

FANUC

PMC Ladder Maintenance

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1. Introduction to PMC Ladder

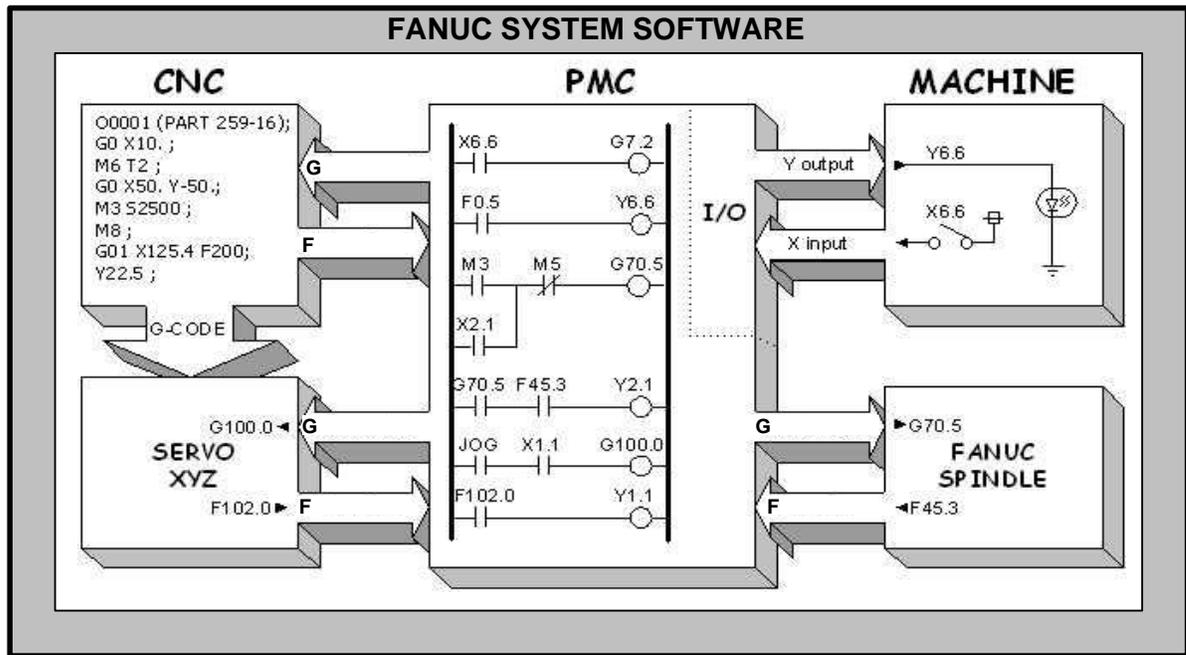
Control of the Machine Tool is performed in three key areas, with the FANUC System Software regulating the entire system. The three areas of control are the CNC, PMC, and Machine.

The **Programmable Machine Control**, or PMC, contains two individual software components: the FANUC PMC system software (example 4067-13) which controls overall operation such as cycle time, G and F address allocation, and I/O module recognition, and the Ladder Diagram (example PMC-RB) which establishes the exact conditions or logic for a process to occur. The machine tool builder writes the ladder diagram per individual machine requirements.

The **FANUC CNC System Software** is responsible for many aspects of control including the power on sequence (or BOOT system), the control of Servo Motors, the display of information to the LCD, and the operation of G-Codes within the part program.

The electronic portion of the **Machine Tool** includes physical switches, pushbuttons, LED's, and mechanical contactors. Many of these devices are located on the machine's operator panel, along the axis or tool change device, or in the electronics cabinet.

The PMC serves as the interface between the CNC and the Machine Tool.



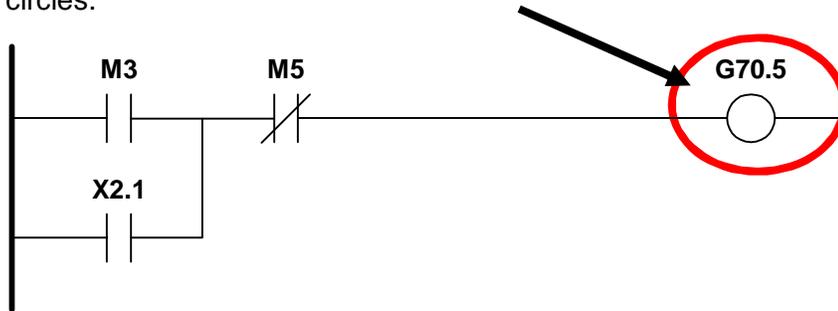
1.1. The PMC function

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, and 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 +24VDC 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.



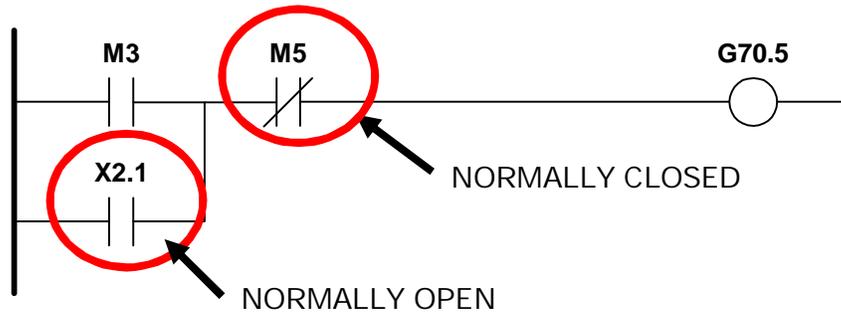
Each coil has an ADDRESS assigned to it. Here is the coil for address G70 bit 5. The address determines where the signal output will go. G70.5 is a dedicated address for the PMC to command the SPINDLE to go clockwise (M3). When the coil becomes active in the ladder, the command is sent to the spindle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

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

- **Y = Physical Outputs** to the machine that activate 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 purposes determined by the ladder developer.
- **D = Data Register Bits**, data registers are used for internal ladder data storage.
- **K = Keep Relays**, relays that are used to set ladder options, controlled by a parameter screen.
- **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.
- **Y = Physical Outputs**, to the machine that activate relays, solenoids, etc.
- **F = System Inputs**, that confirm the CNC, servos, or spindle system status to the PMC.
- **K = Keep Relays**, 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 Specifications

The performance of the PMC varies with the type and model of the control used. The 3xi series has more processing power than the 0i-D so it processes ladder instructions faster.

Furthermore, the 3xi series can operate multiple ladders (referred to as paths) – the 30i-A can control up to three paths and the 30i-B can control up to five paths. The 0i-D only controls a single ladder. In addition to the path(s) that the CNCs can control, there is an optional feature called Dual Check Safety (DCS) that has its own ladder as well.

Function	0i Model D	3xi Model A	3xi Model B	DCS
PMC Memory Type (see Note 1)	Standard & PMC/L	1 st PMC – B & C 2 nd PMC – A & B 3 rd PMC - A	1 st PMC – B, C, or D 2 nd – 5 th PMC – A, B, or C	-
Programming Language	Ladder, Function Block (option)	Ladder, Step Sequence (only available on the 1 st PMC), Function Block (op.)		Ladder, Func. Blk. (op.)
# of ladder levels	3; 2 on PMC/L	3		2
Ladder scan time	8 msec	4 or 8 msec (see Note 2)		8 msec
Processing speed	25 nsec/step 1 µsec/step (PMC/L)	25 nsec/step	9.1 nsec/step	1 µsec/step
Program capacity	32,000 steps 8,000 steps (PMC/L)	100,000 steps	300,000 steps	3,000 steps
Possible I/O points	2,048 inputs (X) 4,096 outputs (Y) 1,024 inputs (PMC/L) 1,024 outputs (PMC/L)	4,096 inputs (X) 4,096 outputs (Y)		64 inputs 64 outputs
Max. ladder size	384 KB 128 KB (PMC/L)	2 MB (PMC1) 768 KB (PMC 2 & 3)	5 MB (All paths combined)	128 KB

Note 1 (does not apply to 0i-D): The ladder memory type to be used is set by CNC parameter. PRM 11940 – 11944 sets the memory type of PMCs 1-5 respectively (the 3xi-A only uses PRMs 11940-11942).

A setting of: 1 = PMC Memory A, 2 = PMC Memory B, 3 = PMC Memory C, 4 = PMC Memory D, - 1 = uses the same memory as the 1st PMC.

Note 2: CNC parameter 11930 specifies the ladder scan time – set to 4 for 4 msec or to 8 for 8 msec.

1.1.4. Address Table

Like ladder performance, the address table varies between CNC Series and Model as well as the ladder memory type. The 3xi-A control can use PMC memory types A, B, or C, the 3xi-B utilizes PMC memory types A, B, C, or D, and the 0i-D can use its standard ladder or the ladder that the 0iMate-D uses (PMC/L).

Table of addresses available to the user for the 0i-D series:

Address	Description	0i Model D	0i Model D 0iMate Model D (PMC/L)	DCS
X	PMC Input from physical machine side (limit switches)	X0 ~ X127 X200 ~ X327	X0 ~ X127	X0 ~ X127
Y	PMC Output to physical machine side (relays/solenoids)	Y0 ~ Y127 Y200 ~ Y327	Y0 ~ Y127	Y0 ~ Y127
F	PMC Input from CNC, Servo, or Spindle system (confirmation)	F0 ~ F767 F1000 ~ F1767	F0 ~ F767	F0 ~ F767
G	PMC Output to CNC, Servo, or Spindle system (command)	G0 ~ G767 G1000 ~ G1767	G0 ~ G767	G0 ~ G767
R	PMC Internal Relays – contacts and coils found only within the ladder	R0 ~ R7999	R0 ~ R1499	R0 ~ R1499
E	Extra relays – similar in use to R addresses but can be sent to different machines (via Profibus, DeviceNet, etc.)	E0 ~ E9999	E0 ~ E9999	-
A	PMC Output to CNC message display (Alarms)	A0 ~ A249	A0 ~ A249	-
C	PMC Counters	C0 ~ C399 C5000 ~ C5199	C0 ~ C79 C5000 ~ C5039	C0 ~ C79 C5000 ~ C5039
K	PMC Keep relays – can be used like an R address but maintains state through a power cycle unlike R	K0 ~ K99	K0 ~ K19	K0 ~ K19
T	PMC Timers	T0 ~ T499	T0 ~ T79	T0 ~ T79
D	PMC Data register	D0 ~ D9999	D0 ~ D2999	D0 ~ D2999
L	PMC Labels	L1 ~ L9999	L1 ~ L9999	L1 ~ L9999
P	PMC Subprograms	P1 ~ P5000	P1 ~ P512	P1 ~ P512

Table of addresses available to the user for 3xi Series:

Address	Description	3xi Model A & B	DCS
X	PMC Input from physical machine side (limit switches)	X0 ~ X127, X200 ~ X327, X400 ~ X527, X600 ~ X727	X0 ~ X127
Y	PMC Output to physical machine side (relays/solenoids)	Y0 ~ Y127, Y200 ~ Y327, Y400 ~ Y527, Y600 ~ Y727	Y0 ~ Y127
F	PMC Input from CNC, Servo, or Spindle system (confirmation)	F0 ~ F767, F1000 ~ F1767, F2000 ~ F2767, F3000 ~ F3767, F4000 ~ F4767, F5000 ~ F5767, F6000 ~ F6767, F7000 ~ F7767, F8000 ~ F8767, F9000 ~ F9767	F0 ~ F767
G	PMC Output to CNC, Servo, or Spindle system (command)	G0 ~ G767, G1000 ~ G1767, G2000 ~ G2767, G3000 ~ G3767, G4000 ~ G4767, G5000 ~ G5767, G6000 ~ G6767, G7000 ~ G7767, G8000 ~ G8767, G9000 ~ G9767	G0 ~ G767
R	PMC Internal Relays – contacts and coils found only within the ladder	R0 ~ R1499 (Memory Type A) R0 ~ R7999 (Memory Type B) R0 ~ R15999 (Memory Type C) R0 ~ R59999 (Memory Type D)	R0 ~ R1499
E	Extra relays – similar in use to R addresses but can be sent to different ladders or machines (via Profibus, DeviceNet, etc.)	E0 ~ E9999	-
A	PMC Output to CNC message display (Alarms)	A0 ~ A249 (Memory Type A & B) A0 ~ A499 (Memory Type C) A0 ~ A749 (Memory Type D)	-
C	PMC Counters	C0 ~ C79, C5000 ~ C5039 (Memory Type A) C0 ~ C399, C5000 ~ C5199 (Memory Type B) C0 ~ C799, C5000 ~ C5399 (Memory Type C) C0 ~ C1199, C5000 ~ C5599 (Memory Type D)	C0 ~ C79 C5000 ~ C5039
K	PMC Keep relays – can be used like an R address but maintains state through a power cycle unlike R	K0 ~ K19 (Memory Type A) K0 ~ K99 (Memory Type B) K0 ~ K199 (Memory Type C) K0 ~ K299 (Memory Type D)	K0 ~ K19
T	PMC Timers	T0 ~ T79 (Memory Type A) T0 ~ T499 (Memory Type B) T0 ~ T999 (Memory Type C & D)	T0 ~ T79
D	PMC Data register	D0 ~ D2999 (Memory Type A) D0 ~ D9999 (Memory Type B) D0 ~ D19999 (Memory Type C) D0 ~ D59999 (Memory Type D)	D0 ~ D2999
L	PMC Labels	L1 ~ L9999	L1 ~ L9999
P	PMC Subprograms	P1 ~ P512 (3xi-A Memory Type A) P1 ~ P5000 (3xi-A Memory Type B & C) P1 ~ P5000 (3xi-B Memory Type A-D)	P1 ~ P512
M	Input signals from another PMC	M0 ~ M767	-
N	Output signals to another PMC	N0 ~ N767	-

1.2. The CNC function

G-Code - The primary function of the CNC is to read the G-Code programs 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 addresses) are physical switches, contacts, or sensors. The PMC outputs (Y addresses) are physical relay coils, solenoids, or contactors.

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

1. The physical Cycle Start button is pressed on the machine operator panel.
2. This causes +24VDC to be sent to an I/O module.
3. The I/O module **inputs this signal to the PMC Ladder** at address **X12.1**.
4. The ladder uses **X12.1** to activate the **G7.2** coil
5. This **commands the CNC** to Cycle Start.
6. The CNC starts processing the current G-Code program.
7. **Address F0.5 confirms** to the PMC that it is in Cycle Start.
8. The ladder uses the **F0.5** contact to activate the **Y12.1** coil.
9. The **Y12.1** coil address is recognized by the I/O module.
10. The I/O module **outputs +24VDC** at the wire connected to the **Y12.1** address.
11. The lamp in the Cycle Start push button is turned on.

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

2. Basic Ladder Items

The basic building blocks of a ladder are normally open and normally closed contacts as well as output, inverted output, and set/reset coils.



1) Press the  button on the MDI panel.

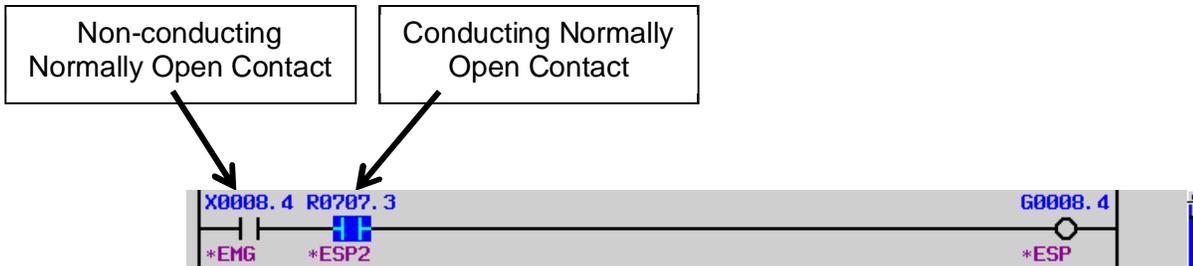
2) Press the  soft key on the CNC menu until you see the 3 main PMC choices:



3) Press the  soft key, then press the  soft key on the LCD menu.

2.1. Normally Open Input Contacts

Contacts are inputs to the PMC; they can be duplicated in the ladder. The normally open contact **conducts when the input is activated (status=1)** and is **highlighted** on the display; it does not conduct when the input is inactive (status=0) and is **not** highlighted.



4) Push in the Emergency Stop button to control the logic.

2.2. Normally Closed Input Contacts

Contacts are inputs to the PMC; they can be duplicated in the ladder. The normally closed contact **conducts when the input is not activated (status=0)** and is **highlighted** on the display; it does not conduct when the input is active (status=1).

Conducting Normally Closed Contact



Non-Conducting Normally Closed Contact



2.3. Output Coils

Coils are outputs from the PMC; they cannot be duplicated in the ladder. If the **contacts before the output coil conduct**, the output **coil is activated (status=1)**. If there is not a complete path of conducting contacts from the left side of the screen to the coil, the output coil is inactive (status=0). The coil has a highlighted appearance when active.

Conducting Output Coil



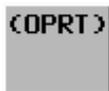
Non - Conducting Output Coil



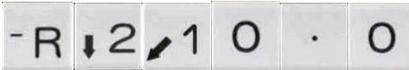
2.4. Inverted Output Coil

Coils are outputs from the PMC; they cannot be duplicated in the ladder. The inverted coil's behavior is the inverse of an output coil. If there is not a complete path of conducting contacts in front of the coil, this output **coil is active (status=1)**. If the contacts before the output coil conduct, the output coil is de-activated (status=0).



1) Press the  soft key.

2) Press the  soft key.

3) Enter  and press the  soft key.

Conducting Inverted Output Coil



Non - Conducting Inverted Output Coil



4) Press the  button on the operator panel to control the logic.

2.5. SET Output Coil

The SET coils are outputs from the PMC; unlike other coils they can have a duplicate, the RESET 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.



- 1) The R210.1 coil should be visible on the screen, if not just press the  button to see it.



- 2) Press the  button on the Operator Panel to SET the coil (it's already set because of the previous section).

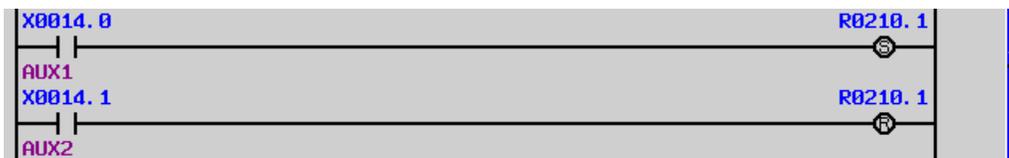
Note that when the coil is set, both the SET and RESET coils are highlighted.

2.6. RESET Output Coil

The RESET coil works with a SET coil of the same address. 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.



- 3) Press the  button on the Operator Panel to RESET the coil.



Note that when the coil is not set, neither the SET nor RESET coils are highlighted.



- 4) While holding down the  button, press the  button – notice that the coil will not SET.

2.7. Logical AND Circuit

When contacts are **arranged in series** with each other, this is called **ANDing**.

In the next example, both the AUX1 **AND** AUX 2 contacts must conduct before the output R210.2 turns ON.

5) Enter  and press the  soft key.



6) Press and hold the  and  buttons on the Operator Panel to see the coil conduct.

2.8. Logical OR Circuit

When contacts are **arranged in parallel** with each other, this is called **ORing**.

Either AUX1 **OR** AUX2 must conduct before the output R210.3 turns ON

7) Enter  and press the  soft key.



8) Press and hold either the  or the  button on the Operator Panel to see the coil conduct.

2.9. 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.

9) Enter  and press the  soft key.



In this example, when  turned ON, the coil R210.5 was turned ON.

When the coil R210.5 turns ON, the contact R210.5 then conducts, causing the coil to **LATCH and HOLD** the output ON, even if AUX5 stops conducting.

The only way the circuit can turn OFF is for F1.1 to stop conducting.

Address F1.1 is the  button on the MDI key pad.

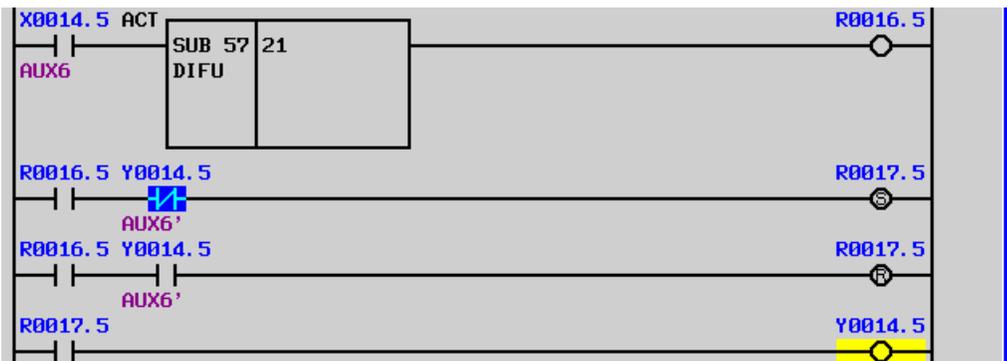
2.10. Momentary Switches to Latching Switches

The circuit below converts the input from a momentary switch and causes it to latch within the ladder logic. This is very common today for operator panel and other switch inputs. The circuit uses a Sub 57 DIFU rising edge detection function block to hold the coil on for one ladder scan. The logic acts like a basic flip-flop circuit.

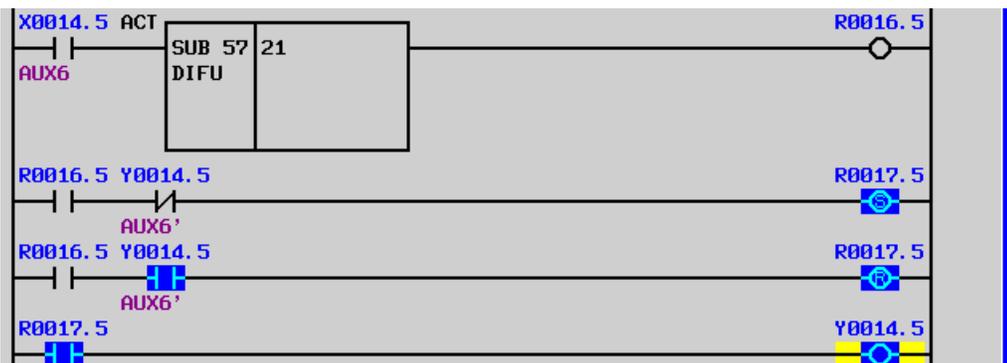


1) Enter  and press the  soft key. Cursor down four times to see the complete circuit.

In the example below, even a very brief input from X14.5 will cause the Sub 57 function block to turn on coil R16.5. This will cause the contacts R16.5 to conduct and activate the SET coil R17.5 if the output coil, Y14.5, is in the off state. Coil R17.5 will cause the output coil Y14.5 to latch on as seen below.



If the output is in the on/set state, when the input X14.5 is activated again, the Reset coil, R17.5 will be activated and coil output will be turned off, turning off the output coil Y14.5.



2) Press the  button on the operator panel to control the circuit.

3. PMC Screen Review



These three soft keys offer access to nearly all the information that pertains to the PMC side of the system. This section will cover what is available from each soft key.

3.1. PMC LADDER Display

The PMC LADDER display allows you to see the ladder logic written by the machine builder. You also have the ability to search for specific addresses or comments, view the current status of a signal, or trace signal status.

3.1.1. LIST Display



1) Press the  button on the MDI key pad.

2) Press the  soft key on the CNC menu until you see the three main PMC choices.

3) Press the  soft key on the CNC menu.

The **PMC LIST VIEW** will appear ...

SP	PROGRAM	STRT	GLOBAL (30iMA FANUC Simulator)	1-5/453NET
	COLLECT			
	GLOBAL	9K		
	LEVEL1	124		
	LEVEL2	7K		
	P0010	44		
	P0020	128		
	P0021	128		
	P0022	136		
	P0200	220		
	P0300	196		
	P0400	480		

In the LIST view there are several choices available:

<u>COLLECT</u> = Collective Monitor	(Tool to create a personalized view)
<u>GLOBAL</u> = View all ladder logic	(Displays everything listed below)
<u>LEVEL1</u> = View high priority ladder logic only	(Machine safety circuits)
<u>LEVEL2</u> = View general machine ladder logic only	(General Machine operation)
<u>P0010</u> = Sub program	(Part load/unload processing)
<u>P0020</u> = Sub Program	(Changes a CNC Parameter)
<u>P0021</u> = Sub Program	(Changes a CNC Parameter)
<u>P0022</u> = Sub Program	(Changes a CNC Parameter)
<u>P0200</u> = Sub program	(Spindle S-Code processing)
<u>P0300</u> = Sub program	(Tool T-Code processing)
<u>P0400</u> = Sub program	(Index table B-Code processing)

MDI: **** * 08:47:34

LIST LADDER DUP. COIL (OPRT)

The first time you look at the LADDER display it automatically shows the LIST view; you can



bring up this screen at any time by pressing the soft key.



4) Press the buttons on the MDI keypad to choose GLOBAL.

5) There are two ways to focus the display on one of the LIST choices.



You can: Press the and then soft keys, or press the soft key.

3.1.2. LADDER Display



6) Press the soft key on the CNC menu to view the GLOBAL ladder.

The ladder DIAGRAM MONITOR screen appears.

By default, the ladder elements that are conducting appear highlighted in BLUE or GREEN (Blue = 3xi, Green = 0iD). The colors can be customized as we'll see later.

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

3.1.2.1. SEARCH Menu



By pressing the  soft key, the search menu is displayed. When searching, the signals address or symbol name (comment) may be entered.

TRY THIS



1) Press the  soft key, and then the  soft key on the CNC menu.

Several new soft key choices are displayed:



- This soft key moves the display to the top or the bottom of the ladder each time it is pressed.



- This soft key searches for the next instance of whatever the cursor is on top of, or whatever you type in – such as NET numbers or addresses of contacts, coils, registers, etc.



- This soft key searches for coils **ONLY**. From a maintenance perspective, this is the primary search button – usually when searching the ladder you are looking for the address of a coil. SET and RESET coils are the only coils that can be duplicated in the ladder – if your cursor is on one of these and you press this soft key again, it will switch you between the two.



- This soft key searches for functional instructions **ONLY**. Each type of functional instruction is assigned a SUBroutine number – such as 3 for a timer; you type in the SUB number and press the soft key to search for that functional instruction. If the cursor is highlighting SUB # inside a functional instruction, you will be taken to the next instance of that type of functional instruction.



- This soft key selects the rung pointed to by the cursor. The selected net will appear on the **COLLECTIVE** display.



- This soft key functions precisely like the  soft key with the exception that it searches in the opposite direction.



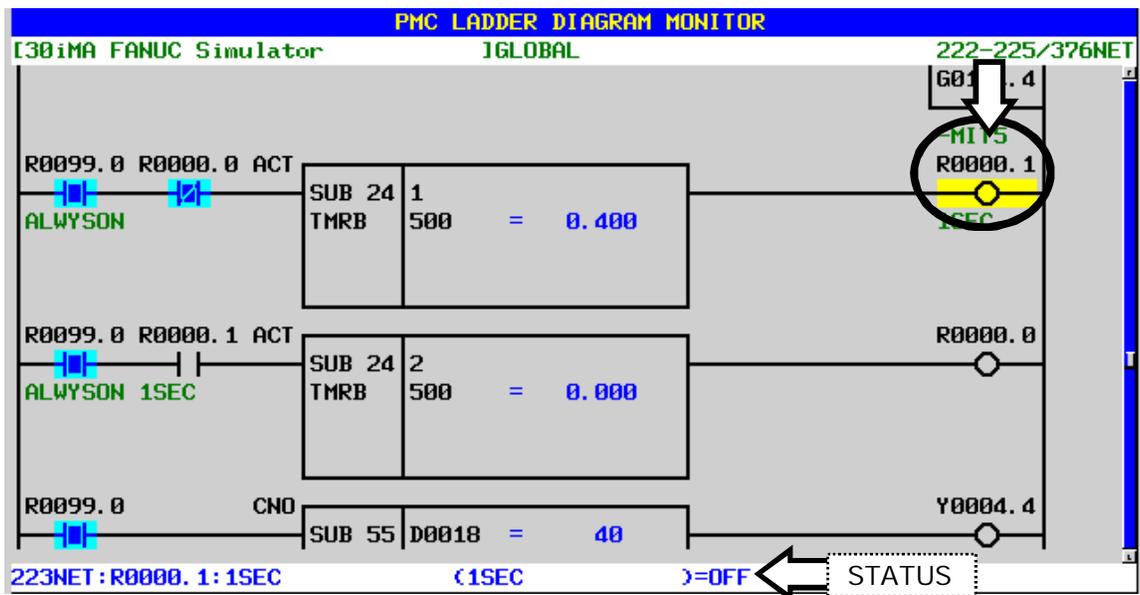
- This soft key functions precisely like the  soft key.



- This soft key closes the .



2) Enter address **-R 0 . 1**, and then press the **W-SRCH** soft key. The coil for R0.1 appears on the display, and the status is shown below.



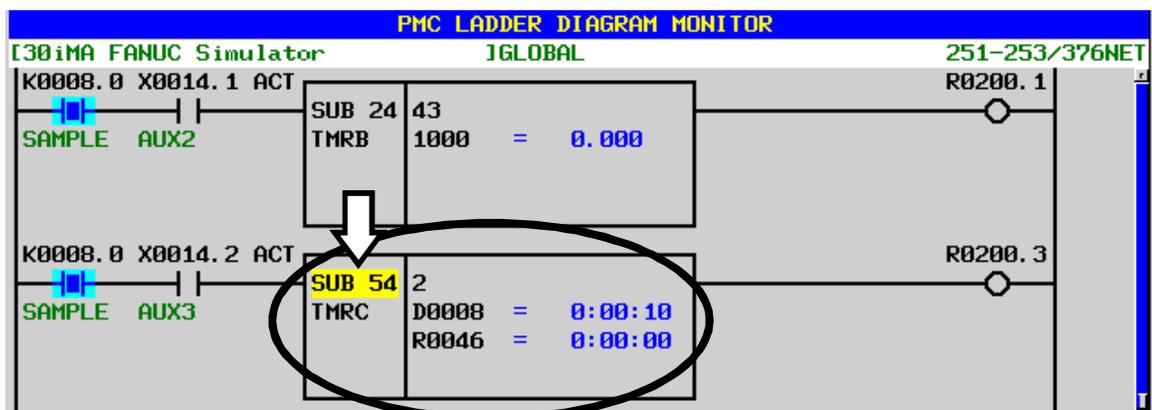
3) Once the cursor selects an address, you can press the **SEARCH** soft key again to find the related contacts. Press it a few times.

4) Press **W-SRCH** to return to the coil.

5) Press **TOP BOTTOM** to return to the top of the ladder.

6) Enter **↓ 2 ↓ 2 ↗ 3** then press **SEARCH** to search NET number 223.

7) Enter **W 5 ← 4** then press **FUNC SEARCH** to search for function block SUB 54.



3.1.3. COLLECTIVE Monitor Function

The collective display is a screen that allows you to choose the ladder rungs you want to display. This allows you to choose rungs from multiple sections or levels of the ladder and view them in one central location.

If coming from the previous section, steps 1-3 are not necessary:



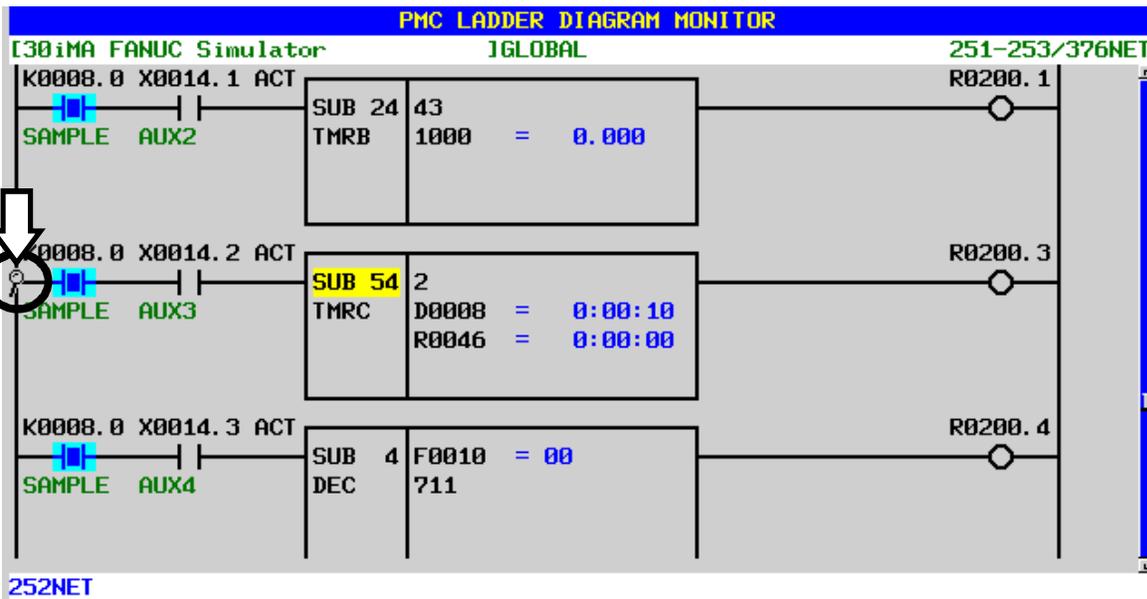
1) From the LADDER display screen, press the  soft key.

2) Press the  soft key on the CNC menu.

3) Enter   then press the  soft key.

4) Press the  soft key, notice the looking glass appears on the left edge.

Note: The ladder cursor must be enabled for the pickup key to appear.



5) Enter  then press  to search for function block SUB 3.

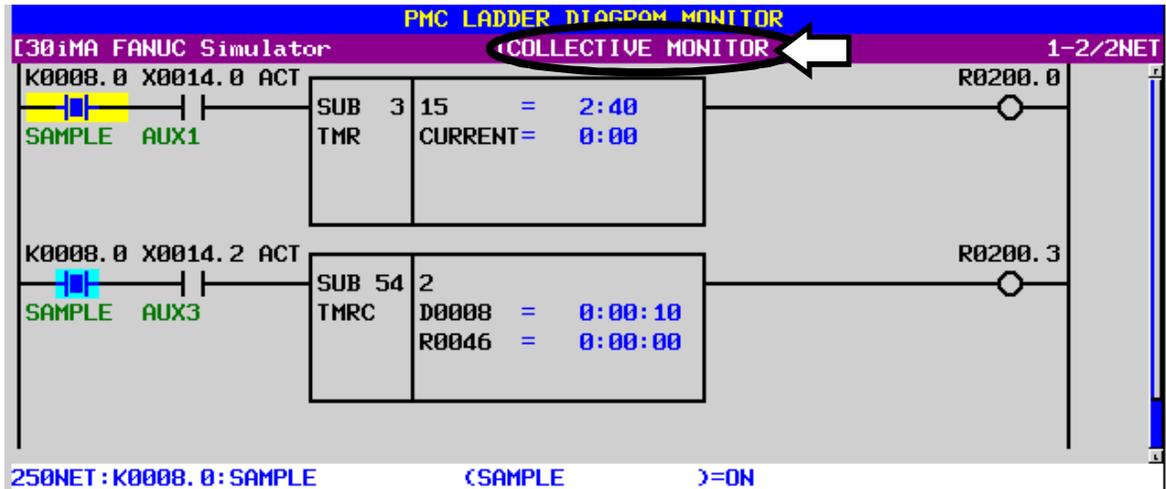
6) Press the  soft key, notice the looking glass appears on the left edge.



7) Press the **EXIT** soft key to change the soft key menu.



8) Press the **SWITCH** soft key to change to the **COLLECTIVE** display view.



9) Press the **SWITCH** soft key again to return to the **GLOBAL** display view.



10) Press the **SWITCH** soft key to change to the **COLLECTIVE** display view.



11) Move the cursor down to the line with the SUB 54 block. Press the **JUMP** soft key. Notice that this soft key takes you to that particular spot in the LADDERL view.



12) Press the **SWITCH** soft key to change to the **COLLECTIVE** display view.



13) Press the **DELETE** soft key. Notice that the rung that the cursor was on is no longer in the collective display.



14) Press the **DELETE ALL** soft key. Notice that the CNC asks you if you really want to do that (in its own way).



15) Press the **YES** soft key to remove all rungs on the collective display.

3.1.4. SCREEN SETTING Display

The SCREEN SETTING page allows you to change the appearance of the ladder display.



From the previous section, press the **EXIT** soft key to close the search menu.



- 1) From the LADDER display, press the **SCREEN SETTING** soft key on the CNC menu. The **DIAGRAM MONITOR (SETTING)** screen appears ...

PMC LADDER DIAGRAM MONITOR (SETTING)	
ADDRESS NOTATION	= SYMBOL / ADDRESS
FUNCTION STYLE	= COMPACT / WIDE / TALL
SHOW COMMENT OF CONTACT	= NONE / 1 LINE / 2 LINE
CONTACT WIDTH	= NORMAL / WIDE
SHOW COMMENT OF COIL	= YES / NO
SHOW CURSOR	= YES / NO
SUBPROGRAM NET NUMBER	= LOCAL / GLOBAL
WRAP SEARCH ENABLED	= YES / NO

- **ADDRESS NOTATION**

SYMBOL

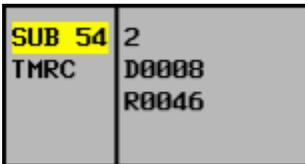


ADDRESS

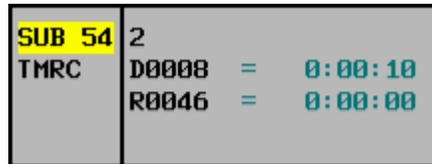


- **FUNCTION STYLE**

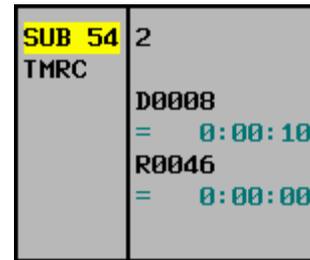
COMPACT



WIDE



TALL



- **CONTACT WIDTH**

NORMAL



WIDE



- **SHOW COMMENT OF COIL**

YES



NO



- **SHOW CURSOR**

YES



NO



- **SUBPROGRAM NET NUMBER**

This applies to when you are viewing a PMC subprogram.

When set to **LOCAL** the NET numbers do not refer to where the subprogram is in the global ladder but strictly to that subprogram alone – so the first net in the subprogram is number 1.

When set to **GLOBAL**, the NET numbers conform to the numbering of the global ladder – so unless the subprogram is at the very top of the ladder its NET numbering will not start at 1.

- **WRAP SEARCH ENABLED**



This setting affects how the  soft key works.

When set to **YES**, if you reach the bottom of the ladder while searching and press the  soft key again, then the system will go back to the top of the ladder and continue looking for the next result.

When set to **NO**, once you reach the result closest to the bottom of the ladder you will get the message **THE ADDRESS IS NOT FOUND** if you continue to press the  soft key.



Press the  and  soft keys to return to the Ladder list.

3.2. PMC MAINT Display

3.2.1. 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  button on the MDI key pad.

2) Press the  soft key on the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key on the CNC menu.

5) Enter **X14** on the MDI key pad.

6) Press the  soft key on the CNC 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 **X14 bit 0** is wired to the **AUX1** button.

7) Activate the **AUX1** button on the operator panel, and see the bit change.

PMC SIGNAL STATUS									
ADDRESS	7	6	5	4	3	2	1	0	HEX
	AUX8	AUX7	AUX6	AUX5	AUX4	AUX3	AUX2	AUX1	
X0014	0	0	0	0	0	0	0	0	00

8) Enter **Y14** on the MDI key pad.

9) Press the  soft key on the CNC menu.

10) Press the  button on the MDI key pad to **highlight bit 0**.

PMC SIGNAL STATUS									
ADDRESS	7	6	5	4	3	2	1	0	HEX
Y0014	AUX8'	AUX7'	AUX6'	AUX5'	AUX4'	AUX3'	AUX2'	AUX1'	00
	0	0	0	0	0	0	0	0	

11) Press the  soft key on the CNC menu. (The soft key does not exist unless RAM

WRITE ENABLE or PROGRAMMER ENABLE is set to YES under  and 

12) Press the  soft key on the CNC menu.

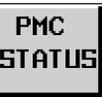
Notice the LED on the operator panel flashes ON/OFF each time it's pressed, or may appear to have done nothing at all.

The **FORCE** function can force any output address, but it will only stay forced when the PMC is **STOPPED**.

13) Press the  soft key to exit the FORCE menu.

14) Press the  soft key **2 times** to change the soft key menu.

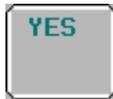
15) Press the  soft key on the CNC menu.

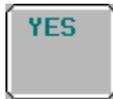
16) Press the  soft key on the CNC menu.

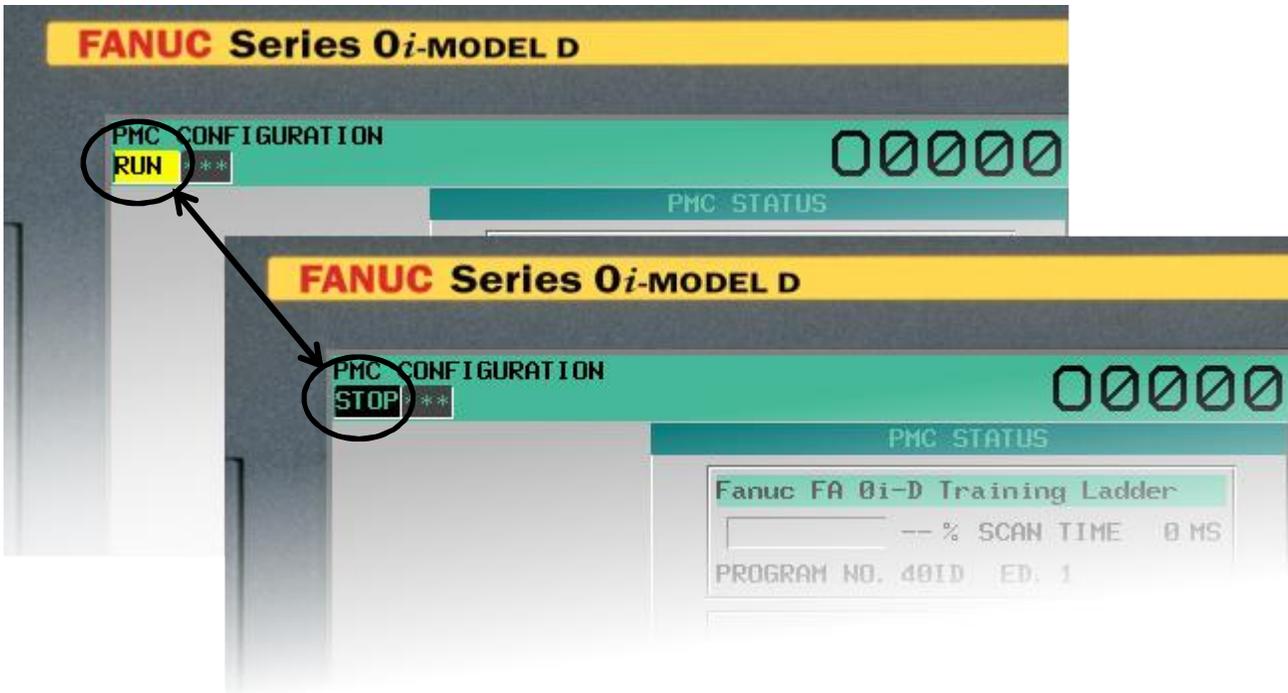
17) Press the  soft key on the CNC menu.

18) Press the  soft key, to stop the ladder execution.

The message 'DO YOU WANT TO STOP (ALL PMC) PROGRAM(S)?' appears...



19) Press the  soft key on the CNC menu.



20) Press the  soft key 2 times to change the soft key menu.



21) Press the  soft key on the CNC menu.



22) Press the  soft key on the CNC menu.



23) Press the  soft key on the CNC menu.



24) Press the  soft key on the CNC menu.



25) Press the  soft key on the CNC menu.
Notice the AUX1 led turns ON...and stays on.



26) Press the **OFF** soft key on the CNC menu.
Notice the AUX1 led turns OFF...



27) Press the **ON** soft key on the CNC menu again.



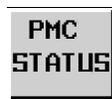
28) Press the **EXIT** soft key on the CNC menu.



29) Press the **Left Arrow** soft key 2 times to change the soft key menu.



30) Press the **PMC CONFIG** soft key to change the soft key menu.



31) Press the **PMC STATUS** soft key on the CNC menu.



32) Press the **(OPRT)** soft key on the CNC menu.



33) Press the **RUN** soft key to start the ladder execution again.
The message **DO YOU WANT TO RUN (ALL PMC) PROGRAM(S)?** appears...



34) Press the **YES** soft key to change the soft key menu.

Notice the AUX1 led turns OFF when the ladder takes control.
If the ladder coil you force does not exist within the ladder logic the coil will force on and off even with the ladder in RUN mode.

3.2.2. I/O LINK Display

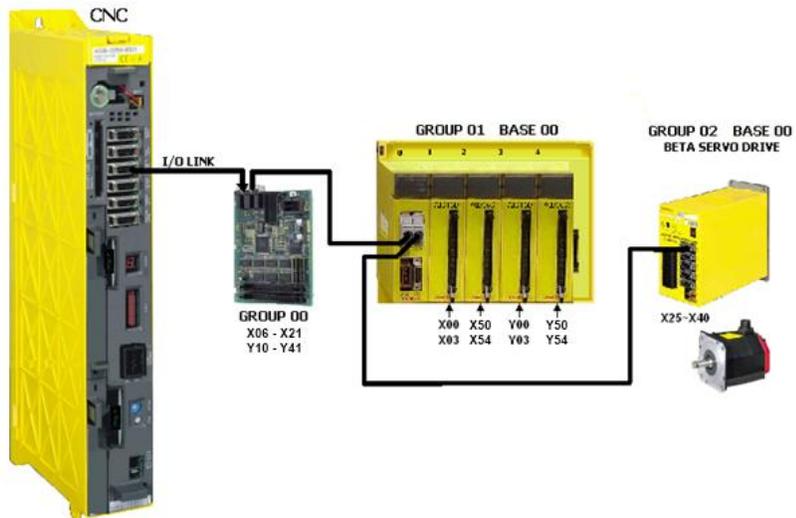
All of the Input/Output devices for the machine are connected through the I/O link. The link is a serial connection (electrical cable) that starts at CNC connector JD51A and then daisy chains from device to device. There are a maximum number of devices (16) that can be daisy chained together on the I/O link but this amount can be multiplied by using multiple I/O link chains – called channels.

The 3xi series can operate up to four I/O link channels and the 0i-D can operate two.

Each I/O device on the link has an address which is set by the order in which it is connected to the cable.

Starting from the CNC, the first device is Group 0, the next is Group 1, etc. up to Group 15.

The address of the device can be further refined as we will discuss later in the course.



The I/O LINK soft key brings up a display that list all the I/O devices connected to the CNC.

TRY THIS



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

PMC MAINTENANCE			00000 N00000		
RUN ***1ST PMC					
PMC I/O LINK MONITOR					
			CHANNEL 1		
GROUP	ID	I/O UNIT TYPE	GROUP	ID	I/O UNIT TYPE
00	A8	MACHINE OPERATOR PANEL B	15		
01					
02					
03					
04					

3.2.3. PMC ALARM Display

The alarm display indicates faults that occur during ladder processing. In most cases you will never see an alarm on this screen. If the PMC's configuration is incorrect, or the I/O link should fail, a message may appear here.

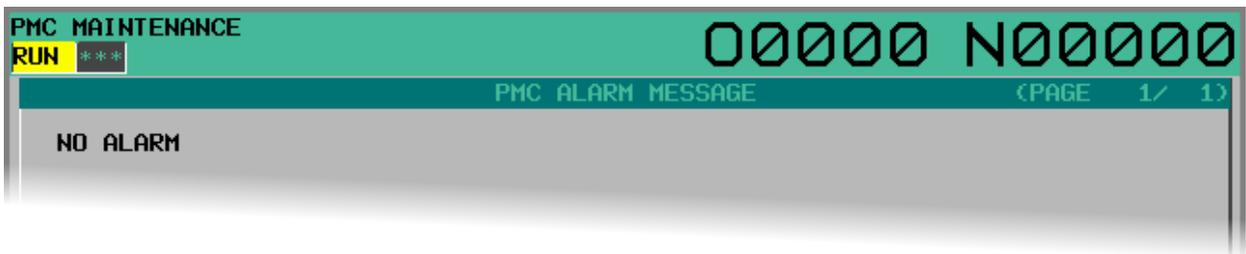


1) Press the  button on the MDI key pad.

2) Press the  soft key on the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key on the CNC menu.
The PMC ALARM screen appears...



If all is good on the PMC side of the control, the message **NO ALARM** 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.



3.2.4. I/O Display



The  screen is used for saving and loading PMC data. This data includes the PMC parameters, PMC ladders, message (alarm) data, and trace settings.

3.2.4.1. PMC Ladder Backup

The PMC ladder is stored in FROM memory. The FROM memory typically does not get lost, however it is a good idea to have a backup of the ladder program. Follow this procedure...



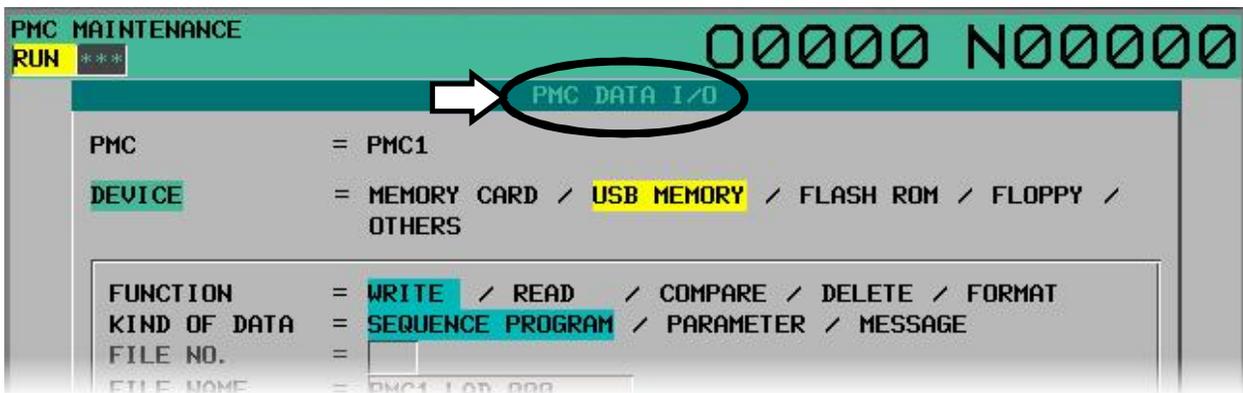
1) Select  mode on the operator panel.

2) Press the  button 2 times on the MDI key panel.

3) Press the  soft key.

4) Press the  soft key on the CNC menu.

5) Press the  soft key on the CNC menu.
The PMC DATA I/O screen appears...



Using the keys:

6) Select DEVICE = USB MEMORY (or MEMORY CARD).

7) Select FUNCTION = WRITE.

8) Select **KIND OF DATA = SEQUENCE PROGRAM.**



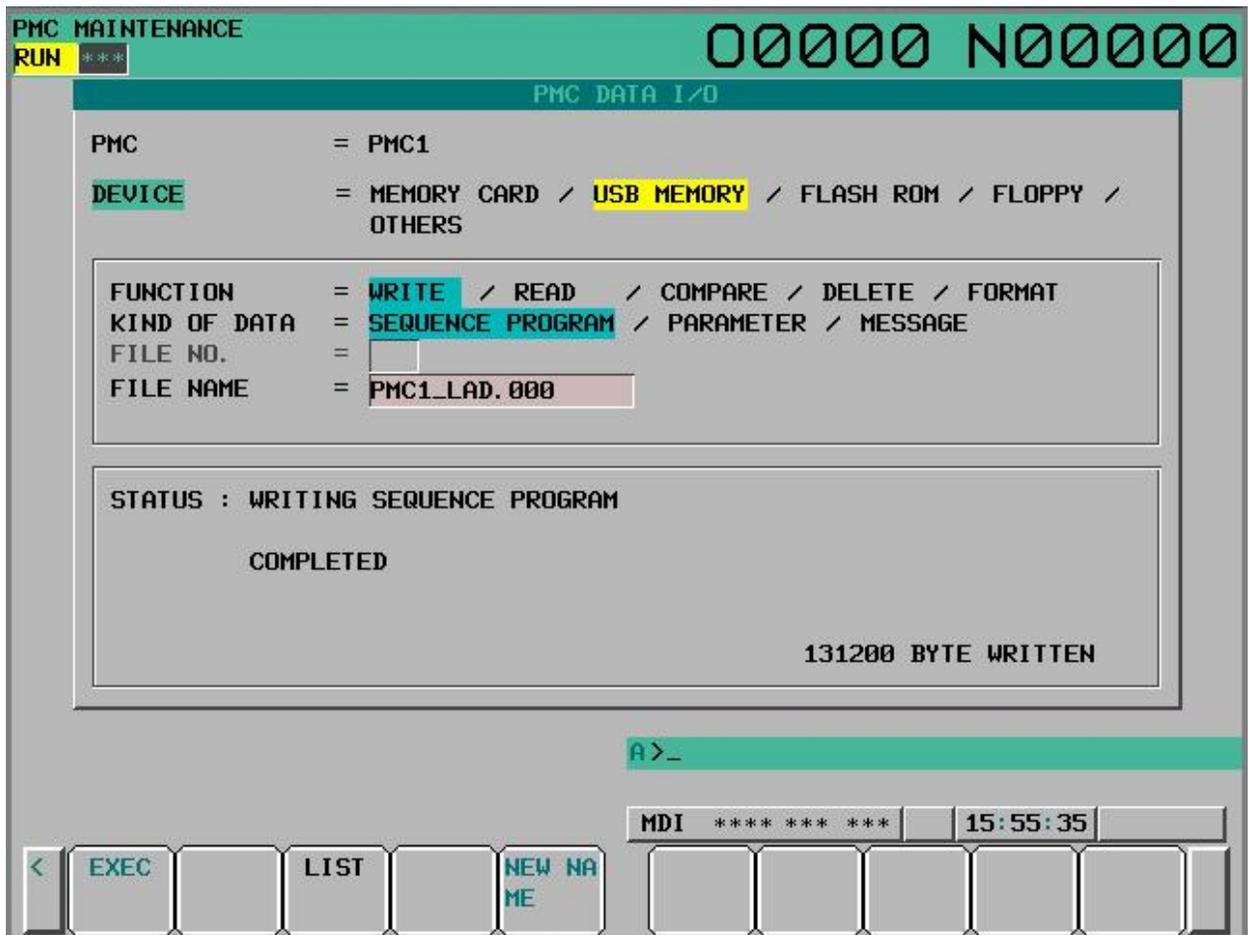
9) Press the **COPRT** soft key on the CNC menu.



10) Press the **NEW NAME** soft key on the CNC menu.
The CNC will automatically file in the FILE NAME field.



11) Press the **EXEC** soft key on the CNC menu.



The PMC will begin outputting the ladder program to the memory device. At the bottom of the screen the byte count increments as the data is sent out and **EXECUTING** appears. When the ladder has been saved the status message on the screen says **COMPLETED.**

3.2.4.2. PMC Parameter Backup

The PMC has its own parameter settings; unlike the ladder, these are stored in SRAM. SRAM is kept alive by a battery mounted on the control, if the battery dies then the PMC parameters will be lost. The battery should be replaced annually. The parameters are defined by the machine builder, so it is a good idea to have a backup of them.

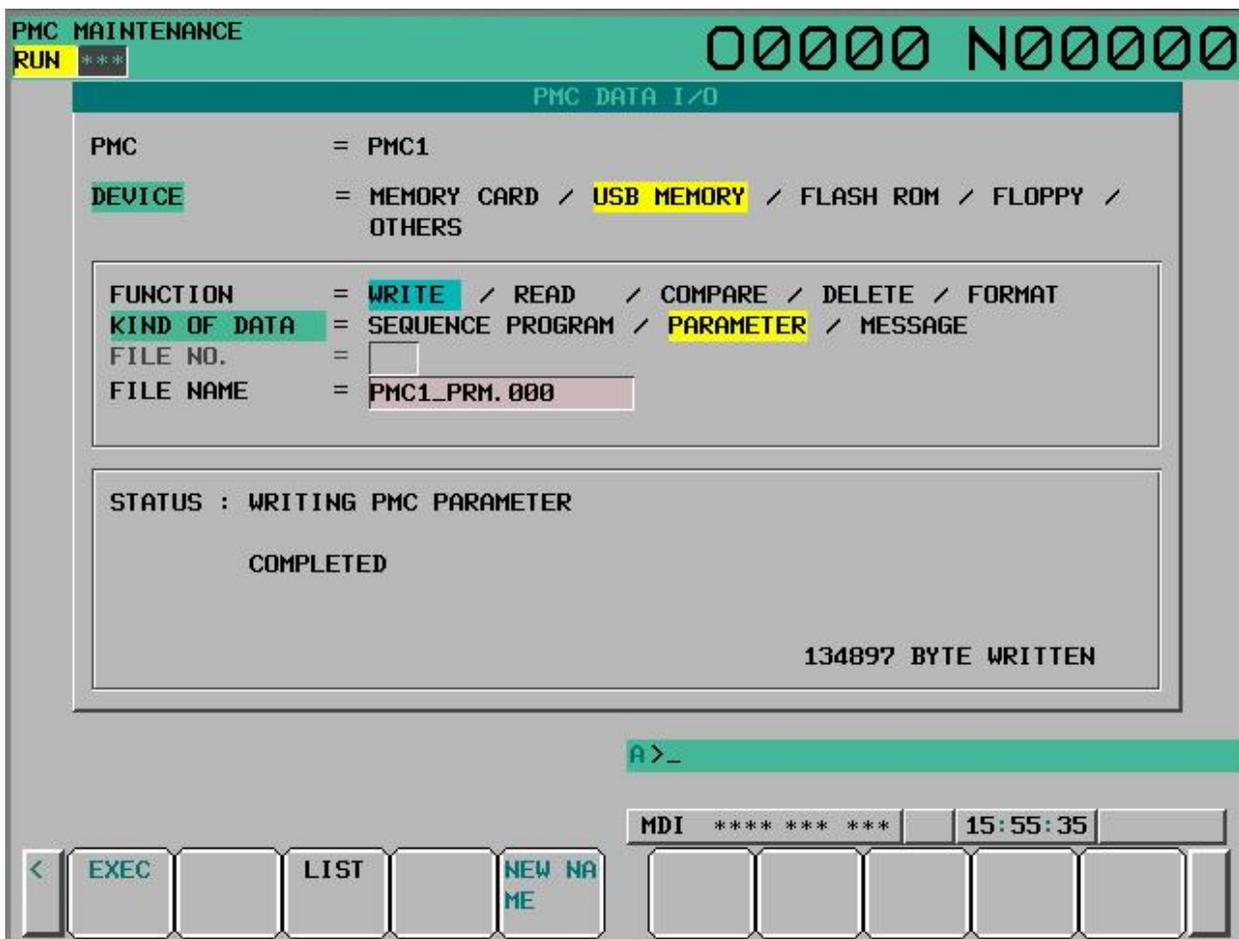
12) Select **KIND OF DATA = PARAMETER.**



13) Press the **NEW NAME** soft key on the CNC menu.
The CNC will automatically change the FILE NAME field.



14) Press the **EXEC** soft key on the CNC menu.



At the bottom of the screen the byte count increments as the data is sent out and **EXECUTING** appears. When all parameters have been output the status message on the screen says **COMPLETED.**

3.2.4.3. Exercise 1 – PMC Data 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) After downloading the ladder to your laptop, how can you confirm the file is correct?

- 5) How often should you make a backup of the LADDER?

- 6) How often should you make a backup of the PMC PARAMETERS?

3.2.5. PMC Parameter Display

The PMC parameters provide the PMC with data values. Their purpose is determined by the machine builder at the time the ladder is written. 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.

3.2.5.1. TIMER Setting Display

The timers are used to delay a coil output. **The timer function blocks labeled SUB3** can be adjusted on this page. Contact the machine builder to determine the timer’s purpose.



1) Press the **SYSTEM** button on the MDI panel.



2) Press the **play** soft key to change the CNC menu.

3) Press the **play** soft key on the CNC menu.



4) Press the **play** soft key to change the CNC menu.



5) Press the **TIMER** soft key on CNC menu.

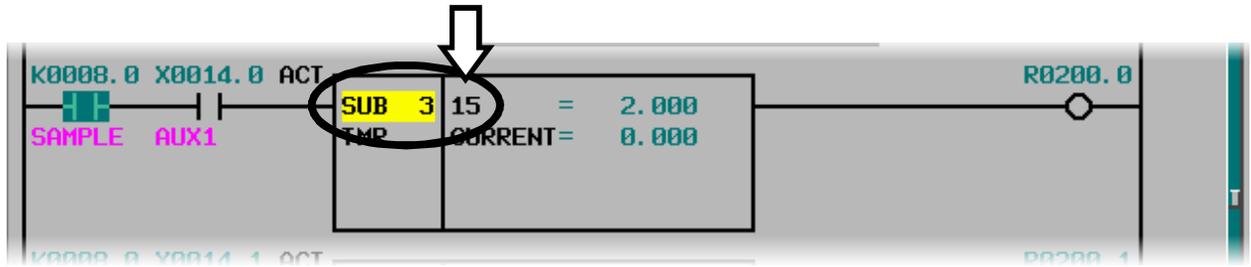
The **TIMER** setting screen appears...

There are 4 columns on this screen, **NO.**, **ADDRESS**, **PRESET**, and **ACC.**

PMC MAINTENANCE				00000 N00000			
PMC PARAM (TIMER)				PAGE 1 / 9			
NO.	ADDRESS	PRESET	ACC	NO.	ADDRESS	PRESET	ACC
1	T0000	2496	48	15	T0028	2000	1
2	T0002	0	48	16	T0030	0	8
3	T0004	96	48	17	T0032	8	8
4	T0006	0	48	18	T0034	0	8
5	T0008	0	48	19	T0036	0	8
6	T0010	0	48	20	T0038	0	8
7	T0012	0	48	21	T0040	0	8

The **NO.** column refers to the number in the **SUB3** function block.

TIMER number 15 is associated with address **T28** on the PMC diagnostic screen.



6) Press the  button on the MDI key pad, to select timer No. 15.

7) Press the  soft key.

8) Press the  soft key then press  again.

This button allows you to see any comments that the ladder programmer may have entered to describe the timer purpose

9) Press the  soft key on CNC menu.
 This allows you to set the update interval of each individual timer.
 (Note: to see the ACCRCY soft key on the 0iD control, PWE=1 and MDI mode must be selected.)

The accuracy changes the increment that the timer actually counts time by.

10) Enter 4000 then press  (4000=4.000sec).

11) Press the  left menu 3 times to return to the original menu.

12) Press the  soft key on the CNC menu.



13) Press the **LADDER** soft key on the CNC menu to view the ladder selection.



14) Press the **(OPRT)** soft key on the CNC menu.

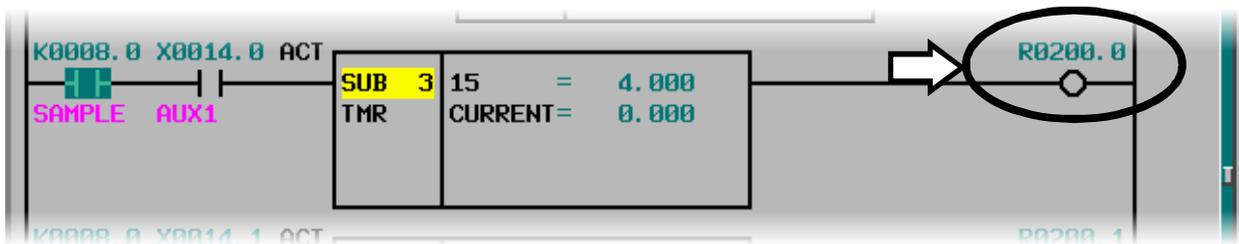


15) Press the **SEARCH MENU** soft key on the CNC menu.



16) Enter **3** then press the **SEARCH MENU** soft key.

This is a timer FUNCTION BLOCK. When the input is activated, the timer counts. When the preset value is reached, the coil R200.0 turns ON.



17) Hold the **AUX1 X14.0** button and watch the timer run.



18) Press the **EXIT** soft key to change the soft key menu.

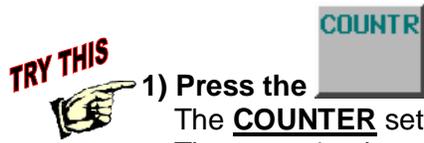


19) Press the **Left Arrow** soft key 2 times to return to the original menu.

20) Press the **SEARCH MENU** soft key on the CNC menu.

3.2.5.2. 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 **COUNTR** soft key on CNC menu.
The **COUNTER** setting screen appears.

There are 4 columns on this screen, **NO.**, **ADDRESS**, **PRESET** and **CURRENT**

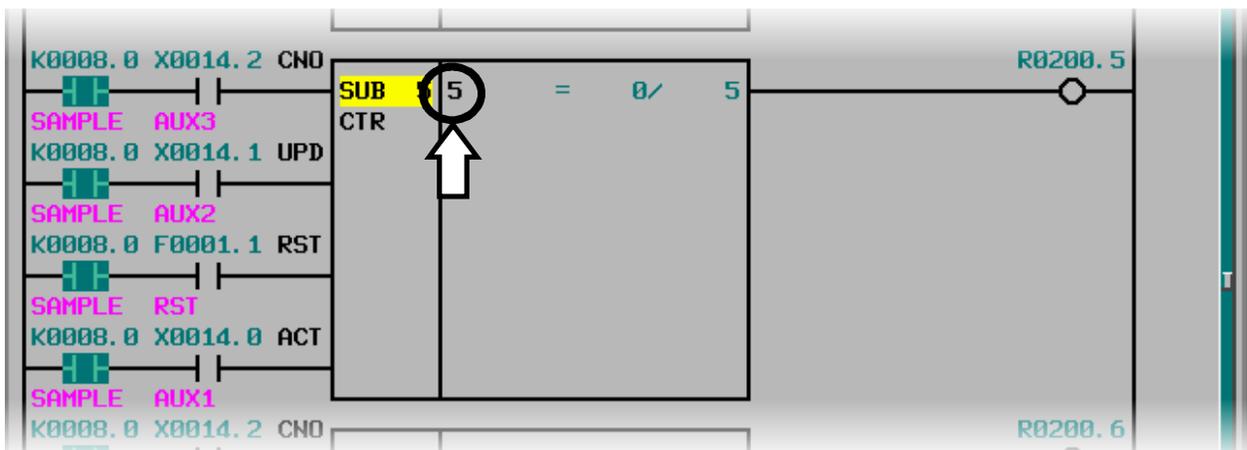
PMC MAINTENANCE				00000 N00000			
PMC PARAM (COUNTER)				BINARY (PAGE 1/4)			
NO.	ADDRESS	PRESET	CURRENT	NO.	ADDRESS	PRESET	CURRENT
1	C0000	0	0	15	C0056	0	0
2	C0004	0	0	16	C0060	0	0
3	C0008	0	0	17	C0064	0	0
4	C0012	0	0	18	C0068	0	0
5	C0016	10	0	19	C0072	0	0
6	C0020	0	0	20	C0076	0	0
7	C0024	0	0	21	C0080	0	0
8	C0028	0	0	22	C0084	0	0

COUNTER number 5 is associated with PMC diagnostic address C0016.

- 2) Press the button on the MDI key pad, to select **counter No. 5**.

- 3) Enter then press .

- 4) Return to the ladder display and watch the counter count.

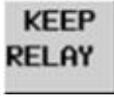


The **ACT** input (**X14.0**) is the action that will be counted. When the **current** count reaches the **preset** value (5), the output coil (**R200.5**) becomes active.

3.2.5.3. KEEP RELAY Setting Display

The KEEP RELAYS are used to enable/disable machine side functions 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.

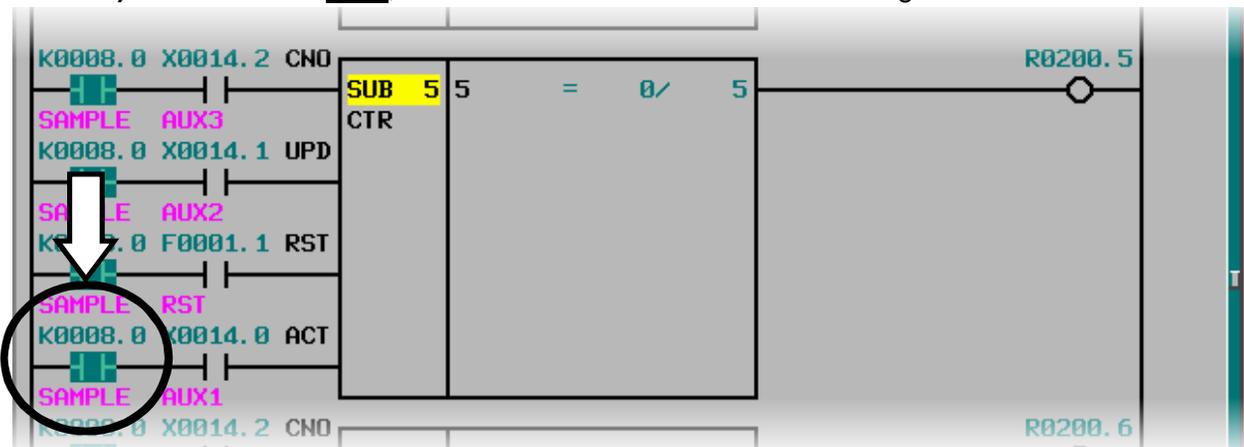


- 1) Press the  soft key on the CNC menu. The KEEP RELAY setting screen appears.

ADDRESS	7	6	5	4	3	2	1	0	HEX	ADDRESS	7	6	5	4	3	2	1	0	HEX
K0000	0	0	0	0	0	0	0	0	00	K0014	0	0	0	0	0	0	0	0	00
K0001	0	0	0	0	0	0	0	0	00	K0015	0	0	0	0	0	0	0	0	00
K0002	0	0	0	0	0	0	0	0	00	K0016	0	0	0	0	0	0	0	0	00
K0003	0	0	0	0	0	0	0	0	00	K0017	0	0	0	0	0	0	0	0	00
K0004	0	0	0	0	0	0	0	0	00	K0018	0	0	0	0	0	0	0	0	00
K0005	0	0	0	0	0	0	0	0	00	K0019	0	0	0	0	0	0	0	0	00
K0006	0	0	0	0	0	0	0	0	00	K0020	0	0	0	0	0	0	0	0	00
K0007	0	0	0	0	0	0	0	0	00	K0021	0	0	0	0	0	0	0	0	00
K0008	0	0	0	0	0	0	0	1	01	K0022	0	0	0	0	0	0	0	0	00
K0009	0	0	0	0	0	0	0	0	00	K0023	0	0	0	0	0	0	0	0	00
K0010	0	0	0	0	0	0	0	0	00	K0024	0	0	0	0	0	0	0	0	00
K0011	0	0	0	0	0	0	0	0	00	K0025	0	0	0	0	0	0	0	0	00
K0012	0	0	0	0	0	0	0	0	00	K0026	0	0	0	0	0	0	0	0	00

Keep relays K00 through K299 (depending on PMC memory type) are user defined, and may be used by the machine builder for any purpose they choose. It is possible to have ladder coils with K addresses, or they may be manually controlled on this parameter screen.

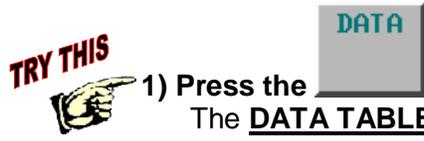
- 2) Turn OFF/ON K8.0, and see the status of the contact change in the ladder.



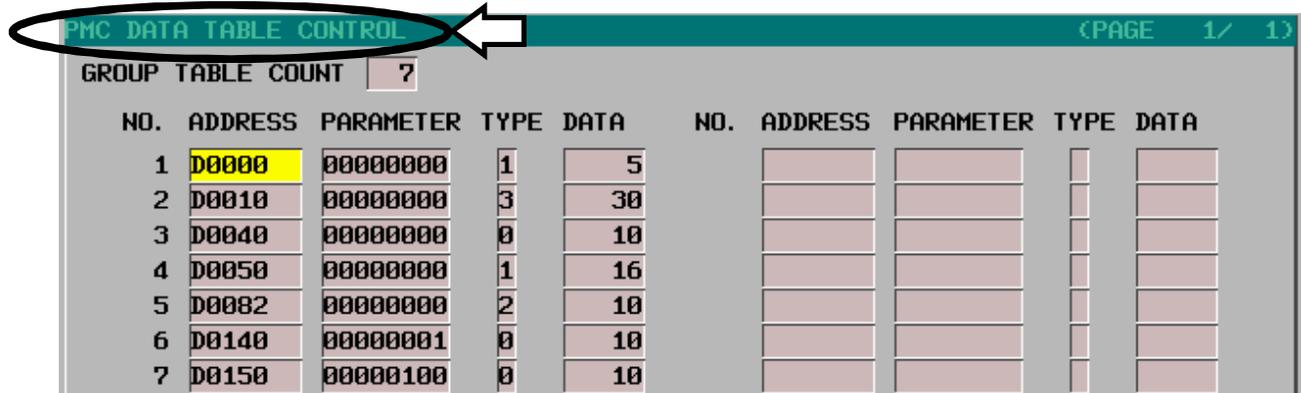
K900 through K999 are system relays used to control the PMC screens.

3.2.5.4. DATA Table Display

The data table store data values to be used by the ladder logic. The values 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 **DATA** soft key on the CNC menu.
The **DATA TABLE CONTROL** screen appears...



- 2) Press the **↓** button on the MDI key pad, to select the GROUP.

- 3) Press the **(OPRT)** soft key on the CNC menu.

- 4) Press the **ZOOM** soft key on the CNC menu.



- 5) Press the **PAGE ↓** button on the MDI key pad, to view the other GROUPS.

- 6) Press the **LIST** soft key on the CNC menu, to return to the CONTROL table.

The DATA registers are separated into GROUPS. At the top of the screen shows there are 7 groups in this PMC. Group1 starts at address D0000.

NO.	ADDRESS	PARAMETER	TYPE	DATA	NO.	ADDRESS	PARAMETER	TYPE	DATA
1	D0000	00000000	1	5					
2	D0010	00000000	3	30					
3	D0040	00000000	0	10					
4	D0050	00000000	1	16					
5	D0082	00000000	2	10					
6	D0140	00000001	0	10					
7	D0150	00000100	0	10					

GROUP1

ADDRESS D0000 is the start address of the GROUP.

TYPE is set to 1 (16bits), so each register takes up 2 addresses.

DATA is set to 5 (5 registers), so from address D0000~D0009 are used.

GROUP2

ADDRESS D0010 is the start address of the GROUP.

TYPE is set to 3 (8bits), so each register takes up 1 address.

DATA is set to 30 (30 registers), so from address D0010~D0039 are used.

ADDRESS – Sets the D start address for the GROUP.

PARAMETER – Determines how the data is displayed, and if it is protected.

Bit 0 – 0=Data is BINARY, 1=Data is BCD

Bit 1 – 0=Data is not protected, 1=Data is protected

Bit 2 – 0=Data is BCD, 1=Data is HEX

Bit 3 – 0=Data has a sign, 1=Data is unsigned

TYPE – Determines how many bytes are used for each register.

0 = 1 byte (unsigned -0~255, signed -128~+128)

1 = 2 bytes (unsigned - 0~65536, signed -32767~+32767)

2 = 4 bytes (unsigned 0~4,294,967,295, signed +/-2,147,483,647)

3 = 8 bits

DATA – Number of data registers assigned to the GROUP.

3.2.6. TRACE Display

The trace display allows you to monitor changes in status of any PMC address. Up to 32 different addresses may be monitored at the same time.



1) Press the  button on the MDI key pad.

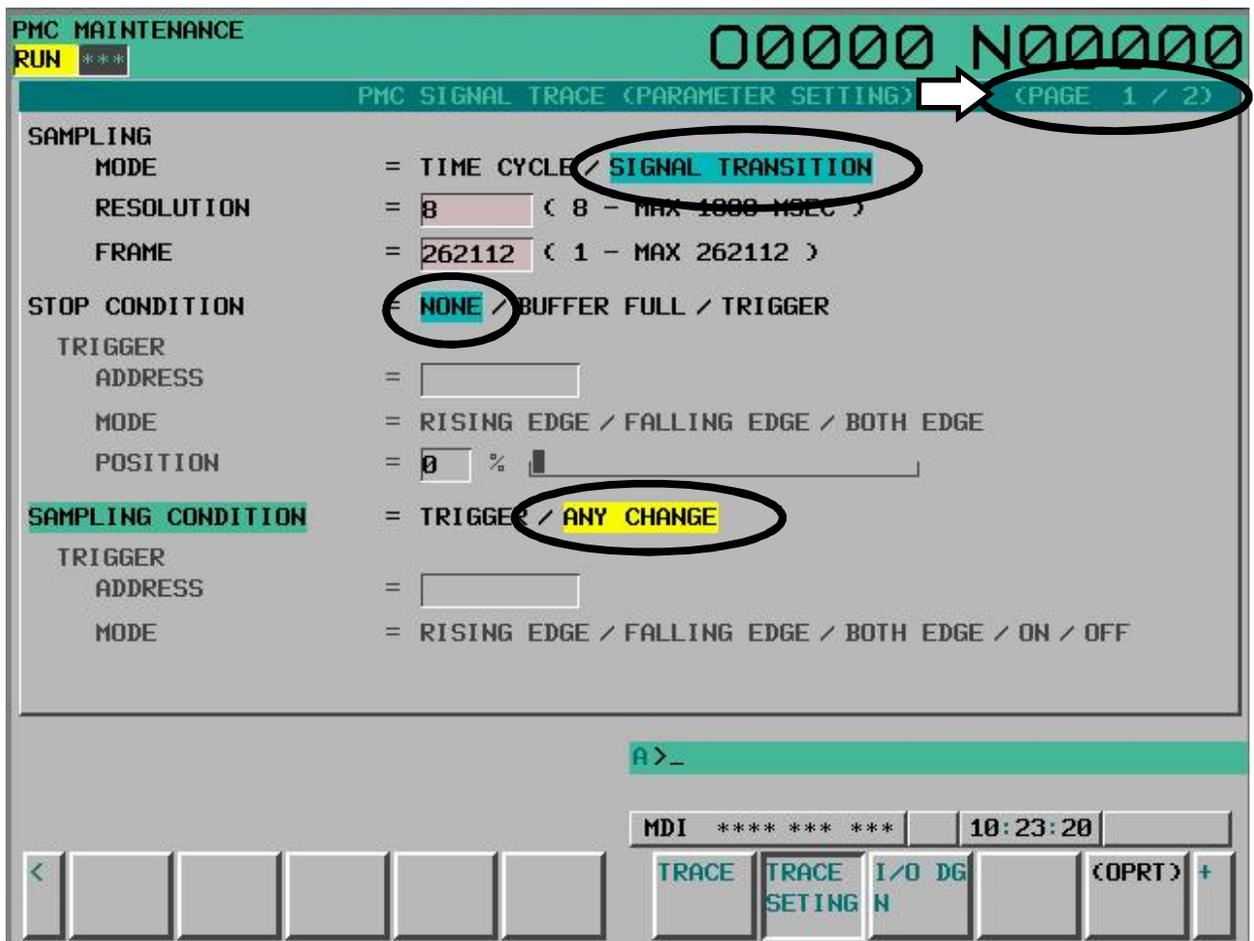
2) Press the  soft key on the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key on the CNC menu.

5) Press the  soft key on the CNC menu.

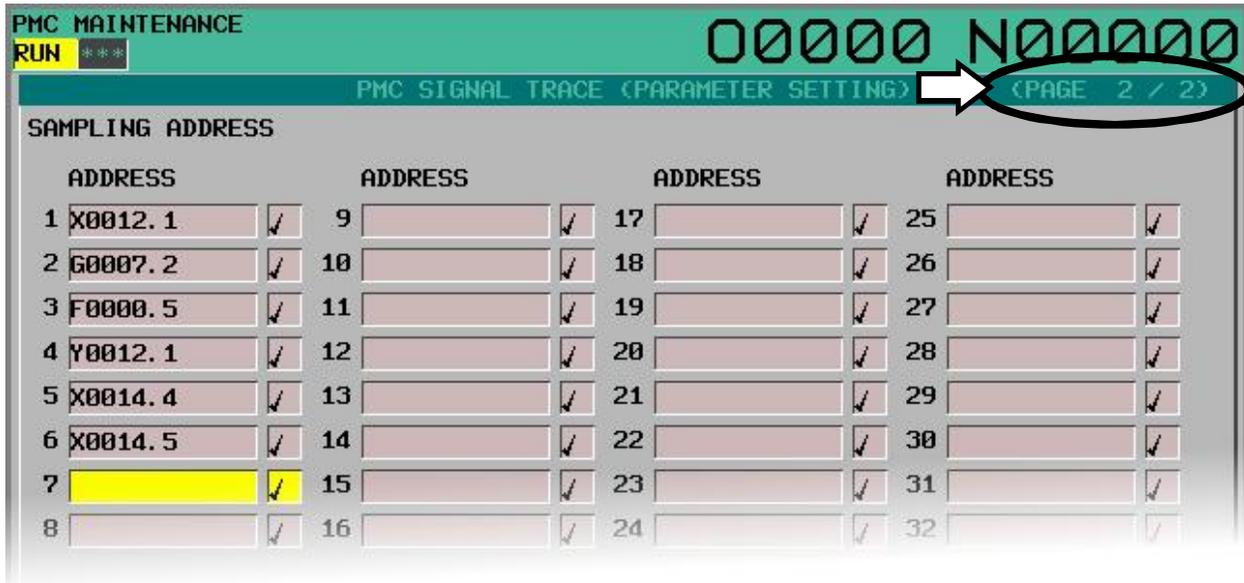
Set the screen up as follows:





6) Press the  button on the MDI key pad.
The **SAMPLING ADDRESS** screen appears ...

Set the screen up as follows:



7) Enter the address  X  1  2   1 then press .

Notice that the screen displays:

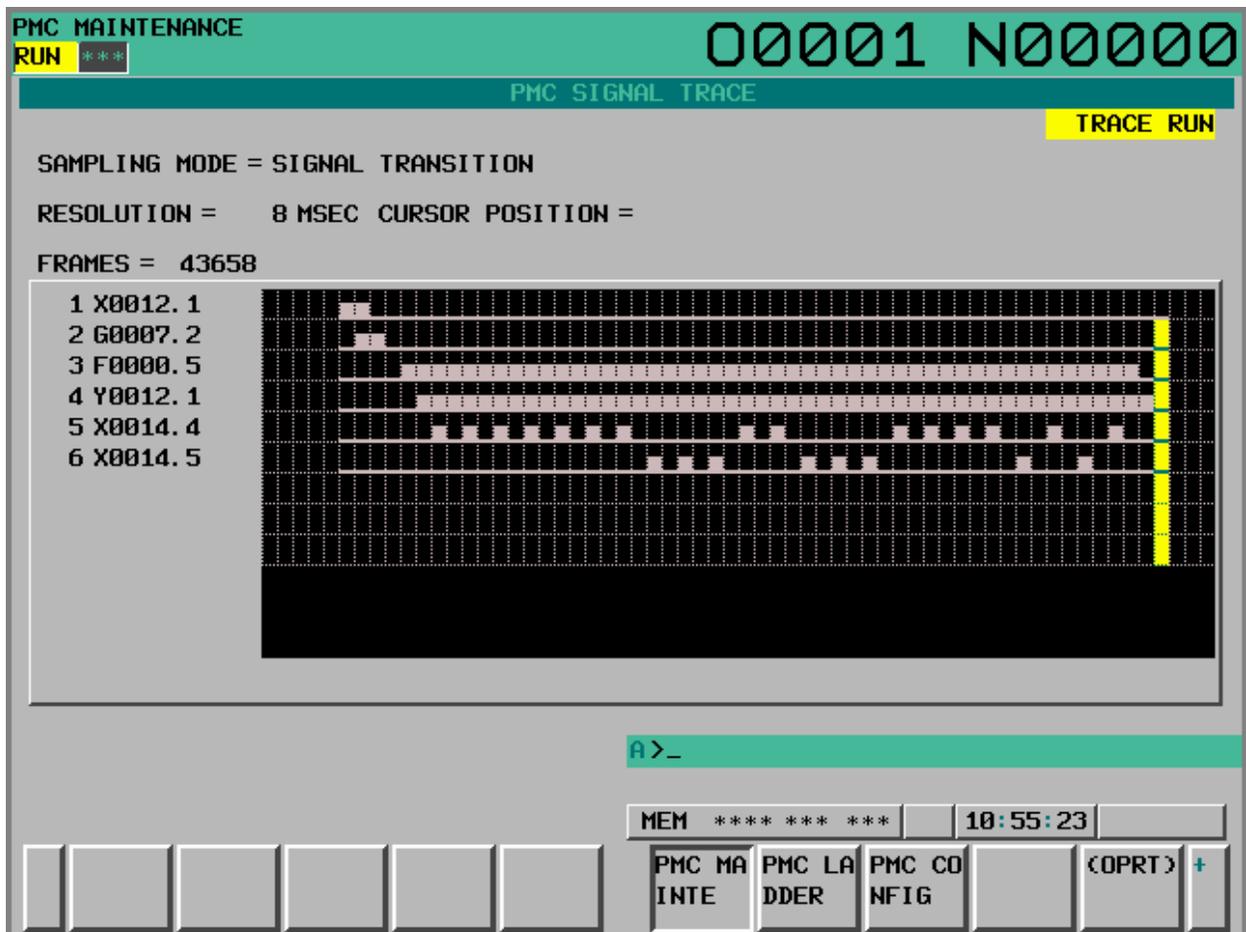


8) Press the  soft key on the CNC menu to display addresses. (It changes to )

9) Also enter the addresses G7.2, F0.5, Y12.1, X14.4, X14.5.

10) Press the  soft key to return to the previous menu.

- 11) Press the  soft key on the CNC menu.
- 12) Press the  soft key on the CNC menu.
- 13) Press the  soft key on the CNC menu. The TRACE begins.
- 14) Press the  button on the operator panel to put the CNC into memory mode.
- 15) Press the  button on the operator panel.
- 16) Press the  button a few times on the operator panel
- 17) Press the  button a few times on the operator panel



The screen is only updated when a watched signal turns either on or off – the state of all watched signals is shown at that time.



18) Press the **STOP** soft key to stop tracing the signals.



19) Press the **TRACE SETTING** soft key on the CNC menu.



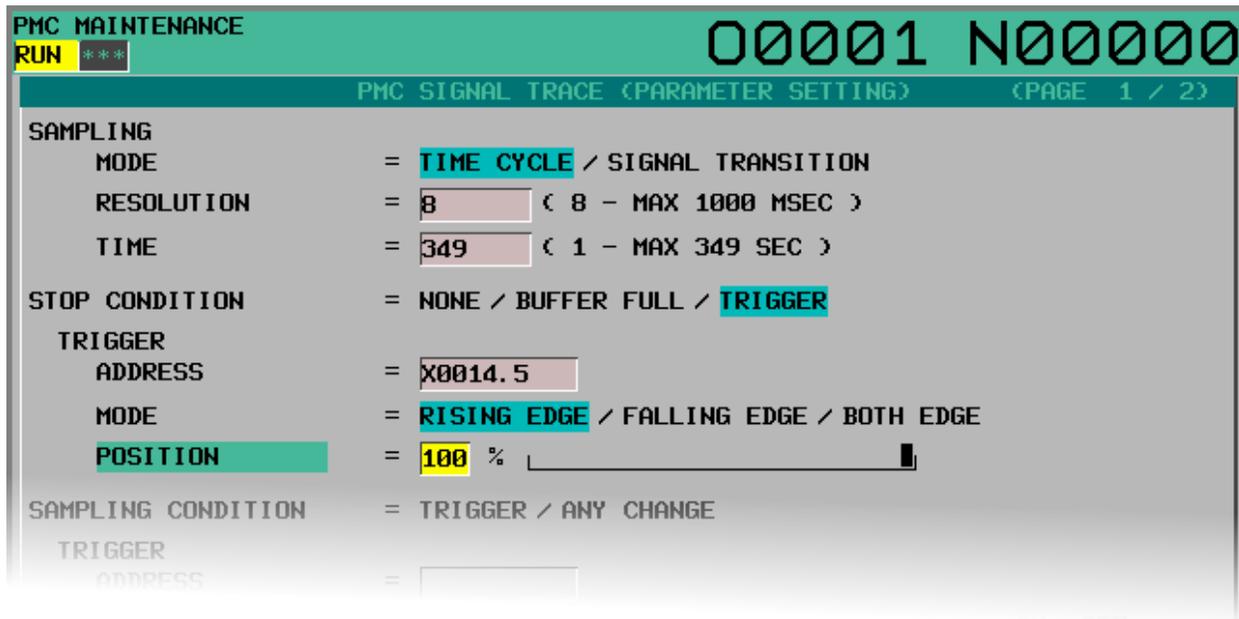
20) Press the **PAGE** button on the MDI key pad.
The **PARAMETER SETTING** page 1/2 appears ...

21) Change the **MODE** to **TIME CYCLE**

22) Change the **STOP CONDITION** to **TRIGGER**

23) Change the **ADDRESS** to **X14.5** (AUX6)

24) Change the **POSITION** to **100%**



25) Press the **TRACE** soft key on the CNC menu.



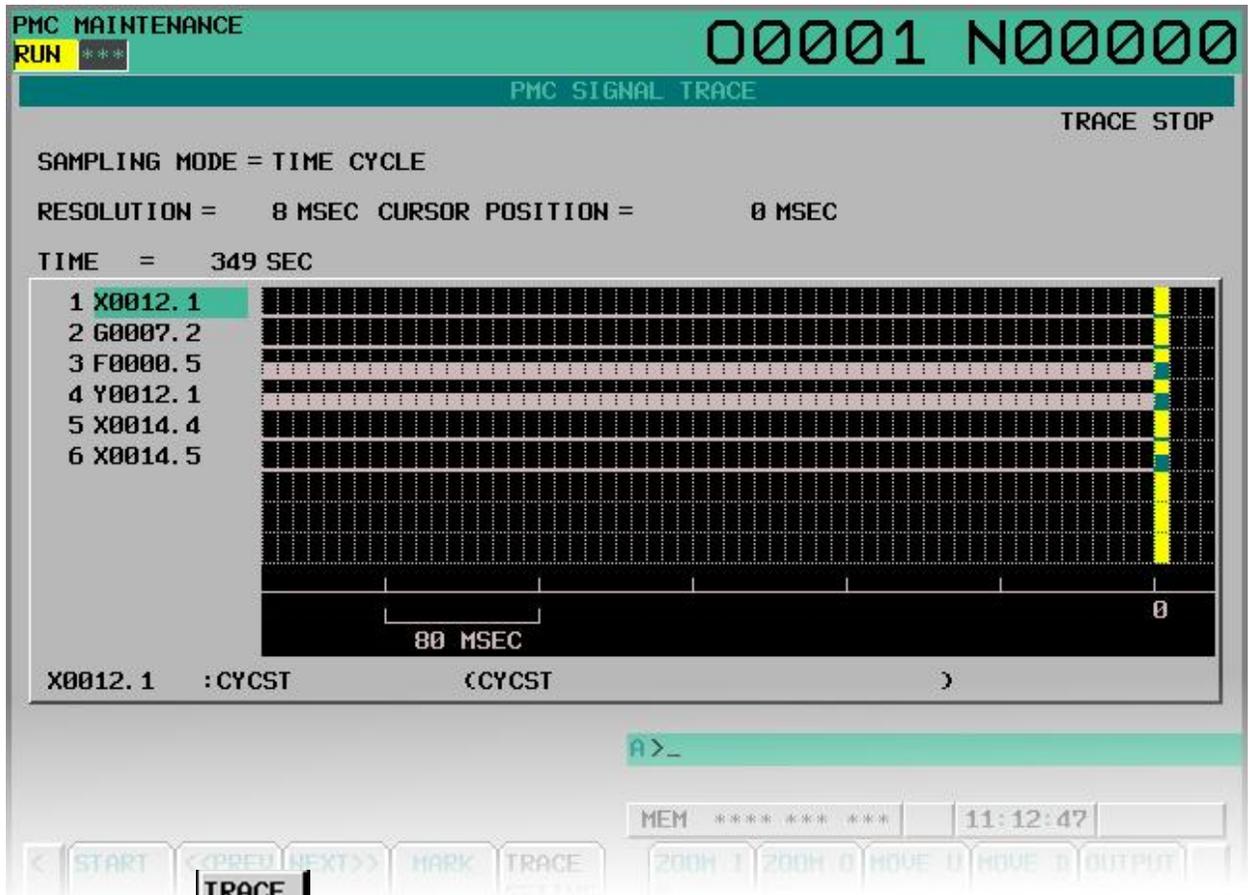
27) Press the **START** soft key on the CNC menu. The TRACE begins.



29) Press the **CYCLE START** button on the operator panel.

30) Press the  button a few times on the operator panel.

31) Press the  button to stop the trace.
Notice the cursor is at the stop condition.



32) Press the  soft key on the CNC menu.
The TRACE PARAMETER setting screen appears.

33) Change the POSITION to 98%

34) Press the  soft key on the CNC menu.

35) Press the  soft key on the CNC menu. The TRACE begins.

36) Press the  button on the operator panel.

37) Press the  button a few times on the operator panel



38) Press the **AUX6 X14.5** button to stop the trace.



39) Press the **AUX5 X14.4** button a few times on the operator panel
 Notice the trace continues for 2% of the TIME value after the stop condition (2% of 349 = ~7 sec.)



40) Press the **ZOOM OUT** soft key several times to view the entire trace.



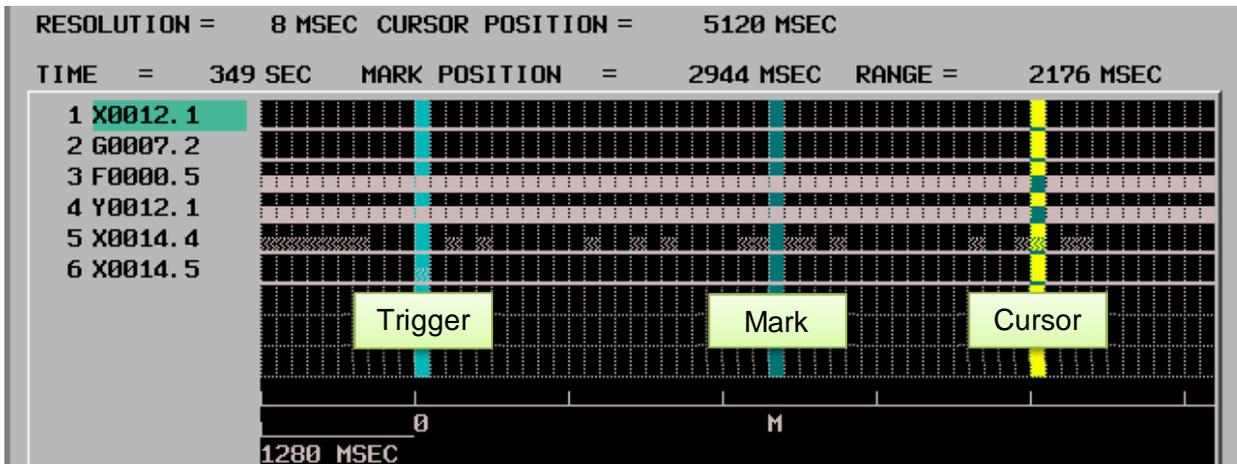
41) Move the yellow cursor with the **←** and **→** buttons on the MDI keypad.
 For 3xi: Notice the dark green line left at where the trace stop trigger occurred.
 For 0i-D: Notice the light green line left at where the trace stop trigger occurred.



42) Move the cursor to the right of the trigger line. Press the **MARK** soft key.



43) Press the **→** button on the MDI key pad a few times.
 For 3xi: Notice the blue line left at where the mark was left.
 For 0i-D: Notice the semi-dark green line left at where the mark was left.



Only 1 MARK can be left on the signal trace.
 CURSOR POSITION is distance from cursor to trigger point.
 MARK POSITION is distance from trigger point to the mark.
 RANGE is distance from the mark to the cursor.

ZOOM IN / **ZOOM OUT** performs at the cursor position.

3.3. PMC CONFIG Display

3.3.1. Title Display

The title screen displays information about the ladder file.

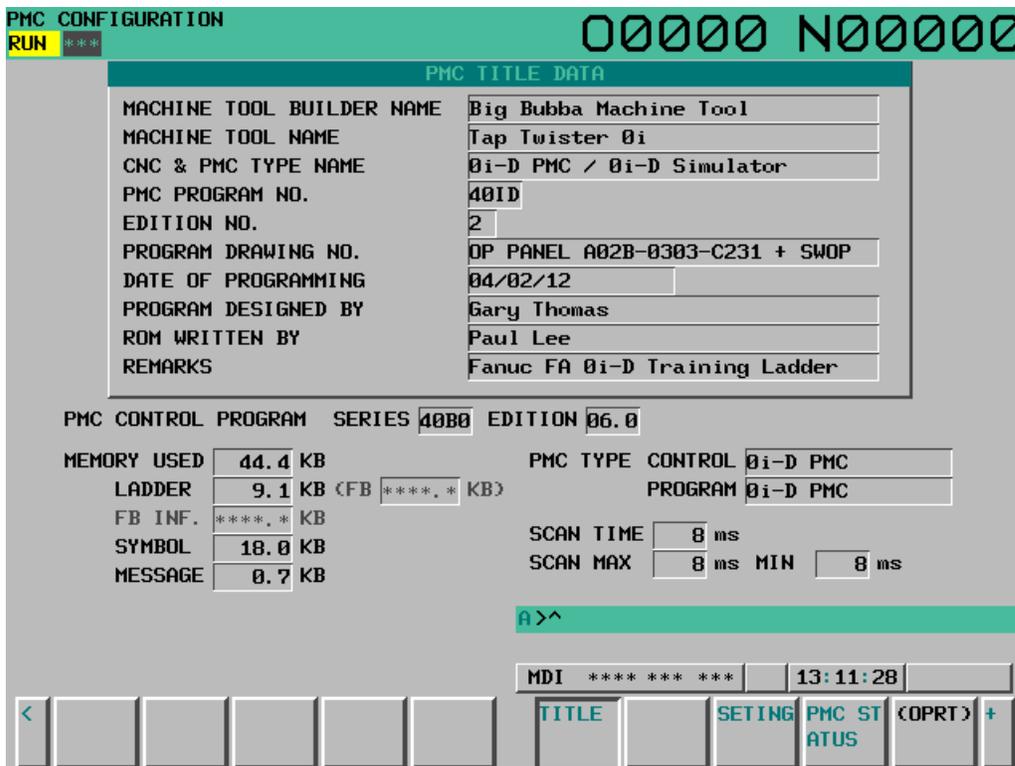


1) Press the  button on the MDI panel.

2) Press the  soft key to change the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key.



The top half of the screen is information that is entered in by the person creating the ladder program (such as the MTB's ladder version). The bottom half of the screen is filled in automatically by the CNC system.



The top portion can be edited by pressing the  and  soft keys.

3.3.2. Configuration Parameters (3xi Only)

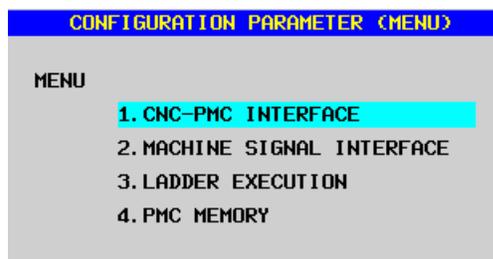
The configuration parameters allow you to modify how the multiple PMCs operate – both on an individual basis and with the other PMCs.

TRY THIS



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key to change the CNC menu.
- 3) Press the  soft key on the CNC menu.
- 4) Press the  soft key.

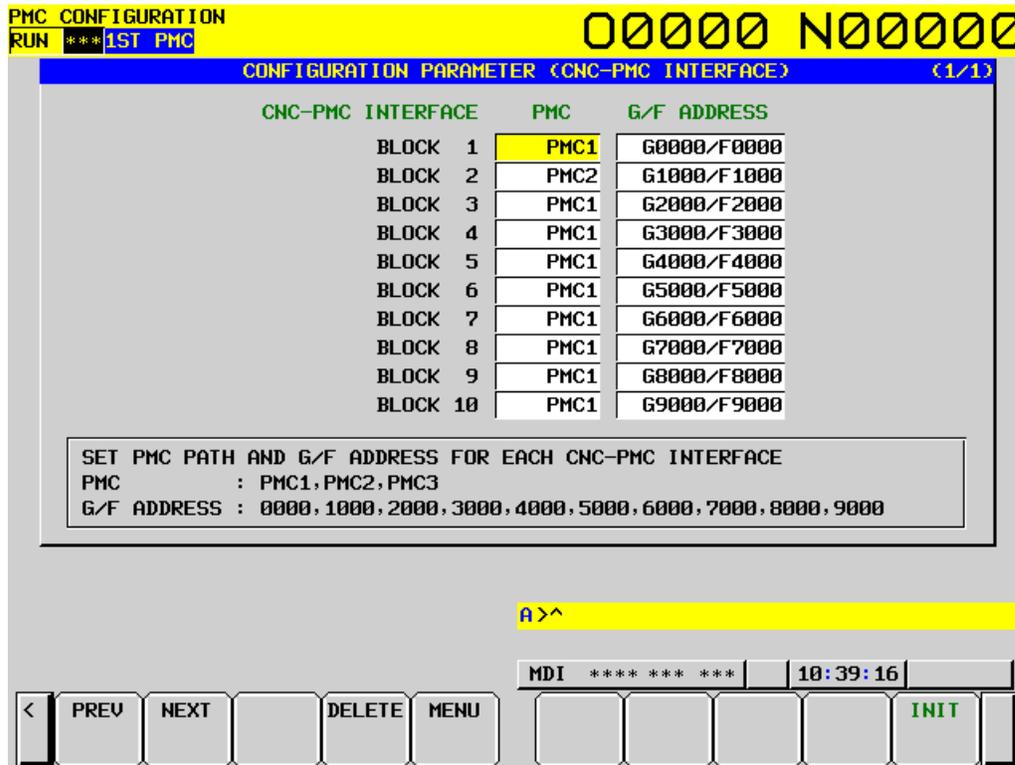
The screen opens with a menu offering four choices:



- 5) Press the  soft key.
- 6) Use the  buttons to move the cursor to the desired selection.
- 7) Press the  soft key.

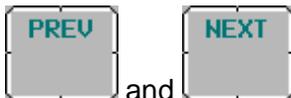
3.3.2.1. CNC-PMC Interface

The CNC-PMC Interface screen allows you to assign groups of G and F addresses to particular PMCs.



Use caution when on this screen, most of the soft keys will make a change without confirmation that requires a restart and afterward the PMC might not function correctly any more.

G/F0000 group includes addresses G/F 0-999, G/F1000 includes 1000-1999, etc.



- The **PREV** and **NEXT** soft keys are used to cycle through the available choices for PMC and address groups.



- The **DELETE** soft key will clear out the values on a particular line.



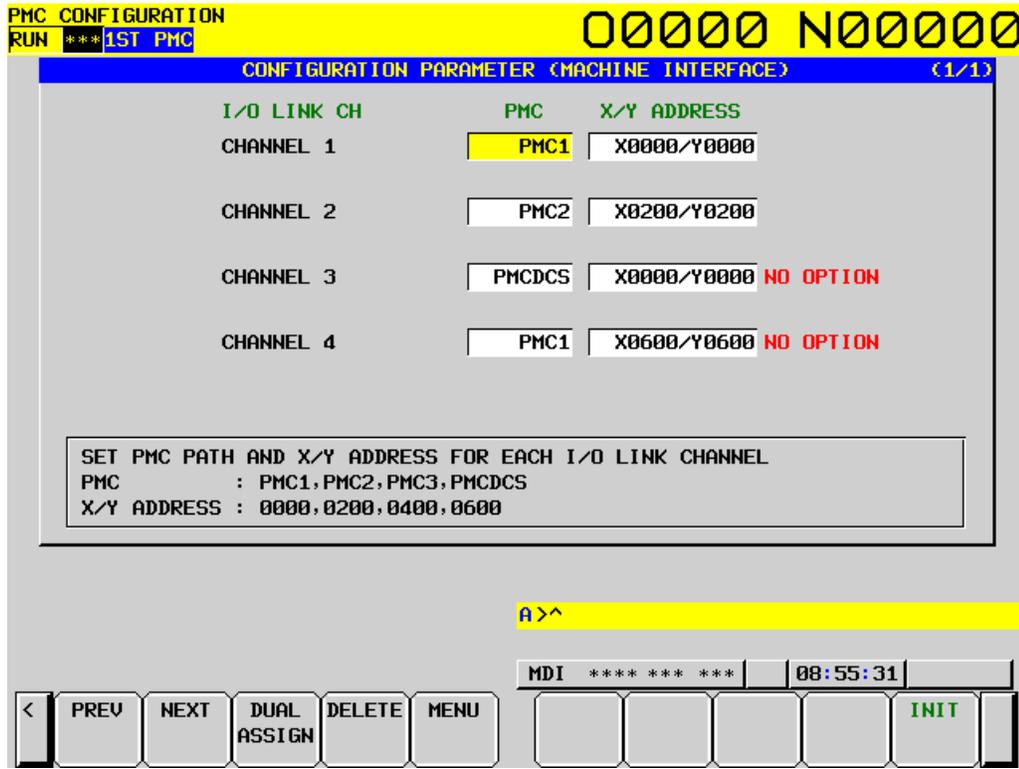
- The **INIT** soft key sets all the values back to their default setting.



- The **MENU** soft key allows you to exit the screen.

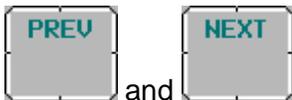
3.3.2.2. Machine Interface

The Machine Interface screen allows you to assign both PMCs and X/Y address groups to particular I/O Link channels.



Use caution when on this screen, most of the soft keys will make a change without confirmation that requires a restart and afterward the PMC might not function correctly any more.

X/Y0000 group includes addresses X/Y 0-199, X/Y200 includes 200-399, etc.



- The **PREV** and **NEXT** soft keys are used to cycle through the available choices for PMC and address groups.



- The **DUAL ASSIGN** soft key allows you to set additional PMCs and/or address groups to an I/O channel.

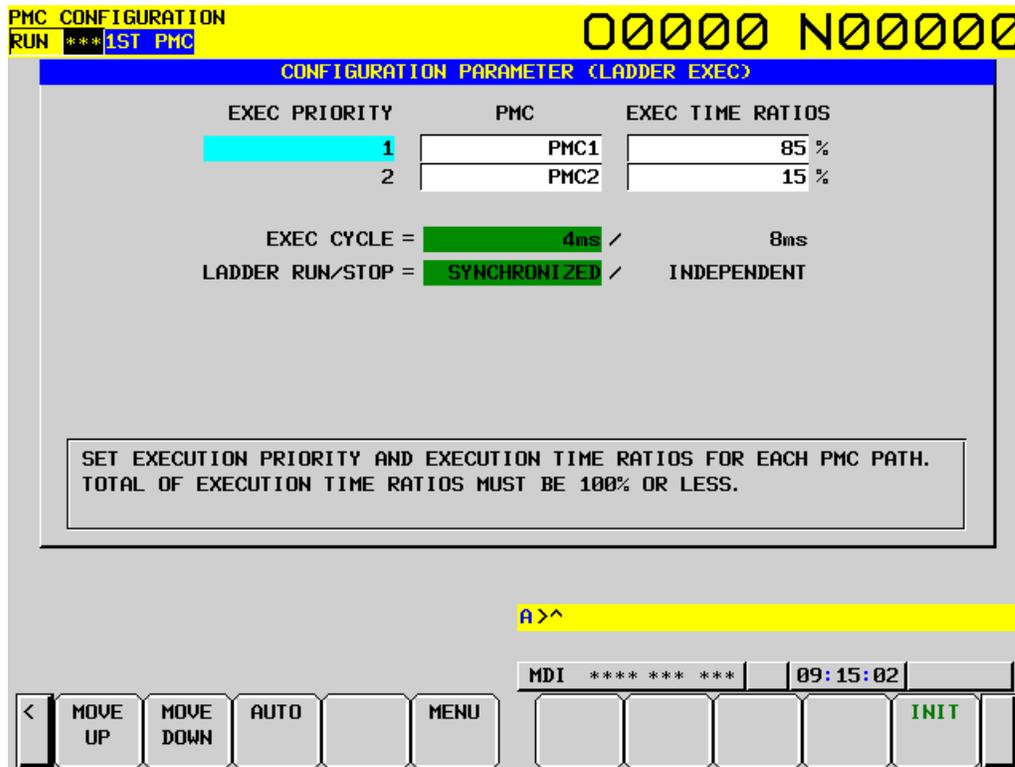
I/O LINK CH		PMC	X/Y ADDRESS
CHANNEL 1	BLOCK 1	PMC1	X0000/Y0000
	BLOCK 2	PMC1	X0400/Y0400
CHANNEL 2	BLOCK 1	PMC2	X0200/Y0200



- The **DELETE**, **MENU**, and **INIT** soft keys function just as in the previous section.

3.3.2.3. Ladder Execution

The Ladder Execution screen allows you to customize the execution priority and scan time percentages that each PMC is allotted.



Use caution when on this screen, most of the soft keys will make a change without confirmation that requires a restart and afterward the PMC might not function correctly any more.

- The  and  soft keys juggle the PMCs among the Exec Priority column.

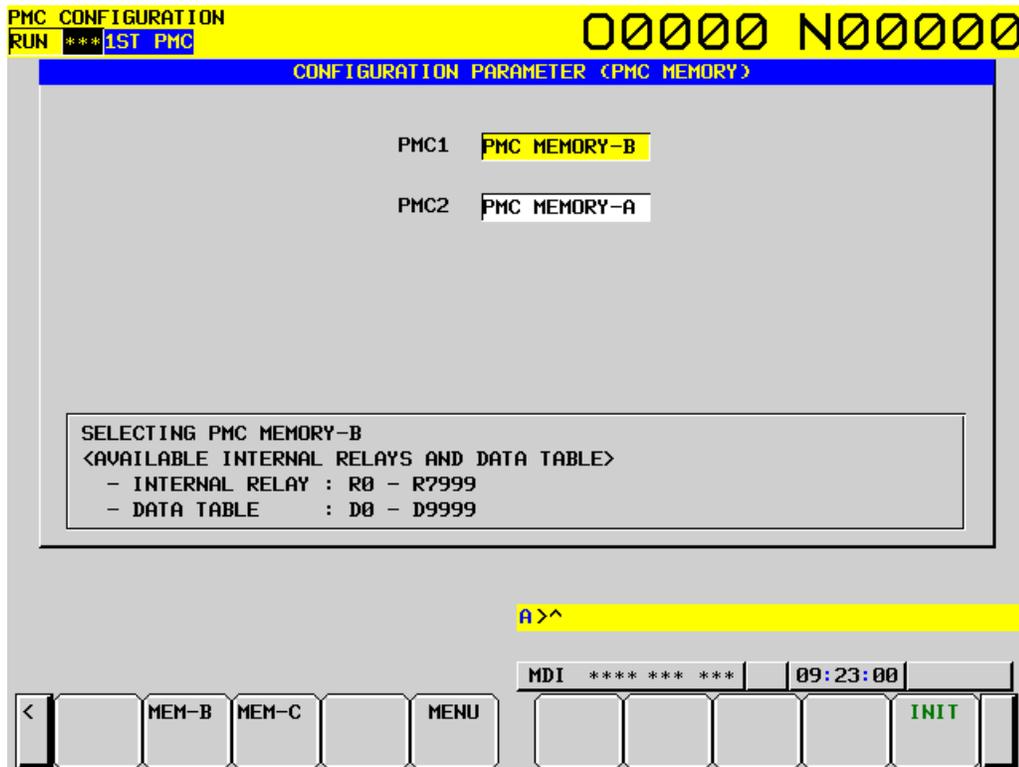
- The  soft key automatically determines the scan time percentage to assign to each PMC.

- To change the Exec Time Ratio, place the cursor on the line you want to modify, type in the value you desire, and press  .

- The  and  soft keys function as in the previous sections.

3.3.2.4. PMC Memory

The PMC Memory screen is where the PMC Memory type is defined for each ladder. PMC Memory A offers the least amount of available addresses, B offers more, C even more, etc.



Use caution when on this screen, most of the soft keys will make a change without confirmation that requires a restart and afterward the PMC might not function correctly any more.

- The , , and  soft keys are used to define the memory type.

Memory A uses R0-1499, D0-2999, B uses R0-7999 and D0-9999, C utilizes R0-15999 and D0-19999.

- The  soft key sets that PMC to use the same memory type as another PMC.

- The  and  soft keys function as in the previous sections.

3.3.3. Setting (General) Display

The setting display has settings that determine how the ladder special functions will work. These are related to the K900~K930 keep relays and the functions are described below.

TRY THIS



- 1) Press the  button on the MDI panel.
- 2) Press the  soft key to change the CNC menu.
- 3) Press the  soft key on the CNC menu.
- 4) Press the  soft key.

The **PMC SETTING (GENERAL)** screen appears...



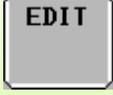
TRACE START: decides if the **TRACE** automatically starts at CNC power ON.

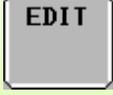


MANUAL = Start the **TRACE** by the  soft key

AUTO = Start the **TRACE** at CNC power on.

EDIT ENABLE: determines if the **EDIT** soft key is available on various PMC screens.



NO =  soft key is **NOT** displayed.

YES = the soft key **IS** displayed.

WRITE TO FROM (EDIT): the message “WRITE TO FROM?” appears after ladder editing.

NO = message **does not** appear after editing ladder in DRAM.
YES = message automatically appears after editing ladder in DRAM.



RAM WRITE ENABLE: enable the  soft key as well as ability to change PMC params.

NO = forcing function and PMC parameter writing is disabled.
YES = PMC addresses can be forced and parameters can be changed.

DATA TBL CNTL SCREEN: determines if the DATA TABLE CONTROL screen



YES = is displayed when the  soft key is pressed.
NO = is **NOT** displayed when that soft key is pressed.

HIDE PMC PARAM: determines if the PMC parameters are visible.

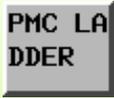


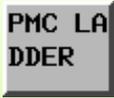
NO = PMC parameters are visible under  soft key.
YES = PMC parameters are **NOT** visible.

PROTECT PMC PARAM: determines if the PMC parameters can be changed.

NO = PMC parameters are visible, and can be edited.
YES = PMC parameters are visible, but cannot be edited.

HIDE PMC PROGRAM: determines if the PMC ladder diagram can be viewed.



NO = PMC ladder is visible under the  soft key.
YES = PMC ladder is **NOT** visible.

IO GROUP SELECTION: if the IO Link assignment screen is visible.

NO = the IO Link assignment screen is not visible.
YES = the IO Link assignment screen is visible.

KEEP RELAY (SYSTEM) determines if the K900-K999 KEEP RELAYS can be viewed.

SHOW = K900-K999 are visible.
HIDE = K900-K999 are **NOT** visible.

LADDER START: determines if the ladder is in the RUN or STOP state at power-on.

AUTO = ladder execution is running at power-on.
MANUAL = ladder execution is stopped at power-on.

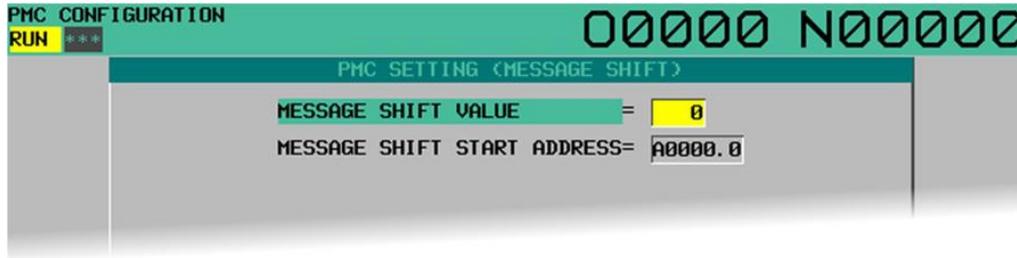
ALLOW PMC STOP: determines if the RUN/STOP button is displayed on the soft menu.

NO =  /  soft key is hidden.
YES = These soft keys are visible.
*It is possible to stop the ladder at power on by holding **CANCEL + Z**.*

PROGRAMMER ENABLE: acts as an override for all of the above settings.

NO = the above individual settings for editing, writing, etc. are used
YES = editing, writing, etc. is possible regardless of above settings.

5) Press the  button.



The message shift settings enable the ladder programmer to set up alarms for multiple languages and then depending on what language the end-user understands, the system can display them.

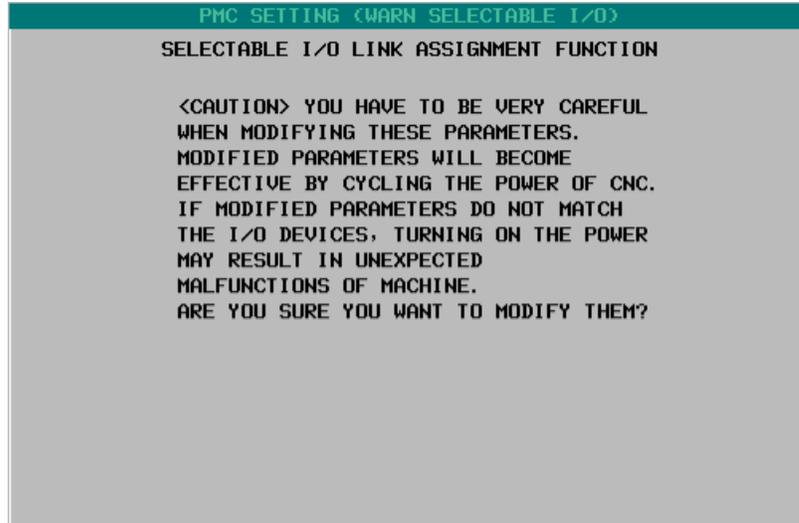
First you set up a consistent repeating pattern of how the alarms are set up:
IE, A0.0 is Alarm 1 in English, A0.1 is Alarm 1 in Japanese, A0.2 is Alarm 1 in Italian;
A1.0 is Alarm 2 in English, A1.1 is Alarm 2 in Japanese, A1.2 in Alarm 2 in Italian, etc.

If the shift value is set to 1 and A0.0 activates in the ladder, the message attached to A0.1 will be displayed, if set to 2 then the message address is shifted by 2 bits. So in the above example, a shift value of 0 means English, 1 means Japanese, and 2 means Italian.

The start address sets up where this shifting actually begins at – if the start address is A100.0 then A0.0-A99.7 will display normally but everything else will be shifted.

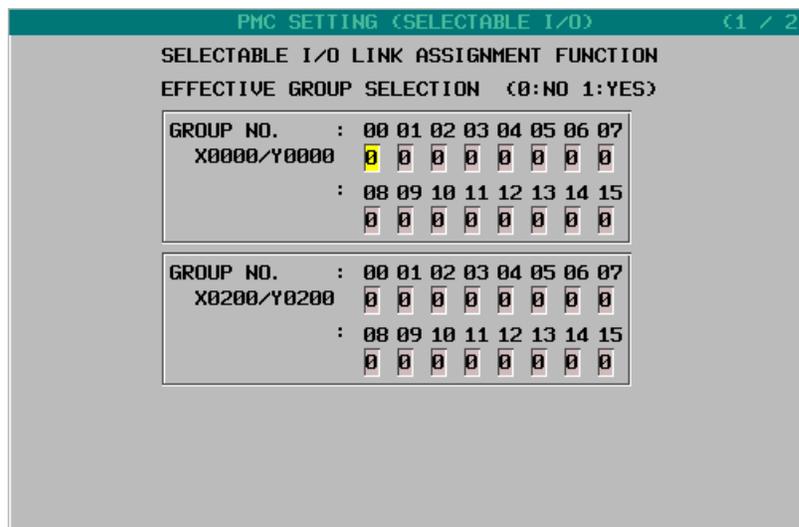
The following ominous warning only appears if the Selectable I/O Link Assignment Function has been enabled on the PMC Config – System Param screen.

6) Press the  button.



To modify the settings, you press the  and  soft keys.

At this point you can assign PMC addresses to work only with certain IO group numbers:



Press either the  or  soft key to exit this screen.

7) Press the  button.



The Override screen is only available if Programmer Enable is set to YES and changes to this setting only take effect after cycling power.

Override enable expands the ability of the FORCE function in the PMC Signal Status screen.

If override enable is turned on, it is possible to force an X address with the ladder running overriding the actual physical input and causing the PMC logic to act accordingly.

It is possible to force a Y address and have it stay on while the ladder is running regardless of the actual PMC logic.

Override does not work on A, G, F, or PMC parameter addresses (T,C,K,D).

3.3.4. PMC Status

This screen displays the operational status of the ladder(s). This is the place to go to stop or start the ladder. It's a good idea to stop the ladder execution when manually controlling switches on the machine.

TRY THIS


1) Press the  button on the MDI panel.

2) Press the  soft key to change the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key.

5) Press the  soft key.

6) Press the  soft key and then the  soft key.

7) Now the ladder is stopped. **Restart it.**

3.3.5. System Parameter

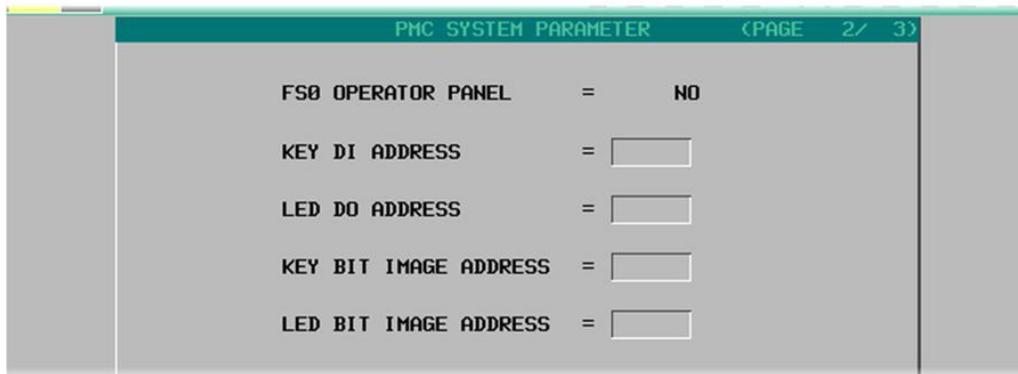
The system parameter screen allows you to control how PMC counters count, setup the system to work with an operator’s panel from a Fanuc Series 0 control, and control selectable IO Link group assignments.

- TRY THIS** 
- 1) Press the  button on the MDI panel.
 - 2) Press the  soft key to change the CNC menu.
 - 3) Press the  soft key on the CNC menu.
 - 4) Press the  soft key to change the CNC menu.
 - 5) Press the  soft key.



Each counter has a C address associated with it in the PMC. By default this address uses the binary number system. This screen allows you to switch to BCD if desired.

- 6) Press the  button.



This screen controls setup of a Fanuc Series 0 operator panel. Detailed information can be found in the appropriate PMC Ladder Language Programming manual for your particular control.

7) Press the  button.



This screen allows you to control whether certain X/Y address groups can be assigned to individual IO groups. The actual assignment of these addresses to IO groups is accomplished on the PMC Config – Setting screen.

3.3.6. Online Monitor

The online monitor function is used with Fanuc Ladder III software on your PC to allow the computer to make a live connection with the ladder. You can watch ladder execution remotely on your computer, make changes, and update the control’s ladder.

TRY THIS

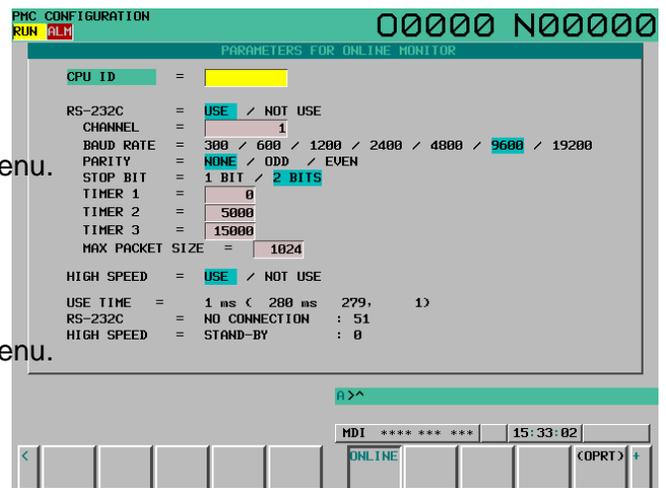

1) Press the  button on the MDI panel.

2) Press the  soft key to change the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key to change the CNC menu.

5) Press the  soft key.



Note that when RS-232 is set to USE, RS-232 on the CNC side doesn't work. High-speed refers to the Ethernet connection.

4. Exercise 2 – 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 TRACE function?



3) What is the  soft key used for?

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

5) What is the current ladder edition in your simulator?

6) Using the PMC Signal 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?

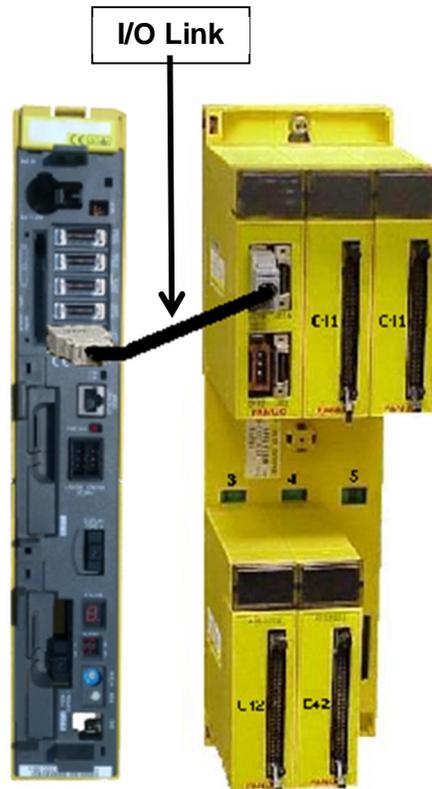
8) What mode must the CNC be in to change PMC parameters?

9) On the PMC CONFIG SETTING screen, what is the purpose of the PROGRAMMER ENABLE setting?

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

5. Input/Output Connection

Fanuc offers several different types of I/O connections. They are all connected to the CNC by an electrical serial communication link which is referred to as the **I/O Link**.

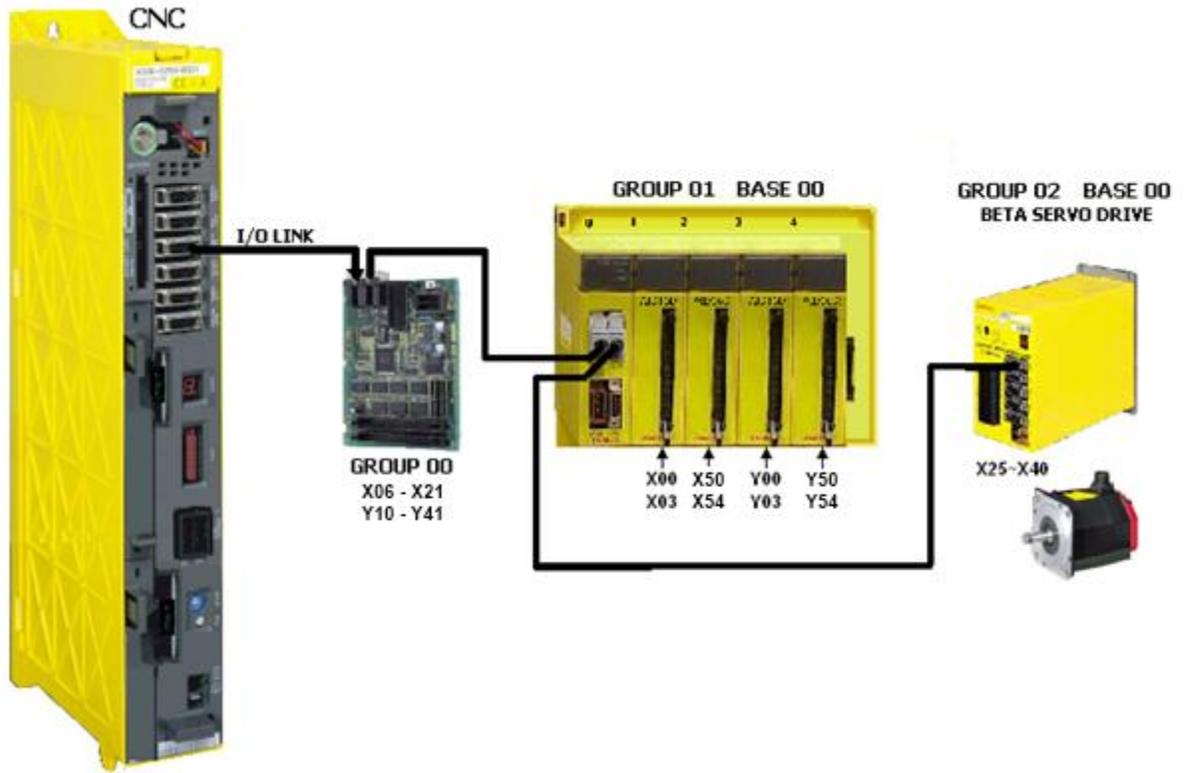


All the types of I/O are available with **SINKING** or **SOURCING** connections. Sinking (also called NPN) connections provide a path to ground; sourcing (also called PNP) connections provide a path to 24VDC. More detail about these connections is shown in the following sections, but generally the I/O style is determined by the area where the machine was manufactured.

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

5.1. Input/Output Configuration

The I/O modules must be connected on the I/O LINK serial communications daisy chain. The connection starts at the CNC JD51A where there are 2 I/O link channels. Each connection on the serial link is called a **GROUP**. There can be up to 16 groups on each I/O LINK channel. The I/O addressing is assigned by the machine builder, set by **GROUP**, **BASE**, and **SLOT**.



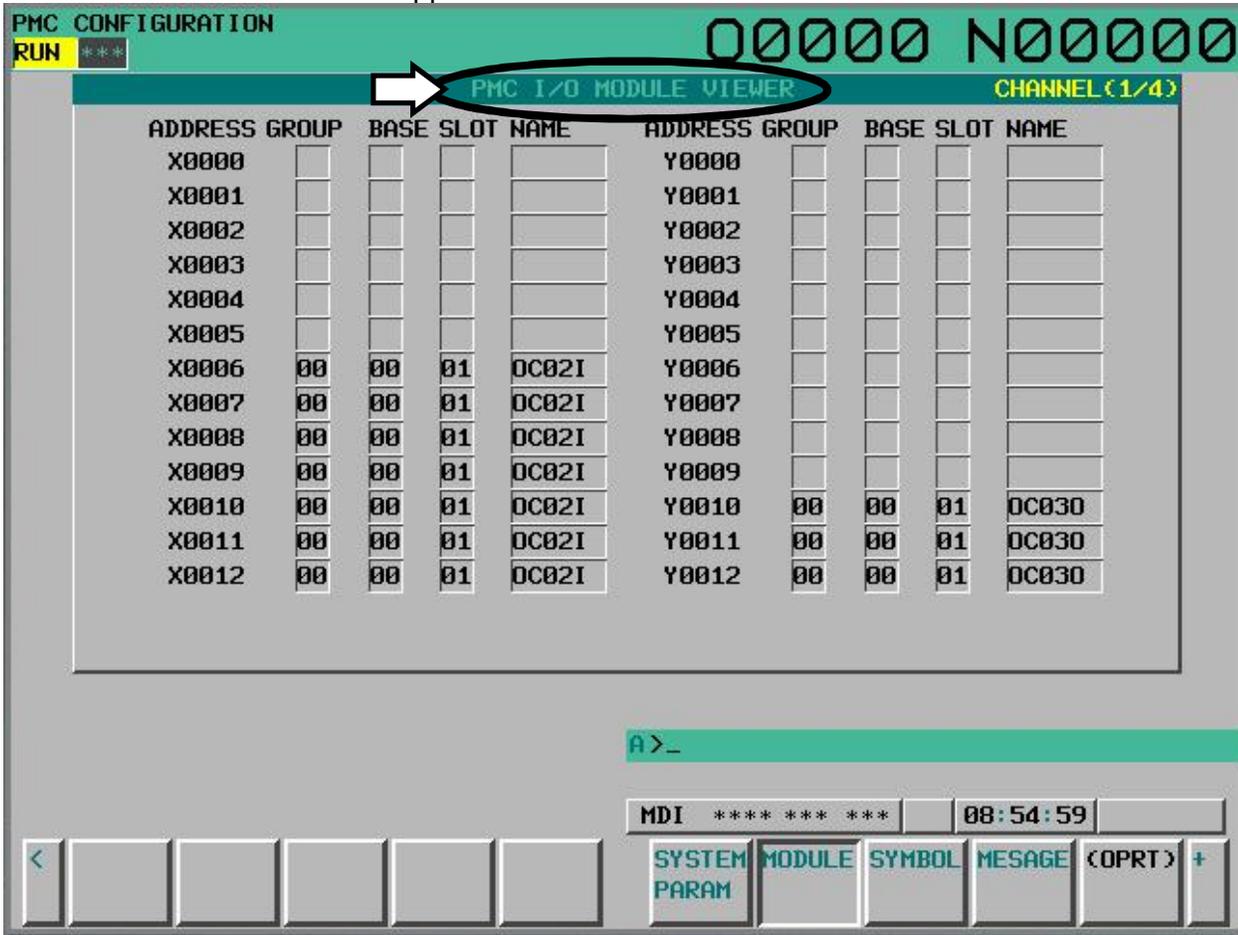
To view the I/O configuration, do the following:

TRY THIS

- 1) Press the  **SYSTEM** button on the MDI panel.
- 2) Press the  soft key to change the CNC menu.
- 3) Press the  **PMC CONFIG** soft key on the CNC menu.
- 4) Press the  soft key to change the CNC menu.
- 5) Press the  **MODULE** soft key on the CNC menu.

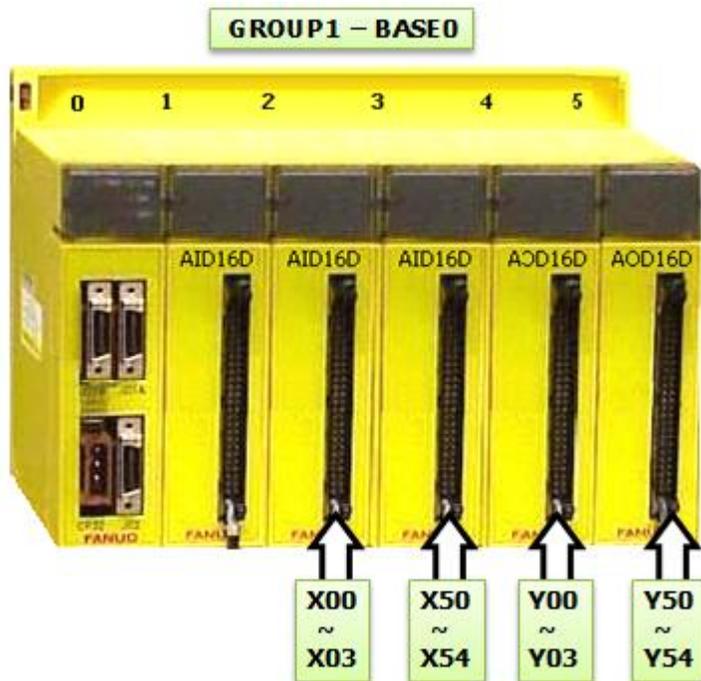
Input/Output Connection

The PMC I/O MODULE screen appears...



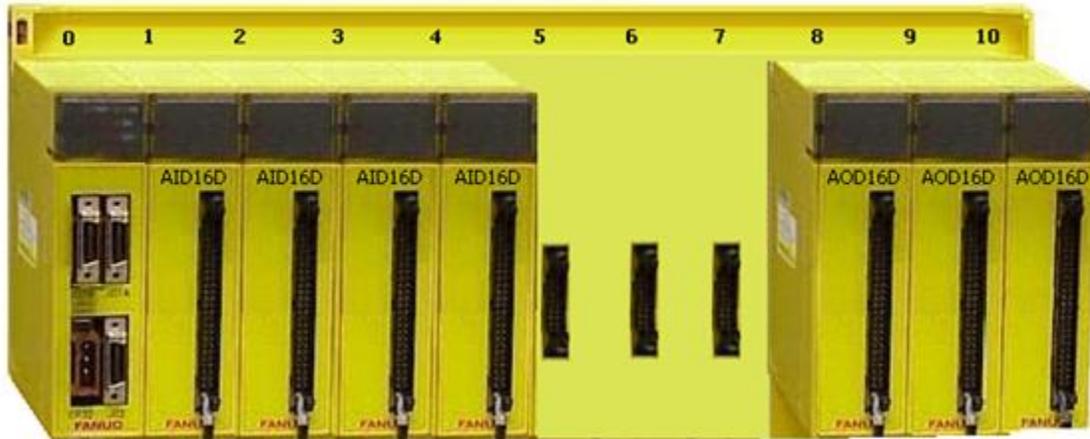
6) Notice X0006 and Y0010 is set to GROUP00, BASE00, SLOT1.

This is an operator panel interface board with 128 inputs and 256 outputs so it uses addresses X0006-X0021 and Y0010-Y0041 (the person that set up the I/O system specified the starting address).



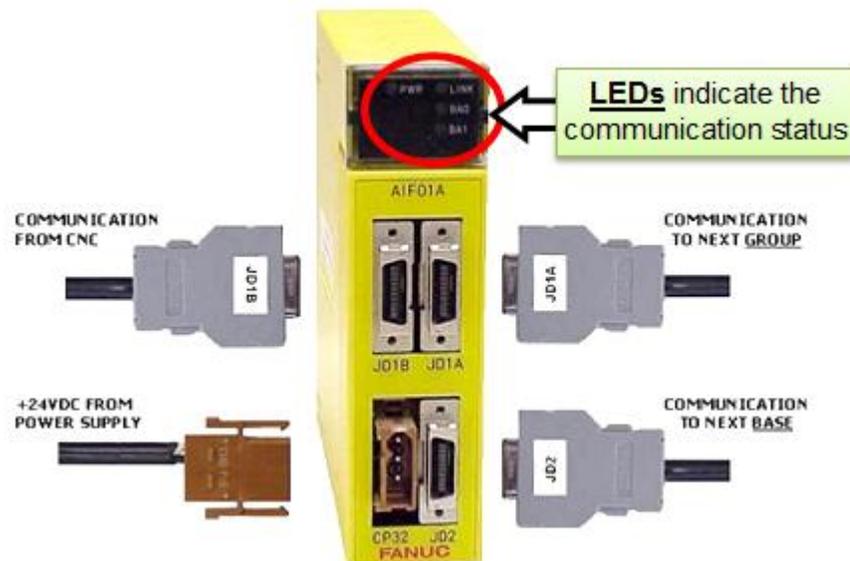
5.2. I/O Model A

The I/O Model A is the PLC rack style I/O modules. There are 5 slot racks and 10 slot racks. Many different I/O modules are available for each slot. In slot 0 of the rack is the communication module.



5.2.1. Communication Module

The communication module is located in slot 0 of the rack. It sends the X input data back to the PMC, and receives the Y output data from the PMC, through the JD1B connector. It also passes the data to the next GROUP device through the JD1A connector, and/or passes data to the next BASE through the JD2 connector.

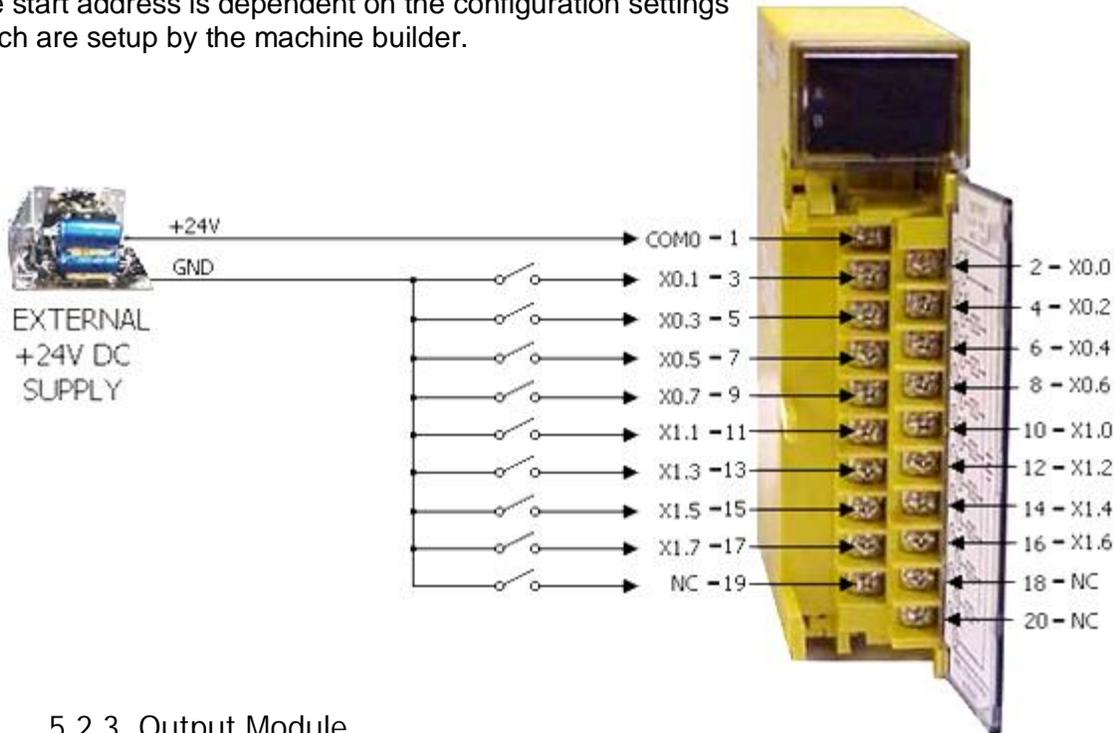


PWR = indicates +24VDC is input on connector **CP32**
LINK = indicates the serial communication to the CNC is active. (**JD1B**)
BA0 = indicates communication to BASE 0 is active.
BA1 = indicates communication to BASE 1 is active. (**JD2**)

Input/Output Connection

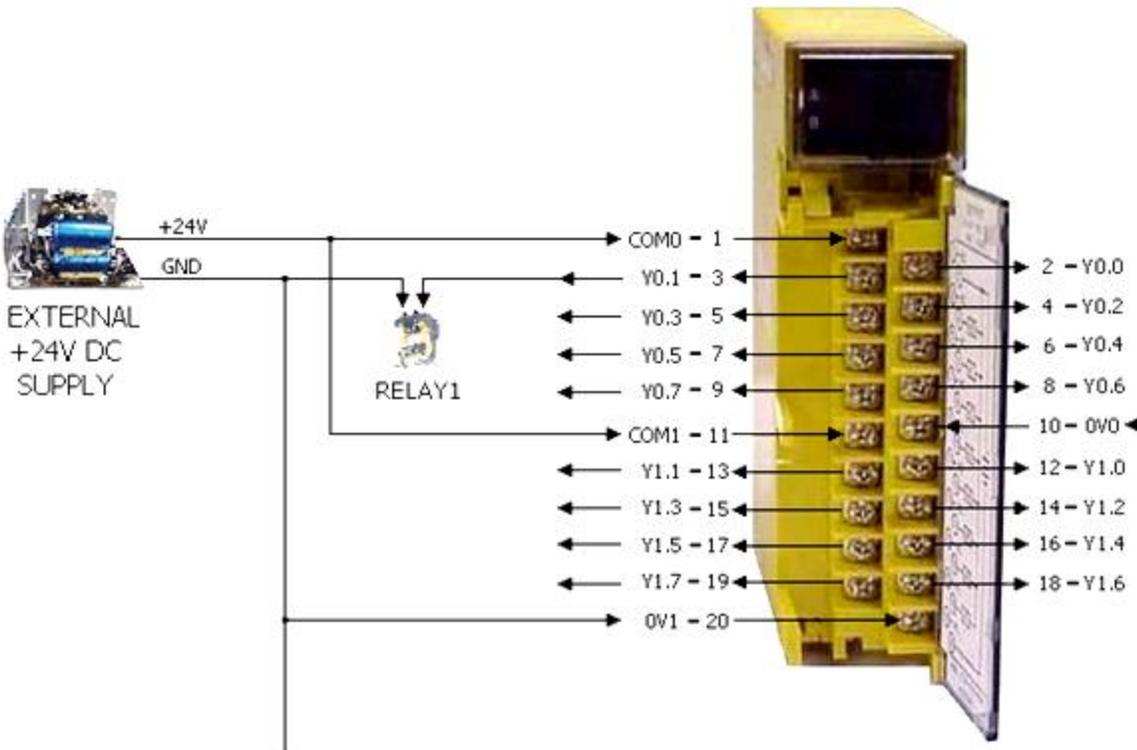
5.2.2. Input Module

The **AID16D TERMINAL BLOCK** connection input module is shown here. The rated current per input is 7.5mA and these inputs are wired **sourcing** (GND is switched). The start address is dependent on the configuration settings which are setup by the machine builder.



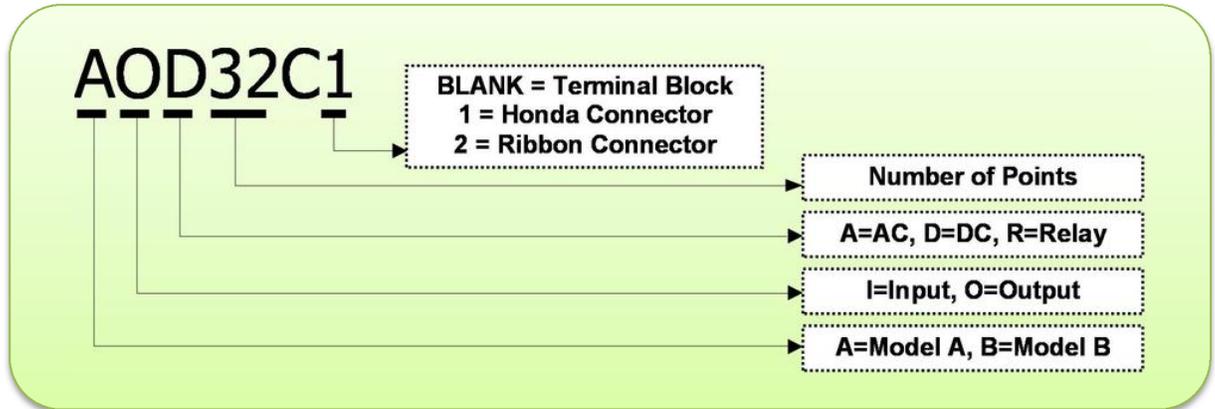
5.2.3. Output Module

The **TERMINAL BLOCK** style output module AOD16D is shown here. The external +24V supply is switched out the outputs when they are activated. The maximum output current is 500mA per output.



5.2.4. 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 **B-61813EN, 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
	AID08H1	24VDC	7.5mA	Both	2mSec	8	Honda	N
DC Opto-isolated Input	AID16C	24VDC	7.5mA	Source	20mSec	16	TB	Y
	AID16K	24VDC	7.5mA	Source	2mSec	16	TB	Y
	AID16D	24VDC	7.5mA	Sink	20mSec	16	TB	Y
	AID16L	24VDC	7.5mA	Sink	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	100~240VAC	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

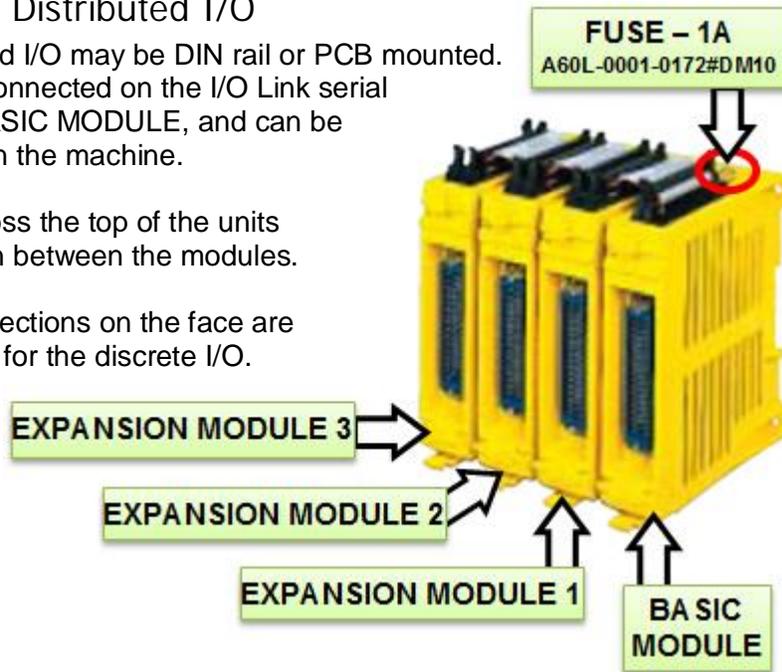
Input/Output Connection

5.3. Type 1 Distributed I/O

The Type 1 Distributed I/O may be DIN rail or PCB mounted. These modules are connected on the I/O Link serial daisy chain by the BASIC MODULE, and can be mounted anywhere on the machine.

The ribbon cable across the top of the units allows communication between the modules.

The blue Honda connections on the face are the connection points for the discrete I/O.



5.3.1. Basic Module – A03B-0815-C001

The basic module communicates to the PMC through the I/O Link and also serves 24 input points and 16 output points. Up to 3 expansion modules may be connected to each basic module, for a maximum of 96 inputs and 64 outputs.

This module is powered by +24VDC, which is input on the blue Honda connector, on the front of the unit. (pins 18 and 50=+24V, pins 19,20,21,22,23=GND)



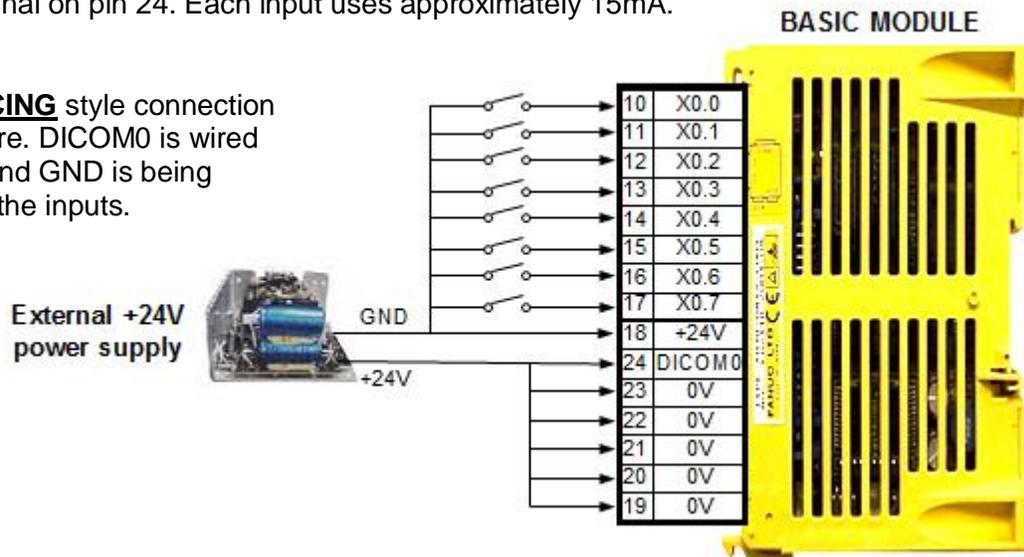
18	+24V		50	+24V	
17	X2.7		49	X0.7	
16	X2.6		48	X0.6	
15	X2.5	32	X1.7	47	X0.5
14	X2.4	31	X1.6	46	X0.4
13	X2.3	30	X1.5	45	X0.3
12	X2.2	29	X1.4	44	X0.2
11	X2.1	28	X1.3	43	X0.1
10	X2.0	27	X1.2	42	X0.0
9	Y1.7	26	X1.1	41	Y0.7
8	Y1.6	25	X1.0	40	Y0.6
7	Y1.5	24	DICOM0	39	Y0.5
6	Y1.4	23	0V	38	Y0.4
5	Y1.3	22	0V	37	Y0.3
4	Y1.2	21	0V	36	Y0.2
3	Y1.1	20	0V	35	Y0.1
2	Y1.0	19	0V	34	Y0.0
1	DCOM0			33	DCOM0

NOTE: Addresses shown assume the basic module is mapped at X0/Y0.

5.3.2. Input Connection

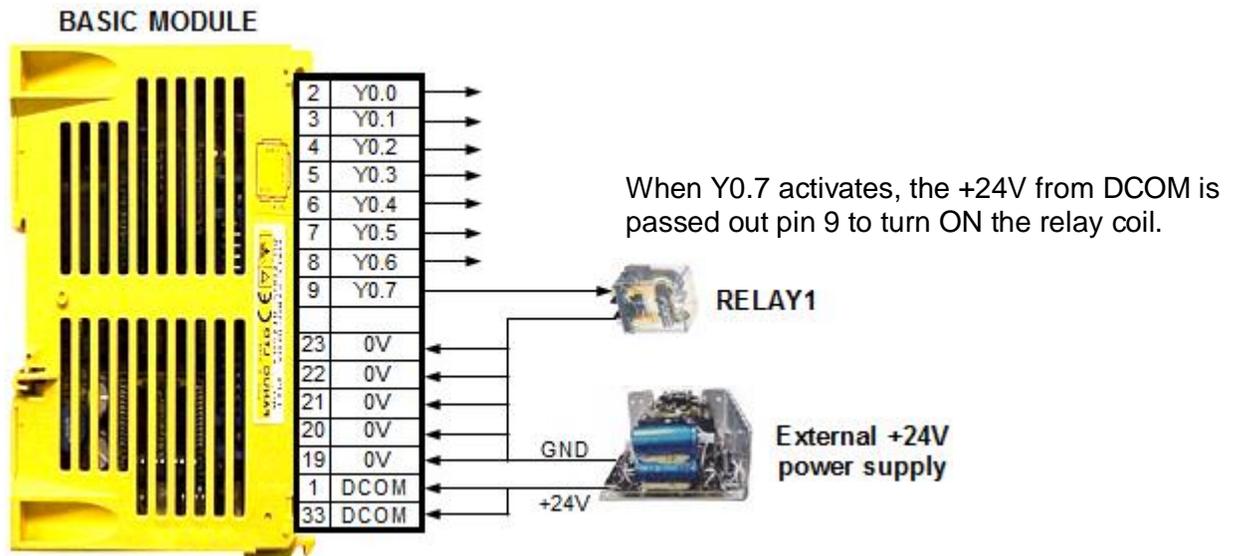
For the basic module inputs, **SINKING** or **SOURCING** may be selected by the wiring to the DCOM0 signal on pin 24. Each input uses approximately 15mA.

The **SOURCING** style connection is shown here. DCOM0 is wired to ground, and GND is being switched to the inputs.



5.3.3. Output Connection

For the basic module outputs are fixed as **SOURCING**. The external +24V power supply is fed into the basic module through the DCOM0 pin, then when the output is activated it is switched through the output circuit. Each output has a maximum rating of 200mA. It is possible to parallel two outputs to realize 400mA output.



5.3.4. Basic Module DO Alarm Status

At the BASIC module start address +15, in this example Y15, there are bits to indicate if overcurrent or overheat of an output occurs.

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

Input/Output Connection

5.3.5. Expansion Modules

The expansion modules are available in different models - one with a manual handle interface, another with analog inputs, and standard units with discrete I/O points.

A rotary switch is provided near the ribbon cable connection, which allows the builder to skip address ranges. Typically the switches are all set to '0', which means the module addresses are consecutive. When replacing these units, confirm the switch setting of the old unit.

Module Name	Part Number	Description
Expansion Module A	A03B-0815-C002	24inputs/16outputs with handle I/F (JA3)
Expansion Module B	A03B-0815-C003	24inputs/16outputs
Expansion Module C	A03B-0815-C004	16outputs (2A outputs, 12A max overall)
Expansion Module D	A03B-0815-C005	Analog inputs (0~10V or 4~20mA selectable)
Ribbon cable	A660-2040-T045#34B0020	Connection between modules - 20mm length

When expansion module A is used, it must be placed in expansion module 1 position.

EXPANSION MODULE A

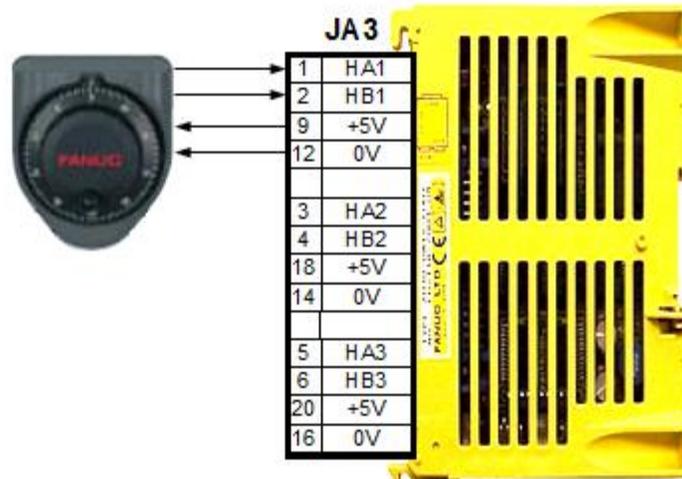


CB150

18	+24V		50	+24V	
17	X5.7		49	X3.7	
16	X5.6		48	X3.6	
15	X5.5	32	X4.7	47	X3.5
14	X5.4	31	X4.6	46	X3.4
13	X5.3	30	X4.5	45	X3.3
12	X5.2	29	X4.4	44	X3.2
11	X5.1	28	X4.3	43	X3.1
10	X5.0	27	X4.2	42	X3.0
9	Y3.7	26	X4.1	41	Y2.7
8	Y3.6	25	X4.0	40	Y2.6
7	Y3.5	24	DICOM0	39	Y2.5
6	Y3.4	23	0V	38	Y2.4
5	Y3.3	22	0V	37	Y2.3
4	Y3.2	21	0V	36	Y2.2
3	Y3.1	20	0V	35	Y2.1
2	Y3.0	19	0V	34	Y2.0
1	DCOM0			33	DCOM0

NOTE: Addresses shown assume the basic module is mapped at X0/Y0.

The handle count may be seen at the start X address +12, so in this example where the basic module is mapped to begin at X0, address X12 shows the handle count in binary.

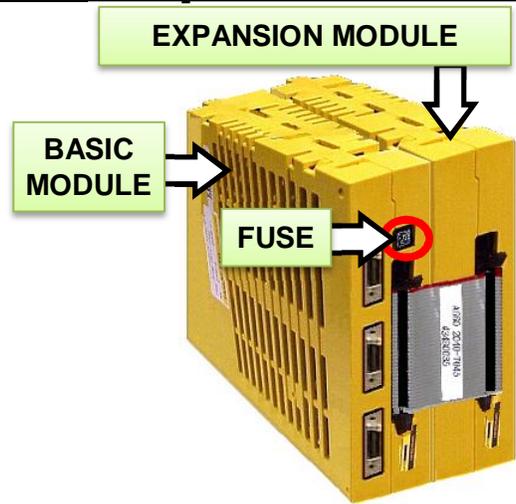


5.4. Type 2 Distributed I/O

The Type 2 Distributed I/O can be mounted directly onto the machines relay PCB board.

The BASIC module connects on the I/O LINK serial bus, and may have one EXPANSION unit connected to it by ribbon cable.

This allows for up to 96 inputs and 64 outputs total, each unit having 48 inputs and 32 outputs.

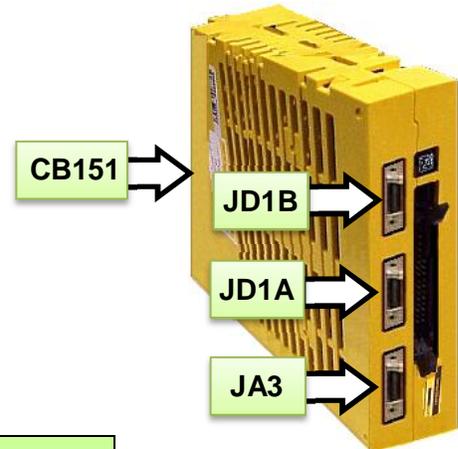


5.4.1. Type 2 Basic Module – A03B-0815-C041

The BASIC module communicates to the PMC through the I/O Link. Connection JD1B is the input and JD1A is the output to the next GROUP.

This module is powered by +24VDC, which is input on the blue Honda connector on the back of the unit (CB151). This connector also serves 48 input points and 32 output points.

Two BASIC modules are available, one with a manual handle interface JA3, and one without. Both have a DI/DO of 48inputs/32outputs.



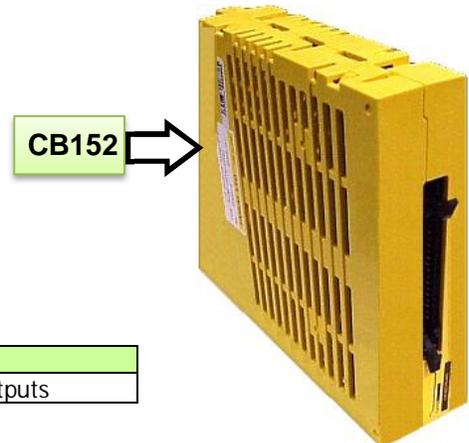
Module Name	Part Number	Description
Basic Module - B1	A03B-0815-C040	48in/32out with handle I/F (JA3)
Basic Module - B2	A03B-0815-C041	48in/32out <i>without</i> handle I/F
FUSE	A60L-0001-0172#DM10	1 Amp

5.4.2. Type 2 Expansion Module – A03B-0815-C042

Only one expansion module is available in the Type 2 configuration. It has a DI/DO of 48inputs/32outputs.

Only one EXPANSION module may be connected to the BASIC module.

The blue Honda connector on the back of the unit (CB152) serves 48 input points and 32 output points.



Module Name	Part Number	Description
Expansion Module - E1	A03B-0815-C042	48 inputs/32 outputs

6. Exercise 3 – Physical Input/Output

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

- 2) On the PMC Signal Status screen, search for address X8.4. Is the status 1 or 0?

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

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

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

- 6) How is the module address specified?

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

- 8) Using Type 1 I/O, which expansion module needs to be used to accept an analog input?

7. PMC Interface Signals

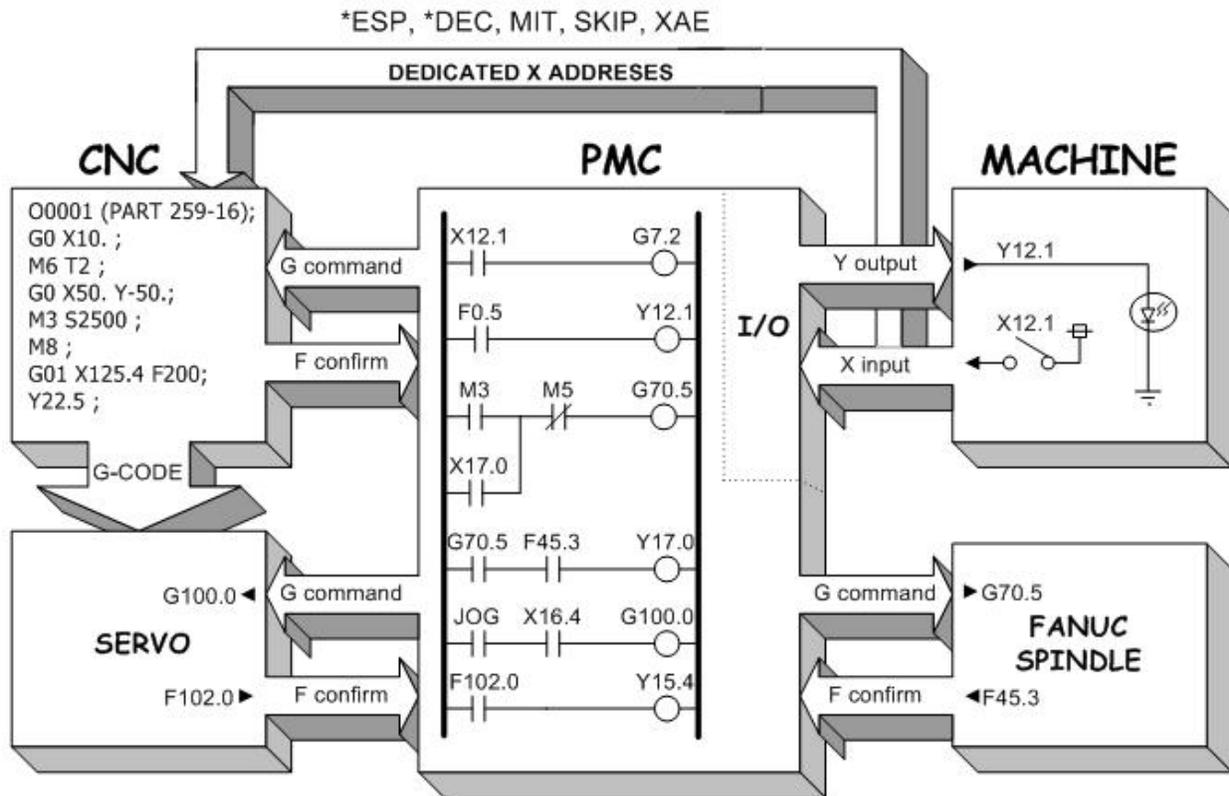
The manuals **0i-D Connection Manual (FUNCTION) B-64303EN-1**, **30i-A Connection Manual (FUNCTION) B-63943EN-1**, and **30i-B Connection Manual (FUNCTION) B-64483EN-1** detail these signals. This section contains the X, G and F address lists for the 0i-D controls; the 3xi series do have a few more signals, refer to their respective manuals if necessary.

7.1. Dedicated X Addresses

There are dedicated X addresses assigned to time critical signals. Emergency stop, the tool setter switches, and home return deceleration switches are mapped here. These signals will function even if they are not included in the ladder logic.

SYSTEM	DESCRIPTION	SYMBOL	ADDRESS
T (LATHE)	X tool measurement point reached (automatic)	XAE1	X4.0
	Z tool measurement point reached (automatic)	XAE2	X4.1
	X+ tool measurement point reached (manual), path 1	+MIT1 ^{#1}	X4.2
	X- tool measurement point reached (manual), path 1	-MIT1 ^{#1}	X4.3
	Z+ tool measurement point reached (manual), path 1	+MIT2 ^{#1}	X4.4
	Z- tool measurement point reached (manual), path 1	-MIT2 ^{#1}	X4.5
	X+ tool measurement point reached (manual), path 2	+MIT1 ^{#2}	X13.2
	X- tool measurement point reached (manual), path 2	-MIT1 ^{#2}	X13.3
	Z+ tool measurement point reached (manual), path 2	+MIT2 ^{#2}	X13.4
	Z- tool measurement point reached (manual), path 2	-MIT2 ^{#2}	X13.5
M (MILL)	X tool measurement point reached (automatic)	XAE1	X4.0
	Y tool measurement point reached (automatic)	XAE2	X4.1
	Z tool measurement point reached (automatic)	XAE3	X4.2
COMMON to LATHE and MILL	Multi-step Skip signal for probe, path 1	SKIPn ^{#1}	X4.0 - 4.7
	1 st axis home return deceleration switch, path 2	*DEC1 ^{#2}	X7.0
	2 nd axis home return deceleration switch, path 2	*DEC2 ^{#2}	X7.1
	3 rd axis home return deceleration switch, path 2	*DEC3 ^{#2}	X7.2
	4 th axis home return deceleration switch, path 2	*DEC4 ^{#2}	X7.3
	5 th axis home return deceleration switch, path 2	*DEC5 ^{#2}	X7.4
	Emergency Stop signal	*ESP	X8.4
	1 st axis home return deceleration switch, path 1	*DEC1 ^{#1}	X9.0
	2 nd axis home return deceleration switch, path 1	*DEC2 ^{#1}	X9.1
	3 rd axis home return deceleration switch, path 1	*DEC3 ^{#1}	X9.2
	4 th axis home return deceleration switch, path 1	*DEC4 ^{#1}	X9.3
	5 th axis home return deceleration switch, path 1	*DEC5 ^{#1}	X9.4
	Multi-step Skip signal for probe, path 2	SKIPn ^{#2}	X13.0 - 13.7

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. The following material explains the function of the dedicated addresses.

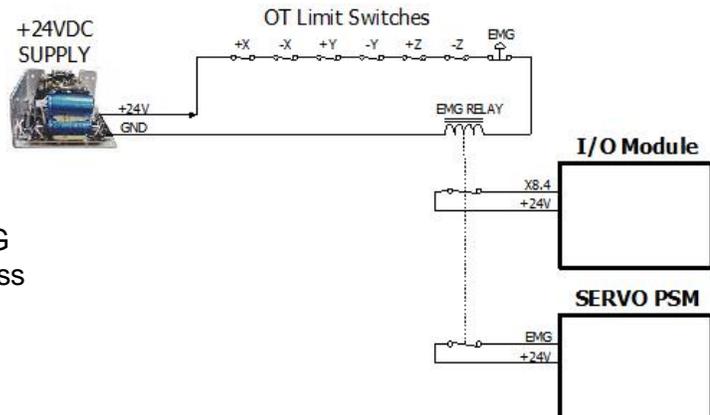


7.1.1. *ESP - Emergency Stop

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.

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**.

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.



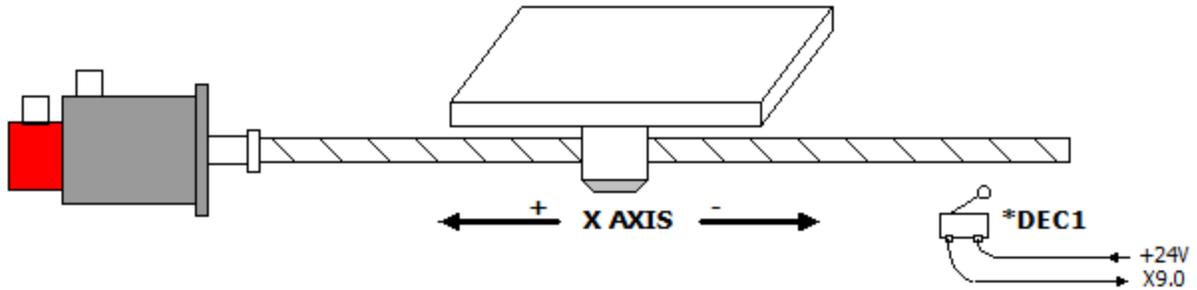
In this case, the switches enable the **EMG relay coil** in the electrical cabinet.

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

7.1.2. *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.

There is a separate address for each axis, as well as each path. **The first PMC** 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), X9.3 is used for the 4th axis, and X9.4 is for the 5th axis. **The second PMC** uses address X7, with the same bit assignments.



7.1.3. SKIP Input

The skip input function is used when the machining end point is not programmed; 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.

Multiple SKIP addresses are available which allows for multiple dimension measuring instruments: for the first PMC, X4.0 – X4.7 is used, and X13.0 – X13.7 are used for the second PMC.

7.1.4. XAE1, XAE2, XAE3 - 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.

7.1.5. +MIT1, -MIT1 - Manual Feed Interlock

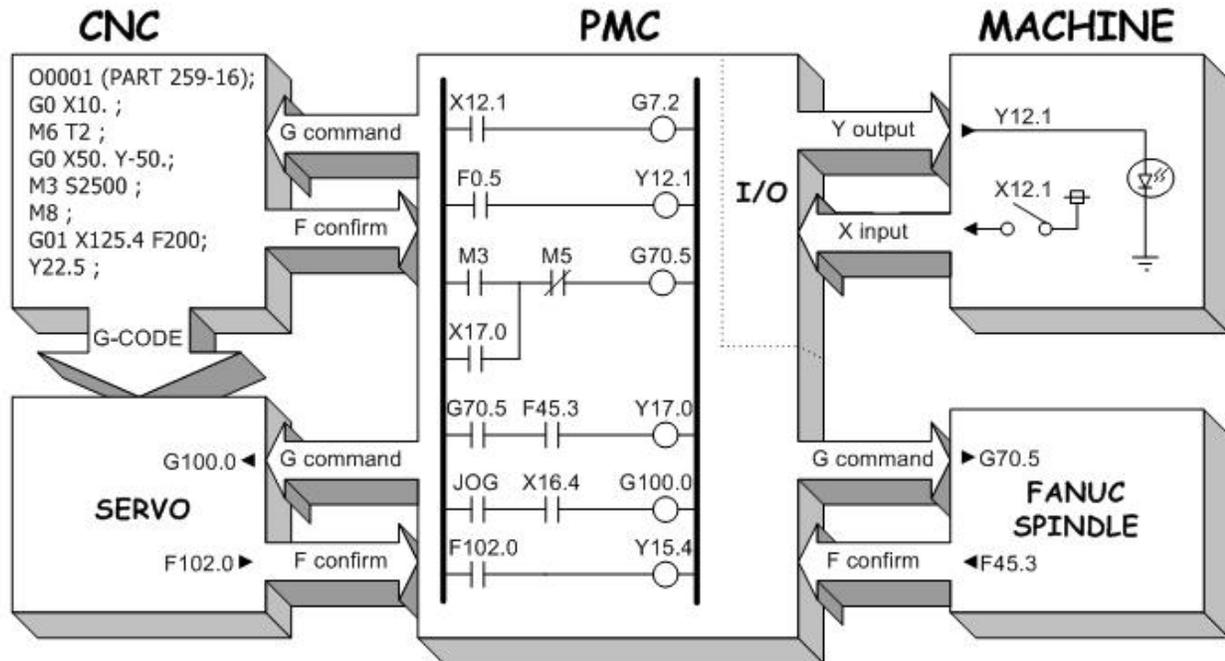
These signals are used when **manual tool length measurement** is performed. These signals are wired to the tool setter arm switches. The tool is manually moved to touch the setter arm switches. When activated, the axis cannot continue moving in the same direction. The signal +MIT1 is the +X direction, -MIT1 = -X, +MIT2 = +Z, and -MIT2 = -Z direction. The dedicated X addresses are used on **LATHE** controls only. X4.2 - .5 is for the first PMC, the second PMC uses X13.2 - .5.

The MILL control has the same function; however it uses addresses G132/G134.

The addresses for MIT are the same addresses used for the 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.

7.2. Dedicated G & 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) addresses 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 the tables that follow. This information is typically given in the Maintenance manual for the control, in addition to the Connection (Function) Manual. The following examples are from the **0i-D Connection Manual (FUNCTION) B-64303EN-1**.

The information is given in more than one way. There are 3 lists of the G & F addresses, the first is a **LIST (organized) by FUNCTION**, the second is a **LIST (organized) by SYMBOL**, and the third is a **LIST (organized) 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. These lists also point out whether the signal is used on a lathe, a mill, or both. The two columns labeled T and M refer to Turning Center (Lathe) and Mill, these symbols indicate the signals usage.

- : Available
- : Available only with 2-path control
- : Unavailable

The list organized by function is arranged alphabetically and details what signals are used for a particular function. For example, the auxiliary function lock has two addresses that work with it, G5.6 and F4.4. As long as you know a particular function of interest, you can use this list to be aware of all the signals that work with it.

Function	Signal name	Symbol	Address	T	M	Reference item
Auxiliary function lock	Auxiliary function lock signal	AFL	G005.6	○	○	9.2
	Auxiliary function lock check signal	MAFL	F004.4	○	○	

Each of the G and F addresses has an assigned mnemonic called the symbol. The list organized by symbol is arranged alphabetically by the first letter of these assigned mnemonics. If you know the **SYMBOL** for a signal, this is a good place to find its description.

The first group of signals has an 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. These are called **ACTIVE LOW** signals. For example, the **emergency stop signals are addresses X8.4 and G8.4.**

Group	Symbol	Signal name	Address	T	M	Reference item
		signals (PMC axis control)				
*	*ESP	Emergency stop signals	X008.4	○	○	2.1
			G008.4	○	○	
	*ESPA	Emergency stop signals (serial spindle)	G071.1	○	○	10.3
	*ESPB		G075.1	○	○	
	*ESPC		G205.1	○	-	

The next two groups are axis direction specific – positive and negative direction. +LM1 is the first axis positive stroke limit and -LM1 is the first axis negative stroke limit.

+	+LM1~+LM5	Stroke limit external setting signals	G110.0~G110.4	○	○	2.3.5
-	-Jg,-Ja	selection signals	G086.1,G086.3	○	○	3.4
	-LM1~LM5	Stroke limit external setting signals	G112.0~G112.4	○	○	2.3.5

Following the active low and direction-specific signals come all the symbols that start with an actual letter. As you can see below, ABTSP2 is the 2nd spindle unexpected disturbance torque detection signal and is assigned address F90.2.

A	ABTSP1	disturbance torque detection signal	F090.1	○	○	2.9
	ABTSP2	2nd spindle unexpected disturbance torque detection signal	F090.2	○	○	2.9
	AFL	Auxiliary function lock signal	G005.6	○	○	9.2
	AICC	AI contour control mode signal	F062.0	○	○	7.1.11

The final list is organized 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. This is especially helpful when you are looking at the ladder, see a G or F address, and are curious what it does.

Address	Signal name	Symbol	T	M	Reference item
F001.2	Battery alarm signal	BAL	○	○	2.4
F001.3	Distribution completion signals	DEN	○	○	9.1
F001.4	Spindle enable signal	ENB	○	○	10.6

For multi-path controls, add 1000 to the PMC address for path 2, add 2000 for path 3, etc. For example, G058.1 is the External read start signal for Path 1, G1058.1 is the External read start signal for Path 2, G2058.1 is for Path 3, and so on.

The following information comes from the Connection (Function) manual, the 'reference item' column is referring to chapters in that manual.

7.2.1. List by Function

This table lists the PMC addresses by what **FUNCTION** they are involved with.

- : Available
- : Available only with 2-path control
- : Unavailable

Function	Signal name	Symbol	Address	T	M	Reference item
2nd reference position return/3rd, 4th reference position return	2nd reference position return completion signals	ZP21~ZP27	F096.0~F096.6	○	○	4.4
	3rd reference position return completion signals	ZP31~ZP37	F098.0~F098.6	○	○	
	4th reference position return completion signals	ZP41~ZP47	F100.0~F100.6	○	○	
3-dimensional coordinate system conversion	3-dimensional coordinate system conversion manual interruption switch signal	M3R	G031.3	○	○	12.20
	3-dimensional coordinate conversion mode signal	D3ROT	F062.6	○	○	12.20
3-dimensional manual feed function	Tool axis direction feed mode signal	ALNGH	G023.7	—	○	3.7
	Tool axis right-angle direction feed mode signal	RGHTH	G023.6	—	○	3.7
	Tool tip center rotation feed mode signal	RNDH	G298.2	—	○	
	Table base signal	TB_BASE	G298.0	—	○	
Absolute position detection	Absolute position detector battery voltage zero alarm signal	PBATZ	F172.6	○	○	1.4.3
	Absolute position detector battery voltage low alarm signal	PBATL	F172.7	○	○	
Actual spindle speed output	Actual spindle speed signals	AR00~AR15	F040,F041	○	○	10.9
		AR002~AR152	F202,F203	○	○	
AI control I/II	AI contour control mode signal	AICC	F062.0	○	○	7.1.11
Alarm signal	Alarm signal	AL	F001.0	○	○	2.4
	Battery alarm signal	BAL	F001.2	○	○	
Angular axis control	Signal for disabling angular axis control for the perpendicular axis	NOZAGC	G063.5	○	○	1.8
Automatic data backup	Automatic data backup executing signal	ATBK	F520.0	○	○	
Auxiliary function lock	Auxiliary function lock signal	AFL	G005.6	○	○	9.2
	Auxiliary function lock check signal	MAFL	F004.4	○	○	
Auxiliary function output in moving axis	Auxiliary function during axis movement output signal	MVAF1~MVAF2	F316.4~F316.5	○	○	9.5

Function	Signal name	Symbol	Address	T	M	Reference item
Auxiliary function/2nd auxiliary function	Auxiliary function code signals	M00~M31	F010~F013	○	○	9.1
	Auxiliary function strobe signals	MF	F007.0	○	○	
	Decode M signals	DM00	F009.7	○	○	
		DM01	F009.6	○	○	
		DM02	F009.5	○	○	
		DM30	F009.4	○	○	
	Spindle function code signals	S00~S31	F022~F025	○	○	
	Spindle function strobe signal	SF	F007.2	○	○	
	Tool function code signals	T00~T31	F026~F029	○	○	
	Tool function strobe signal	TF	F007.3	○	○	
	2nd auxiliary function code signals	B00~B31	F030~F033	○	○	
	2nd auxiliary function strobe signal	BF	F007.7	○	○	
End signal	FIN	G004.3	○	○		
Distribution completion signals	DEN	F001.3	○	○		
Axis non-display	Axis non-display signals	NPOS1~NPOS7	G198.0~G198.6	○	○	
Axis synchronous control	Signals for selecting the manual feed axis for axis synchronous control	SYNCJ1~SYNCJ7	G140.0~G140.6	○	○	1.6
	Machine coordinate match state output signals	SYNMT1~SYNMT7	F210.0~F210.6	○	○	
	Axis synchronous control status signals	SYNO1~SYNO7	F532.0~F532.6	○	○	
	Synchronization compensation enable state output signals	SYNOF1~SYNOF7	F211.0~F211.6	○	○	
	Signal for indicating a positional deviation error alarm for axis synchronous control	SYNER	F403.0	○	○	
	Synchronous control axis selection signals	SYNC1~SYNC7	G138.0~G138.6	○	○	
	Signal for disabling torque difference alarm detection for axis synchronous control	NSYNCA	G059.7	○	○	
Canned cycle / multiple repetitive canned cycle	Chamfering signal	*CDZ	G053.7	○	—	12.8
Canned cycle for drilling	Small-hole peck drilling cycle in progress signal	PECK2	F066.5	—	○	12.7
	Tapping signal	TAP	F001.5	○	○	
Chuck / tail stock barrier	Tail stock barrier selection signal	*TSB	G060.7	○	—	2.3.6
CNC ready signal	CNC ready signal	MA	F001.7	○	○	2.2
	Servo ready signal	SA	F000.6	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
CNC screen dual display	Key control selection signal	CNCKY	G295.7	○	○	13.1.9
	Dual display forcible end request signal	C2SEND	G295.6	○	○	
	Key control selection status signal	CNCNYO	F295.7	○	○	
	Dual display forcible end status signal	C2SENO	F295.6	○	○	
Constant surface speed control	Constant surface speed signal	CSS	F002.2	○	○	10.8
Controlled axis detach	Controlled axis detach signals	DTCH1~DTCH7	G124.0~G124.6	○	○	1.2.5
	Controlled axis detach status signals	MDTCH1~ DTCH7	F110.0~F110.6	○	○	
Cs contour control	Cs contour control change signal	CON	G027.7	○	○	10.11.1
	Cs contour control change signal (for each spindle)	CONS1	G274.0	○	○	
		CONS2	G274.1	○	○	
		CONS3	G274.2	○	—	
	Cs contour control change completion signal	FSCSL	F044.1	○	○	
	Cs contour control change completion signal (for each spindle)	FCSS1	F274.0	○	○	
FCSS2		F274.1	○	○		
FCSS3		F274.2	○	—		
Cs contour control axis coordinate establishment	Cs axis coordinate establishment request signals	CSFI1	G274.4	○	○	10.11.3
		CSFI2	G274.5	○	○	
		CSFI3	G274.6	○	—	
	Cs axis coordinate establishment alarm signals	CSFO1	F274.4	○	○	
		CSFO2	F274.5	○	○	
		CSFO3	F274.6	○	—	
	Cs axis origin established state signals	CSPENA	F048.4	○	○	
		CSPENB	F052.4	○	○	
		CSPENC	F171.4	○	—	
Custom macro	Input signals for custom macro	UI000~UI031	G054~G057	○	○	12.6
		UI100~UI131	G276~G279	○	○	
		UI200~UI231	G280~G283	○	○	
		UI300~UI331	G284~G287	○	○	
	Output signals for custom macro	UO000~UO031	F054,F055, F276,F277	○	○	
		UO100~UO131	F056~F059	○	○	
		UO200~UO231	F280~F283	○	○	
		UO300~UO331	F284~F287	○	○	
Cycle start / feed hold	Cycle start signal	ST	G007.2	○	○	5.1
	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	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item	
Direct input of tool offset value measured	Position record signal	PRC	G040.6	○	—	15.4.1	
Direct input of tool offset value measured B	Tool offset number selection signals	OFN0~OFN5, OFN6~OFN9	G039.0~G039.5, G040.0~G040.3	○	—	15.4.2	
	Tool offset write mode select signal	GOQSM	G039.7	○	—		
	Workpiece coordinate system shift value write mode select signal	WOQSM	G039.6	○	—		
	Tool offset write signals	+MIT1,-MIT1 +MIT2,-MIT2	X004.2,X004.3 X004.4,X004.5	G132.0~G132.1 G134.0~G134.1	○		—
		+MIT1~+MIT2 -MIT1~-MIT2					
Workpiece coordinate system shift value write signal	WOSET	G040.7	○	—			
Direct operation by Open CNC	Direct operation select signal	DMMC	G042.7	○	○	5.13	
DNC operation	DNC operation select signal	DNCI	G043.5	○	○	5.11	
	DNC operation selection confirm signal	MRMT	F003.4	○	○	5.11, 5.13	
Dry run	Dry run signal	DRN	G046.7	○	○	5.3.2	
	Dry run check signal	MDRN	F002.7	○	○		
Each axis workpiece coordinate system preset signals	Each axis workpiece coordinate system preset signals	WPRST1 to WPRST7	G358.0~G358.6	○	○	1.5.2.6	
	Each axis workpiece coordinate system preset completion signals	WPSF1 to WPSF7	F358.0~F358.6	○	○		
Electronic gear box	Retract signal	RTRCT	G066.4	○	○	1.9, 6.13	
	Retract completion signal	RTRCTF	F065.4	○	○		
	EGB mode signal	SYNMOD	F065.6	○	○	1.9	
Emergency stop	Emergency stop signals	*ESP	G008.4	○	○	2.1	
			X008.4	○	○		
Extended external machine zero point shift	Extended external machine zero point shift signal	EMZ0~EMZ15	Specifying by parameter No.1280.	○	○	16.3	
External data input	Address signals for external data input	EA6~EA0	G002.6~G002.0	○	○	16.2	
	Data signals for external data input	ED31~ED0	G211,G210, G001,G000	○	○		
	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	○	○		
	Search cancel signal for external data input	ESCAN	F060.2	○	○		

Function	Signal name	Symbol	Address	T	M	Reference item
External deceleration	External deceleration signals 1	*+ED1~*+ED7	G118.0~G118.6	○	○	7.1.9
		-ED1~-ED7	G120.0~G120.6	○	○	
	External deceleration signals 2	*+ED21~*+ED27	G101.0~G101.6	○	○	
		-ED21~-ED27	G103.0~G103.6	○	○	
	External deceleration signals 3	*+ED31~*+ED37	G107.0~G107.6	○	○	
-ED31~-ED37		G109.0~G109.6	○	○		
External I/O device control	External read start signal	EXRD	G058.1	○	○	14.2
	External read/punch stop signal	EXSTP	G058.2	○	○	
	External punch start signal	EXWT	G058.3	○	○	
	Read/punch busy signal	RPBSY	F053.2	○	○	
	Read/punch alarm signal	RPALM	F053.3	○	○	
External key input	External key input mode selection signal	ENBKY	G066.1	○	○	16.5
	Key code signals	EKC0~EKC7	G098	○	○	
	Key code read signal	EKSET	G066.7	○	○	
	Key code read completion signal	EKENB	F053.7	○	○	
	Key input disable signal	INHKY	F053.0	○	○	
	Key input disable signal	PRGDPL	F053.1	○	○	
External workpiece number search	External workpiece number search signals	PN1,PN2,PN4,PN8,PN16	G009.0~G009.4	○	○	16.4
	Extended external workpiece number search signals	EPN0~EPN13	G024.0~G025.5	○	○	
	External workpiece number search start signal	EPNS	G025.7	○	○	
Feedrate override	Feedrate override signals	*FV0~*FV7	G012	○	○	7.1.7.2
Follow-up	Follow-up signal	*FLWU	G007.5	○	○	1.2.8
High-speed M/S/T/B interface	Auxiliary function completion signal	MFIN	G005.0	○	○	9.4
	Spindle function completion signal	SFIN	G005.2	○	○	
	Tool function completion signal	TFIN	G005.3	○	○	
	2nd auxiliary function completion signal	BFIN	G005.7	○	○	
	2nd M function completion signal	MFIN2	G004.4	○	○	
	3rd M function completion signal	MFIN3	G004.5	○	○	
High-speed skip signal	High-speed skip status signals	HDO0~HDO3	F122.0~F122.3	○	○	15.3.2
I/O Link β Manual handle interface (Peripheral equipment control interface)	Manual handle generators selection signal	IOLBH1, IOLBH2	G199.0, G199.1	○	○	3.4
In-feed control (for grinding machine)	In-feed control cut start signal	INFD	G063.6	—	○	12.9
In-position check	In-position signals	INP1~INP7	F104.0~F104.6	○	○	7.2.5
	In-position check signal	SMZ	G053.6	○	○	
Inch/metric conversion	Inch input signal	INCH	F002.0	○	○	12.5

Function	Signal name	Symbol	Address	T	M	Reference item
Index table indexing function	B axis clamp signal	BCLP	F061.1	—	○	13.12
	B axis clamp completion signal	*BECLP	G038.7	—	○	
	B axis unclamp signal	BUCLP	F061.0	—	○	
	B axis unclamp completion signal	*BEUCP	G038.6	—	○	
Interference check	Path interference check in progress signal	TICHK	F064.6	●	—	8.3
	Path interference alarm signal	TIALM	F064.7	●	—	
Interlock	Start lock signal	STLK	G007.1	○	○	2.5
	Interlock signal for all axes	*IT	G008.0	○	○	
	Interlock signal for each axis	*IT1~*IT7	G130.0~G130.6	○	○	
	Interlock signal for each axis direction	+MIT1~+MIT7 -MIT1~-MIT7	G132.0~G132.6 G134.0~G134.6	—	○	
	Cutting block start interlock signal	*CSL	G008.1	○	○	
	Block start interlock signal	*BSL	G008.3	○	○	
Interrupt type custom macro	Interrupt signal for custom macro	UINT	G053.3	○	○	12.6.2
Jog feed/incremental feed	Feed axis and direction selection signals	+J1~+J7 -J1~-J7	G100.0~G100.6 G102.0~G102.6	○	○	3.1
	Manual feedrate override signals	*JV0~*JV15	G010,G011	○	○	
	Manual rapid traverse selection signal	RT	G019.7	○	○	
Machine lock	All-axis machine lock signal	MLK	G044.1	○	○	5.3.1
	Each-axis machine lock signal	MLK1~MLK7	G108.0~G108.6	○	○	
	All-axis machine lock check signal	MMLK	F004.1	○	○	
Machine operation menu	Machine operation menu screen select signal	EXSFT	G295.0	○	○	13.4
	Machine operation menu select number notification signal	ESFM1~ESFM8	F317.0~G317.7	○	○	
	Soft key number select state notification signal	ESF01~ESF10	F318.0~G319.1	○	○	
Macro executor	Input signals for P-code macro	EUI00~EUI15	G082,G083	○	○	12.15
	Output signals for P-code macro	EUO00~EUO15	F084,F085	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
Manual absolute on/off	Manual absolute signal	*ABSM	G006.2	○	○	5.4
	Manual absolute check signal	MABSM	F004.2	○	○	
Manual handle feed	Manual handle feed axis selection signals	HS1A~HS1D	G018.0~G018.3	○	○	3.2
		HS2A~HS2D	G018.4~G018.7	○	○	
		HS3A~HS3D	G019.0~G019.3	—	○	
	Manual handle feed amount selection signals (incremental feed signals)	MP1,MP2	G019.4,G019.5	○	○	3.2, 3.5
	Manual handle feed amount selection signals	MP21, MP22 MP31, MP32	G087.0,G087.1 G087.3,G087.4	○	○	3.2
	Maximum manual handle feedrate switch signal	HNDLF	G023.3	○	○	
Manual handle feed direction inversion signal	HDN	G347.1	○	○		
Manual handle interrupt	Manual handle interrupt axis selection signals	HS1IA~HS1ID	G041.0~G041.3	○	○	3.3
		HS2IA~HS2ID	G041.4~G041.7	○	○	
		HS3IA~HS3ID	G042.0~G042.3	○	○	
Manual handle retrace	Checking mode signal	MMOD	G067.2	○	○	3.5
	Handle available signal in checking mode	MCHK	G067.3	○	○	
	Forward movement prohibition signal	FWSTP	G531.0	○	○	
	Reverse movement prohibition signal	MRVM	G531.1	○	○	
	Reverse movement signal	MRVMD	F091.0	○	○	
	Direction change prohibition signal	MNCHG	F091.1	○	○	
	Reverse movement prohibition signal	MRVSP	F091.2	○	○	
Check mode confirmation signal	MMMOD	F091.3	○	○		
Manual reference position return	Manual reference position return selection signal	ZRN	G043.7	○	○	4.1
	Manual reference position return selection check signal	MREF	F004.5	○	○	
	Reference position return deceleration signals	*DEC1~*DEC7	G196.0~G196.6 X009.0~X009.6	○ ○	○ ○	
		ZP1~ZP7	F094.0~F094.6	○	○	
	Reference position establishment signals	ZRF1~ZRF7	F120.0~F120.6	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
Manual tool compensation	Manual tool compensation tool number signal (4 digits)	MTLN00~MTLN15	G068,G069	○	—	11.1.4
	Manual tool compensation tool number signal (8 digits)	MT8N00~MT8N31	G525~G528	○	—	
	Manual tool compensation command number	MTLC	G067.0	○	—	
	Manual tool compensation completion signal	MTLA	F061.5	○	—	
	Manual tool compensation uncompleted signal	MTLANG	F061.4	○	—	
Memory protection key	Memory protection signals	KEY1~KEY4	G046.3~G046.6	○	○	13.2.1
		KEYP	G046.0	○	○	13.2.2
Mirror image	Mirror image signals	MI1~MI7	G106.0~G106.6	○	○	1.2.7
	Mirror image check signals	MMI1~MMI7	F108.0~F108.6	○	○	
Mode selection	Mode selection signals	MD1,MD2,MD4	G043.0~G0432	○	○	2.6
	Manual data input selection check signal	MMDI	F003.3	○	○	
	Automatic operation selection check signal	MMEM	F003.5	○	○	
	Memory edit selection check signal	MEDT	F003.6	○	○	
	Manual handle feed selection check signal	MH	F003.1	○	○	
	Incremental feed selection check signal	MINC	F003.0	○	○	
	Jog feed selection check signal	MJ	F003.2	○	○	
Multi-spindle control	Spindle selection signals	SWS1	G027.0	○	○	10.12
		SWS2	G027.1	○	○	
		SWS3	G027.2	○	—	
	Individual spindle stop signals	*SSTP1	G027.3	○	○	
		*SSTP2	G027.4	○	○	
		*SSTP3	G027.5	○	—	
	Gear selection signals (input)	GR21,GR22	G029.0,G029.1	○	○	
		GR31,GR32	G029.2,G029.3	○	—	
	2nd position coder selection signal	PC2SLC	G028.7	○	○	
	3rd position coder selection signal	PC3SLC	G026.0	○	○	
	4th position coder selection signal	PC4SLC	G026.1	○	○	
	2nd spindle speed override signals	SOV20 to SOV27	G376	○	○	
	3rd spindle speed override signals	SOV30 to SOV37	G377	○	—	
Spindle command path specification signal	SPSP	G536.7	○	○		

Function	Signal name	Symbol	Address	T	M	Reference item
Multi-spindle control	Spindle enable signal	ENB2	F038.2	○	○	10.12
		ENB3	F038.3	○	—	
	S 12-bit code signals	R01O2~R12O2	F200.0~F201.3	○	○	
		R01O3~R12O3	F204.0~F205.3	○	○	
		R01O4~R12O4	F270.0~F271.3	○	○	
Multi-spindle address P signals	MSP00~MSP15	F160,F161	○	○		
Multi-step skip function	Skip signal	SKIPP	G006.6	○	○	15.3.3
		SKIP	X004.7	○	○	
		SKIP2~SKIP6, SKIP7,SKIP8	X004.2~X004.6 X004.0,X004.1	○	○	
Multiple M commands in a single block	2nd M function code signals	M200~M215	F014,F015	○	○	9.3
	3rd M function code signals	M300~M315	F016,F017	○	○	
	2nd M function strobe signal	MF2	F008.4	○	○	
	3rd M function strobe signal	MF3	F008.5	○	○	
One-digit F code feed	One-digit F code feed signal	F1D	G016.7	—	○	7.1.5
One touch macro call	Macro call start signal	MCST1~MCST16	G512,G513	○	○	16.6
	Mode change completion signal	MCFIN	G514.0	○	○	
	Macro call executing signal	MCEXE	F512.0	○	○	
	Mode change request signal	MCRQ	F512.1	○	○	
	Mode notification signal	MD1R	F513.0	○	○	
		MD2R	F513.1	○	○	
		MD4R	F513.2	○	○	
		DNCIR	F513.5	○	○	
ZRNR	F513.7	○	○			
Abnormal end signal	MCSP	F512.2	○	○		
Call program confirmation signal	MCEX1~MCEX16	F514,F515	○	○		
Optional block skip/addition of optional block skip	Optional block skip signals	BDT1	G044.0	○	○	5.5
		BDT2~BDT9	G045	○	○	
	Optional block skip check signals	MBDT1	F004.0	○	○	
		MBDT2~MBDT9	F005	○	○	
Outputting the movement state of an axis	Axis moving signals	MV1~MV7	F102.0~F102.6	○	○	1.2.6
	Axis moving direction signals	MVD1~MVD7	F106.0~F106.6	○	○	
Override cancel	Override cancel signal	OVC	G006.4	○	○	7.1.7.4
Overtravel	Overtravel signals	*+L1~*+L7	G114.0~G114.6	○	○	2.3.1
		-L1~-L7	G116.0~G116.6	○	○	
Path select	Path select signal (Tool post select signal)	HEAD	G063.0	●	—	8.11, 13.3

Function	Signal name	Symbol	Address	T	M	Reference item
Path spindle control	Path spindle command selection signals	SLSPA,SLSPB	G063.2,G063.3	●	—	8.8
	Path spindle feedback selection signals	SLPCA,SLPCB	G064.2,G064.3	●	—	
	Path spindle command confirmation signal	COSP	F064.5	●	—	
	Path spindle command confirmation signal	COSP1 COSP2	F063.3 F063.4	● ●	— —	
Paths polygon turning	Polygon spindle stop signal	*PLSST	G038.0	○	○	6.9.2
	Polygon spindle speed arrival signal	PSAR	F063.2	○	○	
	Polygon master axis not arrival signal	PSE1	F063.0	○	○	
	Polygon synchronization axis not arrival signal	PSE2	F063.1	○	○	
PMC axis control/PMC axis speed control function	Control axis selection signals (PMC axis control)	EAX1~EAX7	G136.0~G136.6	○	○	16.1
	Axis control command signals (for group 1 to 4) (PMC axis control)	EC0A~EC6A	G143.0~G143.6	○	○	
		EC0B~EC6B	G155.0~G155.6	○	○	
		EC0C~EC6C	G167.0~G167.6	○	○	
		EC0D~EC6D	G179.0~G179.6	○	○	
	Axis control feedrate signals (for group 1 to 4) (PMC axis control)	EIF0A~EIF15A	G144~G145	○	○	
		EIF0B~EIF15B	G156~G157	○	○	
		EIF0C~EIF15C	G168~G169	○	○	
		EIF0D~EIF15D	G180~G181	○	○	
	Axis control command read signals (for group 1 to 4) (PMC axis control)	EBUFA	G142.7	○	○	
		EBUFB	G154.7	○	○	
		EBUFC	G166.7	○	○	
		EBUFD	G178.7	○	○	
	Axis control data signals (for group 1 to 4) (PMC axis control)	EID0A~EID31A	G146~G149	○	○	
		EID0B~EID31B	G158~G161	○	○	
		EID0C~EID31C	G170~G173	○	○	
		EID0D~EID31D	G182~G185	○	○	
	Axis control command read completion signals (for group 1 to 4) (PMC axis control)	EBSYA	F130.7	○	○	
		EBSYB	F133.7	○	○	
		EBSYC	F136.7	○	○	
		EBSYD	F139.7	○	○	
	Reset signals (for group 1 to 4) (PMC axis control)	ECLRA	G142.6	○	○	
		ECLRB	G154.6	○	○	
		ECLRC	G166.6	○	○	
	Axis control temporary stop signals (for group 1 to 4) (PMC axis control)	ECLRD	G178.6	○	○	
		ESTPA	G142.5	○	○	
		ESTPB	G154.5	○	○	
ESTPC		G166.5	○	○		
Block stop signals (for group 1 to 4) (PMC axis control)	ESTPD	G178.5	○	○		
	ESBKA	G142.3	○	○		
	ESBKB	G154.3	○	○		
	ESBKC	G166.3	○	○		
	ESBKD	G178.3	○	○		

Function	Signal name	Symbol	Address	T	M	Reference item
PMC axis control/PMC axis speed control function	Block stop disable signals (for group 1 to 4) (PMC axis control)	EMSBKA	G143.7	○	○	16.1
		EMSBKB	G155.7	○	○	
		EMSBKC	G167.7	○	○	
		EMSBKD	G179.7	○	○	
	Auxiliary function code signals (for group 1 to 4) (PMC axis control)	EM11A~EM48A	F132,F142	○	○	
		EM11B~EM48B	F135,F145	○	○	
		EM11C~EM48C	F138,F148	○	○	
		EM11D~EM48D	F141,F151	○	○	
	Auxiliary function strobe signals (for group 1 to 4) (PMC axis control)	EMFA	F131.0	○	○	
		EMFB	F134.0	○	○	
		EMFC	F137.0	○	○	
		EMFD	F140.0	○	○	
	Auxiliary function 2nd strobe signals (for group 1 to 4) (PMC axis control)	EMF2A	F131.2	○	○	
		EMF2B	F134.2	○	○	
		EMF2C	F137.2	○	○	
		EMF2D	F140.2	○	○	
	Auxiliary function 3rd strobe signals (for group 1 to 4) (PMC axis control)	EMF3A	F131.3	○	○	
		EMF3B	F134.3	○	○	
		EMF3C	F137.3	○	○	
		EMF3D	F140.3	○	○	
	Auxiliary function completion signal (for group 1 to 4) (PMC axis control)	EFINA	G142.0	○	○	
		EFINB	G154.0	○	○	
		EFINC	G166.0	○	○	
		EFIND	G178.0	○	○	
	Servo off signals (for group 1 to 4) (PMC axis control)	ESOFA	G142.4	○	○	
		ESOFB	G154.4	○	○	
		ESOFC	G166.4	○	○	
		ESOFD	G178.4	○	○	
	Buffering disable signals (for group 1 to 4) (PMC axis control)	EMBUFA	G142.2	○	○	
		EMBUFB	G154.2	○	○	
		EMBUFC	G166.2	○	○	
		EMBUFD	G178.2	○	○	
	Controlled axis selection status signals (PMC axis control)	*EAXSL	F129.7	○	○	
	In-position signals (for group 1 to 4) (PMC axis control)	EINPA	F130.0	○	○	
		EINPB	F133.0	○	○	
		EINPC	F136.0	○	○	
		EINPD	F139.0	○	○	
	Following zero checking signals (for group 1 to 4) (PMC axis control)	ECKZA	F130.1	○	○	
		ECKZB	F133.1	○	○	
		ECKZC	F136.1	○	○	
		ECKZD	F139.1	○	○	
	Alarm signal (for group 1 to 4) (PMC axis control)	EIALA	F130.2	○	○	
		EIALB	F133.2	○	○	
		EIALC	F136.2	○	○	
		EIALD	F139.2	○	○	
	Axis moving signals (for group 1 to 4) (PMC axis control)	EGENA	F130.4	○	○	
		EGENB	F133.4	○	○	
		EGENC	F136.4	○	○	
		EGEND	F139.4	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
PMC axis control/PMC axis speed control function	Auxiliary function executing signals (for group 1 to 4) (PMC axis control)	EDENA	F130.3	○	○	16.1
		EDENB	F133.3	○	○	
		EDENC	F136.3	○	○	
		EDEND	F139.3	○	○	
	Negative-direction overtravel signals (for group 1 to 4) (PMC axis control)	EOTNA	F130.6	○	○	
		EOTNB	F133.6	○	○	
		EOTNC	F136.6	○	○	
		EOTND	F139.6	○	○	
	Positive-direction overtravel signals (for group 1 to 4) (PMC axis control)	EOTPA	F130.5	○	○	
		EOTPB	F133.5	○	○	
		EOTPC	F136.5	○	○	
		EOTPD	F139.5	○	○	
	Feedrate override signals (for group 1 to 4) (PMC axis control)	*EFOV0~*EFOV7	G151	○	○	
		*EFOV0B~*EFOV7B	G163	○	○	
		*EFOV0C~*EFOV7C	G175	○	○	
		*EFOV0D~*EFOV7D	G187	○	○	
	Override cancel signal (for group 1 to 4) (PMC axis control)	EOVC	G150.5	○	○	
		EOVCB	G162.5	○	○	
		EOVCC	G174.5	○	○	
		EOVCD	G186.5	○	○	
	Rapid traverse override signals (PMC axis control)	EROV1,EROV2	G150.0,G150.1	○	○	
	Dry run signal (PMC axis control)	EDRN	G150.7	○	○	
	Manual rapid traverse selection signal (PMC axis control)	ERT	G150.6	○	○	
	Override 0% signal (PMC axis control)	EOV0	F129.5	○	○	
	Skip signal (PMC axis control)	ESKIP	X004.6	○	○	
	Distribution completion signals (PMC axis control)	EADEN1~EADEN7	F112.0~F112.6	○	○	
	Buffer full signals (for group 1 to 4) (PMC axis control)	EABUFA	F131.1	○	○	
		EABUFB	F134.1	○	○	
		EABUFC	F137.1	○	○	
		EABUFD	F140.1	○	○	
	Controlling signals (PMC axis control)	EACNT1~EACNT7	F182.0~F182.6	○	○	
	Accumulated zero check signal (for group 1 to 4) (PMC axis control)	ELCKZA	G142.1	○	○	
		ELCKZB	G154.1	○	○	
		ELCKZC	G166.1	○	○	
ELCKZD		G178.1	○	○		
Torque control mode signal (PMC axis control)	TRQM1~TRQM8	F190	○	○		
A/B phase detector disconnection alarm ignore signal (PMC axis control)	NDCAL1~NDCAL8	G202	○	○		

Function	Signal name	Symbol	Address	T	M	Reference item
Polygon turning	Polygon synchronization under way signal	PSYN	F063.7	○	○	6.9
Position switch	Position switch signals	PSW01~PSW16	F070,F071	○	○	1.2.10
Program restart	Program restart signal	SRN	G006.0	○	○	5.7
	Program restart under way signal	SRNMV	F002.4	○	○	
Rapid traverse block overlap	Rapid traverse block overlap disable signal	ROVLP	G053.5	○	○	7.2.1.2
Rapid traverse override	Rapid traverse override signals	ROV1,ROV2	G014.0,G014.1	○	○	7.1.7.1
	1% step rapid traverse override selection signals	HROV	G096.7	○	○	7.1.7.1
	1% rapid traverse override signals	*HROV0~*HROV6	G096.0~G096.6	○	○	7.1.9
	0.1% step rapid traverse override selection signals	FHROV	G353.7	○	○	7.1.7.1
	0.1% rapid traverse override signals	*FHRO0~*FHRO9	G352.0~G352.7 G353.0~G353.1	○	○	
Reference position setting with mechanical stopper	Torque limit reach signals for reference position setting with mechanical stopper	CLRCH1~CLRCH7	F180.0~F180.6	○	○	4.5
Reset and rewind	External reset signal	ERS	G008.7	○	○	5.2
	MDI reset confirmation signal	MDIRST	F006.1	○	○	
	Reset & rewind signal	RRW	G008.6	○	○	
	Resetting signal	RST	F001.1	○	○	
	Rewinding signal	RWD	F000.0	○	○	
Retrace	Reverse execution signal	RVS	G007.0	—	○	5.8
	Reverse execution in-progress signal	RVSL	F082.2	—	○	
Retraction for Rigid tapping	Rigid tapping retraction start signal	RTNT	G062.6	—	○	5.10
	Rigid tapping retraction completion signal	RTPT	F066.1	—	○	
Rigid tapping	Rigid tapping signal	RGTAP	G061.0	○	○	10.13
	Spindle rotation direction signals	RGSP	F065.0	○	○	
		RGSPM	F065.1	○	○	
	Rigid tapping-in-progress signal	RTAP	F076.3	○	○	
Rigid tapping spindle selection signals	RGTSP1~RGTSP3	G061.4~G061.6	○	—		
Run hour and part count display	Target part count reached signal	PRTSF	F062.7	○	○	13.1.1
	General-purpose integrating meter start signal	TMRON	G053.0	○	○	
Screen erasure	Automatic screen erasing signal	ERTVA	F006.2	○	○	13.1.12

Function	Signal name	Symbol	Address	T	M	Reference item
Screen hard copy function	Hard copy cancellation request signal	HCABT	G067.6	○	○	13.1.14
	Hard copy execution request signal	HCREQ	G067.7	○	○	
	Hard copy cancellation request reception signal	HCAB2	F061.2	○	○	
	Hard copy execution status signal	HCEXE	F061.3	○	○	
Servo axis control	Servo warning detail signals	SVWRN1	F093.4	○	○	18.1
		SVWRN2	F093.5	○	○	
		SVWRN3	F093.6	○	○	
		SVWRN4	F093.7	○	○	
Servo off / mechanical handle feed	Servo off signals	SVF1~SVF7	G126.0~G126.6	○	○	1.2.9
Simple spindle electronic gear box	Simple spindle EGB signals	SSEGB1	G351.0	○	○	10.21
		SSEGB2	G351.1	○	○	
		SSEGB3	G351.2	○	—	
	Simple spindle EGB mode signals	SSEGBM1	F351.0	○	○	
		SSEGBM2	F351.1	○	○	
SSEGBM3	F351.2	○	—			
Simple spindle synchronous control	Simple spindle synchronous control signal	ESRSYC	G064.6	—	○	10.17
	Simple spindle synchronous control signal (for each spindle)	ESSYC1	G264.0	—	○	
		ESSYC2	G264.1	—	○	
	1st spindle parking signal	PKESS1	G122.6 (G031.6)	—	○	
	2nd spindle parking signal	PKESS2	G122.7 (G031.7)	—	○	
	Simple spindle synchronous parking signal (for each spindle)	PKESE1	G265.0	—	○	
		PKESE2	G265.1	—	○	
	Phase error monitor signal	SYCAL	F044.4	○	○	
Phase error monitor signal (for each spindle)	SYCAL1	F043.0	○	○		
	SYCAL2	F043.1	○	○		
Single block	Single block signal	SBK	G046.1	○	○	5.3.3
	Single block check signal	MSBK	F004.3	○	○	
Skip function	Skip signal	SKIPP	G006.6	○	○	15.3
		SKIP	X004.7	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
Software operator's panel	Software operator's panel signal (MD1)	MD1O	F073.0	○	○	13.1.2
	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~+J4)	+J1O~+J4O	F081.0,F081.2, F081.4,F081.6	○	○	
	Software operator's panel signal (-J1~-J4)	-J1O~-J4O	F081.1,F081.3, F081.5,F081.7	○	○	
	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	○	○	
	Software operator's panel signal (MP2)	MP2O	F076.1	○	○	
	Software operator's panel signal (*JV0~*JV15)	*JV0O~*JV15O	F079,F080	○	○	
	Software operator's panel signal (*FV0~*FV7)	*FV0O~*FV7O	F078	○	○	
	Software operator's panel signal (ROV1)	ROV1O	F076.4	○	○	
	Software operator's panel signal (ROV2)	ROV2O	F076.5	○	○	
	Software operator's panel signal (BDT)	BDTO	F075.2	○	○	
	Software operator's panel signal (SBK)	SBKO	F075.3	○	○	
	Software operator's panel signal (MLK)	MLKO	F075.4	○	○	
	Software operator's panel signal (DRN)	DRNO	F075.5	○	○	
	Software operator's panel signal (KEY1~KEY4)	KEYO	F075.6	○	○	
Software operator's panel signal (*SP)	SPO	F075.7	○	○		
Software operator's panel general-purpose switch signals	OUT0~OUT15	F072,F074	○	○		
Speed display function of a milling tool with servo motor	Speed display change signal	SDPC	G38.5	○	○	13.1.10

Function	Signal name	Symbol	Address	T	M	Reference item
Spindle control with servo motor	SV speed control mode signals	SRVON1~SRVON7	G521.0~G521.6	○	○	10.19
	SV reverse signals	SVRVS1~SVRVS7	G523.0~G523.6	○	○	
	SV speed control mode in-progress signals	SVREV1~SVREV7	F521.0~F521.6	○	○	
	Spindle indexing signal for each axis	SPP1~SPP7	F522.0~F522.6	○	○	
Spindle orientation	Spindle orientation external stop position command signals	SH00A~SH11A	G078.0~G079.3	○	○	10.15
		SH00B~SH11B	G080.0~G081.3	○	○	
		SH00C~SH11C	G0208~G0209.3	○	—	
Spindle output control by the PMC	Spindle motor speed command selection signals	SIND	G033.7	○	○	10.7
		SIND2	G035.7	○	○	
		SIND3	G037.7	○	—	
	Spindle motor speed command signals	R011~R12I	G032.0~G033.3	○	○	
		R0112~R12I2	G034.0~G035.3	○	○	
		R0113~R12I3	G036.0~G037.3	○	—	
	Spindle motor command polarity selection signals	SSIN	G033.6	○	○	
		SSIN2	G035.6	○	○	
		SSIN3	G037.6	○	—	
	Spindle motor command polarity command signals	SGN	G033.5	○	○	
SGN2		G035.5	○	○		
SGN3		G037.5	○	—		
Spindle positioning	Spindle stop completion signal	SPSTPA	G028.6	○	○	10.10
		SPSTPB	G402.1	○	○	
		SPSTPC	G402.2	○	—	
	Spindle unclamp signal	SUCLPA	F038.1	○	○	
		SUCLPB	F400.1	○	○	
		SUCLPC	F400.2	○	—	
	Spindle unclamp completion signal	*SUCPFA	G028.4	○	○	
		*SUCPFB	G400.1	○	○	
		*SUCPFC	G400.2	○	—	
	Spindle clamp completion signal	*SCPFA	G028.5	○	○	
		*SCPFB	G401.1	○	○	
		*SCPFC	G401.2	○	—	
	Spindle clamp signal	SCLPA	F038.0	○	○	
		SCLPB	F401.1	○	○	
		SCLPC	F401.2	○	—	
Spindle positioning mode signals	MSPOSA	F039.0	○	○		
	MSPOSB	F402.1	○	○		
	MSPOSC	F402.2	○	—		
Spindle revolution number history	Total spindle revolution number reset signals	SSR1	G533.0	○	○	10.20
		SSR2	G533.1	○	○	
		SSR3	G533.2	○	—	
	Total spindle revolution number reset selection signal	SSRS	G533.4	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
Spindle serial output	Torque limit command LOW signals (serial spindle)	TLMLA	G070.0	○	○	10.3
		TLMLB	G074.0	○	○	
		TLMLC	G204.0	○	—	
	Torque limit command HIGH signals (serial spindle)	TLMHA	G070.1	○	○	
		TLMHB	G074.1	○	○	
		TLMHC	G204.1	○	—	
	Clutch/gear signals (serial spindle)	CTH1A,CTH2A	G070.3,G070.2	○	○	
		CTH1B,CTH2B	G074.3,G074.2	○	○	
		CTH1C,CTH2C	G204.3,G204.2	○	—	
	CCW command signals (serial spindle)	SRVA	G070.4	○	○	
		SRVB	G074.4	○	○	
		SRVC	G204.4	○	—	
	CW command signals (serial spindle)	SFRA	G070.5	○	○	
		SFRB	G074.5	○	○	
		SFRC	G204.5	○	—	
	Orientation command signals (serial spindle)	ORCMA	G070.6	○	○	10.3 10.14
		ORCMB	G074.6	○	○	
		ORCMC	G204.6	○	—	
	Machine ready signals (serial spindle)	MRDYA	G070.7	○	○	10.3
		MRDYB	G074.7	○	○	
		MRDYC	G204.7	○	—	
	Alarm reset signals (serial spindle)	ARSTA	G071.0	○	○	
		ARSTB	G075.0	○	○	
		ARSTC	G205.0	○	—	
	Emergency stop signals (serial spindle)	*ESPA	G071.1	○	○	
		*ESPB	G075.1	○	○	
		*ESPC	G205.1	○	—	
	Spindle selection signals (serial spindle)	SPSLA	G071.2	○	○	
		SPSLB	G075.2	○	○	
		SPSLC	G205.2	○	—	
	Power line switch completion signals (serial spindle)	MCFNA	G071.3	○	○	
		MCFNB	G075.3	○	○	
		MCFNC	G205.3	○	—	
	Soft start/stop cancel signals (serial spindle)	SOCNA	G071.4	○	○	
		SOCNB	G075.4	○	○	
		SOCNC	G205.4	○	—	
Speed integral signals (serial spindle)	INTGA	G071.5	○	○		
	INTGB	G075.5	○	○		
	INTGC	G205.5	○	—		
Output switch request signals (serial spindle)	RSLA	G071.6	○	○		
	RSLB	G075.6	○	○		
	RSLC	G205.6	○	—		
Power line status check signals (serial spindle)	RCHA	G071.7	○	○		
	RCHB	G075.7	○	○		
	RCHC	G205.7	○	—		
Orientation stop position change command signals (serial spindle)	INDXA	G072.0	○	○		
	INDXB	G076.0	○	○		
	INDXC	G206.0	○	—		
Rotational direction command signals for orientation stop position change (serial spindle)	ROTAA	G072.1	○	○		
	ROTAB	G076.1	○	○		
	ROTAC	G206.1	○	—		

Function	Signal name	Symbol	Address	T	M	Reference item
Spindle serial output	Shortcut command signals for orientation stop position change (serial spindle)	NRROA	G072.2	○	○	10.3
		NRROB	G076.2	○	○	
		NRROC	G206.2	○	—	
	Differential speed mode command signals (serial spindle)	DEFMDA	G072.3	○	○	
		DEFMDB	G076.3	○	○	
		DEFMDC	G206.3	○	—	
	Analog override signals (serial spindle)	OVRA	G072.4	○	○	
		OVRB	G076.4	○	○	
		OVRC	G206.4	○	—	
	Incremental command externally set orientation signals (serial spindle)	INCMDA	G072.5	○	○	
		INCMDB	G076.5	○	○	
		INCMDC	G206.5	○	—	
	Spindle switch MAIN MCC contact status signals (serial spindle)	MFNHGA	G072.6	○	○	
		MFNHGB	G076.6	○	○	
		MFNHGC	G206.6	○	—	
	Spindle switch HIGH MCC contact status signals (serial spindle)	RCHHGA	G072.7	○	○	
		RCHHGB	G076.7	○	○	
		RCHHGC	G206.7	○	—	
	Magnetic sensor orientation command signals (serial spindle)	MORCMA	G073.0	○	○	
		MORCMB	G077.0	○	○	
		MORCMC	G207.0	○	—	
	Subordinate operation mode command signals (serial spindle)	SLVA	G073.1	○	○	
		SLVB	G077.1	○	○	
		SLVC	G207.1	○	—	
	Motor power cutoff command signals (serial spindle)	MPOFA	G073.2	○	○	
		MPOFB	G077.2	○	○	
		MPOFC	G207.2	○	—	
	Alarm signals (serial spindle)	ALMA	F045.0	○	○	
		ALMB	F049.0	○	○	
		ALMC	F168.0	○	—	
	Speed zero signals (serial spindle)	SSTA	F045.1	○	○	
		SSTB	F049.1	○	○	
		SSTC	F168.1	○	—	
	Speed detection signals (serial spindle)	SDTA	F045.2	○	○	
		SDTB	F049.2	○	○	
		SDTC	F168.2	○	—	
	Spindle speed arrival signal (serial spindle)	SARA	F045.3	○	○	
		SARB	F049.3	○	○	
		SARC	F168.3	○	—	
	Load detection signals 1 (serial spindle)	LDT1A	F045.4	○	○	
LDT1B		F049.4	○	○		
LDT1C		F168.4	○	—		
Load detection signals 2 (serial spindle)	LDT2A	F045.5	○	○		
	LDT2B	F049.5	○	○		
	LDT2C	F168.5	○	—		
Torque limit signals (serial spindle)	TLMA	F045.6	○	○		
	TLMB	F049.6	○	○		
	TLMC	F168.6	○	—		
Orientation completion signals (serial spindle)	ORARA	F045.7	○	○		
	ORARB	F049.7	○	○		
	ORARC	F168.7	○	—		

Function	Signal name	Symbol	Address	T	M	Reference item
Spindle serial output	Power line switch signals (serial spindle)	CHPA	F046.0	○	○	10.3
		CHPB	F050.0	○	○	
		CHPC	F169.0	○	—	
	Spindle switch completion signals (serial spindle)	CFINA	F046.1	○	○	
		CFINB	F050.1	○	○	
		CFINC	F169.1	○	—	
	Output switch signals (serial spindle)	RCHPA	F046.2	○	○	
		RCHPB	F050.2	○	○	
		RCHPC	F169.2	○	—	
	Output switch completion signals (serial spindle)	RCFNA	F046.3	○	○	
		RCFNB	F050.3	○	○	
		RCFNC	F169.3	○	—	
	Subordinate operation status signals (serial spindle)	SLVSA	F046.4	○	○	
		SLVSB	F050.4	○	○	
		SLVSC	F169.4	○	—	
	Position coder orientation proximity signal (serial spindle)	PORA2A	F046.5	○	○	
		PORA2B	F050.5	○	○	
		PORA2C	F169.5	○	—	
	Magnetic sensor orientation completion signals (serial spindle)	MORA1A	F046.6	○	○	
		MORA1B	F050.6	○	○	
		MORA1C	F169.6	○	—	
	Magnetic sensor orientation proximity signals (serial spindle)	MORA2A	F046.7	○	○	
		MORA2B	F050.7	○	○	
		MORA2C	F169.7	○	—	
	Position coder one-rotation signal detection status signals (serial spindle)	PC1DEA	F047.0	○	○	
		PC1DEB	F051.0	○	○	
		PC1DEC	F170.0	○	—	
Incremental orientation mode signals (serial spindle)	INCSTA	F047.1	○	○		
	INCSTB	F051.1	○	○		
	INCSTC	F170.1	○	—		
All-spindle operation ready signal	SRSRDY	F034.7	○	○		
1st serial spindle ready signals	SRSP1R	F034.6	○	○		
2nd serial spindle ready signals	SRSP2R	F034.5	○	○		
Spindle warning detail signals 1 to 9	SPWRN1~SPWRN9	F264.0~F265.0	○	○		
Spindle speed control	Spindle stop signal	*SSTP	G029.6	○	○	10.6
	Spindle orientation signal	SOR	G029.5	○	○	
	Spindle speed override signals	SOV0~SOV7	G030	○	○	
	Spindle speed arrival signal	SAR	G029.4	○	○	
	Spindle enable signal	ENB	F001.4	○	○	
	Gear selection signals (output)	GR10,GR20,GR30	F034.0~F034.2	—	○	
	Gear selection signals (input)	GR1	G028.1	○	○	
GR2		G028.2	○	○		
S 12-bit code signals	R010~R120	F036.0~F037.3	○	○		
Spindle speed fluctuation detection	Spindle fluctuation detection alarm signal	SPAL	F035.0	○	○	10.18

Function	Signal name	Symbol	Address	T	M	Reference item
Spindle synchronous control	Spindle synchronous control signal	SPSYC	G038.2	○	○	10.14
	Spindle synchronous control signal (for each spindle)	SPSYC1	G288.0	○	○	
		SPSYC2	G288.1	○	○	
		SPSYC3	G288.2	○	—	
	Spindle phase synchronous control signal	SPPHS	G038.3	○	○	
	Spindle phase synchronous control signal (for each spindle)	SPPHS1	G289.0	○	○	
		SPPHS2	G289.1	○	○	
		SPPHS3	G289.2	○	—	
	Spindle phase synchronous control signal	FSPSY	F044.2	○	○	
	Spindle phase synchronous control signal (for each spindle)	FSPSY1	F288.0	○	○	
		FSPSY2	F288.1	○	○	
		FSPSY3	F288.2	○	—	
	Spindle synchronous speed control completion signal	FSPPH	F044.3	○	○	
	Spindle synchronous speed control completion signal (for each spindle)	FSPPH1	F289.0	○	○	
		FSPPH2	F289.1	○	○	
FSPPH3		F289.2	○	—		
Phase error monitor signal	SYCAL	F044.4	○	○		
Phase error monitor signal (for each spindle)	SYCAL1	F043.0	○	○		
	SYCAL2	F043.1	○	○		
	SYCAL3	F043.2	○	—		
Spindle synchronous speed ratio control clamp signal	RSMAX	F065.2	○	○		
Spindle synchronous speed ratio control signal	SBRT	G038.1	○	○		
Status output signal	Rapid traversing signal	RPDO	F002.1	○	○	2.7.7.1.1
	Cutting feed signal	CUT	F002.6	○	○	2.7
Stored stroke check	Stored stroke limit 1 switching signals in axis direction	+EXL1~+EXL7	G104.0~G104.6	○	○	2.3.2
		-EXL1~-EXL7	G105.0~G105.6	○	○	
	Stored stroke limit 1 change signal	EXLM	G007.6	○	○	
	Stroke limit 1 release signal	RLSOT	G007.7	○	○	
	Overtravel alarm signals	+OT1~+OT7	F124.0~F124.6	○	○	
-OT1~-OT7		F126.0~F126.6	○	○		
Stored stroke check 2, 3	Stroke limit 3 release signal	RLSOT3	G007.4	○	○	2.3.3
Stroke limit external setting	Stroke limit external setting signals	+LM1~+LM7	G110.0~G110.6	○	○	2.3.5
		-LM1~-LM7	G112.0~G112.6	○	○	

Function	Signal name	Symbol	Address	T	M	Reference item
Superimposed control	Superimposed control axis selection signals	OVLS1~OVLS7	G190.0~G190.6	○	○	8.6
	Superimposed control master axis confirmation signals	OVM01~OVM07	F344.0~F344.6	○	○	
Superimposed control	Superimposed control slave axis confirmation signals	OVS01~OVS07	F345.0~F345.6	○	○	8.6
	Synchronous/composite/superimposed control under way signals	SYN10~SYN70	F118.0~F118.6	○	○	
Synchronous and composite control	Composite control axis change selection signals	MIX1~MIX7	G128.0~G128.6	○	○	8.5
	Composite axis confirmation signals	MIX01~MIX07	F343.0~F343.6	○	○	
	Synchronous control axis selection signals	SYNC1~SYNC7	G138.0~G138.6	○	○	
	Synchronous master axis confirmation signals	SYCM1~SYCM7	F341.0~F341.6	○	○	
	Synchronous slave axis confirmation signals	SYCS1~SYCS7	F342.0~F342.6	○	○	
	Synchronous/composite/superimposed control under way signals	SYN10~SYN70	F118.0~F118.6	○	○	
	Parking signals	PK1~PK7	G122.0~G122.6	○	○	
	Parking axis confirmation signals	SMPK1~SMPK7	F346.0~F346.6	○	○	
Threading	Threading signal	THRD	F002.3	○	○	6.5
Tool life management	Tool change signal	TLCH	F064.0	○	○	11.4
	Tool change reset signal	TLRST	G048.7	○	○	
	Individual tool change signal	TLCHI	F064.2	○	○	
	Individual tool change reset signal	TLRSTI	G048.6	○	○	
	Tool skip signal	TLSKP	G048.5	○	○	
	New tool select signal	TLNW	F064.1	○	○	
	Tool group number selection signals	TL01 to TL256	G047.0~G048.0	○	○	
	Tool life count override signals	*TLV0 to *TLV9	G049.0~G050.1	○	○	
	Tool life arrival notice signal	TLCHB	F064.3	○	○	
	Tool life counting disable signal	LFCIV	G048.2	○	○	
	Tool life counting disable signal	LFCIF	F093.2	○	○	
	Remaining tool count notification signal	TLAL	F154.0	—	○	
Torque limit skip	Torque limit reached signals	TRQL1~TRQL7	F114.0~F114.6	○	○	15.3.4
Touch panel check signal	Touch panel check signal	TPPRS	F006.0	○	○	13.1.6

Function	Signal name	Symbol	Address	T	M	Reference item
Trouble diagnosis	Trouble forecast signal (For the thermal simulation data)	TDSML1~TDSML8	F298.0~F298.7	○	○	18.3
	Trouble forecast signal (For the disturbance level)	TDFTR1~TDFLR8	F299.0~F299.7	○	○	
Unexpected disturbance torque detection	Unexpected disturbance torque detection ignore signal	IUDD1~IUDD5	G125.0~G125.4	○	○	2.9
	Unexpected disturbance torque detection signal	ABDT1~ABDT5	F184.0~F184.4	○	○	
	Servo axis unexpected disturbance torque detection signal	ABTQSV	F090.0	○	○	
	1st spindle unexpected disturbance torque detection signal	ABTSP1	F090.1	○	○	
	2nd spindle unexpected disturbance torque detection signal	ABTSP2	F090.2	○	○	
	3rd spindle unexpected disturbance torque detection signal	ABTSP3	F090.3	○	—	
VRDY off alarm ignore signal	All-axis VRDY off alarm ignore signal	IGNVRY	G066.0	○	○	2.8
	Each-axis VRDY off alarm ignore signal	IGVRY1~IGVRY7	G192.0~G192.6	○	○	
Waiting M code	No-wait signal	NOWT	G063.1	●	—	8.2
	No-wait signal	NMWT	G063.7	●	—	
	Waiting signal	WATO	F063.6	●	—	
Warning function against modification of setting	Notification signal for modification of C language executor program	CDCEX	F558.0	○	○	13.1.14
	Notification signal for modification of 1st path PMC Ladder program	CDLAD1	F558.1	○	○	
	Notification signal for modification of Dual Check Safety PMC Ladder program	CDDCL	F558.4	○	○	
	Notification signal for modification of CNC parameter	CDPRM	F558.5	○	○	
Wrong operation prevention	Start check signal	STCHK	G408.0	○	○	2.12

7.2.2. 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	M	Reference item
	*ABSM	Manual absolute signal	G006.2	○	○	5.4
	+ED1~+ED5	External deceleration signals 1	G118.0~G118.4	○	○	7.1.9
	+ED21~+ED25	External deceleration signals 2	G101.0~G101.4	○	○	7.1.9
	+ED31~+ED35	External deceleration signals 3	G107.0~G107.4	○	○	7.1.9
	+L1~+L5	Overtravel signals	G114.0~G114.4	○	○	2.3.1
	-ED1~-ED5	External deceleration signals 1	G120.0~G120.4	○	○	7.1.9
	-ED21~-ED25	External deceleration signals 2	G103.0~G103.4	○	○	7.1.9
	-ED31~-ED35	External deceleration signals 3	G109.0~G109.4	○	○	7.1.9
	-L1~-L5	Overtravel signals	G116.0~G116.4	○	○	2.3.1
	*BSL	Block start interlock signal	G008.3	○	○	2.5
	*BECLP	B axis clamp completion signal	G038.7	—	○	13.12
	*BEUCP	B axis unclamp completion signal	G038.6	—	○	13.12
	*CDZ	Chamfering signal	G053.7	○	—	12.8
	*CSL	Cutting block start interlock signal	G008.1	○	○	2.5
	*DEC1~*DEC5	Reference position return deceleration signals	X009.0~X009.4 G196.0~G196.4	○ ○	○ ○	4.1
	*EAXSL	Controlled axis selection status signals (PMC axis control)	F129.7	○	○	16.1
	*ESP	Emergency stop signals	X008.4 G008.4	○ ○	○ ○	2.1
*	*ESPA	Emergency stop signals (serial spindle)	G071.1	○	○	10.3
	*ESPB		G075.1	○	○	
	*ESPC		G205.1	○	—	
	*FHRO0~*FHRV9	0.1% rapid traverse override signals	G352.0~G352.7 G353.0~G353.1	○	○	7.1.7.1
	*FLWU	Follow-up signal	G007.5	○	○	1.2.8
	*FV0~*FV7	Feedrate override signals	G012	○	○	7.1.7.2
	*EFOV0~*EFOV7	Feedrate override signals (for group 1 to 4) (PMC axis control)	G151	○	○	16.1
	*EFOV0B~*EFOV7B		G163	○	○	
	*EFOV0C~*EFOV7C		G175	○	○	
	*EFOV0D~*EFOV7D		G187	○	○	
	*FV00~*FV70	Software operator's panel signal (*FV0~*FV7)	F078	○	○	13.1.2
	*HROV0~*HROV6	1% rapid traverse override signals	G096.0~G096.6	○	○	7.1.7.1, 7.1.9
	*IT	Interlock signal for all axes	G008.0	○	○	2.5
	*IT1~*It5	Interlock signal for each axis	G130.0~G130.4	○	○	2.5
	*JV0~*JV15	Manual feedrate override signals	G010,G011	○	○	3.1
	*JV00~*JV150	Software operator's panel signal (*JV0~*JV15)	F079,F080	○	○	13.1.2
	*PLSST	Polygon spindle stop signal	G038.0	○	○	6.9.2
	*SCPFA	Spindle clamp completion signal	G028.5	○	○	10.10
	*SCPFB		G401.1	○	○	
	*SP	Feed hold signal	G008.5	○	○	5.1
	*SSTP	Spindle stop signal	G029.6	○	○	10.6

Group	Symbol	Signal name	Address	T	M	Reference item
*	*SSTP1	Individual spindle stop signals	G027.3	○	○	10.12
	*SSTP2		G027.4	○	○	
	*SUCPFA	Spindle unclamp completion signal	G028.4	○	○	10.10
	*SUCPFB		G400.1	○	○	
	*TLV0~*TLV9	Tool life count override signals	G049.0~G050.1	○	○	11.4
	*TSB	Tail stock barrier selection signal	G060.7	○	—	2.3.6
+	+EXL1~+EXL5	Stored stroke limit 1 switching signals in axis direction	G104.0~G104.4	○	○	2.3.2
	+J1~+J5	Feed axis and direction selection signals	G100.0~G100.4	○	○	3.1
	+J10~+J40	Software operator's panel signal (+J1~+J4)	F081.0,F081.2, F081.4,F081.6	○	○	13.1.2
	+LM1~+LM5	Stroke limit external setting signals	G110.0~G110.4	○	○	2.3.5
	+MIT1,+MIT2	Tool offset write signals	X004.2,X004.4 G132.0,G132.1	○	—	15.4.2
	+MIT1~+MIT5	Interlock signal for each axis direction	G132.0~G132.4	—	○	2.5
	+OT1~+OT5	Overtravel alarm signals	F124.0~F124.4	○	○	2.3.2
-	-EXL1~EXL5	Stored stroke limit 1 switching signals in axis direction	G105.0~G105.4	○	○	2.3.2
	-J1~J5	Feed axis and direction selection signals	G102.0~G102.4	○	○	3.1
	-J10~J40	Software operator's panel signal (-J1~J4)	F081.1,F081.3, F081.5,F081.7	○	○	13.1.2
	-Jg,-Ja	Feed axis and direction selection signals	G086.1,G086.3	○	○	3.4
	-LM1~LM5	Stroke limit external setting signals	G112.0~G112.4	○	○	2.3.5
	-MIT1,-MIT2	Tool offset write signals	X004.3,X004.5 G134.0,G134.1	○	—	15.4.2
	-MIT1~MIT5	Interlock signal for each axis direction	G134.0~G134.4	—	○	2.5
	-OT1~OT5	Overtravel alarm signals	F126.0~F126.4	○	○	2.3.2
A	ABDT1~ABDT5	Unexpected disturbance torque detection signal	F184.0~F184.4	○	○	2.9
	ABTQSV	Servo axis unexpected disturbance torque detection signal	F090.0	○	○	2.9
	ABTSP1	1st spindle unexpected disturbance torque detection signal	F090.1	○	○	2.9
	ABTSP2	2nd spindle unexpected disturbance torque detection signal	F090.2	○	○	2.9
	AFL	Auxiliary function lock signal	G005.6	○	○	9.2
	AICC	AI contour control mode signal	F062.0	○	○	7.1.11
	AL	Alarm signal	F001.0	○	○	2.4
	ALMA	Alarm signals (serial spindle)	F045.0	○	○	10.3
	ALMB		F049.0	○	○	
	ALMC		F168.0	○	—	

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
A	AR00~AR15	Actual spindle speed signals	F040,F041	○	○	10.9
	AR002~AR152		F202,F203	○	○	
	ARSTA	Alarm reset signals (serial spindle)	G071.0	○	○	10.3
	ARSTB		G075.0	○	○	
	ARSTC		G205.0	○	—	
ATBK	Automatic data backup executing signal	F520.0	○	○		
B	B00~B31	2nd auxiliary function code signals	F030~F033	○	○	9.1
	BAL	Battery alarm signal	F001.2	○	○	2.4
	BCLP	B axis clamp signal	F061.1	—	○	13.12
	BDT1	Optional block skip signals	G044.0	○	○	5.5
	BDT2~BDT9		G045	○	○	
	BDTO	Software operator's panel signal (BDT)	F075.2	○	○	13.1.2
	BF	2nd auxiliary function strobe signal	F007.7	○	○	9.1
	BFIN	2nd auxiliary function completion signal	G005.7	○	○	9.4
	BUCLP	B axis unclamp signal	F061.0	—	○	13.12
C	C2SEND	Dual display forcible end request signal	G295.6	○	○	13.1.9
	C2SENO	Dual display forcible end status signal	F295.6	○	○	13.1.9
	CFINA	Spindle switch completion signals (serial spindle)	F046.1	○	○	10.3
	CFINB		F050.1	○	○	
	CFINC		F169.1	○	—	
	CHPA	Power line switch signals (serial spindle)	F046.0	○	○	10.3
	CHPB		F050.0	○	○	
	CHPC		F169.0	○	—	
	CLRCH1~CLRCH5	Torque limit reach signals for reference position setting with mechanical stopper	F180.0~F180.4	○	○	4.5
	CNCKY	Key control selection signal	G295.7	○	○	13.1.9
	CNCKYO	Key control selection status signal	F295.7	○	○	13.1.9
	CON	Cs contour control change signal	G027.7	○	○	10.11
	COSP	Path spindle command confirmation signal	F064.5	●	—	8.8
	COSP1	Path spindle command confirmation signal	F063.3	●	—	8.8
	COSP2		F063.4	●	—	
	CSF11	Cs axis coordinate establishment request signals	G274.4	○	○	10.11.3
	CSFO1	Cs axis coordinate establishment alarm signals	F274.4	○	○	
	CSPENA	Cs axis origin established state signals	F048.4	○	○	
	CSS	Constant surface speed signal	F002.2	○	○	10.8
	CTH1A, CTH2A	Clutch/gear signals (serial spindle)	G070.3, G070.2	○	○	10.3
	CTH1B, CTH2B		G074.3, G074.2	○	○	
CTH1C, CTH2C	G204.3, G204.2		○	—		
CUT	Cutting feed signal	F002.6	○	○	2.7	

Group	Symbol	Signal name	Address	T	M	Reference item
D	DEFMDA	Differential speed mode	G072.3	○	○	10.3
	DEFMDB	command signals (serial spindle)	G076.3	○	○	
	DEFMDC		G206.3	○	—	
	DEN	Distribution completion signals	F001.3	○	○	9.1
	DM00	Decode M signals	F009.7	○	○	9.1
	DM01		F009.6	○	○	
	DM02		F009.5	○	○	
	DM30		F009.4	○	○	
	DMMC	Direct operation select signal	G042.7	○	○	5.13
	DNCI	DNC operation select signal	G043.5	○	○	5.11
	DNCIR	Mode notification signal	F513.5	○	○	16.6
	DRN	Dry run signal	G046.7	○	○	5.3.2
	DRNO	Software operator's panel signal (DRN)	F075.5	○	○	13.1.2
	DTCH1~DTCH5	Controlled axis detach signals	G124.0~G124.4	○	○	1.2.5
E	EA6 to EA0	Address signals for external data input	G002.6~G002.0	○	○	16.2
	EABUFA	Buffer full signals (for group 1 to 4) (PMC axis control)	F131.1	○	○	16.1
	EABUFB		F134.1	○	○	
	EABUFC		F137.1	○	○	
	EABUFD		F140.1	○	○	
	EACNT1~EACNT5	Controlling signals(PMC axis control)	F182.0~F182.4	○	○	16.1
	EADEN1~EADEN5	Distribution completion signals(PMC axis control)	F112.0~F112.4	○	○	16.1
	EAX1~EAX5	Control axis selection signals(PMC axis control)	G136.0~G136.4	○	○	16.1
	EBSYA	Axis control command read completion signals (for group 1 to 4) (PMC axis control)	F130.7	○	○	16.1
	EBSYB		F133.7	○	○	
	EBSYC		F136.7	○	○	
	EBSYD		F139.7	○	○	
	EBUFA	Axis control command read signals (for group 1 to 4) (PMC axis control)	G142.7	○	○	16.1
	EBUFB		G154.7	○	○	
	EBUFC		G166.7	○	○	
	EBUFD		G178.7	○	○	
	EC0A~EC6A	Axis control command signals (for group 1 to 4) (PMC axis control)	G143.0~G143.6	○	○	16.1
	EC0B~EC6B		G155.0~G155.6	○	○	
	EC0C~EC6C		G167.0~G167.6	○	○	
	EC0D~EC6D		G179.0~G179.6	○	○	
	ECKZA	Following zero checking signals (for group 1 to 4) (PMC axis control)	F130.1	○	○	16.1
	ECKZB		F133.1	○	○	
	ECKZC		F136.1	○	○	
	ECKZD		F139.1	○	○	
	ECLRA	Reset signals (for group 1 to 4) (PMC axis control)	G142.6	○	○	16.1
	ECLRB		G154.6	○	○	
	ECLRC		G166.6	○	○	
	ECLRD		G178.6	○	○	
	ED31 to ED0	Data signals for external data input	G211,G210, G001,G000	○	○	16.2
	EDENA	Auxiliary function executing signals (for group 1 to 4) (PMC axis control)	F130.3	○	○	16.1
	EDENB		F133.3	○	○	
EDENC	F136.3		○	○		
EDEND	F139.3		○	○		

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
E	EDRN	Dry run signal(PMC axis control)	G150.7	○	○	16.1
	EFINA	Auxiliary function completion signal (for group 1 to 4) (PMC axis control)	G142.0	○	○	16.1
	EFINB		G154.0	○	○	
	EFINC		G166.0	○	○	
	EFIND		G178.0	○	○	
	EGENA	Axis moving signals (for group 1 to 4) (PMC axis control)	F130.4	○	○	16.1
	EGENB		F133.4	○	○	
	EGENC		F136.4	○	○	
	EGEND		F139.4	○	○	
	EIALA	Alarm signal (for group 1 to 4) (PMC axis control)	F130.2	○	○	16.1
	EIALB		F133.2	○	○	
	EIALC		F136.2	○	○	
	EIALD		F139.2	○	○	
	EID0A~EID31A	Axis control data signals (for group 1 to 4) (PMC axis control)	G146~G149	○	○	16.1
	EID0B~EID31B		G158~G161	○	○	
	EID0C~EID31C		G170~G173	○	○	
	EID0D~EID31D		G182~G185	○	○	
	EIF0A~EIF15A	Axis control feedrate signals (for group 1 to 4) (PMC axis control)	G144,G145	○	○	16.1
	EIF0B~EIF15B		G156,G157	○	○	
	EIF0C~EIF15C		G168,G169	○	○	
	EIF0D~EIF15D		G180,G181	○	○	
	EINPA	In-position signals (for group 1 to 4) (PMC axis control)	F130.0	○	○	16.1
	EINPB		F133.0	○	○	
	EINPC		F136.0	○	○	
	EINPD		F139.0	○	○	
	EKC0~EKC7	Key code signals	G098	○	○	16.5
	EKENB	Key code read completion signal	F053.7	○	○	16.5
	EKSET	Key code read signal	G066.7	○	○	16.5
	ELCKZA	Accumulated zero check signal (for group 1 to 4) (PMC axis control)	G142.1	○	○	16.1
	ELCKZB		G154.1	○	○	
	ELCKZC		G166.1	○	○	
	ELCKZD		G178.1	○	○	
	EM11A~EM48A	Auxiliary function code signals (for group 1 to 4) (PMC axis control)	F132,F142	○	○	16.1
	EM11B~EM48B		F135,F145	○	○	
	EM11C~EM48C		F138,F148	○	○	
	EM11D~EM48D		F141,F151	○	○	
	EMBUFA	Buffering disable signals (for group 1 to 4) (PMC axis control)	G142.2	○	○	16.1
	EMBUFB		G154.2	○	○	
	EMBUFC		G166.2	○	○	
	EMBUFD		G178.2	○	○	
	EMFA	Auxiliary function strobe signals (for group 1 to 4) (PMC axis control)	F131.0	○	○	16.1
	EMFB		F134.0	○	○	
	EMFC		F137.0	○	○	
	EMFD		F140.0	○	○	
	EMF2A	Auxiliary function 2nd strobe signals (for group 1 to 4) (PMC axis control)	F131.2	○	○	16.1
EMF2B	F134.2		○	○		
EMF2C	F137.2		○	○		
EMF2D	F140.2		○	○		
EMF3A	Auxiliary function 3rd strobe signals (for group 1 to 4) (PMC axis control)	F131.3	○	○	16.1	
EMF3B		F134.3	○	○		
EMF3C		F137.3	○	○		
EMF3D		F140.3	○	○		

Group	Symbol	Signal name	Address	T	M	Reference item
E	EMSBKA	Block stop disable signals (for group 1 to 4) (PMC axis control)	G143.7	○	○	16.1
	EMSBKB		G155.7	○	○	
	EMSBKC		G167.7	○	○	
	EMSBKD		G179.7	○	○	
	EMZ0 to EMZ15	Extended external machine zero point shift signal	Specifying by parameter No.1280.	○	○	16.3
	ENB	Spindle enable signal	F001.4	○	○	10.6
	ENB2		F038.2	○	○	10.12
	ENBKY	External key input mode selection signal	G066.1	○	○	16.5
	EOTNA	Negative-direction overtravel signals (for group 1 to 4) (PMC axis control)	F130.6	○	○	16.1
	EOTNB		F133.6	○	○	
	EOTNC		F136.6	○	○	
	EOTND		F139.6	○	○	
	EOTPA	Positive-direction overtravel signals (for group 1 to 4) (PMC axis control)	F130.5	○	○	16.1
	EOTPB		F133.5	○	○	
	EOTPC		F136.5	○	○	
	EOTPD		F139.5	○	○	
	EOV0	Override 0% signal (PMC axis control)	F129.5	○	○	16.1
	EOVC	Override cancel signal (for group 1 to 4) (PMC axis control)	G150.5	○	○	16.1
	EOVCB		G162.5	○	○	
	EOVCC		G174.5	○	○	
	EOVCD		G186.5	○	○	
	EPN0~EPN13	Extended external workpiece number search signals	G024.0~G025.5	○	○	16.4
	EPNS	External workpiece number search start signal	G025.7	○	○	16.4
	EREND	Read completion signal for external data input	F060.0	○	○	16.2
	EROV1,EROV2	Rapid traverse override signals (PMC axis control)	G150.0,G150.1	○	○	16.1
	ERS	External reset signal	G008.7	○	○	5.2
	ERT	Manual rapid traverse selection signal (PMC axis control)	G150.6	○	○	16.1
	ERTVA	Automatic screen erasing signal	F006.2	○	○	13.1.13
	ESBKA	Block stop signals (for group 1 to 4) (PMC axis control)	G142.3	○	○	16.1
	ESBKB		G154.3	○	○	
	ESBKC		G166.3	○	○	
	ESBKD		G178.3	○	○	
ESCAN	Search cancel signal for external data input	F060.2	○	○	16.2	
ESEND	Search completion signal for external data input	F060.1	○	○	16.2	
ESF01~ESF10	Soft key number select state notification signal	F318.0~F319.1	○	○	13.4	
ESFM1~ESFM8	Machine operation menu select number notification signal	F317.0~F317.7	○	○	13.4	
ESKIP	Skip signal(PMC axis control)	X004.6	○	○	16.1	

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
E	ESOFA	Servo off signals (for group 1 to 4) (PMC axis control)	G142.4	○	○	16.1
	ESOFB		G154.4	○	○	
	ESOFC		G166.4	○	○	
	ESOFD		G178.4	○	○	
	ESRSYC	Simple spindle synchronous control signal	G064.6	○	○	10.17
	ESSYC1	Simple spindle synchronous control signal (for each spindle)	G264.0	○	○	10.17
	ESSYC2		G264.1	○	○	
	ESTB	Read signal for external data input	G002.7	○	○	16.2
	ESTPA	Axis control temporary stop signals (for group 1 to 4) (PMC axis control)	G142.5	○	○	16.1
	ESTPB		G154.5	○	○	
	ESTPC		G166.5	○	○	
	ESTPD		G178.5	○	○	
	EUI00~EUI15	Input signals for P-code macro	G082,G083	○	○	12.15
	EUO00~EUO15	Output signals for P-code macro	F084,F085	○	○	12.15
	EXLM	Stored stroke limit 1 change signal	G007.6	○	○	2.3.2
	EXRD	External read start signal	G058.1	○	○	14.2
	EXSFT	Machine operation menu screen select signal	G295.0	○	○	13.4
EXSTP	External read/punch stop signal	G058.2	○	○	14.2	
EXWT	External punch start signal	G058.3	○	○	14.2	
F	F1D	One-digit F code feed signal	G016.7	—	○	7.1.5
	FHROV	0.1% step rapid traverse override selection signals	G353.7	○	○	7.1.7.1
	FIN	End signal	G004.3	○	○	9.1
	FSCSL	Cs contour control change completion signal	F044.1	○	○	10.11
	FSPPH	Spindle synchronous speed control completion signal	F044.3	○	○	10.14
	FSPPH1	Spindle synchronous speed control completion signal (for each spindle)	F289.0	○	○	10.14
	FSPPH2		F289.1	○	○	
	FSPSY	Spindle phase synchronous control signal	F044.2	○	○	10.14
	FSPSY1	Spindle phase synchronous control signal (for each spindle)	F288.0	○	○	10.14
	FSPSY2		F288.1	○	○	
	FWSTP	Forward movement prohibition signal	G531.0	○	○	3.5
	G	GOQSM	Tool offset write mode select signal	G039.7	○	○
GR1,GR2		Gear selection signals (input)	G028.1,G028.2	○	○	10.6
GR10,GR20,GR30		Gear selection signals (output)	F034.0~F034.2	—	○	10.6
GR21,GR22		Gear selection signals (input)	G029.0,G029.1	○	○	10.12

Group	Symbol	Signal name	Address	T	M	Reference item
H	HCAB2	Hard copy cancellation request reception signal	F061.2	○	○	13.1.14
	HCABT	Hard copy cancellation request signal	G067.6	○	○	13.1.14
	HCEXE	Hard copy execution status signal	F061.3	○	○	13.1.14
	HCREQ	Hard copy execution request signal	G067.7	○	○	13.1.14
	HDO0~HDO3	High-speed skip status signals	F122.0~F122.3	○	○	15.3.2
	HEAD	Path select signal(Tool post select signal)	G063.0	●	—	8.11, 13.3
	HNDLF	Maximum manual handle feedrate switch signal	G023.3	○	○	3.2
	HDN	Manual handle feed direction inversion signal	G347.1	○	○	3.2
	HROV	1% step rapid traverse override selection signals	G096.7	○	○	7.1.7.1 7.1.9
	HS1A~HS1D	Manual handle feed axis selection signals	G018.0~G018.3	○	○	3.2
	HS1AO	Software operator's panel signal (HS1A)	F077.0	○	○	13.1.2
	HS1BO	Software operator's panel signal (HS1B)	F077.1	○	○	13.1.2
	HS1CO	Software operator's panel signal (HS1C)	F077.2	○	○	13.1.2
	HS1DO	Software operator's panel signal (HS1D)	F077.3	○	○	13.1.2
	HS1IA~HS1ID	Manual handle interrupt axis selection signals	G041.0~G041.3	○	○	3.3
	HS2A~HS2D	Manual handle feed axis selection signals	G018.4~G018.7	○	○	3.2
	HS2IA~HS2ID	Manual handle interrupt axis selection signals	G041.4~G041.7	○	○	3.3
	HS3A~HS3D	Manual handle feed axis selection signals	G019.0~G019.3	○	○	3.2
	HS3IA~HS3ID	Manual handle interrupt axis selection signals	G042.0~G042.3	○	○	3.3
	I	IGNVRY	All-axis VRDY off alarm ignore signal	G066.0	○	○
IGVRY1~IGVRY5		Each-axis VRDY off alarm ignore signal	G192.0~G192.4	○	○	2.8
INCH		Inch input signal	F002.0	○	○	12.5
INCMDA		Incremental command externally set orientation signals (serial spindle)	G072.5	○	○	10.3
INCMDB			G076.5	○	○	
INCMDC			G206.5	○	—	
INCSTA		Incremental orientation mode signals (serial spindle)	F047.1	○	○	
INCSTB			F051.1	○	○	
INCSTC			F170.1	○	—	
INDXA		Orientation stop position change command signals (serial spindle)	G072.0	○	○	
INDXB			G076.0	○	○	
INDXC			G206.0	○	—	
INFD		In-feed control cut start signal	G063.6	—	○	12.9
INHKY		Key input disable signal	F053.0	○	○	16.5
INP1~INP5		In-position signals	F104.0~F104.4	○	○	7.2.5

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
I	INTGA	Speed integral signals (serial spindle)	G071.5	○	○	10.3
	INTGB		G075.5	○	○	
	INTGC		G205.5	○	—	
	IOLBH1, IOLBH2	Manual handle generators selection signal	G199.0, G199.1	○	○	3.4
IUDD1~IUDD5	Unexpected disturbance torque detection ignore signal	G125.0~G125.4	○	○	2.9	
K	KEY1~KEY4	Memory protection signals	G046.3~G046.6	○	○	13.2.1
	KEYO	Software operator's panel signal (KEY1~KEY4)	F075.6	○	○	13.1.2
	KEYP	Memory protection signals	G046.0	○	○	13.2.2
L	LDT1A	Load detection signals 1 (serial spindle)	F045.4	○	○	10.3
	LDT1B		F049.4	○	○	
	LDT1C		F168.4	○	—	
	LDT2A	Load detection signals 2 (serial spindle)	F045.5	○	○	
	LDT2B		F049.5	○	○	
	LDT2C		F168.5	○	—	
	LFCIF	Tool life counting disable signal	F093.2	○	○	
LFCIV	Tool life counting disable signal	G048.2	○	○	11.4	
M	M00~M31	Auxiliary function code signals	F010~F013	○	○	9.1
	M200~M215	2nd M function code signals	F014~F015	○	○	9.3
	M300~M315	3rd M function code signals	F016~F017	○	○	9.3
	MA	CNC ready signal	F001.7	○	○	2.2
	MABSM	Manual absolute check signal	F004.2	○	○	5.4
	MAFL	Auxiliary function lock check signal	F004.4	○	○	9.2
	MBDT1	Optional block skip check signals	F004.0	○	○	5.5
	MBDT2~MBDT9		F005	○	○	
	MCEX1~MCEX16	Call program confirmation signal	F514,F515	○	○	16.6
	MCEXE	Macro call executing signal	F512.0	○	○	16.6
	MCFIN	Mode change completion signal	G514.0	○	○	16.6
	MCFNA	Power line switch completion signals (serial spindle)	G071.3	○	○	10.3
	MCFNB		G075.3	○	○	
	MCFNC		G205.3	○	—	
	MCHK	Handle available signal in checking mode	G067.3	○	○	3.5
	MCRQ	Mode change request signal	F512.1	○	○	16.6
	MCSP	Abnormal end signal	F512.2	○	○	16.6
	MCST1~MCST16	Macro call start signal	G512,G513	○	○	16.6
	MD1,MD2,MD4	Mode selection signals	G043.0~G043.2	○	○	2.6
	MD1O	Software operator's panel signal (MD1)	F073.0	○	○	13.1.2
	MD1R	Mode notification signal	F513.0	○	○	16.6
	MD2O	Software operator's panel signal (MD2)	F073.1	○	○	13.1.2
	MD2R	Mode notification signal	F513.1	○	○	16.6
	MD4O	Software operator's panel signal (MD4)	F073.2	○	○	13.1.2
	MD4R	Mode notification signal	F513.2	○	○	16.6
	MDIRST	MDI reset confirmation signal	F006.1	○	○	5.2

Group	Symbol	Signal name	Address	T	M	Reference item
M	MDRN	Dry run check signal	F002.7	○	○	5.3.2
	MDTCH1~MDTCH5	Controlled axis detach status signals	F110.0~F110.4	○	○	1.2.5
	MEDT	Memory edit selection check signal	F003.6	○	○	2.6
	MF	Auxiliary function strobe signals	F007.0	○	○	9.1
	MF2	2nd M function strobe signal	F008.4	○	○	9.3
	MF3	3rd M function strobe signal	F008.5	○	○	9.3
	MFIN	Auxiliary function completion signal	G005.0	○	○	9.4
	MFIN2	2nd M function completion signal	G004.4	○	○	9.4
	MFIN3	3rd M function completion signal	G004.5	○	○	9.4
	MFNHGA	Spindle switch MAIN MCC contact status signals (serial spindle)	G072.6	○	○	10.3
	MFNHGB		G076.6	○	○	
	MFNHGC		G206.6	○	—	
	MH	Manual handle feed selection check signal	F003.1	○	○	2.6
	MI1~MI5	Mirror image signals	G106.0~G106.4	○	○	1.2.7
	MINC	Incremental feed selection check signal	F003.0	○	○	2.6
	MIT	Tool offset write signals	X004.2~X004.5	○	—	15.4.2
	MIX1~MIX5	Composite control axis change selection signals	G128.0~G128.4	○	○	8.5
	MIXO1~MIXO5	Composite axis confirmation signals	F343.0~F343.4	○	○	8.5
	MJ	Jog feed selection check signal	F003.2	○	○	2.6
	MLK	All-axis machine lock signal	G044.1	○	○	5.3.1
	MLK1~MLK5	Each-axis machine lock signal	G108.0~G108.4	○	○	5.3.1
	MLKO	Software operator's panel signal (MLK)	F075.4	○	○	13.1.2
	MMDI	Manual data input selection check signal	F003.3	○	○	2.6
	MMEM	Automatic operation selection check signal	F003.5	○	○	2.6
	MMI1~MMI5	Mirror image check signals	F108.0~F108.4	○	○	1.2.7
	MMLK	All-axis machine lock check signal	F004.1	○	○	5.3.1
	MMMOD	Check mode confirmation signal	F091.3	○	○	3.5
	MMOD	Checking mode signal	G067.2	○	○	3.5
	MNCHG	Direction change prohibition signal	F091.1	○	○	3.5
	MORA1A	Magnetic sensor orientation completion signals (serial spindle)	F046.6	○	○	10.3
	MORA1B		F050.6	○	○	
	MORA1C		F169.6	○	—	
	MORA2A	Magnetic sensor orientation proximity signals (serial spindle)	F046.7	○	○	10.3
	MORA2B		F050.7	○	○	
	MORA2C		F169.7	○	—	

List by Symbol

PMC Maintenance – 3xi & 0i-D

Group	Symbol	Signal name	Address	T	M	Reference item
M	MORCMA	Magnetic sensor orientation command signals (serial spindle)	G073.0	○	○	10.3
	MORCMB		G077.0	○	○	
	MORCMC		G207.0	○	—	
	MP1,MP2	Manual handle feed amount selection signals (incremental feed signals)	G019.4,G019.5	○	○	3.2, 3.5
	MP21,MP22 MP31,MP32	Manual handle feed amount selection signals	G087.0,G087.1 G087.3,G087.4	○	○	3.2
	MP10	Software operator's panel signal (MP1)	F076.0	○	○	13.1.2
	MP20	Software operator's panel signal (MP2)	F076.1	○	○	13.1.2
	MPOFA	Motor power cutoff command signals (serial spindle)	G073.2	○	○	10.3
	MPOFB		G077.2	○	○	
	MPOFC		G207.2	○	—	
	MRDYA	Machine ready signals (serial spindle)	G070.7	○	○	10.3
	MRDYB		G074.7	○	○	
	MRDYC		G204.7	○	—	
	MREF	Manual reference position return selection check signal	F004.5	○	○	4.1
	MRMT	DNC operation selection confirm signal	F003.4	○	○	5.11, 5.13
	MRVM	Reverse movement prohibition signal	G531.1	○	○	3.5
	MRVMD	Reverse movement signal	F091.0	○	○	3.5
	MRVSP	Reverse movement prohibition signal	F091.2	○	○	3.5
	MSBK	Single block check signal	F004.3	○	○	5.3.3
	MSP00~MSP15	Multi-spindle address P signals	F160,F161	○	○	10.12
	MSPOSA	Spindle positioning mode signals	F039.0	○	○	10.10
	MSPOSB		F402.1	○	○	
	MT8N00~MT8N31	Manual tool compensation tool number signal (8 digits)	G525~G528	○	—	11.1.4
	MTLA	Manual tool compensation completion signal	F061.5	○	—	11.1.4
	MTLANG	Manual tool compensation uncompleted signal	F061.4	○	—	11.1.4
	MTLC	Manual tool compensation command number	G067.0	○	—	11.1.4
	MTLN00~MTLN15	Manual tool compensation tool number signal (4 digits)	G068,G069	○	—	11.1.4
	MV1~MV5	Axis moving signals	F102.0~F102.4	○	○	1.2.6
	MVD1~MVD5	Axis moving direction signals	F106.0~F106.4	○	○	1.2.6
	N	NDCAL1~NDCAL8	A/B phase detector disconnection alarm ignore signal(PMC axis control)	G202	○	○
NMWT		No-wait signal	G063.7	●	—	8.2
NOWT		No-wait signal	G063.1	●	—	8.2
NOZAGC		Signal for disabling angular axis control for the perpendicular axis	G063.5	○	○	1.8
NPOS1~NPOS5		Axis non-display signals	G198.0~G198.4	○	○	

Group	Symbol	Signal name	Address	T	M	Reference item
N	NRROA	Shortcut command signals for orientation stop position change (serial spindle)	G072.2	○	○	10.3
	NRROB		G076.2	○	○	
	NRROC		G206.2	○	—	
	NSYNCA	Signal for disabling torque difference alarm detection for axis synchronous control	G059.7	○	○	1.6
O	OFN0~OFN5, OFN6~OFN9	Tool offset number selection signals	G039.0~G039.5, G040.0~G040.3	○	○	15.4.2
	OP	Automatic operation signal	F000.7	○	○	5.1
	ORARA	Orientation completion signals (serial spindle)	F045.7	○	○	10.3
	ORARB		F049.7	○	○	
	ORARC		F168.7	○	—	
	ORCMA	Orientation command signals (serial spindle)	G070.6	○	○	10.3
	ORCMB		G074.6	○	○	
	ORCMC		G204.6	○	—	
	OUT0~OUT15	Software operator's panel general-purpose switch signals	F072,F074	○	○	13.1.2
	OVC	Override cancel signal	G006.4	○	○	7.1.7.4
	OVLS1~OVLS5	Superimposed control axis selection signals	G190.0~G190.4	○	○	8.6
	OVM01~OVM05	Superimposed control master axis confirmation signals	F344.0~F344.4	○	○	8.6
	OVRA	Analog override signals (serial spindle)	G072.4	○	○	10.3
	OVRB		G076.4	○	○	
	OVRC		G206.4	○	—	
	OVSO1~OVSO5	Superimposed control slave axis confirmation signals	F345.0~F345.4	○	○	8.6
	P	PBATL	Absolute position detector battery voltage low alarm signal	F172.7	○	○
PBATZ		Absolute position detector battery voltage zero alarm signal	F172.6	○	○	1.4.3
PC1DEA		Position coder one-rotation signal detection status signals (serial spindle)	F047.0	○	○	10.3
PC1DEB			F051.0	○	○	
PC1DEC			F170.0	○	—	
PC2SLC		2nd position coder selection signal	G028.7	○	○	10.12
PC3SLC		3rd position coder selection signal	G026.0	○	○	10.12
PC4SLC		4th position coder selection signal	G026.1	○	○	10.12
PECK2		Small-hole peck drilling cycle in progress signal	F066.5	—	○	12.7
PK1~PK5		Parking signals	G122.0~G122.4	○	○	8.5
PKESS1		1st spindle parking signal	G122.6 (G031.6)	○	○	10.17
PKESS2		2nd spindle parking signal	G122.7 (G031.7)	○	○	10.17
PKESE1		Simple spindle synchronous parking signal (for each spindle)	G265.0	○	○	10.17
PKESE2			G265.1	○	○	
PN1,PN2,PN4, PN16	External workpiece number search signals	G009.0~G009.4	○	○	16.4	

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item	
P	PORA2A	Position coder orientation proximity signal (serial spindle)	F046.5	○	○	10.3	
	PORA2B		F050.5	○	○		
	PORA2C		F169.5	○	—		
	PRC	Position record signal	G040.6	○	—	15.4.1	
	PRGDPL	Key input disable signal	F053.1	○	○	16.5	
	PRTSF	Target part count reached signal	F062.7	○	○	13.1.1	
	PSAR	Polygon spindle speed arrival signal	F063.2	○	○	6.9.2	
	PSE1	Polygon master axis not arrival signal	F063.0	○	○	6.9.2	
	PSE2	Polygon synchronization axis not arrival signal	F063.1	○	○	6.9.2	
	PSW01~PSW16	Position switch signals	F070,F071	○	○	1.2.10	
	PSYN	Polygon synchronization under way signal	F063.7	○	○	6.9	
R	R01I~R12I	Spindle motor speed command signals	G032.0~G033.3	○	○	10.7	
	R01I2~R12I2		G034.0~G035.3	○	○		
	R01O~R12O		F036.0~F037.3	○	○	10.6	
	R01O2~R12O2	S 12-bit code signals		F200.0~F201.3	○	○	10.12
	R01O3~R12O3			F204.0~F205.3	○	○	
	R01O4~R12O4			F270.0~F271.3	○	○	
	RCFNA	Output switch completion signals (serial spindle)		F046.3	○	○	10.3
	RCFNB			F050.3	○	○	
	RCFNC			F169.3	○	—	
	RCHA	Power line status check signals (serial spindle)		G071.7	○	○	
	RCHB			G075.7	○	○	
	RCHC			G205.7	○	—	
	RCHHGA	Spindle switch HIGH MCC contact status signals (serial spindle)		G072.7	○	○	
	RCHHGB			G076.7	○	○	
	RCHHGC			G206.7	○	—	
	RCHPA	Output switch signals (serial spindle)		F046.2	○	○	
	RCHPB			F050.2	○	○	
	RCHPC			F169.2	○	—	
	RGSPM	Spindle rotation direction signals		F065.1	○	○	10.13
	RGSP			F065.0	○	○	
	RGTAP	Rigid tapping signal		G061.0	○	○	10.13
	RGTS1~RGTS2	Rigid tapping spindle selection signals		G061.4~G061.5	○	—	10.13
	RLSOT	Stroke limit 1 release signal		G007.7	○	○	2.3.2
	RLSOT3	Stroke limit 3 release signal		G007.4	○	○	2.3.3
	ROTAA	Rotational direction command signals for orientation stop position change (serial spindle)		G072.1	○	○	10.3
	ROTAB			G076.1	○	○	
	ROTAC			G206.1	○	—	
	ROV1,ROV2	Rapid traverse override signals		G014.0,G014.1	○	○	7.1.7.1
	ROV1O	Software operator's panel signal (ROV1)		F076.4	○	○	13.1.2
	ROV2O	Software operator's panel signal (ROV2)		F076.5	○	○	13.1.2
	ROVLP	Rapid traverse block overlap disable signal		G053.5	○	○	7.2.1.2
	RPALM	Read/punch alarm signal		F053.3	○	○	14.2
	RPBSY	Read/punch busy signal		F053.2	○	○	14.2
RPDO	Rapid traversing signal		F002.1	○	○	2.7.7.1.1	

Group	Symbol	Signal name	Address	T	M	Reference item
R	RRW	Reset & rewind signal	G008.6	○	○	5.2
	RSLA	Output switch request signals (serial spindle)	G071.6	○	○	10.3
	RSLB		G075.6	○	○	
	RSLC		G205.6	○	—	
	RSMAX	Spindle synchronous speed ratio control clamp signal	F065.2	○	○	10.14
	RST	Resetting signal	F001.1	○	○	5.2
	RT	Manual rapid traverse selection signal	G019.7	○	○	3.1
	RTAP	Rigid tapping-in-progress signal	F076.3	○	○	10.13
	RTNT	Rigid tapping retraction start signal	G062.6	—	○	5.10
	RTO	Software operator's panel signal (RT)	F077.6	○	○	13.1.2
	RTPT	Rigid tapping retraction completion signal	F066.1	—	○	5.10
	RTRCT	Retract signal	G066.4	○	○	1.9, 6.13
	RTRCTF	Retract completion signal	F065.4	○	○	1.9, 6.13
	RVS	Reverse execution signal	G007.0	—	○	5.8
	RVSL	Reverse execution in-progress signal	F082.2	—	○	
	RWD	Rewinding signal	F000.0	○	○	5.2
S	S00~S31	Spindle function code signals	F022~F025	○	○	9.1
	S2TLS	Spindle measurement select signal	G040.5	○	—	15.4.2
	SA	Servo ready signal	F000.6	○	○	2.2
	SAR	Spindle speed arrival signal	G029.4	○	○	10.6
	SARA	Spindle speed arrival signal (serial spindle)	F045.3	○	○	10.3
	SARB		F049.3	○	○	
	SARC		F168.3	○	—	
	SBK	Single block signal	G046.1	○	○	5.3.3
	SBKO	Software operator's panel signal (SBK)	F075.3	○	○	13.1.2
	SBRT	Spindle synchronous speed ratio control signal	G038.1	○	○	10.14
	SCLPA	Spindle clamp signal	F038.0	○	○	10.10
	SCLPB		F401.1	○	○	
	SDTA	Speed detection signals (serial spindle)	F045.2	○	○	10.3
	SDTB		F049.2	○	○	
	SDTC		F168.2	○	—	
	SF	Spindle function strobe signal	F007.2	○	○	9.1
	SFIN	Spindle function completion signal	G005.2	○	○	9.4
	SFRA	CW command signals (serial spindle)	G070.5	○	○	10.3
	SFRB		G074.5	○	○	
	SFRC		G204.5	○	—	
	SGN	Spindle motor command polarity command signals	G033.5	○	○	10.7
	SGN2		G035.5	○	○	
	SH00A~SH11A	Spindle orientation external stop position command signals	G078.0~G079.3	○	○	10.15
	SH00B~SH11B		G080.0~G081.3	○	○	
	SIND	Spindle motor speed command selection signals	G033.7	○	○	10.7
	SIND2		G035.7	○	○	
	SKIP	Skip signal	X004.7	○	○	15.3

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
S	SKIP2~SKIP6, SKIP7, SKIP8	Skip signal	X004.2~X004.6, X004.0, X004.1	○	○	15.3.3
	SKIPP	Skip signal	G006.6	○	○	15.3
	SLPCA	Path spindle feedback selection signals	G064.2	●	—	8.8
	SLPCB		G064.3	●	—	
	SLSPA	Path spindle command selection signals	G063.2	●	—	8.8
	SLSPB		G063.3	●	—	
	SLVA	Subordinate operation mode command signals (serial spindle)	G073.1	○	○	10.3
	SLVB		G077.1	○	○	
	SLVC		G207.1	○	—	
	SLVSA	Subordinate operation status signals (serial spindle)	F046.4	○	○	
	SLVSB		F050.4	○	○	
	SLVSC		F169.4	○	—	
	SMPK1~SMPK5	Parking axis confirmation signals	F346.0~F346.4	○	○	8.5
	SMZ	In-position check signal	G053.6	○	○	7.2.5
	SOCNA	Soft start/stop cancel signals (serial spindle)	G071.4	○	○	10.3
	SOCNB		G075.4	○	○	
	SOCNC		G205.4	○	—	
	SOR	Spindle orientation signal	G029.5	○	○	10.6
	SOV0~SOV7	Spindle speed override signals	G030	○	○	10.6
	SOV20~SOV27	2nd spindle speed override signals	G376	○	○	10.12
	SPAL	Spindle fluctuation detection alarm signal	F035.0	○	○	10.18
	SPL	Feed hold lamp signal	F000.4	○	○	5.1
	SPO	Software operator's panel signal (*SP)	F075.7	○	○	13.1.2
	SPP1 to SPP5	Spindle indexing signal for each axis	F522.0~F522.4	○	○	10.19
	SPPHS	Spindle phase synchronous control signal	G038.3	○	○	10.14
	SPPHS1	Spindle phase synchronous control signal (for each spindle)	G289.0	○	○	10.14
	SPPHS2		G289.1	○	○	
	SPSLA	Spindle selection signals (serial spindle)	G071.2	○	○	10.3
	SPSLB		G075.2	○	○	
	SPSLC		G205.2	○	—	
	SPSP	Spindle command path specification signal	G536.7	○	○	10.12
	SPSTPA	Spindle stop completion signal	G028.6	○	○	10.10
	SPSTPB		G402.1	○	○	
	SPSYC	Spindle synchronous control signal	G038.2	○	○	10.14
	SPSYC1	Spindle synchronous control signal (for each spindle)	G288.0	○	○	10.14
	SPSYC2		G288.1	○	○	
	SPWRN1~SPWRN9	Spindle warning detail signals 1 to 9	F264.0~F265.0	○	○	10.3
	SRN	Program restart signal	G006.0	○	○	5.7
	SRNMV	Program restart under way signal	F002.4	○	○	5.7
	SRSP1R	1st serial spindle ready signals	F034.6	○	○	10.3
SRSP2R	2nd serial spindle ready signals	F034.5	○	○	10.3	

Group	Symbol	Signal name	Address	T	M	Reference item
S	SRSRDY	All-spindle operation ready signal	F034.7	○	○	10.3
	SRVA	CCW command signals (serial spindle)	G070.4	○	○	10.3
	SRVB		G074.4	○	○	
	SRVC		G204.4	○	—	
	SRVON1~SRVON5	SV speed control mode signals	G521.0~G521.4	○	○	10.19
	SSIN	Spindle motor command polarity selection signals	G033.6	○	○	10.7
	SSIN2		G035.6	○	○	
	SSTA	Speed zero signals (serial spindle)	F045.1	○	○	10.3
	SSTB		F049.1	○	○	
	SSTC		F168.1	○	—	
	ST	Cycle start signal	G007.2	○	○	5.1
	STCHK	Start check signal	G408.0	○	○	2.12
	STL	Cycle start lamp signal	F000.5	○	○	5.1
	STLK	Start lock signal	G007.1	○	○	2.5
	SUCLPA	Spindle unclamp signal	F038.1	○	○	10.10
	SUCLPB		F400.1	○	○	
	SVF1~SVF5	Servo off signals	G126.0~G126.4	○	○	1.2.9
	SVREV1~SVREV5	SV speed control mode in-progress signals	F521.0~F521.4	○	○	10.19
	SVRVS1~SVRVS5	SV reverse signals	G523.0~G523.4	○	○	10.19
	SVWRN1	Servo warning detail signals	F093.4	○	○	18.1
	SVWRN2		F093.5	○	○	
	SVWRN3		F093.6	○	○	
	SVWRN4		F093.7	○	○	
	SWS1	Spindle selection signals	G027.0	○	○	10.12
	SWS2		G027.1	○	○	
	SYCAL	Phase error monitor signal	F044.4	○	○	10.14, 10.17
	SYCAL1	Phase error monitor signal (for each spindle)	F043.0	○	○	10.14
	SYCAL2		F043.1	○	○	10.17
	SYCM1~SYCM5	Synchronous master axis confirmation signals	F341.0~F341.4	○	○	8.5
	SYCS1~SYCS5	Synchronous slave axis confirmation signals	F342.0~F342.4	○	○	8.5
	SYN10~SYN50	Synchronous/composite/superimposed control under way signals	F118.0~F118.4	○	○	8.5, 8.6
	SYNC1~SYNC5	Synchronous control axis selection signals	G138.0~G138.4	○	○	1.6, 8.5
	SYNCJ1~SYNCJ5	Signals for selecting the manual feed axis for axis synchronous control	G140.0~G140.4	○	○	1.6
	SYNER	Signal for indicating a positional deviation error alarm for axis synchronous control	F403.0	○	○	1.6
SYNMOD	EGB mode signal	F065.6	○	○	1.9	
SYNMT1~SYNMT5	Machine coordinate match state output signals	F210.0~F210.4	○	○	1.6	
SYNO1~SYNO5	Axis synchronous control status signals	F532.0~F532.4	○	○	1.6	
SYNOF1~SYNOF5	Synchronization compensation enable state output signals	F211.0~F211.4	○	○	1.6	

List by Symbol

Group	Symbol	Signal name	Address	T	M	Reference item
T	T00~T31	Tool function code signals	F026~F029	○	○	9.1
	TAP	Tapping signal	F001.5	○	○	12.7
	TDFTR1~TDFTR8	Trouble forecast signal (For the disturbance level)	F299.0~F299.7	○	○	18.3
	TDSML1~TDSML8	Trouble forecast signal (For the thermal simulation data)	F298.0~F298.7	○	○	18.3
	TF	Tool function strobe signal	F007.3	○	○	9.1
	TFIN	Tool function completion signal	G005.3	○	○	9.4
	THRD	Threading signal	F002.3	○	○	6.5
	TIALM	Path interference alarm signal	F064.7	●	—	8.3
	TICLK	Path interference check in progress signal	F064.6	●	—	8.3
	TL01~TL256	Tool group number selection signals	G047.0~G048.0	○	○	11.4
	TLAL	Remaining tool count notification signal	F154.0	—	○	11.4
	TLCH	Tool change signal	F064.0	○	○	11.4
	TLCHB	Tool life arrival notice signal	F064.3	○	○	11.4
	TLCHI	Individual tool change signal	F064.2	○	○	11.4
	TLMA	Torque limit signals (serial spindle)	F045.6	○	○	10.3
	TLMB		F049.6	○	○	
	TLMC		F168.6	○	—	
	TLMHA	Torque limit command HIGH signals (serial spindle)	G070.1	○	○	
	TLMHB		G074.1	○	○	
	TLMHC		G204.1	○	—	
	TLMLA	Torque limit command LOW signals (serial spindle)	G070.0	○	○	
	TLMLB		G074.0	○	○	
	TLMLC		G204.0	○	—	
	TLNW	New tool select signal	F064.1	○	○	11.4
	TLRST	Tool change reset signal	G048.7	○	○	11.4
	TLRSTI	Individual tool change reset signal	G048.6	○	○	11.4
	TLSKP	Tool skip signal	G048.5	○	○	11.4
	TMRON	General-purpose integrating meter start signal	G053.0	○	○	13.1.1
	TPPRS	Touch panel check signal	F006.0	○	○	13.1.6
	TRQL1~TRQL5	Torque limit reached signals	F114.0~F114.4	○	○	15.3.4
TRQM1~TRQM8	Torque control mode signal(PMC axis control)	F190	○	○	16.1	
U	UI000~UI015	Input signals for custom macro	G054~G055	○	○	12.6
	UINT	Interrupt signal for custom macro	G053.3	○	○	12.6.2
	UO000~UO031	Output signals for custom macro	F054,F055, F276,F277	○	○	12.6
	UO100~UO131		F056~F059	○	○	
W	WATO	Waiting signal	F063.6	●	—	8.2
	WOQSM	Workpiece coordinate system shift value write mode select signal	G039.6	○	○	15.4.2
	WOSET	Workpiece coordinate system shift value write signal	G040.7	○	—	15.4.2

Group	Symbol	Signal name	Address	T	M	Reference item
W	WPRST1 to WPRST5	Each axis workpiece coordinate system preset signals	G358.0~G358.4	○	○	1.5.2.6
	WPSF1 to WPSF5	Each axis workpiece coordinate system preset completion signals	F358.0~F358.4	○	○	1.5.2.6
Z	ZP1~ZP5	Reference position return end signals	F094.0~F094.4	○	○	4.1
	ZP21~ZP25	2nd reference position return completion signals	F096.0~F096.4	○	○	4.4
	ZP31~ZP35	3rd reference position return completion signals	F098.0~F098.4	○	○	4.4
	ZP41~ZP45	4th reference position return completion signals	F100.0~F100.4	○	○	4.4
	ZRF1~ZRF5	Reference position establishment signals	F120.0~F120.4	○	○	4.1
	ZRN	Manual reference position return selection signal	G043.7	○	○	4.1
	ZRNO	Software operator's panel signal (ZRN)	F073.4	○	○	13.1.2
	ZRNR	Mode notification signal	F513.7	○	○	16.6

7.2.3. List by Address

Address	Signal name	Symbol	T	M	Reference item
X004.2~X004.6, X004.0,X004.1	Skip signal	SKIP2~SKIP6, SKIP7,SKIP8	○	○	15.3.3
X004.2~X004.6	Tool offset write signals	+MIT1,-MIT1 +MIT2,-MIT2	○	—	15.4.2
X004.6	Skip signal(PMC axis control)	ESKIP	○	○	16.1
X004.7	Skip signal	SKIP	○	○	15.3
X008.4	Emergency stop signals	*ESP	○	○	2.1
X009.0~X009.4	Reference position return deceleration signals	*DEC1~*DEC5	○	○	4.1
G000~G001	Data signals for external data input	ED15~ED0	○	○	16.2
G002.6~G002.0	Address signals for external data input	EA6~EA0	○	○	16.2
G002.7	Read signal for external data input	ESTB	○	○	16.2
G004.3	End signal	FIN	○	○	9.1
G004.4	2nd M function completion signal	MFIN2	○	○	9.4
G004.5	3rd M function completion signal	MFIN3	○	○	9.4
G005.0	Auxiliary function completion signal	MFIN	○	○	9.4
G005.2	Spindle function completion signal	SFIN	○	○	9.4
G005.3	Tool function completion signal	TFIN	○	○	9.4
G005.6	Auxiliary function lock signal	AFL	○	○	9.2
G005.7	2nd auxiliary function completion signal	BFIN	○	○	9.4
G006.0	Program restart signal	SRN	○	○	5.7
G006.2	Manual absolute signal	*ABSM	○	○	5.4
G006.4	Override cancel signal	OVC	○	○	7.1.7.4
G006.6	Skip signal	SKIPP	○	○	15.3
G007.0	Reverse execution signal	RVS	—	○	5.8
G007.1	Start lock signal	STLK	○	○	2.5
G007.2	Cycle start signal	ST	○	○	5.1
G007.4	Stroke limit 3 release signal	RLSOT3	○	○	2.3.3
G007.5	Follow-up signal	*FLWU	○	○	1.2.8
G007.6	Stored stroke limit 1 change signal	EXLM	○	○	2.3.2
G007.7	Stroke limit 1 release signal	RLSOT	○	○	2.3.2
G008.0	Interlock signal for all axes	*IT	○	○	2.5
G008.1	Cutting block start interlock signal	*CSL	○	○	2.5
G008.3	Block start interlock signal	*BSL	○	○	2.5
G008.4	Emergency stop signals	*ESP	○	○	2.1
G008.5	Feed hold signal	*SP	○	○	5.1
G008.6	Reset & rewind signal	RRW	○	○	5.2
G008.7	External reset signal	ERS	○	○	5.2
G009.0~G009.4	External workpiece number search signals	PN1,PN2,PN4,PN8, PN16	○	○	16.4
G010,G011	Manual feedrate override signals	*JV0~*JV15	○	○	3.1
G012	Feedrate override signals	*FV0~*FV7	○	○	7.1.7.2
G014.0,G014.1	Rapid traverse override signals	ROV1,ROV2	○	○	7.1.7.1
G016.7	One-digit F code feed signal	F1D	—	○	7.1.5
G018.0~G018.3	Manual handle feed axis selection signals	HS1A~HS1D	○	○	3.2
G018.4~G018.7		HS2A~HS2D	○	○	
G019.0~G019.3		HS3A~HS3D	—	○	

Address	Signal name	Symbol	T	M	Reference item
G019.4,G019.5	Manual handle feed amount selection signals (incremental feed signals)	MP1,MP2	○	○	3.2, 3.5
G019.7	Manual rapid traverse selection signal	RT	○	○	3.1
G023.3	Maximum manual handle feedrate switch signal	HNDLF	○	○	3.2
G024.0~G025.5	Extended external workpiece number search signals	EPN0~EPN13	○	○	16.4
G025.7	External workpiece number search start signal	EPNS	○	○	16.4
G026.0	Position coder selection signals	PC3SLC	○	○	10.12
G026.1		PC4SLC	○	○	
G027.0	Spindle selection signals	SWS1	○	○	10.12
G027.1		SWS2	○	○	
G027.2		SWS3	○	○	
G027.3	Individual spindle stop signals	*SSTP1	○	○	10.12
G027.4		*SSTP2	○	○	
G027.5		*SSTP3	○	○	
G027.7	Cs contour control change signal	CON	○	○	10.11
G028.1,G028.2	Gear selection signals (input)	GR1,GR2	○	○	10.6
G028.4	Spindle unclamp completion signal	*SUCPFA	○	○	10.10
G028.5	Spindle clamp completion signal	*SCPFA	○	○	10.10
G028.6	Spindle stop completion signal	SPSTPA	○	○	10.10
G028.7	2nd position coder selection signal	PC2SLC	○	○	10.12
G029.0	Gear selection signals (input)	GR21	○	○	10.12
G029.1		GR22	○	○	
G029.4	Spindle speed arrival signal	SAR	○	○	10.6
G029.5	Spindle orientation signal	SOR	○	○	10.6
G029.6	Spindle stop signal	*SSTP	○	○	10.6
G030	Spindle speed override signals	SOV0~SOV7	○	○	10.6
G031.6	1st spindle parking signal	PKESS1	○	○	10.17
G031.7	2nd spindle parking signal	PKESS2	○	○	10.17
G032.0~G033.3	Spindle motor speed command signals	R011~R121	○	○	10.7
G033.5	Spindle motor command polarity command signals	SGN	○	○	10.7
G033.6	Spindle motor command polarity selection signals	SSIN	○	○	10.7
G033.7	Spindle motor speed command selection signals	SIND	○	○	10.7
G034.0~G035.3	Spindle motor speed command signals	R0112~R1212	○	○	10.7
G035.5	Spindle motor command polarity command signals	SGN2	○	○	10.7
G035.6	Spindle motor command polarity selection signals	SSIN2	○	○	10.7
G035.7	Spindle motor speed command selection signals	SIND2	○	○	10.7
G036.0~G037.3	Spindle motor speed command signals	R0113~R1213	○	○	10.7
G037.5	Spindle motor command polarity command signals	SGN3	○	○	10.7
G037.6	Spindle motor command polarity selection signals	SSIN3	○	○	10.7
G037.7	Spindle motor speed command selection signals	SIND3	○	○	10.7
G038.0	Polygon spindle stop signal	*PLSST	○	○	6.9.2

List by Address

Address	Signal name	Symbol	T	M	Reference item
G038.1	Spindle synchronous speed ratio control signal	SBRT	○	○	10.14
G038.2	Spindle synchronous control signal	SPSYC	○	○	10.14
G038.3	Spindle phase synchronous control signal	SPPHS	○	○	10.14
G038.6	B axis unclamp completion signal	*BEUCP	—	○	13.12
G038.7	B axis clamp completion signal	*BECLP	—	○	13.12
G039.0~G039.5	Tool offset number selection signals	OFN0~OFN5	○	○	15.4.2
G040.0~G040.3		OFN6~OFN9	○	○	
G039.6	Workpiece coordinate system shift value write mode select signal	WOQSM	○	○	15.4.2
G039.7	Tool offset write mode select signal	GOQSM	○	○	15.4.2
G040.5	Spindle measurement select signal	S2TLS	○	—	15.4.2
G040.6	Position record signal	PRC	○	—	15.4.1
G040.7	Workpiece coordinate system shift value write signal	WOSET	○	—	15.4.2
G041.0~G041.3	Manual handle interrupt axis selection signals	HS1IA~HS1ID	○	○	3.3
G041.4~G041.7		HS2IA~HS2ID	○	○	
G042.0~G042.3		HS3IA~HS3ID	○	○	
G042.7	Direct operation select signal	DMMC	○	○	5.13
G043.0~G043.2	Mode selection signals	MD1,MD2,MD4	○	○	2.6
G043.5	DNC operation select signal	DNCI	○	○	5.11
G043.7	Manual reference position return selection signal	ZRN	○	○	4.1
G044.0	Optional block skip signals	BDT1	○	○	5.5
G045		BDT2~BDT9	○	○	
G044.1	All-axis machine lock signal	MLK	○	○	5.3.1
G046.0	Memory protection signals	KEYP	○	○	13.2.2
G046.1	Single block signal	SBK	○	○	5.3.3
G046.3~G046.6	Memory protection signals	KEY1~KEY4	○	○	13.2.1
G046.7	Dry run signal	DRN	○	○	5.3.2
G047.0~G048.0	Tool group number selection signals	TL01~TL256	○	○	11.4
G048.2	Tool life counting disable signal	LFCIV	○	○	11.4
G048.5	Tool skip signal	TLSKP	○	○	11.4
G048.6	Individual tool change reset signal	TLRSTI	○	○	11.4
G048.7	Tool change reset signal	TLRST	○	○	11.4
G049.0~G050.1	Tool life count override signals	*TLV0~*TLV9	○	○	11.4
G053.0	General-purpose integrating meter start signal	TMRON	○	○	13.1.1
G053.3	Interrupt signal for custom macro	UINT	○	○	12.6.2
G053.5	Rapid traverse block overlap disable signal	ROVLP	○	○	7.2.1.2
G053.6	In-position check signal	SMZ	○	○	7.2.5
G053.7	Chamfering signal	*CDZ	○	—	12.8
G054~G055	Input signals for custom macro	UI000~UI015	○	○	12.6
G058.1	External read start signal	EXRD	○	○	14.2
G058.2	External read/punch stop signal	EXSTP	○	○	14.2
G058.3	External punch start signal	EXWT	○	○	14.2
G059.7	Signal for disabling torque difference alarm detection for axis synchronous control	NSYNCA	○	○	1.6
G060.7	Tail stock barrier selection signal	*TSB	○	—	2.3.6
G061.0	Rigid tapping signal	RGTAP	○	○	10.13

Address	Signal name	Symbol	T	M	Reference item
G061.4~G061.5	Rigid tapping spindle selection signals	RGTSP1~RGTSP2	○	—	10.13
G062.6	Rigid tapping retraction start signal	RTNT	—	○	5.10
G063.0	Path select signal(Tool post select signal)	HEAD	●	—	8.11, 13.3
G063.1	No-wait signal	NOWT	●	—	8.2
G063.2,G063.3	Path spindle command selection signals	SLSPA,SLSPB	●	—	8.8
G063.5	Signal for disabling angular axis control for the perpendicular axis	NOZAGC	○	○	1.8
G063.6	In-feed control cut start signal	INFD	—	○	12.9
G063.7	No-wait signal	NMWT	●	—	8.2
G064.2,G064.3	Path spindle feedback selection signals	SLPCA,SLPCB	●	—	8.8
G064.6	Simple spindle synchronous control signal	ESRSYC	○	○	10.17
G066.0	All-axis VRDY off alarm ignore signal	IGNVRY	○	○	2.8
G066.1	External key input mode selection signal	ENBKY	○	○	16.5
G066.4	Retract signal	RTRCT	○	○	1.9, 6.13
G066.7	Key code read signal	EKSET	○	○	16.5
G067.0	Manual tool compensation command number	MTLC	○	—	11.1.4
G067.2	Checking mode signal	MMOD	○	○	3.5
G067.3	Handle available signal in checking mode	MCHK	○	○	3.5
G067.6	Hard copy cancellation request signal	HCABT	○	○	
G067.7	Hard copy execution request signal	HCREQ	○	○	
G68,G69	Manual tool compensation tool number signal (4 digits)	MTLN00~MTLN15	○	—	11.1.4
G070.0	Torque limit command LOW signals (serial spindle)	TLMLA	○	○	10.3
G070.1	Torque limit command HIGH signals (serial spindle)	TLMHA	○	○	10.3
G070.3,G070.2	Clutch/gear signals(serial spindle)	CTH1A,CTH2A	○	○	10.3
G070.4	CCW command signals(serial spindle)	SRVA	○	○	10.3
G070.5	CW command signals(serial spindle)	SFRA	○	○	10.3
G070.6	Orientation command signals (serial spindle)	ORCMA	○	○	10.3 10.14
G070.7	Machine ready signals(serial spindle)	MRDYA	○	○	10.3
G071.0	Alarm reset signals (serial spindle)	ARSTA	○	○	10.3
G071.1	Emergency stop signals(serial spindle)	*ESPA	○	○	10.3
G071.2	Spindle selection signals(serial spindle)	SPSLA	○	○	10.3
G071.3	Power line switch completion signals (serial spindle)	MCFNA	○	○	10.3
G071.4	Soft start/stop cancel signals(serial spindle)	SOCNA	○	○	10.3
G071.5	Speed integral signals (serial spindle)	INTGA	○	○	10.3
G071.6	Output switch request signals (serial spindle)	RSLA	○	○	10.3
G071.7	Power line status check signals (serial spindle)	RCHA	○	○	10.3
G072.0	Orientation stop position change command signals (serial spindle)	INDXA	○	○	10.3

List by Address

Address	Signal name	Symbol	T	M	Reference item
G072.1	Rotational direction command signals for orientation stop position change(serial spindle)	ROTAA	○	○	10.3
G072.2	Shortcut command signals for orientation stop position change(serial spindle)	NRROA	○	○	10.3
G072.3	Differential speed mode command signals (serial spindle)	DEFMDA	○	○	10.3
G072.4	Analog override signals (serial spindle)	OVRA	○	○	10.3
G072.5	Incremental command externally set orientation signals(serial spindle)	INCMDA	○	○	10.3
G072.6	Spindle switch MAIN MCC contact status signals(serial spindle)	MFNHGA	○	○	10.3
G072.7	Spindle switch HIGH MCC contact status signals (serial spindle)	RCHHGA	○	○	10.3
G073.0	Magnetic sensor orientation command signals(serial spindle)	MORCMA	○	○	10.3
G073.1	Subordinate operation mode command signals (serial spindle)	SLVA	○	○	10.3
G073.2	Motor power cutoff command signals (serial spindle)	MPOFA	○	○	10.3
G074.0	Torque limit command LOW signals (serial spindle)	TLMLB	○	○	10.3
G074.1	Torque limit command HIGH signals (serial spindle)	TLMHB	○	○	10.3
G074.3,G074.2	Clutch/gear signals(serial spindle)	CTH1B,CTH2B	○	○	10.3
G074.4	CCW command signals(serial spindle)	SRVB	○	○	10.3
G074.5	CW command signals(serial spindle)	SFRB	○	○	10.3
G074.6	Orientation command signals (serial spindle)	ORCMB	○	○	10.3 10.14
G074.7	Machine ready signals(serial spindle)	MRDYB	○	○	10.3
G075.0	Alarm reset signals (serial spindle)	ARSTB	○	○	10.3
G075.1	Emergency stop signals(serial spindle)	*ESPB	○	○	10.3
G075.2	Spindle selection signals(serial spindle)	SPSLB	○	○	10.3
G075.3	Power line switch completion signals (serial spindle)	MCFNB	○	○	10.3
G075.4	Soft start/stop cancel signals(serial spindle)	SOCNB	○	○	10.3
G075.5	Speed integral signals (serial spindle)	INTGB	○	○	10.3
G075.6	Output switch request signals (serial spindle)	RSLB	○	○	10.3
G075.7	Power line status check signals (serial spindle)	RCHB	○	○	10.3
G076.0	Orientation stop position change command signals (serial spindle)	INDXB	○	○	10.3
G076.1	Rotational direction command signals for orientation stop position change(serial spindle)	ROTAB	○	○	10.3
G076.2	Shortcut command signals for orientation stop position change(serial spindle)	NRROB	○	○	10.3
G076.3	Differential speed mode command signals (serial spindle)	DEFMDB	○	○	10.3
G076.4	Analog override signals (serial spindle)	OVRB	○	○	10.3

Address	Signal name	Symbol	T	M	Reference item
G076.5	Incremental command externally set orientation signals(serial spindle)	INCMDB	○	○	10.3
G076.6	Spindle switch MAIN MCC contact status signals (serial spindle)	MFNHGB	○	○	10.3
G076.7	Spindle switch HIGH MCC contact status signals (serial spindle)	RCHHGB	○	○	10.3
G077.0	Magnetic sensor orientation command signals(serial spindle)	MORCMB	○	○	10.3
G077.1	Subordinate operation mode command signals (serial spindle)	SLVB	○	○	10.3
G077.2	Motor power cutoff command signals (serial spindle)	MPOFB	○	○	10.3
G078.0~G079.3	Spindle orientation external stop position command signals	SH00A~SH11A	○	○	10.15
G080.0~G081.3		SH00B~SH11B	○	○	10.15
G082,G083	Input signals for P-code macro	EUI00~EUI15	○	○	
G087.0,G087.1	Manual handle feed amount selection signals	MP21,MP22	○	○	3.2
G087.3,G087.4		MP31,MP32	—	○	
G096.0~G096.6	1% rapid traverse override signals	*HROV0~*HROV6	○	○	7.1.7.1, 7.1.9
G096.7	1% step rapid traverse override selection signals	HROV	○	○	7.1.7.1, 7.1.9
G098	Key code signals	EKC0~EKC7	○	○	16.5
G100.0~G100.4	Feed axis and direction selection signals	+J1~+J5	○	○	3.1
G101.0~G101.4	External deceleration signals 2	*+ED21~*+ED25	○	○	7.1.9
G102.0~G102.4	Feed axis and direction selection signals	-J1~J5	○	○	3.1
G103.0~G103.4	External deceleration signals 2	*-ED21~*-ED25	○	○	7.1.9
G104.0~G104.4	Stored stroke limit 1 switching signals in axis direction	+EXL1~+EXL5	○	○	2.3.2
G105.0~G105.4		-EXL1~EXL5	○	○	2.3.2
G106.0~G106.4	Mirror image signals	MI1~MI5	○	○	1.2.7
G107.0~G107.4	External deceleration signals 3	*+ED31~*+ED35	○	○	7.1.9
G108.0~G108.4	Each-axis machine lock signal	MLK1~MLK5	○	○	5.3.1
G109.0~G109.4	External deceleration signals 3	*-ED31~*-ED35	○	○	7.1.9
G110.0~G110.4	Stroke limit external setting signals	+LM1~+LM5	○	○	2.3.5
G112.0~G112.4		-LM1~LM5	○	○	
G114.0~G114.4	Overtravel signals	*+L1~*+L5	○	○	2.3.1
G116.0~G116.4		*-L1~*-L5	○	○	
G118.0~G118.4	External deceleration signals 1	*+ED1~*+ED5	○	○	7.1.9
G120.0~G120.4		*-ED1~*-ED5	○	○	
G122.0~G122.4	Parking signals	PK1~PK5	○	○	8.5
G122.6(G031.6)	1st spindle parking signal	PKESS1	○	○	10.17
G122.7(G031.7)	2nd spindle parking signal	PKESS2	○	○	10.17
G124.0~G124.4	Controlled axis detach signals	DTCH1~DTCH5	○	○	1.2.5
G125.0~G125.4	Unexpected disturbance torque detection ignore signal	IUDD1~IUDD5	○	○	2.9
G126.0~G126.4	Servo off signals	SVF1~SVF5	○	○	1.2.9
G128.0~G128.4	Composite control axis change selection signals	MIX1~MIX5	○	○	8.5
G130.0~G130.4	Interlock signal for each axis	*IT1~*IT5	○	○	2.5
G132.0~G132.4	Interlock signal for each axis direction	+MIT1~+MIT5	—	○	2.5
G134.0~G134.4		-MIT1~MIT5			
G132.0,G132.1	Tool offset write signals	+MIT1,+MIT2	○	—	15.4.2
G134.0,G134.1	Tool offset write signals	-MIT1,-MIT2	○	—	15.4.2
G136.0~G136.4	Control axis selection signals(PMC axis control)	EAX1~EAX5	○	○	16.1

List by Address

Address	Signal name	Symbol	T	M	Reference item
G138.0~G138.4	Synchronous control axis selection signals	SYNC1~SYNC5	○	○	1.6,8.5
G140.0~G140.4	Signals for selecting the manual feed axis for axis synchronous control	SYNCJ1~SYNCJ5	○	○	1.6
G142.0	Auxiliary function completion signal (for group 1) (PMC axis control)	EFINA	○	○	16.1
G142.1	Accumulated zero check signal (for group 1) (PMC axis control)	ELCKZA	○	○	16.1
G142.2	Buffering disable signals (for group 1) (PMC axis control)	EMBUFA	○	○	16.1
G142.3	Block stop signals (for group 1) (PMC axis control)	ESBKA	○	○	16.1
G142.4	Servo off signals (for group 1) (PMC axis control)	ESOFA	○	○	16.1
G142.5	Axis control temporary stop signals (for group 1) (PMC axis control)	ESTPA	○	○	16.1
G142.6	Reset signals (for group 1) (PMC axis control)	ECLRA	○	○	16.1
G142.7	Axis control command read signal (for group 1) (PMC axis control)	EBUFA	○	○	16.1
G143.0~G143.6	Axis control command signals (for group 1) (PMC axis control)	EC0A~EC6A	○	○	16.1
G143.7	Block stop disable signals (for group 1) (PMC axis control)	EMSBKA	○	○	16.1
G144,G145	Axis control feedrate signals (for group 1) (PMC axis control)	EIF0A~EIF15A	○	○	16.1
G146~G149	Axis control data signals (for group 1) (PMC axis control)	EID0A~EID31A	○	○	16.1
G150.0,G150.1	Rapid traverse override signals(PMC axis control)	EROV1,EROV2	○	○	16.1
G150.5	Override cancel signal (for group 1) (PMC axis control)	EOVC	○	○	16.1
G150.6	Manual rapid traverse selection signal(PMC axis control)	ERT	○	○	16.1
G150.7	Dry run signal(PMC axis control)	EDRN	○	○	16.1
G151	Feedrate override signals (for group 1) (PMC axis control)	*EFOV0~*EFOV7	○	○	16.1
G154.0	Auxiliary function completion signal (for group 2) (PMC axis control)	EFINB	○	○	16.1
G154.1	Accumulated zero check signal (for group 2) (PMC axis control)	ELCKZB	○	○	16.1
G154.2	Buffering disable signals (for group 2) (PMC axis control)	EMBUFB	○	○	16.1
G154.3	Block stop signals (for group 2) (PMC axis control)	ESBKB	○	○	16.1
G154.4	Servo off signals (for group 2) (PMC axis control)	ESOFB	○	○	16.1
G154.5	Axis control temporary stop signals (for group 2) (PMC axis control)	ESTPB	○	○	16.1
G154.6	Reset signals (for group 2) (PMC axis control)	ECLRB	○	○	16.1
G154.7	Axis control command read signals (for group 2) (PMC axis control)	EBUFB	○	○	16.1
G155.0~G155.6	Axis control command signals (for group 2) (PMC axis control)	EC0B~EC6B	○	○	16.1

Address	Signal name	Symbol	T	M	Reference item
G155.7	Block stop disable signals (for group 2) (PMC axis control)	EMSBKB	○	○	16.1
G156,G157	Axis control feedrate signals (for group 2) (PMC axis control)	EIF0B~EIF15B	○	○	16.1
G158~G161	Axis control data signals (for group 2) (PMC axis control)	EID0B~EID31B	○	○	16.1
G162.5	Override cancel signal (for group 2) (PMC axis control)	EOVCB	○	○	16.1
G163	Feedrate override signals (for group 2) (PMC axis control)	*EFOV0B~*EFOV7B	○	○	16.1
G166.0	Auxiliary function completion signal (for group 3) (PMC axis control)	EFINC	○	○	16.1
G166.1	Accumulated zero check signal (for group 3) (PMC axis control)	ELCKZC	○	○	16.1
G166.2	Buffering disable signals (for group 3) (PMC axis control)	EMBUFC	○	○	16.1
G166.3	Block stop signals (for group 3) (PMC axis control)	ESBKC	○	○	16.1
G166.4	Servo off signals (for group 3) (PMC axis control)	ESOFC	○	○	16.1
G166.5	Axis control temporary stop signals (for group 3) (PMC axis control)	ESTPC	○	○	16.1
G166.6	Reset signals (for group 3) (PMC axis control)	ECLRC	○	○	16.1
G166.7	Axis control command read signals (for group 3) (PMC axis control)	EBUFC	○	○	16.1
G167.0~G167.6	Axis control command signals (for group 3) (PMC axis control)	EC0C~EC6C	○	○	16.1
G167.7	Block stop disable signals (for group 3) (PMC axis control)	EMSBKC	○	○	16.1
G168,G169	Axis control feedrate signals (for group 3) (PMC axis control)	EIF0C~EIF15C	○	○	16.1
G170~G173	Axis control data signals (for group 3) (PMC axis control)	EID0C~EID31C	○	○	16.1
G174.5	Override cancel signal (for group 3) (PMC axis control)	EOVCC	○	○	16.1
G175	Feedrate override signals (for group 3) (PMC axis control)	*EFOV0C~*EFOV7C	○	○	16.1
G178.0	Block stop signals (for group 4) (PMC axis control)	EFIND	○	○	16.1
G178.1	Accumulated zero check signal (for group 4) (PMC axis control)	ELCKZD	○	○	16.1
G178.2	Buffering disable signals (for group 4) (PMC axis control)	EMBUFD	○	○	16.1
G178.3	Block stop signals (for group 4) (PMC axis control)	ESBKD	○	○	16.1
G178.4	Servo off signals (for group 4) (PMC axis control)	ESOFD	○	○	16.1
G178.5	Axis control temporary stop signals (for group 4) (PMC axis control)	ESTPD	○	○	16.1
G178.6	Reset signals (for group 4) (PMC axis control)	ECLRD	○	○	16.1
G178.7	Axis control command read signals (for group 4) (PMC axis control)	EBUFD	○	○	16.1

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Address	Signal name	Symbol	T	M	Reference item
G179.0~G179.6	Axis control command signals (for group 4) (PMC axis control)	EC0D~EC6D	○	○	16.1
G179.7	Block stop disable signals (for group 4) (PMC axis control)	EMSBKD	○	○	16.1
G180,G181	Axis control feedrate signals (for group 4) (PMC axis control)	EIF0D~EIF15D	○	○	16.1
G182~G185	Axis control data signals (for group 4) (PMC axis control)	EID0D~EID31D	○	○	16.1
G186.5	Override cancel signal (for group 4) (PMC axis control)	EOVCD	○	○	16.1
G187	Feedrate override signals (for group 4) (PMC axis control)	*EFOV0D~*EFOV7D	○	○	16.1
G190.0~G190.4	Superimposed control axis selection signals	OVLS1~OVLS5	○	○	8.6
G192.0~G192.4	Each-axis VRDY off alarm ignore signal	IGVRY1~IGVRY5	○	○	2.8
G196.0~G196.4	Reference position return deceleration signals	*DEC1~*DEC5	○	○	4.1
G199.0,G199.1	Manual handle generators selection signal	IOLBH1, IOLBH2	○	—	3.4
G202	A/B phase detector disconnection alarm ignore signal (PMC axis control)	NDCAL1~NDCAL8	○	—	16.1
G204.0	Torque limit command LOW signals (serial spindle)	TLMLC	○	—	10.3
G204.1	Torque limit command HIGH signals (serial spindle)	TLMHC	○	—	10.3
G204.3,G204.2	Clutch/gear signals (serial spindle)	CTH1C,CTH2C	○	—	10.3
G204.4	CCW command signals (serial spindle)	SRVC	○	—	10.3
G204.5	CW command signals (serial spindle)	SFRC	○	—	10.3
G204.6	Orientation command signals (serial spindle)	ORCMC	○	—	10.3 10.14
G204.7	Machine ready signals (serial spindle)	MRDYC	○	—	10.3
G205.0	Alarm reset signals (serial spindle)	ARSTC	○	—	10.3
G205.1	Emergency stop signals (serial spindle)	*ESPC	○	—	10.3
G205.2	Spindle selection signals (serial spindle)	SPSLC	○	—	10.3
G205.3	Power line switch completion signals (serial spindle)	MCFNC	○	—	10.3
G205.4	Soft start/stop cancel signals (serial spindle)	SOCNC	○	—	10.3
G205.5	Speed integral signals (serial spindle)	INTGC	○	—	10.3
G205.6	Output switch request signals (serial spindle)	RSLC	○	—	10.3
G205.7	Power line status check signals (serial spindle)	RCHC	○	—	10.3
G206.0	Orientation stop position change command signals (serial spindle)	INDXC	○	—	10.3
G206.1	Rotational direction command signals for orientation stop position change (serial spindle)	ROTAC	○	—	10.3
G206.2	Shortcut command signals for orientation stop position change (serial spindle)	NRROC	○	—	10.3
G206.3	Differential speed mode command signals (serial spindle)	DEFMDC	○	—	10.3
G206.4	Analog override signals (serial spindle)	OVRC	○	—	10.3

Address	Signal name	Symbol	T	M	Reference item
G206.5	Incremental command externally set orientation signals (serial spindle)	INCMDC	○	—	10.3
G206.6	Spindle switch MAIN MCC contact status signals (serial spindle)	MFNHGC	○	—	10.3
G206.7	Spindle switch HIGH MCC contact status signals (serial spindle)	RCHHGC	○	—	10.3
G207.0	Magnetic sensor orientation command signals (serial spindle)	MORCMC	○	—	10.3
G207.1	Subordinate operation mode command signals (serial spindle)	SLVC	○	—	10.3
G207.2	Motor power cutoff command signals (serial spindle)	MPOFC	○	—	10.3
G210~G211	Data signals for external data input	ED31~ED16	○	○	16.2
G264.0~G264.1	Simple spindle synchronous control signal (for each spindle)	ESSYC1~ESSYC2	○	○	10.17
G265.0~G265.1	Simple spindle synchronous parking signal (for each spindle)	PKESE1~PKESE2	○	○	10.17
G274.4	Cs axis coordinate establishment request signals (for each spindle)	CSF11	○	○	10.11.3
G288.0~G288.1	Spindle synchronous control signal (for each spindle)	SPSYC1~SPSYC2	○	○	10.14
G289.0~G289.1	Spindle phase synchronous control signal (for each spindle)	SPPHS1~SPPHS2	○	○	10.14
G295.0	Machine operation menu screen select signal	EXSFT	○	○	13.4
G295.6	Dual display forcible end request signal	C2SEND	○	○	13.1.9
G295.7	Key control selection signal	CNCKY	○	○	13.1.9
G352.0~G353.1	0.1% rapid traverse override signals	*FHRO0~*FHRO9	○	○	7.1.7.1
G353.7	0.1% step rapid traverse override selection signals	FHROV	○	○	7.1.7.1
G358.0~G358.4	Each axis workpiece coordinate system preset signals	WPRST1~WPRST5	○	○	1.5.2.6
G376	2nd spindle speed override signals	SOV20~SOV27	○	○	10.12
G400.1	Spindle unclamp completion signal	*SUCPFB	○	○	10.10
G401.1	Spindle clamp completion signal	*SCPFB	○	○	10.10
G402.1	Spindle stop completion signal	SPSTPB	○	○	10.10
G408.0	Start check signal	STCHK	○	○	2.12
G512,G513	Macro call start signal	MCST1~MCST16	○	○	16.6
G514.0	Mode change completion signal	MCFIN	○	○	16.6
G521.0~G521.4	SV speed control mode signals	SRVON1~SRVON5	○	○	10.19
G523.0~G523.4	SV reverse signals	SVRVS1~SVRVS5	○	○	10.19
G525~G528	Manual tool compensation tool number signal (8 digits)	MT8N00~MT8N31	○	—	11.1.4
G531.0	Forward movement prohibition signal	FWSTP	○	○	3.5
G531.1	Reverse movement prohibition signal	MRVM	○	○	3.5
G536.7	Spindle command path specification signal	SPSP	○	○	10.12
F000.0	Rewinding signal	RWD	○	○	5.2
F000.4	Feed hold lamp signal	SPL	○	○	5.1
F000.5	Cycle start lamp signal	STL	○	○	5.1
F000.6	Servo ready signal	SA	○	○	2.2
F000.7	Automatic operation signal	OP	○	○	5.1
F001.0	Alarm signal	AL	○	○	2.4
F001.1	Resetting signal	RST	○	○	5.2

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Address	Signal name	Symbol	T	M	Reference item
F001.2	Battery alarm signal	BAL	○	○	2.4
F001.3	Distribution completion signals	DEN	○	○	9.1
F001.4	Spindle enable signal	ENB	○	○	10.6
F001.5	Tapping signal	TAP	○	○	12.7
F001.7	CNC ready signal	MA	○	○	2.2
F002.0	Inch input signal	INCH	○	○	12.5
F002.1	Rapid traversing signal	RPDO	○	○	2.7.7.1.1
F002.2	Constant surface speed signal	CSS	○	○	10.8
F002.3	Threading signal	THRD	○	○	6.5
F002.4	Program restart under way signal	SRNMV	○	○	5.7
F002.6	Cutting feed signal	CUT	○	○	2.7
F002.7	Dry run check signal	MDRN	○	○	5.3.2
F003.0	Incremental feed selection check signal	MINC	○	○	2.6
F003.1	Manual handle feed selection check signal	MH	○	○	2.6
F003.2	Jog feed selection check signal	MJ	○	○	2.6
F003.3	Manual data input selection check signal	MMDI	○	○	2.6
F003.4	DNC operation selection confirm signal	MRMT	○	○	5.11
F003.5	Automatic operation selection check signal	MMEM	○	○	2.6
F003.6	Memory edit selection check signal	MEDT	○	○	2.6
F004.0	Optional block skip check signals	MBDT1	○	○	5.5
F005		MBDT2~MBDT9	○	○	
F004.1	All-axis machine lock check signal	MMLK	○	○	5.3.1
F004.2	Manual absolute check signal	MABSM	○	○	5.4
F004.3	Single block check signal	MSBK	○	○	5.3.3
F004.4	Auxiliary function lock check signal	MAFL	○	○	9.2
F004.5	Manual reference position return selection check signal	MREF	○	○	4.1
F006.0	Touch panel check signal	TPPRS	○	○	13.1.6
F006.1	MDI reset confirmation signal	MDIRST	○	○	5.2
F006.2	Automatic screen erasing signal	ERTVA	○	○	
F007.0	Auxiliary function strobe signals	MF	○	○	9.1
F007.2	Spindle function strobe signal	SF	○	○	9.1
F007.3	Tool function strobe signal	TF	○	○	9.1
F007.7	2nd auxiliary function strobe signal	BF	○	○	9.1
F008.4	2nd M function strobe signal	MF2	○	○	9.3
F008.5	3rd M function strobe signal	MF3	○	○	9.3
F009.4	Decode M signals	DM30	○	○	9.1
F009.5		DM02	○	○	
F009.6		DM01	○	○	
F009.7		DM00	○	○	
F010~F013	Auxiliary function code signals	M00~M31	○	○	9.1
F014~F015	2nd M function code signals	M200~M215	○	○	9.3
F016~F017	3rd M function code signals	M300~M315	○	○	9.3
F022~F025	Spindle function code signals	S00~S31	○	○	9.1
F026~F029	Tool function code signals	T00~T31	○	○	9.1
F030~F033	2nd auxiliary function code signals	B00~B31	○	○	9.1
F034.0~F034.2	Gear selection signals (output)	GR10,GR20,GR30	—	○	10.6
F034.3	4th serial spindle ready signals	SRSP4R	○	○	10.3
F034.4	3rd serial spindle ready signals	SRSP3R	○	○	10.3
F034.5	2nd serial spindle ready signals	SRSP2R	○	○	10.3
F034.6	1st serial spindle ready signals	SRSP1R	○	○	10.3
F034.7	All-spindle operation ready signal	SRSRDY	○	○	10.3

Address	Signal name	Symbol	T	M	Reference item
F035.0	Spindle fluctuation detection alarm signal	SPAL	○	○	10.18
F036.0~F037.3	S12-bit code signals	R010~R120	○	○	10.6
F038.0	Spindle clamp signal	SCLPA	○	○	10.10
F038.1	Spindle unclamp signal	SUCLPA	○	○	10.10
F038.2	Spindle enable signal	ENB2	○	○	10.12
F039.0	Spindle positioning mode signals	MSPOSA	○	○	10.10
F040,F041	Actual spindle speed signals	AR00~AR15	○	○	10.9
F043.0~F043.3	Phase error monitor signal (for each spindle)	SYCAL1~SYCAL4	○	○	10.14,10.17
F044.1	Cs contour control change completion signal	FSCSL	○	○	10.11
F044.2	Spindle phase synchronous control signal	FSPSY	○	○	10.14
F044.3	Spindle synchronous speed control completion signal	FSPPH	○	○	10.14
F044.4	Phase error monitor signal	SYCAL	○	○	10.14,10.17
F045.0	Alarm signals(serial spindle)	ALMA	○	○	10.3
F045.1	Speed zero signals(serial spindle)	SSTA	○	○	10.3
F045.2	Speed detection signals(serial spindle)	SDTA	○	○	10.3
F045.3	Spindle speed arrival signal(serial spindle)	SARA	○	○	10.3
F045.4	Load detection signals 1(serial spindle)	LDT1A	○	○	10.3
F045.5	Load detection signals 2(serial spindle)	LDT2A	○	○	10.3
F045.6	Torque limit signals(serial spindle)	TLMA	○	○	10.3
F045.7	Orientation completion signals(serial spindle)	ORARA	○	○	10.3
F046.0	Power line switch signals(serial spindle)	CHPA	○	○	10.3
F046.1	Spindle switch completion signals (serial spindle)	CFINA	○	○	10.3
F046.2	Output switch signals(serial spindle)	RCHPA	○	○	10.3
F046.3	Output switch completion signals (serial spindle)	RCFNA	○	○	10.3
F046.4	Subordinate operation status signals(serial spindle)	SLVSA	○	○	10.3
F046.5	Position coder orientation proximity signal(serial spindle)	PORA2A	○	○	10.3
F046.6	Magnetic sensor orientation completion signals(serial spindle)	MORA1A	○	○	10.3
F046.7	Magnetic sensor orientation proximity signals(serial spindle)	MORA2A	○	○	10.3
F047.0	Position coder one-rotation signal detection status signals(serial spindle)	PC1DEA	○	○	10.3
F047.1	Incremental orientation mode signals (serial spindle)	INCSTA	○	○	10.3
F048.4	Cs axis origin established state signals	CSPENA	○	○	10.11.3
F049.0	Alarm signals(serial spindle)	ALMB	○	○	10.3
F049.1	Speed zero signals(serial spindle)	SSTB	○	○	10.3
F049.2	Speed detection signals(serial spindle)	SDTB	○	○	10.3
F049.3	Spindle speed arrival signal(serial spindle)	SARB	○	○	10.3
F049.4	Load detection signals 1(serial spindle)	LDT1B	○	○	10.3
F049.5	Load detection signals 2(serial spindle)	LDT2B	○	○	10.3
F049.6	Torque limit signals(serial spindle)	TLMB	○	○	10.3

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Address	Signal name	Symbol	T	M	Reference item
F049.7	Orientation completion signals(serial spindle)	ORARB	○	○	10.3
F050.0	Power line switch signals(serial spindle)	CHPB	○	○	10.3
F050.1	Spindle switch completion signals (serial spindle)	CFINB	○	○	10.3
F050.2	Output switch signals(serial spindle)	RCHPB	○	○	10.3
F050.3	Output switch completion signals (serial spindle)	RCFNB	○	○	10.3
F050.4	Subordinate operation status signals(serial spindle)	SLVSB	○	○	10.3
F050.5	Position coder orientation proximity signal(serial spindle)	PORA2B	○	○	10.3
F050.6	Magnetic sensor orientation completion signals(serial spindle)	MORA1B	○	○	10.3
F050.7	Magnetic sensor orientation proximity signals(serial spindle)	MORA2B	○	○	10.3
F051.0	Position coder one-rotation signal detection status signals(serial spindle)	PC1DEB	○	○	10.3
F051.1	Incremental orientation mode signals (serial spindle)	INCSTB	○	○	10.3
F053.0	Key input disable signal	INHKY	○	○	16.5
F053.1	Key input disable signal	PRGDPL	○	○	16.5
F053.2	Read/punch busy signal	PRBSY	○	○	14.2
F053.3	Read/punch alarm signal	PRALM	○	○	14.2
F053.7	Key code read completion signal	EKENB	○	○	16.5
F054,F055	Output signals for custom macro	UO000~UO015	○	○	12.6
F056~F059		UO100~UO131	○	○	
F060.0	Read completion signal for external data input	EREND	○	○	16.2
F060.1	Search completion signal for external data input	ESEND	○	○	16.2
F060.2	Search cancel signal for external data input	ESCAN	○	○	16.2
F061.0	B axis unclamp signal	BUCLP	—	○	13.12
F061.1	B axis clamp signal	BCLP	—	○	13.12
F061.4	Manual tool compensation uncompleted signal	MTLANG	○	—	11.1.4
F061.5	Manual tool compensation completion signal	MTLA	○	—	11.1.4
F062.0	AI contour control mode signal	AICC	○	○	7.1.11
F062.7	Target part count reached signal	PRTSF	○	○	13.1.1
F063.0	Polygon master axis not arrival signal	PSE1	○	○	6.9.2
F063.1	Polygon synchronization axis not arrival signal	PSE2	○	○	6.9.2
F063.2	Polygon spindle speed arrival signal	PSAR	○	○	6.9.2
F063.3	Path spindle command confirmation signal	COSP1	●	—	8.8
F063.4		COSP2	●	—	
F063.6	Waiting signal	WATO	●	—	8.2
F063.7	Polygon synchronization under way signal	PSYN	○	○	6.9
F064.0	Tool change signal	TLCH	○	○	11.4
F064.1	New tool select signal	TLNW	○	○	11.4
F064.2	Individual tool change signal	TLCHI	○	○	11.4
F064.3	Tool life arrival notice signal	TLCHB	○	○	11.4

Address	Signal name	Symbol	T	M	Reference item
F064.5	Path spindle command confirmation signal	COSP	●	—	8.8
F064.6	Path interference check in progress signal	TICLK	●	—	8.3
F064.7	Path interference alarm signal	TIALM	●	—	8.3
F065.0	Spindle rotation direction signals	RGSP	○	○	10.13
F065.1		RGSPM	○	○	
F065.2	Spindle synchronous speed ratio control clamp signal	RSMAX	○	○	10.14
F065.4	Retract completion signal	RTRCTF	○	○	1.9, 6.13
F065.6	EGB mode signal	SYNMOD	○	○	1.9
F066.1	Rigid tapping retraction completion signal	RTPT	—	○	5.10
F066.3	Mcachining start point signal	RTNMVS	○	○	
F066.5	Small-hole peck drilling cycle in progress signal	PECK2	—	○	12.7
F070,F071	Position switch signals	PSW01~PSW16	○	○	1.2.10
F072	Software operator's panel general-purpose switch signals	OUT0~OUT7	○	○	13.1.2
F073.0	Software operator's panel signal (MD1)	MD1O	○	○	13.1.2
F073.1	Software operator's panel signal (MD2)	MD2O	○	○	13.1.2
F073.2	Software operator's panel signal (MD4)	MD4O	○	○	13.1.2
F073.4	Software operator's panel signal (ZRN)	ZRNO	○	○	13.1.2
F074	Software operator's panel general-purpose switch signals	OUT8~OUT15	○	○	13.1.2
F075.2	Software operator's panel signal (BDT)	BDTO	○	○	13.1.2
F075.3	Software operator's panel signal (SBK)	SBKO	○	○	13.1.2
F075.4	Software operator's panel signal (MLK)	MLKO	○	○	13.1.2
F075.5	Software operator's panel signal (DRN)	DRNO	○	○	13.1.2
F075.6	Software operator's panel signal (KEY1~KEY4)	KEYO	○	○	13.1.2
F075.7	Software operator's panel signal (*SP)	SPO	○	○	13.1.2
F076.0	Software operator's panel signal (MP1)	MP1O	○	○	13.1.2
F076.1	Software operator's panel signal (MP2)	MP2O	○	○	13.1.2
F076.3	Rigid tapping-in-progress signal	RTAP	○	○	10.13
F076.4	Software operator's panel signal (ROV1)	ROV1O	○	○	13.1.2
F076.5	Software operator's panel signal (ROV2)	ROV2O	○	○	13.1.2
F077.0	Software operator's panel signal (HS1A)	HS1AO	○	○	13.1.2
F077.1	Software operator's panel signal (HS1B)	HS1BO	○	○	13.1.2
F077.2	Software operator's panel signal (HS1C)	HS1CO	○	○	13.1.2
F077.3	Software operator's panel signal (HS1D)	HS1DO	○	○	13.1.2
F077.6	Software operator's panel signal (RT)	RTO	○	○	13.1.2
F078	Software operator's panel signal (*FV0~*FV7)	*FV00~*FV70	○	○	13.1.2
F079,F080	Software operator's panel signal (*JV0~*JV15)	*JV00~*JV150	○	○	13.1.2
F081.0,F081.2, F081.4,F081.6	Software operator's panel signal (+J1~+J4)	+J10~+J40	○	○	13.1.2
F081.1,F081.3, F081.5,F081.7	Software operator's panel signal (-J1~-J4)	-J10~-J40	○	○	13.1.2
F082.2	Reverse execution in-progress signal	RVSL	—	○	5.8
F084,F085	Output signals for P-code macro	EUO00~EUO15	○	○	
F090.0	Servo axis unexpected disturbance torque detection signal	ABTQSV	○	○	2.9

List by Address

Address	Signal name	Symbol	T	M	Reference item
F090.1	1st spindle unexpected disturbance torque detection signal	ABTSP1	○	○	2.9
F090.2	2nd spindle unexpected disturbance torque detection signal	ABTSP2	○	○	2.9
F091.0	Reverse movement signal	MRVMD	○	○	3.5
F091.1	Direction change prohibition signal	MNCHG	○	○	3.5
F091.2	Reverse movement prohibition signal	MRVSP	○	○	3.5
F091.3	Check mode confirmation signal	MMMOD	○	○	3.5
F093.2	Tool life counting disable signal	LFCIF	○	○	11.4
F093.4	Servo warning detail signals	SVWRN1	○	○	18.1
F093.5		SVWRN2	○	○	
F093.6		SVWRN3	○	○	
F093.7		SVWRN4	○	○	
F094.0~F094.4	Reference position return end signals	ZP1~ZP5	○	○	4.1
F096.0~F096.4	2nd reference position return completion signals	ZP21~ZP25	○	○	4.4
F098.0~F098.4	3rd reference position return completion signals	ZP31~ZP35	○	○	4.4
F100.0~F100.4	4th reference position return completion signals	ZP41~ZP45	○	○	4.4
F102.0~F102.4	Axis moving signals	MV1~MV5	○	○	1.2.6
F104.0~F104.4	In-position signals	INP1~INP5	○	○	7.2.5
F106.0~F106.4	Axis moving direction signals	MVD1~MVD5	○	○	1.2.6
F108.0~F108.4	Mirror image check signals	MMI1~MMI5	○	○	1.2.7
F110.0~F110.4	Controlled axis detach status signals	MDTCH1~MDTCH5	○	○	1.2.5
F112.0~F112.4	Distribution completion signals(PMC axis control)	EADEN1~EADEN5	○	○	16.1
F114.0~F114.4	Torque limit reached signals	TRQL1~TRQL5	○	○	15.3.3
F118.0~F118.4	Synchronous/composite/superimposed control under way signals	SYN10~SYN50	○	○	8.5,8.6
F120.0~F120.4	Reference position establishment signals	ZRF1~ZRF5	○	○	4.1
F122.0~F122.3	High-speed skip status signals	HDO0~HDO3	○	○	15.3.2
F124.0~F124.4	Overtravel alarm signals	+OT1~+OT5	○	○	2.3.2
F126.0~F126.4		-OT1~-OT5	○	○	2.3.2
F129.5	Override 0% signal(PMC axis control)	EOV0	○	○	16.1
F129.7	Controlled axis selection status signals(PMC axis control)	*EAXSL	○	○	16.1
F130.0	In-position signals(PMC axis control)	EINPA	○	○	16.1
F130.1	Following zero checking signals(PMC axis control)	ECKZA	○	○	16.1
F130.2	Alarm signal(PMC axis control)	EIALA	○	○	16.1
F130.3	Auxiliary function executing signals(PMC axis control)	EDENA	○	○	16.1
F130.4	Axis moving signals(PMC axis control)	EGENA	○	○	16.1
F130.5	Positive-direction overtravel signals(PMC axis control)	EOTPA	○	○	16.1
F130.6	Negative-direction overtravel signals(PMC axis control)	EOTNA	○	○	16.1
F130.7	Axis control command read completion signals(PMC axis control)	EBSYA	○	○	16.1
F131.0	Auxiliary function strobe signals(PMC axis control)	EMFA	○	○	16.1
F131.1	Buffer full signals(PMC axis control)	EABUFA	○	○	16.1

Address	Signal name	Symbol	T	M	Reference item
F131.2	Auxiliary function 2nd strobe signals (PMC axis control)	EMF2A	○	○	16.1
F131.3	Auxiliary function 3rd strobe signals (PMC axis control)	EMF3A	○	○	16.1
F132,F142	Auxiliary function code signals(PMC axis control)	EM11A~EM48A	○	○	16.1
F133.0	In-position signals(PMC axis control)	EINPB	○	○	16.1
F133.1	Following zero checking signals(PMC axis control)	ECKZB	○	○	16.1
F133.2	Alarm signal(PMC axis control)	EIALB	○	○	16.1
F133.3	Auxiliary function executing signals(PMC axis control)	EDENB	○	○	16.1
F133.4	Axis moving signals(PMC axis control)	EGENB	○	○	16.1
F133.5	Positive-direction overtravel signals(PMC axis control)	EOTPB	○	○	16.1
F133.6	Negative-direction overtravel signals(PMC axis control)	EOTNB	○	○	16.1
F133.7	Axis control command read completion signals(PMC axis control)	EBSYB	○	○	16.1
F134.0	Auxiliary function strobe signals(PMC axis control)	EMFB	○	○	16.1
F134.1	Buffer full signals(PMC axis control)	EABUFB	○	○	16.1
F134.2	Auxiliary function 2nd strobe signals (PMC axis control)	EMF2B	○	○	16.1
F134.3	Auxiliary function 3rd strobe signals (PMC axis control)	EMF3B	○	○	16.1
F135,F145	Auxiliary function code signals(PMC axis control)	EM11B~EM48B	○	○	16.1
F136.0	In-position signals(PMC axis control)	EINPC	○	○	16.1
F136.1	Following zero checking signals(PMC axis control)	ECKZC	○	○	16.1
F136.2	Alarm signal(PMC axis control)	EIALC	○	○	16.1
F136.3	Auxiliary function executing signals(PMC axis control)	EDENC	○	○	16.1
F136.4	Axis moving signals(PMC axis control)	EGENC	○	○	16.1
F136.5	Positive-direction overtravel signals(PMC axis control)	EOTPC	○	○	16.1
F136.6	Negative-direction overtravel signals(PMC axis control)	EOTNC	○	○	16.1
F136.7	Axis control command read completion signals(PMC axis control)	EBSYC	○	○	16.1
F137.0	Auxiliary function strobe signals(PMC axis control)	EMFC	○	○	16.1
F137.1	Buffer full signals(PMC axis control)	EABUFC	○	○	16.1
F137.2	Auxiliary function 2nd strobe signals (PMC axis control)	EMF2C	○	○	16.1
F137.3	Auxiliary function 3rd strobe signals (PMC axis control)	EMF3C	○	○	16.1
F138,F148	Auxiliary function code signals(PMC axis control)	EM11C~EM48C	○	○	16.1
F139.0	In-position signals(PMC axis control)	EINPD	○	○	16.1
F139.1	Following zero checking signals(PMC axis control)	ECKZD	○	○	16.1
F139.2	Alarm signal(PMC axis control)	EIALD	○	○	16.1

List by Address

Address	Signal name	Symbol	T	M	Reference item
F139.3	Auxiliary function executing signals(PMC axis control)	EDEND	○	○	16.1
F139.4	Axis moving signals(PMC axis control)	EGEND	○	○	16.1
F139.5	Positive-direction overtravel signals(PMC axis control)	EOTPD	○	○	16.1
F139.6	Negative-direction overtravel signals(PMC axis control)	EOTND	○	○	16.1
F139.7	Axis control command read completion signals(PMC axis control)	EBSYD	○	○	16.1
F140.0	Auxiliary function strobe signals(PMC axis control)	EMFD	○	○	16.1
F140.1	Buffer full signals(PMC axis control)	EABUFD	○	○	16.1
F140.2	Auxiliary function 2nd strobe signals (PMC axis control)	EMF2D	○	○	16.1
F140.3	Auxiliary function 3rd strobe signals (PMC axis control)	EMF3D	○	○	16.1
F141,F151	Auxiliary function code signals(PMC axis control)	EM11D~EM48D	○	○	16.1
F154.0	Remaining tool count notification signal	TLAL	—	○	11.4
F160,F161	Multi-spindle address P signals	MSP00~MSP15	○	○	10.12
F168.0	Alarm signals(serial spindle)	ALMC	○	—	10.3
F168.1	Speed zero signals(serial spindle)	SSTC	○	—	10.3
F168.2	Speed detection signals(serial spindle)	SDTC	○	—	10.3
F168.3	Spindle speed arrival signal(serial spindle)	SARC	○	—	10.3
F168.4	Load detection signals 1(serial spindle)	LDT1C	○	—	10.3
F168.5	Load detection signals 2(serial spindle)	LDT2C	○	—	10.3
F168.6	Torque limit signals(serial spindle)	TLMC	○	—	10.3
F168.7	Orientation completion signals(serial spindle)	ORARC	○	—	10.3
F169.0	Power line switch signals(serial spindle)	CHPC	○	—	10.3
F169.1	Spindle switch completion signals (serial spindle)	CFINC	○	—	10.3
F169.2	Output switch signals(serial spindle)	RCHPC	○	—	10.3
F169.3	Output switch completion signals (serial spindle)	RCFNC	○	—	10.3
F169.4	Subordinate operation status signals(serial spindle)	SLVSC	○	—	10.3
F169.5	Position coder orientation proximity signal(serial spindle)	PORA2C	○	—	10.3
F169.6	Magnetic sensor orientation completion signals(serial spindle)	MORA1C	○	—	10.3
F169.7	Magnetic sensor orientation proximity signals(serial spindle)	MORA2C	○	—	10.3
F170.0	Position coder one-rotation signal detection status signals(serial spindle)	PC1DEC	○	—	10.3
F170.1	Incremental orientation mode signals (serial spindle)	INCSTC	○	—	10.3
F172.6	Absolute position detector battery voltage zero alarm signal	PBATZ	○	○	1.4.3
F172.7	Absolute position detector battery voltage low alarm signal	PBATL	○	○	1.4.3
F180.0~F180.4	Torque limit reach signals for reference position setting with mechanical stopper	CLRCH1~CLRCH5	○	○	4.5

Address	Signal name	Symbol	T	M	Reference item
F182.0~F182.4	Controlling signals(PMC axis control)	EACNT1~EACNT5	○	○	16.1
F184.0~F184.4	Unexpected disturbance torque detection signal	ABDT1~ABDT5	○	○	2.9
F190	Torque control mode signal(PMC axis control)	TRQM1~TRQM8	○	○	16.1
F200.0~F201.3	S 12-bit code signals	R01O2~R12O2	○	○	10.12
F202,F203	Actual spindle speed signals	AR002~AR152	○	○	10.9
F204.0~F205.3	S 12-bit code signals	R01O3~R12O3	○	○	10.12
F210.0~F210.4	Machine coordinate match state output signals	SYNMT1~SYNMT5	○	○	1.6
F211.0~F211.4	Synchronization compensation enable state output signals	SYNOF1~SYNOF5	○	○	1.6
F264.0~F265.0	Spindle warning detail signals 1 to 9	SPWRN1~SPWRN9	○	○	10.3
F270.0~F271.3	S 12-bit code signals	R01O4~R12O4	○	○	10.12
F274.4	Cs axis coordinate establishment alarm signals (for each spindle)	CSFO1	○	○	10.11.3
F288.0~F288.1	Spindle phase synchronous control signal (for each spindle)	FSPSY1~FSPSY2	○	○	10.14
F289.0~F289.1	Spindle synchronous speed control completion signal (for each spindle)	FSPPH1~FSPPH2	○	○	10.14
F295.6	Dual display forcible end status signal	C2SENO	○	○	13.1.9
F295.7	Key control selection status signal	CNCKYO	○	○	13.1.9
F298.0~F298.7	Trouble forecast signal (For the thermal simulation data)	TDSML1~TDSML8	○	○	18.3
F299.0~F299.7	Trouble forecast signal (For the disturbance level)	TDFTR1~TDFTR8	○	○	18.3
F317.0~F317.7	Machine operation menu select number notification signal	ESPM1~ESPM8	○	○	13.4
F318.0~F319.1	Soft key number select state notification signal	ESF01~ESF10	○	○	13.4
F341.0~F341.4	Synchronous master axis confirmation signals	SYCM1~SYCM5	○	○	8.5
F342.0~F342.4	Synchronous slave axis confirmation signals	SYCS1~SYCS5	○	○	8.5
F343.0~F343.4	Composite axis confirmation signals	MIXO1~MIXO5	○	○	8.5
F344.0~F344.4	Superimposed control master axis confirmation signals	OVMO1~OVMO5	○	○	8.6
F345.0~F345.4	Superimposed control slave axis confirmation signals	OVSO1~OVSO5	○	○	8.6
F346.0~F346.4	Parking axis confirmation signals	SMPK1~SMPK5	○	○	8.5
F358.0~F358.4	Each axis workpiece coordinate system preset completion signals	WPSF1~WPSF5	○	○	1.5.2.6
F400.1	Spindle unclamp signal	SUCLPB	○	○	10.10
F401.1	Spindle clamp signal	SCLPB	○	○	10.10
F402.1	Spindle positioning mode signals	MSPOSB	○	○	10.10
F403.0	Signal for indicating a positional deviation error alarm for axis synchronous control	SYNER	○	○	1.6
F512.0	Macro call executing signal	MCEXE	○	○	16.6
F512.1	Mode change request signal	MCRQ	○	○	16.6
F512.2	Abnormal end signal	MCSP	○	○	16.6

List by Address

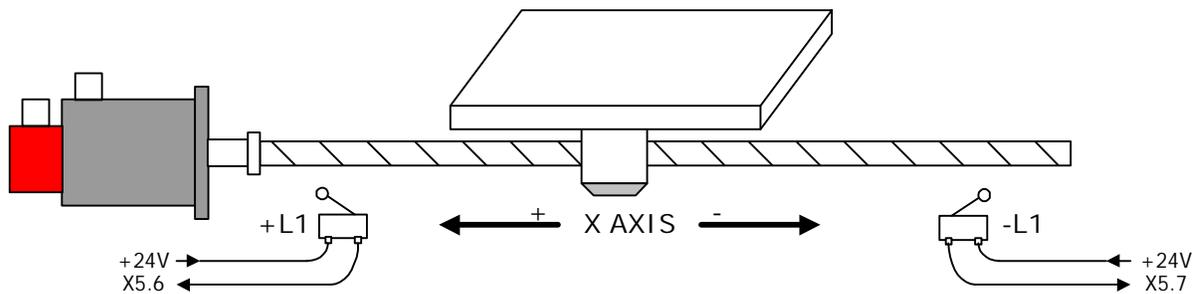
Address	Signal name	Symbol	T	M	Reference item
F513.0	Mode notification signal	MD1R	○	○	16.6
F513.1		MD2R	○	○	
F513.2		MD4R	○	○	
F513.5		DNCIR	○	○	
F513.7		ZRNR	○	○	
F514,F515	Call program confirmation signal	MCEX1~MCEX16	○	○	16.6
F520.0	Automatic data backup executing signal	ATBK	○	○	
F521.0~F521.4	SV speed control mode signals	SVREV1~SVREV5	○	○	10.19
F522.0~F522.4	Spindle indexing signal for each axis	SPP1~SPP5	○	○	10.19
F531.3	MDI selection confirmation signal	MMDISL	○	○	13.1.6
F532.0~F532.4	Axis synchronous control status signals	SYNO1 to SYNO5	○	○	1.6

7.2.4. Active Low Signals

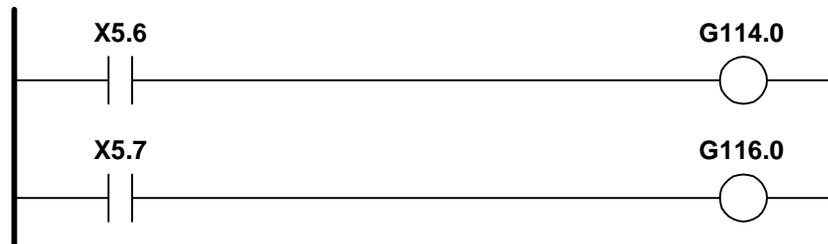
As shown in the previous pages, the signals with asterisks in their SYMBOL name are active low signals. These signals are considered to be operation critical signals and are designed active low to provide enhanced machine safety. The EMG-STOP signal X8.4 is an active low signal. It is this way so that 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.

7.2.4.1. *+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 OT 0506 + OVERTRAVEL (HARD)
OT 0507 - OVERTRAVEL (HARD)

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.

Dedicated G&F Addresses

7.2.4.2. *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.

7.2.4.3. *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 *ESP B (G75.1) and *ESP C (G205.1) are used for the second and third spindle.

7.2.4.4. *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 254%. Because this is an active low signal, the bits that have a status of 0 are the binary override amount.



1) On the PMC 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 MAINTENANCE
RUN ***1ST PMC

00000 N00000

PMC SIGNAL STATUS

ADDRESS	7	6	5	4	3	2	1	0	HEX
G0012	FV128 1	FV64 1	FV32 1	FV16 1	FV8 1	FV4 1	FV2 1	FV1 1	FF
G0013	AFV128 0	AFV64 0	AFV32 0	AFV16 0	AFV8 0	AFV4 0	AFV2 0	AFV1 0	00
G0014	0	0	0	0	0	0	0	0	00
G0015	0	0	0	0	0	0	0	0	00
G0016	0	0	0	0	0	0	0	0	00
G0017	0	0	0	0	0	0	0	0	00

G0012 :

A>^

MDI ***** 14:09:52

< SEARCH DEC FORCE SWITCH PMC

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	HEX
G0012	FV128	FV64	FV32	FV16	FV8	FV4	FV2	FV1	F5
	1	1	1	1	0	1	0	1	

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

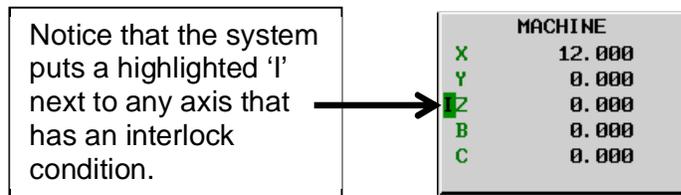
Address G13 is a secondary feedrate override and does not necessarily change with changes in G12. It only changes on this simulator because it is written into the ladder this way.

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

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

7.2.4.5. *IT G8.0 - All Axes Interlock

If the interlock signal is active (0), **it will lock ALL servo axes 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.



7.2.4.6. *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.

7.2.4.7. *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 G10 and the high bits are address G11, 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**.

TRY THIS



- 1) Select  **JOG** mode on the machine operator panel.
- 2) On the **PMC STATUS** screen, search for address G10.
- 3) Turn the **FEEDRATE** rotary switch to **100%** on the machine operator panel.
What is the binary value of G10~G11 addresses?



- 4) Press the **POS** button, on the MDI keypad to view the POSITION screen.



- 5) Press the **X** and then **+** buttons on the machine operator panel.

The screenshot shows the 'ACTUAL POSITION' screen with the following data:

ACTUAL POSITION			EXERCISE 1		00001 N00000	
ABSOLUTE			MACHINE		DISTANCE TO GO	
*X	1592.800		*X	1592.800		
Y	0.000		Y	0.000		
Z	0.000		Z	0.000		
B	0.000		B	0.000		
C	0.000		C	0.000		
MODAL			F		12000 MM/MIN	
G00	G80	G15	F15000.00	M		
G17	G98	G40.1	H			
G90	G50	G25	D			
G22	G67	G160	T			
G94	G97	G13.1	S			
G21	G54	G50.1				
G40	G64	G54.2				
G49	G69	G80.5				
			S		0 /MIN	
			SOV		0%	
			PARTS COUNT		70	
			RUN TIME		9H43M28S	
			CYCLE TIME		0H 0M 0S	
			A>>			
			JOG		**** * 14:30:26	
			ABSOLUTE		RELATIVE	
			TE		VE	
			ALL		HANDLE	
			HANDLE		COPRT	
			+			

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

7.2.4.8. *SP/SPL G8.5/F0.4 - Feed Hold/Cycle Stop

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.

TRY THIS



- 1) On the **PMC STATUS** screen, search for address G8.5.
Is the status 1 or 0?
- 2) 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?

7.2.5. Axis Specific Signals + -

The next group of addresses on the List of PMC Addresses is the + - group. These signals are related to the servo axis directions + and -

7.2.5.1. +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) jogs 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 PMC STATUS screen, search for address G100.



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

3) Using the **X**, **Y**, **Z**, **4**, **5**, **6** and **+**, **-** buttons on the operator panel, jog the axes and view the behavior of G100 and G102.

4) Find the G100.0 coil in the PMC LADDER.
Which X address is wired to the +X jog button?

7.2.5.2. +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.

Dedicated G&F Addresses

7.2.6. 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 **CONNECTION (FUNCTION) manual** has details on all of the CNC functions and how the dedicated signals operate.

7.2.6.1. 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-codes 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.

7.2.6.2. 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. This bit does not turn on for an Operator Message, only when ALM is flashing in the status display at the bottom of the screen.

1) On the **PMC STATUS** screen, search for address F1.

Notice that F1.0 is probably **OFF on your screen**, because there is no alarm present.

ADDRESS	7	6	5	4	3	2	1	0	HEX
F0001	1	0	0	0	0	0	RST	NCALM 1	81
F0002	0	0	0	0	0	0	0	0	00
F0003	0	0	0	0	1	0	0	0	08
F0004	0	0	0	0	0	1	0	0	04
F0005	0	0	0	0	0	0	0	0	00
F0006	0	0	0	0	0	0	0	0	00

F0001.0 : NCALM (NCALM)

MDI ***** ALM 15:08:38

7.2.6.3. 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.

7.2.6.4. 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)

7.2.6.5. 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.

TRY THIS



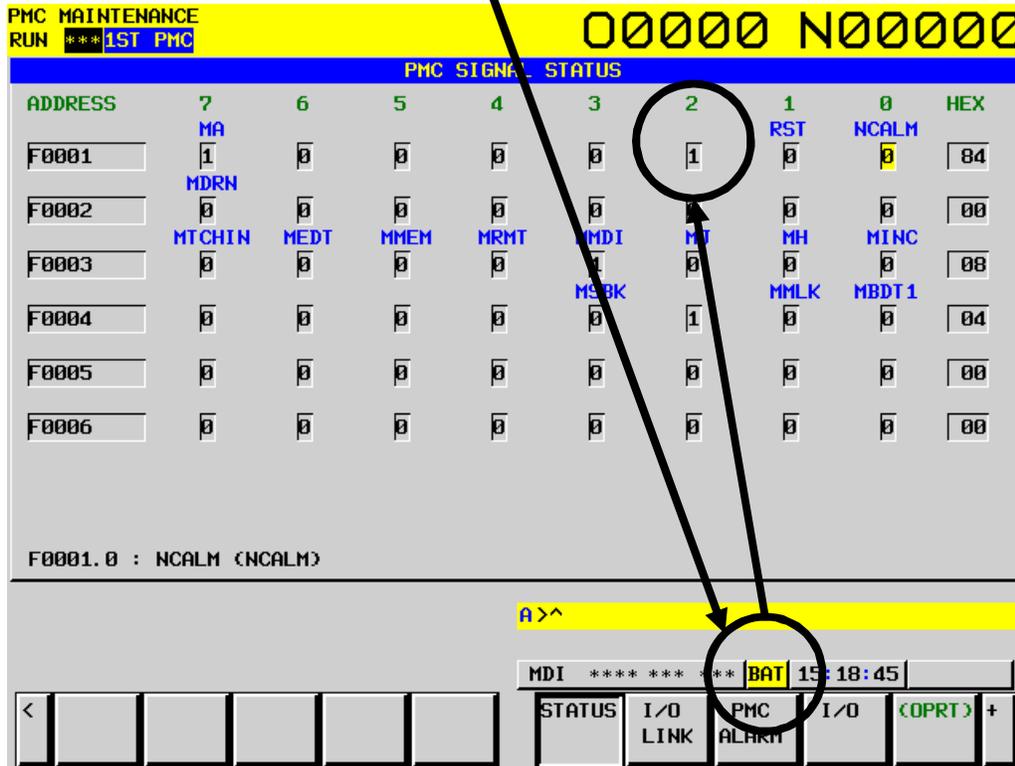
1) On the PMC STATUS screen search for address F1. Notice that F1.2 is now **OFF**, because there is no alarm present.

2) Leave the power on; locate the **BATTERY** on the CNC control and unplug it.



Dedicated G&F Addresses

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



The CNC uses a lithium battery that does not recharge. The 3xi controls use a SANYO battery, the Fanuc part number is A98L-0031-0012. The 0i-D uses a battery cartridge, part number A98L-0031-0026.

3) Plug the BATTERY back into the CNC, then press  to clear the alarm.

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

Dry run 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 dry run operation with G46.7, and then the CNC sends confirmation back to the PMC using F2.7, to tell the PMC it is using dry run.

1) Which X address is wired to the  button?

Find it on the PMC LADDER screen.

7.2.6.7. 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.

7.2.6.8. 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.

7.2.6.9. 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)

TRY THIS



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



- 2) Press the **RESET** button, on the MDI keypad. Notice the status of F1.1 changes.

ADDRESS	7	6	5	4	3	2	1	0	HEX
F0001	MA						RST	NCALM	82
F0002	MDRN								00
F0003	MTCHIN	MEDT	MMEM	MRMT	MMDI	MJ	MH	MINC	08
F0004					MSBK		MMLK	MBDT1	04
F0005									00
F0006									02

F0001.0 : NCALM (NCALM)

MDI *** -RESET- 15:57:47

Dedicated G&F Addresses

7.2.6.10. 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%.

7.2.6.11. 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 PMC STATUS screen search for address G18.



2) Select **HANDLE mode** on the operator panel.

3) Select **X**, **Y**, **Z**, **4**, **5**, **6** 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

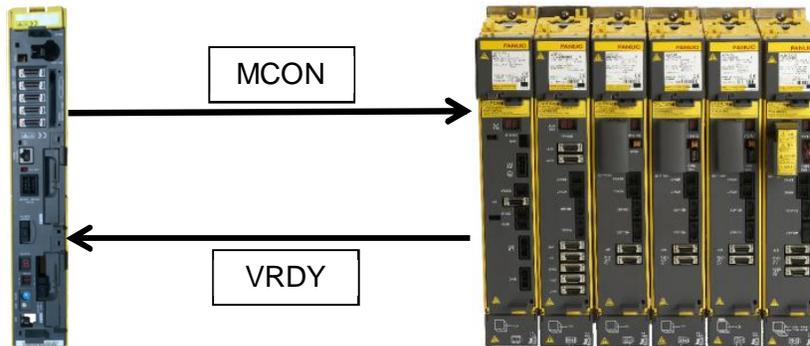
7.2.6.12. MP1~MP2 G19.4~G19.5 - Manual Handle Multiplier

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)

7.2.6.13. IGNVRY G66.0 - Ignore VRDY OFF Alarm All Axes

This signal ignores the servo alarm **SV0401 V READY OFF**. This occurs whenever an 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 VRDY**. This tells the CNC that the drive (velocity unit) is ready.

If at any time during the servo operation, an alarm is detected by the servo drive, it turns off the VRDY signal to the CNC. This indicates to the CNC that there is a problem with the drive and the CNC stops, and alarm **SV0401 V READY OFF** is presented.

7.2.6.14. IGNVRY1~8 G192 - Ignore V READY OFF Alarm

These addresses ignore the servo alarm **SV0401 V READY 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 axes. This alarm occurs whenever an 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 axes controlled by the drive must be ignored.

7.2.6.15. INCH F2.0 - Inch Input

This bit indicates 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.

7.2.6.16. INP1~INP8 F104 - In-Position Signal

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

Dedicated G&F Addresses

7.2.6.17. 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.

SYMBOL	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	PMC data

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.

7.2.6.18. 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 screenshot shows a CNC status screen with the following data:

- ACTUAL POSITION:** EXERCISE 1, 00001 N00000
- ABSOLUTE:** *X 1592.800, Y 0.000, Z 0.000, B 0.000, C 0.000
- MACHINE:** *X 1592.800, Y 0.000, Z 0.000, B 0.000, C 0.000
- DISTANCE TO GO:** (Empty)
- MODAL:** G00 G80 G15 F15000.00 M, G17 G98 G40.1 H, G90 G50 G25 D, G22 G67 G160 T, G94 G97 G13.1 S, G21 G54 G50.1, G40 G64 G54.2, G49 G69 G80.5
- F:** 12000 MM/MIN
- S:** 0 /MIN
- SOV:** 0%
- PARTS COUNT:** 70
- RUN TIME:** 9H43M28S
- CYCLE TIME:** 0H 0M 0S
- STATUS LINE:** JOG *** ***, 14:38:26
- Buttons:** ABSOLUTE, RELATIVE, ALL, HANDLE, (OPRT), +

A black arrow points from the top right towards a circled 'A' button on the status line.

The mode selections sometimes go by different names on the operator's panel; this is dependent on the machine builder. For example, the FANUC panel has AUTO on the Memory mode switch; on the status line it will say MEM.



1) On the PMC STATUS screen search for address G43.

2) Using the  AUTO,  EDIT,  MDI,  REMOTE,  REF,  JOG,  INC, and  HANDLE buttons, fill in the bit patterns on the chart below.

Note: For RAPID mode, put the control into  JOG mode and press the  RAPID button.

G19.7 RT	G43.7 ZRN	G43.5 DNC1	G43.2 MD4	G43.1 MD2	G43.0 MD1	MODE SELECTED
						MEMORY OR AUTO (Auto operation)
						EDIT
						MDI (Manual Data Input)
						REMOTE (DNC)
						Z-RTN, REF RETURN OR HOME (Zero Return)
						JOG (Manual jog)
						INC (Incremental mode)
						HANDLE OR MPG1/ MPG2
						RAPID OR TRVRS (Rapid manual jog)

Note2: Handle mode is an option – it has the same bit pattern as Incremental mode; if the option is present, the screen displays HND, if not it displays INC.

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)

7.2.6.19. 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 (black screen alarms) will cause this bit to change status.

7.2.6.20. 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 VRDY 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.

7.2.6.21. 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.

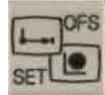
- ❶ By PMC address G106.
- ❷ By manual entry on the [OFFSET SETTING] <SETTING> screen
- ❸ By G-Code command G51.1/G68 (programmable mirror image)

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.

TRY THIS


1) On the PMC STATUS screen, search for address G106. Notice the bit status.

2) Select  mode on the operator panel.

3) Press the  button on the MDI panel.

4) Press the  soft key on the LCD menu.

5) Press the  button twice on the MDI key pad.

The mirror image screen should appear.



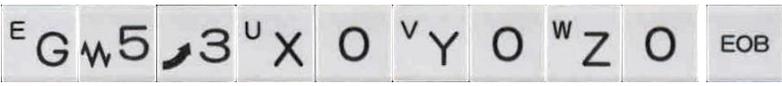
6) Press  then press the  key on the MDI panel.

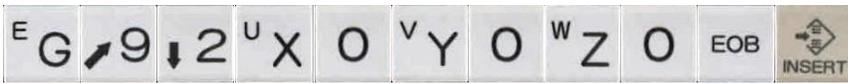
The X axis mirror image bit should change to 1.

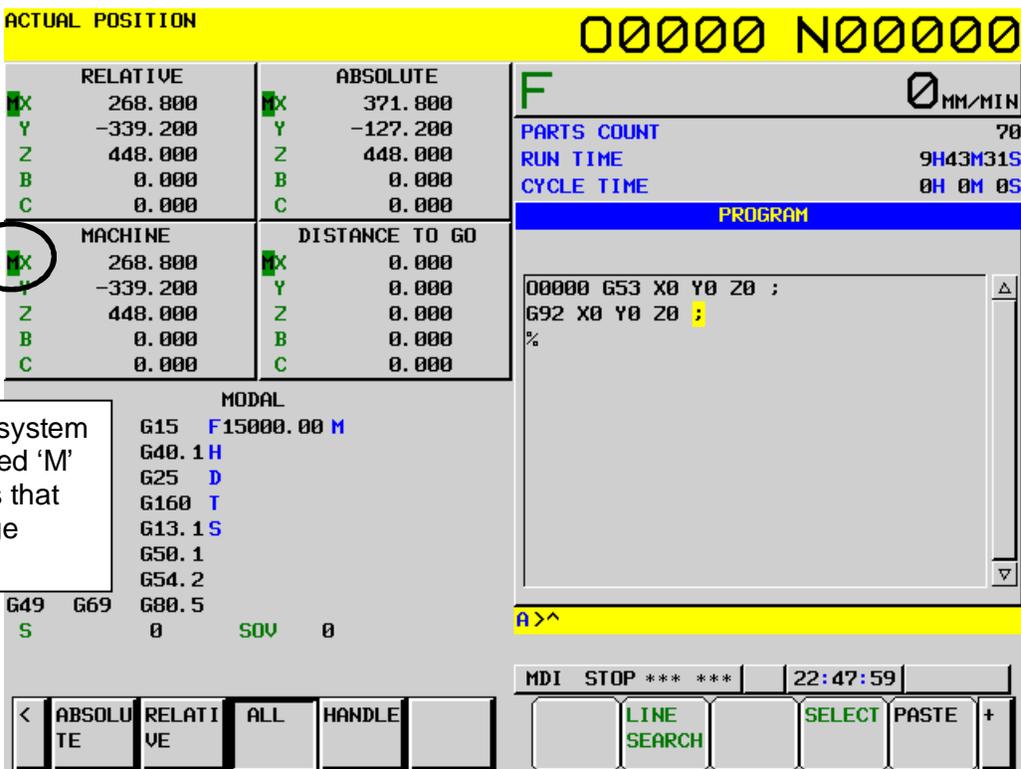
7) Press the  button on the MDI keypad.

8) Press the  soft key on the LCD menu.

9) Press the  soft key on the LCD menu.

10) Enter , then

press .



ACTUAL POSITION 00000 N00000

RELATIVE		ABSOLUTE	
X	268.800	X	371.800
Y	-339.200	Y	-127.200
Z	448.000	Z	448.000
B	0.000	B	0.000
C	0.000	C	0.000

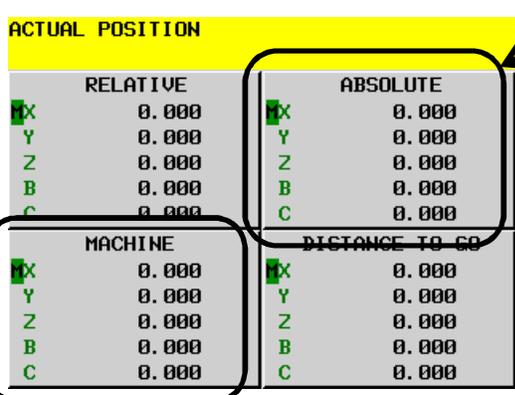
MACHINE		DISTANCE TO GO	
X	268.800	X	0.000
Y	-339.200	Y	0.000
Z	448.000	Z	0.000
B	0.000	B	0.000
C	0.000	C	0.000

MODAL
 G15 F15000.00 M
 G40.1 H
 G25 D
 G160 T
 G13.1 S
 G50.1
 G54.2
 G49 G69 G80.5
 S 0 SOV 0

PROGRAM
 00000 G53 X0 Y0 Z0 ;
 G92 X0 Y0 Z0 ;
 %

Notice that the system puts a highlighted 'M' next to any axis that has mirror image turned on.

11) Press the  button.



ACTUAL POSITION

RELATIVE		ABSOLUTE	
X	0.000	X	0.000
Y	0.000	Y	0.000
Z	0.000	Z	0.000
B	0.000	B	0.000
C	0.000	C	0.000

MACHINE		DISTANCE TO GO	
X	0.000	X	0.000
Y	0.000	Y	0.000
Z	0.000	Z	0.000
B	0.000	B	0.000
C	0.000	C	0.000

The G53 command sends the machine to X, Y, and Z0 in the machine coordinate system.

The G92 command sets the absolute coordinate system to X, Y, and Z0.

12) Enter  then press .

ACTUAL POSITION			
	RELATIVE		ABSOLUTE
X	-10.000	X	10.000
Y	0.000	Y	0.000
Z	0.000	Z	0.000
B	0.000	B	0.000
C	0.000	C	0.000
	MACHINE		DISTANCE TO GO
X	-10.000	X	0.000
Y	0.000	Y	0.000
Z	0.000	Z	0.000
B	0.000	B	0.000
C	0.000	C	0.000

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

7.2.6.22. MLK/MMLK G44.1/F4.1 - Machine Lock All Axes

The machine lock function stops all servo axes 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 axes are not moving.

You should zero return the machine in manual zero return mode, after using this function.

Notice that the system puts a highlighted 'L' next to any axis that has machine lock turned on.

MACHINE	
L X	0.000
L Y	0.000
L Z	0.000
L B	0.000
L C	0.000

7.2.6.23. MLK1~MLK8 G108 - Machine Lock Individual Axis

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

7.2.6.24. 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.

7.2.6.25. 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 PMC **STATUS** screen, search for address F102.



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

3) Press the **X**, **Y**, or **Z** and **+**, **-** buttons on the machine operator panel.

Watch the status of F102 and F106 bits.



4) Select **AUTO mode** on the machine operator panel.



5) Press the **CYCLE START button** on the machine operator panel.

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

7.2.6.26. 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 known chip load at the cutting tool. Often the machine builder will provide an M-Code to turn ON (1) this address.

7.2.6.27. 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/inches/degrees per minute. These signal addresses are only used if address G96.7 (HROV) is OFF (0).

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

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



1) Select **AUTO mode** on the machine operator panel.



2) Press the **PROG button** and then the **PROGRAM soft key**.



3) Press the **SINGLE BLOCK button**, on the operator panel



4) Press the **CYCLE START** 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 is executed when is pressed. The next few lines that are displayed in a different color are being pre-read (called look-ahead) by the CNC to prepare for their execution.

```

PROGRAM
BC: 00000000
N80 G02 X20.000 R10.000 ;
N90 G03 X25.000 Y-15.000 R5.000 ;
N100 G01 X50.000 Y-5.000 F500.0 ;
N110Y-30.0;
N120X0.0;
N130Y-10.0;
N140Z20.0;
N150G59M05;
N160G40G49Z0M9;
N170G90G53X0Y0Z0;
N180M30;
%
```

7.2.6.29. 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?

7.2.6.30. 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.

7.2.6.31. 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 axes 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.

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

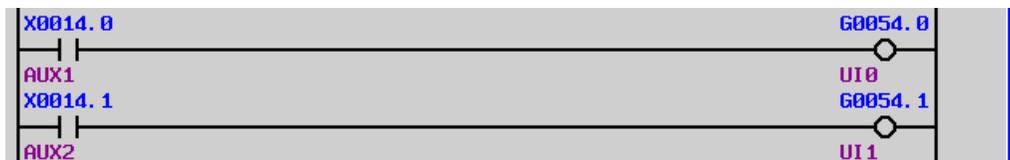
The macro user inputs are used to make decisions in G-Code programs. The status of these addresses is read through macro variables #1000~#1015.

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 specific G addresses by Fanuc. In the ladder logic, these G addresses are activated by 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 AUX1 is activated, the coil G54.0 will turn ON.
 When **G54.0 turns ON**, the status of system variable **#1000** changes from **0 to 1**.

In the SECOND ladder rung ...

When the limit switch AUX2 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**.

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

Dedicated G&F Addresses

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

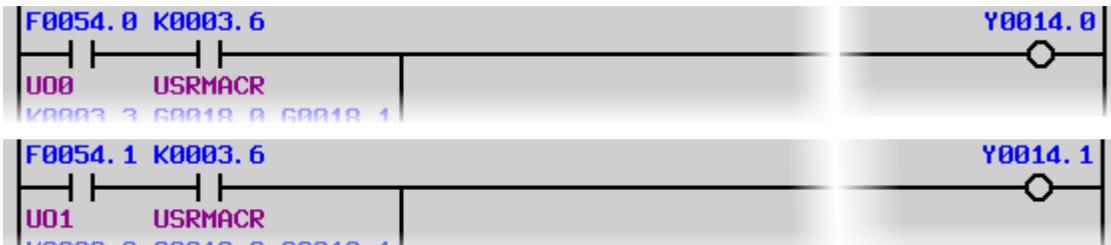
These variables are used to **write PHYSICAL OUTPUTS** to the machine side. For example, during tool change, a door may need to be opened to allow the spindle access to the tool magazine. The system variable can be **WRITTEN** to 1, which activates the output to the door motor. Because they use physical 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 PMC 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 Y14.0 (the light for the Aux1 button on the simulator); causing it to send +24VDC from the physical output to the machine side, which would typically activate a relay or solenoid.

#1100 = 0; - This command will cause the output Y14.0 to turn OFF.

The system variable **#1132 writes 16 bits together** as a word, **#1100~#1115**.

(1) UI/UO G54/F54 - Using Macro Inputs and Outputs

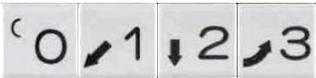
In this example we will write a small program that will use a macro input and output. This will demonstrate how decisions can be made in a G-code program.



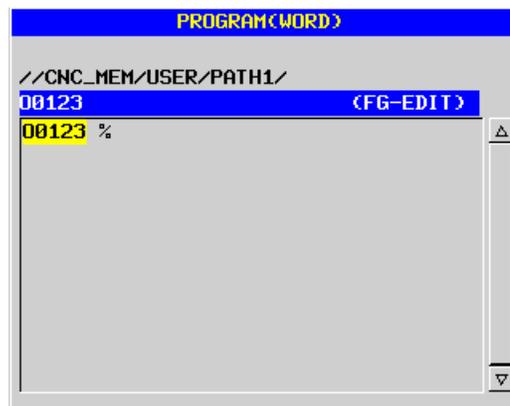
Turn on Keep Relay 3.6: (we will do it in a way we haven't previously shown you)

- 1) Press the  button two times.
- 2) Press the  soft key.
- 3) Press the  soft key.
- 4) Press the  soft key.
- 5) Enter in  and then press the  soft key.
- 6) Press the  soft key and then press the  soft key.

Now create a part program:

- 7) Select  mode on the operator panel.
- 8) Press the  button, and then press the  soft key.
- 9) Enter in  and then press .

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





10) Press the **EOB** and then **INSERT** buttons on the MDI key pad; now the program can be entered.

11) Enter the rest of the program, as shown below:

```

PROGRAM(WORD)
//CNC_MEM/USER/PATH1/
00123 (FG-EDIT)
00123 ;
N10 G0 X10. ;
N20 IF[#1002 EQ 1] GOTO 80 ;
N30 G4 X1. ;
N40 G0 X11. ;
N50 #1102=1 ;
N60 G0 X12. ;
N70 GOTO 20 ;
N80 #1102=0 ;
M30 ;
    
```



12) Press the **RESET** button and confirm the cursor is located at the top of the program.



13) Select **AUTO** mode on the operator panel.



14) Press the **CYCLE START** button, the program will execute.

The program will loop between lines N20 and N70 as long as #1002 is equal to 0. #1002 is assigned to G54.2, which is tied to a physical input in the ladder program. When #1002 changes to 1, the program will jump to line N80.

In this scenario #1102 could be an output from the CNC to tell the robot to load a part, and the input #1002 could be a robot loader output to tell the CNC the part has been loaded.

- What button do you need to press on the operator panel to get the program to stop looping?

15) Turn off Keep Relay 3.6.

- Why did you have to turn on KR 3.6?

7.2.6.34. 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 axes 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.

7.2.6.35. 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 axes 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 the measurement system of the particular axis (mm, inch, degrees) and assumes 3 or 4 decimal places. For example a setting of 234567 would be 234.567 millimeters or degrees from the G28 reference point, or 23.4567 inches.

7.2.6.36. 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 axes 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 the measurement system of the particular axis (mm, inch, degrees) and assumes 3 or 4 decimal places. For example a setting of 234567 would be 234.567 millimeters or degrees from the G28 reference point, or 23.4567 inches.

7.2.6.37. 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 axes 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 the measurement system of the particular axis (mm, inch, degrees) and assumes 3 or 4 decimal places. For example a setting of 234567 would be 234.567 millimeters or degrees from the G28 reference point, or 23.4567 inches.

8. 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 prohibit axis movement, but the absolute position display will still change?

- 4) Which PMC signal will prohibit axis movement, 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 G0 X10.?



Press and hold the **REMOTE** button for 5 seconds.
(You will have to start all over again if you power off during the exercise.)

All of the following problems occur, solve them in any order you wish:

- 6) The control is in Emergency Stop. Fix it.



- 7) **REF** mode cannot be selected. Fix it.



- 8) While in **INC** or **HANDLE** mode, **X10** and **X1000** cannot be selected. Fix it.

- 9) X axis mirror image is turned on. Turn it off.

- 10) Single Block is turned on. Turn it off.

9. Software Operator Panel

The software operator panel is displayed on the CNC screen. Typically it is used by Fanuc for control testing and verification. There are two pages of mode selection, feed override and other functions, and two pages of general purpose switches that may be labeled and used by machine builder to add functions that are not on the physical operator panel. A machine builder could use this feature as the only operator panel to lower costs but there is a trade-off of less functionality than a physical panel.

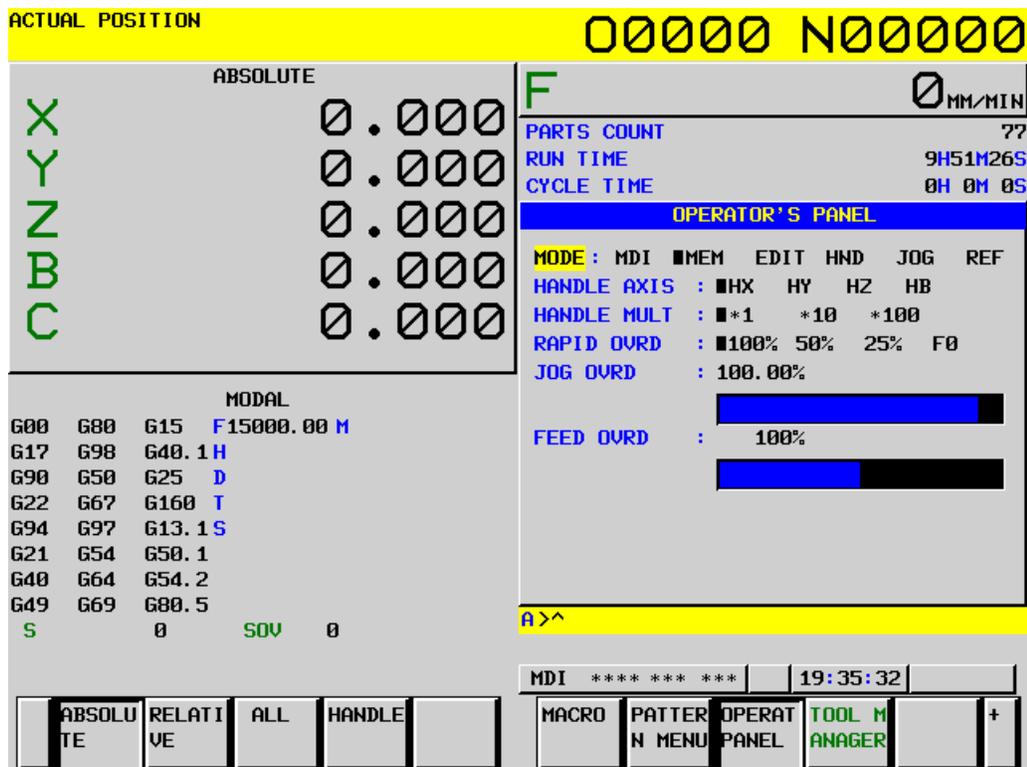


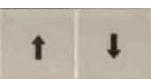
1) Press the  button on the MDI key pad.

2) Press the  soft key on the LCD.

3) Press the  soft key on the LCD.

The software operator panel appears. Each of the functions on this screen has a dedicated F address.

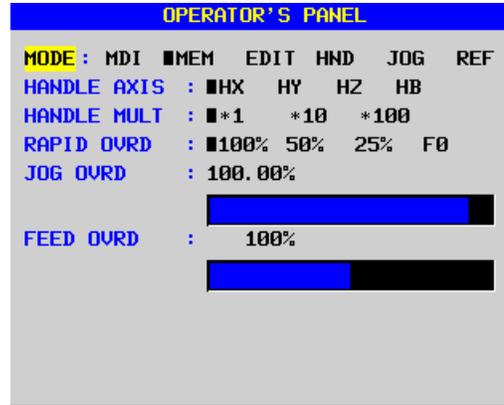


4) Use the  buttons to navigate the screen and  to make selections.

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

The mode is the first selection displayed at the top of the window. Obviously it wouldn't be good practice to have this mode select and the physical operator panel mode select work at the same time; the ladder is usually written to use one or the other. These F addresses will be used to activate the standard mode select G addresses in G43. Notice the lack of a couple modes.

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



9.2. Manual Handle Feed Axis HSAO~HSDO – 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. Notice only four axes are selectable.

F77.3 HSDO	F77.2 HSCO	F77.1 HSBO	F77.0 HSAO	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

9.3. 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. Notice the lack of X1000.

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)

9.4. 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/inches/degrees 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.

9.5. 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 F79 and the high bits are address F80, 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.

9.6. Feedrate Override *FV00~*FV70 – F78

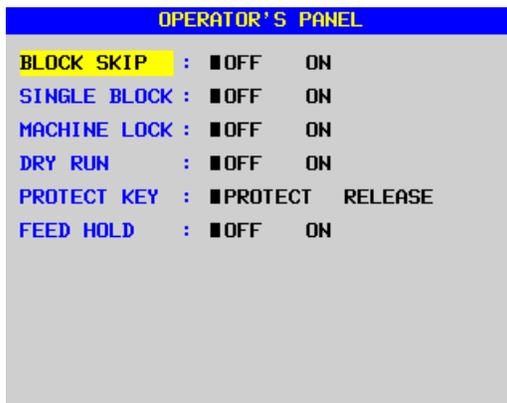
The feedrate override signal overrides the feedrate commanded by the G-code program (F command). This signal uses all of the bits in address F78 to create a binary pattern of the override amount. The override amount can be from 0% to 254%. Because this is an active low signal, the bits that have a status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

9.7. Software Operator Panel Function Switches



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

The function switch screen appears ...



- F75.2 (BDTO)
- F75.3 (SBKO)
- F75.4 (MLKO)
- F75.5 (DRNO)
- F75.6 (KEYO)
- F75.7 (SPO)

These addresses would be tied into the corresponding G addresses for the listed functions.

9.8. General Purpose Switches

There are 16 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.

TRY THIS



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

The first eight general purpose switches appear...

OPERATOR'S PANEL			
CYCSTART	: ■ OFF	ON	F72.0 (OUT0)
FEEDHOLD	: ■ OFF	ON	F72.1 (OUT1)
OPT STOP	: ■ OFF	ON	F72.2 (OUT2)
DNC MODE	: ■ OFF	ON	F72.3 (OUT3)
SERUSTND	: ■ OFF	ON	F72.4 (OUT4)
	: ■ OFF	ON	F72.5 (OUT5)
USE SWOP	: ■ OFF	ON	F72.6 (OUT6)
EMG STOP	: ■ OFF	ON	F72.7 (OUT7)

The label names are set in parameters 7220–7299 (switches 1-10) and 7352–7399 (switches 11-16). Each of these parameters sets one letter of the label name; a number that corresponds with a letter is entered in the parameter. This number is an ASCII character code.

Search for parameter 7260 then set the parameters as shown below...

PARAMETER	
07260	NAME OF SWITCH 6
	70
07261	65
07262	78
07263	85
07264	67
07265	82
07266	79
07267	88

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

OPERATOR'S PANEL		
CYCSTART	: ■ OFF	ON
FEEDHOLD	: ■ OFF	ON
OPT STOP	: ■ OFF	ON
DNC MODE	: ■ OFF	ON
SERUSTND	: ■ OFF	ON
FANUCROX	: ■ OFF	ON
USE SWOP	: ■ OFF	ON
EMG STOP	: ■ OFF	ON

Turn on the software operator panel with this switch.

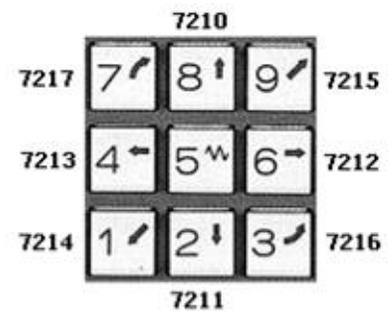
9.9. ASCII Code Chart

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

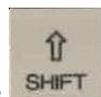
9.10. Software Operator Jog Buttons

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 the X axis.

10. Number Systems

There are several different types of numbers, from different number systems, used in the PMC. The decimal number system is what we humans learn as children – 1, 2, 3, etc. Computers can use binary, hexadecimal, even binary coded decimal (BCD) numbers. Binary consists of 1s and 0s, hexadecimal uses a combination of digits 0-9 as well as letters A-F, and BCD uses 1s and 0s like binary but in a different manner. We discuss each in this section.

10.1. Binary

In most instances in the Fanuc control, we are only working with an 8-bit binary number – 10110101 for example. To convert a binary number to decimal, we have to assign a value, or weight, to each bit. Starting with the right-most bit (bit zero) and continuing to the left-most bit (bit seven), each bit has a higher and higher value. This illustrates what the value is:

Decimal Value	128	64	32	16	8	4	2	1
Bit #	7	6	5	4	3	2	1	0

When we are converting a binary number to a decimal number, we add up the decimal values of only the bits that are set to 1.

<u>VALUE</u>	<u>128</u>	<u>64</u>	<u>32</u>	<u>16</u>	<u>8</u>	<u>4</u>	<u>2</u>	<u>1</u>
	1	0	1	1	0	1	0	1
<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>

128 + 32 + 16 + 4 + 1 = 181

10110101 binary = 181 decimal

Convert the following binary numbers to decimal:

00000000 = _____ 11111111 = _____ 11000101 = _____

10.2. Hexadecimal (Hex)

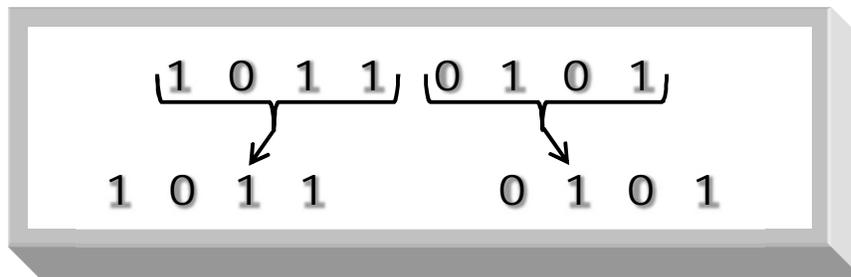
Hexadecimal looks very similar to our decimal number system but it adds some letters to the mix. Decimal is considered a base 10 system, binary is a base 2 system – decimal uses 10 digits, binary uses two. Hexadecimal is a base 16 system – it uses 16 digits; they are 0-9 and the letters A-F.

The conversion of decimal to hexadecimal is as follows:

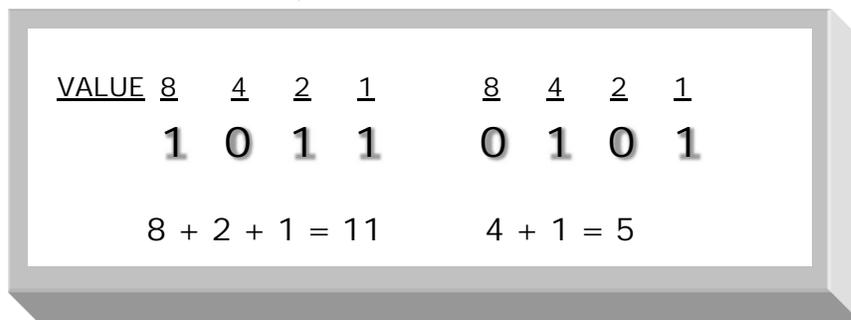
Dec	Hex	Dec	Hex	Dec	Hex
0	0	6	6	12	C
1	1	7	7	13	D
2	2	8	8	14	E
3	3	9	9	15	F
4	4	10	A		
5	5	11	B		

Ordinarily, we have to convert an 8-bit binary number to a hexadecimal number. The conversion is accomplished by splitting the 8-bit number into two 4-bit numbers and first converting to decimal and then finally to hex.

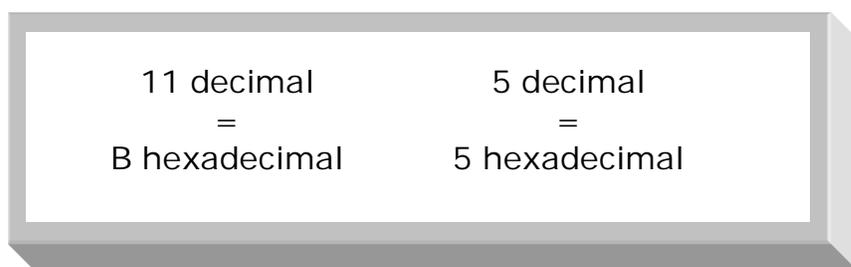
1) Split your 8-bit binary number into two 4-bit binary numbers:



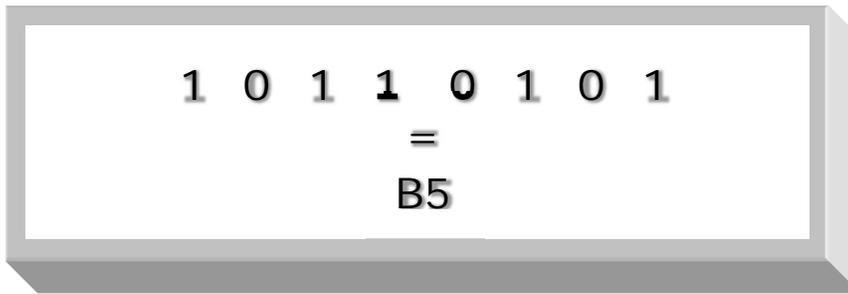
2) Convert the two 4-bit binary numbers into two decimal numbers:



3) Lastly, convert the two decimal numbers into hexadecimal digits.



4) So our binary to hexadecimal conversion is:



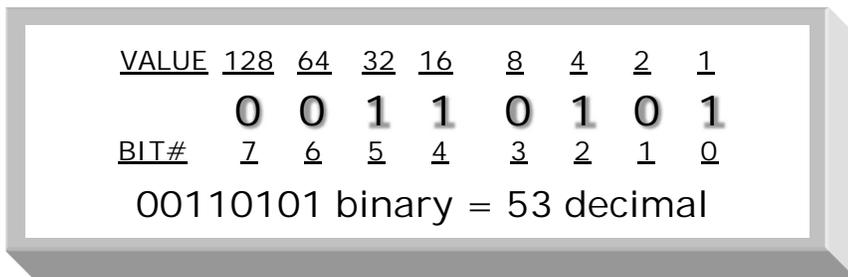
Convert the following binary numbers to hexadecimal:

00111110 = _____ 11111111 = _____ 11000101 = _____

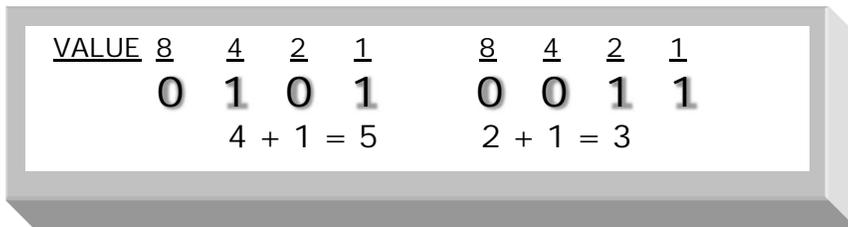
10.3. Binary Coded Decimal (BCD)

BCD is just like decimal except that all the digits are in 4-bit binary form. There is a ones place, a tens place, even a hundreds and thousands place. To convert binary or hexadecimal to BCD, or vice-versa, you first need to convert to decimal.

1) Convert binary to decimal:



2) Convert the decimal digits to four-bit binary numbers:



Therefore, 00110101 in binary is 01010011 in BCD. As you can see, it's very important to know what number system is being used when looking at a number.

Convert the following numbers to BCD:

00111110 = _____ 72 = _____ 18 = _____

11. Functional Instructions

The functional instructions perform complex operations. Each functional instruction is a subroutine; therefore each one is assigned a SUB number. The more advanced the PMC is, the more functional instructions that are available.

Functional Instruction List

Instruction name	SUB No.	Processing	30i/31i/32i-A PMC				32i-A PMC/L	30i/31i/32i-B PMC	0i-D PMC	0i-D / 0i-Mate-D PMC/L
			1st PMC	2nd PMC (Opt.)	3rd PMC (Opt.)	DCS PMC (Note1)				
END1	1	End of first-level program	○	○	○	○	○	○	○	
END2	2	End of second-level program	○	○	○	○	○	○	○	
TMR	3	Timer processing	○	○	○	○	○	○	○	
DEC	4	Decoding	○	○	○	○	○	○	○	
CTR	5	Counter processing	○	○	○	○	○	○	○	
ROT	6	Rotation control	○	○	○	○	○	○	○	
COD	7	Code conversion	○	○	○	○	○	○	○	
MOVE	8	Data transfer after logical product	○	○	○	○	○	○	○	
COM	9	Common line control	○	○	○	○	○	○	○	
JMP	10	Jump	○	○	○	○	○	○	○	
PARI	11	Parity check	○	○	○	○	○	○	○	
DCNV	14	Data conversion	○	○	○	○	○	○	○	
COMP	15	Comparison	○	○	○	○	○	○	○	
COIN	16	Coincidence check	○	○	○	○	○	○	○	
DSCH	17	Data search	○	○	○	○	○	○	○	
XMOV	18	Index modification data transfer	○	○	○	○	○	○	○	
ADD	19	Addition	○	○	○	○	○	○	○	
SUB	20	Subtraction	○	○	○	○	○	○	○	
MUL	21	Multiplication	○	○	○	○	○	○	○	
DIV	22	Division	○	○	○	○	○	○	○	
NUME	23	Constant definition	○	○	○	○	○	○	○	
TMRB	24	Fixed-timer processing	○	○	○	○	○	○	○	
DECB	25	Binary decoding	○	○	○	○	○	○	○	
ROTB	26	Binary rotation control	○	○	○	○	○	○	○	
CODB	27	Binary code conversion	○	○	○	○	○	○	○	
MOVOR	28	Data transfer after logical sum	○	○	○	○	○	○	○	
COME	29	End of common line control	○	○	○	○	○	○	○	
JMPE	30	End of jump	○	○	○	○	○	○	○	
DCNVB	31	Extended data conversion	○	○	○	○	○	○	○	
COMPB	32	Binary comparison	○	○	○	○	○	○	○	
SFT	33	Shift register	○	○	○	○	○	○	○	
DSCHB	34	Binary data search	○	○	○	○	○	○	○	
XMOVb	35	Index modification binary data transfer	○	○	○	○	○	○	○	
ADDB	36	Binary addition	○	○	○	○	○	○	○	
SUBB	37	Binary subtraction	○	○	○	○	○	○	○	
MULB	38	Binary multiplication	○	○	○	○	○	○	○	
DIVB	39	Binary division	○	○	○	○	○	○	○	
NUMEB	40	Binary constant definition	○	○	○	○	○	○	○	
DISPB	41	Message display	○	○	○	△	○	○	○	
EXIN	42	External data input	○	○	○	△	○	○	○	
MOVB	43	1-byte transfer	○	○	○	×	○	○	○	
MOVW	44	2-byte transfer	○	○	○	×	○	○	○	
MOVN	45	Transfer of arbitrary number of bytes	○	○	○	○	○	○	○	
SPCNT	46	Spindle control	△	△	△	△	△	△	△	

(○: Usable. ●: The option of Extended PMC Ladder Instruction Function is needed. △: Executed as NOP instruction ×: Unusable.)

Functional Instructions

PMC Maintenance – 3xi & 0i-D

Instruction name	SUB No.	Processing	30i/31i/32i-A PMC				32i-A PMC/L	30i/31i/32i-B PMC	0i-D PMC	0i-D / 0i Mate-D PMC/L
			1st PMC	2nd PMC (Opt.)	3rd PMC (Opt.)	DCS PMC (Note1)				
MOVD	47	4-byte transfer	○	○	○	×	○	○	○	
END3	48	End of third-level program	○ (Note3)	○ (Note3)	○ (Note3)	△ (Note4)	△ (Note4)	○ (Note3)	△ (Note4)	
DISP	49	Message display	△	△	△	△	△	△	△	
PSGNL	50	Position signal	○	○	○	△	○	○	○	
WINDR	51	CNC window data read	○	○	○	△	○	○	○	
WINDW	52	CNC window data write	○	○	○	△	○	○	○	
AXCTL	53	PMC axis control	○	○	○	△	○	○	○	
TMRC	54	Timer processing	○	○	○	○	○	○	○	
CTRC	55	Counter processing	○	○	○	○	○	○	○	
CTRB	56	Counter processing	○	○	○	○	○	○	○	
DIFU	57	Rising-edge detection	○	○	○	○	○	○	○	
DIFD	58	Falling-edge detection	○	○	○	○	○	○	○	
EOR	59	Exclusive OR	○	○	○	○	○	○	○	
AND	60	Logical AND	○	○	○	○	○	○	○	
OR	61	Logical OR	○	○	○	○	○	○	○	
NOT	62	Logical NOT	○	○	○	○	○	○	○	
PSGN2	63	Position signal	○	○	○	△	○	○	○	
END	64	End of ladder program	○	○	○	○	○	○	○	
CALL	65	Conditional subprogram call	○	○	○	○	○	○	○	
CALLU	66	Unconditional subprogram call	○	○	○	○	○	○	○	
JMPB	68	Label jump 1	○	○	○	○	○	○	○	
LBL	69	Label	○	○	○	○	○	○	○	
NOP	70	No operation	○	○	○	○	○	○	○	
SP	71	Subprogram	○	○	○	○	○	○	○	
SPE	72	End of subprogram	○	○	○	○	○	○	○	
JMPC	73	Label jump 2	○	○	○	○	○	○	○	
CS	74	Case call	○	○	○	○	○	○	○	
CM	75	Sub program call in case call	○	○	○	○	○	○	○	
CE	76	End of case call	○	○	○	○	○	○	○	
TMRBF	77	Fixed off-delay timer	○	○	○	○	○	○	○	
FNC90	90	Arbitrary-function instruction 1	△	△	△	△	△	△	△	
FNC91	91	Arbitrary-function instruction 2	△	△	△	△	△	△	△	
FNC92	92	Arbitrary-function instruction 3	△	△	△	△	△	△	△	
FNC93	93	Arbitrary-function instruction 4	△	△	△	△	△	△	△	
FNC94	94	Arbitrary-function instruction 5	△	△	△	△	△	△	△	
FNC95	95	Arbitrary-function instruction 6	△	△	△	△	△	△	△	
FNC96	96	Arbitrary-function instruction 7	△	△	△	△	△	△	△	
FNC97	97	Arbitrary-function instruction 8	△	△	△	△	△	△	△	
MMCWR	98	MMC window data read	△	△	△	△	△	△	△	
MMCWW	99	MMC window data write	△	△	△	△	△	△	△	

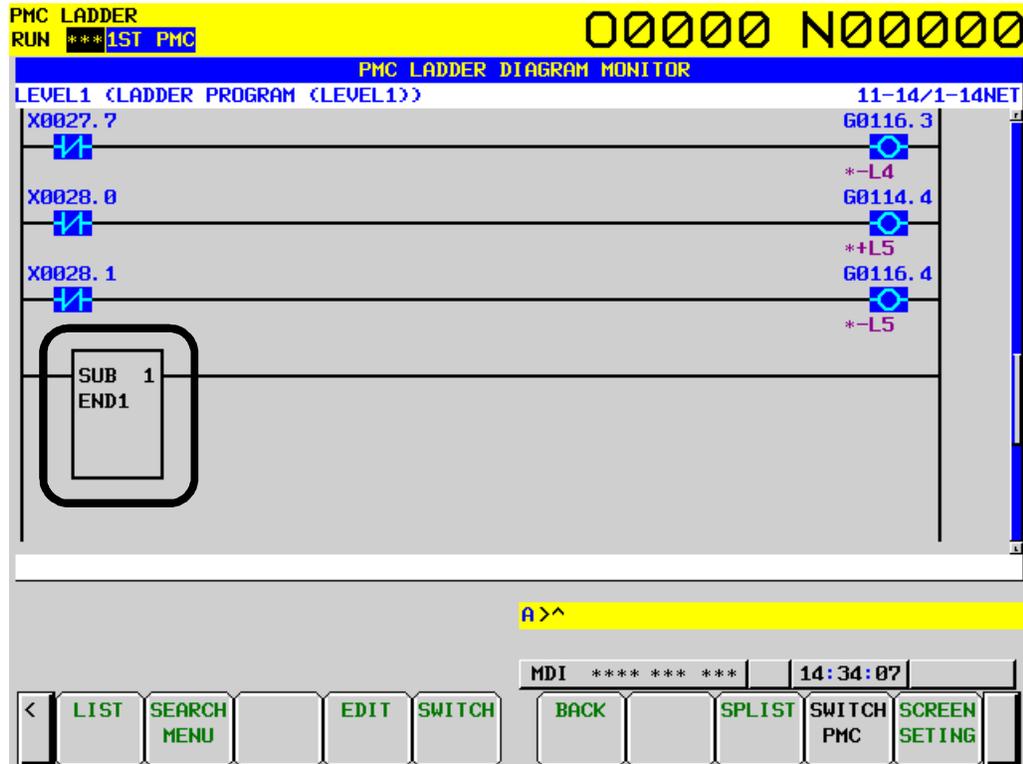
(○: Usable. ●: The option of Extended PMC Ladder Instruction Function is needed. △: Executed as NOP instruction ×: Unusable.)

The above list of functional instructions is not the complete list, there are a couple-hundred more; refer to the following PMC PROGRAMMING MANUALs to find complete information on the subroutines available for your specific PMC type:

3xi-A	3xi-B	0i-D
B-63983EN	B-64513EN	B-64393EN

11.1. SUB1 – END1 Ladder 1st Level End

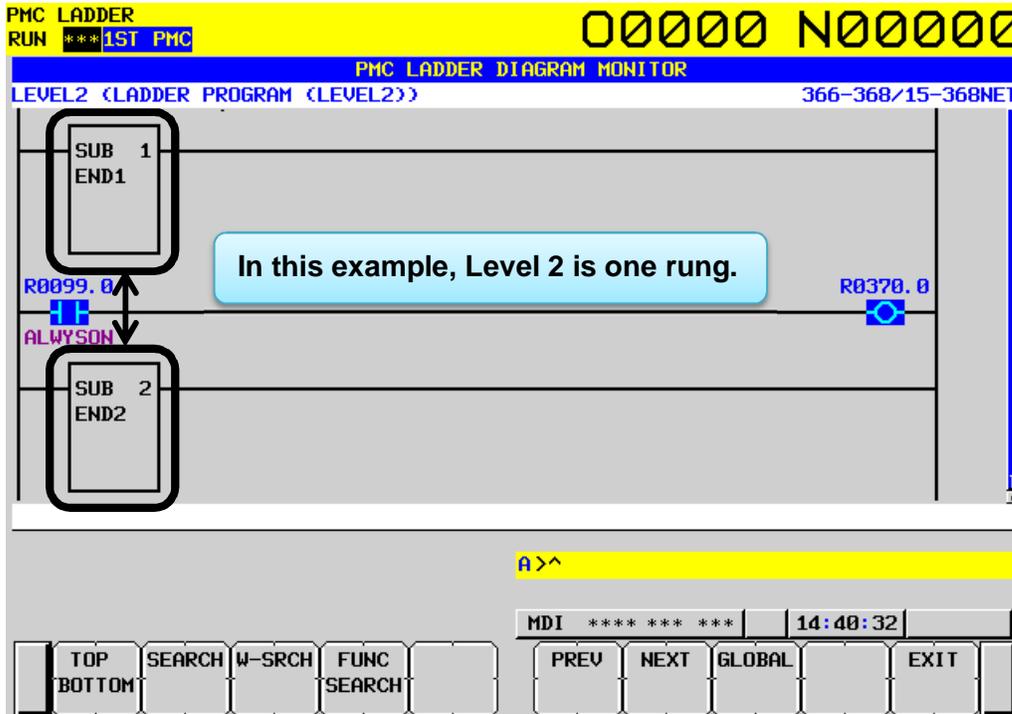
The 1st level is the high priority processing section. This section of ladder is guaranteed to be completely processed every 8 milliseconds (or 4, depending on the control being a 3xi Series and PRM 11930=4). Signals that are time critical are typically inserted in this section - things like emergency stop and hard over travel, 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 2ms to process level 1 that leaves 6ms to process level 2; at the end of the total 8ms the program must return to level 1 to process it again.

11.2. 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 ms to process all of level 2. Level 1 gets processed first, this takes 2ms, leaving 6ms until level 1 must be processed again. Level 2 begins processing, and uses the remaining 6ms of time. At this point there is still 4ms 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 processes the remaining 4ms of ladder logic. At the end of level 2, there is 2ms remaining. If the ladder has a 3rd level, the remaining 2ms is used to process it. If not the system idles for 2ms then returns to level 1.

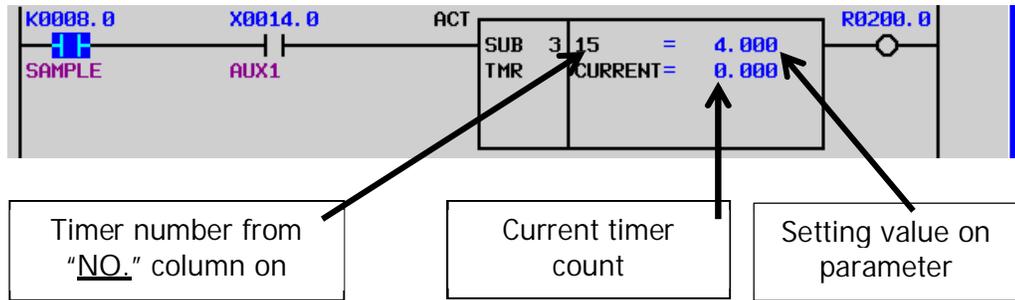
Because of this processing priority, **a contact address in level 1 may display a different status than the same contact address in level 2**, simply because during the processing delay of level 2 the contact had changed status.

11.3. 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 not available on the 0i Model D.

11.4. 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

Current timer count

Setting value on parameter



1) From the LADDER screen, press the **SEARCH MENU** soft key on the LCD menu.

2) Enter **3** on the MDI keypad, then press the **FUNC SEARCH** soft key.

3) Press the **AUX1 X14.0** button on the operator panel, and watch the timer count. When the count reaches 4.000, the R200.0 coil will turn ON.

4) Press the **EXIT** soft key to get out of the search menu.

5) Press the **←** soft key **TWICE** to return to the PMC selection soft keys.

6) Press the **TIMER** soft key on the LCD menu.

7) Press the **TIMER** soft key on the LCD menu.

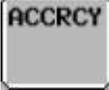
The **TIMER** setting screen appears.

NO.	ADDRESS	PRESET	ACC
15	T0028	4000	1
16	T0030	0	1
17	T0032	8	8
18	T0034	0	8
19	T0036	0	8
20	T0038	96	8
21	T0040	0	8
22	T0042	0	8
23	T0044	0	8
24	T0046	0	8
25	T0048	0	8
26	T0050	0	8
27	T0052	0	8
28	T0054	0	8

By default, timers 1-8 are set in increments of 48ms and timers 9 and up are set in increments of 8ms. If you enter a value into timers 1-8 that is not equally divisible by 48, the number you entered will be rounded down to a value that is; for timers 9 and up it will round down to something divisible by 8.

Notice the ACC column – this indicates the ACCuracy of the timer; the **timers can be modified** to accept increments of 1ms, 10ms, 100ms, 1 second, or 1 minute.

8) Press the  soft key.

9) Press the  soft key.

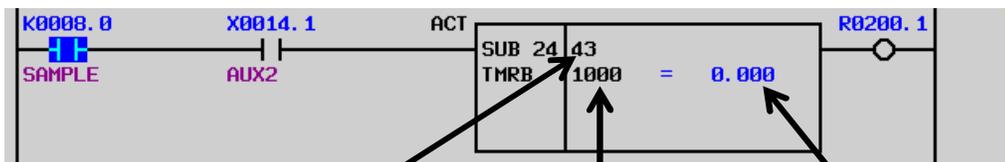
10) With timer 15 highlighted, press the various accuracy soft keys to see how the value in TMR 15 is affected.

11) Change the value of timer 15, return to the LADDER display and see the change.

Timer type (and number)	Max. setting time	PMC type	# of SUB3 timers
48ms (1 to 8) (initial value)	1572.8 seconds	3xi Memory A	40
8ms (9 & up) (initial value)	262.1 seconds	3xi Memory B	250
1ms (1 & up)	32.7 seconds	3xi Memory C	500
10ms (1 & up)	327.7 seconds	3xi Memory D	500
100ms (1 & up)	54.6 minutes	0i Model D	250
1 sec (1 & up)	546 minutes	0i PMC/L	40
1 min (1 & up)	546 hours	Dual Check Safety	40

11.5. 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 ~ depends on PMC type

Fixed setting value in milliseconds

Current timer count

PMC type	# of SUB 24 tmrs
A	100
B	500
C	1000
D	1500
0i-D	500
PMC/L	100
DCS	100

TRY THIS



1) From the LADDER screen, press the  soft key.

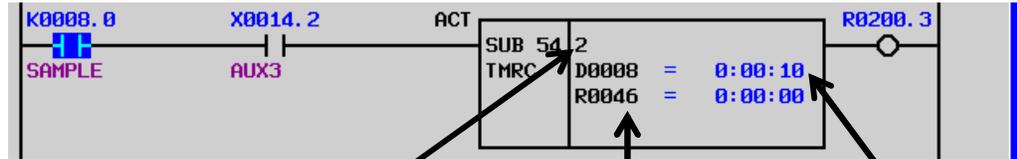
2) Enter  on the MDI keypad, and then press the  soft key.

3) Press the  button on the operator panel, and watch the timer count. When the count reaches 1.000, the R200.1 coil will turn ON.

11.6. 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.



- Timer increments
- 0 = 8 millisecond
 - 1 = 48 millisecond
 - 2 = 1 second
 - 3 = 10 second
 - 4 = 1 minute
 - 5 = 1 millisecond
 - 6 = 10 millisecond
 - 7 = 100 millisecond

Register used to perform the count

Register to hold preset value

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 X14.2 conducts the coil R200.3 will turn ON.



1) Press the **PMC MAINTENANCE** soft key.

2) Press the **DATA TABLE CONTROL** soft key.

The **DATA TABLE CONTROL** screen appears.

NO.	ADDRESS	PARAMETER	TYPE	DATA
1	D0000	00000000	1	5
2	D0010	00000000	3	30
3	D0040	00000000	0	10
4	D0050	00000000	1	16
5	D0082	00000000	2	10
6	D0140	00000001	0	

3) Press the **(OPRT)** soft key.

4) With Group No. 1 highlighted, press the **ZOOM** soft key.

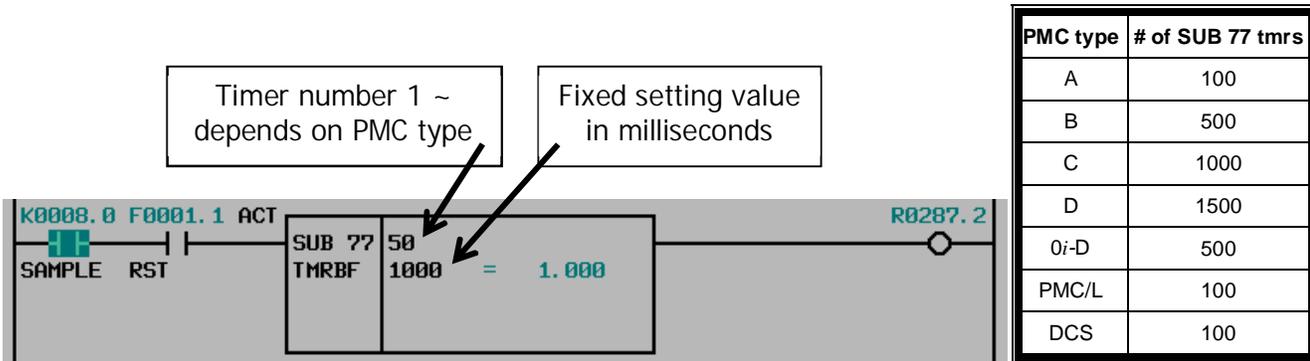
The **DATA TABLE** screen appears.

NO.	ADDRESS	DATA
0	D0000	384
1	D0002	0
2	D0004	0
3	D0006	0
4	D0008	10

5) Change the value in **D0008** then return to the LADDER screen and view the timer change.

11.7. SUB 77 – TMRBF Instant-On, Delay-Off Timer

The SUB 77 works in reverse of the SUB 24. When the contact(s) before the function block conduct, the coil turns on. If a contact before the timer stops conducting, the timer begins timing. When the timer reaches its preset value it turns off the output coil to the right. If the contact(s) before the timer start conducting again, the timer resets and the coil stays/turns on. The delay time of TMRBF is set in the functional instruction.



TRY THIS



1) From the LADDER screen, press the  soft key.

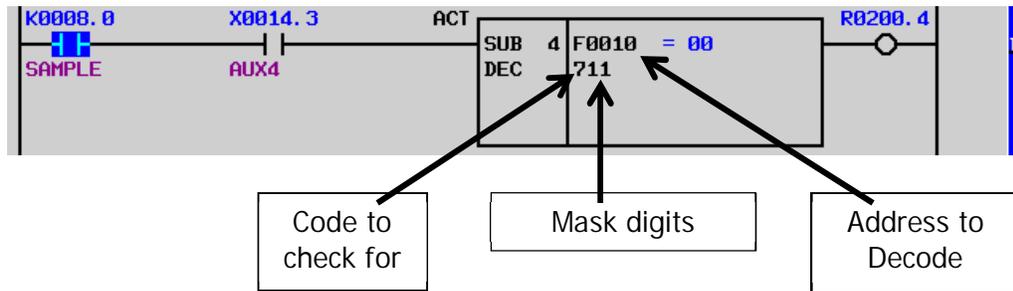
2) Enter   on the MDI keypad, and then press the  soft key.

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

When the count reaches 1.000, the R287.2 coil will turn OFF.

11.8. 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 value shown in blue is the hexadecimal equivalent of the value in the address to decode.

The BCD **CODE TO CHECK FOR** is **07**, when F10 = 07 the output R200.4 turns ON. Notice the block is only displaying a 7, not 07 – **leading zeros are not displayed**.

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.

TRY THIS



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

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

3) Press the  soft key ( on the 0i-D) on the LCD menu.

4) Enter    then press , then press .

5) Return to the **LADDER** screen.

6) Press the  button on the operator panel, and watch the decoder operate.

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

11.9. SUB – 25 DECB Binary Decoding

The purpose of the SUB25 DECB function block is to output a single bit, based on the binary value that is input. When the M-codes are passed from the CNC to the PMC, the CNC puts the code into address F10, then turns on the M-code flag F7.0. The PMC then has to decode F10 to determine which M-code it needs to process. This is usually performed using the SUB25 DECODE-B function block.

TRY THIS

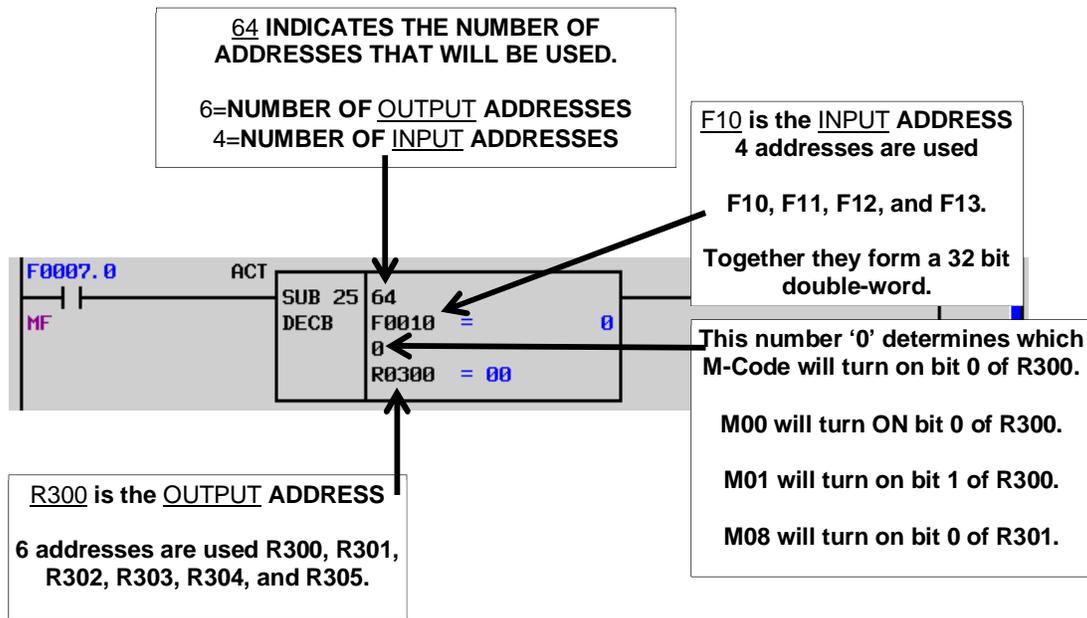


1) From the LADDER screen, press the  soft key.

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

3) If the SUB25 that you found does not have address **F0010** displayed in it, continue to press the  soft key until it does.

Typically the addresses in the ladder are 8 bits, each group of 8 bits is called a byte.



- The number of output addresses used, determines how many M-codes this function block can decode. R300 has 8 bits, 6 output addresses are assigned, 6x8=48.
- This function block decodes 48 M-Codes, from M00 to M47.
- M00 will turn ON bit 0 of address R300
- The remaining consecutive M-codes will turn on the next bits of R300.

TRY THIS



1) Setup the **TRACE** function, to trace all bits in PMC Addresses R300, R301, and R302. (You can just enter R300 on Address line 1 and it will fill in all 8 bits, same for the other addresses.)

2) the trace.



3) Select **MDI mode** on the operator panel.



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



5) Press the **PROGRAM** soft key (**MDI** on the 0i-D) on the LCD menu.



6) Enter **# M 3 EOB** then press **INSERT**.



7) Enter **# M 5 EOB** then press **INSERT**.



8) Enter **# M 8 EOB** then press **INSERT**.



9) Enter **# M 9 EOB** then press **INSERT**.



10) Enter **# M 1 9 EOB** then press **INSERT**, then press **CYCLE START**.



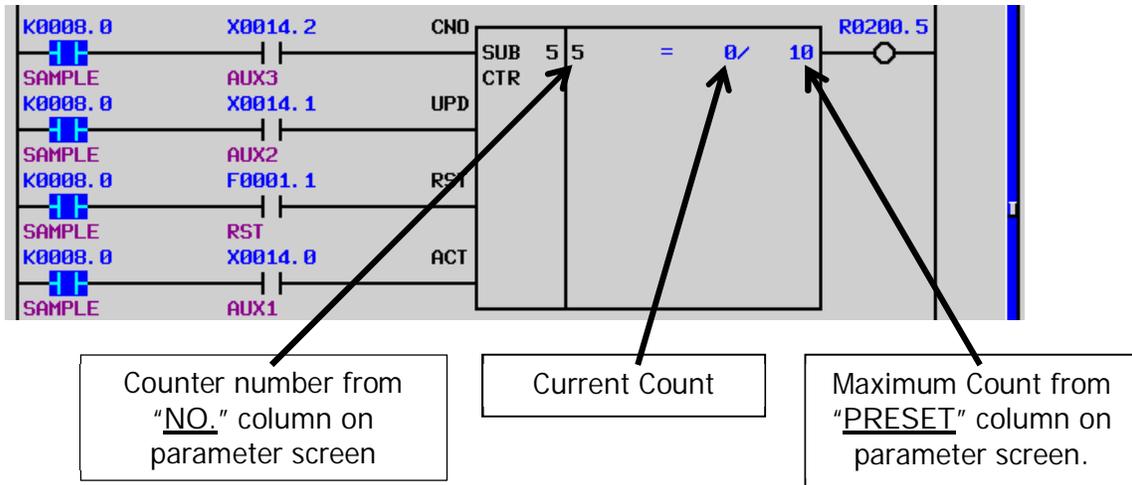
11) Return to the **PMC TRACE** screen, **STOP** the trace, then use



PAGE to view the result.

11.10. SUB 5 – CTR Counter

The counter function block is used to count events. The counter acts as a ring counter, when the counter reaches its maximum count the output coil R200.5 turns ON. The next count action (X14.0) will change the count back to the start count and turn OFF the coil.



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

CNO = counter start number
0 = Start with 0

1 = Start with 1

UPD = 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

PMC type	# of SUB5 counters
3xi Memory A	20
3xi Memory B	100
3xi Memory C	200
3xi Memory D	300
0i Model D	100
0i PMC/L	20
Dual Check Safety	20

TRY THIS



1) From the LADDER screen, press the  soft key.

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

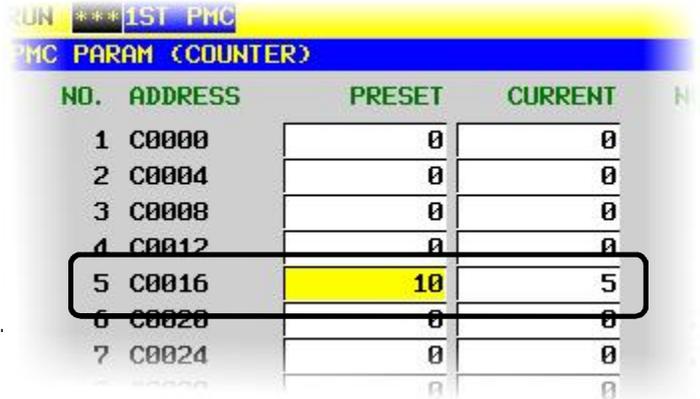
3) Press the  button on the operator panel, and watch the timer count.

Watch the count change each time you press the button.

4) Press the  soft key TWICE.

5) Press the  soft key.

6) Press the  soft key.



NO.	ADDRESS	PRESET	CURRENT
1	C0000	0	0
2	C0004	0	0
3	C0008	0	0
4	C0012	0	0
5	C0016	10	5
6	C0020	0	0
7	C0024	0	0

The PRESET value is what the counter counts to.
The CURRENT value is just that.

You can change the values in both columns.

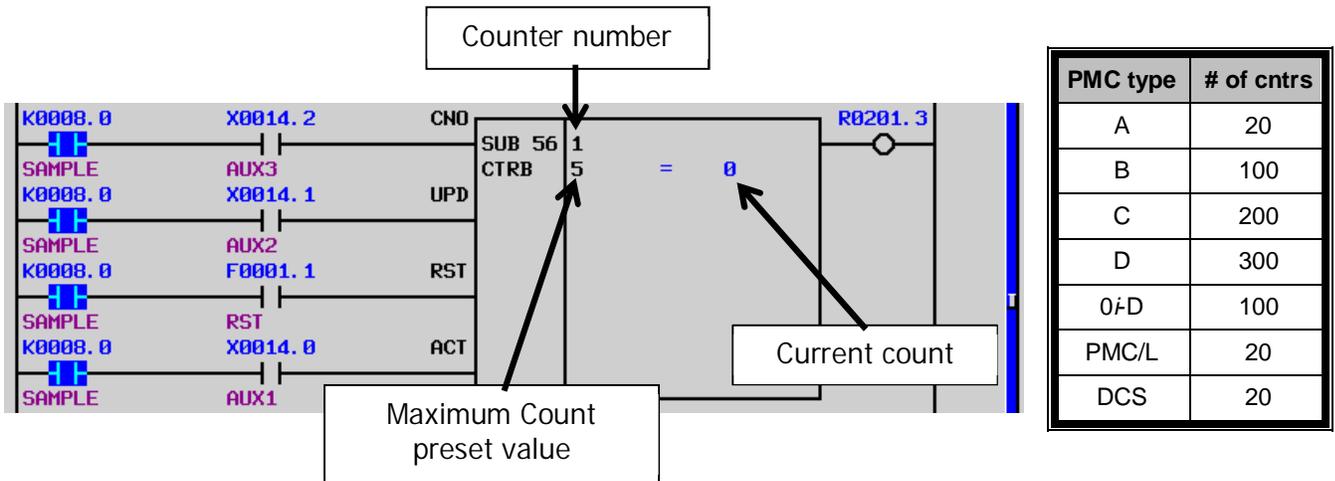
Notice that the counter counts when you press the  button.

7) Change the value in the PRESET column, return to the LADDER display to see the change.

11.11. 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 R201.3 turns ON. The next count action will change the count back to the start count and turn OFF the output coil.

The current count is stored at address C5000 as a 2 byte word. Counter 1 corresponds to C5000; counter 2 corresponds to C5002, etc.



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

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

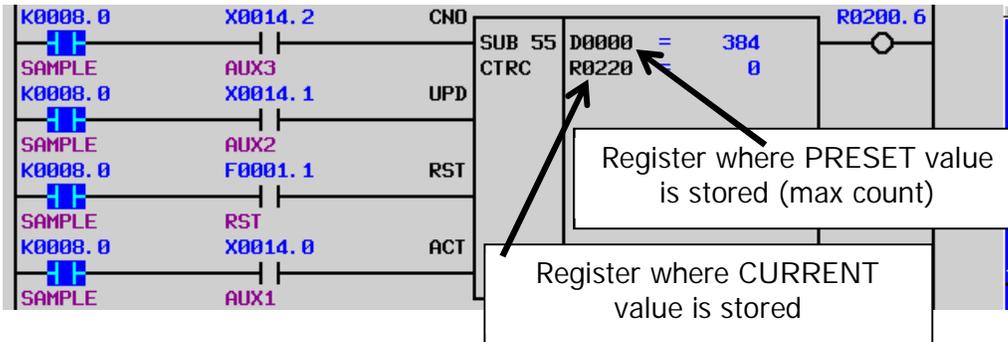
RST = counter RESET

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

11.12. 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 counter acts as a ring counter, when the counter reaches its maximum count the output coil R200.6 turns ON. The next count action will change the count back to the start count and turn OFF the output coil.



PMC type	# of ctrs
A	20
B	100
C	200
D	300
0#D	100
PMC/L	20
DCS	20

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

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

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

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

The **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 **CURRENT register is a 32 bit register**. In the example above R0220 is used. Since R registers are 8 bits, 4 registers will be used by the counter R0220~R0223. **If an R register is used the value is cleared to 0 at power on. If a D register is used, it will retain its value at power off.**



1) From the LADDER screen, press the  soft key.

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

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

Watch the count change each time you press the button.

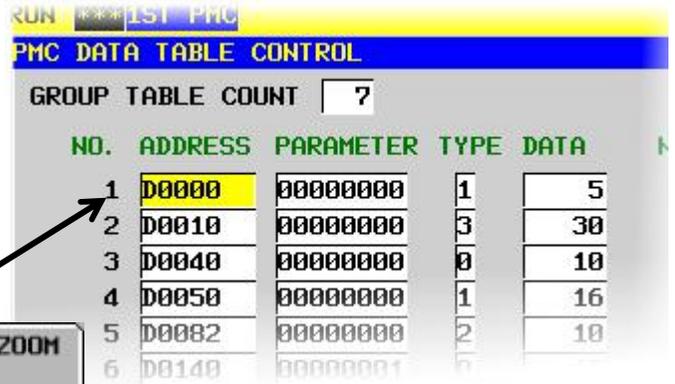
4) Press the  soft key to get out of the search menu.

5) Press the  soft key TWICE to return to the PMC selection soft keys.

6) Press the  soft key on the LCD menu.

7) Press the  soft key.

The **DATA TABLE CONTROL** screen appears.



NO.	ADDRESS	PARAMETER	TYPE	DATA
1	D0000	00000000	1	5
2	D0010	00000000	3	30
3	D0040	00000000	0	10
4	D0050	00000000	1	16
5	D0082	00000000	2	10
6	D0140	00000001	0	

8) Press the  soft key.

9) With Group No. 1 highlighted, press the  soft key.

The **DATA TABLE** screen appears.

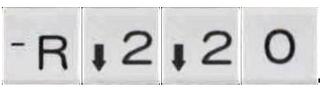


10) Adjust register D0000 then return to the LADDER screen to view the change.

11) View address R220 to see the CURRENT count:

- Press the  soft key.

- Press the  soft key.

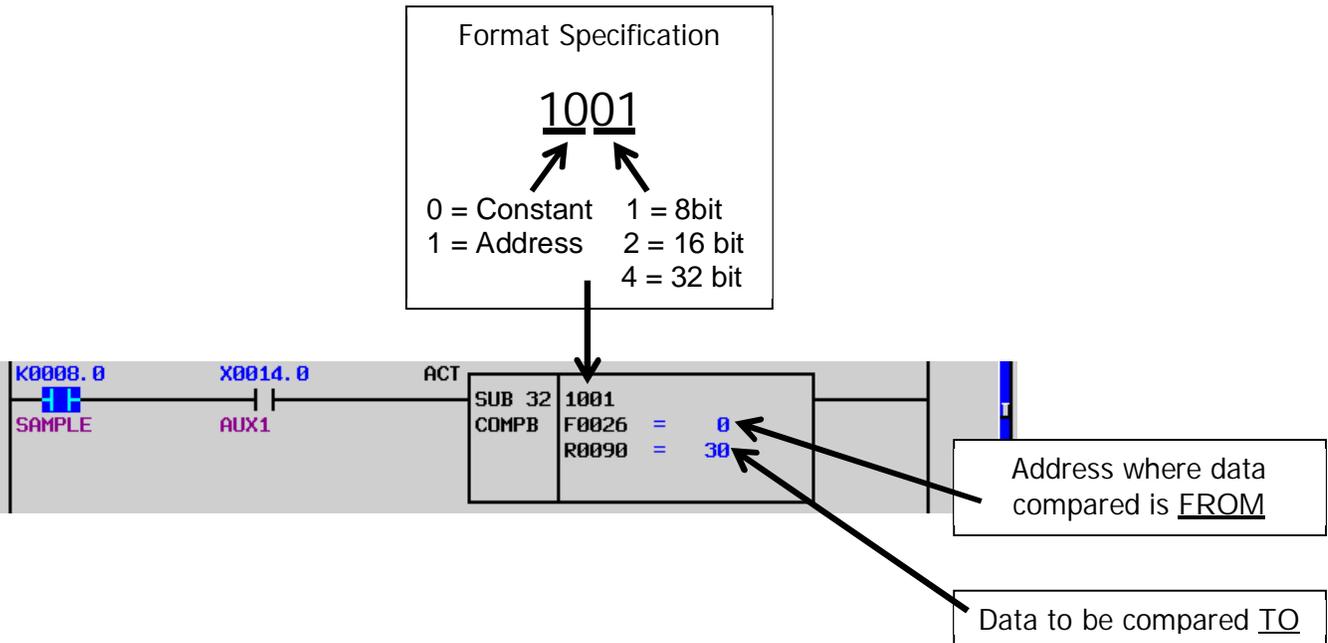
- Type in .

- Press the  soft key.

12) Press the  button to see how R220 changes.

11.13. SUB 32 – CMPB Comparison Between Binary Data

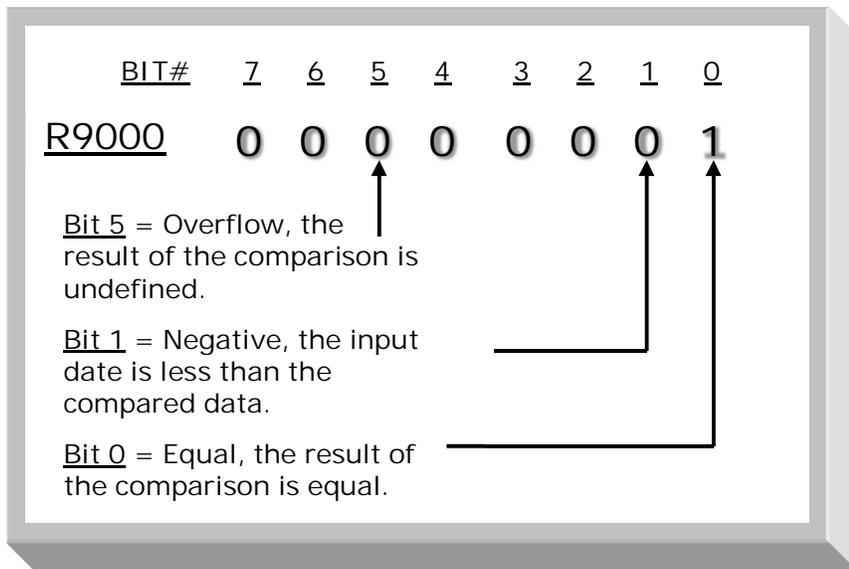
The CMPB function compares binary data. When the input activated (X14.0), the result of the comparison is output to address R9000. The values displayed in this block are shown in decimal.



This function block outputs its results to R9000, as do many other function blocks.

In order to ensure that the data that is contained in R9000 actually pertains to this particular function block, R9000 must appear next in the ladder before any other function block that might use the same address and overwrite it.

Notice the next rung in the ladder.

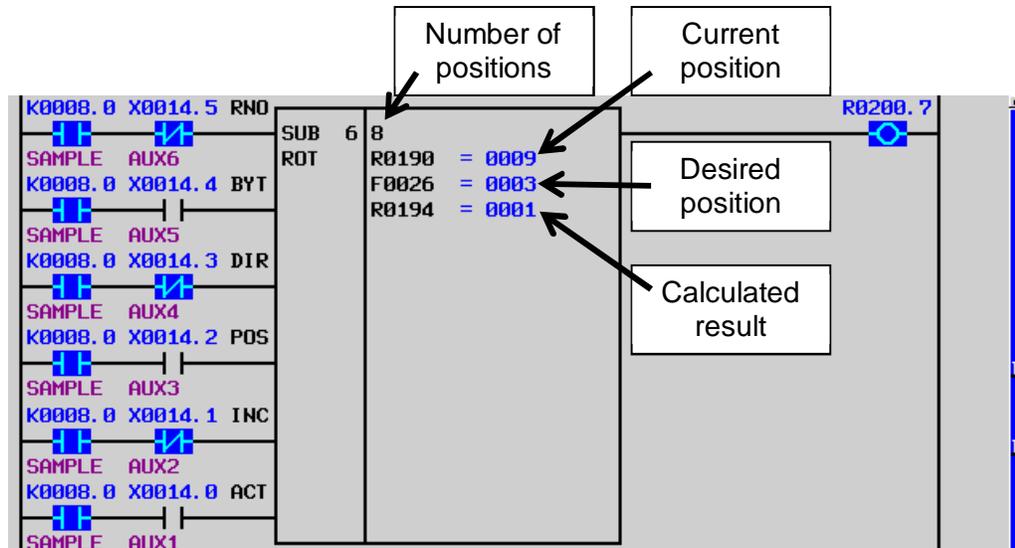


11.14. SUB 6 – ROT Rotation Control

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

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

DIR = Calculate shortest direction to goal position
 0 = No, always rotate forward
 1 = Yes, output shortest direction

BYT = The number of BCD digits to process
 0 = Two BCD digits
 1 = Four BCD digits

POS = Position calculation is ...
 0 = Calculates the goal position
 1 = Calculates the position one position before the goal position

INC = Calculate goal position or number of steps to goal position
 0 = Calculate the number of the position. If the position one position before the goal position is to be calculated, specify INC=0 and POS=1
 1 = Calculate number of steps. If the difference between the current position and the goal position is to be calculated, specify INC=1 and (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



1) From the LADDER screen, press the  soft key.

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

3) Rotate the feedrate override switch.

Notice the R190 value changes. In this example, this switch will serve as the turret feedback.

Turn the switch to 10%



4) Select  mode on the operator panel.

5) Press the  button on the MDI key pad.

6) Press the  soft key ( on the 0i-D) on the LCD menu.

7) M: Enter , press , then press .

T: Enter , press , then .

8) Return to the LADDER screen, notice F26 holds the T-code you entered.

9) Press the  button on the operator panel, and watch calculation occur.

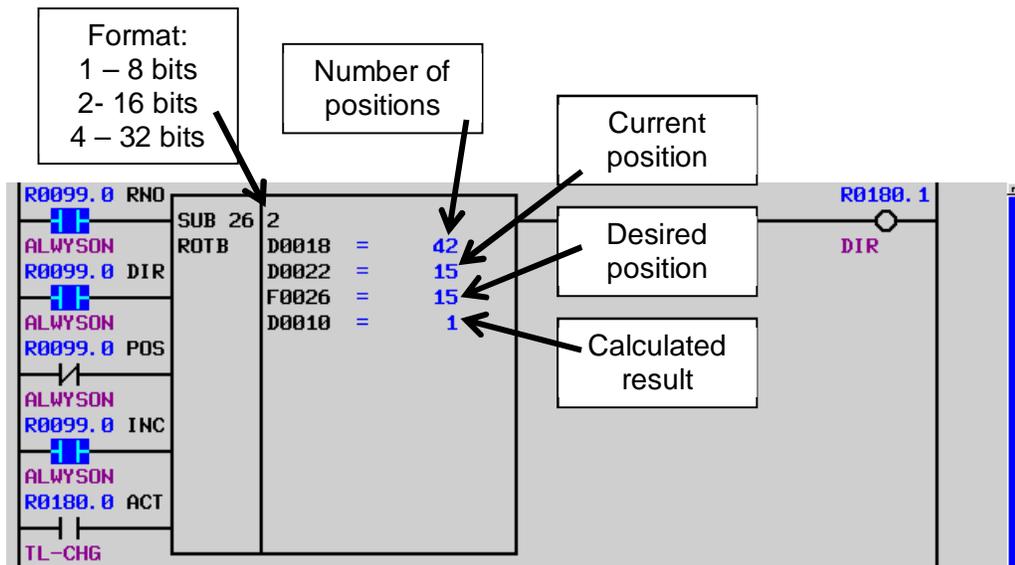
The result - number of steps to goal - will be placed into R194.

11.15. 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 be used for a PMC controlled rotary axis. This function just performs the calculation; other ladder functions will be used to actually rotate the control axis. It can perform 3 functions ...

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



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 ...

- 0 = Calculates the goal position
- 1 = Calculates the position one position before the goal position

INC = Calculate goal position or number of steps to goal position

- 0 = Calculate the number of the position. If the position one position before the goal position is to be calculated, specify INC=0 and POS=1
- 1 = Calculate number of steps. If the difference between the current position and the goal position is to be calculated, specify INC=1 and (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



1) From the LADDER screen, press the  soft key.

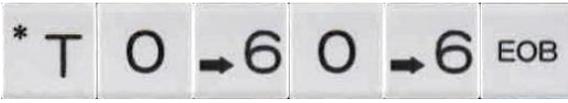
2) Enter  on the MDI keypad, and then press the  soft key.

3) Select  mode on the operator panel.

4) Press the  button on the MDI key pad.

5) Press the  ( on the 0i-D) soft key on the LCD menu.

6) Enter , press , **DO NOT** press .

T: Enter , press .

7) Return to the LADDER screen.

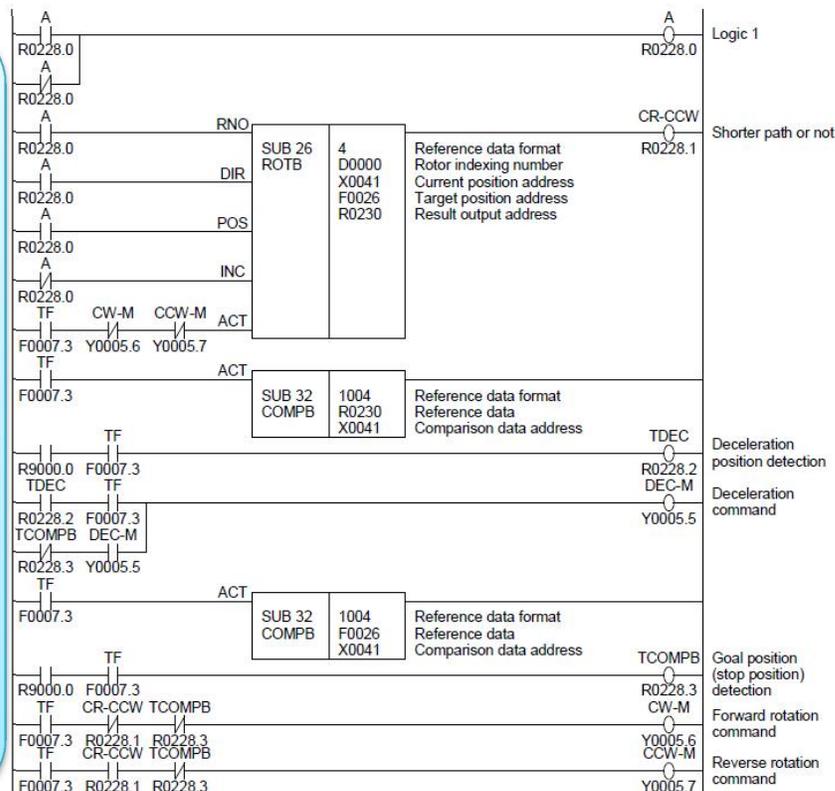
8) Press the  button on the operator panel.

Watch the rotate command function.

SUB26 Usage example:

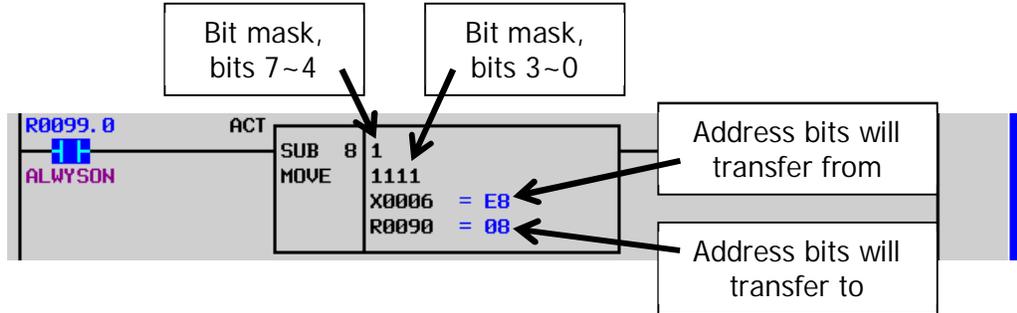
12 position rotor; rotates by shortest path; stops 1 position before the goal:

- The goal position is specified by address F26 to F29.
- The current position comes from the machine tool by address X41.
- The result of calculating the position one position before the goal is output to address R230.
- Operation starts with the output TF (address F7.3) from the NC.
- The binary compare instruction (COMPB) is used to detect the deceleration and stop positions.



11.16. 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.



This function block doesn't display the leading zeros in the bit mask – so for the bit 7 ~ 4 mask, it looks like 1 but it's really 0001.

In this example bits 4~0 are masked, so only those bits that are 1 in the mask data transfer to address R90.

BIT#	7	6	5	4	3	2	1	0	
<u>X006</u>	1	1	1	0	1	0	0	0	=E8
<u>MASK</u>	0	0	0	1	1	1	1	1	=1F
<hr/>									
<u>R090</u>	0	0	0	0	1	0	0	0	=08

X6 bits 0 ~ 4 are the **FEEDRATE OVERRIDE** switch on the operator panel, and bits 6 & 7 are part of the **SPINDLE SPEED OVERRIDE** switch.

Rotate each of the switches and watch the data change.

Only information from the FEEDRATE OVERRIDE switch will be moved into R090.

This process is called **LOGICAL ANDING** with a move...

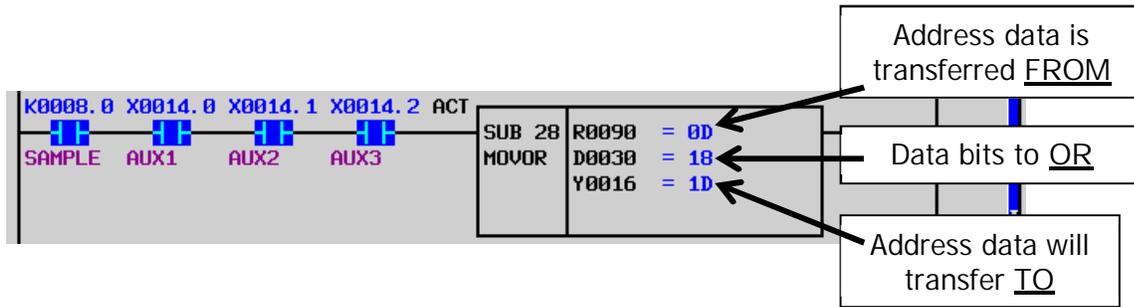


LOGIC TABLE

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	0
0	1	0
1	1	1

11.17. 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 OR'ed, then the result will be moved (copied) to the output address.



In this example, address R90 is OR'ed with a hexadecimal 18 and the result is transferred to address Y16. Notice the bits that are ON in the result address are those that are ON in address R90, or D30, or both. (Y16 controls lights on the operator panel.)

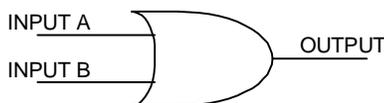
BIT#	7	6	5	4	3	2	1	0	
<u>R90</u>	0	0	0	0	1	1	0	1	=0D
<u>OR</u>	0	0	0	1	1	0	0	0	=18
<u>Y16</u>	0	0	0	1	1	1	0	1	=1D

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.



1) While holding down , , &  rotate the FEEDRATE OVERRIDE switch.

This process is called **LOGICAL OR'ing** with a move...

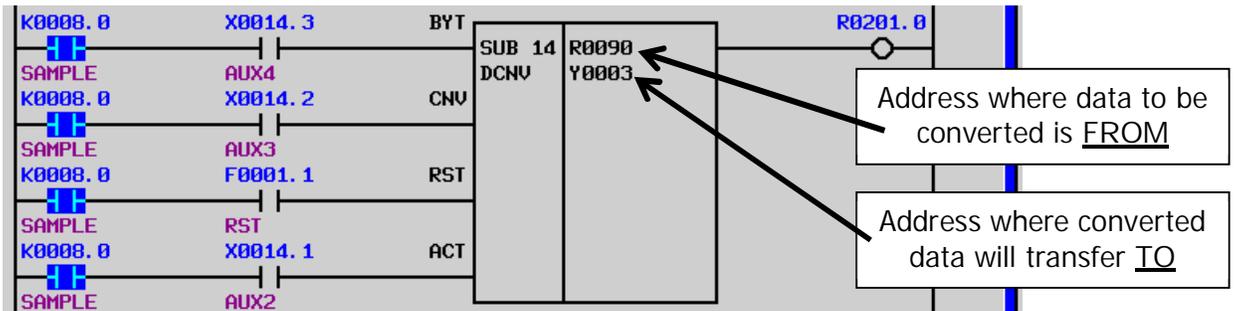


OR LOGIC TABLE

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	1

11.18. 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.



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

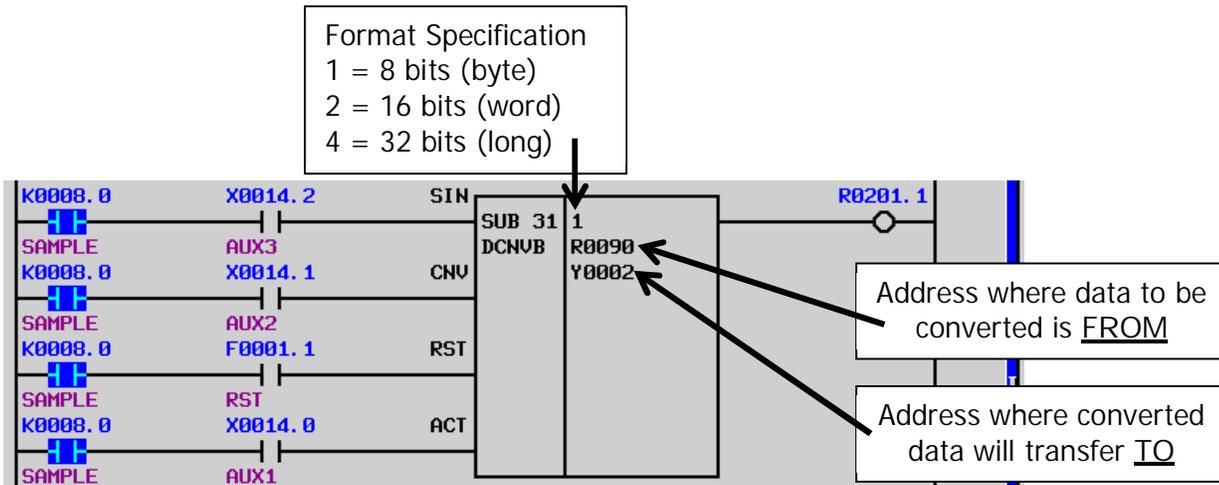
ACT = Activate command, causes calculation to perform
0 = No conversion is done
1 = Perform conversion

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))

11.19. 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 (8, 16, or 32 bit) 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.



The inputs to the **DCNVB** function block are described below...

SIN = Sign of the data to be converted, only 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 error output coil

ACT = Activate command, causes calculation to perform

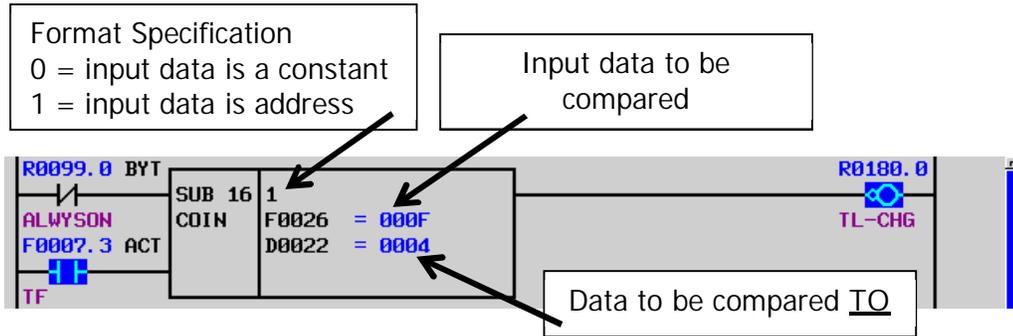
- 0 = No conversion is done
- 1 = Perform conversion

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))

11.20. SUB 16 – COIN Coincidence Check

The COIN function compares the input address with the comparison address; if they are equal (coincide) 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.

TRY THIS



1) From the LADDER screen, press the soft key.

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

3) Select MDI mode on the operator panel.

4) Press the PROG button on the MDI key pad.

5) Press the PROGRAM soft key (on the 0i-D) on the LCD menu.

6) Enter , press , **DO NOT** press

T: Enter , press .

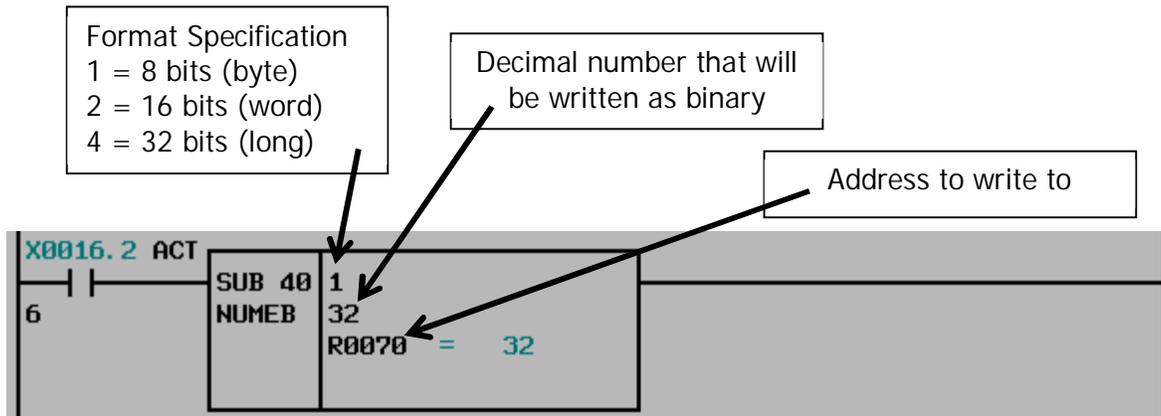
7) Return to the LADDER screen.

8) Press the CYCLE START button on the operator panel. Watch the COIN command function.

11.21. SUB 40 – NUMEB Definition of Binary Constants

The SUB 40 function writes a stored binary value to an address or set of addresses. There are two ways to implement the NUMEB referred to as Basic and Extended. The Basic functionality of the NUMEB is to write a value to a single 8-bit, 16-bit, or 32-bit area. The Extended functionality allows for writing a value to a series of 8-bit, 16-bit, or 32-bit areas.

The Basic functionality is as follows:



To use the Extended functionality, the format specification is modified slightly from Basic. By placing up to two digits in front of the previously described Format Specification of 1, 2, or 4 you can define a series of addresses that will be written to. 02 through 99 is allowable; if 00 or 01 is used then the SUB 40 will function as above.

For example, if the Format Specification is 321, 32 consecutive 8-bit addresses will be set to the value stored on the second line beginning at the address defined in the functional instruction. A Format Spec. of 994 would write to 99 consecutive 32-bit addresses.

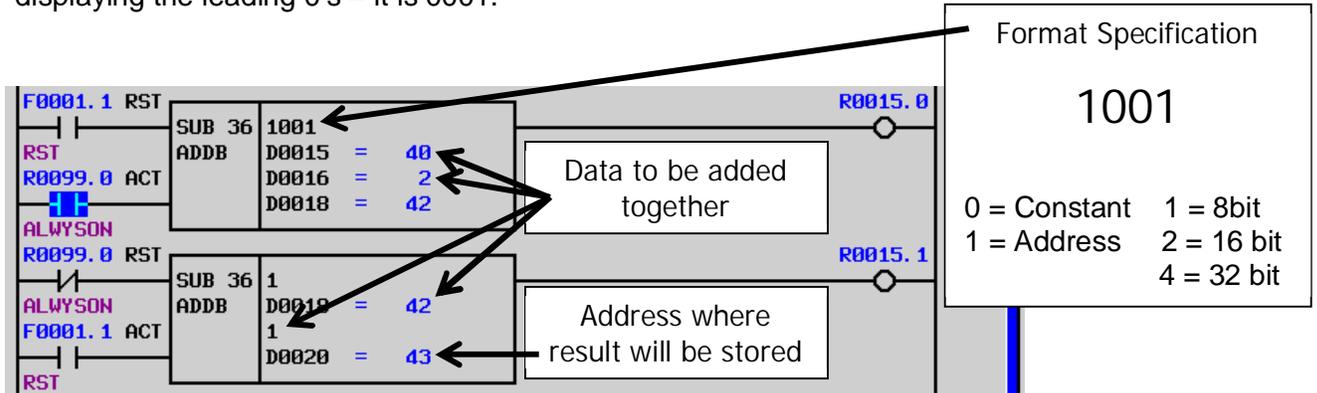
In the example below, the binary equivalent of 2147483647 will be written into (2) 32-bit addresses starting at Y10 (Y10-13 and Y14-Y17).



11.22. 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 a constant value or an address, as specified in the format specification. If an error occurs in the addition process, the output coil will turn ON, in these examples R15.0 and R15.1.

Notice with the second SUB 36 block that the format specification appears to be 1 but it is not displaying the leading 0's – it is 0001.



In the example above, F1.1 is not conducting. There is no coil for F1.1. **When will this addition occur?**



Change the value in D15 or D16 and watch the result address data change. What happens if you change D18?

RST = Reset input

- 0 = Not reset, normal operation
- 1 = Resets error output coil

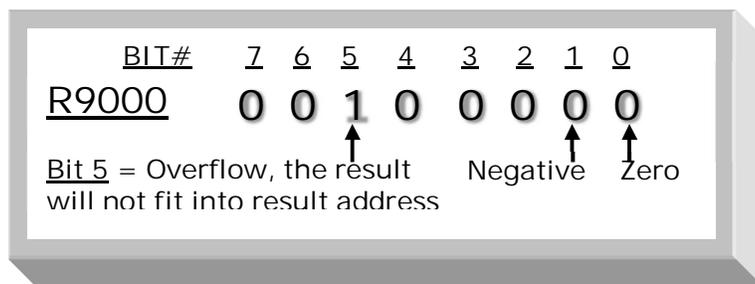
ACT = Activate command, causes calculation to perform

- 0 = No addition is performed
- 1 = Perform addition

OUTPUT COIL = If an error occurs during the addition of the addresses

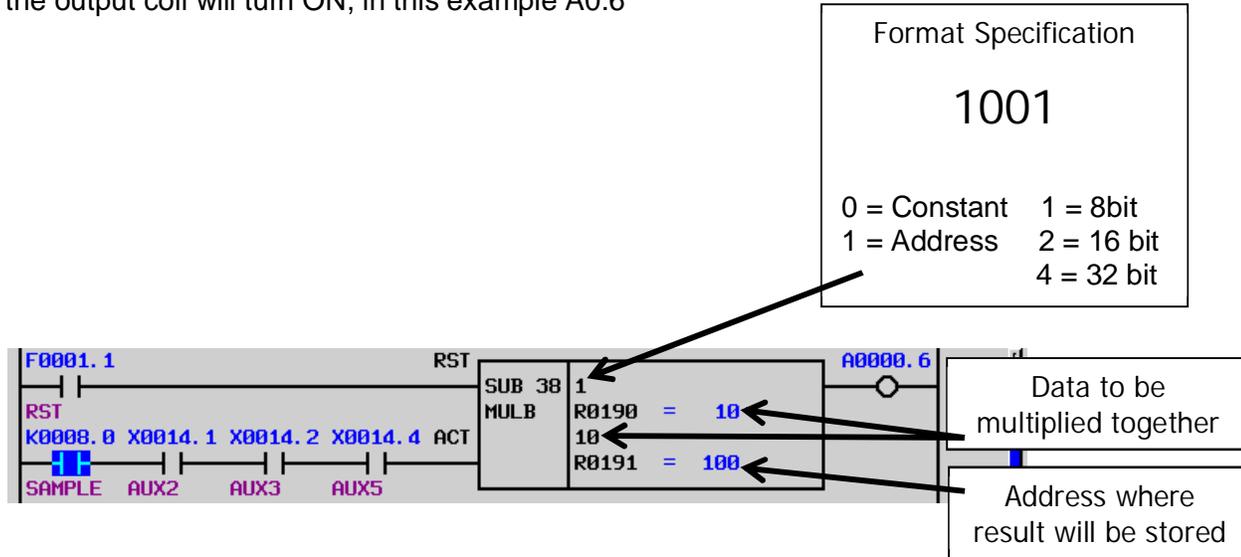
- 0 = Addition was normal
- 1 = Error occurred during addition (An error occurs if the addition result data will not fit into the commanded byte/word/long data size (format specification))

Address R9000 will also indicate if an error occurs during the addition process.



11.23. 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 a constant value or an address, as specified in the format specification. If an error occurs in the multiplication process, the output coil will turn ON, in this example A0.6



In the example above, R190 will be multiplied by the constant 10, and then the result will be stored in R191. If the result is too large to fit into R191, alarm A0.6 will occur.

RST = Reset input

- 0 = Not reset, normal operation**
- 1 = Resets error output coil**

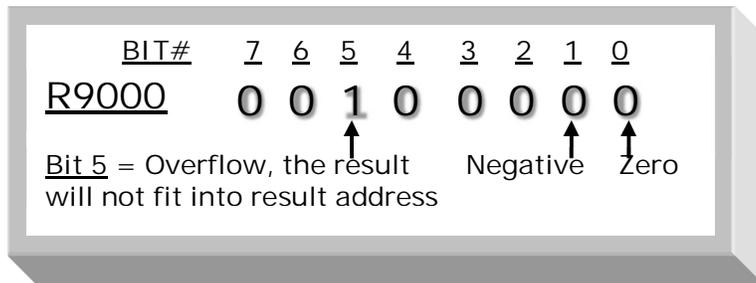
ACT = Activate command, causes calculation to perform

- 0 = No multiplication is performed**
- 1 = Perform multiplication**

OUTPUT COIL = If an error occurs during the multiplication of the data

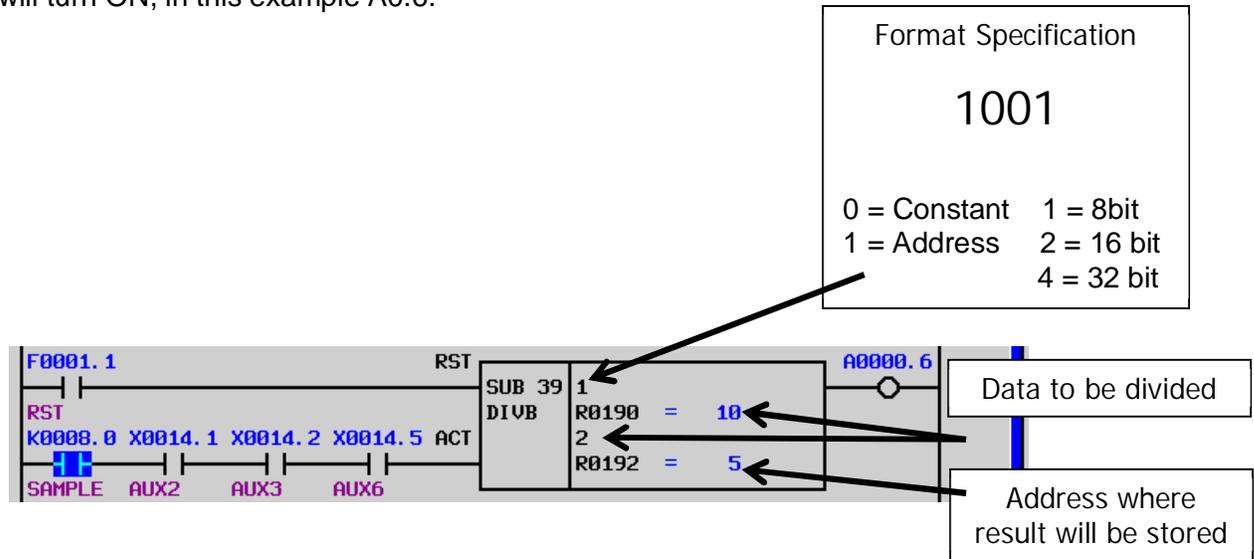
- 0 = Multiplication was normal**
- 1 = Error occurred during multiplication** (an error occurs if the multiplication result data will not fit into the commanded byte/word/long data size (format specification))

Address R9000 will also indicate if an error occurs during the multiplication process.



11.24. 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 a constant value or an address, as specified in the format specification. If an error occurs in the division process, the output coil will turn ON, in this example A0.6.



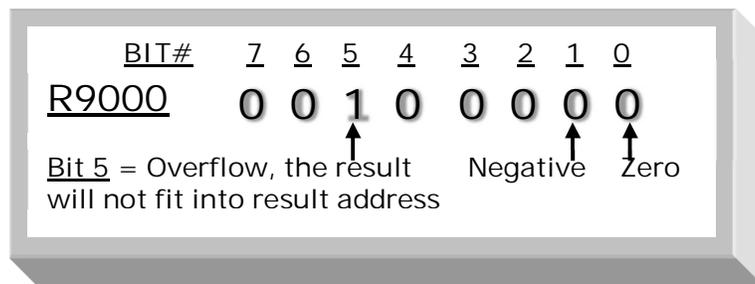
In the example above, R190 will be divided by the constant 2, and then the result will be stored in R192.

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

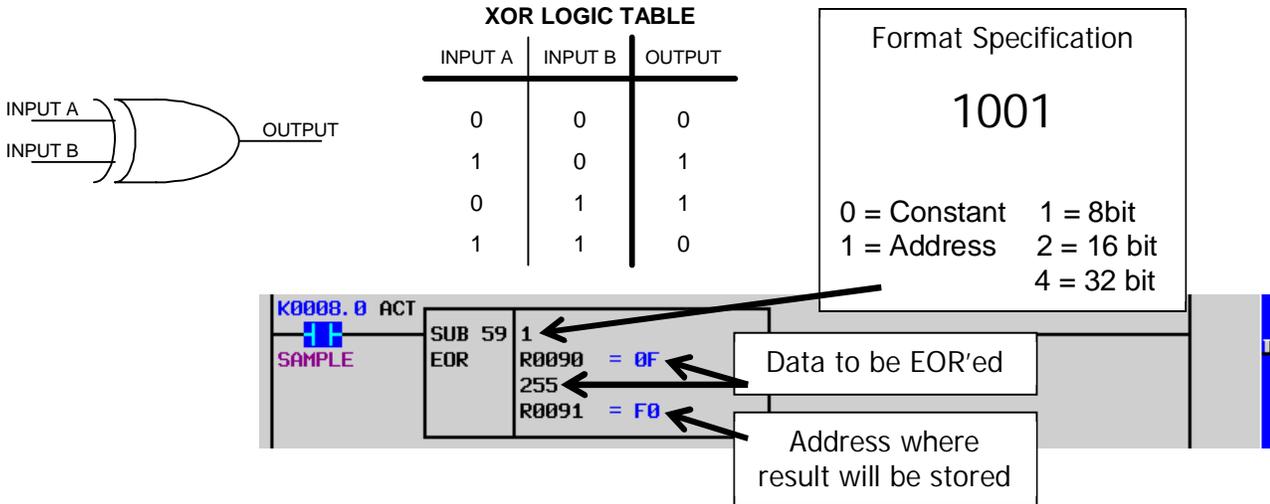
OUTPUT COIL = If an error occurs during the division of the data
 0 = division was normal
 1 = Error occurred during division (an error occurs if the division result data will not fit into the commanded byte/word/long data size (format specification))

Address R9000 will also indicate if an error occurs during the division process.



11.25. SUB 59 – EOR Logical Exclusive OR

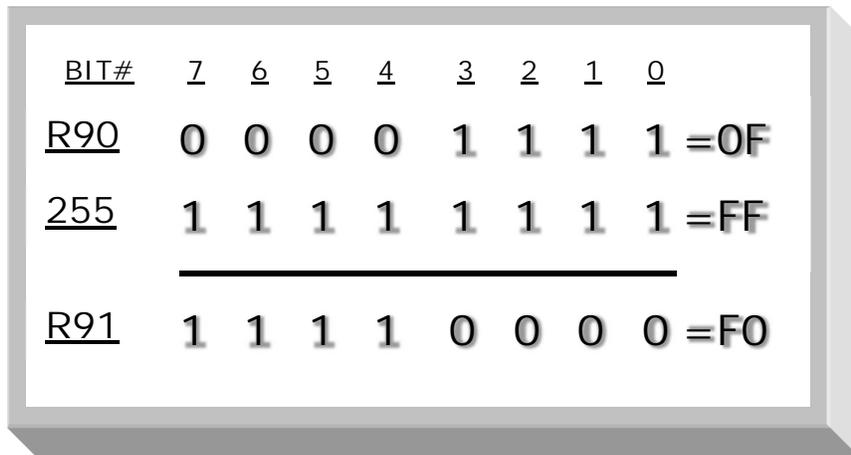
The EOR function can be used to **toggle a bit** or **invert bits**. It works like a digital logic gate; if a **SINGLE** input is ON between the two inputs, the output is ON, if **BOTH** inputs are ON or OFF between the two inputs, then the output is OFF.



ACT = Activate command, causes **exclusive OR** to perform
 0 = No process is performed
 1 = Perform exclusive OR process

The bits from the first address are EXCLUSIVE OR'ed 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 constant value or an address, as specified in the format specification.

In this example, address R90 is exclusive-OR'ed with decimal 255 and the result is transferred to address R91. 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.



The result of this operation is the inverse of the value in R90. 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 (R90) and convert it to active low (R91).



1) From the LADDER screen, press the  soft key.

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

3) Rotate the feedrate override switch.

Notice the values change.



4) Press the  soft key to get out of the search menu.

5) Press the  soft key TWICE to return to the PMC selection soft keys.

6) Press the  soft key on the LCD menu.

7) Press the  soft key on the LCD menu.

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

Rotate the feedrate override switch and notice that the bits in R91 are the direct inverse of R90.

11.26. SUB 61 – OR

The OR operator can be used to **turn ON a bit**. It works like a digital logic gate. If either input OR both inputs are ON the output is ON.

INPUT A	INPUT B	OUTPUT
0	0	0
1	0	1
0	1	1
1	1	1

Format Specification

1001

0 = Constant 1 = 8bit
 1 = Address 2 = 16 bit
 4 = 32 bit

K0008.0 X0014.0 ACT

SAMPLE AUX1

SUB 61	1	
OR		
	R0090 = 19	← Data to be OR'ed
	40	
	D0034 = 39	← Address where result will be stored

ACT = Activate command, causes **OR** operation to perform
 0 = No process is performed
 1 = Perform OR process

In this example address R90 is OR'ed with **decimal** 40 (in hex) 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.

BIT#	7	6	5	4	3	2	1	0	
<u>R90</u>	0	0	0	1	1	0	0	1	=19
<u>40</u>	0	0	1	0	1	0	0	0	=28
<u>D34</u>	0	0	1	1	1	0	0	1	=39

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 40 will be transferred to D34. This is a useful function when you want to be sure a minimum value is used.



- 1) From the LADDER screen, press the soft key.
- 2) Enter on the MDI keypad, and then press the soft key.

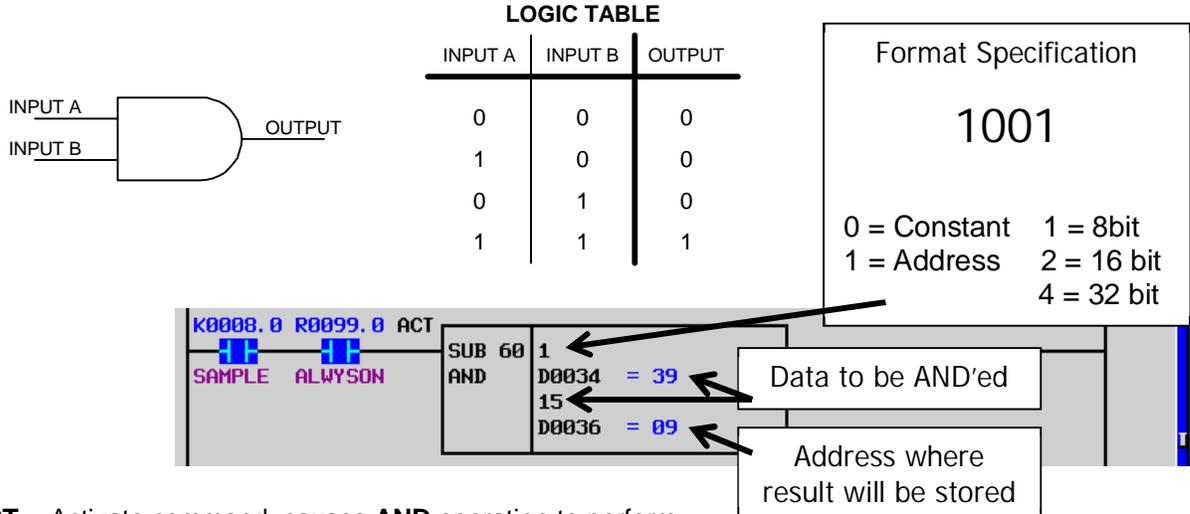
3) Rotate the feedrate override switch.
 Notice the R90 values change instantly.



What must you do to make the OR function?

11.27. SUB 60 – AND

The AND function can be used to **check the status of a bit** or **turn a bit OFF**. It works like a 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.



ACT = Activate command, causes **AND** operation to perform
0 = No process is performed
1 = Perform AND process

The bits from the first address are AND'ed 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 either a constant or address, as specified in the format specification.

In this example address D34 is AND'ed with **decimal** 15 (in hex) and the result is transferred to address D36.

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>D34</u>	0	0	1	1	1	0	0	1	=39
<u>15</u>	0	0	0	0	1	1	1	1	=0F
—————									
<u>D36</u>	0	0	0	0	1	0	0	1	=09

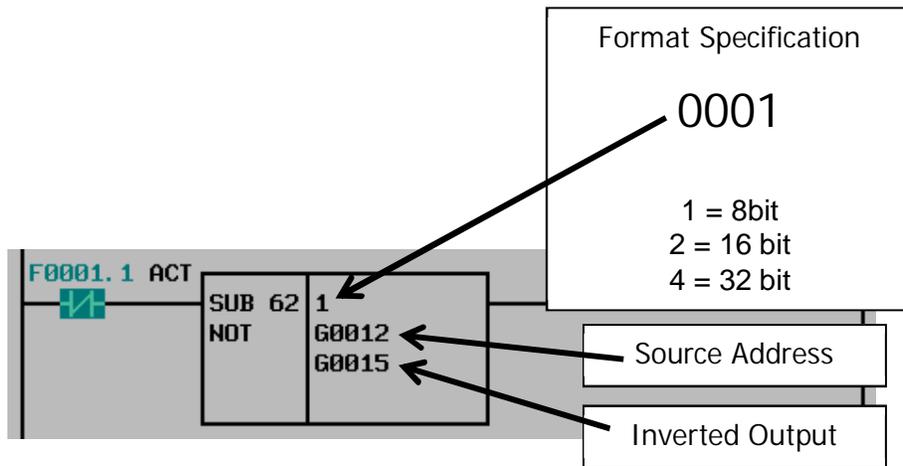
The result of this operation allows you to select the bits you want to transfer. This is a valuable function when you want to act upon a specific group of bits while ignoring other bits in the same address

Notice bits 4~7 of D34 are filtered out of the result in D36.

What changes the data in the D34 address?

11.28. SUB 62 – NOT

The NOT function is used to invert all of the bits in an address or addresses.

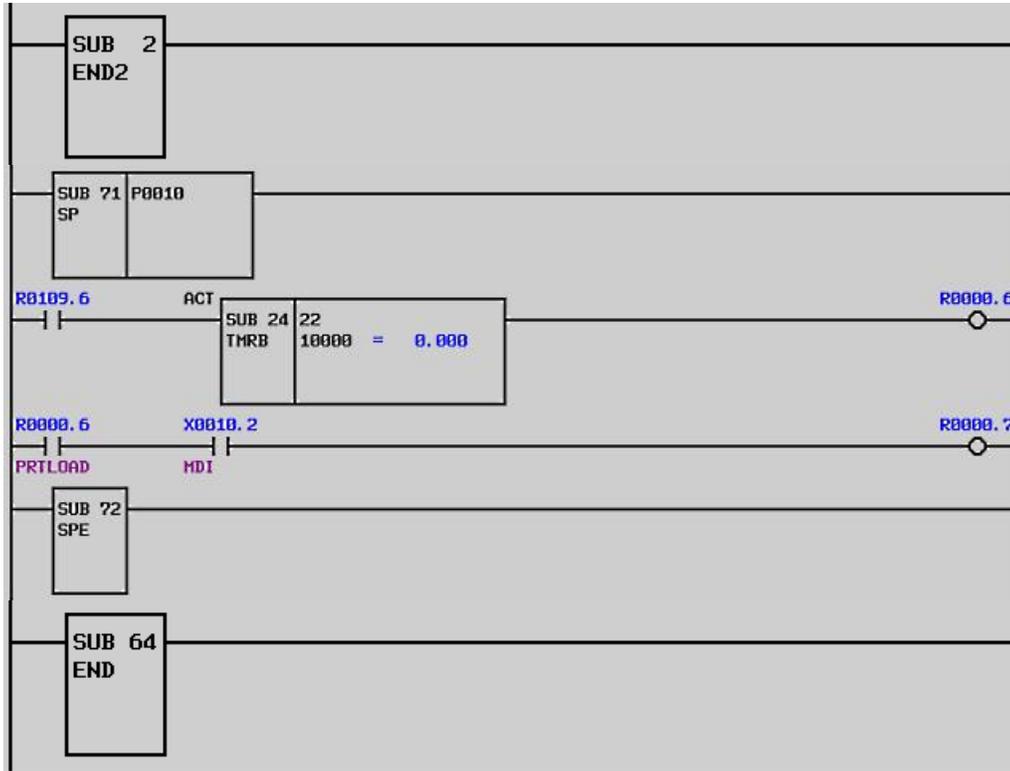


PMC SIGNAL STATUS

ADDRESS	7	6	5	4	3	2	1	0	HEX
G0012	1	1	0	0	0	0	1	1	C3
G0013	0	0	0	0	0	0	0	0	00
G0014	0	0	0	0	0	0	0	0	00
G0015	0	0	1	1	1	1	0	0	3C
G0016	0	0	0	0	0	0	0	0	00

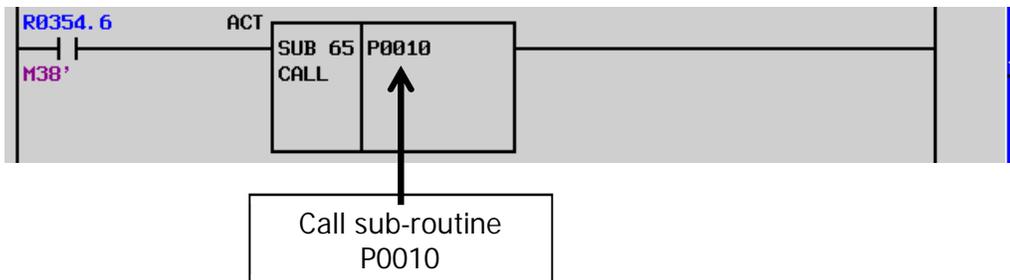
11.29. Ladder Subroutines

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 workpiece, 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.



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.

12. 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.

- 0000~7999** **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 yellow FANUC manuals.

- EX1000~EX1999** **Machine builder alarms**, generated in the PMC. They cause the machine to stop operation and can be cleared by RESET on the CNC MDI key pad. The descriptions for these faults are in the machine builders OPERATOR manual.

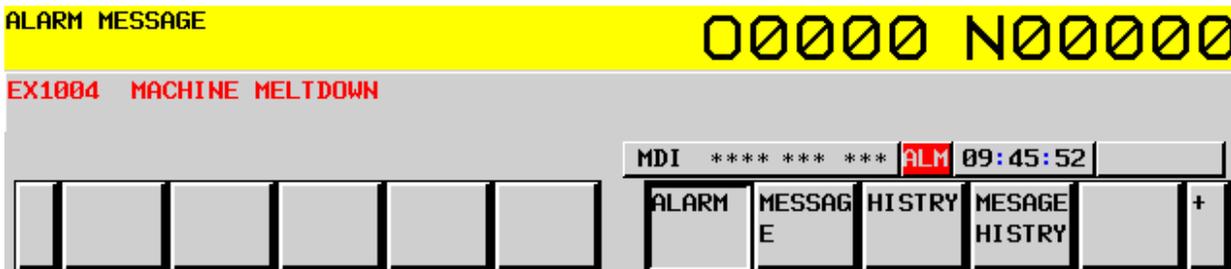
- No.2000~No.2999** **Machine builder messages**. These do not stop machine operation when they occur. The message appears and the machine continues to run. The descriptions for these faults are found in the machine builders OPERATOR manual. Messages numbered **2100~2999** display without a number.

- MC3000~MC3124** **G-Code programs generated alarms**. Typically contained inside of 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.

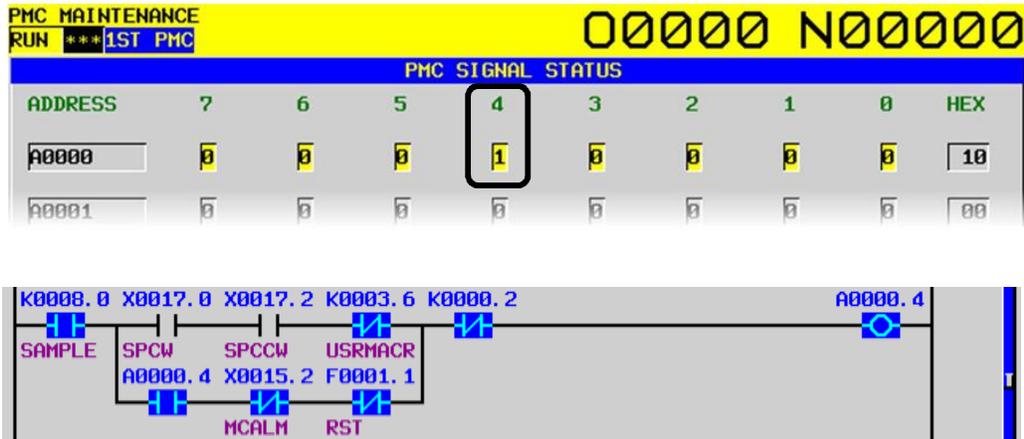


12.1. A Address Alarm Coils

The A coils in the ladder are tied to alarm conditions. When the coil turns ON (1), an alarm message is sent to the CNC message screen through the use of the SUB 41 explained shortly.

- TRY THIS** 
- 1) Press the  and  buttons at the same time. **DO NOT** press .
 - 2) Press the  button.
 - 3) Press the  soft key.
 - 4) Press the  soft key.
 - 5) Press and release  and then press , press the  soft key.
 - 6) Find the 'A' bit that is ON then go to the ladder and find the coil of that 'A' bit.

If you make it to A9000, you missed it – go back and look again. A9000 and up is for system purposes, you will not find these bits in the ladder.



The screenshot shows the 'PMC SIGNAL STATUS' screen with a table of bit addresses and their states. Bit 4 at address A0000 is highlighted with a '1', indicating it is ON. Below the table is a ladder logic diagram showing a coil at address A0000.4. The coil is energized by a series of normally open contacts: K0008.0, X0017.0, X0017.2, K0003.6, and K0000.2. The coil is reset by two normally closed contacts: MCALM (address A0000.4) and RST (address F0001.1).

ADDRESS	7	6	5	4	3	2	1	0	HEX
A0000	0	0	0	1	0	0	0	0	10
A0001	0	0	0	0	0	0	0	0	00

Typically the alarm circuit is a latch and hold type circuit that will latch itself ON. In this example,

the  button (F1.1) or the  button (X15.2) will unlatch the circuit – clearing the alarm.

- 7) Press the  button and then track down and clear alarm 1142.

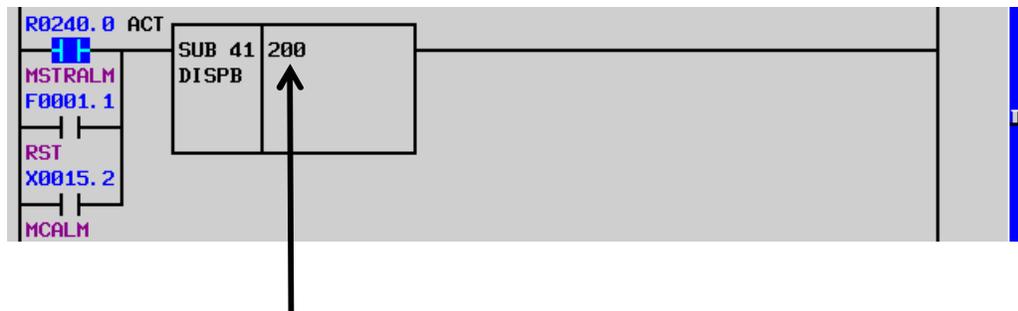
12.3. SUB 41 - DISPB Display Alarm Message

The DISPB function block is what actually causes the alarm messages to appear on the CNC screen. Even if an A coil is activated, even if there is a corresponding alarm in the PMC message list, the alarm doesn't appear unless the DISPB function block is activated.



1) From the LADDER screen, press the  soft key.

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



This value used to signify the maximum amount of messages the block would allow to be displayed; it's no longer used.

If an older ladder is converted to this newer style of ladder, the number will be retained but it does nothing.

The total number of messages possible to display is determined by the PMC type.

PMC type	Maximum # of messages available
3xi Memory A	2000
3xi Memory B	2000
3xi Memory C	4000
3xi Memory D	6000
Oi Model D	2000
Oi PMC/L	2000
Dual Check Safety	0

12.4. Master Alarm Circuit

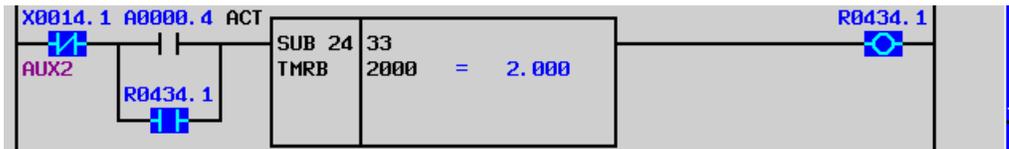
Most machine builders include a master alarm circuit in their ladder. This circuit turns ON a common coil when any of the alarm coils (A) are activated. The common coil address can be used as a contact in any circuit that may be affected by alarms.



- 1) Highlight the R240.0 contact with the cursor. Press the  soft key.
- 2) Find the contact that is activating the R240.0 coil.



- 3) Highlight the A114.2 contact with the cursor. Press the  soft key.
- 4) Trace the logic back until you find logic that will allow you to break the circuit.



You have three different ways to troubleshoot machine alarms:

- Find the A bit in the PMC diagnostics.
- Find the A bit in the PMC Message list.
- Find what logic is activating the SUB 41.

13. Exercise 5 – PMC Functional Instructions



1) Which timer(s) can be adjusted on the screen?

SUB3 TMR

SUB24 TMRB

SUB54 TMRC

2) If you input 2100 for Timer 001, the value changes to 2064.
Why doesn't the system accept 2100 as a valid input?

3) *On your simulator...*

How many M-codes are decoded by the SUB4 DEC function block?

How many M-codes are decoded by the SUB25 DECB function block?

4) Search for the SUB8 MOVE function block, what is the purpose of the Mask Bits?

5) The CNC will not allow you to enter a new value into data address D36 on the PMC parameter screen. Why not?



Press and hold the **INC** button for 5 seconds.
(You will have to start all over again if you power off during the exercise.)

6) Alarm **EX1095 PROX. SWITCH ERROR** occurs. Fix the alarm.

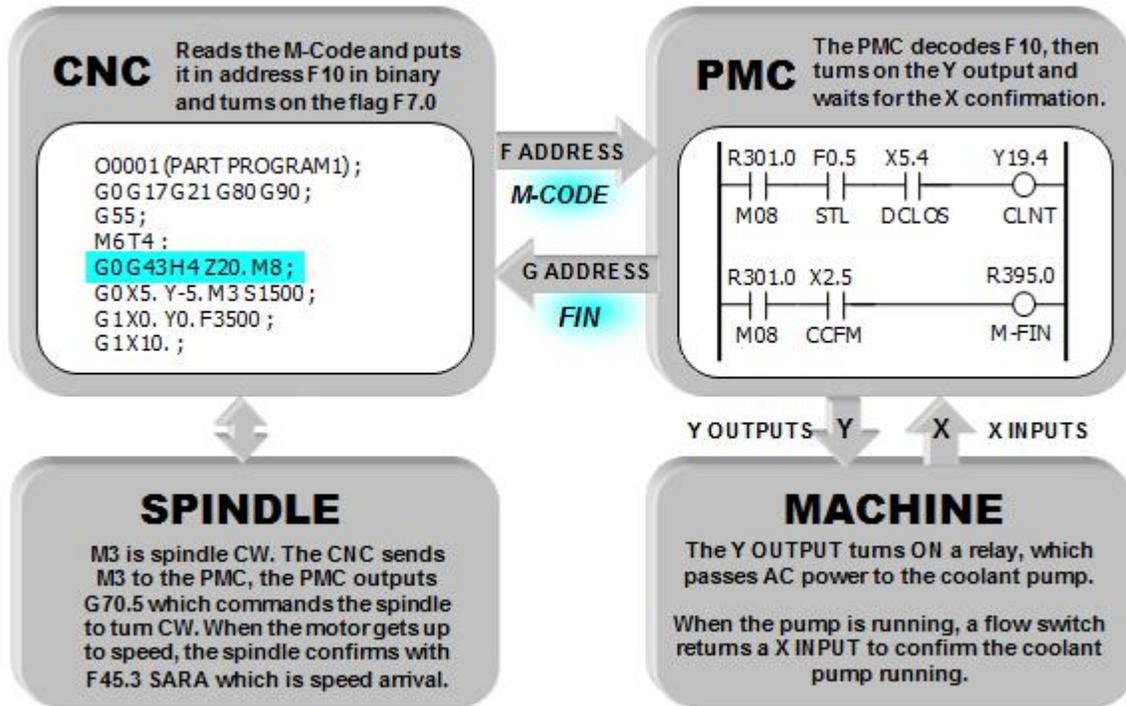
7) Alarm **EX1033 TURRET UNCLAMPED** occurs. Fix the alarm.

8) Alarm **EX1997 SERVSTND SETTING ERROR** occurs. Fix the alarm.

9) The operator panel appears to have an issue. Use the ladder logic to make it act normal again.

14. Auxiliary Functions – M, S, T & B Codes

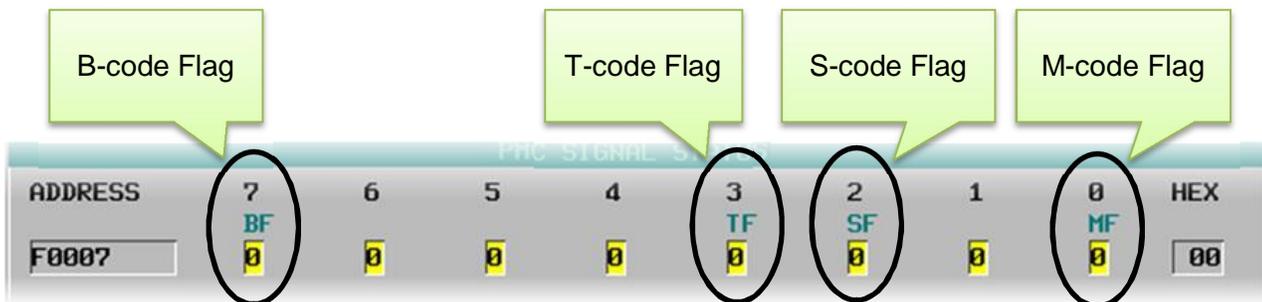
The M, S, T, and B codes are often referred to as MISCELLANEOUS or AUXILIARY functions, which control machine side functions. These codes are read in the Part Program by the CNC, the CNC passes them to the PMC through some F addresses, and it is the PMC’s job to process them. When the PMC has confirmed that the auxiliary function was completed, it sends the “FIN” signal back to the CNC to tell the CNC it has finished processing the M, S, T, or B code. Then the CNC processes the next line in the Part Program.



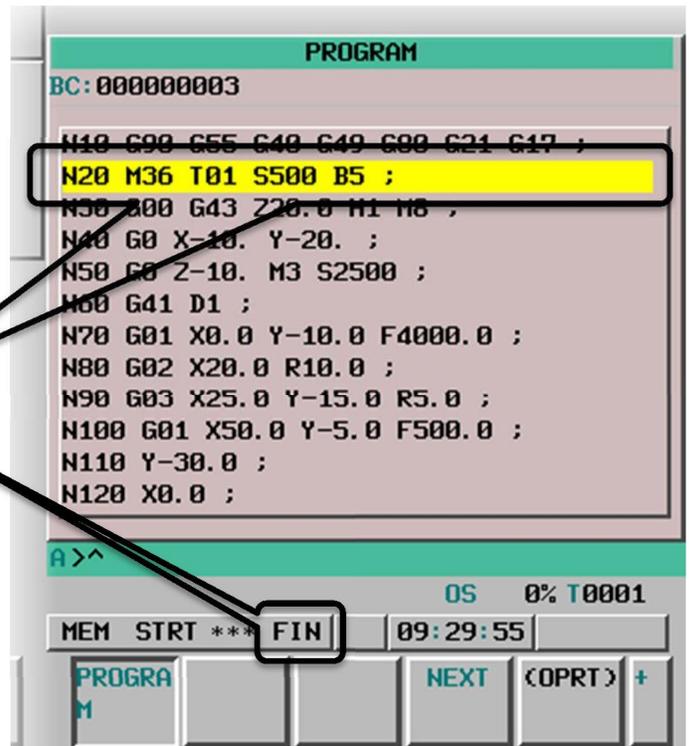
14.1. Determining why 'FIN' is on the screen

Whenever an auxiliary function is called for in a G-code program, there are a couple things that happen immediately after the code is read by the CNC: the CNC puts the word 'FIN' on the bottom middle of the screen to indicate it is waiting for the FINish signal from the PMC and will not run any more G-code until it gets it **and** it turns on a flag bit to let the PMC know that it has an auxiliary function to deal with.

The flag bits are located at PMC address F0007.

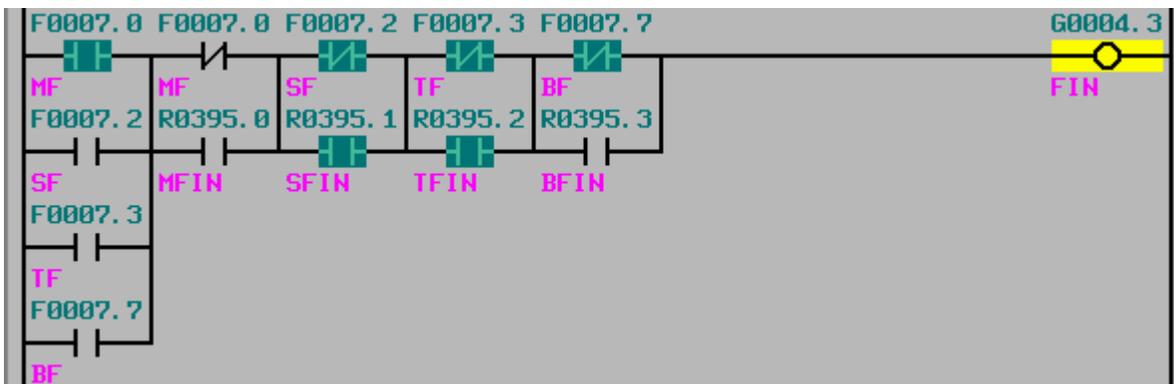


Sometimes when you look at a G-code program to figure out what it is waiting on, it is not very obvious!



When the CNC receives the finish signal from the PMC - indicating whatever auxiliary function it was told to perform has been completed - the CNC will turn off the flag bit, removing the word 'FIN' from the screen.

Even though there are many things that can cause FIN to appear on the screen, in the vast majority of all cases there is only one thing the CNC is waiting for – PMC address G4.3 to change to a 1.



The next sections will discuss how to troubleshoot the cause of FIN on the screen.

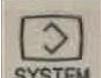
14.2. M-Codes

M-Codes are called MISCELLANEOUS or AUXILIARY functions and are used to control machine side actions. The M-Codes are processed by the PMC ladder and are specific to each machine. Depending on the functionality of the machine, the M-Codes can vary widely. There are several M codes which are common that are listed below.

- | | |
|----------------------------|--|
| <u>M00</u> = Program STOP | <u>M08</u> = Coolant ON |
| <u>M01</u> = Option STOP | <u>M09</u> = Coolant OFF |
| <u>M02</u> = Program RESET | <u>M19</u> = Spindle Orient |
| <u>M03</u> = Spindle CW | <u>M30</u> = Program RESET and REWIND |
| <u>M04</u> = Spindle CCW | <u>M98</u> = Call a sub-program |
| <u>M05</u> = Spindle Stop | <u>M99</u> = Return to the calling program |
| <u>M06</u> = Tool Change | |

When troubleshooting an M-Code problem, it is often most efficient to follow the processing backward to find the cause of a failure. This section details the procedure.



1) Press the  button on the MDI key pad.

2) Press the  soft key on the CNC menu.

3) Press the  soft key on the CNC menu.

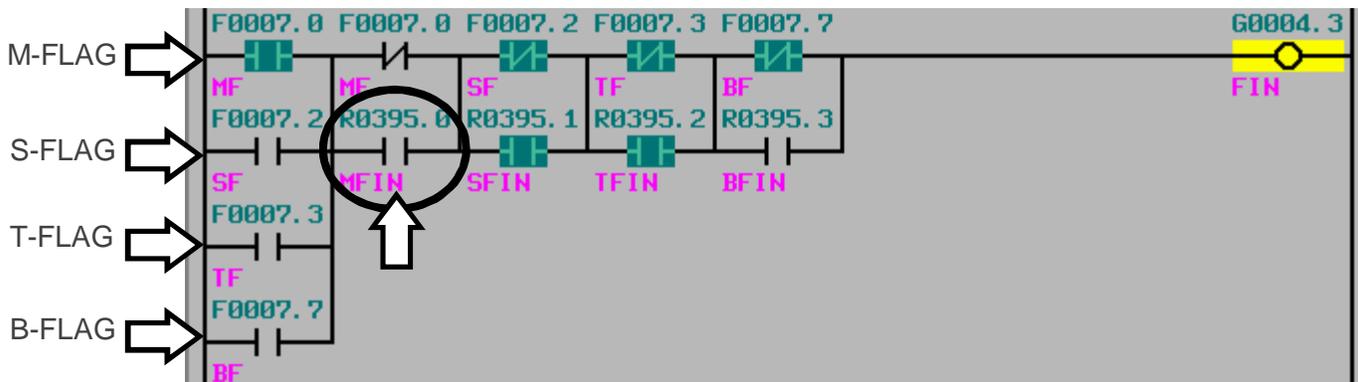
4) Press the  soft key on the CNC menu.

5) Press the  soft key on the CNC menu.

6) Enter G4.3 on the MDI key pad.

7) Press the  soft key on the CNC menu.

The MASTER FIN circuit appears...

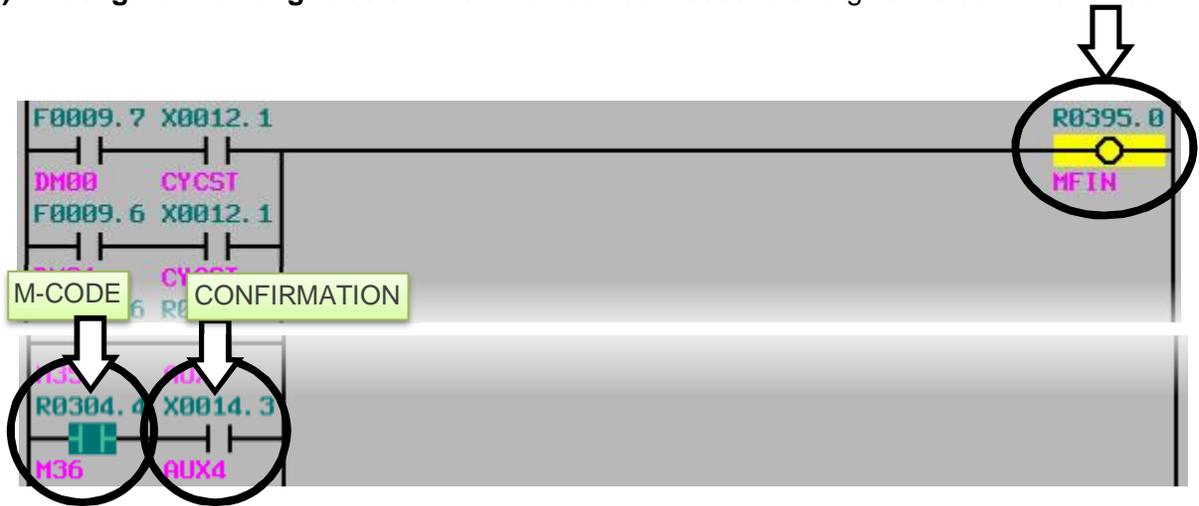


From this net you can see that contact F7.0 is ON, and you can also see which address the MTB has chosen for the confirmation, in this example R395.0. **Search for the confirmation address coil.**

8) Highlight the R395.0 contact with the cursor.

9) Press the **soft key** on the CNC menu.

10) Investigate this rung to determine which contact needs to energize the confirmation coil.



14.3. S-Codes

S-Codes are used to command the spindle drive to a certain speed. The CNC passes the S-code to the PMC and the PMC sends it to the spindle drive. Whenever an S-code needs to be processed, the CNC will turn on the S-code flag F7.2; use the following to determine why an S-code is not being processed.

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

2) Press the  **soft key** on the CNC menu.

3) Press the **soft key** on the CNC menu.

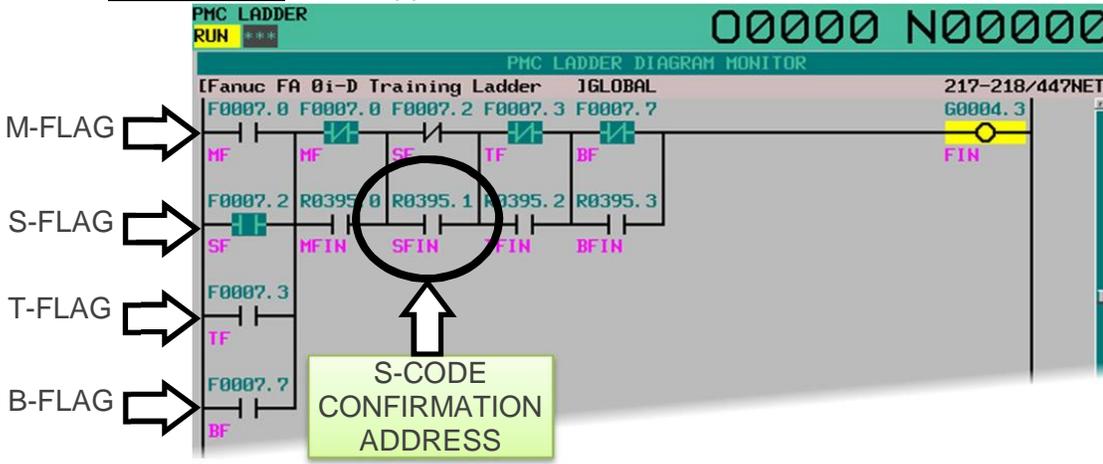
4) Press the  **soft key** on the CNC menu.

5) Press the  **soft key** on the CNC menu.

6) Enter G4.3 on the MDI key pad.



7) Press the **W-SRCH** soft key on the CNC menu.
The **MASTER FIN** circuit appears...



From this net you can see that contact F7.2 is ON, and you can also see which address the MTB has chosen for the confirmation, in this example R395.1. **Search for the confirmation address coil and then troubleshoot the logic that would cause it to activate.**

14.4. T-Codes

T-codes are used to call up a tool. The code is sent to the PMC and the ladder logic then uses that code to determine what tool to get from the magazine or what tool to turn the turret to. Whenever a T-code needs to be processed, the CNC will turn on the T-code flag F7.3.

As in the previous sections for M-codes and S-codes, search for address G4.3 in the ladder and troubleshoot the logic to find what is keeping that coil from turning on. Refer to sections 10.2 or 10.3 for examples of what to do.

14.5. B-Codes

The technical name for a B-code is 'Second Auxiliary Function'. They can be used like additional M-codes. In fact, depending on how parameter 3460 is set, they might not be called up with the letter B but with A, C, U, V, or W; for instance if you have an actual B axis on your machine you cannot use the letter B to also call up this function so you'd use a different letter. Only a small percentage of machines use this feature. Whenever a B-code needs to be processed, the CNC will turn on the B-code flag F7.7.

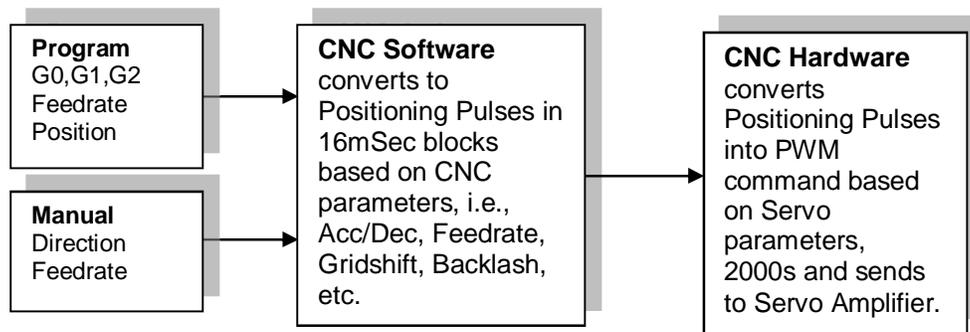
As in the previous sections for M-codes and S-codes, search for address G4.3 in the ladder and troubleshoot the logic to find what is keeping that coil from turning on. Refer to sections 10.2 or 10.3 for examples of what to do.

15. PMC Controlled Axis

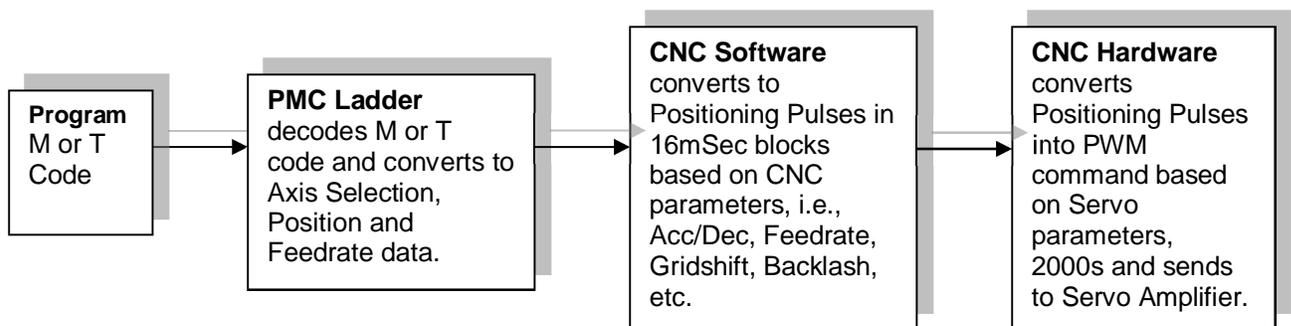
A CNC controlled axis is a motor that is commanded using G-code programming or the operator panel. These axes can be simultaneously controlled and are mainly used for cutting. Parameter settings for the axis; feedrate, acc/dec, axis and motor type, tuning, etc., are the standard 1000s,1400s,1600s,1800-2200s.

A PMC controlled axis is typically used for positioning only and are commanded by M or T codes in the G-code program. They can also be commanded from the operator panel, such as in manual turret indexing. These are not simultaneously controlled and are not typically displayed on the position screen. Parameter settings for the axis; feedrate, acc/dec, axis and motor type, tuning, etc., can be the standard 1000s,1400s,1600s,1800-2200s, or set by use of the PMM (Power Motion Manager) screens for I/O link Beta Amplifiers or Power Mates.

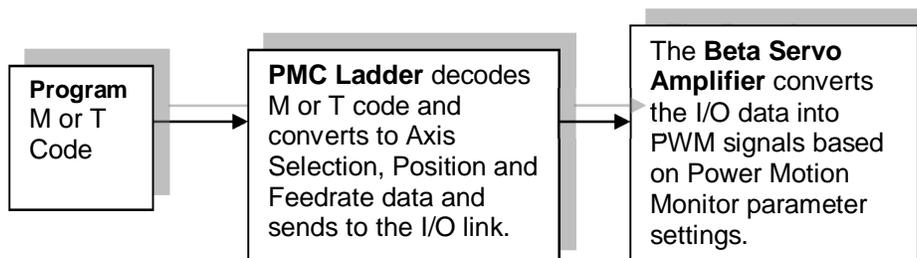
15.1. CNC Controlled Axis



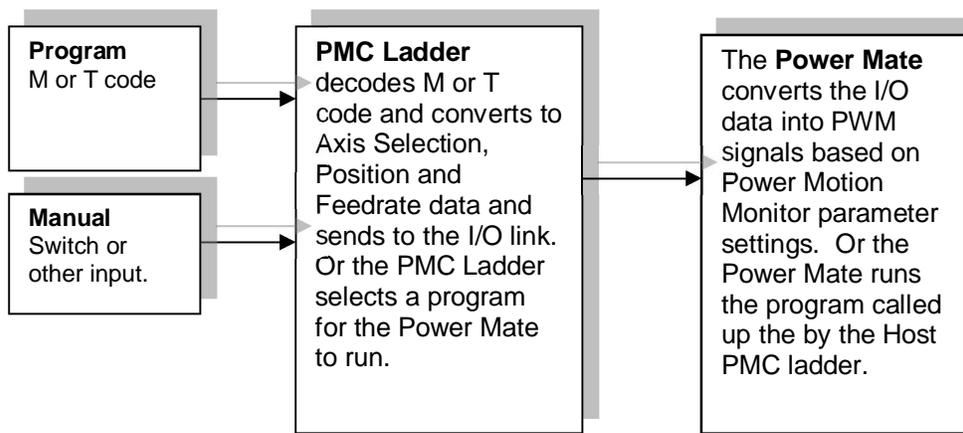
15.2. PMC Controlled Axis



15.2.1. I/O Link PMC Axis



15.2.2. Power Mate Controlled Axis



15.3. PMC Controlled Axis Operations

The PMC can directly control any given axis, independent of the CNC. In other words, moving the tool along axes that are not controlled by the CNC is possible by entering commands, such as those specifying move distance and feedrate from the PMC. This enables control of turrets, tool magazines, part catchers, live tooling motors, sub spindle motors, etc.

Whether the CNC or PMC controls an axis is determined by the input signal provided by the PMC for that particular axis.

The PMC can directly control the following operations.

1. Rapid traverse with move distance specified
2. Cutting feed – feed/minute with move distance specified
3. Cutting feed – feed/revolution with move distance specified
4. Skip – feed/minute with move distance specified
5. Dwell
6. Continuous feed – jog or spindle operation
7. 1st thru 4th reference return
8. External pulse synchronization - Main Spindle
9. External pulse synchronization – 1st thru 3rd Handle
10. Feedrate control
11. Selection of machine coordinates
12. Torque control

15.4. PMC Axis Control Parameter

The PMC provides multiple paths to control these operations using input (F addresses) and output signals (G addresses). By issuing commands through these paths, the PMC can simultaneously control multiple separate axes.

Parameter 8010 is used to determine which path controls which axis. The Oi-D M-series can control up to 4 paths while the T-series can control up to 8 if it is setup as a 2-path control. The 3xi series can control up to 40.

8010	Selection of the DI/DO group for each axis controlled by the PMC
------	--

[Input type] Parameter input
 [Data type] Byte axis
 [Valid data range] T series: 1 to 4 (at 1-path control), 1 to 8 (at 2-path control)
 M series: 1 to 4
 Specify the DI/DO group to be used to specify a command for each PMC-controlled axis.

P8010	Description
1	Uses path 1 DI/DO group A (G142 to G153)
2	Uses path 1 DI/DO group B (G154 to G165)
3	Uses path 1 DI/DO group C (G166 to G177)
4	Uses path 1 DI/DO group D (G178 to G189)
5	Uses path 2 DI/DO group A (G1142 to G1153)
6	Uses path 2 DI/DO group B (G1154 to G1165)
7	Uses path 2 DI/DO group C (G1166 to G1177)
8	Uses path 2 DI/DO group D (G1178 to G1189)

Refer to the 30-series Parameter Manual for address details on groups 9-40 if needed.

Input/Output signals from the four paths are called group A (path 1), group B (path 2), group C (path 3) and group D (path 4).

15.5. Set Up Signals

The name of an input/output signal used for PMC axis control always contains a lowercase “g” for group, as in EBUFg, where the actual signal name is EBUFA, EBUFB, etc.

The same group of signals can be used to control more than one axis, however parameter settings related to feedrate, acc/dec, linear/rotational axis, etc., must be the identical for each axis to be controlled.

To enable direct PMC axis control the PMC controlled axis selection signal (EAX1 to EAX8) must be set to a one.

15.6. Operation Signals

Three groups of operations signals need to be provided by the PMC to the appropriate group addresses. These signals, along with the block stop prohibition signal EMSBKg, determine one complete operation, which is the same as the CNC executing one block of program code in automatic operation.

15.6.1. Axis control selection signal – EXA1 to EXA8

This signal is used to select which axis, as designate in parameter 1023, to receive the PMC commands.

15.6.2. Axis control command signal – EC0g to EC6g

These signals specify the type of operation

15.6.3. Axis control feedrate signals – EIF0g to EIF15g

This 16 bit group signals are provided by the PMC to set the feedrate for the selected axis.

15.6.4. Axis control data signals - EID0g to EID31g

This 32 bit group of signals provided by the PMC specifies the moving distance and other data.

Generic name	Signal name	Symbol	Data type
Axis control block data signals	Block stop prohibition signal	EMSBKg	Bit
	Axis control command signal	EC0g to EC6g	Byte
	Axis control feedrate signal	EIF0g to EIF15g	Word
	Axis control data signal	EID0g to EID31g	Two-word

15.7. Handshaking Signals

Axis control block data signal (Read Signal) – EBUFg

When the operation signals have been set for that particular command event, this signal must reverse its logical state(i.e., from 0 to 1 or vice versa). This signal transition stores the operation data into the Input Buffer on the CNC side.

Axis control command read completion signal (Completion Signal) EBSYg

This signal is transferred from the CNC to the PMC when the CNC has read a command data for PMC axis control and stored it in the Input Buffer.

15.8. PMC Sequences

The following sequence example show the steps required to command a rotary axis for a turret on a lathe machine.

1. T code transferred from CNC to PMC on F-address.

2. PMC decodes T code, transfers desired tool station address to comparison function block.
3. PMC performs comparison check to determine if turret is at tool station already.
4. If turret is not at desired tool station, PMC activates Axis CNTL by PMC function block (AXCTL) for appropriate tool station and axis select signal EAXg.
5. When AXCTL is activated, the command data set in 8 consecutive Input registers are transfer to the appropriate G address group.

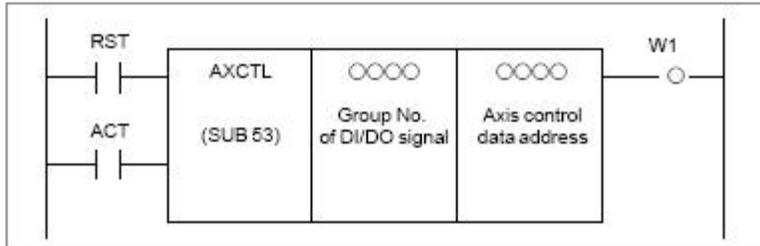


Fig. 5.72.2 AXCTL instruction format

Table 5.72.2 AXCTL instruction coding

Step Number	Instruction	Address Number	Bit Number	Remarks
1	RD	0000. 0		RST
2	RD. STK	0000. 0		ACT
3	SUB	53		AXCTL command
4	(PRM)	0000		Number of DI/DO signal
5	(PRM)	0000		Axis control data address
6	WRT	0000. 0		W1, processing completion

+0	FANUC reserved	Specify 0.
1	Control command	Specify the command to set EC0x–EC6x.
2	Command data 1	Specify the data to set EIF0x–EIF15x.
3		
4	Command data 2	Specify the data to set EID0x–EID31x.
5		
6		
7		(x=A / B / C / D)

The following functions are available.

Operation	Control	Command data 1	Command data 2
Rapid traverse	00H	Feedrate Need not to set if CNC PRM. 8002#0 = 0.	Total travel amount
Cutting feed (feed per min.)	01H	Feedrate (Note 1)	Total travel amount
Cutting feed (Note 2) (feed per revolution)	02H	Feedrate per revolution	Total travel amount
Skip (feed per min.) (Note 2)	03H	Feedrate	Total travel amount
Dwell	04H	not used	Dwell time
Reference pos. return	05H	not used	not used
Continuous feed (Note 3)	06H	Feedrate	Feed direction (Note 4)
1st ref. pos. return 2nd ref. pos. return 3rd ref. pos. return 4th ref. pos. return (Note 2)	07H 08H 09H 0AH	Feed rate Need not to set if CNC PRM. 8002#0 = 0.	not used
External pulse synchronization (Note 2) (Note 3)	0BH 0DH 0EH 0FH	Pulse weighting (Only M series)	not used
Speed command (Note 2) (Note 5) (Note 6)	10H	Feedrate	not used
Machine coordinate positioning (Rapid traverse) (Note 2) (Note 6)	20H	Feedrate Need not to set if CNC PRM. 8002#0 = 0.	Position of machine coordinate. (absolute)

Example 1) In case of cutting feed (feed per min.)

+0	0H	Not used (Specify 0).
1	01H	Command code for cutting feed. (feed per min.)
2	Feedrate	unit: mm/min.
3		
4	Total travel amount	unit: 0.001mm
5		
6		(x=A / B / C / D)
7		

16. PMC Window Function

The PMC WINDOW function allows the PMC to access information displayed on the CNC screens. A data register stack is setup initially, then the SUB51 WNDR/SUB52 WINDW function block points to the D register stack, when it's activated.

16.1. D Register Stack

The D register stack contains the function code, completion code, data length, data number, data attribute, and writing data. The stack begins at a register determined by the programmer. In this example code D20 is the head of the stack.

Stack Head	+0	Function Code
	+2	Completion Code
	+4	Data Length
	+6	Data Number
	+8	Data Attribute
	+10	Writing Data

16.1.1. Function Code

The function code tells the SUB52 WNDW function what to do. A function code of 14 tells it to WRITE a TOOL OFFSET, while function code 18 tells it to WRITE a CNC PARAMETER. The complete list of function codes can be located in the PMC Programming Manual for your particular control, below is a small sampling.

5.3.2 List of Window Functions (Function Code Order)

Function code	Description	Response	R/W
0	Reading CNC system information	High-speed	R
13	Reading a tool offset	High-speed	R
14	Writing a tool offset	Low-speed	W
15	Reading a work piece origin offset value	High-speed	R
16	Writing a work piece origin offset value	Low-speed	W
17	Reading a parameter	High-speed	R
18	Writing a parameter	Low-speed	W
19	Reading setting data	High-speed	R
20	Writing setting data	Low-speed	W
21	Reading a custom macro variable	High-speed	R
22	Writing a custom macro variable	Low-speed	W
23	Reading the CNC alarm status	High-speed	R
24	Reading the current program number	High-speed	R
25	Reading the current sequence number	High-speed	R
26	Reading the actual velocity of controlled axes	High-speed	R
27	Reading the absolute position (absolute coordinates) of controlled axes	High-speed	R
28	Reading the machine position (machine coordinates) of controlled axes	High-speed	R
29	Reading a skip position (stop coordinates of skip operation (G31)) of controlled axes	High-speed	R
30	Reading the servo delay for controlled axes	High-speed	R
31	Reading the acceleration/deceleration delay on controlled axes	High-speed	R

16.1.2. Completion Code

The completion code is a status returned by the SUB52 WNDW function block, to tell if the function was completed or if an error occurred.

<i>CODE</i>	<i>DESCRIPTION</i>
0	Function completed
1	Error-invalid function code
2	Error-data length
3	Error-invalid data number
4	Error-invalid data attribute
5	Error-invalid writing data
6	Error-option missing
7	Error-write protected

16.1.3. Data Length

This tells the WNDW function the size of the data to write/read. Each of the CNC parameters or data have a specific size. Parameters are either BYTE(8 bits), WORD(16bits) or DWORD(32bits). The size of each parameter is stated in the parameter manual.

16.1.4. Data Number

This tells the WNDW function the parameter number or data number that is to be written/read. For example, if you want to change parameter 6711, the data number is set to 6711.

16.1.5. Data Attribute

This sets the column of the data to be set. For example, parameter 1005 has a setting for each axis XYZ. If you want to set 1005 for X axis, the DATA NUMBER will be 1005 and the ATTRIBUTE will be 0. If you want to change the Y axis setting the attribute is 1, and for Z it will be 2.

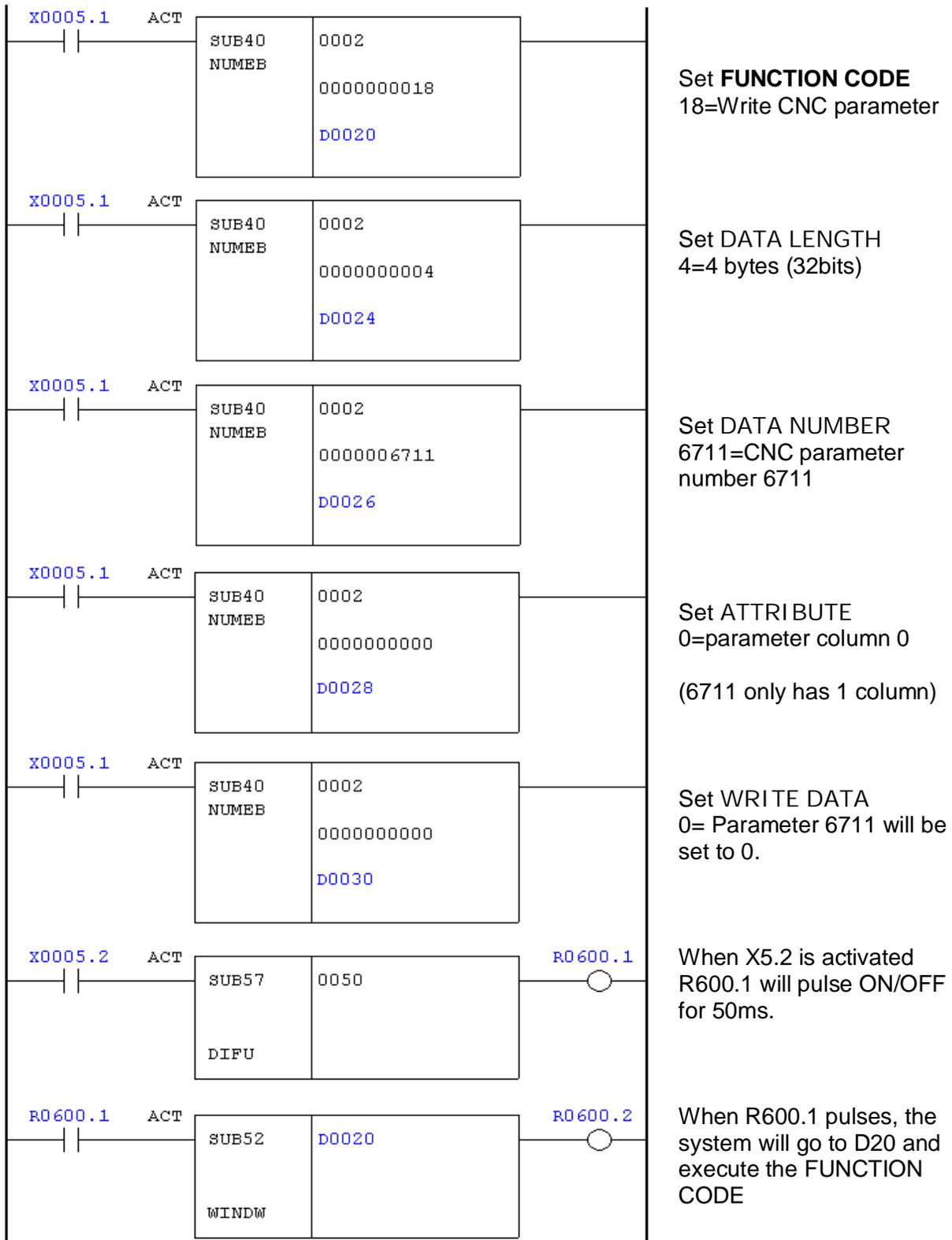
For a tool offset, when the 4 column offset screen is used (LENGTH/WEAR/RADIUS/WEAR), if you want to change offset 002 in the radius column, the DATA NUMBER will be 0002, and the ATTRIBUTE will be 1. The attribute is incremented right to left, RADIUS WEAR=0, RADIUS=1, LENGTH WEAR=2, and LENGTH=3.

16.1.6. Write Data

This is the actual data you want to write to the parameter or CNC data setting. If you wanted to set 5 into the parts counter, DATA NUMBER=6711, ATTRIBUTE=0, and WRITE DATA=0005.

16.2. WINDW Example

This example writes 0 to the parts counter. The first five function blocks set the data in the stack, the DIFU function outputs a 50ms pulse when the input activates, and the SUB52 WINDW function block commands the PMC to execute the command at D20.



17. CNC Screen Review

While the three PMC soft keys offer most of the information that pertains to the PMC section, there are two functions on the CNC side of the control system that are useful in troubleshooting issues related to PMC signals.

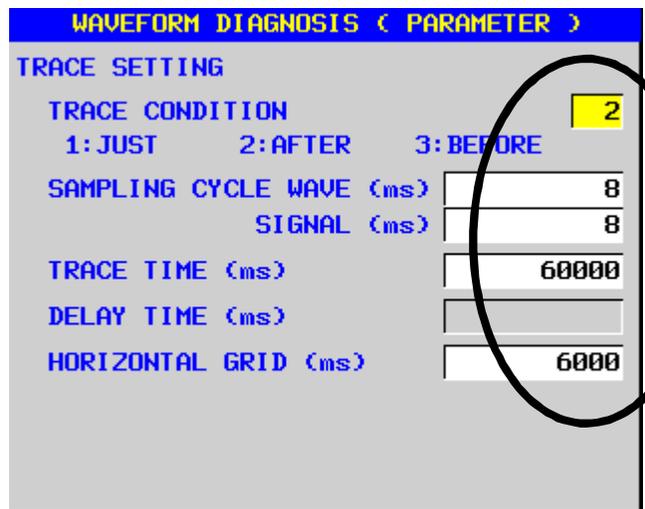
17.1. Wave Diagnostic Function

The waveform diagnostic function has the capability to graph signals within the control system, similar to a 4 channel digital oscilloscope. Servo, spindle, and PMC signals can be monitored. This function is standard on 3xi and 0i Model D controls.

17.1.1. Wave Diagnostic Parameters

The parameter settings determine the type of data that will be captured, how long the sample will be, and what will trigger the data capture. To view the wave diagnostic parameter settings, press the following key sequence.

- TRY THIS** 
- 1) Press the  button.
 - 2) Press the  soft key.
 - 3) Press the  soft key.
 - 4) Press the  soft key.



This is the WAVE DIAGNOSIS (PARAMETER) screen. It sets the timing of the sample. **Set your screen as shown above.** Each of the settings are described below...

TRACE CONDITION determines when the sample will begin.

1:JUST starts sampling when the TRACE soft key is pressed.

2:AFTER samples after the TRACE soft key, and the TRIGGER event.

3:BEFORE samples after the TRACE soft key is pressed, and stops sampling when the TRIGGER event occurs.

CYCLE WAVE determines how often the signal is checked during the TRACE TIME period.

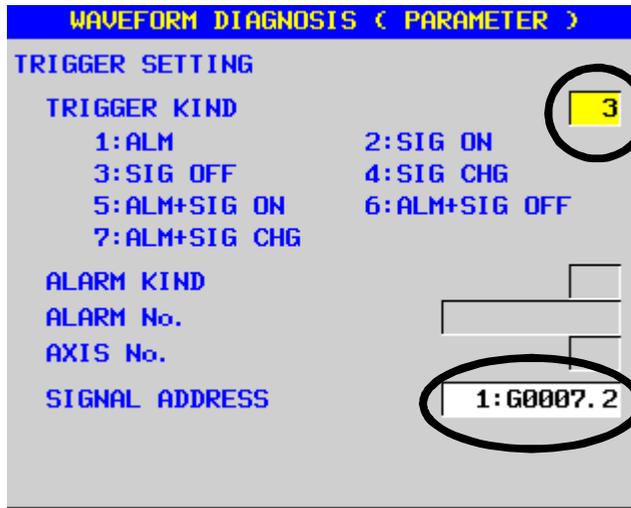
TRACE TIME determines how long the sample will collect data.

DELAY TIME will delay the end of the sample beyond the trigger event, only used when TRACE CONDITION 3:BEFORE is selected.

HORIZONTAL GRID selects the time graduations on the GRAPH display.

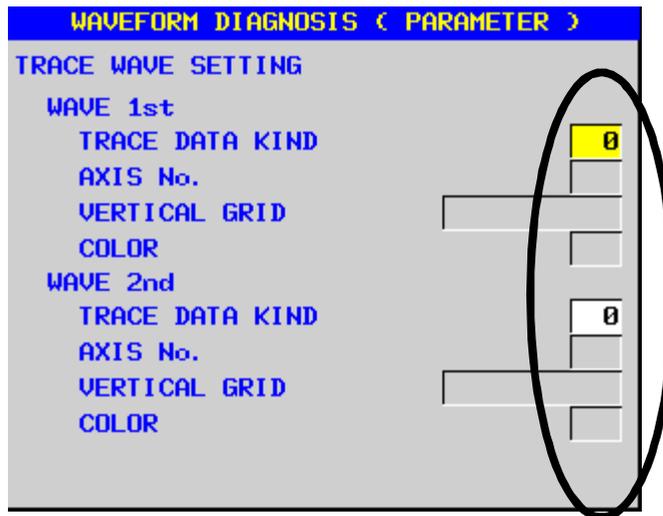


5) Press the **PAGE** button, on the MDI key pad.
The **TRIGGER SETTING** screen appears...



6) Set the **TRIGGER KIND** and **SIGNAL ADDRESS** as shown above.

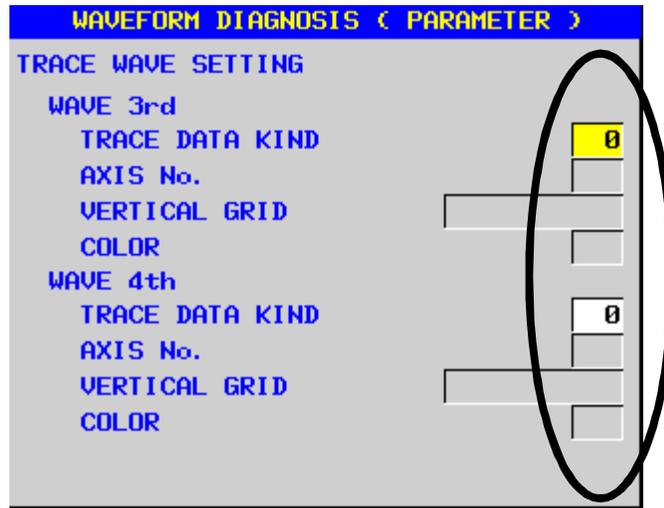
7) Press the **PAGE** button, on the MDI key pad.
The **TRACE WAVE SETTING** screen appears...



8) The trace wave settings allow you to graph servo and spindle signals. As we are only watching PMC signals, set the **TRACE WAVE SETTINGS** as shown above.



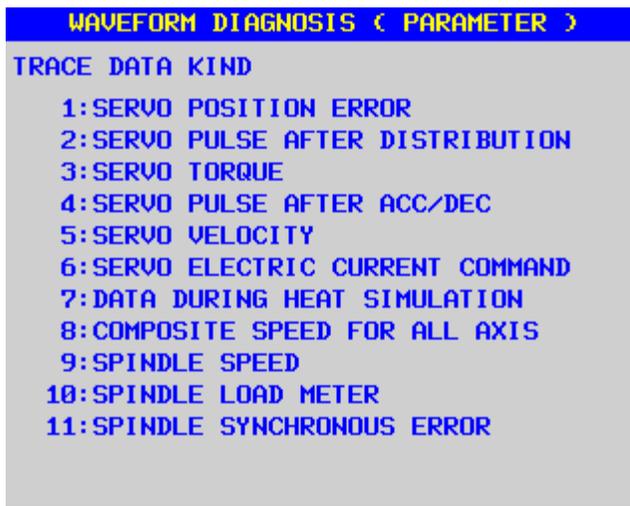
- 9) Press the **PAGE** button, on the MDI key pad.
The **TRACE WAVE SETTING** screen page 2 appears...



- 10) Set the **TRACE WAVE SETTINGS** as shown above.
11) Position the cursor on the **TRACE DATA KIND** or **COLOR** field.



- 12) Press the **EXPLAN** soft key, on the CNC menu.
A **HELP** window appears to explain the possible settings.

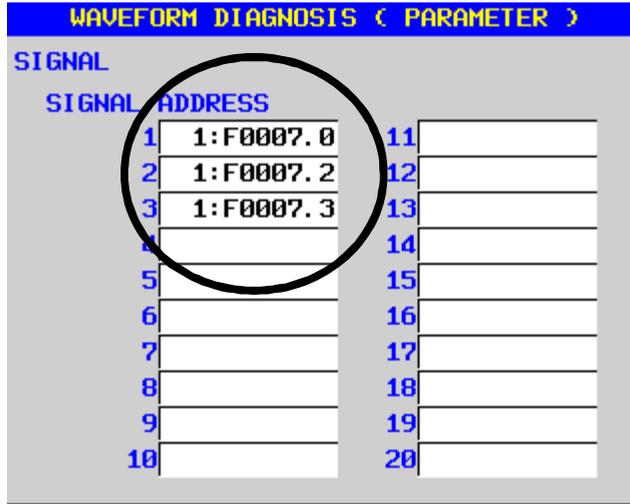


- 13) Press the **RETURN** soft key, to exit the help window screen.



14) Press the **PAGE** button, on the MDI key pad.

The **SIGNAL** screen appears; we will set up the trace to count the number of M, S, & T codes that appear within a program. The results of the trace will allow us to see exactly how long it takes to process each auxiliary function.



15) Set the screen up as shown above.

17.1.2. Waveform Diagnostic Capture Program

After the parameters are set, the system is ready to capture the data specified. The trace condition set in the previous section determines when the data capture begins. In our usage, the trace will run for 60 seconds after the Cycle Start (G7.2) signal turns off.



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



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



3) Enter **C 0 1 0 1** then press the **PROGRAM SEARCH** soft key.



4) Set the **FEEDRATE OVERRIDE** to **100%**.

17.1.3. Capture Waveform Data

The capture data begins sampling based on the TRIGGER KIND parameter setting. In this



example the trigger kind is set to 2, which means that after the  soft key is pressed and after the trigger condition occurs the tracing starts; when the trace time has elapsed the software stops sampling.



1) Press the **SYSTEM** button, on the MDI key pad.



2) Press the **Play** soft key on the CNC menu.



3) Press the **WAVE DIAG** soft key on the CNC menu.



4) Press the **WAVE GRAPH** soft key on the CNC menu.
The **WAVE DIAGNOSTIC (GRAPHIC)** screen appears...



5) Press the **OPRT** soft key, on the CNC menu.

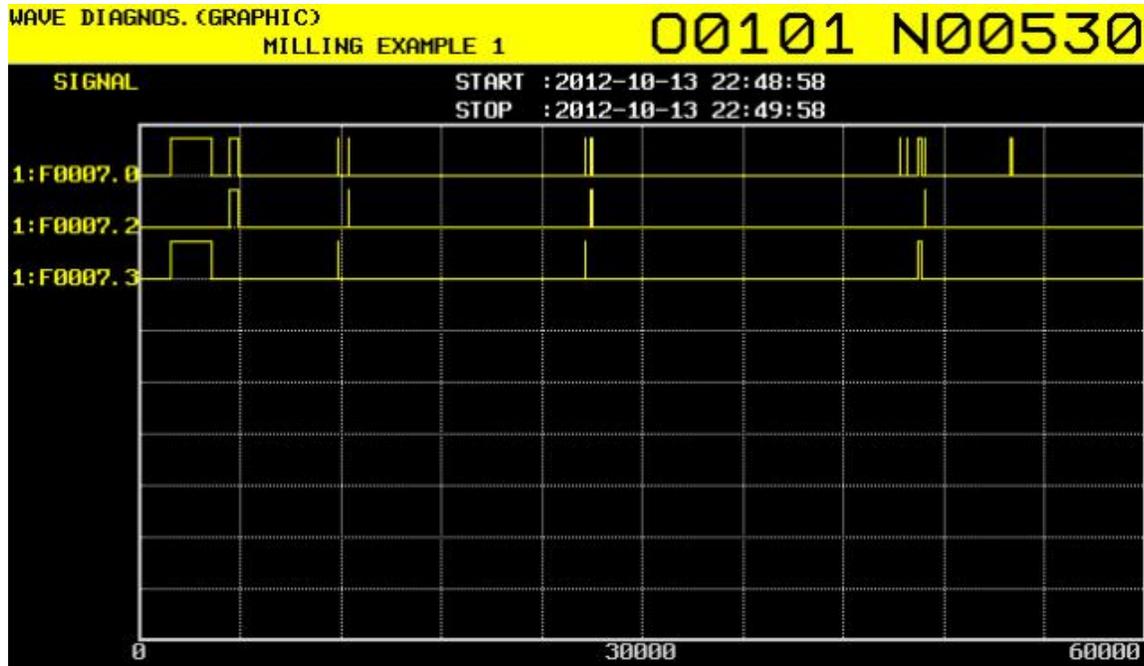


6) Press the **TRACE** soft key, on the CNC menu.
The message **Now Sampling...** flashes on the display.
The system is waiting for the trigger event.

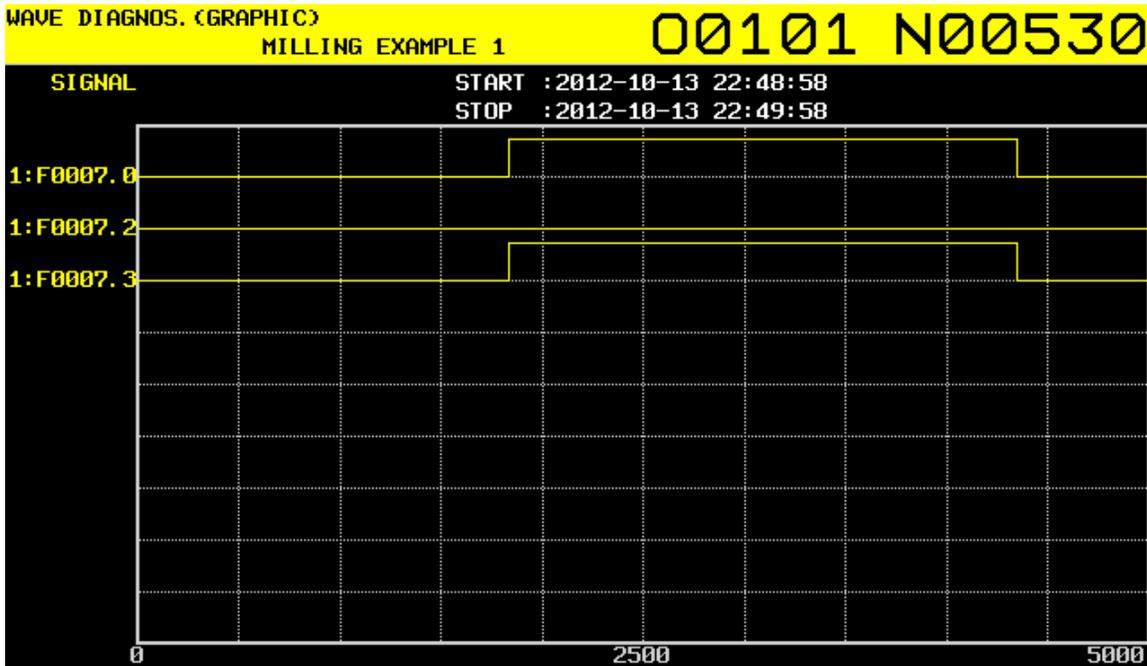


7) Press the **CYCLE START** button on the operator panel.
After the part program has completed, the graph will be displayed.

The full 60 seconds of capture is displayed on the screen.



8) Press the  soft key three times to zoom in on the sample.



Looking horizontally, each block represents 500 milliseconds; it took 2.5 seconds to process the first M and T codes in the above example.



9) Press the   soft keys to shift along the sample.  will zoom out.

17.2. CNC Diagnostic 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.

TRY THIS  1) Press the  button.

2) Press the  soft key.

To the right of the diagnostic is a status bit. If anything is causing the CNC to stop there will be a '1' next to the item.

Several of these diagnostics are based on the status of PMC addresses:

DIAGNOSTIC	
0000	
G53.6	Inposition Check
G12	Feedrate Override 0%
G10, G11	Jog Feed Override 0%
G8.0, G130, G132, G134, G7.1	Inter/Start Lock on
G29.4	Speed Arrival on
	Wait Revolution
	Stop Position Coder
	Feed Stop

3) Select  mode.

4) Press the  button and the cycle begins.

5) Set the **FEED OVERRIDE** to 0%. Notice the diagnostic bit turns ON.

6) Turn the **FEED OVERRIDE** back up and notice the bit turns OFF.

18. Ladder Editing

For the **16/18/21 iB-series, 0 iC & D-series, and 30/31/32 iA & B series**, ladder editing can be done on the control's PMC screens and either on or off line using FANUC Ladder III software. The editing functions are usually password protected; if so, the password can be obtained from the Machine builder.

18.1. Settings



1) Press the  button on the MDI panel.

2) Press the  soft key to change the CNC menu.

3) Press the  soft key on the CNC menu.

4) Press the  soft key.
The **PMC SETTING (GENERAL)** screen appears...

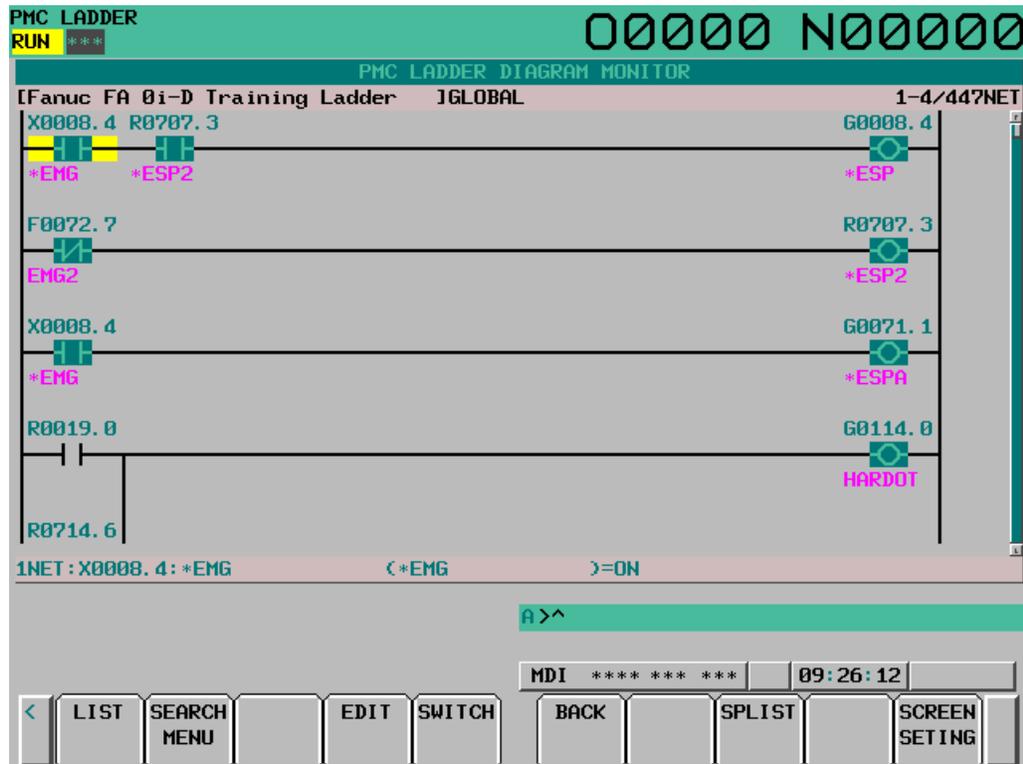
5) Make sure **PROGRAMMER ENABLE** is turned on, this will force all the settings needed for editing to be on.

PMC SETTING (GENERAL)		
TRACE START	=	MANUAL / AUTO
EDIT ENABLE	=	NO / YES
WRITE TO F-ROM(EDIT)	=	NO / YES
RAM WRITE ENABLE	=	NO / YES
DATA TBL CNTL SCREEN	=	YES / NO
HIDE PMC PARAM	=	NO / YES
PROTECT PMC PARAM	=	NO / YES
HIDE PMC PROGRAM	=	NO / YES
IO GROUP SELECTION	=	HIDE / SHOW
KEEP RELAY(SYSTEM)	=	HIDE / SHOW
LADDER START	=	AUTO / MANUAL
ALLOW PMC STOP	=	NO / YES
PROGRAMMER ENABLE	=	NO / YES

18.2. Altering Existing Ladder Logic

Once the ladder edit settings are on, ladder changes can be made directly on the control.

- TRY THIS** 
- 1) Press the  button on the MDI panel.
 - 2) Press the  soft key to change the CNC menu.
 - 3) Press the  soft key on the LCD menu.
 - 4) Press the  soft key on the LCD menu.
 - 5) Press the  soft key on the LCD menu.

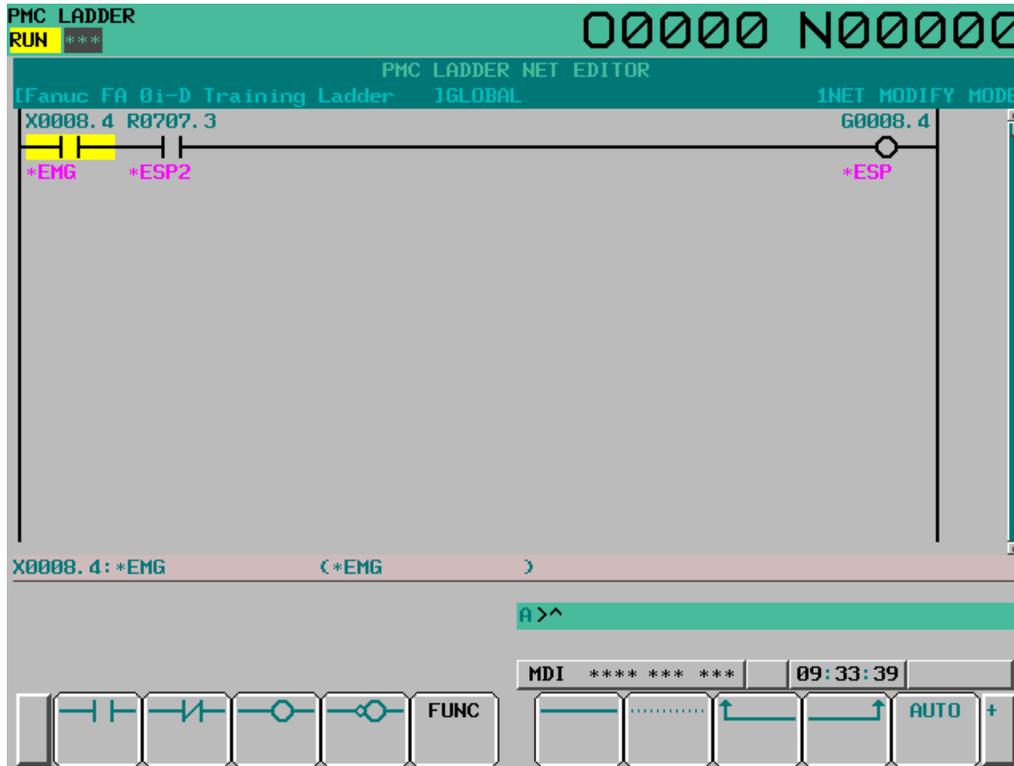


- 6) The **EDIT** key is available on the Ladder main soft key menu because of the EDIT

ENABLE setting under the  soft key. Press the  soft key to start editing.



7) With the **cursor highlighting the first rung** press the  soft key.



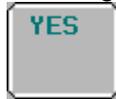
8) With the **cursor on the X0008.4 contact** press the  soft key.



9) Press the  soft key and then the  soft key.

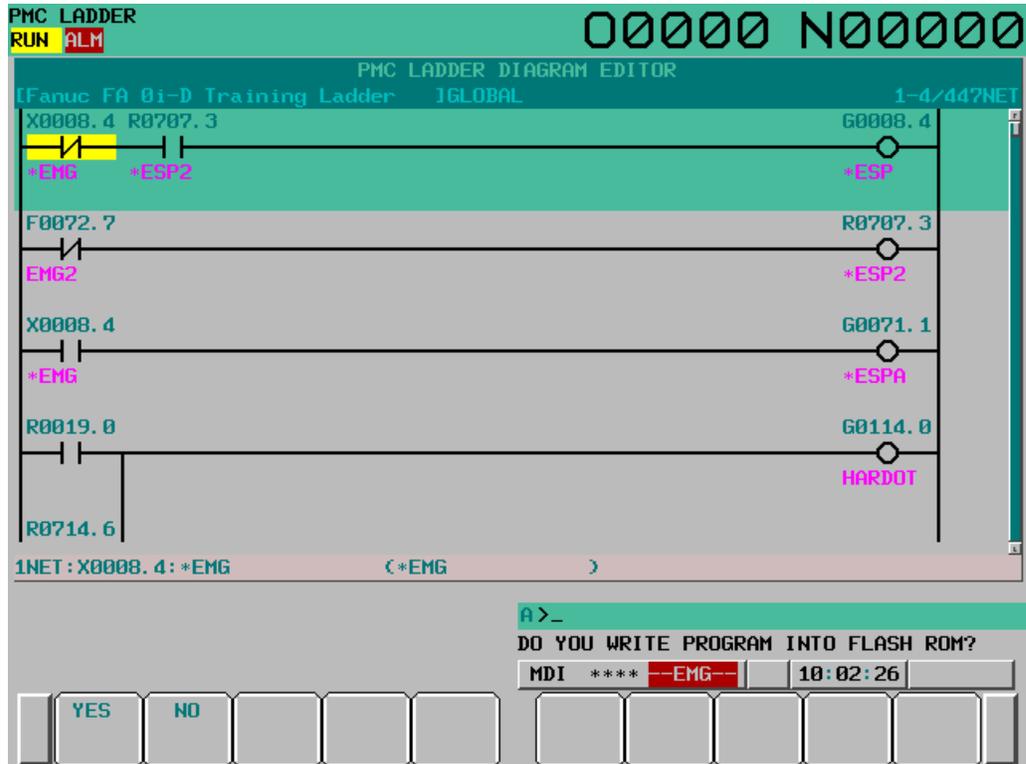
10) Press the  soft key and then the  soft key.

11) The message “PMC RUNNING. DO YOU UPDATE PROGRAM?” appears. Press



the soft key.

12) The changes you made now take effect.



Because WRITE TO FROM (EDIT) is set to YES, the system will now ask “DO YOU WRITE PROGRAM INTO FLASH ROM?” to make the changes permanent.



13) Press the soft key.

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.

14) Now check the change you made:

Notice that you are in Emergency Stop without the E-Stop button pushed in: E-Stop is active low – both the X8.4 address and the G8.4 address must have a status of 1 or the control goes into E-Stop. The G8.4 coil is off causing E-Stop.

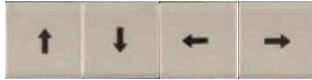
Press in the E-Stop button. Now the G8.4 coil is on but you’re still in Emergency Stop because X8.4 now has a status of 0.

15) Fix the E-stop circuit (change it back).

18.3. Adding New Ladder Logic



The **CREATE NET** soft key allows you to add new lines of ladder logic. You can insert multiple line of logic on the CREATE screen.



1) Using the **↑ ↓ ← →** buttons on the MDI panel, position the cursor on **the line below** where you would like to add a new ladder line.



2) Press the **CREATE NET** soft key on the ladder edit menu.

3) Type in an X address. (X14.2, for example)

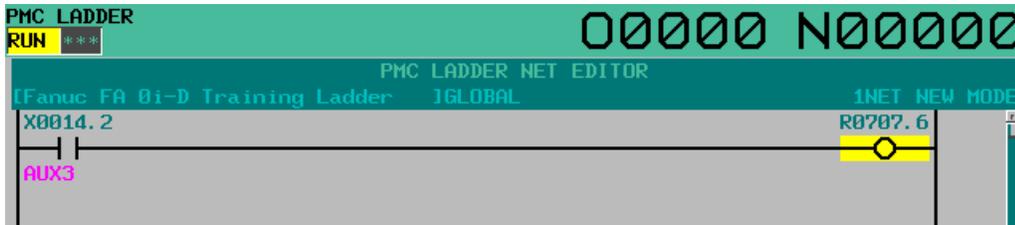


4) Press the soft key.

5) Type in **-R 7 0 7 . 6**.



6) Press the soft key.



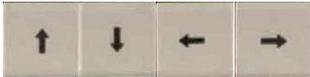
7) Press the soft key and then the **EXIT A DD** soft key.



8) Press the soft key and then the **EXIT E DIT** soft key.
Update the PMC Program but don't save it to the Flash ROM.

18.3.1. Adding a New Functional Instruction



1) Using the  buttons on the MDI panel, position the cursor on **the line below** where you would like to add a new ladder line.

2) Press the  and  soft keys on the ladder edit menu.

3) Type in an X address. (X14.0, for example)

4) Press the  soft key.

The functional instruction can be added now. If you know the SUB number, just enter it then press the  soft key. If you do not know the SUB number then press the  soft key and a list of all the sub functions will appear.

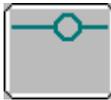
5) Enter  **3** then press the  soft key. The functional instruction appears.



6) Enter  **2**  then press  to assign the timer number.

7) Press  and  to position the cursor just to the right of your new functional instruction.



8) Enter   **2**  **1**  **2**  **0** then press the  soft key.



FFA-0910

9) Press the  soft key and then the  soft key.

10) Press the  soft key and then the  soft key.
Update the PMC Program but don't save it to the Flash ROM.

If you test the logic, the coil turns on instantly because we have not put a value into timer 20 in the PMC parameters.

18.4. Deleting Ladder Logic



The  soft key allows you to delete ladder nets. A single line or multiple lines can be deleted at one time.



1) Using the  buttons on the MDI panel, position the cursor on the line you would like to delete. We will delete the first line we added.

2) Press the  and  soft keys on the ladder edit menu.

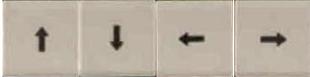


3) Use extreme caution, as there is **NO** confirmation message for this function. If you make a mistake and want to undo it, press the  soft key.

18.5. Deleting a Single Contact

It is possible to delete a single contact or function block without deleting the entire ladder net.



- 1) Using the  buttons on the MDI panel, position the cursor on the line you would like to modify.



- 2) Press the  and  soft keys on the ladder edit menu.

- 3) Use the cursor buttons to highlight the contact and then press the  soft key.

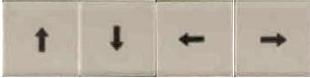


18.6. CUT and COPY Functions

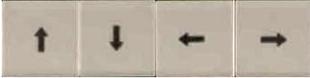
The **COPY** function allows you to copy ladder rungs then paste them to a different part of the ladder. This is useful when similar logic is used for parallel functions.

The **CUT** function allows you to move ladder rungs. This is useful for rearranging the ladder to have a logical flow.



- 1) Using the  buttons on the MDI panel, position the cursor on the line where you want to start copying/moving.

- 2) Press the  and  soft keys on the ladder edit menu.

- 3) Use the  buttons to highlight your selection.

- 4) Press the  or  soft key.

- 5) Move the cursor to where you want it to go. Press .

18.7. Symbols and Comments

Ladder contact and coil comments can be added to simplify ladder troubleshooting. Symbols are short names and comments can be descriptive. 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 LCD menu.
- 3) Press the  soft key on the LCD menu.
- 4) Press the  soft key on the LCD menu.
- 5) Press the  soft key on the LCD menu.
- 6) Press the  soft key on the LCD menu.
- 7) Press the  soft key on the LCD menu.

The system asks, “DO YOU WANT TO STOP PROGRAM?” - the ladder execution has to be stopped to edit the symbols and comments.

- 8) Press the  soft key on the LCD menu.

PMC CONFIGURATION
STOP ALM 00000 N00000

PMC SYMBOL & COMMENT DATA EDITOR

ADDRESS	SYMBOL	COMMENT
A0000.1		
A0005.1		FEED OVERRIDE
A0011.0	MANOVR	MAN OVR
A0011.1	FEEDOVR	FEED OVR
A0011.2	AUTOVR	AUTO OVR
A0011.3	RPDOVR	RAPID OVR
R0000.1	1SEC	1SEC
R0000.6	PRTLOAD	PRTLOAD
R0000.7	LOADFIN	LOADFIN
R0001.0	U00'	U00'
R0001.1	U01'	U01'
R0001.2	U02'	U02'
R0001.3	U03'	U03'
R0001.4	U04'	U04'

211.0KB FREE

A > ^

MDI ***** 13:18:41

ZOOM NEW EN DELETE DELETE SEARCH EXIT EDIT

18.7.1. Altering Existing Addresses

Even if they are in the ladder logic, address must be manually entered on this screen for them to be listed.

To change address A0.1 to have a symbol of UHOH, and a comment of ALARM:



1) Position the cursor on the address to change and press the  soft key.



2) Press the  key and enter **UHOH** 

3) Press the  key and key in **ALARM** 

4) Press the  soft key.



5) Press the  soft key.

6) The system asks “DO YOU WRITE PROGRAM INTO FLASH ROM?” Press .

7) The system asks “DO YOU WANT TO RUN PROGRAM?” Press .

18.7.2. Adding New Addresses

If you have added new logic to the ladder and want to assign a symbol/comment to it, use this procedure:



1) Press the  soft key on the LCD menu.

The system asks, “DO YOU WANT TO STOP PROGRAM?” - the ladder execution has to be stopped to edit the symbols and comments.

2) Press the  soft key on the LCD menu.

3) Press the  soft key on the LCD menu.

PMC CONFIGURATION
STOP ALM 00000 N00000

PMC SYMBOL & COMMENT DATA EDITOR

ADDRESS	SYMBOL	COMMENT
F0102.2	MV3	MV3
F0102.3	MV4	MV4
F0102.4	MV5	MV5
F0102.5	MV6	MV6
P0010	PARTLOAD	PARTLOAD
P0011		
P0100	M-CODE_PROCESS	M-CODE PROCESS
P0200	S-CODE_PROCESS	S-CODE PROCESS
P0300	T-CODE_PROCESS	T-CODE PROCESS
P0400	B-CODE_PROCESS	B-CODE PROCESS

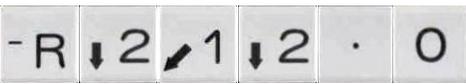
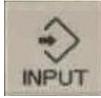
211.0KB FREE

A >>

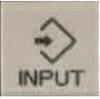
MDI ***** 13:52:05

INPUT MODE ADD DELETE CANCEL EDIT

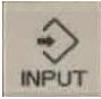
Address – R212.0 Symbol – BTIME Comment – BREAK TIME

4) Enter  then press  , the contact ADDRESS is added.

5) Press the  key.

6) Enter **BTIME** then press  , the contact SYMBOL is added.

7) Press the  key.

8) Enter **BREAK TIME** then press  , the contact COMMENT is added.

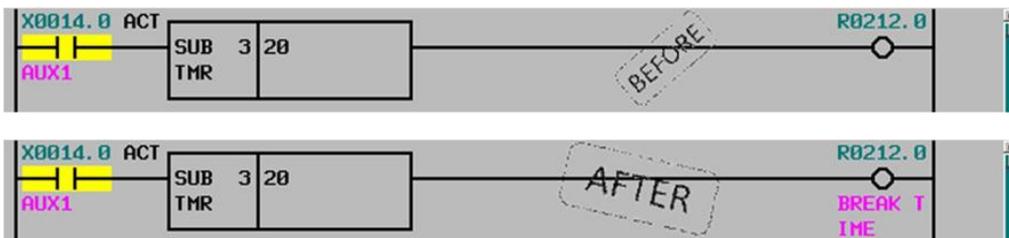
8) Press the  soft key to add the new entry to the list.

9) Press the  soft key when finished.

10) The system asks “DO YOU WRITE PROGRAM INTO FLASH ROM?” Press .

11) The system asks “DO YOU WANT TO RUN PROGRAM?” Press .

12) Go to the Ladder display and see the change you made:



18.8. Machine Alarm Messages

In order to have a machine alarm display on the CNC's alarm screen, three things must be set up. First, the ladder has to contain logic that controls an A-address coil. Second, the A address for the alarm has to be tied into the SUB41 functional instruction. Lastly, the number and text you want displayed has to be defined.



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

PMC CONFIGURATION 00000 N00000

RUN ***

PMC MESSAGE DATA VIEWER

ADDRESS	MON	NO.	MESSAGE
A0000.0	OFF	1000	CALL SERVICE 1-888-FANUCUSA
A0000.1	OFF	1001	PLEASE WORK HARDER
A0000.2	OFF	1002	CABINET OVERHEAT
A0000.3	OFF	1003	LUBE LEVEL EMPTY
A0000.4	OFF	1004	MACHINE MELTDOWN
A0000.5	OFF	1005	TOOL CODE FAULT
A0000.6	OFF	1006	STEP AWAY FROM THE MACHINE
A0000.7	OFF	1007	HYDRAULIC OVERLOAD TRIPPED
A0001.0	OFF	2001	CABINET TEMPERATURE HIGH
A0001.1	OFF	2002	LUBE LEVEL LOW

1000 CALL SERVICE 1-888-FANUCUSA

A>^

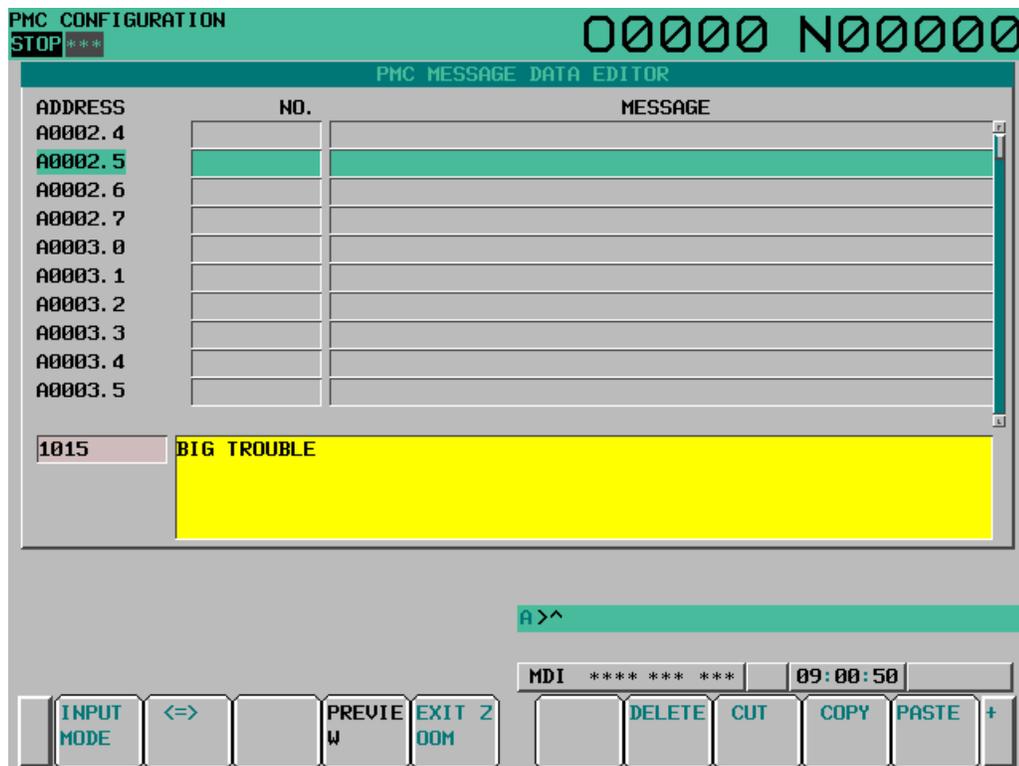
MDI **** * 08:52:24

<
SYSTEM PARAM
MODULE
SYMBOL
MESSAGE
(OPRT)
+

- 5) Move the cursor  to highlight A002.5.
- 6) Press the  soft key.
- 7) Press the  soft key.

The system asks, “DO YOU WANT TO STOP PROGRAM?” - the ladder execution has to be stopped to edit the alarm messages.

- 8) Press the  soft key on the LCD menu.
- 9) Press the  soft key.
- 10) Enter      then press .
- 11) Enter BIG TROUBLE .



- 12) Press the  soft key.

- 13) Press the  soft key.

14) Don't write the changes into FROM but do start the ladder up again.

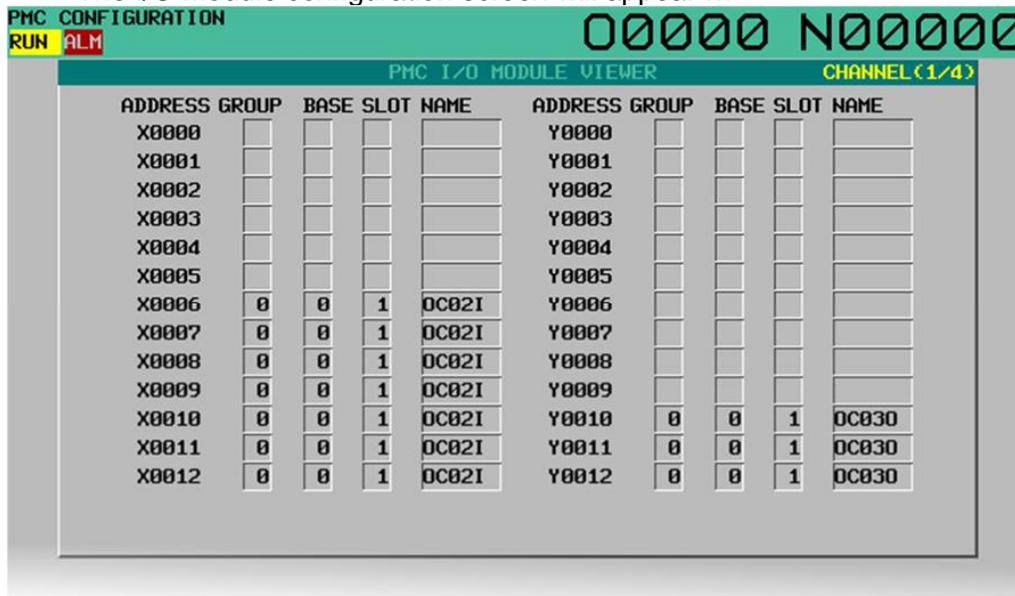
Now when the coil A2.5 is active in the ladder, and the DISPB function is activated, then the message will be displayed.

18.9. Adding I/O Link Modules



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

The I/O module configuration screen will appear ...



- 5) Press the  soft key.
- 6) Press the  and  buttons on the MDI panel, to highlight address **Y0005**.
- 7) Enter  **1.0W5.COR16EG** 
- 8) Press the  soft key.

Y0005	1	0	5	OR16G
Y0006	1	0	5	OR16G

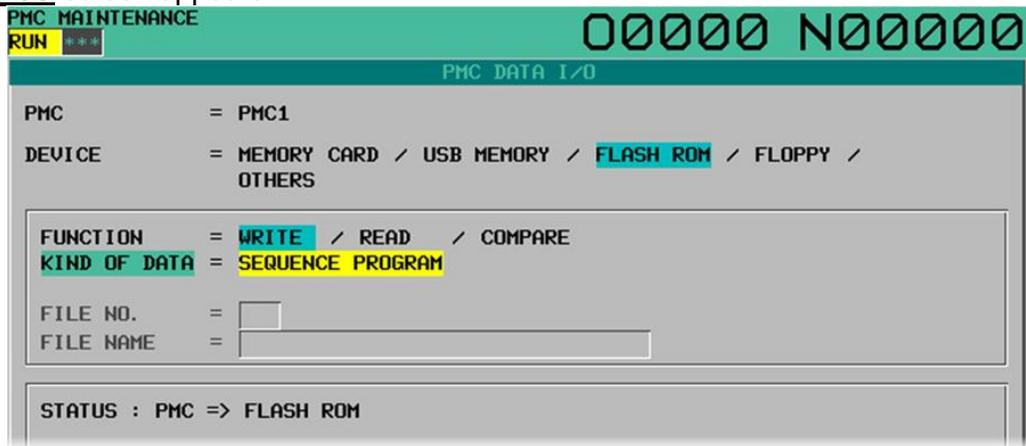
You have just added an I/O module. The control now believes there is an **AOR16G** module installed at **GROUP1, BASE0, in SLOT5**.

18.10. 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.

- TRY THIS** 
- 1) Press the  button on the MDI panel.
 - 2) Press the  soft key on the LCD menu.
 - 3) Press the  soft key on the LCD menu.
 - 4) Press the  soft key.

The **PMC I/O** screen appears:



- 5) Using the  keys, set **DEVICE**, **FUNCTION**, and **KIND OF DATA** as shown above. If your control has multiple PMCs, set the **PMC** to the proper setting.

- 6) Press the  soft key on the LCD menu.
- 7) Press the  soft key on the LCD menu.



19. 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) Where can you purchase ladder edit software from?
- 5) When editing ladder logic, what is the most important consideration?
- 6) Add a machine alarm, **1016 HYDRAULIC PRESSURE LOW**. It should become active when pressing the AUX 1 button. *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 in **AUTO** and **JOG** mode. If it is set to any position other than 100 %, 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.
 - A. When M63 is read, it will cause (4) outputs to turn on in sequence (2) seconds apart from each other.
 - B. **Y14.0** turns ON, 2 seconds later **Y14.1** turns ON, 2 seconds later **Y14.2** turns ON, 2 seconds later **Y14.3** turns ON.
 - C. After 5 seconds the conveyors turn OFF in reverse order with a 2 second delay between each action.

(The Y addresses may already exist in the ladder. Add a parallel circuit to these addresses to avoid conflict)

20. Revision History of FFA-091012

REVISION	DATE	CHANGES	SECTION/PAGES
1.0	09/10/12 12/17/12	Work on new course started. Version 1 complete.	All
1.1	1/7/13	Removed extraneous material	14
1.2	3/6/13	Made all the pictures consistently	All
2.0	5/24/13	Added Sub 40, 62, 77; incorporated minor differences between 0i and 3xi; new Exercise 4&5; new cover page.	

21. Operator Panel Layout

