMLK	All-axis machine lock check signal	F004#1	○	○
	MORA1A	Signal for completion of spindle orientation with a magnetic sensor (serial spindle)	F046#6	○	○
	MORA1B		F050#6	○	○
	MORA1C		F169#6	○	○
	MORA2A	Signal for approximate spindle orientation with a magnetic sensor (serial spindle)	F046#7	○	○
	MORA2B		F050#7	○	○
	MORA2C		F169#7	○	○
	MORCMA	Command for spindle orientation with a magnetic sensor (serial spindle)	G073#0	○	○
	MORCMB		G077#0	○	○
	MORCMC		G207#0	○	○
	MP1,MP2	Manual handle feed amount selection signal (incremental feed signal)	G019#4,#5	○	○
	MP1O	Software operator's panel signal(MP1)	F076#0	○	○
	MP2O	Software operator's panel signal(MP2)	F076#1	○	○
	MPOFA	Motor power stop signal (serial spindle)	G073#2	○	○
	MPOFB		G077#2	○	○
	MPOFC		G207#2	○	○
	MRDYA	Machine ready signal (serial spindle)	G070#7	○	○
	MRDYB		G074#7	○	○
	MRDYC		G204#7	○	○
	MREF	Manual reference position return selection check signal	F004#5	○	○
	MRMT	DNC operation select check signal	F003#4	○	○
	MSBK	Single block check signal	F004#3	○	○
	MSDFON	Motor speed detection function enable signal	G016#0	○	○
	MTCHIN	TEACH IN select check signal	F003#7	○	○
MV1 to MV8	Axis moving signal	F102	○	○	
MVD1 to MVD8	Axis moving direction signal	F106	○	○	
N	NOWT	No-wait signal	G063#1	●	●
	NOZAGC	Perpendicular/angular axis control disable signal	G063#5	○	○
	NPOS1 to NPOS8	Position display neglect signal	G198	○	○
	NRROA	Short-distant movement command while changing the orientation stop position signal (serial spindle)	G072#2	○	○
	NRROB		G076#2	○	○
	NRROC		G206#2	○	○

Group	Symbol	Signal name	Address	T series	M series
O	OFN0 to OFN5, OFN6	Tool offset number select signal	G039#0 to #5, G040#0	○	-
	OP	Automatic operation signal	F000#7	○	○
	ORARA	Orientation completion signal (serial spindle)	F045#7	○	○
	ORARB		F049#7	○	○
	ORARC		F168#7	○	○
	ORCMA	Orientation command signal (serial spindle)	G070#6	○	○
	ORCMB		G074#6	○	○
	ORCMC		G204#6	○	○
	OUT0 to OUT7	Software operator's panel general-purpose switch signal	F072	○	○
	OVC	Override cancel signal	G006#4	○	○
	OVCE	Override cancellation signal (PMC axis control)	G150#5	○	○
	OVLS1 to OVLS7	Superimposed control axis selection signals	G190#0 to #6	●	-
	OVRIDA	Analog override command signal (serial spindle)	G072#4	○	○
	OVRIDB		G076#4	○	○
	OVRIDC		G206#4	○	○
P	PC1DEA	Signal indicating the status of the detected one-rotation position coder signal (serial spindle)	F047#0	○	○
	PC1DEB		F051#0	○	○
	PC1DEC		F170#0	○	○
	PC2SLC	2nd position coder selection signal	G028#7	○	-
	PECK2	Small-diameter peck drilling in progress signal	F066#5	-	○
	PK1 to PK8	Parking signals	G122	○	-
	PK1 to PK7	Parking signals	G122#0 to #6	●	-
	PKESS1	First spindle synchronous control signal	G122#6 (G031#6)	○	○
	PKESS2	Second spindle synchronous control signal	G122#7 (G031#7)	○	○
	PN1, PN2, PN4, PN8, PN16	Workpiece number search signal	G009#0 to 4	○	○
	PORA2A	Signal for approximate spindle orientation with a position coder (serial spindle)	F046#5	○	○
	PORA2B		F050#5	○	○
	PORA2C		F169#5	○	○
	PRC	Position record signal	G040#6	○	-
	PRGDPL	program screen display mode signal	F053#1	○	○
	PRTSF	Target parts count reached signal	F062#7	○	○
	PSAR	Spindle polygon speed arrival signal	F063#2	○	-

Group	Symbol	Signal name	Address	T series	M series
P	PSE1	Master axis not arrival signal	F063#0	○	-
	PSE2	Polygon synchronous axis not arrival signal	F063#1	○	-
	PSW01 to PSW10	Position switch signal	F070#0 to F071#1	○	○
	PSYN	Polygon synchronization under way signal	F063#7	○	-
R	R011 to R121	Spindle motor speed command signal	G032#0 to G033#3	○	○
	R0112 to R1212		G034#0 to G035#3	○	○
	R0113 to R1213		G036#0 to G037#3	○	○
	R010 to R120	S12-bit code signal	F036#0 to F037#3	○	○
	RCFNA	Output switch completion signal (serial spindle)	F046#3	○	○
	RCFNB		F050#3	○	○
	RCFNC		F169#3	○	○
	RCHA	Power line status check signal (serial spindle)	G071#7	○	○
	RCHB		G075#7	○	○
	RCHC		G205#7	○	○
	RCHHGA	High-output MCC status signal while a magnetic sensor (serial spindle)	G072#7	○	○
	RCHHGB		G076#7	○	○
	RCHHGC		G206#7	○	○
	RCHPA	Output switch signal (serial spindle)	F046#2	○	○
	RCHPB		F050#2	○	○
	RCHPC		F169#2	○	○
	RCYO	Retry complete signal	F063#5	-	○
	RGHTH	Tool axis perpendicular direction handle feed mode signal	G023#6	-	○
	RGSPM	Spindle rotation direction signal	F065#1	-	○
	RGSPF		F065#0	-	○
	RGTAP	Rigid tapping signal	G061#0	○	○
	RGTSP1, RGTSP2	Rigid tapping spindle selection signal	G061#4, #5	○	-
	RLSOT3	Stroke check 3 release signal	G007#4	○	○
	RMTDI0 to RMTDI7	Input signal for remote buffer	G052	○	○
	RMTDO0 to RMTDO7	Output signal for remote buffer	F069	○	○
	ROTA A	Rotation direction command while changing the orientation stop position signal (serial spindle)	G072#1	○	○
	ROTA B		G076#1	○	○
	ROTA C		G206#1	○	○
	ROV1, ROV2	Rapid traverse override signal	G014#0, #1	○	○

Group	Symbol	Signal name	Address	T series	M series
R	ROV1E,ROV2E	Rapid traverse override signal(PMC axis control)	G150#0,#1	○	○
	ROV1O	Software operator's panel signal(ROV1)	F076#4	○	○
	ROV2O	Software operator's panel signal(ROV2)	F076#5	○	○
	RPALM	Read/punch alarm signal	F053#3	○	○
	RPBSY	Read/punch in-progress signal	F053#2	○	○
	RPDO	Rapid traversing signal	F002#1	○	○
	RRW	Reset&rewind signal	G008#6	○	○
	RSLA	Output switch request signal (serial spindle)	G071#6	○	○
	RSLB		G075#6	○	○
	RSLC		G205#6	○	○
	RST	Reset signal	F001#1	○	○
	RT	Manual rapid traverse selection signal	G019#7	○	○
	RTAP	Rigid tapping in-progress signal	F076#3	○	○
	RTE	Manual rapid traverse selection signal (PMC axis control)	G150#6	○	○
	RTO	Software operator's panel signal(RT)	F077#6	○	○
	RTNCY	Retry start signal	G064#0	-	○
	RTNMVS	Retry point signal	F066#3	-	○
	RTRCT	Retract signal	G066#4	-	○
	RTRCTF	Retract completion signal	F065#4	-	○
	RVS	Retrace signal	G007#0	-	○
RVSL	Retrace-in-progress signal	F082#2	-	○	
RWD	Rewinding signal	F000#0	○	○	
S	S00 to S31	Spindle speed code signal	F022 to F025	○	○
	SA	Servo ready signal	F000#6	○	○
	SAR	Spindle speed arrival signal	G029#4	○	○
	SARA	Speed arrival signal (serial spindle)	F045#3	○	○
	SARB		F049#3	○	○
	SARC		F168#3	○	○
	SBK	Single block signal	G046#1	○	○
	SBKO	Software operator's panel signal(SBK)	F075#3	○	○
	SCLP	Spindle clamp signal	F038#0	○	-
	SDTA	Speed detection signal (serial spindle)	F045#2	○	○
	SDTB		F049#2	○	○
	SDTC		F168#2	○	○

Group	Symbol	Signal name	Address	T series	M series
S	SF	Spindle speed strobe signal	F007#2	○	○
	SFIN	Spindle function completion signal	G005#2	○	○
	SFRA	CW command signal (serial spindle)	G070#5	○	○
	SFRB		G074#5	○	○
	SFRC		G204#5	○	○
	SGN	Spindle motor command polarity select signal	G033#5	○	○
	SGN2		G035#5	○	○
	SGN3		G037#5	○	○
	SHA00 to SHA11	Spindle orientation external stop position command signal	G078#0 to G079#3	○	○
	SHB00 to SHB11		G080#0 to G081#3	○	○
	SHC00 to SHC11	Spindle orientation stop position external command signal	G208#0 to G209#3	○	○
	SIND	Spindle motor speed command select signal	G033#7	○	○
	SIND2		G035#7	○	○
	SIND3		G037#7	○	○
	SKIP	Skip signal	X004#7	○	○
		Overload torque signal	X004#7	-	○
	SKIP2 to SKIP6, SKIP7,SKIP8	Skip signal	X004#2 to #6, #0,#1	○	○
	SKIPP	Skip signal	G006#6	○	-
	SLCSEQ	Retry point selection signal	G064#1		○
	SLPCA,SLPCB	Spindle return select signal	G064#2,#3	●	-
	SLSPA,SLSPB	Spindle command select signal	G063#2,#3	●	-
	SLVA	Slave operation command signal (serial spindle)	G073#1	○	○
	SLVB		G077#1	○	○
	SLVC		G207#1	○	○
	SLVSA	Slave operation status signal (serial spindle)	F046#4	○	○
	SLVSB		F050#4	○	○
	SLVSC		F169#4	○	○
	SMZ	Error detect signal	G053#6	○	-
	SOCNA	Soft start/stop cancel signal (serial spindle)	G071#4	○	○
	SOCNB		G075#4	○	○
	SOCNC		G205#4	○	○
	SOR	Spindle orientation signal	G029#5	○	○
	SOV0 to SOV7	Spindle speed override signal	G030	○	○
SPAL	Spindle fluctuation detection alarm signal	F035#0	○	○	
SPL	Feed hold lamp signal	F000#4	○	○	

Group	Symbol	Signal name	Address	T series	M series
S	SPO	Software operator's panel signal(*SP)	F075#7	○	○
	SPPHS	Spindle phase synchronous control signal	G038#3	○	○
	SPSLA	Spindle select signal (serial spindle)	G071#2	○	○
	SPSLB		G075#2	○	○
	SPSLC		G205#2	○	○
	SPSTP	Spindle stop complete signal	G028#6	○	-
	SPSYC	Spindle synchronous control signal	G038#2	○	○
	SRLNI0 to SRLNI3	Group number specification signals	G091#0 to #3	○	○
	SRLNO0 to SRLNO3	Group number output signals	F178#0 to #3	○	○
	SRN	Program restart signal	G006#0	○	○
	SRNMV	Program restart under way signal	F002#4	○	○
	SRVA	CCW command signal (serial spindle)	G070#4	○	○
	SRVB		G074#4	○	○
	SRVC		G204#4	○	○
	SSIN	Spindle motor command polarity select signal	G033#6	○	○
	SSIN2		G035#6	○	○
	SSIN3		G037#6	○	○
	SSTA	Speed zero signal (serial spindle)	F045#1	○	○
	SSTB		F049#1	○	○
	SSTC		F168#1	○	○
	ST	Cycle start lamp signal	G007#2	○	○
	STL	Cycle start signal	F000#5	○	○
	STLK	Start lock signal	G007#1	○	-
	STRD	Input and run simultaneous mode select signal	G058#5	-	○
	STWD	Output and run simultaneous mode select signal	G058#6	-	○
	SUCLP	Spindle unclamp signal	F038#1	○	-
	SVF1 to SVF8	Servo off signal	G126	○	○
	SWS1	Spindle selection signal	G027#0	○	-
	SWS2		G027#1	○	-
	SWS3		G027#2	○	-
	SYCAL	Spindle synchronous control alarm signal	F044#4	○	○
	SYCAL	Phase error monitor signal	F044#4	○	○
SYN10 to SYN80	Synchronous control under way signals	F118	○	-	

Group	Symbol	Signal name	Address	T series	M series
S	SYN10 to SYN70	Synchronous/composite/superimposed control under way signals	F118#0 to #6	●	-
	SYNC1 to SYNC8	Simple synchronous axis select signal	G138	○	○
	SYNC to SYNC8	Synchronous control axis selection signals	G138	○	-
	SYNC to SYNC7	Synchronous control axis selection signals	G138#0 to #6	●	-
	SYNCJ1 to SYNCJ8	Simple synchronous manual feed axis select signal	G140	-	○
	SYNMOD	EGB mode signal	F065#6		○
T	T00 to T31	Tool function code signal	F026 to F029	○	○
	TAP	Tapping signal	F001#5	○	○
	TF	Tool function strobe signal	F007#3	○	○
	TFIN	Tool function completion signal	G005#3	○	○
	THRD	Thread cutting signal	F002#3	○	○
	TIALM	Tool post interference alarm signal	F064#7	●	-
	TICLK	Tool post interference check signal	F064#6	●	-
	TL01 to TL64	Tool group number select signal	G047#0 to #6	○	-
	TL01 to TL256		G047#0 to G048#0	-	○
	TLCH	Tool change signal	F064#0	○	○
	TLCHI	Individual tool change signal	F064#2	-	○
	TLMA	Torque limit signal (serial spindle)	F045#6	○	○
	TLMB		F049#6	○	○
	TLMC		F168#6	○	○
	TLMHA	Torque limit command HIGH signal (serial spindle)	G070#1	○	○
	TLMHB		G074#1	○	○
	TLMHC		G204#1	○	○
	TLMLA	Torque limit command LOW signal (serial spindle)	G070#0	○	○
	TLMLB		G074#0	○	○
	TLMLC		G204#0	○	○
	TLNW	New tool select signal	F064#1	○	○
	TLRST	Tool change reset signal	G048#7	○	○
	TLRSTI	Individual tool change reset signal	G048#6	-	○
	TLSKP	Tool skip signal	G048#5	○	○
	TMRON	General-purpose integrating meter start signal	G053#0	○	○
	TRACT	Tool retraction mode signal	F092#3	○	○
	TRESC	Tool retraction signal	G059#0	○	○
	TRQL1 to TRQL8	Torque limit reached signal	F114	○	-
	TRRTN	Tool return signal	G059#1	○	○
	TRSPS	Tool return completion signal	F092#5	○	○

Group	Symbol	Signal name	Address	T series	M series
U	UI000 to UI015	Input signal for custom macro	G054,G055	○	○
	UINT	Interrupt signal for custom macro	G053#3	○	○
	UO000 to UO015	Output signal for custom macro	F054,F055	○	○
	UO100 to UO131		F056 to F059	○	○
W	WATO	Waiting signal	F063#6	●	●
	WQISM	Workpiece coordinate system shift value write mode select signal	G039#6	○	-
	WOSET	Workpiece coordinate system shift value write signal	G040#7	○	-
X	XAE	Measuring position reached signal	X004#0	○	○
Y	YAE		X004#1	-	○
Z	ZAE		X004#1	○	-
	ZAE		X004#2	-	○
	ZP1 to ZP8	Reference position return end signal	F094	○	○
	ZP21 to ZP28	2nd reference position return end signal	F096	○	○
	ZP31 to ZP38	3rd reference position return end signal	F098	○	○
	ZP41 to ZP48	4th reference position return end signal	F100	○	○
	ZPX	Spindle orientation completion signal	F094	○	-
	ZRF1 to ZRF8	Reference position establishment signal	F120	○	○
	ZRN	Manual reference position return selection signal	G043#7	○	○
	ZRNO	Software operator's panel signal(ZRN)	F073#4	○	○

A.3 List by Address

Address	Signal name	Symbol	T series	M series
X004#0	Measuring position reached signal	XAE	○	○
X004#1		YAE	-	○
X004#1		ZAE	○	-
X004#2		ZAE	-	○
X004#2,#4	Manual feed interlock signal for each axis	+MIT1,+MIT2	○	-
X004#2,#4	Tool offset write signal	+MIT1,+MIT2	○	-
X004#2 to #6,#0,#1	Skip signal	SKIP2 to SKIP6, SKIP7,SKIP8	○	○
X004#3,#5	Manual feed interlock signal for each axis	-MIT1,-MIT2	○	-
X004#3,#5	Tool offset write signal	-MIT1,-MIT2	○	-
X004#6	Skip signal (PMC axis control)	ESKIP	○	○
X004#7	Skip signal	SKIP	○	○
X004#7	Overload torque signal	SKIP	-	○
X008#4	Emergency stop signal	*ESP	○	○
X009	Reference position return deceleration signal	*DEC1 to *DEC8	○	○
Y(n+0)	Servo motor speed detection signals	DSV1 to DSV8	○	○
Y(n+1)#0 to #2	Spindle motor speed detection signals	DSP1, DSP2, DSP3	○	○
G000,G001	Data signal for external data input	ED0 to ED15	○	○
G002#0 to #6	Address signal for external data input	EA0 to EA6	○	○
G002#7	Read signal for external data input	ESTB	○	○
G004#3	End signal	FIN	○	○
G004#4	2nd M function completion signal	MFIN2	○	○
G004#5	3rd M function completion signal	MFIN3	○	○
G005#0	Auxiliary function completion signal	MFIN	○	○
G005#1	External operation function completion signal	EFIN	-	○
G005#2	Spindle function completion signal	SFIN	○	○
G005#3	Tool function completion signal	TFIN	○	○
G005#4	2nd auxiliary function completion signal	BFIN	○	-
G005#6	Auxiliary function lock signal	AFL	○	○
G005#7	2nd auxiliary function completion signal	BFIN	-	○
G006#0	Program restart signal	SRN	○	○
G006#2	Manual absolute signal	*ABSM	○	○
G006#4	Override cancel signal	OVC	○	○
G006#6	Skip signal	SKIPP	○	-

Address	Signal name	Symbol	T series	M series
G007#0	Retrace signal	RVS	-	○
G007#1	Start lock signal	STLK	○	-
G007#2	Cycle start signal	ST	○	○
G007#4	Stroke check 3 release signal	RLSOT3	○	○
G007#5	Follow-up signal	*FLWU	○	○
G007#6	Stored stroke limit select signal	EXLM	○	○
G007#7	Stroke limit release signal	RLSOT	-	○
G008#0	Interlock signal	*IT	○	○
G008#4	Emergency stop signal	*ESP	○	○
G008#5	Feed hold signal	*SP	○	○
G008#6	Reset & rewind signal	RRW	○	○
G008#7	External reset signal	ERS	○	○
G009#0 to 4	Workpiece number search signal	PN1,PN2,PN4, PN8,PN16	○	○
G010,G011	Manual feedrate override signal	*JV0 to *JV15	○	○
G012	Feedrate override signal	*FV0 to *FV7	○	○
G013	2nd feedrate override signal	*AFV0 to *AFV7	○	○
G014#0,#1	Rapid traverse override signal	ROV1,ROV2	○	○
G016#0	Motor speed detection function enable signal	MSDFON	○	○
G016#7	F1-digit feed select signal	F1D	-	○
G018#0 to #3	Manual handle feed axis selection signal	HS1A to HS1D	○	○
G018#4 to #7		HS2A to HS2D	○	○
G019#0 to #3		HS3A to HS3D	-	○
G019#4,#5	Manual handle feed amount selection signal (incremental feed signal)	MP1,MP2	○	○
G019#7	Manual rapid traverse selection signal	RT	○	○
G023#6	Tool axis perpendicular direction handle feed mode signal	RGHTH	-	○
G023#7	Tool axis direction handle feed mode signal	ALNGH	-	○
G027#0	Spindle selection signal	SWS1	○	-
G027#1		SWS2	○	-
G027#2		SWS3	○	-
G027#3	Stop signal in each spindle	*SSTP1	○	-
G027#4		*SSTP2	○	-
G027#5		*SSTP3	○	-
G027#7	Cs contour control switch signal	CON	○	○
G028#1,#2	Gear selection signal (input)	GR1,GR2	○	○
G028#4	Spindle unclamp completion signal	*SUCPF	○	-
G028#5	Spindle clamp completion signal	*SCPF	○	-
G028#6	Spindle stop complete signal	SPSTP	○	-

Address	Signal name	Symbol	T series	M series
G028#7	2nd position coder selection signal	PC2SLC	○	-
G029#0	Gear select signal (input)	GR21	○	-
G029#2		GR31	○	-
G029#4	Spindle speed arrival signal	SAR	○	○
G029#5	Spindle orientation signal	SOR	○	○
G029#6	Spindle stop signal	*SSTP	○	○
G030	Spindle speed override signal	SOV0 to SOV7	○	○
G032#0 to G033#3	Spindle motor speed command signal	R011 to R121	○	○
G033#5	Spindle motor command polarity select signal	SGN	○	○
G033#6		SSIN	○	○
G033#7	Spindle motor speed command select signal	SIND	○	○
G034#0 to G035#3	Spindle motor speed command signal	R0112 to R1212	○	○
G035#5	Spindle motor command polarity select signal	SGN2	○	○
G035#6	Spindle motor command polarity select signal	SSIN2	○	○
G035#7	Spindle motor speed command select signal	SIND2	○	○
G036#0 to G037#3	Spindle motor speed command signal	R0113 to R1213	○	○
G037#5	Spindle motor command polarity select signal	SGN3	○	○
G037#6	Spindle motor command polarity select signal	SSIN3	○	○
G037#7	Spindle motor speed command select signal	SIND3	○	○
G038#0	Polygon spindle stop signal	*PLSST	○	-
G038#2	Spindle synchronous control signal	SPSYC	○	○
G038#3	Spindle phase synchronous control signal	SPPHS	○	○
G038#6	B-axis unclamp completion signal	*BEUCP	-	○
G038#7	B-axis clamp completion signal	*BECLP	-	○
G039#0 to #5, G040#0	Tool offset number select signal	OFN0 to OFN5, OFN6	○	-
G039#6	Workpiece coordinate system shift value write mode select signal	WOQSM	○	-
G039#7	Tool offset value write mode select signal	GOQSM	○	-
G040#6	Position record signal	PRC	○	-
G040#7	Workpiece coordinate system shift value write signal	WOSET	○	-
G041#0 to #3	Manual handle interrupt axis selection signal	HS11A to HS11D	○	○
G041#4 to #7		HS21A to HS21D	○	○
G042#0 to #3		HS31A to HS31D	-	○
G042#7	Direct operation select signal	DMMC	○	○
G043#0 to #2	Mode selection signal	MD1, MD2, MD4	○	○
G043#5	DNC operation select signal	DNCI	○	○

Address	Signal name	Symbol	T series	M series
G043#7	Manual reference position return selection signal	ZRN	○	○
G044#0,G045	Optional block skip signal	BDT1, BDT2 to BDT9	○	○
G044#1	All-axis machine lock signal	MLK	○	○
G046#1	Single block signal	SBK	○	○
G046#3 to #6	Memory protect signal	KEY1 to KEY4	○	○
G046#7	Dry run signal	DRN	○	○
G047#0 to #6	Tool group number select signal	TL01 to TL64	○	-
G047#0 to G048#0		TL01 to TL256	-	○
G048#5	Tool skip signal	TLSKP	○	○
G048#6	Individual tool change reset signal	TLRSTI	-	○
G048#7	Tool change reset signal	TLRST	○	○
G049#0 to G050#1	Tool life count override signal	*TLV0 to *TLV9	-	○
G051#0 to #3	Chopping feedrate override signals	*CHP8 to *CHP0	-	○
G051#6	Chopping start signal	CHPST	-	○
G051#7	Chopping hold signal	*CHLD	-	○
G052	Input signal for remote buffer	RMTDI0 to RMTDI7	○	○
G053#0	General-purpose integrating meter start signal	TMRON	○	○
G053#3	Interrupt signal for custom macro	UINT	○	○
G053#6	Error detect signal	SMZ	○	-
G053#7	Chamfering signal	CDZ	○	-
G054,G055	Input signal for custom macro	UI000 to UI015	○	○
G058#0	External start signal program input	MINP	○	○
G058#1	External read start signal	EXRD	○	○
G058#2	External read/punch stop signal	EXSTP	○	○
G058#3	External punch start signal	EXWT	○	○
G058#5	Input and run simultaneous mode select signal	STRD	-	○
G058#6	Output and run simultaneous mode select signal	STWD	-	○
G059#0	Tool retraction signal	TRESC	○	○
G059#1	Tool return signal	TRRTN	○	○
G060#7	Tail stock barrier select signal	*TSB	○	-
G061#0	Rigid tapping signal	RGTAP	○	○
G061#4,#5	Rigid tap spindle select signal	RGTSP1, RGTSP2	○	-
G062#1	Automatic erase CRT screen display cancel signal	*CRTOF	○	○
G063#0	Path selection signal (Tool post selection signal)	HEAD	●	●

Address	Signal name	Symbol	T series	M series
G063#1	No-wait signal	NOWT	●	●
G063#2,#3	Spindle command select signal	SLSPA,SLSPB	●	-
G063#5	Perpendicular/angular axis control disable signal	NOZAGC	○	○
G064#0	Retry start signal	RTNCY	-	○
G064#1	Retry point selection signal	SLCSEQ	-	○
G064#2,#3	Spindle feedback select signal	SLPCA,SLPCB	●	-
G064#6	Simple spindle synchronous control signal	ESRSYC	○	○
G066#0	All-axis VRDY OFF alarm ignore signal	IGNVRY	○	○
G066#1	External key input mode selection signal	ENBKY	○	○
G066#4	Retract signal	RTRCT	-	○
G066#7	Key code read signal	EKSET	○	○
G070#0	Torque limit command LOW signal (serial spindle)	TLMLA	○	○
G070#1	Torque limit command HIGH signal (serial spindle)	TLMHA	○	○
G070#3,#2	Clutch/gear signal (serial spindle)	CTH1A,CTH2A	○	○
G070#4	CCW command signal (serial spindle)	SRVA	○	○
G070#5	CW command signal (serial spindle)	SFRA	○	○
G070#6	Orientation command signal (serial spindle)	ORCMA	○	○
G070#7	Machine ready completion signal (serial spindle)	MRDYA	○	○
G071#0	Alarm reset signal (serial spindle)	ARSTA	○	○
G071#1	Emergency stop signal (serial spindle)	*ESPA	○	○
G071#2	Spindle select signal (serial spindle)	SPSLA	○	○
G071#3	Power line switch completion signal (serial spindle)	MCFNA	○	○
G071#4	Soft start stop cancel signal (serial spindle)	SOCNA	○	○
G071#5	Signal for controlling velocity integration (serial spindle)	INTGA	○	○
G071#6	Output switch request signal (serial spindle)	RSLA	○	○
G071#7	Power line status check signal (serial spindle)	RCHA	○	○
G072#0	Orientation stop position change signal (serial spindle)	INDXA	○	○
G072#1	Rotation direction command while changing the orientation stop position signal (serial spindle)	ROTA	○	○
G072#2	Short-distant movement command while changing the orientation stop position signal (serial spindle)	NRROA	○	○
G072#3	Differential mode command signal (serial spindle)	DEFMDA	○	○
G072#4	Analog override command signal (serial spindle)	OVRIDA	○	○
G072#5	Incremental command external setting type orientation signal (serial spindle)	INCMDA	○	○
G072#6	Main spindle MCC status signal while changing spindles signal (serial spindle)	MFNHGA	○	○
G072#7	High-output MCC status signal while a magnetic sensor (serial spindle)	RCHHGA	○	○

Address	Signal name	Symbol	T series	M series
G073#0	Command for spindle orientaion with a magnetic sensor (serial spindle)	MORCMA	○	○
G073#1	Slave operation command signal (serial spindle)	SLVA	○	○
G073#2	Motor power stop signal (serial spindle)	MPOFA	○	○
G074#0	Torque limit command LOW signal (serial spindle)	TLMLB	○	○
G074#1	Torque limit command HIGH signal (serial spindle)	TLMHB	○	○
G074#3,#2	Clutch/gear signal (serial spindle)	CTH1B,CTH2B	○	○
G074#4	CCW command signal (serial spindle)	SRVB	○	○
G074#5	CW command signal (serial spindle)	SFRB	○	○
G074#6	Orientation command signal (serial spindle)	ORCMB	○	○
G074#7	Machine ready completion signal (serial spindle)	MRDYB	○	○
G075#0	Alarm reset signal (serial spindle)	ARSTB	○	○
G075#1	Emergency stop signal (serial spindle)	*ESPB	○	○
G075#2	Spindle select signal (serial spindle)	SPSLB	○	○
G075#3	Power line switch completion signal (serial spindle)	MCFNB	○	○
G075#4	Soft start stop cancel signal (serial spindle)	SOCNB	○	○
G075#5	Signal for controlling velocity integration (serial spindle)	INTGB	○	○
G075#6	Output switch request signal (serial spindle)	RSLB	○	○
G075#7	Power line status check signal (serial spindle)	RCHB	○	○
G076#0	Orientation stop position change signal (serial spindle)	INDXB	○	○
G076#1	Rotation direction command while changing the orientation stop position signal (serial spindle)	ROTAB	○	○
G076#2	Short-distant movement command while changing the orientation stop position signal (serial spindle)	NRROB	○	○
G076#3	Differential mode command signal (serial spindle)	DEFMDB	○	○
G076#4	Analog override command signal (serial spindle)	OVRIDB	○	○
G076#5	Incremental command external setting type orientation signal (serial spindle)	INCMDB	○	○
G076#6	Main spindle MCC status signal while changing spindles signal (serial spindle)	MFNHGB	○	○
G076#7	High-output MCC status signal while a magnetic sensor (serial spindle)	RCHHGB	○	○
G077#0	Command for spindle orientaion with a magnetic sensor (serial spindle)	MORCMB	○	○
G077#1	Slave operation command signal (serial spindle)	SLVB	○	○
G077#2	Motor power stop signal (serial spindle)	MPOFB	○	○
G078#0 to G079#3	Spindle orientation external stop position command signal	SHA00 to SHA11	○	○
G080#0 to G081#3		SHB00 to SHB11	○	○

Address	Signal name	Symbol	T series	M series
G086#0 to #3	Feed axis and direction selection signals	+Jg, -Jg, +Ja, -Ja	○	○
G091#0 to #3	Group number specification signals	SRLNI0 to SRLNI3	○	○
G092#0	I/O Link confirmation signal	IOLACK	○	○
G092#1	I/O Link specification signal	IOLS	○	○
G092#2	Power Mate read/write inprogress signal	BGION	○	○
G092#3	Power Mate read/write alarm signal	BGIALM	○	○
G092#4	Power Mate background busy signal	BGEN	○	○
G096#0 to #6	1% step rapid traverse override signal	*HROV0 to *HROV6	○	○
G096#7	1% step rapid traverse override select signal	HROV	○	○
G098	Key code signal	EKC0 to EKC7	○	○
G100	Feed axis and direction selection signal	+J1 to +J8	○	○
G102		-J1 to -J8	○	○
G106	Mirror image signal	MI1 to MI8	○	○
G108	Each-axis machine lock signal	MLK1 to MLK8	○	○
G110	Stroke limit external setting signal	+LM1 to +LM8	-	○
G112		-LM1 to -LM8	-	○
G114	Overtravel signal	*+L1 to *+L8	○	○
G116		*-L1 to *-L8	○	○
G118	External deceleration signal	*+ED1 to *+ED8	○	○
G120		*-ED1 to *-ED8	○	○
G122	Parking signals	PK1 to PK8	○	-
G122#0 to #6		PK1 to PK7	●	-
G122#6 (G031#6)	First spindle synchronous control signal	PKESS1	○	○
G122#7 (G031#7)	Second spindle synchronous control signal	PKESS2	○	○
G124	Controlled axis detach signal	DTCH1 to DTCH8	○	○
G126	Servo off signal	SVF1 to SVF8	○	○
G128#0 to #6	Composite control axis selection signals	MIX1 to MIX7	●	-
G130	Interlock signal for each axis	*IT1 to *IT8	○	○
G132#0 to #3	Interlock signal for each axis and direction	+MIT1 to +MIT4	-	○
G134#0 to #3		-MIT1 to -MIT4	-	○
G136	Control axis select signal (PMC axis control)	EAX1 to EAX8	○	○
G138	Simple synchronous axis select signal	SYNC1 to SYNC8	○	○
G140	Simple synchronous manual feed axis select signal	SYNCJ1 to SYNCJ8	-	○
G138	Synchronous control axis selection signals	SYNC to SYNC8	○	-
G138#0 to #6		SYNC to SYNC7	●	-
G142#0	Auxiliary function completion signal (PMC axis control)	EFINA	○	○

Address	Signal name	Symbol	T series	M series
G142#2	Buffering disable signal (PMC axis control)	EMBUFA	○	○
G142#3	Block stop signal (PMC axis control)	ESBKA	○	○
G142#4	Servo off signal (PMC axis control)	ESOFA	○	○
G142#5	Axis control temporary stop signal (PMC axis control)	ESTPA	○	○
G142#6	Reset signal (PMC axis control)	ECLRA	○	○
G142#7	Axis control command read signal (PMC axis control)	EBUFA	○	○
G143#0 to #6	Axis control command signal (PMC axis control)	EC0A to EC6A	○	○
G143#7	Block stop disable signal (PMC axis control)	EMSBKA	○	○
G144,G145	Axis control feedrate signal (PMC axis control)	EIF0A to EIF15A	○	○
G146 to G149	Axis control data signal (PMC axis control)	EID0A to EID31A	○	○
G150#0,#1	Rapid traverse override signal (PMC axis control)	ROV1E,ROV2E	○	○
G150#5	Override cancel signal (PMC axis control)	OVCE	○	○
G150#6	Manual rapid traverse selection signal (PMC axis control)	RTE	○	○
G150#7	Dry run signal (PMC axis control)	DRNE	○	○
G151	Feedrate override signal (PMC axis control)	*FV0E to *FV7E	○	○
G154#0	Auxiliary function completion signal (PMC axis control)	EFINB	○	○
G154#2	Buffering disable signal (PMC axis control)	EMBUFB	○	○
G154#3	Block stop signal (PMC axis control)	ESBKB	○	○
G154#4	Servo off signal (PMC axis control)	ESOFB	○	○
G154#5	Axis control temporary stop signal (PMC axis control)	ESTPB	○	○
G154#6	Reset signal (PMC axis control)	ECLRB	○	○
G154#7	Axis control command read signal (PMC axis control)	EBUFB	○	○
G155#0 to #6	Axis control command signal (PMC axis control)	EC0B to EC6B	○	○
G155#7	Block stop disable signal (PMC axis control)	EMSBKB	○	○
G156,G157	Axis control feedrate signal (PMC axis control)	EIF0B to EIF15B	○	○
G158 to G161	Axis control data signal (PMC axis control)	EID0B to EID31B	○	○
G166#0	Auxiliary function completion signal (PMC axis control)	EFINC	○	○
G166#2	Buffering disable signal (PMC axis control)	EMBUFC	○	○
G166#3	Block stop signal (PMC axis control)	ESBKC	○	○
G166#4	Servo off signal (PMC axis control)	ESOFC	○	○
G166#5	Axis control temporary stop signal (PMC axis control)	ESTPC	○	○
G166#6	Reset signal (PMC axis control)	ECLRC	○	○
G166#7	Axis control command read signal (PMC axis control)	EBUFC	○	○
G167#0 to #6	Axis control command signal (PMC axis control)	EC0C to EC6C	○	○

Address	Signal name	Symbol	T series	M series
G167#7	Block stop disable signal (PMC axis control)	EMSBKC	○	○
G168,G169	Axis control feedrate signal (PMC axis control)	EIF0C to EIF15C	○	○
G170 to G173	Axis control data signal (PMC axis control)	EID0C to EID31C	○	○
G178#0	Auxiliary function completion signal (PMC axis control)	EFIND	○	○
G178#2	Buffering disable signal (PMC axis control)	EMBUFD	○	○
G178#3	Block stop signal (PMC axis control)	ESBKD	○	○
G178#4	Servo off signal (PMC axis control)	ESOFD	○	○
G178#5	Axis control temporary stop signal (PMC axis control)	ESTPD	○	○
G178#6	Reset signal (PMC axis control)	ECLRD	○	○
G178#7	Axis control command read signal (PMC axis control)	EBUFD	○	○
G179#0 to #6	Axis control command signal (PMC axis control)	EC0D to EC6D	○	○
G179#7	Block stop disable signal (PMC axis control)	EMSBKD	○	○
G180,G181	Axis control feedrate signal (PMC axis control)	EIF0D to EIF15D	○	○
G182 to G185	Axis control data signal (PMC axis control)	EID0D to EID31D	○	○
G190#0 to #6	Superimposed control axis selection signals	OVLS1 to OVLS7	●	-
G192	Each-axis VRDY OFF alarm ignore signal	IGVRY1 to IGVRY8	○	○
G198	Position display neglect signal	NPOS1 to NPOS8	○	○
G204#0	Torque limit command LOW signal (serial spindle)	TLMLC	○	○
G204#1	Torque limit command HIGH signal (serial spindle)	TLMHC	○	○
G204#3,#2	Clutch/gear signal (serial spindle)	CTH1C,CTH2C	○	○
G204#4	CCW command signal (serial spindle)	SRVC	○	○
G204#5	CW command signal (serial spindle)	SFRC	○	○
G204#6	Orientation command signal (serial spindle)	ORCMC	○	○
G204#7	Machine ready signal (serial spindle)	MRDYC	○	○
G205#0	Alarm reset signal (serial spindle)	ARSTC	○	○
G205#1	Emergency stop signal (serial spindle)	*ESPC	○	○
G205#2	Spindle select signal (serial spindle)	SPSLC	○	○
G205#3	Power line switch completion signal (serial spindle)	MCFNC	○	○
G205#4	Soft start/stop cancel signal (serial spindle)	SOCNC	○	○
G205#5	Signal for controlling velocity integration (serial spindle)	INTGC	○	○
G205#6	Output switch request signal (serial spindle)	RSLC	○	○
G205#7	Power line status check signal (serial spindle)	RCHC	○	○
G206#0	Orientation stop position change signal (serial spindle)	INDXC	○	○

Address	Signal name	Symbol	T series	M series
G206#1	Rotation direction command while changing the orientation stop position signal (serial spindle)	ROTAC	○	○
G206#2	Short-distant movement command while changing the orientation stop position signal (serial spindle)	NRROC	○	○
G206#3	Differential mode command signal (serial spindle)	DEFMDC	○	○
G206#4	Analog override command signal (serial spindle)	OVRIDC	○	○
G206#5	Incremental command external setting type orientation signal (serial spindle)	INCMDC	○	○
G206#6	Main spindle MCC status signal while changing spindles signal (serial spindle)	MFNHGC	○	○
G206#7	High-output MCC status signal while a magnetic sensor (serial spindle)	RCHHGC	○	○
G207#0	Command for spindle orientaion with a magnetic sensor (serial spindle)	MORCMC	○	○
G207#1	Slave operation command signal (serial spindle)	SLVC	○	○
G207#2	Motor power stop signal (serial spindle)	MPOFC	○	○
G208#0 to G209#3	Spindle orientation stop position external command signal	SHC00 to SHC11	○	○
F000#0	Rewinding signal	RWD	○	○
F000#4	Feed hold lamp signal	SPL	○	○
F000#5	Cycle start lamp signal	STL	○	○
F000#6	Servo ready completion signal	SA	○	○
F000#7	Automatic operation signal	OP	○	○
F001#0	Alarm signal	AL	○	○
F001#1	Resetting signal	RST	○	○
F001#2	Battery alarm signal	BAL	○	○
F001#3	Distribution end signal	DEN	○	○
F001#4	Spindle enable signal	ENB	○	○
F001#5	Tapping signal	TAP	○	○
F001#7	CNC signal	MA	○	○
F002#0	Inch input signal	INCH	○	○
F002#1	Rapid traversing signal	RPDO	○	○
F002#2	Constant surface speed signal	CSS	○	○
F002#3	Thread cutting signal	THRD	○	○
F002#4	Program restart under way signal	SRNMV	○	○
F002#6	Cutting feed signal	CUT	○	○
F002#7	Dry run check signal	MDRN	○	○
F003#0	Incremental feed select check signal	MINC	○	○
F003#1	Manual handle feed select check signal	MH	○	○
F003#2	Jog feed select check signal	MJ	○	○
F003#3	Manual data input select check signal	MMDI	○	○
F003#4	DNC operation selection confirm signal	MRMT	○	○

Address	Signal name	Symbol	T series	M series
F003#5	Automatic operation select check signal	MMEM	○	○
F003#6	Memory edit select check signal	MEDT	○	○
F003#7	TEACH IN select check signal	MTCHIN	○	○
F004#0,F005	Optional block skip check signal	MBDT1,MBDT2 to MBDT9	○	○
F004#1	All-axis machine lock check signal	MMLK	○	○
F004#2	Manual absolute check signal	MABSM	○	○
F004#3	Single block check signal	MSBK	○	○
F004#4	Auxiliary function lock check signal	MAFL	○	○
F004#5	Manual reference position return selection check signal	MREF	○	○
F007#0	Miscellaneous function strobe signal	MF	○	○
F007#1	External operation signal for high-speed interface	EFD	-	○
F007#2	Spindle-speed function strobe signal	SF	○	○
F007#3	Tool function strobe signal	TF	○	○
F007#4	2nd auxiliary function strobe signal	BF	○	-
F007#7		BF	-	○
F008#0	External operation signal	EF	-	○
F008#4	2nd M function strobe signal	MF2	○	○
F008#5	3rd M function strobe signal	MF3	○	○
F009#4	Decode M signal	DM30	○	○
F009#5		DM02	○	○
F009#6		DM01	○	○
F009#7		DM00	○	○
F010 to F013	Miscellaneous function code signal	M00 to M31	○	○
F014 to F015	2nd M function code signal	M200 to M215	○	○
F016 to F017	3rd M function code signal	M300 to M315	○	○
F022 to F025	Spindle speed code signal	S00 to S31	○	○
F026 to F029	Tool function code signal	T00 to T31	○	○
F030 to F033	2nd miscellaneous function code signal	B00 to B31	○	○
F034#0 to #2	Gear selection signal (output)	GR10,GR20,GR30	-	○
F035#0	Spindle fluctuation detection alarm signal	SPAL	○	○
F036#0 to F037#3S	12-bit code signal	R010 to R120	○	○
F038#0	Spindle clamp signal	SCLP	○	-
F038#1	Spindle unclamp signal	SUCLP	○	-
F038#2	Spindle enable signal	ENB2	○	-
F038#3		ENB3	○	-
F039#2	Chopping-in-progress signal	CHPMD	-	○

Address	Signal name	Symbol	T series	M series
F039#3	Chopping cycle signal	CHPCYL	-	○
F040,F041	Actual spindle speed signal	AR0 to AR15	○	-
F044#1	Cs contour control switch completion signal	FSCSL	○	○
F044#2	Spindle synchronous speed control completion signal	FSPSY	○	○
F044#3	Spindle phase synchronous control completion signal	FSPPH	○	○
F044#4	Spindle synchronous control alarm signal	SYCAL	○	○
F044#4	Phase error monitor signal	SYCAL	○	○
F045#0	Alarm signal (serial spindle)	ALMA	○	○
F045#1	Speed zero signal (serial spindle)	SSTA	○	○
F045#2	Speed detection signal (serial spindle)	SDTA	○	○
F045#3	Speed arrival signal (serial spindle)	SARA	○	○
F045#4	Load detection signal 1 (serial spindle)	LDT1A	○	○
F045#5	Load detection signal 2 (serial spindle)	LDT2A	○	○
F045#6	Torque limit signal (serial spindle)	TLMA	○	○
F045#7	Orientation completion signal (serial spindle)	ORARA	○	○
F046#0	Power line switch signal (serial spindle)	CHPA	○	○
F046#1	Spindle switch completion signal (serial spindle)	CFINA	○	○
F046#2	Output switch signal (serial spindle)	RCHPA	○	○
F046#3	Output switch completion signal (serial spindle)	RCFNA	○	○
F046#4	Slave operation status signal (serial spindle)	SLVSA	○	○
F046#5	Signal for approximate spindle orientation with a position coder (serial spindle)	PORA2A	○	○
F046#6	Signal for completion of spindle orientation with a magnetic sensor (serial spindle)	MORA1A	○	○
F046#7	Signal for approximate spindle orientation with a magnetic sensor (serial spindle)	MORA2A	○	○
F047#0	Signal indicating the status of the detected one-rotation position coder signal (serial spindle)	PC1DEA	○	○
F047#1	Incremental method orientation signal (serial spindle)	INCSTA	○	○
F049#0	Alarm signal (serial spindle)	ALMB	○	○
F049#1	Speed zero signal (serial spindle)	SSTB	○	○
F049#2	Speed detection signal (serial spindle)	SDTB	○	○
F049#3	Speed arrival signal (serial spindle)	SARB	○	○
F049#4	Load detection signal 1 (serial spindle)	LDT1B	○	○
F049#5	Load detection signal 2 (serial spindle)	LDT2B	○	○
F049#6	Torque limit signal (serial spindle)	TLMB	○	○
F049#7	Orientation completion signal (serial spindle)	ORARB	○	○
F050#0	Power line switch signal (serial spindle)	CHPB	○	○

Address	Signal name	Symbol	T series	M series
F050#1	Spindle switch completion signal (serial spindle)	CFINB	○	○
F050#2	Output switch signal (serial spindle)	RCHPB	○	○
F050#3	Output switch completion signal (serial spindle)	RCFNB	○	○
F050#4	Slave operation status signal (serial spindle)	SLVSB	○	○
F050#5	Signal for approximate spindle orientation with a position coder (serial spindle)	PORA2B	○	○
F050#6	Signal for completion of spindle orientation with a magnetic sensor (serial spindle)	MORA1B	○	○
F050#7	Signal for approximate spindle orientation with a magnetic sensor (serial spindle)	MORA2B	○	○
F051#0	Signal indicating the status of the detected one-rotation position coder signal (serial spindle)	PC1DEB	○	○
F051#1	Incremental method orientation signal (serial spindle)	INCSTB	○	○
F053#0	Key input disable signal	INHKY	○	○
F053#1	Program screen display mode signal	PRGDPL	○	○
F053#2	Read/punch in-progress signal	RPBSY	○	○
F053#3	Read/punch alarm signal	RPALM	○	○
F053#4	Background busy signal	BGEACT	○	○
F053#7	Key code read completion signal	EKENB	○	○
F054, F055	Output signal for custom macro	UO000 to UO015	○	○
F056 to F059		UO100 to UO131	○	○
F060#0	Read completion signal for external data input	EREND	○	○
F060#1	Search completion signal for external data input	ESEND	○	○
F061#0	B-axis unclamp signal	BUCLP	-	○
F061#1	B-axis clamp signal	BCLP	-	○
F062#7	Target part count reached signal	PRTSF	○	○
F063#0	Master axis not arrival signal	PSE1	○	-
F063#1	Polygon synchronous axis not arrival signal	PSE2	○	-
F063#2	Spindle polygon speed arrival signal	PSAR	○	-
F063#5	Retry complete signal	RCYO	-	○
F063#6	Waiting signal	WATO	●	●
F063#7	Polygon synchronization under way signal	PSYN	○	-
F064#0	Tool change signal	TLCH	○	○
F064#1	New tool select signal	TLNW	○	○
F064#2	Individual tool change signal	TLCHI	-	○
F064#5	Spindle command signal	COSP	●	-
F064#6	Tool post interference check signal	TCHK	●	-
F064#7	tool post interference alarm signal	TIALM	●	-

Address	Signal name	Symbol	T series	M series
F065#0	Spindle rotation direction signal	RGSP	-	○
F065#1		RGSPM	-	○
F065#4	Retract completion signal	RTRCTF	-	○
F065#6	EGB mode signal	SYNMOD	-	○
F066#0	Lock-ahead control mode signal	G08MD	-	○
F066#3	Retry point signal	RTNMVS	-	○
F066#5	Small-diameter peck drilling in progress signal	PECK2	-	○
F066#6	HPCC mode signal	MHPCC	-	○
F066#7	HPCC operation signal	EXHPCC	-	○
F069	Output signal for remote buffer	RMTD00 to RMTD07	○	○
F070#0 to F071#1	Position switch signal	PSW01 to PSW10	○	○
F072	Software operator's panel general-purpose switch signal	OUT0 to OUT7	○	○
F073#0	Software operator's panel signal (MD1)	MD1O	○	○
F073#1	Software operator's panel signal (MD2)	MD2O	○	○
F073#2	Software operator's panel signal (MD4)	MD4O	○	○
F073#4	Software operator's panel signal (ZRN)	ZRNO	○	○
F075#2	Software operator's panel signal (BDT)	BDTO	○	○
F075#3	Software operator's panel signal (SBK)	SBKO	○	○
F075#4	Software operator's panel signal (MLK)	MLKO	○	○
F075#5	Software operator's panel signal (DRN)	DRNO	○	○
F075#6	Software operator's panel signal (KEY1 to KEY4)	KEYO	○	○
F075#7	Software operator's panel signal (*SP)	SPO	○	○
F076#0	Software operator's panel signal (MP1)	MP1O	○	○
F076#1	Software operator's panel signal (MP2)	MP2O	○	○
F076#3	Rigid tapping mode signal	RTAP	○	○
F076#4	Software operator's panel signal (ROV1)	ROV1O	○	○
F076#5	Software operator's panel signal (ROV2)	ROV2O	○	○
F077#0	Software operator's panel signal (HS1A)	HS1AO	○	○
F077#1	Software operator's panel signal (HS1B)	HS1BO	○	○
F077#2	Software operator's panel signal (HS1C)	HS1CO	○	○
F077#3	Software operator's panel signal (HS1D)	HS1DO	○	○
F077#6	Software operator's panel signal (RT)	RTO	○	○
F078	Software operator's panel signal (*FV0 to *FV7)	*FV0O to *FV7O	○	○
F079,F080	Software operator's panel signal (*JV0 to *JV15)	*JV0O to *JV15O	○	○
F081#0,#2, #4,#6	Software operator's panel signal (+J1 to +J4)	+J1O to +J4O	○	○
F081#1,#3, #5,#7	Software operator's panel signal (-J1 to -J4)	-J1O to -J4O	○	○
F082#2	Retrace-in-progress signal	RVSL	-	○

Address	Signal name	Symbol	T series	M series
F090#0	Servo axis abnormal load detected signal	ABTQSV	○	○
F090#1	First—spindle abnormal load detected signal	ABTSP1	○	○
F090#2	Second—spindle abnormal load detected signal	ABTSP2	○	○
F090#3	Abnormal load detection for the third spindle	ABTSP3	○	○
F092#3	Tool retraction mode signal	TRACT	○	○
F092#5	Tool return completion signal	TRSPS	○	○
F094	Reference position return end signal	ZP1 to ZP8	○	○
	Spindle orientation completion signal	ZPX	○	-
F096	2nd reference position return end signal	ZP21 to ZP28	○	○
F098	3rd reference position return end signal	ZP31 to ZP38	○	○
F100	4th reference position return end signal	ZP41 to ZP48	○	○
F102	Axis moving signal	MV1 to MV8	○	○
F104	In—position signal	INP1 to INP8	○	○
F106	Axis moving direction signal	MVD1 to MVD8	○	○
F108	Mirror image check signal	MMI1 to MMI8	○	○
F110	Controlled axis detach status signal	MDTCH1 to MDTCH8	○	○
F112	Distribution completion signal (PMC axis control)	EADEN1 to EADEN8	○	○
F114	Torque limit reached signal	TRQL1 to TRQL8	○	-
F116	Floating reference position return end signal	FRP1 to FRP8	○	○
F118	Synchronous control under way signals	SYN10 to SYN80	○	-
F118#0 to #6	Synchronous/composite/superimposed control under way signals	SYN10 to SYN70	●	-
F120	Reference position establishment signal	ZRF1 to ZRF8	○	○
F122	High—speed skip status signal	HDO0 to HDO7	○	○
F129#5	Override 0% signal (PMC axis control)	EOV0	○	○
F129#7	Control axis selection status signal (PMC axis control)	*EAXSL	○	○
F130#0	In—position signal (PMC axis control)	EINPA	○	○
F130#1	Following zero checking signal (PMC axis control)	ECKZA	○	○
F130#2	Alarm signal (PMC axis control)	EIALA	○	○
F130#3	Auxiliary function executing signal (PMC axis control)	EDENA	○	○
F130#4	Axis moving signal (PMC axis control)	EGENA	○	○
F130#5	Positive—direction overtravel signal (PMC axis control)	EOTPA	○	○
F130#6	Negative—direction overtravel signal (PMC axis control)	EOTNA	○	○
F130#7	Axis control command read completion signal (PMC axis control)	EBSYA	○	○
F131#0	Auxiliary function strobe signal (PMC axis control)	EMFA	○	○

Address	Signal name	Symbol	T series	M series
F131#1	Bufferful signal (PMC axis control)	EABUFA	○	○
F132,F142	Auxiliary function code signal (PMC axis control)	EM11A to EM48A	○	○
F133#0	In-position signal (PMC axis control)	EINPB	○	○
F133#1	Following zero checking signal (PMC axis control)	ECKZB	○	○
F133#2	Alarm signal (PMC axis control)	EIALB	○	○
F133#3	Auxiliary function executing signal (PMC axis control)	EDENB	○	○
F133#4	Axis moving signal (PMC axis control)	EGENB	○	○
F133#5	Positive-direction overtravel signal (PMC axis control)	EOTPB	○	○
F133#6	Negative-direction overtravel signal (PMC axis control)	EOTNB	○	○
F133#7	Axis control command read completion signal (PMC axis control)	EBSYB	○	○
F134#0	Auxiliary function strobe signal (PMC axis control)	EMFB	○	○
F134#1	Bufferful signal (PMC axis control)	EABUFB	○	○
F135,F145	Auxiliary function code signal (PMC axis control)	EM11B to EM48B	○	○
F136#0	In-position signal (PMC axis control)	EINPC	○	○
F136#1	Following zero checking signal (PMC axis control)	ECKZC	○	○
F136#2	Alarm signal (PMC axis control)	EIALC	○	○
F136#3	Auxiliary function executing signal (PMC axis control)	EDENC	○	○
F136#4	Axis moving signal (PMC axis control)	EGENC	○	○
F136#5	Positive-direction overtravel signal (PMC axis control)	EOTPC	○	○
F136#6	Negative-direction overtravel signal (PMC axis control)	EOTNC	○	○
F136#7	Axis control command read completion signal (PMC axis control)	EBSYC	○	○
F137#0	Auxiliary function strobe signal (PMC axis control)	EMFC	○	○
F137#1	Buffer full signal (PMC axis control)	EABUFC	○	○
F138,F148	Auxiliary function code signal (PMC axis control)	EM11C to EM48C	○	○
F139#0	In-position signal (PMC axis control)	EINPD	○	○
F139#1	Following zero checking signal (PMC axis control)	ECKZD	○	○
F139#2	Alarm signal (PMC axis control)	EIALD	○	○
F139#3	Auxiliary function executing signal (PMC axis control)	EDEND	○	○
F139#4	Axis moving signal (PMC axis control)	EGEND	○	○
F139#5	Positive-direction overtravel signal (PMC axis control)	EOTPD	○	○
F139#6	Negative-direction overtravel signal (PMC axis control)	EOTND	○	○
F139#7	Axis control command read completion signal (PMC axis control)	EBSYD	○	○

Address	Signal name	Symbol	T series	M series
F140#0	Auxiliary function strobe signal (PMC axis control)	EMFD	○	○
F140#1	Buffer full signal (PMC axis control)	EABUFD	○	○
F141,F151	Auxiliary function code signal (PMC axis control)	EM11D to EM48D	○	○
F168#0	Alarm signal (serial spindle)	ALMC	○	○
F168#1	Speed zero signal (serial spindle)	SSTC	○	○
F168#2	Speed detection signal (serial spindle)	SDTC	○	○
F168#3	Speed arrival signal (serial spindle)	SARC	○	○
F168#4	Load detection signal 1 (serial spindle)	LDT1C	○	○
F168#5	Load detection signal 2 (serial spindle)	LDT2C	○	○
F168#6	Torque limit signal (serial spindle)	TLMC	○	○
F168#7	Orientation completion signal (serial spindle)	ORARC	○	○
F269#0	Power line switch signal (serial spindle)	CHPC	○	○
F169#1	Spindle switch completion signal (serial spindle)	CFINC	○	○
F169#2	Output switch signal (serial spindle)	RCHPC	○	○
F169#3	Output switch completion signal (serial spindle)	RCFNC	○	○
F169#4	Slave operation status signal (serial spindle)	SLVSC	○	○
F169#5	Signal for approximate spindle orientation with a position coder (serial spindle)	PORA2C	○	○
F169#6	Signal for completion of spindle orientation with a magnetic sensor (serial spindle)	MORA1C	○	○
F169#7	Signal for approximate spindle orientation with a magnetic sensor (serial spindle)	MORA2C	○	○
F170#0	Signal indicating the status of the detected one-rotation position coder signal (serial spindle)	PC1DEC	○	○
F170#1	Incremental method orientation signal (serial spindle)	INCSTC	○	○
F177#0	Slave I/O Link selection signal	IOLNK	○	○
F177#1	Slave external read start signal	ERDIO	○	○
F177#2	Slave read/write stop signal	ESTPIO	○	○
F177#3	Slave external write start signal	EWIO	○	○
F177#4	Slave program selection signal	EPRG	○	○
F177#5	Slave macro variable selection signal	EVAR	○	○
F177#6	Slave parameter selection signal	EPARM	○	○
F177#7	Slave diagnosis selection signal	EDGN	○	○
F178#0 to #3	Group number output signals	SRLNO0 to SRLNO3	○	○
F180	Torque limit reach signals for butt-type reference position setting	CLRCH1 to CLRCH8	○	○
F182	Controlling signal (PMC axis control)	EACNT1 to EACNT8	○	○

B. FS15 PMC Address List

This section contains the G and F address lists for the 15 controls. The list in this section is LIST by FUNCTION which lists all of the CNC functions possible for the 15 control.

B.1 List by Function

No.	Function	Related input signal			Related output signal				
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
1	Ready					MA SA	F000.7 F000.6	F096.7 F096.6	
2	Mode selection	TEST S H J D T MEM EDT AGJ MOVL	G002.2 G003.0 G003.1 G003.2 G003.3 G003.4 G003.5 G003.6 G003.7 G002.4	G097.0 G097.1 G097.2 G097.3 G097.5 G097.6 G097.7 G098.4		MTEST MS MH MJ MD MT MMEM MEDT MAGJ MMOVL	F002.2 F003.0 F003.1 F003.2 F003.3 F003.4 F003.5 F003.6 F003.7 F002.4	F099.0 F099.1 F009.2 F099.3 F099.5 F099.6 F099.7 F098.4	
3	Reset, emergency stop	ERS RRW *ESP	G000.7 G000.6 G000.4	G096.7 G096.6 G096.4		RST RWD	F000.2 F000.0	F096.2 F096.0	
4	Alarm	DVAL	G026.1	G110.7		AL PSALM SVALM OHALM OTALM SYALM TIALM	F000.1 F006.0 F006.1 F006.2 F006.3 F006.4	F096.1 F101.0 F101.1 F101.2 F101.3 F101.4 F101.6	
5	Battery alarm					BATL PBATL PBATZ	F040.7 F040.6 F040.5	F120.7 F120.1 F120.2	
6	Manual continus feed, Manual step feed	+J1 +J2 +J3 +J4 +J5 +J6 +J7 +J8 +J9 +J10 -J1 -J2 -J3 -J4 -J5 -J6 -J7 -J8 -J9 -J10 *JV0 ~ *JV15 RT DIST0 ~ DIST26	G065.0 G069.0 G073.0 G077.0 G081.0 G085.0 G089.0 G093.0 G097.0 G101.0 G065.1 G069.1 G073.1 G077.1 G081.1 G085.1 G089.1 G093.1 G097.1 G101.1 G014 ~ G015 G006.7 G020 ~ G023	G129.0 G133.0 G137.0 G141.0 G145.0 G149.0 G153.0 G157.0 G161.0 G165.0 G129.1 G133.1 G137.1 G141.1 G145.1 G149.1 G153.1 G157.1 G161.1 G165.1 G104 ~ G105 G101.7 G106 ~ G109					

No.	Function	Related input signal				Related output signal									
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT							
				HEAD #1	HEAD #2			HEAD #1	HEAD #2						
7	Manual handle feed	HS1A	G011.0	G103.0											
		HS1B	G011.1	G103.1											
		HS1C	G011.2	G103.2											
		HS1D	G011.3	G103.3											
		HS2A	G011.4	G103.4											
		HS2B	G011.5	G103.5											
		HS2C	G011.6	G103.6											
		HS2D	G011.7	G103.7											
		HS3A	G010.0	G102.0											
		HS3B	G010.1	G102.1											
		HS3C	G010.2	G102.2											
		HS3D	G010.3	G102.3											
		MP1	G006.2	G101.2											
		MP2	G006.3	G101.3											
MP4	G006.4	G101.4													
8	Three-dimensional handle feed	ALNGH	G156.0												
		RGHTH	G156.1												
		RNDH	G156.2												
		CNGTL	G156.3												
9	Manual interruption function for three-dimensional coordinate conversion	NOT3DM	G157#7			3DM	F157#5								
10	Manual arbitrary angle feed	AJSTB	G016.7	G122.7											
		AJA0 ~ AJA12	G016 ~ G017	G122 ~ G123											
		AJP1A	G018.0	G124.0											
		AJP1B	G018.1	G124.1											
		AJP1C	G018.2	G124.2											
		AJP1D	G018.3	G124.3											
		AJP2A	G018.4	G124.4											
		AJP2B	G018.5	G124.5											
		AJP2C	G018.6	G124.6											
		AJP2D	G018.7	G124.7											
		+AJ	G016.5	G122.5											
		-AJ	G016.6	G122.6											
		11	Automatic manual simultaneous operation	MOVL	G002.4					G098.4					
				PK1	G065.4										
PK2	G069.4														
PK3	G073.4														
PK4	G077.4														
PK5	G081.4														
PK6	G085.4														
PK7	G089.4														
PK8	G093.4														
PK9	G097.4														
PK10	G101.4														
12	Function to compensate for manual intervention during automatic operation	MIGET	G046#7	G008#3	G056#3	MIFIN	F046#3	F012#5	F060#5						
13	Reference position return	ZRN	G002.7	G098.7		MZRN	F002.7	F098.7							
		*DEC1	G064.5	G128.5		ZP1	F064.0	F128.0							
		*DEC2	G068.5	G132.5		ZP2	F068.0	F132.0							
		*DEC3	G072.5	G136.5		ZP3	F072.0	F136.0							
		*DEC4	G076.5	G140.5		ZP4	F076.0	F140.0							
		*DEC5	G080.5	G144.5		ZP5	F080.0	F144.0							
		*DEC6	G084.5	G148.5		ZP6	F084.0	F148.0							
		*DEC7	G088.5	G152.5		ZP7	F088.0	F152.0							
		*DEC8	G092.5	G156.5		ZP8	F092.0	F156.0							
		*DEC9	G096.5	G160.5		ZP9	F096.0	F160.0							
		*DEC10	G100.5	G164.5		ZP10	F100.0	F164.0							

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
13	Reference position return	ZD1	} These signals are directly signals input to the controller			ZP21	F064.1	F128.1	
		ZD2				ZP22	F068.1	F132.1	
ZD3				ZP23	F072.1	F136.1			
ZD4				ZP24	F076.1	F140.1			
ZD5				ZP25	F080.1	F144.1			
ZD6				ZP26	F084.1	F148.1			
ZD7				ZP27	F088.1	F152.1			
ZD8				ZP28	F092.1	F156.1			
ZD9				ZP29	F096.1	F160.1			
ZD10				ZP210	F100.1	F164.1			
					ZP31	F064.4	F128.4		
					ZP32	F068.4	F132.4		
					ZP33	F072.4	F136.4		
					ZP34	F076.4	F140.4		
					ZP35	F080.4	F144.4		
					ZP36	F084.4	F148.4		
					ZP37	F088.4	F152.4		
					ZP38	F092.4	F156.4		
					ZP39	F096.4	F160.4		
					ZP310	F100.4	F164.4		
					ZP41	F064.5	F128.5		
					ZP42	F068.5	F132.5		
					ZP43	F072.5	F136.5		
					ZP44	F076.5	F140.5		
					ZP45	F080.5	F144.5		
					ZP46	F084.5	F148.5		
					ZP47	F088.5	F152.5		
					ZP48	F092.5	F156.5		
					ZP49	F096.5	F160.5		
					ZP410	F100.5	F164.5		
14	Floating reference position return				FRP1	F065.5	F129.5		
					FRP2	F069.5	F133.5		
					FRP3	F073.5	F137.5		
					FRP4	F077.5	F141.5		
					FRP5	F081.5	F145.5		
					FRP6	F085.5	F149.5		
					FRP7	F089.5	F153.5		
					FRP8	F093.5	F157.5		
					FRP9	F097.5	F161.5		
					FRP10	F101.5	F165.5		
15	Automatic reference position setting function	RAST1 RAST2 RAST3	G067.2 G071.2 G075.2	G131.2 G135.2 G139.2					
16	Automatic operation start, stop, restart	ST *SP SBK SRN BRN ABS	G005.0 G000.5 G004.3 G002.5 G002.6 G004.5	G100.0 G096.5 G099.3 G099.5	OP STL SPL MSBK MABS	F000.5 F000.4 F000.3 F004.3 F004.5	F096.5 F096.4 F096.3 F100.3 F100.5		
17	Active block cancel	BCAN	G157.6		MBCAN	G157.4			
18	Feedrate override	*FV0 ~ *FV7 ROV1 ROV2 *AFV0 ~ *AFV7 OVC *RV0B ~ *RV6B *APF00 ~ *APF15	G012 G006.5 G006.6 G013 G004.4 G40.0 ~ G40.6 G146 ~ G147	G012 G010.5 G010.6 G013 G004.4 G120.0 ~ G120.6	G060 G061 G052.4				

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
19	F1-digit feed	F1D	G005.3						
20	Automatic operation test	DRN	G004.1		G099.1	MDRN	F004.1		F100.1
		MLK	G004.7		G099.7	MMLK	F004.7		F100.7
		DLK	G004.6		G099.6	MDLK	F004.6		F100.6
		AFL	G004.0		G099.0	MAFL	F004.0		F100.0
		MLK1	G065.3		G129.3	MMLK1	F065.1		F129.1
		MLK2	G069.3		G133.3	MMLK2	F069.1		F133.1
		MLK3	G073.3		G137.3	MMLK3	F073.1		F137.1
		MLK4	G077.3		G141.3	MMLK4	F077.1		F141.1
		MLK5	G081.3		G145.3	MMLK5	F081.1		F145.1
		MLK6	G085.3		G149.3	MMLK6	F085.1		F149.1
		MLK7	G089.3		G153.3	MMLK7	F089.1		F153.1
		MLK8	G093.3		G157.3	MMLK8	F093.1		F157.1
		MLK9	G097.3		G161.3	MMLK9	F097.1		F161.1
		MLK10	G101.3		G165.3	MMLK10	F101.1		F165.1
21	Optional block skip	BDT1	G004.2	G004.2	G052.2	MBDT1	F004.2	F001.2	F049.2
		BDT2	G007.0	G007.0	G055.0	MBDT2	F005.0	F002.0	F050.0
		BDT3	G007.1	G007.1	G055.1	MBDT3	F005.1	F002.1	F050.1
		BDT4	G007.2	G007.2	G055.2	MBDT4	F005.2	F002.2	F050.2
		BDT5	G007.3	G007.3	G055.3	MBDT5	F005.3	F002.3	F050.3
		BDT6	G007.4	G007.4	G055.4	MBDT6	F005.4	F002.4	F050.4
		BDT7	G007.5	G007.5	G055.5	MBDT7	F005.5	F002.5	F050.5
		BDT8	G007.6	G007.6	G055.6	MBDT8	F005.6	F002.6	F050.6
		BDT9	G007.7	G007.7	G055.7	MBDT9	F005.7	F002.7	F050.7
22	Corner control	*CSMZ *CHF	G008.1 G008.0	G008.1 G008.0	G056.1 G056.0				
23	Anxiliary function, tool function, spindle function, 2nd auxiliary function	FIN	G005.1	G005.1	G053.1	MF M0 - M31	F008.0 F016 - F019	F004.0 F016 - F019	F052.0 F064 - F067
						DEN	F001.0	F000.0	F048.0
						IPEN	F001.1	F000.1	F048.1
						DM00	F009.4	F005.4	F053.4
						DM01	F009.5	F005.5	F053.5
						DM02	F009.6	F005.6	F053.6
						DM30	F009.7	F005.7	F053.7
						TF	F008.2	F004.2	F052.2
						T0 - T31	F024 - F027	F024 - F027	F072 - F075
						SF	F008.1	F004.1	F052.1
						S0 - S31	F020 - F023	F020 - F023	F068 - F071
						BF	F008.3	F008.3	F052.3
						B0 - B31	F028 - F031	F028 - F031	F076 - F079
24	High-speed M,S,T,B interface	MFIN	G046.0	G006.0	G054.0	(MF)	F008.0	F004.0	F052.0
		SFIN	G046.1	G006.1	G054.1	(SF)	F008.1	F004.1	F052.1
		TFIN	G046.2	G006.2	G054.2	(TF)	F008.2	F004.2	F052.2
		BFIN	G046.3	G006.3	G054.3	(BF)	F008.3	F004.3	F052.3
25	1 block plural M command	(FIN) (MFIN) MFIN2 MFIN3 MFIN4 MFIN5	G005.1 G046.0 G047.1 G047.2 G047.3 G047.4			(MF) MF2 MF3 MF4 MF5 (M0 - M31) M200 - M215 M300 - M315 M400 - M415 M500 - M515	F008.0 F045.1 F045.2 F045.3 F045.4 F016 - F019 F144 - F145 F146 - F147 F148 - F149 F150 - F151		

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
26	External operation	(FIN)	G005.1	G005.1	G053.1	EF (DEN) (IPEN)	F008.4 F001.0 F001.1	F004.4 F000.0 F000.1	F052.4 F048.0 F048.1
27	Canned cycle spindle function	FFIN	G005.2	G005.2	G053.2	FMF SSP SRV (DEN) (IPEN)	F008.5 F008.7 F008.6 F001.0 F001.1	F004.5 F004.7 F004.6 F000.0 F000.1	F052.5 F052.7 F052.6 F048.0 F048.1
28	Spindle analog output control	RISGN RIO ~ RI12	G024.7 G024 ~ G025	G24.7 G024 ~ G025	G072.7 G072 ~ G023	RO0 ~ RO15 AR0 ~ AR15 MR0 ~ MR15 SPAL1 SPAL2 SPAL4 SPAL8	F010 ~ F011 F012 ~ F013 F014 ~ F015 F040.0 F040.1 F040.2 F040.3	F006 ~ F007 F008 ~ F009 F010 ~ F011 F012.0 F012.1 F012.2 F012.3	F054 ~ F055 F056 ~ F057 F058 ~ F059 F060.0 F060.1 F060.2 F060.3
29	Spindle positionning	*SECLP *SEUCL SPSTP GS1 GS2 GS4	G026.3 G026.2 G026.0 G026.4 G026.5 G026.6	G026.3 G026.2 G026.0 G026.4 G026.5 G026.6		SCLP SUCLP	F042.1 F042.0	F124.1 F124.0	
30	Spindle speed fluctuation detection	(RIO ~ RI12) (GS1) (GS2) (GS4)	G024 ~ G025 G026.4 G026.5 G026.6	G024 ~ G025 G026.4 G026.5 G026.6	G072 ~ G073	SPAL	F042.2		
31	Arbitrary spindle gear ratio	FIN	G005.1			MF	F008.0		
32	Spindle serial output Cs contour control	For 1st axis	TLMLA	G227.0	G227.0	SLDMA0 ~	F232 ~	F232 - F233	
			TLMHA	G227.1	G227.1	SLDMA15	F233		
CTH2A	G227.2		G227.2	SSPDA0 ~	F234 ~	F234 - F235			
CTH1A	G227.3		G227.3	SSPDA15	F235				
SRVA	G227.4		G227.4	SSPAA0 ~	F236	F236			
SFRA	G227.5		G227.5	SSPAA7					
ORCMA	G227.6		G227.6	ALMA	F229.0	F229.0			
MRDYA	G227.7		G227.7	SSTA	F229.1	F229.1			
ARSTA	G226.0		G226.0	SDTA	F229.2	F229.2			
*ESPA	G226.1		G226.1	SARA	F229.3	F229.3			
INDXA	G229.0	G229.0	LDT1A	F229.4	F229.4				
ROTA	G229.1	G229.1	LDT2A	F229.5	F229.5				
NRROA	G229.2	G229.2	TLMA	F229.6	F229.6				
				ORARA	F229.7	F229.7			
For 2nd axis	TLMLB	G235.0	G235.0	SLDMB0 ~	F248 ~	F248 - F249			
	TLMHB	G235.1	G235.1	SLDMB15	F249				
	CTH2B	G235.2	G235.2	SSPDB0 ~	F250 ~	F250 - F251			
	CTH1B	G235.3	G235.3	SSPDB15	F251				
	SRVB	G235.4	G235.4	SSPAB0 ~	F252	F252			
	SFRB	G235.5	G235.5	SSPAB7					
	ORCMB	G235.6	G235.6	ALMB	F245.0	F245.0			
	MRDYB	G235.7	G235.7	SSTB	F245.1	F245.1			
	ARSTB	G234.0	G234.0	SDTB	F245.2	F245.2			
	*ESPB	G234.1	G234.1	SARB	F245.3	F254.3			
	INDXB	G237.0	G237.0	LDT1B	F245.4	F245.4			
	ROTAB	G237.1	G237.1	LDT2B	F245.5	F245.5			
	NRROB	G237.2	G237.2	TLMB	F245.6	F245.6			
				ORARB	F245.7	F245.7			

No.	Function	Related input signal			Related output signal				
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
32	Spindle serial output Cs contour control	SCNTR1	G067.7	G131.7		MSCNTR1	F067.7	F131.7	
		SCNTR2	G071.7	G135.7		MSCNTR2	F071.7	F135.7	
		SCNTR3	G075.7	G139.7		MSCNTR3	F075.7	F139.7	
		SCNTR4	G079.7	G143.7		MSCNTR4	F079.7	F143.7	
		SCNTR5	G083.7	G147.7		MSCNTR5	F083.7	F147.7	
		SCNTR6	G087.7	G151.7		MSCNTR6	F087.7	F151.7	
		SCNTR7	G091.7	G155.7		MSCNTR7	F091.7	F155.7	
		SCNTR8	G095.7	G159.7		MSCNTR8	F095.7	F159.7	
		SCNTR9	G099.7	G163.7		MSCNTR9	F099.7	F163.7	
		SCNTR10	G103.7	G167.7		MSCNTR10	F103.7	F167.7	
33	Serial interface spindle position coder method spindle orientation	(ORCMA)	G227.6	G227.6		(ORARA)	F229.7	F229.7	
		(INDXA)	G229.0	G229.0					
		(ROATA)	G229.1	G229.1					
		SHA00 - SHA11	G230 - G231	G230 - G231					
		(ORCMB)	G235.6	G235.6		(ORARB)	F245.7	F245.7	
		(INDXB)	G237.0	G237.0					
		(ROTAB)	G237.1	G237.1					
		SHB00 - SHB11	G238 - G239	G238 - G239					
		NRROA		G229.2					
		NRROB		G237.2					
34	Serial interface spindle synchronous control	SPSYC	G047.6	G111.6		MSPSYC	F046.6	F111.6	
		SPPHS	G047.7	G111.7		MSPPHS	F046.7	F111.7	
		(RISGN #1)	G024.7	G024.7		SPSYAL	F046.5	F111.5	
		(RI0 - RI12 #1)	G024 - G025	G024 - G025					
		INTGA	G226.5	G226.5					
		INTGB	G234.5	G234.5					
35	Serial interface spindle speedrange switching	RCHA	G226.7	G226.7		RCFNA	F228.3	F228.3	
		RSLA	G226.6	G226.6		RCHPA	F228.2	F228.2	
		RCHB	G234.7	G234.7		RCFNB	F244.3	F244.3	
		RSLB	G234.6	G234.6		RCHPB	F244.2	F244.2	
36	Spindle speedrange switching	PCSPN0	G045.4		SPN0	F155.4	F013.0	F061.0	
					SPN1	F.155.5	F013.1	F061.1	
37	Program status output				INCH	F001.3	F097.3		
					TAP	F001.4	F000.4	F048.4	
					RPD	F001.5	F000.5	F048.5	
					THRD	F001.6	F000.6	F048.6	
					CSS	F001.7	F000.7	F048.7	
38	Axis move status output				INP1	F064.6	F128.6		
					INP2	F068.6	F132.6		
					INP3	F072.6	F136.6		
					INP4	F076.6	F140.6		
					INP5	F080.6	F144.6		
					INP6	F084.6	F148.6		
					INP7	F088.6	F152.6		
					INP8	F092.6	F156.6		
					INP9	F096.6	F160.6		
					INP10	F100.6	F164.6		
			MV1	F064.2	F128.2				
			MV2	F068.2	F132.2				
			MV3	F072.2	F136.2				
			MV4	F076.2	F140.2				
			MV5	F080.2	F144.2				
			MV6	F084.2	F148.2				
			MV7	F088.2	F152.2				
			MV8	F092.2	F156.2				
			MV9	F096.2	F160.2				
			MV10	F100.2	F164.2				

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
38	Axis move status output					MD1	F064.3	F128.3	
						MD2	F068.3	F132.3	
						MD3	F072.3	F136.3	
						MD4	F076.3	F140.3	
						MD5	F080.3	F144.3	
						MD6	F084.3	F148.3	
						MD7	F088.3	F152.3	
						MD8	F092.3	F156.3	
						MD9	F096.3	F160.3	
						MD10	F100.3	F164.3	
39	Mirror image	MI1	G065.2		G129.2	MMI1	F065.0		G129.0
		MI2	G069.2		G133.2	MMI2	F069.0		G133.0
		MI3	G073.2		G137.2	MMI3	F073.0		G137.0
		MI4	G077.2		G141.2	MMI4	F077.0		G141.0
		MI5	G081.2		G145.2	MMI5	F081.0		G145.0
		MI6	G085.2		G149.2	MMI6	F085.0		G149.0
		MI7	G089.2		G153.2	MMI7	F089.0		G153.0
		MI8	G093.2		G157.2	MMI8	F093.0		G157.0
		MI9	G097.2		G161.2	MMI9	F097.0		G161.0
		MI10	G101.2		G165.2	MMI10	F101.0		G165.0
40	Over travel	*+L1	G064.0		G128.0				
		*+L2	G068.0		G132.0				
		*+L3	G072.0		G136.0				
		*+L4	G076.0		G140.0				
		*+L5	G080.0		G144.0				
		*+L6	G084.0		G148.0				
		*+L7	G088.0		G152.0				
		*+L8	G092.0		G156.0				
		*+L9	G096.0		G160.0				
		*+L10	G100.0		G164.0				
		*-L1	G064.1		G128.1				
		*-L2	G068.1		G132.1				
		*-L3	G072.1		G136.1				
		*-L4	G076.1		G140.1				
		*-L5	G080.1		G144.1				
		*-L6	G084.1		G148.1				
		*-L7	G088.1		G152.1				
		*-L8	G092.1		G156.1				
		*-L9	G096.1		G160.1				
		*-L10	G100.1		G164.1				
41	Chuck tail stock barrier	*TSB	G030.7						
42	External deceleration	*+ED1	G064.2		G128.2				
		*+ED2	G068.2		G132.2				
		*+ED3	G072.2		G136.2				
		*+ED4	G076.2		G140.2				
		*+ED5	G080.2		G144.2				
		*+ED6	G084.2		G148.2				
		*+ED7	G088.2		G152.2				
		*+ED8	G092.2		G156.2				
		*+ED9	G096.2		G160.2				
		*+ED10	G100.2		G164.2				
		*-ED1	G064.3		G128.3				
		*-ED2	G068.3		G132.3				
		*-ED3	G072.3		G136.3				
		*-ED4	G076.3		G140.3				
		*-ED5	G080.3		G144.3				
		*-ED6	G084.3		G148.3				
		*-ED7	G088.3		G152.3				
		*-ED8	G092.3		G156.3				
		*-ED9	G096.3		G160.3				
		*-ED10	G100.3		G164.3				

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
43	Interlock	*IT	G000.0	G096.0					
		*AIT	G001.0	G001.0	G049.0				
		*CSL	G000.1	G000.1	G048.1				
		*BSL	G001.1	G001.1	G049.1				
		*IT1	G064.4		G128.4				
		*IT2	G068.4		G132.4				
		*IT3	G072.4		G136.4				
		*IT4	G076.4		G140.4				
		*IT5	G080.4		G144.4				
		*IT6	G084.4		G148.4				
		*IT7	G088.4		G152.4				
*IT8	G092.4		G156.4						
*IT9	G096.4		G160.4						
*IT10	G100.4		G164.4						
44	Servo off	*SVF1	G064.6		G128.6				
		*SVF2	G068.6		G132.6				
		*SVF3	G072.6		G136.6				
		*SVF4	G076.6		G140.6				
		*SVF5	G080.6		G144.6				
		*SVF6	G084.6		G148.6				
		*SVF7	G088.6		G152.6				
		*SVF8	G092.6		G156.6				
		*SVF9	G096.6		G160.6				
		*SVF10	G100.6		G164.6				
45	Control axis removal	DTCH1	G064.7		G128.7	MDTCH1	F064.7	F128.7	
		DTCH2	G068.7		G132.7	MDTCH2	F068.7	F132.7	
		DTCH3	G072.7		G136.7	MDTCH3	F072.7	F136.7	
		DTCH4	G076.7		G140.7	MDTCH4	F076.7	F140.7	
		DTCH5	G080.7		G144.7	MDTCH5	F080.7	F144.7	
		DTCH6	G084.7		G148.7	MDTCH6	F084.7	F148.7	
		DTCH7	G088.7		G152.7	MDTCH7	F088.7	F152.7	
		DTCH8	G092.7		G156.7	MDTCH8	F092.7	F156.7	
		DTCH9	G096.7		G160.7	MDTCH9	F096.7	F160.7	
		DTCH10	G100.7		G164.7	MDTCH10	F100.7	F164.7	
46	Axis switching	AXC1	C041.0						
		AXC2	G041.1						
		AXC4	G041.2						
47	Memory protection key	KEY1	G005.4		G100.4				
		KEY2	G005.5		G100.5				
		KEY3	G005.6		G100.6				
		KEY4	G005.7		G100.7				
48	External input / output command	EXPUN	G032.0		G112.0	RPBSY	F007.4	F102.4	
		EXRD	G032.1		G112.1				
		EXSTP	G032.2		G112.2				
49	External work number search	WN1	G019.0	G019.0	G067.0				
		WN2	G019.1	G019.1	G067.1				
		WN4	G019.2	G019.2	G067.2				
		WN8	G019.3	G019.3	G067.3				
		WN16	G019.4	G019.4	G067.4				
50	External data input / output	EOREND	G032.5		G112.5	EOSTB	F032.7	F112.7	
		ERDRQ	G032.6		G112.6	EIREND	F032.5	F112.5	
		EISTB	G032.7		G112.7	ESEND	F007.5	F003.5 | F051.5	
		EIA0 ~ EIA7	G033		G113	EOA0 ~ EOA7	F033	F113	
		EID0 ~ EID47	G034 ~ G039		G114 - G119	EOD0 ~ EOD47	F034 ~ F039	F114 ~ F119	
		EIHEAD			G112.4	EOHEAD		F112.4	
51	Skip function	SKIP1	G000.3	G000.3	G048.3				
		SKIP2	G001.5						
		SKIP3	G001.6						
		SKIP4	G001.7						

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
56	Tool life management	TLRST	G010.7	G010.7	G058.7	TLCHA	F007.6	F003.6	F051.6
		TLSKP	G009.7	G009.7	G057.7	TLCHB	F007.7	F003.7	F051.7
		TL01	G009.0	G009.0	G057.0				
		TL02	G009.1	G009.1	G057.1				
		TL04	G009.2	G009.2	G057.2				
		TL08	G009.3	G009.3	G057.3				
		TL16	G009.4	G009.4	G057.4				
		TL32	G009.5	G009.5	G057.5				
		TL64	G009.6	G009.6	G057.6				
		TL128	G043.7						
		TL256	G042.0						
		TL512	G043.6						
		*TLV0	G155.0						
		*TLV1	G155.1						
		*TLV2	G155.2						
		*TLV3	G155.3						
		*TLV4	G155.4						
		*TLV5	G155.5						
		*TLV6	G155.6						
		*TLV7	G155.7						
*TLV8	G154.0								
*TLV9	G154.1								
57	Tool retract & recover (15-T/15-M)	TRRTN	G031.1			TRSPS	F044.5		
		TRESC	G031.0			TRMTN	F044.4		
58	Tool retract & recover (15-TT)	TRHD1				TRACT			F110#3
		TRHD2				TRMTN			F110#4
59	Software operator's panel	(S)	G003.0			SO	F129.0		
		(H)	G003.1			HO	F129.1		
		(J)	G003.2			JO	F129.2		
		(D)	G003.3			MDIO	F129.3		
		(T)	G003.4			TO	F129.4		
		(MEM)	G003.5			MEMO	F129.5		
		(EDT)	G003.6			EDTO	F129.6		
		(ZRN)	G002.7			ZRNO	F128.7		
		(+J1)	G065.0			+J1O	F136.0		
		(+J2)	G069.0			+J2O	F136.2		
		(+J3)	G073.0			+J3O	F136.4		
		(+J4)	G077.0			+J4O	F136.6		
		(+J5)	G081.0			+J5O	F138.0		
		(+J6)	G085.0			+J6O	F138.2		
		(-J1)	G065.1			-J1O	F136.1		
		(-J2)	G069.1			-J2O	F136.3		
		(-J3)	G073.1			-J3O	F136.5		
		(-J4)	G077.1			-J4O	F136.7		
		(-J5)	G081.1			-J5O	F138.1		
		(-J6)	G085.1			-J6O	F138.3		
		RT	G006.7			RTO	F132.7		
		HS1A	G011.0			HS1AO	F131.0		
		HS1B	G011.1			HS1BO	F131.1		
		HS1C	G011.2			HS1CO	F131.2		
		HS1D	G011.3			HS1DO	F131.3		
		MP1	G006.2			MP1O	F132.2		
		MP2	G006.3			MP2O	F132.3		
		MP4	G006.4			MP4O	F132.4		
		ROV1	G006.5			ROV1O	F132.5		
		ROV2	G006.6			ROV2O	F132.6		
		*JV0 ~	G014 ~			*JV0O ~	F134 ~		
		*JV15	G015			*JV15O	F135		
		*FV0 ~	G012			*FV0O ~	F133		
		*FV7				*FV7O			
		BDT1	G004.2			BDT1O	F130.2		
		SBK	G004.3			SBKO	F130.3		
MLK	G004.7			MLKO	F130.7				
DRN	G004.1			DRNO	F130.1				
KEY1	G005.4			KEYO	F131.4				
KEY2	G005.5			SPO	F128.5				
KEY3	G005.6			OPU0 ~	F137				
KEY4	G005.7			OPU7					
*SP	G000.5								

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
60	Run hour display	TMRON	G008.7	G008.7					
61	Parts count display					PRTSF	F043.6	F012.6	F060.6
62	Key input		G128 - G139						
63	Index table indexing	*BECLP *BEUCL	G019.7 G019.6			BCLP BUCLP	F007.1 F007.0		
64	Turret axis control	*TECLP *TEUCL TDIR1 TDIR2	G030.3 G030.2 G030.0 G030.1			TCLP TUCLP	F043.1 F043.0		
65	Synchronous / independent switching	SYNC1 SYNC2 SYNC3 SYNC4 SYNC5 SYNC6 SYNC7 SYNC8 SYNC9 SYNC10	G066.2 G070.2 G074.2 G078.2 G082.2 G086.2 G090.2 G094.2 G098.2 G102.2						
66	Parallel axis control	PK1 PK2 PK3 PK4 PK5 PK6 PK7 PK8 PK9 PK10	G065.4 G069.4 G073.4 G077.4 G081.4 G085.4 G089.4 G093.4 G097.4 G101.4						
67	Twin table control / simple synchronous control	(SYNC1) (SYNC2) (SYNC3) (SYNC4) (SYNC5) (SYNC6) (SYNC7) (SYNC8) (SYNC9) (SYNC10)	G066.2 G070.2 G074.2 G078.2 G082.2 G086.2 G090.2 G094.2 G098.2 G102.2						
68	Simple synchronization control					SYNER	F153.1		
69	Tool post selection	IHEAD1 IHEAD2		G110.0 G110.1					
70	Tool post interference check					TICHK		F120.0	
71	Override play back	OMEP OME SPA SPB SPC	G010.6 G010.5 G029.0 G029.1 G029.2			SPAO SPBO SPCO	F042.4 F042.5 F042.6		
72	Depth-of-cut override of canned cycle for lathe	CDV0 - CDV7	G027						
73	Rigid tap	RI0 ~ RI12 SPSTP GS1 GS2 GS4 RSPR	G024 - G025 G026.0 G026.4 G026.5 G026.6 G148.3	G024 ~ G025 G026.0 G026.4 G026.5 G026.6 G026.1	G072 ~ G073 G026.0 G026.4 G026.5 G026.6 G074.1	RTAP RSPP RSPM RSPC	F040.4 F155.0 F155.1 F155.2		

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
74	Retrace	RVS	G029.4			RVSL	F044.2		
75	Play back	TCHIN	G002.3			MTCHIN	F002.3		
76	Chopping function	*CHLD *CHP0 *CHP2 *CHP4 *CHP8	G044.7 G044.0 G044.1 G044.2 G044.3						
77	Override play back	TCHOVR STFOVR STSOVR (SPA) (SPB) (SPC)	G031.7 G031.6 G031.5 G029.0 G029.1 G029.2			(SPA0) (SPBO) (APCO)	F042.4 F042.5 F042.6		
78	Axis control by PMC	1st axis	MSBK1	G384.7	G384.7	CNCA1 DEN1 BUF1	F066.7 F066.6 F066.5	F130.7 F130.6 F130.5	
			CD1X0 ~ CD1X7	G385	G385				
			FD1X0 ~ FD1X15	G386 ~ G387	G386 ~ G387				
			DT1X0 ~ DT1X31	G388 ~ G391	G388 ~ G391				
			PMCA1	G066.7	G130.7				
			RST1	G066.6	G130.6				
			STP1	G066.5	G130.5				
			SBK1	G066.4	G130.4				
			PCAX1	G066.3	G130.3				
		VCSKP1	G067.6	G131.6					
		OV1X0 ~ OV1X7	G368	G368					
		2nd axis	MSBK2	G392.7	G392.7	CNCA2 DEN2 BUF2	F070.7 F070.6 F070.5	F134.7 F134.6 F134.5	
			CD2X0 ~ CD2X7	G393	G393				
			FD2X0 ~ FD2X15	G394 ~ G395	G394 ~ G395				
			DT2X0 ~ DT2X31	G396 ~ G399	G396 ~ G399				
			PMCA2	G070.7	G134.7				
			RST2	G070.6	G134.6				
			STP2	G070.5	G134.5				
			SBK2	G070.4	G134.4				
			PCAX2	G070.3	G134.3				
		VCSKP2	G071.6	G135.6					
OV2X0 ~ OV2X7	G369	G369							
3rd axis	MSBK3	G400.7	G400	CNCA3 DEN3 BUF3	F074.7 F074.6 F074.5	F138.7 F138.6 F138.5			
	CD3X0 ~ CD3X7	G401	G401						
	FD3X0 ~ FD3X15	G402 ~ G403	G402 ~ G403						
	DT3X0 ~ DT3X31	G404 ~ G407	G404 ~ G407						
	PMCA3	G074.7	G138.7						
	RST3	G074.6	G138.6						
	STP3	G074.5	G138.5						
	SBK3	G074.4	G138.4						
	PCAX3	G074.3	G138.3						
VCSKP3	G075.6	G139.6							
OV3X0 ~ OV3X7	G370	G370							

No.	Function	Related input signal			Related output signal								
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT					
				HEAD #1	HEAD #2			HEAD #1	HEAD #2				
78	Axis control by PMC	MSBK4	G408.7	G408.7		CNCA4 DEN4 BUF4	F078.7 F078.6 F078.5	F142.7					
		CD4X0 ~ CD4X7	G409	G409				F142.6					
		FD4X0 ~ FD4X15	G410 ~ G411	G410 - G411				F142.5					
		DT4X0 ~ DT4X31	G412 ~ G415	G412 - G415									
		4th axis	PMCA4	G078.7	G142.7								
			RST4	G078.6	G142.6								
			STP4	G078.5	G142.5								
			SBK4	G078.4	G142.4								
			PCAX4	G078.3	G142.3								
			VCSKP4	G079.6	G143.6								
			OV4X0 ~ OV4X7	G371	G371								
			Axis control by PMC	MSBK5	G416.7			G416.7		CNCA5 DEN5 BUF5	F082.7 F082.6 F082.5	F146.7	
				CD5X0 ~ CD5X7	G417			G417				F146.6	
				FD5X0 ~ FD5X15	G418 ~ G419			G418 - G419				F146.5	
	DT5X0 ~ DT5X31			G420 ~ G423	G420 - G423								
	5th axis			PMCA5	G082.7	G146.7							
				RST5	G082.6	G146.6							
				STP5	G082.5	G146.5							
		SBK5		G082.4	G146.4								
		PCAX5		G082.3	G146.3								
		VCSKP5		G083.6	G147.6								
		OV5X0 ~ OV5X7		G372	G372								
		Axis control by PMC		MSBK6	G424.7	G424.7		CNCA6 DEN6 BUF6	F086.7 F086.6 F086.5			F150.7	
				CD6X0 ~ CD6X7	G425	G425						F150.6	
				FD6X0 ~ FD6X15	G426 ~ G427	G426 - G427						F150.5	
			DT6X0 ~ DT6X31	G428 ~ G431	G428 - G431								
			6th axis	PMCA6	G086.7	G150.7							
				RST6	G086.6	G150.6							
				STP6	G086.5	G150.5							
	SBK6			G086.4	G150.4								
	PCAX6			G086.3	G150.3								
	VCSKP6			G087.6	G151.6								
	OV6X0 ~ OV6X7			G373	G373								
	Axis control by PMC			MSBK7	G432.7	G434.7				CNCA7 DEN7 BUF7	F090.7 F090.6 F090.5	F154.7	
				CD7X0 ~ CD7X7	G433	G433						F154.6	
				FD7X0 ~ FD7X15	G434 ~ G435	G434 - G435						F154.5	
		DT7X0 ~ DT7X31		G436 ~ G439	G436 - G439								
		7th axis		PMCA7	G090.7	G154.7							
				RST7	G090.6	G154.6							
				STP7	G090.5	G154.5							
			SBK7	G090.4	G154.4								
			PCAX7	G090.3	G154.3								
VCSKP7			G091.6	G155.6									
OV7X0 ~ OV7X7			G374	G374									

No.	Function	Related input signal			Related output signal						
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT			
				HEAD #1	HEAD #2			HEAD #1	HEAD #2		
78	Axis control by PMC	MSBK8	G440.7	G440.7		CNCAB	F094.7	F158.7			
		CD8X0 - CD8X7	G441	G441		DEN8	F094.6	F158.6			
		FD8X0 - FD8X15	G442 - G443	G442 - G443		BUF8	F094.5	F158.5			
		8th axis	DT8X0 - DT8X31	G444 - G447	G444 - G447						
			PMCA8	G094.7	G158.7						
			RST8	G094.6	G158.6						
			STP8	G094.5	G158.5						
			SBK8	G094.4	G158.4						
			PCAX8	G094.3	G158.3						
			VCSKP8	G095.6	G159.6						
			OV8X0 - OV8X7	G375	G375						
			9th axis	MSBK9	G448.7	G48.7		CNCA9	F098.7	F162.7	
				CD9X0 - CD9X7	G449	G449		DEN9	F098.6	F162.6	
		FD9X0 - FD9X15		G450 - G451	G450 - G451		BUF9	F098.5	F162.5		
		DT9X0 - DT9X31		G452 - G455	G452 - G455						
		PMCA9		G098.7	G162.7						
		RST9		G098.6	G162.6						
		STP9		G098.5	G162.5						
		SBK9		G098.4	G162.4						
		PCAX9		G098.3	G162.3						
		VCSKP9		G099.6	G163.6						
		OV9X0 - OV9X7	G376	G376							
		10th axis	MSBK10	G456.7	G456.7		CNCA10	F102.7	F166.7		
			CD10X0 - CD10X7	G457	G457		DEN10	F102.6	F166.6		
			FD10X0 - FD10X15	G458 - G459	G458 - G459		BUF10	F102.5	F166.5		
			DT10X0 - DT10X31	G460 - G463	G460 - G463						
			PMCA10	G102.7	G166.7						
			RST10	G102.6	G166.6						
			STP10	G102.5	G166.5						
			SBK10	G102.4	G166.4						
			PCAX10	G102.3	G166.3						
			VCSKP10	G103.6	G167.6						
		OV10X0 - OV10X7	G377	G383							
			FIN1X	G046.4	G110.4		MF1X	F046.0	F106.0		
			FIN2X	G046.5	G110.5		MF2X	F046.1	F106.1		
			FIN3X	G046.6	G110.6		MF3X	F046.2	F106.2		
	OVA0 - OVA7	G383	G383		AF1X0 - AF1X7	F141	F103				
					AF2X0 - AF2X7	F142	F104				
					AF3X0 - AF3X7	F143	F105				
79	PMC axis control speed command	Refer to No.78, Axis control by PMC									
80	Hypothetical axis control	IMGY	G157.3								

No.	Function	Related input signal				Related output signal			
		Signal name	Address for M/T	Address for TT		Signal name	Address for M/T	Address for TT	
				HEAD #1	HEAD #2			HEAD #1	HEAD #2
81	Axis selection at the actual seed display	*ACTF1 *ACTF2 *ACTF3 *ACTF4 *ACTF5 *ACTF6 *ACTF7 *ACTF8 *ACTF9 *ACTF10	G067.4 G071.4 G075.4 G079.4 G083.4 G087.4 G091.4 G095.4 G099.4 G103.4	G131.4 G135.4 G139.4 G143.4 G147.4 G151.4 G155.4 G159.4 G163.4 G167.4					
82	NC window	WHEAD		G111.0	BGEDT	F043.3	F120.4		
83	Remote buffer	RMT10 RMT11 RMT12 RMT13 RMT14 RMT15 RMT16 RMT17	G152.0 G152.1 G152.2 G152.3 G152.4 G152.5 G152.6 G152.7		RMT00 RMT01 RMT02 RMT03 RMT04 RMT05 RMT06 RMT07	F152.0 F152.1 F152.2 F152.3 F152.4 F152.5 F152.6 F152.7			
84	Load meter display	SPA SPB SPC	G029.0 G029.1 G029.2						
85	Serial interface spindle load meter display switching function	SPLDS	G047.5						
86	Position switch function				PSW01 PSW02 PSW03 PSW04 PSW05 PSW06 PSW07 PSW08 PSW09 PSW10	F165.0 F165.1 F165.2 F165.3 F165.4 F165.5 F165.6 F165.7 F164.0 F164.1			
87	Electric gear box	RTRCT	G042.4		RTRCTF EGBM1 EGBM2 EGBM3 EGBM4 EGBM5 EGBM6 EGBM7 EGBM8 EGBM9 EGBM10	F041.4 F066.3 F070.3 F074.3 F078.3 F082.3 F086.3 F090.3 F094.3 F098.3 F102.3			
88	Function for separating UI/UO used in user programs and P-code programs	EUI00 ~ EUI15	G144.0 ~ G145.7		EUO00 ~ EUO15	F166.0 ~ F167.7			
89	High-precision contour control by 64-bit RISC processor				MHPCC EXHPCC	F131.6 F131.7			

C. FSO PMC Address List

This section contains the G and F address lists for the 0 controls. The list in this section is **LIST by FUNCTION** which lists all of the CNC functions possible for the 0 control.

C.1 List by Function

Function	Signal name	Symbol	T	M	Address
Axis moving state output	Axis moving signal	MVX, MVY, MVZ, MV4		○	F188.4 to F188.7
		MVX, MVZ, MV3, MV4	○		
Mirror image	Mirror image check signal	MMI1, MMI2	○		F158.0, F158.1
	Mirror image check signal	MMI1, MMI2, MMI4		○	F158.0, F158.1, F158.3,
	Mirror image signal	MIX, MIZ	○		G120.0, G127.1
	Mirror image signal	MIRX, MIRY, MIR4		○	G127.0, G127.1, G127.7
Follow-up	Follow-up signal	*FLWU	○	○	G104.5
Servo off (mechanical handle)	Servo off signal	SVFX, SVFZ, SVF3, SVF4	○		G105.0, G105.1, G105.2, G105.3
		SVFX, SVFY, SVFZ, SVF4		○	
Position switch	Position switch signal	PSW01 to PSW10	○	○	F190, F191.0, F191.1
Ignore the fourth-axis signal	Ignore the fourth-axis signal	4NG		○	X004.7
Cancel the Z-axis command signal	Cancel the Z-axis command signal	ZNG		○	G103.6
Simple synchronous control	Servo axis synchronization alarm signal	SYNAL		○	F192.7
	Signals to select the slave axis for simple synchronous control	SYNCX, SYNCZ, SYNC3, SYNC4	○		G237.0 to G237.3
		SYNC4		○	
	Signal for selecting the manual feed axis for simple synchronous control	SYNCJ		○	G133.6
Axis recomposition	Synchronization control start signals (tool post 1)	PK1M, PK2M, PK3M, PK4M, PK7M	●		G238.0, G238.1, G238.2, G238.3, G238.4
	Synchronization control start signals (tool post 2)	PK1S, PK2S, PK3S, PK4S	●		G1438.0, G1438.1, G1438.2, G1438.3
	Synchronization control start signals (tool post 1)	SYN1M, SYN2M, SYN3M, SYN4M, SYN7M	●		G237.0, G237.1, G237.2, G237.3, G237.4
	Synchronization control start signals (tool post 2)	SYN1S, SYN2S, SYN3S, SYN4S	●		G1437.0, G1437.1, G1437.2, G1437.3

Function	Signal name	Symbol	T	M	Address
Axis recomposition	Axis recomposition signals (tool post 1)	SYN10M, SYN20M, SYN30M, SYN40M, SYN70M	●		F189.0, F189.1, F189.2, F189.3, F189.4
	Axis recomposition signals (tool post 2)	SYN10S, SYN20S, SYN30S, SYN40S	●		F1389.0, F1389.1, F1389.2, F1389.3
	Composite control start signals	MIX1, MIX2, MIX3, MIX4	●		G1437.4, G1437.5, G1437.7, G1437.6,
Angular axis control (0-GCC, 0-GSC)	Angular axis control-related Z-axis compensation movement signal	NOZAGC	☆		G133.6
				☆	G237.5
Position signal output (T series)	Position signal output signal	PX0 to PX7, PZ0 to PZ7	○		F165.0 to F165.7, F167.0 to F167.7
Cf axis control (T series)	C-axis-off signal	COFF	○		G123.0
Emergency stop	Emergency stop signal	*ESP, *ESP	○	○	X021.4, G121.4
CNC ready signal	Servo ready signal	SA	○	○	F148.6
	CNC ready signal	MA	○	○	F149.7
Overtravel check	Overtravel signal	*+LZ	○		X018.5
		*+LX, *+LY, *+LZ, *-LX, *-LY, *-LZ		○	X020.0, X020.1, X020.2, X020.3, X020.4, X020.5
Stored stroke check 1	Stroke check external setting signals	+LMX, +LMY, +LMZ, -LMX, -LMY, -LMZ		○	G129.0, G129.1, G129.2, G129.3, G129.4, G129.5
	Stroke check release signal	RLSOT		○	G129.7
	Stored stroke check select signal	EXLM2	○	○	G129.6
Tool post interference check (0-TTC)	Tool post interference alarm signal	TAL	●		F180.7
	Tool post interference check signal	BOFF	●		F180.6
Alarm signal	Alarm signal	AL	○	○	F149.0
	Battery alarm signal	BAL	○	○	F149.2
	Absolute pulse coder battery alarm signal	BAL1 to BAL4, BAL7, BAL8		○	F159.0 to F159.5
Start lock/interlock	Interlock signal for each axis	*ITX, *ITY, *ITZ, *IT4		○	G128.0, G128.1, G128.2, G128.3
		ITX, ITZ, IT3, IT4	○		
	Interlock signal for each axis and direction	+MIT1, -MIT1, +MIT2, -MIT2		○	X008.2, X008.3, X008.4, X008.5
		*+MITX, *+MITY, *+MITZ, *+MIT4, *-MITX, *-MITY, *-MITZ, *-MIT4		○	G142.0, G142.1, G142.2, G142.3, G142.4, G142.5, G142.6, G142.7
High-speed interlock signal	*RILK		○	X008.5	

Function	Signal name	Symbol	T	M	Address
Start lock/interlock	Start lock signal	STLK	○		G120.1
	Interlock signal	*ILK		○	G117.0
Mode selection	Mode selection signal	MD1, MD2, MD4	○	○	G122.0, G122.1, G122.2
		DNCI	○	○	G127.5
		ZRN	○	○	G120.7
Tool post selection (0-TTC)	Tool post selection signal	TRT2, TRT2PC	●		X018.3, G133.0
Status output signal	Cutting feed signal	CUT	○	○	F188.6
	Canned cycle start signal	FXST		○	F161.4
VRDY off alarm ignore signal	All-axis CRDY OFF alarm ignore signal	IGNVRY		○	G123.0
		IGNVRY	○		G127.0
Jog feed/incremental feed	Feedrate override signal	*OV1, *OV2, *OV4, *OV8	○	○	G121.0, G121.1, G121.2, G121.3
	Feed axis and direction select signal	+X, -X, +Z, -Z, +3, -3, +4, -4	○		G116.2, G116.3, G117.2, G117.3,
		+X, -X, +Y, -Y, +Z, -Z, +4, -4		○	G118.2, G118.3, G119.2, G119.3
	Jog feedrate override signal	JOV1 to JOV8		○	G104.0 to G104.3
Manual rapid traverse select signal	RT	○	○	G121.6	
Manual handle feed	Manual handle feed axis selection signal for Z axis	SLHZ0, SLHZ1		○	G133.0, G133.1
	Manual handle feed axis selection signal	HX, HZ, H3, H4	○		G116.7, G117.7,
		HX, HY, HZ, H4		○	G118.7, G119.7
	Manual handle heed amount selection signal	MP1, MP2	○		G117.0, G118.0
MP1, MP2			○	G120.0, G120.1	
Manual handle interruption	Manual handle interrupt axis selection signal	HIX, HIY, HIZ, HI4		○	G126.0, G126.1,
		HIX, HIZ, HI3, HI4	○		G126.2, G126.3
Manual reference position return	Manual reference position return selection signal	ZRN	○	○	G120.7
	Reference position establishment signal	ZRFX, ZRFZ, ZRF3, ZRF4	○		F168.0, F168.1,
		ZRFX, ZRFY, ZRFZ, ZRF4		○	F168.2, F168.3
	Reference position return completion signal	ZPX, ZPZ, ZP3, ZP4	○		F148.0, F148.1,
ZPX, ZPY, ZPZ, ZP4			○	F148.2, F148.3	
Reference position return deceleration signals	Reference position return deceleration signals	*DECX, *DECZ, *DEC3, *DEC4,	○		X016.5, X017.5,
		*DECX, *DECY, *DECZ, *DEC4,		○	X018.5, X019.5

Function	Signal name	Symbol	T	M	Address
2nd reference position return / 3rd, 4th reference position return	Second reference position return completion signals	ZP2X, ZP2Z, ZP23, ZP24	○		F161.0, F161.1,
		ZP2X, ZP2Y, ZP2Z, ZP24		○	F161.2, F161.3
	Third reference position return completion signals	ZP3X, ZP3Z, ZP33, ZP34	○		F169.0, F169.1,
		ZP3X, ZP3Y, ZP3Z, ZP34		○	F169.2, F169.3
Fourth reference position return completion signals	ZP4X, ZP4Z, ZP43, ZP44	○		F169.4, F169.5,	
	ZP4X, ZP4Y, ZP4Z, ZP44		○	F169.6, F169.7	
Cycle start/feed hold	Manual data input start signal	DST	○	○	F150.5
	Feed hold lamp signal	SPL	○	○	F148.4
	Automatic operation signal	OP	○	○	F148.7
	Feed hold signal	*SP	○	○	G121.5
	Cycle start lamp signal	STL	○	○	F148.5
	Cycle start signal	ST	○	○	G120.2
Reset and rewind	Reset and rewind signal	RRW	○	○	G104.6
	Resetting signal	RST	○	○	F149.1
	Rewinding signal	RWD	○	○	F164.6
	External reset signal	ERS	○	○	G121.7
Machine lock	All-axis machine lock signal	MLK	○	○	G117.1
Dry run	Dry run signal	DRN	○	○	G118.7
Single block	Single block signal	SBK	○	○	G116.1
Manual absolute on/off	Manual absolute signal	*ABSM	○	○	G127.2
Optional block skip / addition of optional block skip	Optional block skip signals	BDT1, BDT2 to BDT9	○	○	G116.0, G141.0 to G141.7
Program restart	Program restart signal	SRN	○	○	G103.0
	Program restart under way signal	SRNMV	○	○	F188.4
DNC operation	DNC operation select signal	DNCI	○	○	G127.5
Remote buffer DI/DO signals	Output signals for remote buffer	RMTDO0 to RMTDO7	○		F289.0 to F289.7
				○	F290.0 to F290.7
	Input signals for remote buffer	RMTDI0 to RMTDI7	○	○	G239.0 to G239.7
In-feed control	In-feed control cut-in start signal	INFD		★	G237.6
Thread cutting	Thread cutting signal	THRD	○		F188.3
Polygonal turning	Polygon synchronization under way signal	PSYN	○		F160.7
F1-digit feed	F1-digit feed select signal	F1D		○	G140.7
Rapid traverse override	Rapid traverse override signal	ROV1, ROV2	○	○	G116.7, G117.7

Function	Signal name	Symbol	T	M	Address
Feedrate override	Feedrate override signal	*OV1, *OV2, *OV4, *OV8	○	○	G121.0, G121.1, G121.2, G121.3
		*AOV16, *AOV32, *AOV64, *AOV128		○	G116.4, G116.5, G116.6, G117.6
		*AOVR16, *AOVR32, *AOVR64, *AOVR128	○		G140.4, G140.5, G140.6, G140.7
Rapid traverse override B	Rapid traverse override B signal	ROV1D, ROV2D, ROV3D	○		G116.4, G116.5, G116.6
Override cancel	Override cancel signal	OVC	○	○	G126.4
External deceleration	External deceleration signal	*+EDCX, *+EDCZ, *-EDCX, *-EDCZ	○		G138.0, G138.1, G138.3, G138.4
		*+EDCX, *+EDCY, *+EDCZ, *-EDCX, *-EDCY, *-EDCZ		○	G138.0, G138.1, G138.2, G138.3, G138.4, G138.5
In-position check	In-position signals	INP1 to INP4	○	○	F184.0 to F184.3
Error detect	Error detect signal	SMZ	○		G126.6
Signals output according to the speed or travel along an axis (M series)	Signals output according to the speed or travel along an axis	SPDS1, SPDS2, SPDS3, SPDS4		○	F189.0, F189.1, F189.2, F189.3
Miscellaneous function / 2nd auxiliary function	Tool function code signals	T11 to T28	○		F153.0 to F153.7
		T11 to T48		○	F153.0 to F156.7
	Tool function strobe signals	TF	○	○	F150.3
	Second auxiliary function code signals	B0 to B31	○		F276.0 to F279.7
		B11 to B38		○	F155.0 to F154.3
	Second auxiliary function strobe signals	BF	○		F150.7
		BF1, BF2		○	F150.7, F150.6
	Decode M signals	M00, M01, M02, M30		○	F154.7, F154.6, F154.5, F154.4
	Miscellaneous function code signal	M11, M12, M14, M18, M21, M22, M24, M28, M31, M32, M34, M38	○	○	F151.0, F151.1, F151.2, F151.3, F151.4, F151.5, F151.6, F151.7, F157.0, F157.1, F157.2, F157.3
	Miscellaneous function strobe signal	MF	○	○	F150.0
	End signal	FIN	○	○	G120.3
	Distribution end signals	DEN	○	○	F149.3
	Passing point signal	DEN2	○		F149.6
Spindle-speed code signals	S11, S12, S14, S18, S21, S22, S24, S28	○	○	F152.0, F152.1, F152.2, F152.3, F152.4, F152.5, F152.6, F152.7	

Function	Signal name	Symbol	T	M	Address
Miscellaneous function / 2nd auxiliary function	Spindle-speed strobe signals	SF	○	○	F150.2
Auxiliary function lock	Auxiliary function lock signal	AFL	○	○	G103.7
Multiple M commands in a single block	2nd M function code signal	M211, M212, M214, M218, M221, M222, M224, M228, M231, M232, M234, M238	○	○	F193.0, F193.1, F193.2, F193.3, F193.4, F193.5, F193.6, F193.7, F194.0, F194.1, F194.2, F194.3
	3rd M function code signal	M311, M312, M314, M318, M321, M322, M324, M328, M331, M332, M334, M338	○	○	F194.4, F194.5, F194.6, F194.7, F195.0, F195.1, F195.2, F195.3, F195.4, F195.5, F195.6, F195.7
	2nd, 3rd M function strobe signal	MF2, MF3	○	○	F157.4, F157.5
High-speed M/S/T/B interface	Miscellaneous function completion signal	MFIN	○	○	G115.0
	2nd, 3rd M function completion signal	MFIN2, MFIN3	○	○	G134.4, G134.5
	External operation signal for high-speed interface	EF		○	F150.1
	2nd auxiliary function completion signal	BFIN	○		G115.7
		BFIN1, BFIN2		○	G115.7, G115.6
	Tool function completion signal	TFIN	○	○	G115.3
	Spindle function completion signal	SFIN	○	○	G115.2
External operation function completion signal	EFIN		○	G115.1	
Waiting M code (0-TTC)	Waiting signal	WATO	●		F160.6
	No-wait signal	NOWT	●		G133.1
Spindle speed control	Spindle enable signal	ENB	○	○	F149.4
	Gear selection signal	GR1, GR2	○		G118.2, G118.3
				○	G123.2, G123.3
		GR10, GR20, GR30		○	G152.0, G152.1, G152.2
	Spindle speed override signal	SPA, SPB, SPC, SPD	○		G103.3, G103.4, G103.5, G103.2
Spindle speed override signal	SPA, SPB, SPC		○	G103.3, G103.4, G103.5	

Function	Signal name	Symbol	T	M	Address
Spindle speed control	S12-bit code signal	R010 to R120	○	○	F172.0 to F173.3
	Spindle speed arrival signal	SAR	○	○	G120.4
	Spindle orientation signal	SOR	○	○	G120.5
	Spindle stop signal	*SSTP	○	○	G120.6
Spindle speed control for 0-TTC	Spindle command select signal	SLSPA, SLSPB	●		G133.2, G133.3
	Spindle feedback select signal;	SLPCA, SLPCB	●		G1333.2, G1333.3
	Spindle command signal;	COSP	●		F180.5
Spindle speed fluctuation detection	Spindle fluctuation detection alarm signal	SPAL	○		F154.0
Actual spindle speed output (T series)	Actual spindle speed signal	AR0 to AR15	○		F158.0 to F159.7
Spindle positioning (T series)	Spindle unclamp completion signal	*SUCPF	○		G123.4
	Spindle clamp signal	SCLP	○		F164.0
	Spindle unclamp signal	SUCLP	○		F164.1
	Spindle stop complete signal	SPSTP	○		G123.6
	Spindle clamp completion signal	*SCPF	○		G123.5
	Spindle orientation completion signal	ZP3	○		F148.2
	Gear selection signal	CTH1A CTH2A	○	○	G229.3, G229.2
Cs contour control	Spindle contour control change signal	COFF	○		G123.0
		CON		○	G123.7
	Clutch/gear signal (serial spindle)	CTH1A CTH2A	○	○	G229.3, G229.2
	Spindle contour control change completion signal	FSCSL		○	F178.1
	Cs contour control axis reference position return completion signal	ZP3	○		F148.2
		ZP4		○	F148.3
Multi spindle	Individual spindle stop signal	*SSTP1, *SSTP2, *SSTP3	○		G145.3, G145.4, G145.5
	Gear selection signal for 2nd spindle	GR21	○		G145.6
	Gear selection signal for 3rd spindle	GR31	○		G145.7
	Spindle selection signal	SWS1, SWS2, SWS3	○		G145.0, G145.1, G145.2
	2nd position coder selection signal	PC2SLC	○		G146.7

Function	Signal name	Symbol	T	M	Address
Spindle speed control	Spindle enable signal	ENB	○	○	F149.4
		ENB2, ENB3	○		F149.4, F164.2, F164.3
	Gear selection signal	GR10, GR20, GR30		○	G152.0, G152.1, G152.2
Rigid tapping	Spindle rotation direction signal	RGSPM, RGSPP		○	F165.1, F165.0
	Spindle-speed function code signal (BCD output)	S11 to S58	○	○	F185.0 to F187.3
	Spindle function strobe signal	SF	○	○	F150.2
	Rigid tapping signal	RGTPN	○	○	G123.1
Rigid tapping return	Tapping return start signal	RTNT		○	G123.6
	Tapping return completion signal	RTPT		○	F192.6
Spindle synchronous control	Spindle synchronous control signal	SPSYC	○	○	G146.2
	Spindle phase synchronous control signal	SPPHS	○	○	G146.3
	Spindle synchronous speed control completion signal	FSPSY	○	○	F178.2
	Spindle phase synchronous control completion signal	FSPPH	○	○	F178.3
	Spindle synchronous control alarm signal	SYCAL	○	○	F178.4
Controlling the spindle speed ratio for serial interface spindles (0-TTC)	Spindle synchronous polygon code signal	SBRT	●		G146.6
	Serial spindle synchronization polygon signal	RSMAX	●		F189.7
Spindle orientation	1st spindle orientation external stop position command signal	SHA00 to SHA11	○	○	G110.0 to G110.7, G111.0 to G111.3
	2nd spindle orientation external stop position command signal	SHB00 to SHB11	○	○	G112.0 to G112.7, G113.0 to G113.3
Position coder feedback control function	Position coder return control signal	PLCRVON	○	○	G105.7
	Position coder feedback direction selection signal	KILPLUS	○	○	G105.6
Serial spindle simple synchronous control	Parking signal for 1st spindle	PKESS1	○	○	G138.6
	Parking signal for 2nd spindle	PKESS2	○	○	G138.7
Serial spindle simple synchronous control	Spindle simple synchronous control signal	ESRSYC	○	○	G104.4

Function	Signal name	Symbol	T	M	Address
Tool life management	Individual tool change signal	TLCHI		○	F192.0
	All tools' life expired signal	TLCHE		○	F192.1
	New tool select signal	TLNW	○	○	F188.1
	Remaining tool life expired signal	TLCHB		○	F192.2
	Tool change signal	TLCH	○	○	F188.0
	Individual tool change reset signal	TLRSTI		○	G140.4
	Tool skip signal	TLSKP	○	○	G140.0
	Tool group number select signal	TL01, TL02, TL04, TL08, TL16, TL32, TL64	○	○	G139.0, G139.1, G139.2, G139.3, G139.4, G139.5, G139.6
	Tool change reset signal	TLRST	○	○	G139.7
Custom macro	Custom macro output signal	UO000 to UO015, UO100 to UO131	○	○	F162.0 to F163.7, F196.0 to F199.7
	Custom macro input signal	UI000 to UI015	○	○	G130.0 to G131.7
Interruption type custom macro	Interrupt signal for custom macro	UINT	○	○	G140.3
Canned cycle (M series) / Canned cycle for hole machining (T series)	Tapping signal	TAP	○	○	F149.5
Small diameter peck drilling cycle (M series)	Skip signal	SKIP	○	○	X008.7
	Small-diameter peck drilling cycle execution in progress signal	PECK2		○	F180.7
External motion function (M series)	External operation signal	EF		○	F150.1
Canned cycle	Chamfering signal	CDZ	○		G126.7
Index table indexing function (M series)	B axis clamp completion signal	*BECLP		○	G143.7
	B axis unclamp signal	BUCLP		○	F188.2
	B axis clamp signal	BCLP		○	F188.3
	B axis unclamp completion signal	*BEUCP		○	G143.6
Display/setting	Display and setting	*LDSP	○	○	G119.0
	Renewal disable signal of relative coordinate	DLK	○	○	G127.6
Run hour and parts count display	Required parts count reached signal	PRTSF	○	○	F164.7
Graphic display / Dynamic graphic display	Drwing signal	CKGRP	○	○	F164.5

Function	Signal name	Symbol	T	M	Address
Software operator's panel	Software operator's panel general-purpose switch signal (software operator's panel signal)	OUT0 to OUT7	○	○	F171.0 to F171.7
	Jog rapid traverse select signal (software operator's panel signal)	RTO	○	○	F178.6
	Feed hold signal (software operator's panel signal)	SPO	○	○	F178.7
	Mode select signal (software operator's panel signal)	MD10, MD20, MD40	○	○	F174.0, F174.1, F174.2
	Manual pulse generator feed axis select signal (software operator's panel signal)	HXO, HYO, HZO, HZ4		○	F174.4, F174.5, F174.6, F174.7
		HXO, HZO, H3O, H4O	○		
	Jog feedrate override signal (software operator's panel signal)	JV10, JV20, JV40, JV80	○	○	F175.0, F175.1, F175.2, F175.3
	Mode select signal (software operator's panel signal)	ZRNO	○	○	F174.3
	Dry run signal (software operator's panel signal)	DRNO	○	○	F176.7
	Machine lock signal (software operator's panel signal)	MLKO	○	○	F176.6
	Single block signal (software operator's panel signal)	SBKO	○	○	F176.5
	Optional block skip signal (software operator's panel signal)	BDTO	○	○	F176.4
	Jog feed axis select signal (software operator's panel signal)	+XO, -XO, +ZO, -ZO, +YO, -YO, +4O, -4O		○	F177.0, F177.1, F177.2, F177.3, F177.4, F177.5, F177.6, F177.7
		+XO, -XO, +YO, -YO, +ZO, -ZO, +4O, -4O		○	
Rapid traverse override signal (software operator's panel signal)	ROV10, ROV20	○	○	F175.4, F175.5	
Program protect signal (software operator's panel signal)	KEYO	○	○	F178.5	
Feedrate override signal (software operator's panel signal)	OV10, OV20, OV40, OV80	○	○	F176.0, F176.1, F176.2, F176.3	
Select of magnification of manual pulse generator (software operator's panel signal)	MP10, MP20	○	○	F175.6, F175.7	
Memory protection key	Program protect signal	KEY	○	○	G122.3

Function	Signal name	Symbol	T	M	Address
External I/O device control	Read/punch alarm signal	RPALM	○	○	F180.3
	External read/punch stop signal	EXSTP	○	○	G134.2
	External punch start signal	EXWT	○	○	G134.3
	Background editing signal	BGEACT	○	○	F180.4
	External read start signal	EXRD	○	○	G134.1
	Read/punch busy signal	RPBSY	○	○	F180.2
Simultaneous input and output operations	Input and run simultaneous mode select signal	STRD		○	G140.5
	Output and run simultaneous mode select signal	STWD		○	G140.6
External program input	External program input start signal	MINP	○		G117.0
				○	G120.0
Automatic tool length measurement (M series) / automatic tool offset (T series)	Measuring position reached signals	XAE, ZAE	○		X008.0, X008.1
		XAE, YAE, ZAE		○	X008.0, X008.1, X008.2
Skip function	Skip signal	SKIP	○	○	X008.7
Multi-step skip function	Skip signal	SKIP2, SKIP3, SKIP4	☆		X008.2, X008.3, X008.4
Torque limit skip (T series)	Torque limit reached signal	TORQ1, TORQ2, TORQ3, TORQ4, TORQ7, TORQ8	○		F170.0, F170.1, F170.2, F170.3, F170.4, F170.5
Input of tool offset value measured A	Position record signal	PRC	○		G103.6
Input of tool offset value measured B (T series)	Tool offset write mode select signal	GOQSM	○		G132.7
	Tool offset write signal	+MIT1, -MIT1, +MIT2, -MIT2	○		X008.2, X008.3, X008.4, X008.5
	Tool offset number select signal	OFN0, OFN1, OFN2, OFN3, OFN4	○		G132.0, G132.1, G132.2, G132.3, G132.4
	Workpiece coordinate system shift value write signal	WOSET	○		G133.7
	Workpiece coordinate system shift value write mode select signal	WOQSM	○		G132.6
	Tool compensation number automatic selection disable signal	TNFS	○		G132.5
Grinding wheel diameter automatic compensation	Grinding wheel diameter automatic compensation signal	GWLF		☆	F165.3

Function	Signal name	Symbol	T	M	Address
PMC axis control	Axis control command signal (PMC axis control)	EC0A to EC6A, EC0B to EC6B	○	○	G211.0 to G211.6, G219.0 to G219.6
	Auxiliary function executing signal (PMC axis control)	EDENA, EDENB	○	○	F270.3, F273.3
	Alarm signal (PMC axis control)	EIALA, EIALB	○	○	F270.2, F273.2
	Control axis selection status signal (PMC axis control)	*EAXSL	○	○	F188.7
	Following zero checking signal (PMC axis control)	ECKZA, ECZKB	○	○	F270.1, F273.1
	Override 0% signal (PMC axis control)	EOV0	○	○	F188.5
	In-position signal (PMC axis control)	EINPA, EINPB	○	○	F270.0, F273.0
	Axis control feedrate signal (PMC axis control)	EIF0A to EIF15A, EIF0B to EIF15B	○	○	G212.0 to G213.7, G220.0 to G221.7
	Positive-direction overtravel signal (PMC axis control)	EOTPA, EOTPB	○	○	F270.5, F273.5
	Skip signal (PMC axis control)	ESKIP	○	○	X008.6
	Axis moving signal (PMC axis control)	EGENA, EGENB	○	○	F270.4, F273.4
	Axis control data signal (PMC axis control)	EID0A to EID31A, EID0B to EID31B	○	○	G214.0 to G217.7, G222.0 to G225.7
	Auxiliary function strobe signal	EMFA, EMFB	○	○	F271.0, F274.0
	Axis control command read completion signal (PMC axis control)	EBSYA, EBSYB	○	○	F270.7, F273.7
	Negative-direction overtravel signal (PMC axis control)	EOTNA, EOTNB	○	○	F270.6, F273.6
	Dry run signal (PMC axis control)	DRNE	○	○	G147.7
	Block stop signal (PMC axis control)	ESBKA, ESBKB	○	○	G210.3, G218.3
	Auxiliary function completion signal (PMC axis control)	EFINA, EFINB	○	○	G210.0, G218.0
	Servo off signal (PMC axis control)	ESOFA, ESOFB	○	○	G210.4, G218.4
	Axis control temporary stop signal (PMC axis control)	ESTPA, ESTPB	○	○	G210.5, G218.5
Manual rapid traverse selection signal (PMC axis control)	RTE	○	○	G147.6	

Function	Signal name	Symbol	T	M	Address
PMC axis control	Auxiliary function code signal (PMC axis control)	EM11A to EM28A, EM11B to EM28B	○	○	F272.0 to F272.7, F275.0 to F275.7
	Reset signal (PMC axis control)	ECLRA, ECLRB	○	○	G210.6, G218.6
	Axis control command read signal (PMC axis control)	EBUFA, EBUFB	○	○	G210.7, G218.7
	PMC axis rapid traverse override signal	ROV1E, ROV2E	○	○	G146.0, G146.1
	Block stop disable signal (PMC axis control)	EMSBKA, EMSBKB	○	○	F211.0, G219.0
	Control axis selection signal (PMC axis control)	EAX1 to EAX8	○	○	G144.0 to G144.5
	PMC axis override cancel signal	OVCE	○	○	G147.5
	Feedrate override signal (PMC axis control)	*OV1E, *OV2E, *OV4E, *OV8E	○	○	G147.0, G147.1, G147.2, G147.3
External data input	Read completion signal (for external data input)	EREND	○	○	F160.0
	Search completion signal (for external data input)	ESEND	○	○	F160.1
	Read signal (for external data input)	ESTB	○	○	G102.7
	Address signal (for external data input)	EA0 to EA6	○	○	G102.0 to G102.6
	Data signal (for external data input)	ED0 to ED15	○	○	G100.0 to G101.7
External workpiece number search	Workpiece number search signal	PN1, PN2, PN4, PN8	○	○	G122.4, G122.5, G122.6, G122.7
Spindle output control by the PMC	Motor speed command spindle input signal	R011 to R121, R0112 to R1212, R0113 to R1213	○	○	G124.0 to G125.3, G106.0 to G107.3, G108.0 to G109.3
	Spindle motor speed command signal	SIND, SIND2, SIND3	○	○	G125.7, G107.7, G109.7
	Spindle motor command polarity select signal	SGN, SGN2, SGN3	○	○	G125.5, G107.5, G109.5
	Spindle motor command polarity select signal	SSIN, SSIN2, SSIN3	○	○	G125.6, G107.6, G109.6

Function	Signal name	Symbol	T	M	Address
External key input	Key signal	K0, S, K1, U, K2, W, K3, R, K4, X, K5, Z, K6, F, K7, O, K8, N, K9, G, KA, C, KALARM, KALTER, KCAN, KCUS↑, KCUS⇄, KDELET, KDG NOS, KEOB		○	G106.0, G106.1, G106.2, G106.3, G106.4, G106.5, G106.6, G106.7, G107.0, G107.1, G107.5, G109.5, G108.0, G110.7, G110.1, G110.0, G108.2, G109.4, G107.7
		KINPUT, KINSRT, KM, -, KP, Q, KPAGE ↑, KPAGE ↓, KPARAM, KPOS, KPROGRAM, KRESET, KS1, KS2, KS3, KS4, KS5, KSL, KSR, KSTART, KT,, KXZ, KXZ		○	G108.3, G108.1, G107.2, G107.4, G110.3, G110.2, G109.3, G109.0, G109.1, G111.7, G112.6, G112.5, G112.4, G112.3, G112.2, G112.7, G112.1, G108.4, G107.3, G142.7, G110.4
		KFF, KFFE, KFGB, KFI,, KFK%, KFL+, KFM., KFNK, KFOJ, KFRC, KFS=, KFT*, KFUV, KFWH, KFX Y, KFZJ, KH, I, K		○	G114.3, G114.2, G113.2, G114.0, G114.1, G114.7, G114.4, G113.1, G113.0, G113.3, G114.5, G114.6, G113.6, G113.7, G113.4, G113.5, G107.6
		K0, S, K1, H, K2, F, K3, R, K4, X, K5, Y, K6, Z, K7, O, K8, N, K9, G, KALARM, KALTER, KB, K4, D, KCAN, KCUS↑, KCUS↓, KDELET, KDG NOS, KEOB, / , .		○	G106.0, G106.1, G106.2, G106.3, G106.4, G106.5, G106.6, G106.7, G107.0, G107.1, G109.5, G108.0, G107.5, G110.7, G110.1, G110.0, G108.2, G109.4, G107.7

Function	Signal name	Symbol	T	M	Address
External key input	Key signal	KF4TH, KFF, KFF%, KFGE, KFI,, KFJA, KFL+, KFM., KFNK, KFOJ, KFRC, KFS=, KFT*, KFXU, KFXW, KFYV, KH, J, K, KINPUT, KINSRT, KM, -, KOFSET, KP, Q, L, KPAGE↑, KPAGE↓, KPARAM, KPOS, KPROGRAM, KRESET, KS1, KS2, KS3, KS4, KS5, KSL, KSR, KSTART, KT,, KXY, KYZ, KZX		○	G113.7, G114.3, G114.2, G113.2, G114.0, G114.1, G114.7, G114.4, G113.1, G113.0, G113.3, G114.5, G114.6, G113.4, G113.6, G113.5, G107.6, G108.3, G108.1, G107.2, G109.2, G107.4, G110.3, G110.2, G109.3, G109.0, G109.1, G111.7, G112.6, G112.5, G112.4, G112.3, G112.2, G112.7, G112.1, G108.4, G107.3, G110.4, G110.6, G110.5
External key input	Key input disable signal	INHKY	○	○	F180.0
	Program screen display signal	PRGDPL	○	○	F180.1
	External key input mode selection signal	ENBKY	○	○	G134.0
Direct operation by MMC (T series)	Direct operation select signal	DMMC	○	○	G128.7
PMC Window function	Window request signal	WNRQ	○	○	G200.0
	Window completion signal	WNANS	○	○	F250.0
	Window rewrite signal	WNWRT	○	○	G200.1
	Window error signal	WNERR	○	○	F250.1
Functions related to serial spindle	Soft start /stop cancel signal	SOCNA, SOCNB	○	○	G230.4, G234.4
	Spindle orientation stop position change signal	INDXA, INDXB	○	○	G231.0, G235.0
	Spindle rotation direction command signal while changing the orientation stop position	ROTA, ROTAB	○	○	G231.1, G235.1
	Power line switch completion signal	MCFNA, MCFNB	○	○	G230.3, G234.3
	Power line status check signal	RCHA, RCHB	○	○	G230.7, G234.7
	Output switch request signal	RSLA, RSLB	○	○	G230.6, G234.6
	Short-distant movement command while changing the orientation stop position signal	NRROA, NRROB	○	○	G231.2, G235.2
Speed reached signal	SARA, SARB	○	○	F281.3, F285.3	