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## Chapter 8. Symptom/Fix

**Note:** If you are not familiar with the safety notices located in the front of this manual, you should review them before proceeding.

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## How To Use This Chapter

- If you are performing a new installation, follow the complete installation checkout procedure before using this section.
- If a failing symptom or error code exists on the manufacturing system, go to the "Contents" on page 8-1. If not, find the error code or symptom that most closely resembles your failure and go to the page listed for that failure.
- If you determine that a component of the controller needs to be replaced, refer to the *IBM 7537 Industrial Computer - Hardware Maintenance Service* for the component part number.
- If the problem has been reported before and is intermittent, go to the "Intermittent Failures" symptom in this chapter.
- Under each failure symptom is a list of possible fixes along with a brief service check. The fixes are sequenced so that the quickest service check or most likely cause is first. Apply the fixes until the source of the reported problem is found. If the source is not found and all of the fixes for that symptom have been applied, find another symptom that resembles the reported problem and then go to that symptom.
- If a failure symptom does not exist on the system, follow the "Symptom Identification Procedure" on page 8-4. If an error should occur while following the "Symptom Identification Procedure," go directly to the "Symptom List" unless otherwise instructed by the "Symptom Identification Procedure."

### Notes:

1. Obvious problems, such as broken belts, are not listed in this chapter.
2. Whenever the Servo Power Module front cover is removed, the interlock switch must be pulled to the service position in order to power up the Manipulator.
3. Always power off all units before using an ohmmeter to check any circuit.

### Symptom Identification Procedure

1. Ensure that power is turned off and removed from all units.
2. Disconnect any user cables which may be installed at the Controller and/or Servo Power Module.
3. If the reported problem has been intermittent or sporadic in nature, go to "Intermittent Failures" symptom in this chapter.
4. Manually push the axes away from the overrun areas. Check for mechanical binds or noise.
5. Release the Z-axis brake and move the Z shaft up and down. Check for mechanical binds or noise.
6. Manually move the roll axis. Check for mechanical binds or noise.
7. Ensure that all system interconnecting cables are seated correctly (with the exception of the user cables that were disconnected in step 2.)
8. Place the controller and Servo Power Module power cords in their proper receptacles.
9. Attach the pendant to the remote stop cable.
10. Set the Controller and Servo Power Module power switches to ON. Observe the fans. If the fans are not running in the Servo Power Module, there is a problem with ac power or the fans. If the fans are not running in the controller, there is a problem with the dc power supply or the fans. Fans not running properly can cause intermittent failures due to higher than normal internal temperatures.
11. The pendant power-on self-test (POST) will start executing and complete with the following display.

PASS SELF TEST
----------------

If this does not occur, go to the "Pendant Failure" symptom.

12. The POST diagnostics for the 7537 and the Axis Control Cards will start executing at this time.
13. Check the green power LED on the front of the controller. If the LED is not on, there is a power supply problem. Go to the "Power Supply Failures" procedure for the controller.

14. Check the green power LED on the front of the Servo Power Module operator control panel. If the power LED is not on, there is a power supply or operator control panel problem. Go to the "Servo Power Module Power Lost" procedure for the Servo Power Module.

15. If the Error LED comes on, go to "Error Retrieval" in this chapter. Note the error. If a valid error code is recalled, go to the appropriate symptom

If any other LEDs on the Servo Power Module (except Appl) are on, and stay on, go to "Servo Power Module Operator Control Panel Failures" in this chapter.

**Note:** The POST diagnostics should take less than two minutes to execute.

16. Install the diagnostic diskette from the back of this manual in the controller and power the system OFF, then ON. The power-on self-test (POST) will execute again and the diskette diagnostic routines will be loaded.

If the Error LED on the Servo Power Module operator control panel turns on, press the Recall Error key to continue. Note the error.

17. If continuous beeping occurs, go to "Pendant Failure," in this chapter.

18. The diagnostic diskette will signal the beginning of execution by beeping first with the short beep, followed by a long beep from the controller (the pendant also has a beeper) and displaying the following for approximately five seconds.

**Note:** If after three minutes, the diagnostic menu does not display on the pendant, go to "System Hangs Failure," in this chapter.

```
Diagnostic
System
Test
Version x.xx
```

```
Select Option
A: SETUP
B: DIAGNOSTICS
C: POST DATA
```

19. Select the option "B: DIAGNOSTICS", unless you had a "162 Run Setup" error. Option B will display the following menu.

Select Option
A: Automatic
B: Select Test

20. Select the option "A: Continue" to automatically select and execute the diagnostics required for a typical base system. If an error occurs, go to the appropriate symptom, but if your configuration does not match the "typical one" as shown in the install section, ignore the errors for adapters you do not have.
21. Select and execute all additional diagnostic options appropriate for your manufacturing system. For more information about the diagnostics, refer to Chapter 7. If no failure occurs, continue.

## Verify Diagnostics

1. After the motion control system (for example, AML/2) has been loaded, the Manip Power LED will flash.
2. Before applying manipulator power, stand clear of the workspace.
3. Ensure that both Stop pushbuttons are unlatched and press the Manip Power pushbutton when prompted.
4. If manipulator power fails to come up or stay up, go to "Startup Failure" in this chapter.
5. Press the Home pushbutton. Observe the home sequence carefully, paying attention to noise or erratic movement.
6. If the manipulator does not home properly and does not present an error, go to "Does Not Home" symptom in this chapter.
7. On a properly configured manufacturing system, program level 7 will contain the Verify Diagnostics. Select level 7 and press Load on the Servo Power Module operator control panel.
8. After the diskette LED turns off, press Start on the Servo Power Module operator control panel, the following menu will appear.

A COMMANDS
B PENDANT
C EXERCISER
D OPERATOR PANEL

9. If the Verify Diagnostics cannot be loaded in program level 7, use a roll-up tool to load the Verify Diagnostics in a spare program level.
10. Follow the prompts and messages on the pendant. If failures occur, go to the appropriate topic in this chapter.

### Error Retrieval

The following steps will present the error code to the pendant:

1. Attach the pendant to the remote Manip Stop cable. Ensure POST tests execute correctly.
2. If the pendant does not work correctly, replace with another pendant.
3. Press the Recall Error button on the pendant.
4. The error code will be displayed.
5. If the pendant does not display the error, suspect the cable connections, pendant, pendant cable or pendant serial port/adaptor. Refer to "Pendant Failure" or "Servo Power Module Operator Control Panel Failures" in this chapter.

### Error Message Decode - Controller

The error message presented on the pendant may be decoded as follows:

104	System board error	303	Keyboard or system unit error
109	System board error	304	Keyboard or system unit error
161	Dead battery	601	Diskette error
162	Run SETUP	17XX	Hardfile error
163	CMOS checksum error	XXXX	- Other error
164	SETUP memory size		
20X	Memory error		

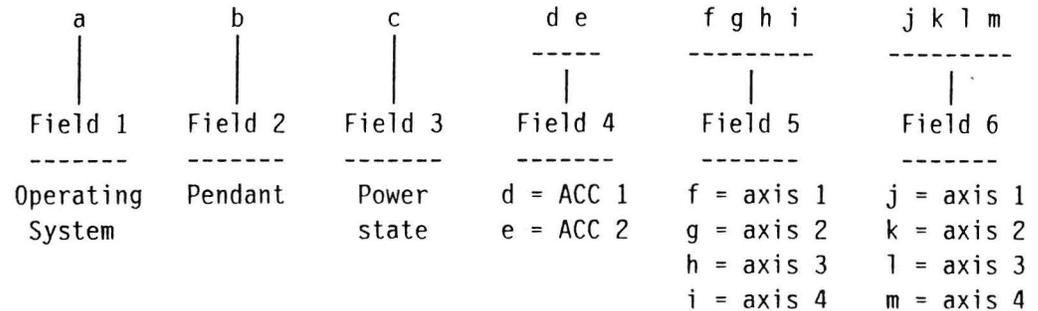
## Error Message Decode - Manipulator

The exception error message presented on the pendant may be decoded as follows:

```

EXCP_RTERR
a b c : d e
f g h i
j k l m
  
```

Note that this diagram shows the typical four axis configuration. Field 4 will contain places for each ACC installed and fields 5 and 6 will contain places for all axes configured.



### Field 1

0 = No error  
non-zero = Operating system error

### Field 3

1 = CR1 error  
2 = ACC cables crossed  
3 = Bad or missing .CFG file  
4 = Motion control system  
not initialized  
5 = Incorrect machine type  
6 = Configuration file contains  
invalid process image address  
7 = Configuration file contains  
invalid process image length  
8 = Bad or missing kinematics  
9 & 10 = Reserved  
11 = Cabling error between SPMs

### Field 5

1 = Axis channel error (in)  
2 = Axis channel error (out)  
3 = Axis overrun  
4 = Axis settle error  
5 = Axis enabled timeout  
6 = Startup jog failure  
7 = Axis in motion during startup

### Field 2

0 = Pendant OK  
non-zero = Pendant failure

### Field 4

1 = Timing error (card)  
2 = Timing error (host)  
3 = ACC not installed  
4 = ACC IPL error  
5 = ACC load error  
6 = ACC BIN file missing  
7 = ACC not downloaded  
8 = ACC jumpered for SW3 and SW7  
9 = ACC reports bad data  
10 = ACC jumper multiple found  
11 = ACC hardware level not  
compatible with software level

### Field 6

1 = Tolerance error  
2 = Drive amplifier error  
3 = Axis over speed  
4 = Axis over current  
5 = Axis channel error (out)  
6 = Axis channel error (in)  
7 = Encoder error  
8 = Index pulse not found  
9 = ACC reports bad data

## Error Message Decode - Recovery

The text below describes the recovery procedure for any error decode failure. If the error persists, go to that topic in this chapter.

### Field 1 - Operating System Error, No Recovery

**Non-zero = Realtime support error.** This is a failure on an Axis Control Card detected by the EXCP\_ error handler. Try to IPL from another AML/2 diskette first.

### Field 2 - Pendant Error

**Non-zero = Pendant failure.** A pendant failure was detected. Press Resume to retry the failing operation.

### Field 3 - General Manipulator STARTUP Failure

**1 = CR1 error.** The relay was detected closed when it should be open. It will usually appear when trying to recover from a manipulator startup failure. CR1 is located on the manipulator interface board board, and could actually be defective. Press Resume on the Servo Power Module operator control panel to retry the failing operation.

**2 = Axis Control Card cables crossed.** Power off the controller and swap the cables at the rear of the Axis Control Cards, then retry the failing operation.

**3 = Bad or missing .CFG file.** Try to IPL from another AML/2 diskette.

**4 = Motion control system not initialized.** Try to IPL from another AML/2 diskette.

**5 = Incorrect machine type.** The machine type entered with the SETUP program at installation time does not match the machine type on the diskette you are attempting to load. Load the correct diskette and try again. Also, if jumper J14 on the system board is in the wrong position, you may get this error, see the "Installation" chapter.

**6 = Configuration file contains invalid process image address.** Segment address must be a four hex digit number. Correct the %softio\_pi entry in the HWDEF.CFG file on the AML/2 diskette.

**7 = Configuration file contains invalid process image length.** Process image length must be an integer between 1 and 192. Correct the %softio\_pi entry in the HWDEF.CFG file on the AML/2 diskette.

**8 = Bad or missing kinematics support.** Kinematic program for the manipulator chosen could not be found on the diskette or it was a downlevel version. Try to IPL from another AML/2 diskette.

**9 & 10 = Reserved.**

**11 = Cabling error between SPMs.** The cable between the main and expansion SPM is not installed correctly. Check the connections.

#### **Field 4 - Axis Control Card Error on Card 1 or 2, No Recovery**

**1 = Timing error (card).** A timing error was detected on the Axis Control Card side of the controller bus. Try to IPL from another AML/2 diskette.

**2 = Timing error (host).** A timing error was detected on the system board side of the controller bus. Try to IPL from another AML/2 diskette.

**3 = Axis Control Card not installed.** Power off the controller and re-seat the failing Axis Control Card. Ensure the Axis Control Card cable is securely attached at both ends. Try to IPL from another AML/2 diskette.

**4 = Axis Control Card IPL error.** The Axis Control Card has failed its internal diagnostic at load time.

**5 = Axis Control Card load error.** Power off the controller and re-seat the failing Axis Control Card. Ensure that the Axis Control Card cable is securely attached at both ends. Try to IPL from another AML/2 diskette.

**6 = Axis Control Card "BIN" file missing.** Try to IPL from another AML/2 diskette.

**7 = Axis Control Card not downloaded.** Power off the controller and re-seat the failing Axis Control Card. Ensure that the Axis Control Card cable is securely attached at both ends. Try to IPL from another AML/2 diskette.

**8 = ACC jumpered for SW3 and SW7.** The AML/2 software has detected that one or both of the axis control cards is jumpered for SW3 and SW7. Only one of these positions may be jumpered. Refer to chapter 4, "Installation", and correct.

**9 = ACC reports bad data.** The axis control card has detected a runtime data error. Try to IPL the motion control system and reload the application program.

**10 = ACC jumper multiple found.** Only one axis control card may be jumpered at SW3 or SW7. The software has detected that both axis control cards are jumpered. Refer to chapter 4, "Installation", and correct.

**11 = ACC hardware/software incompatible.** The axis control card hardware is not compatible with the version of AML/2 that is attempting to load.

### Field 5 - Joint Error

**1 = Axis channel error (in).** This is the same as Timing error (host). A timing error was detected on the system board side of the controller bus. Try to IPL from another AML/2 diskette.

**2 = Axis channel error (out).** This is the same as Timing error (card). A timing error was detected on the Axis Control Card side of the controller bus. Try to IPL from another AML/2 diskette.

**3 = Axis overrun.** Place the failing axis inside the valid work envelope and retry the failing operation.

**4 = Axis settle error.** The failing axis took too much time to stop its movement. Press Resume to continue operation.

**5 = Axis enabled timeout.** The failing axis took too much time to acknowledge the joint enable. Press Resume to retry the failing operation.

**6 = Startup jog failure.** The failing axis moved incorrectly when the Manip Power button was pressed. Press Resume to retry the failing operation.

**7 = Axis in motion during Startup.** The failing axis was detected as moving before servo power was applied to the motor. Press Resume to retry the failing operation.

---

## Field 6 - Joint Error

**1 = Tolerance error.** The failing axis was detected as moving incorrectly. Press Resume to retry the failing operation.

**2 = Drive amplifier fault.** The servo amplifier card was detected as faulty. Press Resume to retry the failing operation.

**3 = Axis over speed.** The failing axis was detected as moving too fast. Press Resume to retry the failing operation.

**4 = Axis over current.** The failing axis is drawing too much current. This problem may be associated with a drive amplifier fault error. Press Resume to retry the failing operation.

**5 = Axis channel error (out).** This is the same as Timing error (card). A timing error was detected on the Axis Control Card side of the controller bus. Try to IPL from another AML/2 diskette.

**6 = Axis channel error (in).** This is the same as Timing error (host). A timing error was detected on the system board side of the controller bus. Try to IPL from another AML/2 diskette.

**7 = Encoder error.** The encoder feedback for that particular move was not as expected, or a missing encoder phase was detected for the failing axis.

**8 = Missed index pulse.** The encoder feedback for the index pulse was not found during the HOME procedure.

**9 = ACC reports bad data.** The axis control card has detected a runtime data error. Try to IPL the motion control system and reload the application program.

---

## Controller Failures

### System "Hangs" Failure

If the manufacturing system "hangs" after powering on the controller, the problem is most likely in the first memory SIMM, the diskette drive, the diskette signal cable, the Math Coprocessor, the hardfile if attached, and certain system board failures.

#### Isolation Procedure

To isolate the failure, perform the following steps:

1. Attach the pendant to the remote stop cable and install the controller diagnostic diskette in the controller. Reset the Controller and Servo Power Module by first turning them off and then turning back on.
2. The pendant should immediately display "PASS SELF TEST." If it does not, go to "Pendant Failure" in this chapter.
3. The controller POST diagnostics will execute.
4. If the Error LED on the Servo Power Module operator control panel turns on, press the Recall Error key to continue. Note the error, if one is presented.
5. Look for one of three conditions:
  - If the pendant displays the menu shown in step 6, proceed to step 6.
  - If an error is presented on the pendant, go to that symptom in this chapter. (Note: If the system "hangs" at power-on time, refer to "Axis Control Card Status Codes" on page 8-18.)
  - If after approximately two minutes, no menu or error is presented on the pendant, try another diskette. If the pendant again fails to display a menu or error, stop here and suspect external hardware or the application program as defective.
6. The following should be displayed for approximately five seconds if the POST diagnostics complete successfully. Allow approximately three minutes after pressing the Reset button.

Diagnostic System Test Version x.xx
--

The Version x.xx indicates the current level number of the diagnostics.

7. The following screen will be displayed:

```
Select Option
A: SETUP
B: DIAGNOSTICS
C: POST DATA
```

8. Select option B: DIAGNOSTICS.

9. The next message display should be as follows:

```
Select Option

A: Automatic
B: Select Test
```

10. Execute the following diagnostics in this sequence:

**Note:** If any diagnostic test fails or hangs, go to the appropriate symptom in this chapter.

- a. **0200 - Memory**
- b. **0500, 0511 - Color monitor (if attached)**
- c. **0610, 0611 - Diskette drive**
- d. **0701 - Math Coprocessor**
- e. **1710, 1715 - Hardfile (if attached)**
- f. **26XX - 4-Port card(s), all wrap plug tests**
- g. **55X0, 55X1 - DI/DO card(s)**

If the above tests complete successfully, run all tests for any options you may have installed on your system.

If no failures are found, suspect the application or program.

11. If the system hang condition only occurs while running the application, load the Verify diagnostics and run option "C-Exerciser." This will check everything except outbound DI/DO. Refer to "Verify Diagnostics" in Chapter 7.
12. If the "Exerciser" routines complete successfully, and only the application continues to hang, stop here and suspect external hardware or the application program as defective.

13. Set the power on the controller to OFF. Remove the adapter cables except for cables attached to the two Axis Control Cards and the first 4-Port communication card. Remove the Math Coprocessor and all of the adapters except for the two Axis Control Cards, first 4-Port communication card, and the disk/diskette adapter.
14. Install the "Diagnostics" diskette. Set the power on the controller to ON. The system should now IPL within 3 minutes. If an error occurs, reset the error using the Pendant and allow the system to continue to IPL. If after three minutes, the diagnostic menu displays, then one of the removed adapters caused the failure. Replace one adapter at a time and repeat steps 13 and 14 until the failing adapter is located.

Select Option A: SETUP B: DIAGNOSTICS C: POST DATA
---

If this menu is not displayed, reinstall the removed items and continue.

15. Set the power on the controller to OFF. Remove the adapter cable attached to one of the Axis Control Cards and then remove the Axis Control Card.
16. Set the power on the controller to ON. The system should now IPL within 3 minutes. If an error occurs, reset the error using the Pendant and allow the system to continue to IPL. If after three minutes the diagnostic menu displays, then the removed card caused the failure. If the diagnostic menu does not display, reinstall the removed Axis Control Card and cable, and repeat the past two steps with the other Axis Control Card.
17. Set the power on the controller to OFF. Remove the pendant communications cable and the first 4-Port Communication Card.
18. Set the power on the controller to ON. The system should now IPL within 3 minutes and signify this by continuously beeping. If continuous beeping occurs, then the system board or the first 4-Port Communication Card was the cause of the failure.

19. With the diagnostic diskette installed in drive A, reset the controller by powering it OFF, then back ON, press and release the Reset button on the controller and wait for approximately two minutes. Look for one of these two indications:
  - a. If two or more beeps occur, suspect the diskette drive, the diskette/disk adapter, or the signal cable. Go to symptom "6xx - Diskette Error".
  - b. If the system does not beep, suspect the system board or memory SIMM as being defective. Continue with this procedure.
20. If the system still hangs, replace the first 2MB memory SIMM.

**Note:** If a monitor is attached to the controller, it will report a 20X memory error when there is a bad module in: Refer to page 8-22 to use the error code to determine which specific memory SIMM is defective.
21. If the system continues to hang without beeping or lighting the diskette access LED, replace the system board.
22. If all of the above checks are correct, suspect both Axis Control Cards.

### Axis Control Card Status Codes

The LED display on each Axis Control Card may present any of the following status codes at power-on time. These status codes may be used in problem isolation for a system "hangs" condition, but they are valid *only* when the system "hangs" at power-on time.

Display	Description of Error
c.	Error - Velocity loop B
c	Error - Velocity loop A
9	Error - ROM checksum
(blank)	Host BIOS did not send done flag
3.	Timer interrupt not working
E	Uninitialized ROM interrupt errors
4	68230 port B to A wrapback failed
4.	Home and index wrap failed
E.	Missing home or index interrupts
b.	Host BIOS error flag active
8	Receiving/Missing encoder interrupts
7	Missing encoder interrupt axis 1
7.	Missing encoder interrupt axis 2
6.	Encoder counter 2 not working
6	Encoder counter 1 not working
b	Downloading host BIOS
8.	Undetermined failure
1	No failures - Awaiting download flag
.	No failures - Download successful
F	Servo Control Fault
F.	Servo Control Fault

In any case of failure, swap the Axis Control Cards, remembering to check the switches and jumpers carefully on each card. Then proceed as follows:

- If the failure stays with an Axis Control Card, replace that card.
- If the problem stays with a position, swap Axis Control Card cables.
- If the problem persists with a position, return to the "Isolation Procedure" on page 8-14.

**Note:** The Servo Control Fault error (F, F.) can have many sources. If a pendant is attached, the actual error will be reported through the display (see EXCP\_RTERR, field 6, in this chapter).

## 104/109 - System Board Error

### Incorrect AC Input Source Voltage

Check the ac input voltage at the source and at the controller. Repair or correct as necessary.

### System Board/Adapter

**Note:** The pendant is driven by Axis Control Card 1 and either the system unit serial port or a 4-Port card. If Axis Control Card 1 is suspected, swap with Axis Control Card 2. If the 4-Port adapter is suspected and is used for the pendant, swap with a new one.

1. Remove the adapter cards one at a time. Retry the failing operation to ensure the system board is at fault.
2. Replace any adapter that causes the failure.
3. If the error remains after checking all adapters, suspect the system board.

## 161 - Dead Battery

### Defective Battery

Replace the controller battery and rerun the diagnostic 0160.

#### **CAUTION:**

**Replace only with IBM P/N 8509237. Use of a different battery could result in ignition or explosion of battery. Order replacement from an IBM authorized dealer.**

## 162 - Run Setup

### SETUP Parameters Incorrect

Load and execute diagnostic 0160 to setup the CMOS memory.

## 163 - CMOS Checksum Error

### **Incorrect AC Input Source Voltage**

Check the ac input voltage at the source and at the controller. Repair or correct as necessary.

Load and execute diagnostic 0160 to setup the CMOS memory if this is the first attempt at this step.

### **Defective Battery**

Replace the controller battery and run diagnostic 160.

#### **CAUTION:**

**Replace only with IBM P/N 8509237. Use of a different battery could result in ignition or explosion of battery. Order replacement from an IBM authorized dealer.**

### **Defective System Board**

If battery replacement does not fix the problem, replace the system board.

## 164 - Setup Memory Size

### **Memory Added/Deleted**

Load and execute diagnostic 0160 if memory was added or deleted.

### **Memory Error**

If Error 20X is also displayed on pendant, go to Symptom 20X before continuing here. Return to this point after completing Symptom 20X.

### **Defective System Board**

If the SETUP program execution does not fix the error, suspect the system board.

## 20X - Memory Error

1. Reset all error indications by pushing the Recall Error button on the lower right of the pendant. This will allow the system to continue its power up sequence.
2. After the completion of the POST test, the first diagnostic menu will be displayed. If the following does not display within three minutes, go to symptom "System Hangs" in this chapter.

```
Select Option
A: SETUP
B: DIAGNOSTICS
C: POST DATA
```

3. Select option B: DIAGNOSTICS, to continue testing.

```
Select Option

A: Automatic
B: Select Test
```

4. Select option B: Select Test and run test 0200.
5. Replace the failing SIMM using the following page for SIMM location if a invalid "bb" is found.

Memory diagnostics will post a 10-digit error code displayed as follows:

**"bb0000 cccc"** where: **bb = bank number**

Refer to the following figures for memory failure isolation:

bb = 00 through 1F	2MB SIMM 1 failure (memory 0-2 MB)	System board - Slot 1
bb = 20 through 3F	2MB SIMM 2 failure (memory 2-4 MB)	System board - Slot 2
bb = 40 through 5F	2MB SIMM 3 failure (memory 4-6 MB)	System board - Slot 3

The above chart assume that only 2MB SIMM's are used in the three memory slots on the system board. If a different size SIMM is used, allow 10 hex banks for each 1 MB of memory when determining the SIMM with the error.

**301 - Keyboard Error**

Ignore all 301 errors displayed on any display. These will be erased automatically.

**303/304 - Keyboard or System Unit Error**

**Note:** A keyboard is not supported, but a keyboard could actually be attached. Also, a keyboard error could be issued erroneously.

**Incorrect AC Input Source Voltage**

Check the ac input voltage at the source and at the controller. Repair or correct as necessary.

**Defective Keyboard**

The system has detected a bad keyboard; however, a keyboard is not supported on this product.

If a keyboard is attached, detach it or swap it with another keyboard.

**Defective System Board**

If detaching or replacing the keyboard did not fix the problem, suspect the system board.

## 4XX/5XX - Display Error

### Defective Color Display

Power down the controller and power up the display. The power indicator on the display should turn on and the screen should be dark. If this does not occur, suspect the display as being defective or that cable is not attached to the system unit.

If the screen is tilted or greatly distorted, suspect the display unit. Swap the color display with a color display that is known to be good.

### Defective Color Display Driver

Select and run diagnostic 0501 through 0508. If an error occurs, suspect the color display driver as being defective. Replace the system board.

## 6XX - Diskette Error

Install the controller diagnostic diskette, attach the pendant to the remote stop cable, and press the Reset button. The first diagnostic menu will appear on the pendant.

```
Select Option
A: SETUP
B: DIAGNOSTICS
C: POST DATA
```

If this does not occur, try a backup diskette before proceeding.

Select option B: DIAGNOSTICS, and wait for the next display.

```
Select Option

A: Automatic
B: Select Test
```

Select and run the diskette diagnostics as they apply to your system (refer to Chapter 5) in the following order:

- **Adapter presence test.** If an error occurs, suspect the diskette/disk adapter as being defective.
- **Sequential access test.** If an error occurs, suspect the diskette drive assembly as being defective.
- **Random seek test.** If an error occurs, suspect the diskette drive assembly as being defective.
- **Verify diskette test.** If an error occurs, suspect the diskette as being defective. Retry the test with another diskette.
- **Speed test.** If an error occurs, suspect the diskette as being defective. Retry the test with another diskette. The speed should be between 1640 and 1695 for a 1.2Mb diskette drive, between 1970 and 2030 for a 1.44 or 2.88Mb diskette drive.

**Defective Diskette**

For error codes 602, 603, 608, and 614, the diskette itself is defective or was inserted incorrectly. The label side of the diskette should face upwards.

For all other error codes, continue.

**Defective Diskette Drive**

Swap a spare diskette drive into the failing position and retry the failing operation.

If the operation still fails, replace the system board otherwise the original diskette drive was defective.

## **7XX - Math Coprocessor Error**

### **Missing Math Coprocessor**

If error 0702 occurs, the diagnostics were unable to communicate with the Math Coprocessor. Ensure that it is installed and rerun the diagnostic 0701.

### **Defective Math Coprocessor**

If an error occurs or the diagnostic hangs while running diagnostic 0701 and the Math Coprocessor is present, suspect the Math Coprocessor as being defective.

### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

## 09XX - Parallel Port Error

### **Incorrect information in Setup (091X only)**

Run the SETUP procedure

### **Incorrect Jumper Setting (092X only)**

Ensure that the Primary/Alternate jumper switch is correct (for LPT2).

### **Wrap Plug Defective**

If the error occurred while running diagnostic 0911 or 0921, ensure that the wrap back connector is properly installed.

If the wrap plug is properly installed, ensure that the wrap plug is not defective.

### **Defective Adapter (092X only)**

If the wrap plug and the jumper position are correct, suspect the adapter as being defective.

### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

**11XX - Serial Port Error****Incorrect information in Setup (111X only)**

Run the SETUP procedure

**Jumper Position Wrong (112X only)**

Ensure that the Primary/Alternate jumper switch is correct (COM2).

**Wrap Plug Defective**

If the error occurred while running diagnostic 1111 or 1121, ensure that the wrap back connector is properly installed.

If the wrap plug is properly installed, ensure that the wrap plug is not defective.

**Defective Adapter (112X only)**

If the wrap plug and the jumper position are correct, suspect the adapter as being defective.

**Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### 17XX - Hardfile Error

Install the controller diagnostic diskette, attach the pendant to the remote stop cable, and press the Reset button. Execute the fixed disk diagnostic 1715.

Use the table below to find the error code and the suspected FRU as listed. Swap the suspected FRU with a known good or new FRU for items listed. Perform the procedure if a procedure is listed instead of a FRU.

Error code	Suspected defective FRU
1701	Disk drive or System Board
1702	System Board
1703	Format: Use diagnostics to format the drive
1704	System Board
1705	Format: Use diagnostics to format the drive
1706	Format: Use diagnostics to format the drive
1707	Format: Use diagnostics to format the drive
1708	Format: Use diagnostics to format the drive
1709	Format: Use diagnostics to format the drive
1710	System Board
1711	Format: Use diagnostics to format the drive
1712	Format: Use diagnostics to format the drive
1713	Format: Use diagnostics to format the drive
1714	Disk drive
1780	Disk drive
1781	Disk drive
1782	System Board
1790	Run diagnostic 0160
1791	Run diagnostic 0160

## **26XX - 4-Port Communications Error**

### **Defective 4-Port Communications Card**

Select and run all 4-Port communications diagnostics which are applicable to your system (2611 through 2624). If an error occurs:

1. Check the card switch setting.
2. Perform a continuity check on the wrap plug. Refer to wiring diagram CO16.
3. Suspect the failing 4-port communications card as being defective.

### **Defective System Board**

If the above fix has been tried and the communication device and cable have been verified, suspect the system board.

## 46XX - Multiport Communications Adapter Failure

### Error 46X0 - Multiport Adapter not present

The diagnostics could not locate the card you indicated to test.

### Error 46X1 - Multiport Basecard Failure

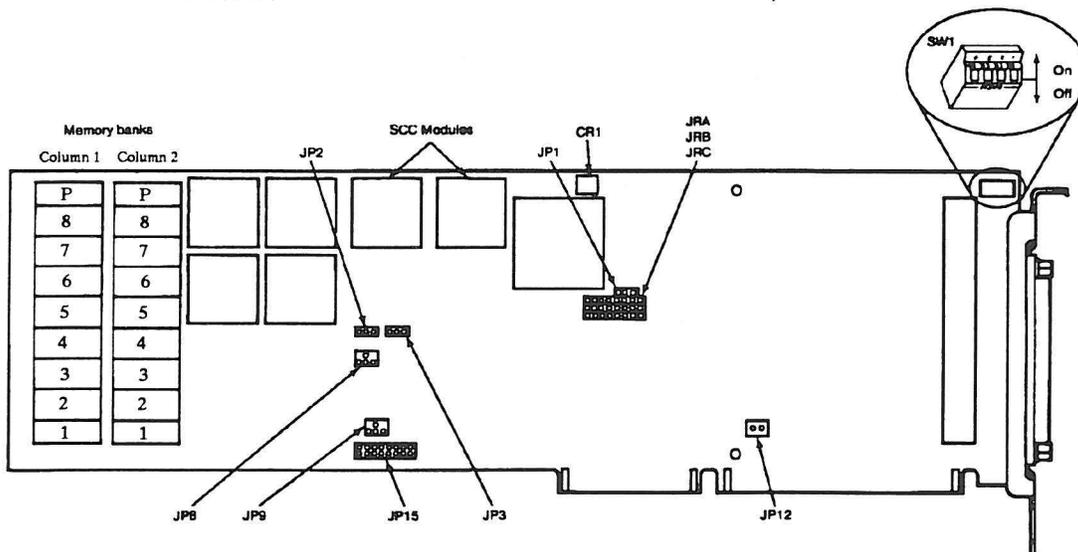
The diagnostics detected an error that requires that you replace the adapter card.

### Error 465X - Multiport Memory Error

A memory error was detected on the multiport card, depending on the error code you may isolate the memory failure. The following locations refer to the Multiport Model 1 Communications Adapter.

Error Code	Memory Error Location
4650	- position unknown -
4651	1
4652	2
4653	3
4654	4
4655	5
4656	6
4657	7
4658	8
4659	P

The memory column that the bad module is located in is determined by the rate at which the LED CR1 flashes. If greater than two times/second the bad module is in column 1, else it is in column 2. If the error code is 4659, replace both P modules.



**55XX - DI/DO Failure****Defective DI/DO Card**

Select and run all DI/DO diagnostics which are applicable to your system (5510 through 5541). If an error occurs:

1. Check the card switch setting.
2. Perform a continuity check on the wrap plug. Refer to wiring diagram CO15.
3. Suspect the failing DI/DO card as being defective.
4. Before installing the user interface to any new DI/DO card, install the new card and test with the diagnostic and wrap connector.

**Defective System Board**

If the above fix has been tried and the digital output device and cable have been verified, suspect the system board.

## 60XX - Axis Control Card Error

### Defective Axis Control Card

1. Check the card switch settings and jumpers.
2. Select and run the Axis Control Card diagnostics for the cards installed in your system.
3. If an error occurs, replace the failing Axis Control Card.

### Defective System Board

If all of the above fixes have been tried, suspect the system board.

## Communication Failures (RS-232)

**Note:** If this topic does not resolve a communications failure, suspect a communication line protocol problem or a programming problem.

### Incorrect Software Setup

For details, refer to chapter 2 of *IBM Manufacturing Systems Software Library AML/2 Manufacturing Control System User's Guide*.

### Defective 4-Port Card

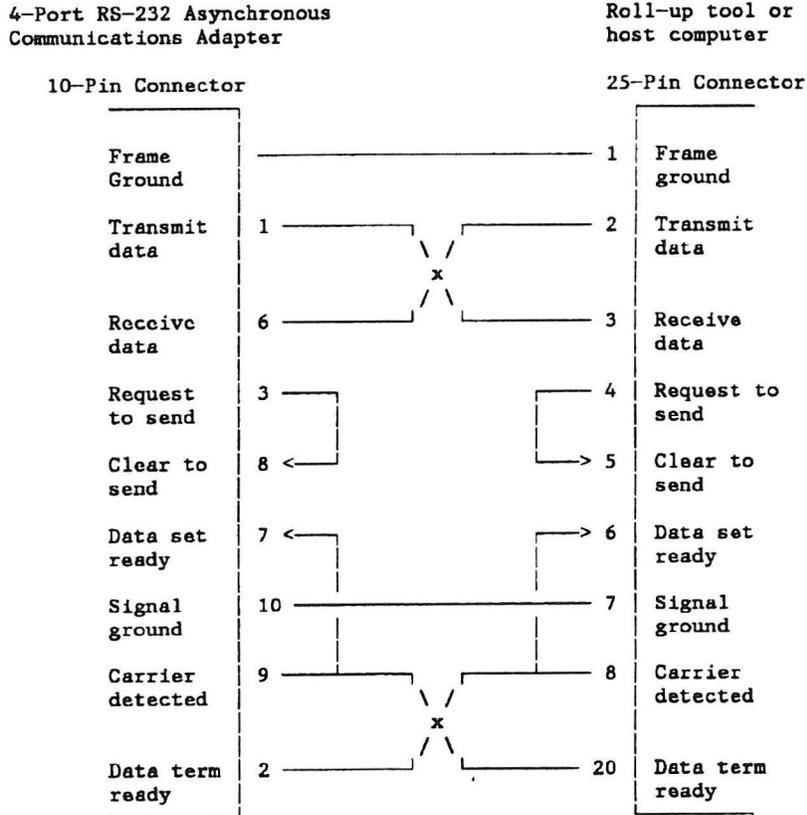
1. Install the controller diagnostic diskette, attach the pendant to the remote stop cable, and reset the controller. Execute the 4-Port card diagnostics and follow the prompts. Check the switch settings on the card.
2. If the above does not provide a fix, swap out the pendant and/or the 4-Port card, as necessary.

### Roll-up/Host Computer

Execute the appropriate roll-up/host diagnostic for the communication feature/adaptor employed.

**Defective Communications Cable From the Roll-up/Host to the Controller**

1. Check for continuity according to the figures below:



Local RS-232-C Cable Wiring

5	10
4	9
3	8
2	7
1	6

4-Port Card Connector  
(as viewed from rear)

2. If continuity is incorrect, repair/replace as necessary.

## DI/DO Failure

**Note:** For helpful information, refer to Appendix C, "Checking DI/DO Points with the Pendant."

### DI/DO Card Failure

**Note:** Loss of DO control, requiring power off and then on to reset, is usually caused by external electrical noise. Check the DI/DO wiring, the arc suppression circuitry, and other sources of extraneous electrical interference. See Appendix E for further technical information.

Check the switch settings on the card.

Load and execute the DI/DO card diagnostic with the wrap connector installed.

Before installing the user interface to any new DI/DO card, install the new card and test with the diagnostic and wrap connector.

### User Circuitry/Wiring

The DI/DO conditions may be checked with the pendant in Teach mode. If you are not familiar with this method of DI/DO point checking, consult your software/application person, or refer to the *IBM Manufacturing Systems Software Library AML/2 Manufacturing Control System User's Guide*, under the topic "Use of the Pendant/Teaching."

### Defective System Board

If the above fix has been tried and the digital output device and cable have been verified, suspect the system board.

### **Controller Power Supply Failure (Power Will Not Stay Up)**

1. Set power on the controller to OFF.
2. Disconnect the suspected FRU(s) (as outlined in step 7 below).
3. Set power on the controller to ON and retry the failing operation.
4. If that FRU does not cause the failure, set power on the controller to OFF.
5. Re-connect the FRU(s).
6. Proceed to the next FRU(s).
7. Isolate the failing component by disconnecting the FRU(s) in the sequence presented below.
  - Disk/diskette drives
  - All Adapter card external cable connectors
  - All Adapter cards, except Diskette/Disk Adapter card
  - Fan
  - Math Coprocessor
8. If the controller fails after the above steps, replace the Power Supply.

## Controller Power Supply Failure (Incorrect Voltage Reading)

### Connections

Ensure that all connectors are secure and seated. Check that all connectors on the disk/diskette drive(s), the power supply adapter board, and the system board are in the proper locations.

### Voltage Selector Setting

1. Set power on the controller to OFF.
2. Ensure that the 115/230 Vac selector switch is in the proper position for the available voltage.
3. Measure the source voltage if necessary.

### Serial-Parallel Port Failures

#### Defective Serial-Parallel Card

1. Set the controller power button to ON.
2. Install the controller diagnostic diskette, attach the pendant to the remote stop cable, and press the reset button.
3. Refer to chapter 7 "Diagnostics", and run all appropriate diagnostics for your system, (09XX and 11XX).
4. If an error occurs, refer to the appropriate symptom.
5. If no error occurs, suspect the attached equipment, or the cable between the controller card and the attached equipment.

#### Defective System Board

If the above fix has been tried and the external device and cable have been verified, suspect the system board.

**XXXX - Other Errors****Incorrect AC Input Source Voltage**

Check the ac input voltage at the source and at the controller. Repair or correct as necessary.

**Defective Adapter**

Unseat the optional adapters one at a time until the POST tests execute correctly or the diagnostic diskette loads successfully.

**Defective System Board**

If all other checks are good, suspect the system board.

---

## System Failures — Error Decode

### Field 1, Non-Zero — Realtime Support Error

#### Defective Software

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

#### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Field 2, Non-Zero — Pendant Error

Go to "Pendant Failure" in this chapter.

### Field 3, Number 1 — CR1 Error

#### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### Defective Axis Control Card Cables

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

#### Defective Manipulator Interface Board

After the above fixes have been tried, suspect the manipulator interface board as defective.

Before replacing the manipulator interface board, use the appropriate wiring diagram for the symptom and perform a continuity check. Repair or replace as necessary.

**Field 3, Number 2 — Axis Control Card Cables Crossed****Axis Control Card Cables**

Swap the Axis Control Card cables at the Axis Control Card connectors. Retry the failing operation.

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. If the error condition changes, replace the appropriate Axis Control Card.

**Field 3, Number 3 — Bad or .CFG File****Defective Software**

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Field 3, Number 4 — Motion Control System Not Initialized****Defective Software**

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### **Field 3, Number 5 — Incorrect machine type**

#### **Wrong Diskette**

The manipulator type entered with the SETUP program at installation time does not match the manipulator type on the diskette you are attempting to load. Load the correct diskette and try again.

#### **J14 in Wrong Position**

If jumper J14 on the system board is in the wrong position, you may get this error, see the "Installation" chapter to set the jumper correctly.

### **Field 4, Number 1 — Timing Error (Card)**

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Defective Math Coprocessor**

Load and execute Math Coprocessor diagnostics.

#### **Defective System Board**

If the POST tests execute correctly, suspect the system board.

### **Field 4, Number 2 — Timing Error (Host)**

#### **Defective Math Coprocessor**

Load and execute Math Coprocessor diagnostics.

#### **Defective System Board**

If the POST tests execute correctly, suspect the system board.

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Field 4, Number 3 — Axis Control Card Not Installed****Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Defective System Board**

If the above fix was attempted, suspect the system board.

**Field 4, Number 4 — Axis Control Card IPL Error****Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Defective System Board**

If all of the above fixes have been tried, suspect the system board.

**Field 4, Number 5 — Axis Control Card Load Error****Defective Software**

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### **Field 4, Number 6 — Axis Control Card BIN File Missing**

#### **Defective Software**

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### **Field 4, Number 7 — Axis Control Card Not Downloaded**

#### **Defective Software**

IPL from the backup manufacturing control system software diskette (for example, the AML/2 backup diskette).

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### **Field 4, Number 8 — Axis Control Card Jumpered for SW3 and SW7**

#### **Defective Axis Control Card**

Ensure that the switches and jumpers are set properly. If all switches and jumpers are set correctly, swap Axis Control Card 1 with Axis Control Card 2. Do not swap Axis Control Card cables at this time.

#### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### **Field 4, Number 9 — Axis Control Card Reports Bad Data**

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Defective System Board**

If the above fix has been tried, suspect the system board.

### **Field 4, Number 10 — Axis Control Card Jumper Multiple Found**

#### **Defective Axis Control Card**

Ensure that the switches and jumpers are set properly. If all switches and jumpers are set correctly, swap Axis Control Card 1 with Axis Control Card 2. Do not swap Axis Control Card cables at this time.

#### **Defective System Board**

If all of the above fixes have been tried, suspect the system board.

### **Field 5, Number 1 — Axis Channel Error (In)**

Go to "Timing Error (host)" symptom in this chapter.

### **Field 5, Number 2 — Axis Channel Error (Out)**

Go to "Timing Error (card)" symptom in this chapter.

### Field 5, Number 3 — Axis Overrun

The system has detected an overrun error. One or more of the LEDs on the manipulator interface board should be on to signal which axis caused the overrun.

If no LEDs are on, press the Resume button and retry the operation.

#### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Loose/Broken Home/Overrun Flag**

1. Ensure that the failing axis flag is not loose or broken.
2. If broken, replace the flag.

#### **Defective Manipulator Interface Board**

After all of the above fixes have been tried, suspect the manipulator interface board as defective.

Before replacing the manipulator interface board, use the appropriate wiring diagram for the symptom and perform a continuity check. Repair or replace as necessary.

---

## Field 5, Number 4 — Axis Settle Error

### Arm May Have Hit An Obstruction

Remove the obstruction and try the failing move again.

### Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter

For one of the axes, the PAYLOAD or Inertia command may be set with an invalid parameter.

Consult your application/software person for assistance.

### Payload Too Large

Make sure that the load is within the specifications for your system and that the PAYLOAD parameter is set correctly in the application program and in the manufacturing control system file. Refer to the manipulator manufacturer's specifications.

### Defective Servo Amplifier Card

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Z-Axis Brake

1. Power off the Servo Power Module.
2. Disengage the Z-axis brake by manually pulling the brake ring. Try to manually move the Z-axis.
3. If the Z-axis does not move correctly, skip to step 7.
4. If the Z-axis moves correctly, remove the Z-axis brake assembly. Power on the Servo Power Module and reissue a STARTUP command to check the failed operation.
5. If the Z-axis moves correctly, replace the Z-axis brake assembly or the circuit wiring. Try adjusting the brake first.
6. If the Z-axis does not move correctly, suspect the Z-axis motor.
7. Suspect a bind in the Z-axis assembly (ball screw assembly).

## Field 5, Number 5 — Axis Enabled Timeout

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Axis Control Card Cables

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

## Field 5, Number 6 — Startup Jog Failure

### SPM Cover Interlock Switch Open

If you have removed the cover on the Servo Power Module, the cover interlock switch must be pulled out to enable servo power.

### Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter

For one of the axes PAYLOAD or Inertia command may be set with an invalid parameter.

Consult your application/software person for assistance.

### Defective Servo Amplifier Card/Fuse

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

### Defective Z Axis Brake or Circuit

In the case of the Z axis, remove the brake after checking the servo amplifier card to isolate a defective Z axis brake or circuit. If this does not reveal the source of the failure, go to "Startup Failure" symptom in this chapter.

## Field 5, Number 7 — Axis In Motion During Startup

**Note:** If the manipulator arm is moved for any reason while the motion control system is loading, this error could occur. This would be a normal condition.

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Z Axis Brake

If the Z axis is the failing axis, ensure the brake holds the the payload in position when the manipulator is powered off. Try to move the Z axis without pulling on the Z axis brake release ring.

If the Z axis moves without pulling the brake release ring, and with the manipulator powered off, refer to the manufacturer's brake adjustments.

## Field 6, Number 1 — Tolerance Error

Check if an overrun LED is on. If the LED is on, go to "Axis Overrun" symptom.

If the overrun LED does not come on, go to "Axis Moves Incorrectly" symptom in this chapter.

## Field 6, Number 2 — Drive Amplifier Error

### Defective Servo Amplifier Card

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Axis Control Card Cables

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

**Field 6, Number 3 — Axis Over Speed**

**Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter**

For one of the axes, the PAYLOAD or INERTIA command may be set with an invalid parameter.

Consult your application/software person for assistance.

Go to "Axis Moves Incorrectly" symptom in this chapter.

**Field 6, Number 4 — Axis Over Current**

**Defective Servo Amplifier Card**

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

If the problem occurs again, go to "Axis Moves Incorrectly" symptom in this chapter.

**Field 6, Number 5 — Axis Channel Error (Out)**

Go to "Timing Error (card)" symptom in this chapter.

**Field 6, Number 6 — Axis Channel Error (In)**

Go to "Timing Error (host)" symptom in this chapter.

**Field 6, Number 7 — Encoder Error****Defective Power Supply**

Measure the voltages provided by the SPM power supply to the encoder. Replace the power supply if bad.

**Defective Motor Encoder**

Measure the encoder voltages per the manufacturers specifications. Replace the motor encoder if bad.

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Defective Axis Control Card Cables**

If the axis control card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

**Defective Manipulator Interface Board**

After the above fixes have been tried, suspect the manipulator interface board as defective. Before replacing the manipulator interface board, use the appropriate wiring diagram for the symptom and perform a continuity check. Repair or replace as necessary.

**Defective Motor Encoder**

If the above fixes do not work, suspect the motor encoder.

**Field 6, Number 8 — Index Pulse not found****Defective Encoder**

Check the encoder index lines for faults using cable diagrams supplied by the manufacturer. If the cables appear good, replace the encoder.

**Field 6, Number 9 — Axis Control Card Reports Bad Data****Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

**Defective System Board**

If the above fix has been tried, suspect the system board.

## Manipulator Power Lost

**Note:** If the Servo Power Module power is also lost, go to "Servo Power Module Power Lost" symptom which follows.

### Defective Servo Power Module Interlock Switch

Ensure that the front panel interlock switch on the Servo Power Module is operating properly.

### Defective CR2 Relay

Refer to "Startup Failure" symptom in this chapter to check the manipulator power circuits and the CR2 relay. Return here if the problem is not fixed.

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Servo Amplifier Card

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

### Defective Axis Control Card Cables

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

## Servo Power Module Power Lost

### Defective Line Fuses

Check line fuses.

### Defective Power LED

To check the power LED, install your manufacturing control system software diskette (for example AML/2) and reset the system. If the Manip Power LED flashes after about four minutes, the Power LED is probably defective. Press the Manip Power button. Check the wiring in the Power LED circuit. If the Manip Power LED does not flash after about four minutes, proceed to the next fix.

### AC Input Power Source

Check the ac input source voltage; correct it, if necessary.

### Defective Circuit Breaker

Check the SPM Circuit Breaker with a voltmeter.

### Defective Servo Amplifier Card

1. If the servo power module dc power fails to stay up, disconnect each servo amplifier card and power up the Servo Power Module.
2. If Servo Power Module dc power stays up, suspect the associated servo amplifier card. Reseat all the cards if the problem still exists.

### Defective Manipulator Interface Board

1. If the servo power module dc power fails to stay up, disconnect each cable at the manipulator interface board one at a time, from the top first and then the bottom, and power up the Servo Power Module. If Servo Power Module dc power stays up, suspect the manipulator interface board or the appropriate cable circuit.
2. After each try, reconnect the cable to the manipulator interface board.
3. If the overrun LED on the manipulator interface board turns on, this isolates the operator control panel as the failing unit.
4. If disconnecting any cable causes a proper voltage reading where none existed before, suspect that cable/circuit as being defective.

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## System Failures — Non-Error Decode

### Axis Moves Incorrectly

**CAUTION:**

If the problem is "Axis Runaway," swap the Axis Control Card and the servo amplifier card for the failing axis. Be ready to use the Manip Stop pushbutton when the failure re-occurs.

**Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter**

The PAYLOAD or Inertia command may be set with an invalid parameter.

Consult your application/software person for assistance.

**Defective Servo Amplifier Card/Fuse**

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

**Broken/Maladjusted Drive Belt**

Check the servo motor drive belts. Replace and/or adjust as necessary.

**Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### **Defective Z-Axis Brake**

1. Power off the Servo Power Module.
2. Disengage the Z-axis brake by manually pulling the brake ring. Try to manually move the Z-axis.
3. If the Z-axis does not move correctly, skip to step 7.
4. If the Z-axis moves correctly, remove the Z-axis brake assembly. Power on the Servo Power Module and reissue a STARTUP command to check the failed operation.
5. If the Z-axis moves correctly, replace the Z-axis brake assembly or the circuit wiring. Try adjusting the brake first.
6. If the Z-axis does not move correctly, suspect the Z-axis motor.
7. Suspect a bind in the Z-axis assembly (ball screw assembly).

### **Defective Servo Motor**

1. Check the motor brushes. Replace them, if necessary.

## Does Not Home

### **Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter**

The PAYLOAD or Inertia command may be set with an invalid parameter.

Consult your application/software person for assistance.

**Defective Sensor** Check the home sensors on your manipulator using the manufacturer's instructions.

### **Defective Home Pushbutton**

**Note:** A HOME command can be issued by the Verify program. Refer to chapter 7, "Verify Diagnostics".

If **all** axes fail to move, suspect the Home pushbutton. Refer to "Servo Power Module Operator Control Panel Failures" symptom in this chapter.

### **Loose/Broken Home/Overrun Flag**

1. Ensure that the failing axis flag is not loose or broken.
2. If broken, replace the flag.
3. If the flag is loose, go to the adjust and tighten it per the manufacturer's recommendations.

### **Servo System Defect**

If one axis only does not move, go to the "Axis Moves Incorrectly" symptom in this chapter.

### **EXCP\_MANIPWR**

Go to "Manipulator Power Lost" symptom in this chapter.

### **EXCP\_MPO**

The system has detected a loss of manipulator power, due to pressing the Manip Stop button. Reset the Manip Stop pushbuttons and press the Manip Power button when its LED starts blinking.

If manipulator power fails to activate, suspect one of the Manip Stop pushbuttons as defective.

### **EXCP\_NOTHOME**

Go to "Does Not Home" symptom in this chapter.

### **EXCP\_OVERRUN**

Go to "Axis Overrun" symptom in this chapter.

### **EXCP\_SPMPWR**

Go to "Servo Power Module Power Lost" symptom in this chapter.

## Servo Power Module Operator Control Panel Failures

Load the Verify program and select option D "OPERATOR PANEL." Refer to Chapter 7, "Verify Diagnostics," for instructions.

**Note:** This tests all keybuttons and switches except Manip Power and Manip Stop, and it checks approximately 90% of the circuitry.

### Defective Pushbutton Circuit

1. Use an ohm meter to check the operation of the switch. Compare with another pushbutton if uncertain.
2. If the switch checks good, use an ohm meter to trace the wiring back to the manipulator interface board.

### Defective LED

Reset the controller by powering the system OFF then ON. All of the LEDs except Manip Power should flash on. (The Manip Power LED will only come on when the servo motor power is active.)

### Defective Axis Control Card

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### Defective Axis Control Card Cables

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

## Startup Failure

The following steps are labelled as to multiple axis failures (M), or single axis failures (S).

### **C5 Connector Not Installed (M)**

Ensure that the C5 connector is installed on the Servo Power Module connector panel and that pins 1 and 2 are connected.

### **Binding Axis (S)**

Manually move each axis, checking for binds or erratic movement. If a bind is detected in one of the axes, see the manufacturers diagnostics for the manipulator.

### **Defective Servo Power Module Interlock Switch (M)**

Ensure that the front panel interlock switch on the Servo Power Module is operating properly.

### **Pressed or Defective Manip Stop Switch (M)**

Ensure that the Manip Stop switches have been reset. Check the on/off functions of both Manip Stop switches with an ohm meter.

### **Defective Servo Amplifier Card/Fuse (S)**

Swap the servo amplifier card for the failing axis.

There is a pluggable fuse on the servo amplifier card. Remove and check the fuse; replace it, if necessary. If the fuse continues to open, replace the servo amplifier card.

### **Defective Servo Motor Brushes (S)**

Check the motor brushes. Replace them, if necessary.

## Pendant Failure

### Defective Pendant

- If the pendant displays "FAIL SELF TEST," the pendant is defective. In this case, refer to the following error code table:

Error code (decimal)	Meaning
35	At least one pushbutton or pendant enable switch was stuck on or pressed during power on diagnostics.
40	USART self test failed; pendant is defective.
41	USART detected a transmission error while decoding a transmission.
50	Microprocessor RAM/ROM test failed; pendant is defective.

- If the display is incorrect:
  - Exchange with another pendant if possible, or try the pendant on another manufacturing system.
  - If the above is not possible, continue.

### Defective 4-Port Card

If your pendant is attached via the 4-Port Card (Port 1), then check the switch setting on the 4-Port card. If they are found to be correct, swap the 4-Port card.

### Defective Pendant Cable

Refer to WD32 and check the pendant cable with an ohm meter. Flex the cable slightly while checking.

#### **Defective Axis Control Card**

Swap the Axis Control Cards. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

#### **Defective Axis Control Card Cables**

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

#### **Defective Pendant from Controller to SPM**

Refer to WD33 or WD34 and use an ohm meter to check for continuity. Flex the cable slightly while checking.

#### **Defective Manipulator Interface Board**

After all of the above fixes have been tried, suspect the manipulator interface board as defective.

Before replacing the manipulator interface board, use the appropriate wiring diagram for the pendant and perform a continuity check to the manipulator interface board. Repair or replace as necessary.

## Repeatability Varies

**Note:** It is important to isolate to a single axis if possible. Use a dial gauge and the Verify program "Exerciser" routine. If you wish, write your own move program.

### **Incorrect PAYLOAD/ROLL\_INERTIA Command Parameter**

For one of the axes, the PAYLOAD or INERTIA command may be set with an invalid parameter.

Consult your application/software person for assistance.

### **Too Much Mass For The Roll Axis**

Ensure that the load is within the specifications for your system. Refer to the specifications for your manipulator.

### **Incorrect Motion Parameters Set in Software**

Consult your software/application person and review the rules for setting accel, decel, settle, speed, payload, and zone parameters.

### **HOME Flag not adjusted**

If the home flag of an axis is not adjusted properly, each time you home the manipulator it may home in a slightly different location. Refer to chapter 6, "HOME Flag Adjustment Program", (4008).

### **DI/DO Noise**

If any arc suppression diode/circuitry is missing or defective, noise can be generated into the encoder/feedback system.

### **Loose Manipulator Base Mounting Bolts**

If your application has a large payload or utilizes high speed moves, loose manipulator base bolts will cause repeatability problems.

### **Low Power Supply Voltages**

Measure the power supply voltages of the controller and Servo Power Module. If any of the voltages are outside their range of the specified output, replace the power supply. Refer to Chapter 6, "Controller Power Supply Check", (4001),

### **Broken/Maladjusted Drive Belt**

For Theta 2, Z, and roll axes, check the servo motor drive belt. Replace and/or adjust as necessary.

### **Defective Servo Amplifier Card**

Swap the failing axis servo amplifier card with a known good axis.

### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### **Defective Harmonic Drive**

**Note:** A loose circular spline or wave generator will cause an axis to move incorrectly.

1. Power off the Servo Power Module. Try to move the failing axis.
2. Pay particular attention to binds and noise.

### **Defective Servo Motor**

Check the motor brushes. Replace them, if necessary.

### **Defective Axis Control Card**

Swap Axis Control Card 1 with Axis Control Card 2. Ensure that the switches and jumpers are set properly. Do not swap Axis Control Card cables at this time.

### **Defective Axis Control Card Cables**

If the Axis Control Card to manipulator interface board cables are suspected, they can be swapped for diagnostic purposes. Ensure that they are swapped end for end, and restored to their original positions when finished.

### **Low/Missing Power Supply Voltages**

If any of the voltages are outside their range of the specified output, replace the power supply.

## Intermittent Failures

Intermittent failures can be classified in one of two ways:

1. The same failure occurring sporadically.
2. Various or miscellaneous failures occurring sporadically.

It is suggested that the technician keep an activity log for tracking maintenance performed in resolving intermittent problems. Putting a date and time for each entry will prevent duplication of effort. It is also suggested that each failure be logged as to the date and time of the failure. Use the log to build an itemized list of failures and corrections to minimize troubleshooting.

If you are troubleshooting any intermittent failure, perform the following steps in the order given:

1. Ensure that the fans are running *properly*. Fans that run slow, stall, or stop intermittently, can cause higher than normal operating temperatures. Be suspicious of noisy fans.
2. Reseat all cables and connectors associated with the circuitry for that failure. Examine carefully cable ends for fraying or poor solder connections. Flex suspected cables during operation if possible.
3. Ensure that all ground cable connections are installed properly with star washers underneath the ring terminals, and that the screws are tight.
4. Check the power supply voltages in the appropriate unit(s), especially at the time of failure. Refer to Chapter 6 for the appropriate power supply check.
5. Swap out the associated FRU(s), one at a time, keeping track of this maintenance activity.
6. Ensure that the site preparation guidelines for the power source concerning ac power *and grounding* have been strictly adhered to. If the power source is suspected, attach an ac power source line monitor. If the source is faulty in some way, an isolation transformer or ac line filter may be required.
7. If your failure(s) occur at a certain time of day, suspect power source surges caused by plant startup or large faulty equipment providing noise at the power source. As in the preceding step, an ac power source line monitor will prove this condition exists.
8. Electromagnetic interference can induce circuit noise. Refer to the installation section of this manual under this topic for guidelines.
9. Electrostatic discharge can cause certain controller failures. Electrostatic discharge is a condition where a person receives an electrical shock when touching metal objects. This usually occurs when temperatures and humidity are lower than normal, as in the winter season. They can also be caused by certain man-made shoe or clothing materials.
10. Missing or defective arc (noise) suppression diodes/circuits on the DI/DO loads will induce circuit noise. These problems usually appear as repeatability problems. Refer to "Repeatability Varies," in this chapter.