# ANILAM

4200T
CNC Motion Setup/Testing
Utility

# Introduction

This section describes how to use the ANILAM Motion Setup/Testing (MST) Utility.  The MST provides commands that carry out motion-specific setup and testing in order to tune the servo system and the Proportional Integral Derivative (PID) filter parameters of a CNC.

A basic knowledge of machine operation and programming is required. Refer to the appropriate programming manual for details on how to program and operate the control.

Setup includes the following procedures:

❑ Servo Board Balancing

❑ Servo Board Signal Gain Setting (motor step response is displayed in open loop)

The CNC provides the following troubleshooting tools:

❑ Detection of Index Pulse

❑ Detection of counts between index pulses (actual resolution)

❑ Tuning for the optimal PID values

The following General Status information is displayed:

❑ Display of active CNC status codes

❑ Display of machine position, feedrates, RPM, dwell, and override

# Accessing the MST Utility

Access the Motion Setup/Testing Utility (MST) from the Software Options Screen.  This screen activates automatically once the CNC has started successfully.

To activate the MST Utility:

1. Start the CNC.

2. Press (**F10**) to continue, as prompted.  The Software Options screen is displayed.

3. Highlight **Motion Setup/Testing**, and press **ENTER**.  The MST screen activates.

## Activating the MST Screen

The axis positions displayed in Figure 1 correspond to the current position. The Graphic Area displays step responses for the Signal Gain and Tuning functions. Refer to **Figure 1** and **Table 1**.
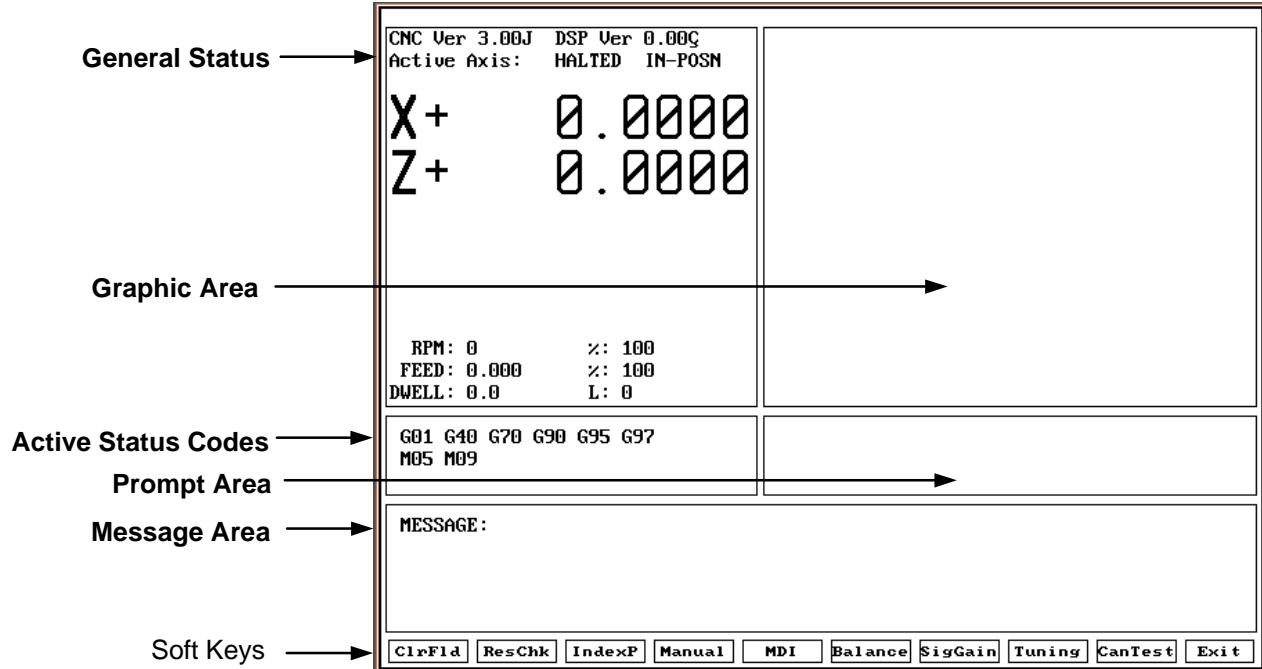


**Figure 1, CNC Motion Setup/Testing Screen**

**Table 1, MST Screen Areas**

| MST Screen Area | Description |
|---|---|
| General Status | Shows Active Modes, Machine Position for each axis, RPM, Dwell, Spindle Speed and Feedrate, Active Axis, and other information regarding the status of the CNC. |
| Graphic Area | Displays step responses for the Signal Gain and Tuning functions. |
| Prompt Area | Displays messages regarding information that must be entered. |
| Active Status Codes | Active G-codes. |
| Message Area | Displays error messages. |
| Soft Keys | Function keys (**F1**–**F10**) located below the CRT on the console used to activate the functions, as labeled. |

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## MST Soft Keys

> **NOTE:** Select an active axis before you select an MST command (**F1**–**F10**).

> **NOTE:** The CNC displays the MST soft keys while the MST screen is active.

Access MST utility features using the labeled soft keys located below the screen on the console.  Press the corresponding soft key (**F1**–**F10**) to activate the function.

Refer to **Table 2** for soft key names and functions.

**Table 2, MST Soft Key Functions**

| Soft Key | Name | Function |
|----------|------|----------|
| **F1** | **ClrFld** | Clears prompt field in SigGain and Tuning tests. |
| **F2** | **ResChk** | Calculates the resolution of the active axis. Troubleshooting tool. |
| **F3** | **IndexP** | Detects Index Pulse and displays an indicator over the Active Axis line of the MST screen. Troubleshooting tool. |
| **F4** | **Manual** | Cancels active MDI or test command. |
| **F5** | **MDI** | Activates an MDI prompt. |
| **F6** | **Balance** | Sends out the signal needed to Balance the outputs of the system (0.0VDC).  Used to balance the Motion Control Board and the Servo Amplifiers. |
| **F7** | **SigGain** | Allows you to set the servo board signal gain for the active axis. |
| **F8** | **Tuning** | Activates the Tuning Pop-Up menu, which allows the CNC to determine optimum PID filter values from the specified parameters and save the results. |
| **F9** | **CanTest** | Tests and troubleshoots Can bus, inputs, and outputs. |
| **F10** | **Exit** | Returns the CNC to the Software Options screen. |
| **(SHIFT+F4)** | **Home** | Performs a Homing Sequence on all axes configured for homing. |

### Clearing a Prompt Field or Message (F1)

Press **ClrFld** (**F1**) to clear an erroneous entry.  This soft key is available during the Signal Gain and Tuning tests.

## Selecting an Axis

> **NOTE:** Select an active axis before you select an MST command (**F1**–**F10**). If you do not select an axis, the CNC displays an Error message that prompts you to select an axis.

Use the following keypad keys to select and activate the corresponding axes:

**X**      Activates/Deactivates X Axis

**Z**      Activates/Deactivates Z axis

**S**      Activates/Deactivates Spindle Axis

The CNC displays the active axis in the upper-left corner of the General Status area of the MST Screen.

## Entering a Password

When you enter the MST Utility and press **Balance** (**F6**), **SigGain** (**F7**), or **Tuning** (**F8**), the CNC prompts for the password. Enter the appropriate password, and press **ENTER**.

The soft key activates. If you have entered the password successfully, the CNC will not prompt for the password again, unless you exit and re-enter the MST Utility.

## Checking Axis Resolution (F2)

Refer to **Figure 2, CNC Resolution Check (ResCheck) Screen**. Press **ResChk (F2)** to calculate the actual resolution for the active axis. In the Graphic Area of the screen, the actual resolution and the resolution in the Setup are displayed for comparison. In addition the screen displays:

❑ The number of times the system tested for resolution (Total Cycles:)

❑ The number of times the encoder lines detected do not match the number of encoder lines in the setup (Errors:). An error indicates that something is wrong, either in the setup parameters or in the hardware.

❑ The actual number of encoder lines found by the test (Encoder Lines:)

❑ The resolution and counts per revolution found. (Encoder Resolution:)

> **NOTE:** Resolution should be four times the number of encoder lines.

Once this test is activated, you must move the axis for at least two encoder revolutions via MDI Mode, Jog Mode, or manual move. The CNC performs the calculation continuously until motion stops.

> **NOTE:** This test is not available for axes with linear encoders.

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> **NOTE:** Do not perform this test during Rapid Mode.  Use it in Feed
> Mode only.

```
CNC Ver 3.00J   DSP Ver 0.00C
Active Axis:X   HALTED   IN-POSN

X+      0.0000              VALUES FROM SETUP UTILITY

Z+      0.0000         Encoder Lines: 1000      Ratio: 1.5
                     Encoder Counts/Rev: 4000
                    Ballscrew Counts/Rev: 6000



                                Total Cycles: 25
                                      Errors: 0
                               Encoder Lines: 1000
 RPM: 0          %: 100    Encoder Resolution: 4000   Cnts/Rev
 FEED: 0.000     %: 100
 DWELL: 0.0      L: 0

  G01 G40 G70 G90 G95 G97
  M05 M09


 MESSAGE: Move axis with (MDI, Jog or manually) to perform test.



 ClrFld  ResChk  IndexP  Manual   MDI   Balance SigGain  Tuning CanTest  Exit
```

**Figure 2, CNC Resolution Check (ResCheck) Screen**

## Detecting the Index Pulse (F3)

Refer to **Figure 1, CNC Motion Setup/Testing Screen**.  When you press
**IndexP** (**F3**), the CNC displays a flashing "**I**" each time it detects an Index
Pulse.  The flashing "I" replaces the axis name (X, Y, or Z) of the active
axis.  The index pulse indicator (flashing "**I**") for the spindle axis is
displayed on the RPM field.  The figure shows the axis display when the
CNC has detected an index pulse in the (active) X-axis.  Refer to
**Figure 3, Index Pulse Indicator**.

To detect an index pulse:

1. Move the active axis to check for the presence of an index pulse.

2. On systems with rotary encoders with index pulses, the index pulse
   should be detected once per revolution.

3. On systems having linear scales, the index pulse should be detected
   where the linear scale specifies location of the index pulse.
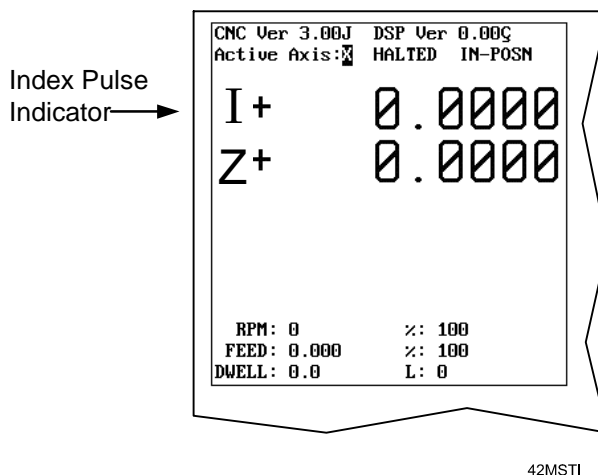
Index Pulse
Indicator⟶

```
CNC Ver 3.00J  DSP Ver 0.00G
Active Axis:X  HALTED  IN-POSN

I+        0.0000
Z+        0.0000




 RPM: 0          %: 100
 FEED: 0.000     %: 100
DWELL: 0.0        L: 0
```

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**Figure 3, Index Pulse Indicator**

## Canceling the Active MDI or Test Command

Press **Manual** (**F4**) to cancel an active MDI or test command.

## Activating Manual Data Input Mode (MDI)

Press **MDI** (**F5**) to activate the MDI prompt.  (Refer to the *CNC Programming and Operations Manual* for information on MDI programming.)

## Balancing Motion Control Axes

To balance the outputs properly, all connections between the Motion Control Board and the servo amplifiers must be complete.

Perform all adjustments on one axis at a time.  Make the adjustments in the following order:

1.  Select an axis

2.  Balance the Motion Control Board outputs

3.  Balance the Servo Amplifier outputs

4.  Set Servo Amplifier gain

5.  Repeat for all axes

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## Servo Drive Test Board

Each CNC that uses ANILAM servo amplifiers (P/Ns 33000039 or 33000123) includes a Servo Drive Test Board, P/N 33000102.  During machine operation, the board provides convenient access to critical signals for alignment and troubleshooting.  Refer to **Figure 4**.

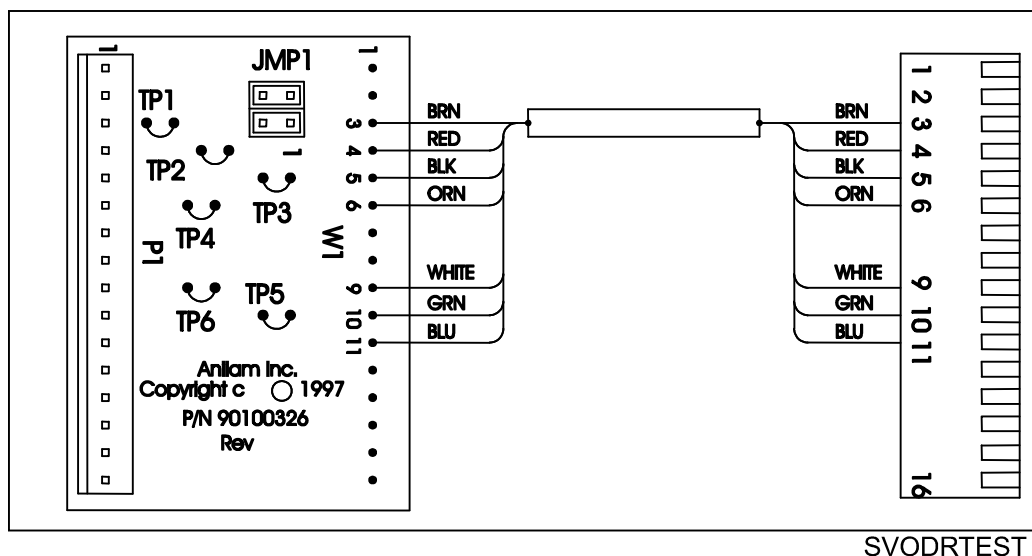NOTE:    The test board works only with amplifiers supplied by ANILAM.



SVODRTEST

**Figure 4, ANILAM Servo Drive Test Board, P/N 33000102**

### Test-Board Installation

IMPORTANT:    Press **E-STOP** to de-energize servos before you install the test board.

1.  Remove the cable attached to **J1** of the Servo Drive you wish to monitor and connect it to **P1** of the test board.

2.  Attach **W1** of the test board to **J1** of the servo.

3.  Re-energize the servos.

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**Test Points**

Refer to **Table 3** for a description of test points and signals.

**Table 3, Servo Drive Test Board: Test Points and Signals**

| Test Point | Pin | Signal |
|---|---|---|
| TP1 | 3 | Command Signal. |
| TP2 | 4 | Common for all servo signals and potentiometers. All readings are referenced to TP2. |
| TP3 | 5 | Tachometer. |
| TP4 | 6 | Motor Current output monitor. The scale factor is 1V = 5A. |
| TP5 | 9 | Clamp input from the SCB. When pulled to chassis ground, the servo's output is forced to 0 VDC. |
| TP6 | 10 | Fault Output. When the servo card is faulted, the output is pulled low. If TP6 is pulled to chassis ground, the Servo is disabled and coasts to a stop. |
| JMP1 | 11 | Command Signal Common. If removed, JMP1 will open the common line at Pin 11 of J1. |
| JMP2 | 3 | Common Signal. If JMP2 is removed, the Command signal will open at Pin 3 of J1. |

**Jumpers**

While troubleshooting, you can remove jumpers to isolate the Servo Drive from the DAC outputs of the Motion Control Board. If you short Pin 2 of JMP1 and JMP2 together, the Servo Drive's input is fixed at 0 VDC; this can be useful while troubleshooting balance problems.

# Balancing the DSP$^2$ Board (F6)

On systems that use an ANILAM Servo Amplifier Board, P/N 33000039 or 33000123 (See **Figure 6 (5 LEDS)** or **Figure 7 (1 LED)**), you can make measurements for this procedure at the J1 input connector with the Servo Drive Test Board, P/N 33000102.

**NOTE:** If ANILAM did not provide the servo amplifiers, follow the guidelines for balancing supplied by the manufacturer.

Refer to **Figure 5, ANILAM DSP$^2$ Board Balance Pots, P/N 33000404**. Measure command voltages across TP1 and TP2 of the test board.

**NOTE:** You can find these signals on Pin 3 and Pin 11 of the J1 input connector on the ANILAM Servo Amplifier Board.
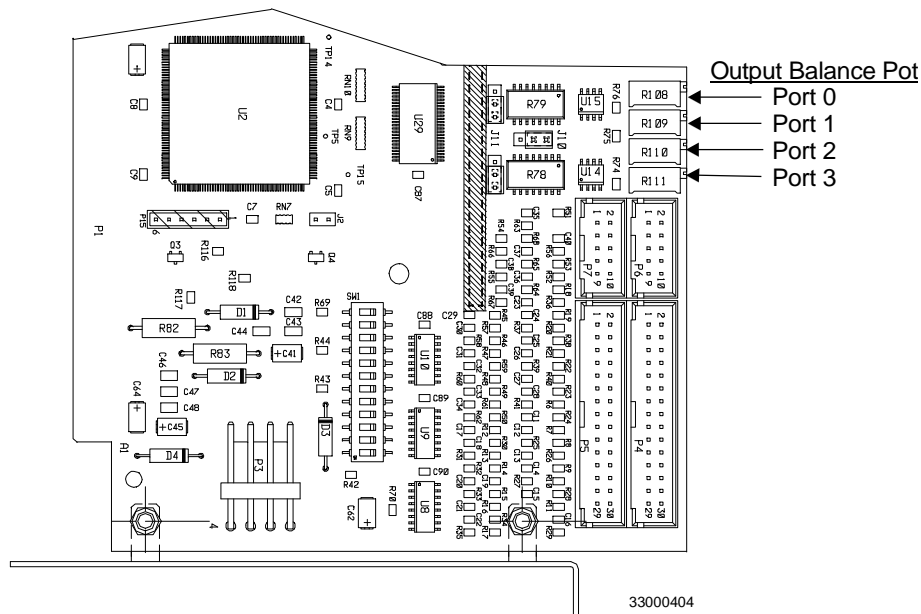
All DSP$^2$ Boards are adjusted at the factory and should be within limits. Balance the DSP$^2$ Board only if it is not at 0 VDC (±0.001V).

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> **NOTE:** On 4200T systems, the DSP[2] Board is located in the CNC
> chassis. Open the CNC chassis by loosening the thumbscrews
> and opening the cover. Balance the DSP[2] Board with the servos
> off, initially. Next, verify the DSP[2] Board balance with the servos
> on, and correct for voltage offset as required.

1. Press **Balance** (**F6**) to output a zero-voltage signal to the axis.

2. Press **START**.

3. Refer to **Figure 5**. Make adjustments for axis outputs 0-3 on the
   DSP[2] Board at potentiometers R108-R111 respectively.

4. Adjust the potentiometer for the selected axis until the voltage across
   the pins is 0VDC ($\pm$ 0.001V).

5. Press **Manual (F4)** to cancel the test.

**Table 4, Axis Output Port Assignments**

| Port | Axis |
|:----:|:----:|
| 0 | X |
| 1 | C/S |
| 2 | Z |



33000404

**Figure 5, ANILAM DSP2 Board Balance Pots, P/N 33000404**

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## Balancing Servo Amplifier Outputs (F6)

When the command signal voltage from the DSP[2] Board is 0, the axis should be stationary and MST balance display should read "0000". Alternatively, read the tachometer voltage from the motor. The tachometer should read 0 VDC ($\pm$ 0.001 V). Monitor the tachometer voltage across TP2 and TP3 of the test board.

> **NOTE:** You can find these signals also on Pins 5 and 11 of the J1 input connector on the ANILAM Servo Amplifier Board, P/N 33000123. Refer to **Figure 6, (5 LEDs)** or **Figure 7, ANILAM Servo Amplifier (1 LED), P/N 33000123**.
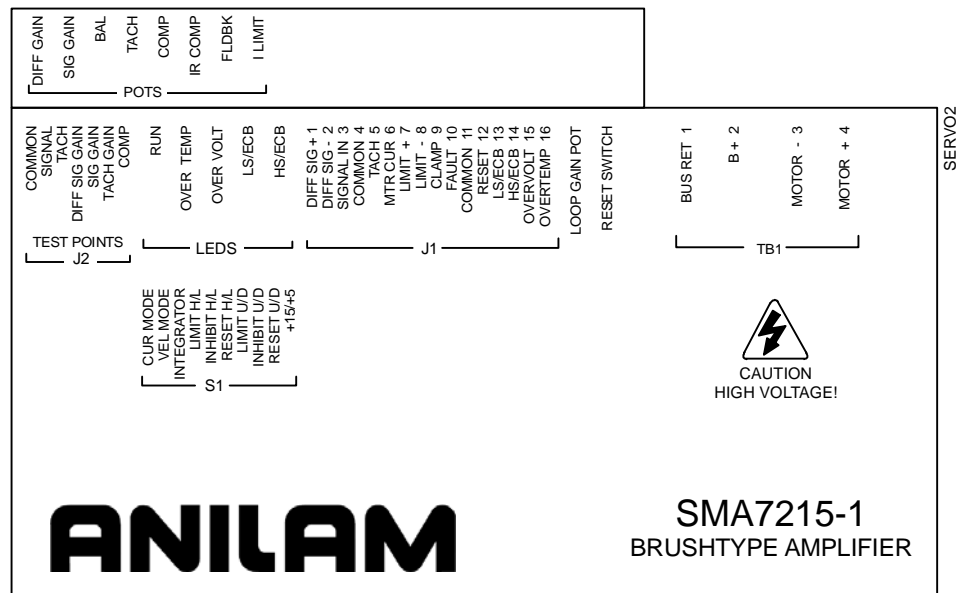


**Figure 6, ANILAM Servo Amplifier (5 LEDS), P/N 33000123**

> **NOTE:** When the amplifier is shipped from the factory, the LOOP GAIN pot is fully counterclockwise (CCW). This is used to shut off uncalibrated amplifiers. When the loop gain is fully CCW, no current is delivered to the motor.

1. Apply main power and fan power.

2. Slowly turn the LOOP GAIN pot clockwise (CW). Motor should be stopped or turning slowly. If motor starts running away, remove power, reverse the tach leads, and retest. Turn the LOOP GAIN fully CW to enable.

3. Energize the servos and select an axis.

4. Refer to **Figure 8, Balance Screen**. Press **Balance** (**F6**) to output a zero voltage signal to the axis.

5. Press **START**.

6.  On the ANILAM Servo Amplifier for the axis being adjusted, adjust the balance potentiometer until the MST display indicates 0000, indicating the active axis is stationary.

*– or –*

Adjust until tach voltage is 0 VDC (±0.001 V), indicating that the active axis is stationary.

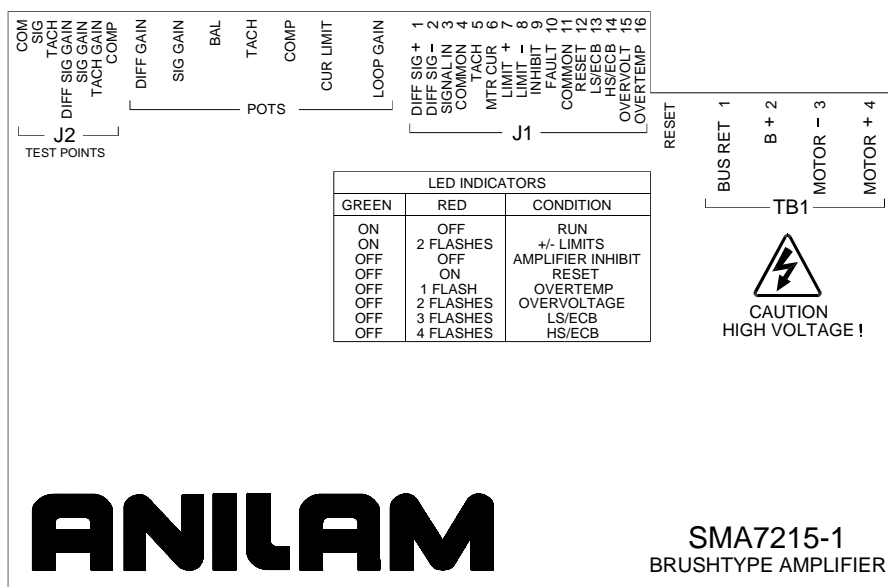7.  Press **MANUAL** (**F4**) to cancel the Balance command.



**Figure 7, ANILAM Servo Amplifier (1 LED), P/N 33000123**

## Amplifier Faults

ANILAM amplifiers do not require any scheduled maintenance, although it is a good idea to occasionally check for dust build up or other contamination.

If an amplifier should cease to operate or one or more of the fault LEDs are lit, review the following sections for information on the fault and possible causes.

**NOTE:** A fault can on be caused by abnormal conditions. Locate and correct the cause of the fault before repeated recycling of power to the amplifier to prevent possible damage.

For LED fault conditions on 5 LED servo amplifiers (**Figure 6, ANILAM Servo Amplifier (5 LEDS), P/N 33000123**), see **Table 5, Table of Fault LED Conditions (5 LEDs)**.

**Table 5, Table of Fault LED Conditions (5 LEDs)**

| Input or Fault Condition | RUN LED | HS/ECB LED | LS/ECB LED | OVER VOLT LED | OVER TEMP LED | FAULT OUTPUT |
|---|---|---|---|---|---|---|
| NORMAL OPERATION | **ON** | OFF | OFF | OFF | OFF | GROUND |
| LIMIT + (ON) | **ON** | OFF | OFF | OFF | OFF | GROUND |
| LIMIT – (ON) | **ON** | OFF | OFF | OFF | OFF | GROUND |
| CLAMP (ON) | OFF | OFF | OFF | OFF | OFF | GROUND |
| RESET (ON) | OFF | OFF | OFF | OFF | OFF | **PULL-UP** |
| EXT. FAULT | OFF | OFF | OFF | OFF | OFF | **PULL-UP** |
| UNDER VOLTAGE (+15V) | OFF | OFF | OFF | OFF | OFF | **PULL-UP** |
| HS/ECB (LATCHED) | OFF | **ON** | OFF | OFF | OFF | **PULL-UP** |
| LS/ECB (LATCHED) | OFF | OFF | **ON** | OFF | OFF | **PULL-UP** |
| OVER VOLTAGE B+ (LATCHED) | OFF | OFF | OFF | **ON** | OFF | **PULL-UP** |
| OVER TEMP (LATCHED) | OFF | OFF | OFF | OFF | **ON** | **PULL-UP** |

For LED fault conditions 1 LED servo amplifiers, see **Figure 7, ANILAM Servo Amplifier (1 LED), P/N 33000123** or **Table 6**.

**Table 6, Table of Fault LED Conditions (1 LED)**

| Green | Red | Condition |
|---|---|---|
| ON | OFF | RUN |
| ON | 2 FLASHES | +/– LIMITS |
| OFF | OFF | AMPLIFIER INHIBIT |
| OFF | ON | RESET |
| OFF | 1 FLASH | OVER TEMPERATURE |
| OFF | 2 FLASHES | OVER VOLTAGE |
| OFF | 3 FLASHES | LS/ECB |
| OFF | 4 FLASHES | HS/ECB |

**Under Voltage Fault**

When the +15VDC power supply is below +12VDC, a level that would cause unreliable operation:

| | |
|---|---|
| For 5 LED amplifiers: | The Run LED turns off, a Fault Output is generated, and the amplifier is inhibited. |
| For 1 LED amplifiers: | The Green LED turns off, the Red LED is off, a Fault Output is generated, and the amplifier is inhibited. |

The following is a list of possible causes:

❑ Main buss line voltage is too low.
❑ Bad power supply.

**High Speed Electronic Circuit Breaker (HS/ECB) Fault**

When the peak output of the amplifier exceeds 80A for 10 microseconds:

| | |
|---|---|
| For 5 LED amplifiers: | The Run LED turns off, the HS/ECB LED turns on, a Fault Output is generated, and the amplifier is inhibited. **NOTE:** This is a latched condition. |
| For 1 LED amplifiers: | The Green LED turns off, the Red LED displays 4 flashes, a Fault Output is generated, and the amplifier is inhibited. **NOTE:** This is a latched condition. |

The following is a list of possible causes:

❑ Shorted motor leads.
❑ Motor inductance too low.
❑ Short from the motor lead to ground.

**Low Speed Electronic Circuit Breaker (LS/ECB) Fault**

When the RMS output of the amplifier exceeds 13A for 5 seconds:

| | |
|---|---|
| For 5 LED amplifiers: | The Run LED turns off, the LS/ECB LED turns on, a Fault Output is generated, and the amplifier is inhibited. **NOTE:** This is a latched condition. |
| For 1 LED amplifiers: | The Green LED turns off, the Red LED displays 3 flashes, a Fault Output is generated, and the amplifier is inhibited. **NOTE:** This is a latched condition. |

The following is a list of possible causes:

❑ Binding or stalling of motor shaft due to excessive mechanical overload.
❑ Overload of amplifier output to motor.
❑ Large reflected load inertia.

### Over Temp Fault

When the amplifier heatsink temperature has reached a level that, if exceeded, would damage the output transistors:

For 5 LED amplifiers: The Run LED turns off, the OVER TEMP LED turns on, a Fault Output is generated, and the amplifier is inhibited.
**NOTE:** This is a latched condition.

For 1 LED amplifiers: The Green LED turns off, the Red LED displays 1 flash, a Fault Output is generated, and the amplifier is inhibited.
**NOTE:** This is a latched condition.

The following is a list of possible causes:

- Loss of cooling, or fans are defective, or airflow is blocked.
- Excessive rise in cooling temperature due to cabinet vents being blocked or excessive hot air being ingested.
- Extended operational duty cycle due to mechanical overload of motor or defective motor.

### Over Voltage Fault

When the DC Buss voltage reaches 250VDC:

For 5 LED amplifiers: The Run LED turns off, the OVER VOLTAGE LED turns on, a Fault Output is generated, and the amplifier is inhibited.
**NOTE:** This is a latched condition.

For 1 LED amplifiers: The Green LED turns off, the Red LED displays 2 flashes, a Fault Output is generated, and the amplifier is inhibited.
**NOTE:** This is a latched condition.

The following is a list of possible causes:

- Main Buss line voltage is too high.
- Decelerating a large inertial load. When decelerating, a DC motor acts as a generator. If the inertial load is large, the generated voltage can pump up the DC-Buss. If this fault occurs, you may need a Regen Clamp. Consult ANILAM.

### Resetting a Fault

The fault latch may be reset by pushing the Reset button, activating the Reset input J1–12 or by removing power and allowing the filter capacitor(s) to discharge. Note that the fault latch will not reset unless the fault has been cleared.

### Amplifier Failure

If the amplifier should fail, that is, if it should cease to operate with no apparent fault, contact ANILAM.

## Setting the Signal Gain (F7)

Adjust the gains of the ANILAM Servo Amplifier.  Refer to **Figure 8**.

```
CNC Ver 3.00J  DSP Ver 0.00C
Active Axis:X  HALTED  IN-POSN

X+      0.0000
Z+      0.0000




 RPM: 0         %: 100
 FEED: 0.000    %: 100
DWELL: 0.0      L: 0

 G01 G40 G70 G90 G95 G97          X  +0000
 M05 M09

 MESSAGE:



ClrFld  ResChk  IndexP  Manual    MDI    Balance SigGain  Tuning  CanTest  Exit
```

**Figure 8, Balance Screen**

| **NOTE:** | If ANILAM did not provide the servo amplifiers, follow the guidelines for balancing supplied by the manufacturer. |
|---|---|

| **NOTE:** | 0.9V output is used during this procedure. |
|---|---|

The gain is adjusted at 10% of the machine's maximum Rapid speed, using the fastest axis.

1. Energize the servos and select an axis.

2. Press **SigGain** (**F7**).

3. Refer to **Figure 9, Signal Gain (SigGain) Screen**. Look at the Prompt Area of the MST screen.  Enter a timed delay at the **T(sec)** entry field (two seconds is usually adequate).  The graph in the Graphic Area plots machine motion as follows:

   ❑ The X-axis represents elapsed time in milliseconds.

   ❑ The Y-axis represents the speed of the machine, from 0 to constant velocity.

   ❑ Rise time is the time required (in milliseconds) for machine movement to go from 10% to 90% of constant velocity.

   ❑ T is the amount of time in seconds that the axis will travel in one direction before it reverses for the same amount of travel in the opposite direction.  The actual distance depends on the feedrate that corresponds to 0.9V.

> **NOTE:** Press **ClrFld** (**F1**) to erase the entry and enter another number.

4. Press **START**. The CNC generates an open-loop step response, including rise time, in the Graphic Area of the screen.

5. Adjust the signal gain pot until the displayed feedrate is at 10% of the machine's maximum Rapid speed, using the fastest axis. The machine builder sets the maximum Rapid speed in the Setup Utility.

6. Press **Manual** (**F4**) to cancel the test.
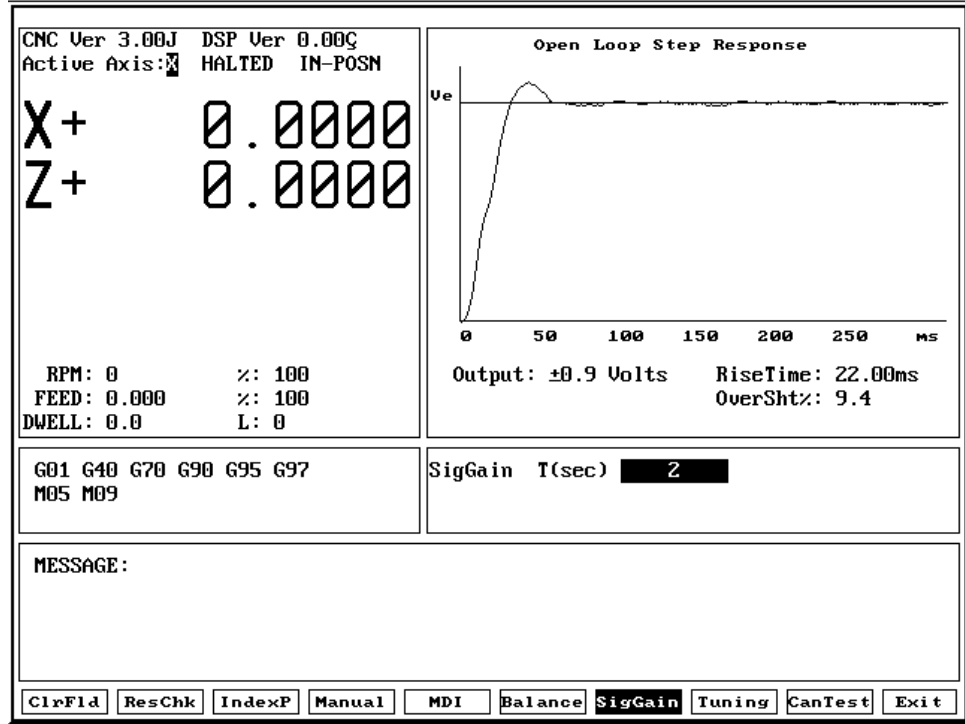


**Figure 9, Signal Gain (SigGain) Screen**

If the system has an ANILAM Servo Amplifier Board, you can make all of the voltage measurements with the Servo Drive Test Board.

Measure command voltage across TP1 and TP2 of the test board. You can find these signals also on Pins 3 and 11 of J1.

Measure the tachometer output across TP2 and TP3 of the test board. You can find these signals also on Pins 5 and 11 of the J1 input connector on the ANILAM Servo Amplifier Board.

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## Tuning (F8)

> **NOTE:** Before tuning, ANILAM recommends that you set signal gain and balance the servo amplifier, as described in the previous section.

> **CAUTION:** **Most machines will operate correctly with the default filter parameters. Only qualified technicians who have knowledge of motion-control tuning parameters should use this tool.**

The Tuning function can determine optimum values within constraints you specify. The default values are usually correct for most machines. To fine-tune, enter values manually or use this test. Refer to **Figure 11, Tuning Parameters Test Results Screen**.

The Tuning Test has a setup menu that allows you to configure the extent of the test. Check the setup parameters (See Table 5), run the test, and then save the results. Refer to **Figure 10** and **Table 7**.

```
┌─────────────────────────────┐
│      Tuning Setup           │
├─────────────────────────────┤
│ 1. Tune Ki ..............  No │
│ 2. Tune Kd .............  No │
│ 3. Tune All Axis ......  No │
│ 4. Match Axis Lag ...  No │
│                             │
└─────────────────────────────┘
```

**Figure 10, Tuning Setup Menu**

**Table 7, Tuning Test Parameters**

| Parameter | Function |
|---|---|
| **Tune Ki** | Switches integral tuning ON or OFF. [Default: **No**] |
| **Tune Kd** | Switches derivative tuning ON or OFF. [Default: **No**] |
| **Tune All Axis** | If set, tunes all axes sequentially. [Default: **No**] |
| **Match Axis Lag** | If set, calculates the inch/min/mil of each axis, chooses the smallest one and matches the inch/min/mil of the other axes to the smallest by decreasing Kp. **Tune All Axis** must be set to use this option. [Default: **No**] |

If you have selected Kd (derivative gain), the CNC begins by measuring derivative sampling time (Ds). It measures the time between 10% and 90% of the final velocity (rise time) to determine the systems time constant, from which the Ds travel is calculated.

---

> **WARNING:  If you select the Kd test, you must have at least 2.5"
> (63mm) of travel in the positive (+) direction.**

Next, the CNC calculates Kp (proportional gain).  If the current overshoot is smaller than the set one, Kp is increased by 1.  If it is larger, Kp is decreased by 0.1.

If you have selected Ki (integral gain), the CNC then calculates Ki and Il (integral limit).  If the lag between the commanded position and the actual position is not zero, Il is increased by 5 and this portion of the test is repeated.

The CNC calculates Kd, if selected.  The CNC will attempt to decrease the overshoot until the set value (Kd overshoot) is matched.  When Kd overshoot is not matched, the CNC increases Kd by 2.

If you have chosen to test only one axis, the test is completed at this time.  If you have chosen to test multiple axes, and have not selected "Lag Matching" the CNC will repeat the test on each axis in turn, until complete.

If you have chosen all axes and Lag Matching, the CNC calculates the inch/min/mil of each axis being tested and matches the inch/min/mil to the lowest value of all axes tuned.

To test:

1. Energize the servos and select an axis.

2. Press **Tuning** (**F8**).  The CNC displays a pop-up menu with the following selections: **Tuning**, **Save Results**, and **Tuning Setup**.

3. Refer to **Table 7, Tuning Test Parameters**.  Check the Tuning Setup menu to determine which parameter(s) you wish to change.  Select **Tuning Setup**, and press **ENTER**.  Choose the parameter(s) you wish to include in the test.

4. Refer to **Table 8**.  Enter values for the following tuning parameters:

> **NOTE:**   Kp overshoot must be greater than Kd overshoot.

### Table 8, Tuning Function Values

| Parameter | Function |
|---|---|
| **Kp Overshoot %** | Determines the amount of overshoot the CNC will seek before ending the Kp cycle.  1% to 5% is a normal overshoot range for this test.  If the detected overshoot exceeds the entered OvSht%, the cycle ends.  [Default: **5**] |
| **Kd Overshoot %** | Sets limit for Kd overshoot.  [Default: **2**] |
| **Kp min** | Sets Kp to starting value during proportional tuning. [Default: **1**] |

5. Press **START**.  The CNC begins the test.

6. Refer to **Figure 11**. After the test, the CNC plots the final step responses (for all axes tested) and displays them in the graphic area of the screen.

7. To save results of the test, press **Tuning** (**F8**) and select **Save Results**.

8. Press **Manual** (**F4**) to exit or cancel the test.

## Saving Final Values
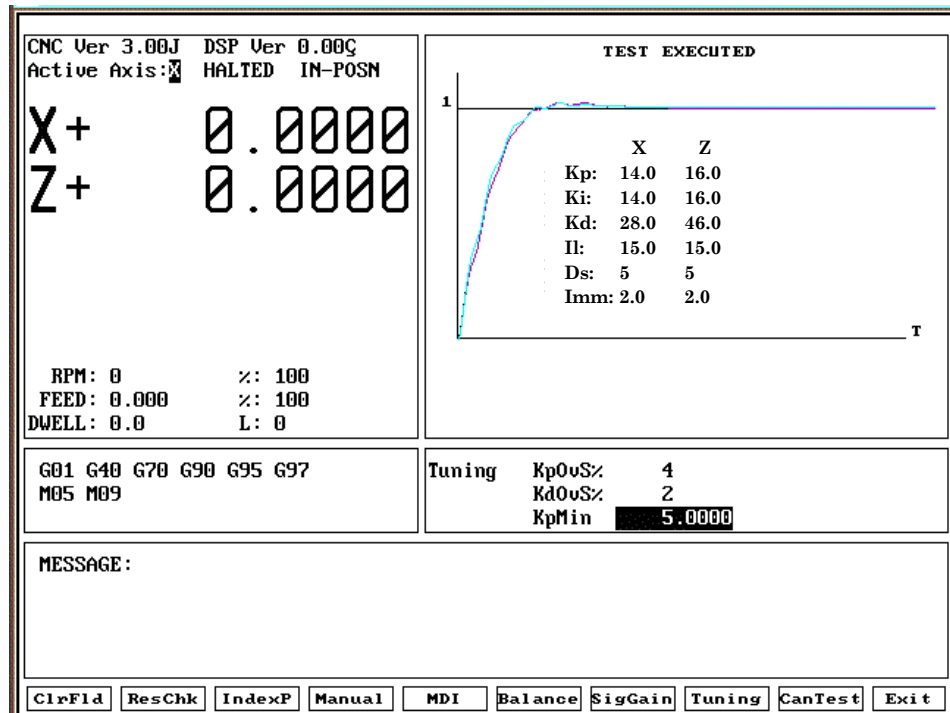


**Figure 11, Tuning Parameters Test Results Screen**

To save the Tuning Test values:

1. Refer to **Figure 11**. After the Tuning Test, the results are displayed in the Graphics Area of the screen. Press **TUNING** (**F8**) and highlight **Save Results**.

2. A pop-up is displayed with the following options: **[No Motion]**, **[Feed]**, **[Rapid]**, **[ALL Tables]**. Highlight the table to which you wish to save the final values, and press **ENTER**. This overrides the values in the Setup Utility. Normally, choose **All Tables**.

3. The CNC stores the new values in the configuration file.

4. Or, press **Cancel** (**F9**).

| **NOTE:** | ANILAM recommends that you back up your configuration file before you save tuning results. This allows you to recover the filter parameters if necessary. Refer to *Setup Utilities* for details on backing up and restoring setup parameters. |
|---|---|

## CanTest (F9)

Refer to **Figure 13**. Press **CanTest** (**F9**) to display Can Bus Test Screen in the graphic area and to troubleshoot the status of all inputs and outputs for the nodes.
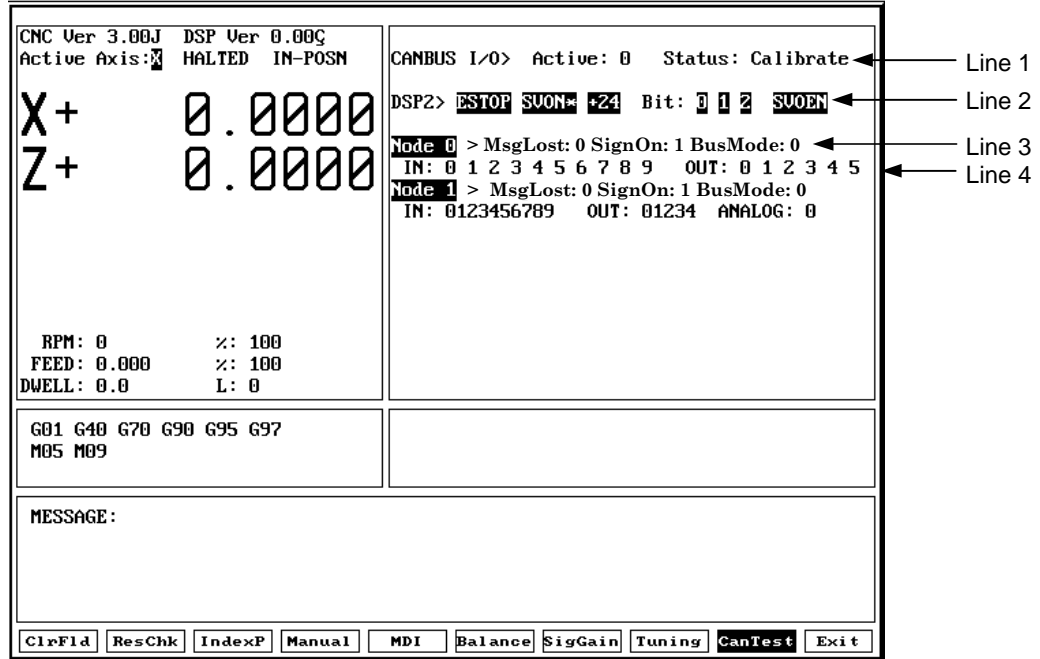


**Figure 13, CAN Bus Test (CanTest) Screen**

**Table 9** lists the CAN bus test results displays.

**Table 9, CAN Bus Test Results Displays**

| Display | Can Bus Status |
|---------|----------------|
| Normal | Normal operation. |
| Calibrate | Node found and CNC is calibrating. |
| Warning | CNC lost a node and is actively searching for active nodes. |
| Bus off | Fatal error. The bus has turned itself off due to errors. |

1. Line 1 of the graphic area indicates the number of active CanBus I/O nodes and their status.

2. Line 2 of the graphic area indicates the basic machine I/O status.

3. Line 3 of the graphic area indicates:

   ❑ The address of the active node. Possible values are 0 to 5.

   ❑ The number of message packets lost between the node and the controller. This should be 0.

---

❑ The number of times the node has signed on since the control started.  This should be 1 unless power was interrupted.

❑ The node bus type.  This is normally 0.

4. Line 4 indicates:

❑ The status of the ten inputs of each node.

❑ The status of the six outputs of each node.

❑ The three-digit decimal value of the digital/analog converter output for nodes configured as digital/analog.

5. Subsequent lines indicate the I/O status of any additional nodes.

## Exiting the MST Screen (F10)

Press **Exit** (**F10**) to exit the MST Screen and return to the Software Options screen in the Setup Utility.

# Setting Up and Tuning the C Axis

| **IMPORTANT:** | You must set up and tune the X-axis and Z-axis together before you set up and tune the C axis. |
|---|---|

To set up and tune the C axis, repeat the procedures for setting up and tuning the X-axis and Z-axis in the previous sections.  Substitute **C axis** whenever the procedures require you to select an axis.

Use M19 to enable C-axis programming and M05 to disable C-axis programming.  After you enable the C-axis, you can use the **C** key on the keypad to activate or deactivate the C axis.  For additional information on C-axis programming, refer to the *4200T CNC Programming and Operations Manual*, P/N 70000412.

**Figure 12, Tuning Parameters Test Results Screen for C Axis** displays the test results screen for the C-axis tuning parameters.

**Figure 12, Tuning Parameters Test Results Screen for C Axis**

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