

---



---

## Section 15: Diagnostics

---



---



---

### Diagnostic System Commands

To enter the Diagnostic System, enter the DI command. The Diagnostic System recognizes the following commands:

**Table 1: Diagnostic Commands**

COMMAND	DESCRIPTION
CE	Clears error message(s) under DE (94.1H-3 or later)
DE	Display last 48 error messages
DS	Display switch values
X	Terminate DS mode and exit
G 0 3000	Enters the diagnostic menu

The Diagnostic System may be exited by pressing “ENTER” alone without typing a command.

### DS - Display Switches

This command causes the continuous display of switch feedback and CNC status data. The display is updated 3 times per second. The display will be continuous until the “X” command is entered. Once in the “DS” mode, the maintenance engineer may return the CNC to the normal command mode by depressing “ENTER” without first typing a command (or by simply depressing “ENTER” twice in succession). The data display will continue during the execution of normal machine functions, however, it is not recommended that the CNC be left in the “DS” mode during the actual machining of production parts. The “DS” mode is terminated by entering the Diagnostic System via the “DI” command and then issuing the “X” command. The switch status values are displayed as zero if the switch is open and as one if the switch is closed. Counts are displayed as two digit hexadecimal numbers. A description of the display follows:

**Note:** All numbers are displayed in Hexadecimal. Refer to General Information Section- Binary Numbers and Reading a Status Group.

**Table 2: Display Switches**

DISPLAY	DESCRIPTION
DISPLAY	DESCRIPTION
ATCXTNDD	Switch closes when the ATC slide is extended
ATCTURET	Switch closes momentarily when the ATC turret motion is complete. May not be seen because closure may occur between screen updates.
ORIENSP	Switch closes when the spindle is at the proper angle for orientation.
ATCHOME	Switch closes when the ATC slide is fully retracted.
ATCFAULT	Switch closes when the ATC is subjected to excessive up or down forces.
DRAWBAR	Switch closes when the drawbar cylinder is pressurized.
OIL LEVEL	Switch closes when the oil level is low for waylube and spindle lube reservoir.
HIGH IDLER	Switch closes when the idler wheel is retracted. (Low range engaged).
LOW IDLER	Switch closes when the idler wheel is retracted. (High range engaged).
PROBE	Switch is open when probe switch is engaged.
SLIDE HOLD	Switch is open when doors are closed (external slide hold).
COMMAND1 Refer to Hex to Binary table	Each binary bit commands one solid state relay. A value of 0 turns the relay on. B0 is the rightmost bit.  B0= M68/M69 B1= High range idler B2= Unused B3= Drawbar/Geneva/Slide Enable B4= Drawbar B5= Air indexer B6= Coolant 1 ON B7= Coolant 2 ON

Table 2: Display Switches

DISPLAY	DESCRIPTION
COMMAND2 Refer to Hex to Binary table	Each binary bit commands one solid state relay. A value of 0 turns the relay on. B0 is the rightmost bit.  B0= Unused B1= Low range idler B2= M62/M63 B3= M66/M67 B4= Turret motor ON B5= Turret motor reverse B6= Spindle coolant pump B7= M64/M65
COMMAND3 Refer to Hex to Binary table	Each binary bit commands one solid state relay. A value of 0 turns the relay on. B0 is the rightmost bit.  B0= Orientation B1= ATC Slide motor ON B2= ATC slide motor REVERSE B2= ATC slide motor REVERSE B3= Way lube pump B4= Limit switch override B5= M60/M61 B6= Axis amplifier ON/OFF B7= Spindle lubricator ON
(MEMORY)	Contents of the memory location specified with the DS command. For example DS A5A5 will cause the display of the contents of memory location A5A5 (A5A5 is a hexadecimal address).
LASTMFUN	The BCD value of the last M-function.
MFUNFDBK	The M-function feedback data from user attached devices.
INT1-CNT	Running count of CRT screen update clock interrupt.
INT2-CNT	Running count of 100 ms clock interrupts.
INT3-CNT	Running count of axis controller interrupts.
INT4-CNT	Running count of RS232-C port interrupts.
INT5-VAL	Last data from keyboard (ASCII with B7=1)
INT6-CNT	Running count of geometric algorithm interrupts.
INT7-CNT	Running count of Emergency stop interrupts.
SPARE-3	Probe feedback switch
SPARE-6	Air indexer feedback switch #2
SPARE-7	Air indexer Feed back switch #1

---

**Menu Diagnostics****WARNING**

Some of these tests are intended for Fadal factory use only. Use only those tests that the Maintenance technician has been trained to use. Call the Fadal Service Department for more information.

AVAILABLE IN SYSTEMS 89.1I (and above)

One of the new features available to the 89 series software is the diagnostics menu. This feature is useful in testing the 1400-2 or higher CPU card, Ram Expansion, RS-232 Port, Video, Axis Controllers, Clocks, and the Mill Interface. Although the tests are designed not to affect memory it is still a good idea to make sure all the programs on the machine are backed up before testing.

To begin, at the prompt "ENTER NEXT COMMAND" enter the following commands:

```
DI <ENTER>  
G O 3000 <ENTER>
```

After entering the above commands, the first of 5 menus will appear. The space bar switches between each menu and the MANUAL key is used to abort a test (Hold this key down until the computer aborts a test).

**Menu Page 1      Function 1 = EPROM CHECKSUM (1610-1)**

Reads the eproms on the 1610 MODULE CARD. After performing the checksum, the result is displayed. This test displays four to six 1 byte numbers. They should be all zeros. If they are all zeros, the test counter is incremented and the test is repeated. The message "CHECKSUM ERROR" is displayed and the test stops if the checksum is not zero. A failure with the test would indicate a bad CPU card or MODULE.

**Function 2 = RAM TEST (1400)**

Performs a write/read test to the 1400 CPU memory. This memory is used by the CPU for such things as parameters, offsets, execution buffers, general usage of the CPU.

While the test is running the current memory segment is displayed as follows:

```
SEGMENT 6 or 4  
SEGMENT 7 or 5  
SEGMENT 8  
PASSED TEST #### TIME(S)
```

The message "MEMORY FAILURE" would appear and the data that failed is displayed. A failure with this test indicates the 1400 card needs to be replaced.

### **Function 3 = RAM EXPANSION TEST (1460)**

Tests is the same as function 2 except it searches for the available memory expansion. Checks up to 422K.

```
SEGMENT 9
SEGMENT A
SEGMENT B
SEGMENT C
SEGMENT D
SEGMENT E
PASSED TEST #### TIME(S)
```

If the card is present, it is tested automatically the same as function 2. When a card is not found the message "NOT PRESENT" appears next to the segment number. Refer to the Attached Optional Devices Section for setting the memory card to the proper segment (1460-2 has no jumper settings).

**Note:** A more thorough RAM test is available on MENU PAGE 5.

### **Function 4 = RS-232 TEST (1030)**

Tests the RS-232 port. You must install the test plug supplied by FADAL (located in the main cabinet) or jumper pins 2 and 3. After selecting the baud rate number, the CNC sends and receives a continuous flow of characters until an error has occurred or the manual key is pressed. There are two procedures that can be performed with this test.

- 1) Install the plug directly in the back of the CNC and cycle the test. This checks the machine for a possible failure with the ribbon cable, wiring or the S-100 (1030) card.
- 2) Install the test plug at the computer's end of the cable. This will check not only the cable but also the environment. A bad cable, solder connection or an electrical noise problem could cause the first test to pass and the second test to fail.

### **Function 5 = NON-DESTRUCTIVE LOOP TEST**

Causes all tests to be continuously performed until a failure has occurred or the manual key is pressed.

Program memory checksum (menu page 3) and all functions on menu pages 4 and 5 will not execute during the loop test.

**Menu Page 2    Function 1 = KEYBOARD TEST**

Tests the keyboard by echoing the key to the screen. Pressing the JOG key allows the hand wheel to be tested.

**CAUTION!**    Check SETP parameters after performing this test.

**Function 2 = START CNC**  
DO NOT USE

**Function 3 = 1010-4 AXIS CONTROLLER DIAGNOSTICS**  
INTENDED FOR FADAL USE ONLY!

**Function 4 = START MOS**  
INTENDED FOR FADAL USE ONLY!

**Function 5 = ZERO MEMORY**  
On the 1400-2 writes zeros to segments 6,8,9,A,B,C,D,E. On the 1400-3 writes zeros to segments 4,5,8,9,A,B,C,D,E.

**WARNING:**

This will clear all memory SETP, backlash user programs, tool and fixture information.

**Menu Page 3    Function 1 = VIDEO TEST (1420)**

This test has two functions.

- 1) A testing of the video ram, which you will see as a quick flicker on the screen. If a failure is reported then there is a possible failure on the 1420-1 (video board) or the 1030-1 on the -3 system.
- 2) A visual test. The screen should show a repeating pattern of characters. If the pattern is not repeating then there is a possible failure on the 1420-1 (video board) or the 1030-1 on the -3 system.

**Function 2 = 1010-1 OR 1010-4 AXIS CONTROLLER TEST**

Tests all the axes, X, Y, Z, A, B, and C. If an axis slot is not populated then the No Response counter will be incremented. If an axis slot is populated and either the No Response counter or the Failure counter has been incremented then there is a possible failure of that card (computer interface 1030) or even possible failure of the CPU. Note that the expected and the received checksum the spindle card is F0 and 80 respectively.

**Function 3 = TEST THE CLOCKS (1020)**

All three of the VMC's clocks will be tested with this function. Interrupt 6 counts from -200 to 0 and then interrupts, interrupt 2 interrupts after approximately

0.1 seconds, and interrupt 3 interrupts after approximately 0.3 seconds. Therefore, as interrupt 1 counts to 0 interrupt 3 should count to about 6 (Note that the counting doesn't have to be perfect but should be in the general area). A message should appear if an interrupt is not counting properly. A failure could indicate a problem with the clock card or communication problem with the computer interface or CPU.

To exit this test you must wait till the exit message "... PRESS MANUAL TO STOP TEST" appears. At the time of the exit message press the manual key to exit the test.

#### **Function 4 = TEST MILL INTERFACE CARD (1040)**

Checks the mill interface. The pass counter will be incremented with each successful pass. Otherwise, a failure message will appear, which possibly indicates a 1040 failure. This test only checks the communication portion between the 1040 and 1030 to 1400.

#### **Function 5 = PROGRAM MEMORY CHECKSUM**

Calculates a four byte checksum of all the current programs in memory. This checksum is used to verify that the memory has not been changed during a power on/off test or during a long period of time with the power off.

### **Menu Page 4**

#### **Function 1 = FILL MEMORY WITH A PATTERN**

INTENDED FOR FADAL USE ONLY!

#### **Function 2 = CHECK MEMORY FOR PATTERN**

INTENDED FOR FADAL USE ONLY!

#### **Function 3 = ENABLE/DISABLE REMOTE DIAGNOSTICS**

INTENDED FOR FADAL USE ONLY!

#### **Function 4 = ECHO RS-232 PORT DATA**

The CNC's back serial port will act just like a test plug. It will echo back any data that it receives on the port.

#### **Function 5 = DESTRUCTIVE RAM TEST**

INTENDED FOR FADAL USE ONLY!

### **Menu Page 5**

#### **Function 1 = COUNT INT1, INT2 AND INT6**

INTENDED FOR FADAL USE ONLY!

#### **Function 2 = FULL DAC WITH INT6 COUNT 0FED4H**

INTENDED FOR FADAL USE ONLY!

**Function 3 = QUARTER DAC WITH INT6 COUNT OFED4H**  
INTENDED FOR FADAL USE ONLY!

**Function 4 = TEST ENCODERS (1010-4)**  
Tests any encoder connected to a 1010-4 axis card. AC Machines.

**Function 5 = TEST ADC**  
INTENDED FOR FADAL USE ONLY!

---

### **Clamp-on Ammeter Testing**

#### **Tooling Required: ExTech AC/DC Clamp-On Ammeter**

The purpose of the procedure is to monitor the amount of current that the axis motor is using to transverse the slide. The ExTech AC/DC Clamp-On ammeter can be used as an indicator for various problems, including: ballscrew alignment, gib and/or gib straps adjustments, insufficient or incorrect waylube, and to check for tightness of the limit stop at the axis limit.

#### **Gib and Gib Strap Verification**

This procedure should only be done to check gib and gib strap adjustments for binding. It is not intended to be a replacement for the procedure outlined in the Maintenance Manual.

- 1) Set the Clamp-On Ammeter to the following selections: ON, DC, 200A and adjust the display to 00.0 with DCA ZERO ADJ.
- 2) Attach the ExTech AC/DC Clamp Meter over the brown wire on the axis amplifier to be checked. Ensure that the jaws remain closed when hanging from the wire. Be careful not to touch the DCA ZERO ADJ. knob, as the readings will be distorted.
- 3) Jog the axis to the + (plus) limit.
- 4) Enter one of the following into MDI, adjusting values to reflect the total travel of this axis. For example, VMC4020 has the values of X=40, Y=20, Z=20.
  - a) G1 F25. G91 X?\_ M49
  - b) G1 F25. G91 Y?\_ M49
  - c) G1 F25. G91 Z?\_ M49
- 5) Monitor the display on the Clamp Meter while traversing along the axis and record the average reading. note that the current reading may rise 1 or 2 amps near the ends from ramping.

- 6) Normal readings for Millimeter ballscrews range from 4 to 6. 5 amps and for Inch ballscrews the range is from 1 to 2.5 amps. 6030 & 8030 4 to 6, 7 amps max.
- 7) For higher than normal readings, check the following items:
  - a) Is the proper waylube being used, and the waylube system operating properly? Refer to the Machine Maintenance Section.
  - b) Do the ways have the proper amount of waylube?
  - c) Loosen the gibs slightly and rerun the above test. Are the new readings less than the original readings? If yes, repeat again until the readings no longer change.

**Ballscrew Alignment**

- 1) Set the Clamp-On Ammeter to the following selections: ON, DC, 200A, and adjust the display to 00.0 using the DCA ZERO ADJ.
- 2) Attach the ExTech AC/DC Clamp Meter over the brown wire on the axis amplifier to be checked. Ensure that the jaws remain closed when hanging from the wire. Be careful not to touch the DCA ZERO ADJ. knob, as the readings will be distorted.
- 3) Jog the axis to the + (plus) limit.
- 4) Enter one of the following into MDI, adjusting values to reflect the total travel of this axis. For example, VMC4020 has the values of X=40, Y=20, Z=20.
  - a) G1 F25. G91 X-\_. M49
  - b) G1 F25. G91 Y-\_. M49
  - c) G1 F25. G91 Z-\_. M49
- 5) Monitor the Ammeter display while traversing along the axis. The readings should not vary more than 2 amps for Millimeter ballscrews and 1 amp for Inch ballscrews.
- 6) Watch for variations as either end is approached. If higher than normal values, check and adjust ballscrew alignment.
- 7) If the ballscrew is realigned, then readjust backlash and retest.

**Limit Stop Check**

- 1) Set the Clamp-On Ammeter to the following selections: ON, DC, 200A and adjust the display to 00.0 with DCA ZERO ADJ.
- 2) Attach the ExTech AC/DC Clamp Meter over the brown wire on the axis amplifier to be checked. Ensure that the jaws remain closed when hanging from the wire. Be careful not to touch the DCA ZERO ADJ. knob, as the readings will be distorted.

- 3) Jog the axis to the + (plus) limit.
- 4) Enter one of the following into NMI, adjusting values to reflect the total travel of this axis. For example, VMC4020 has the values of X=40, Y=20, Z=20.
  - a) GI F25. G91 X\_ . M49
  - b) GI F25. G91 Y\_ . M49
  - c) GI F25. G91 Z\_ M49
- 5) Check the reading on the meter when the axis has reached the limit and stopped. Normal readings should be no higher than 2 amps than the average? current reading along the travel of the axis. Refer to AXIS LIMIT STOP, MECHANICAL ADJUSTMENTS, in the Axis Drive Systems Section.
- 6) Now, check the opposite direction wire by clamping the meter on the WHITE wire at the amplifier output.
- 7) Enter one of the following into MDI, adjusting values to reflect the total travel of this axis. For example, VMC4020 has the values of X=40, Y=20, Z=20.
  - a) GI F25. G91 X\_ . M49
  - b) GI F25. G91 Y. M49
  - c) GI F25. G91 Z\_ . M49
- 8) Check the reading on the meter when the axis has reached the limit and stopped. Normal readings should be no higher than 2 amps than the average current reading along the travel of the axis. Refer to AXIS LIMIT STOP, MECHANICAL ADJUSTMENTS, in the Axis Drive Systems Section.

---

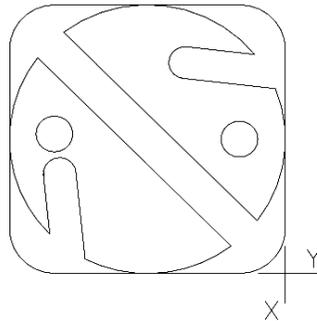
### Test Cut Procedure

- 1) Use program **5836**
- 2) Install test cut block in center (T) slot, and center under spindle. Pull block forward and tighten bolts.
- 3) In MDI type **S600. M3 M49. <ENTER>** Turn spindle on to establish RPM of spindle turn spindle off using spindle off key.
- 4) Insert tool with edge finder in spindle and turn on spindle with **SHIFT-- SPINDLE ON KEYS.**
- 5) Jog Z down to the front edge of part and set edge finder **by jogging Y-axis plus or minus.**

- 6) Jog Z up away from part.
- 7) Turn spindle off.
- 8) Do not move Y axis. In MDI type **Y.1GO** <ENTER>.
- 9) At enter next command type **SETY** The Y-axis is now set.
- 10) Turn on spindle with **SHIFT-SPINDLE ON KEY.**
- 11) To set X axis, jog to right side of part and jog down Z axis, making sure not to hit edge finder on top of part when jogging. Set X axis the same way that Y axis was set.
- 12) Turn off spindle. Do not move X axis in MDI type **X-.1GO** <ENTER>.
- 13) At enter next command **TYPE SETX.** The X axis is now set.
- 14) Remove tool with edge finder from spindle. Install tool with cutter in spindle.
- 15) Use a **1.00 INCH BLOCK** to set the Z tool height. Set block on top of part. Jog Z down until the Z just touches the block. At the ENTER NEXT COMMAND prompt, type **sl,12** <ENTER>.
- 16) At ENTER NEXT COMMAND type **HO** <ENTER>.
- 17) At ENTER NEXT COMMAND type **DT** <ENTER>.
- 18) Type # **1.**
- 19) Then #**12** <ENTER>.
- 20) Change to **.48 TOOL DIAM.**
- 21) Change tool length by -.001.
- 22) Press #1 to accept.
- 23) Set spindle pot and feed rate pot to 100%.
- 24) At enter next command type **AU,28,75** <ENTER> and start program.

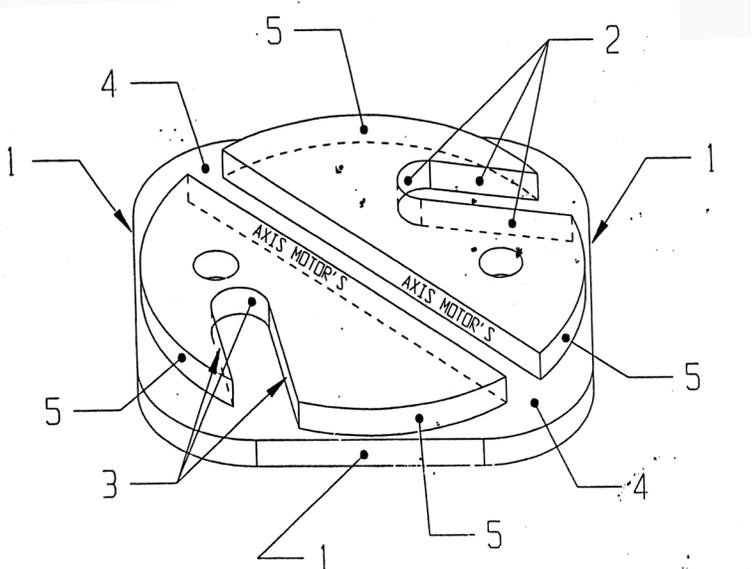
## VMC Test Cut

- 1) Push test part towards back of fixture.
- 2) Home position:
  - X - as shown below
  - Y - as shown below
  - Z - coldstart position
- 3) Program 5836 (TA,2).
- 4) Set tool length 1" above part (SL,12). Tool length may have to be altered if top of part doesn't get cut.
- 5) Use 1/2" diameter 4 flute carbide endmill. Set tool diameter at .480 for initial cut (lower tool diameter if recut is necessary).
- 6) Edit program as indicated below (if necessary).
- 7) Start program @ N28 and stop @ N75. (AU,28 <ENTER>)



VMC	RPM	FEEDRATE
	<i>EDIT N28</i>	<i>EDIT N31, N42, N55, N68</i>
2216	10,000	50 IPM
3016		
4020		
	<i>*NO CHANGE IN PROGRAM REQUIRED*</i>	
5	7,500	32 IPM
10		
15		
6030	10,000	25 IPM
8030		

VMC Test Cut Part



- 1) Belts
- 2) X Motor
- 3) Y Motor
- 4) Belt / End Mill/Spindle Preload Spindle Motor Washer
- 5) Comp./Bad Axis Motor

(This page intentionally left blank).