

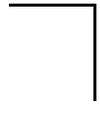
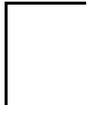


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NOTES:

Overview

Introduction to Y Term

Y Term is a front-end software package for the Yaskawa SMC Series Motion Controller. Y Term provides a user-friendly Windows interface for design, development and debugging of motion control applications. The software package consists of three main sections:

- Programming Section - edit, transfer, and monitor programs for the motion controller.
- Tuning Section - tune the SMC's axis and test the servo system's performance using a four-channel scope to graph performance data.
- Monitoring section - monitor motion and I/O on the controller.

Features of Y Term

Y Term enables you to fully control and program the SMC using:

- Text editor with dual edit windows for user programs and array data .
- Search and replace support.
- Multiple step Undo function.
- Selectable program compression and error checking during download.
- Real-time monitoring of program execution (includes multi-tasking).
- Full screen zoom capability in programming, online manual, and terminal window section.
- Extensive on-screen context sensitive SMC keyword help text.
- Graphical online manual and auto tuning.
- Online scoping of up to four channels of data.
- Quickload/save of SMC parameters in and out of the controller.
- Real-time monitoring speed, position error, position, and torque for all connected motors (numerical and graphical).
- Real-time monitoring of all analog and digital I/O.
- Sigma servo amplifier quick setup (Hardware required: YS-11 cable).
- Context sensitive pop-up menus.
- Online ASCII Terminal emulator window.
- Scroll-back buffer for viewing data in the Terminal window.
- Clipboard access to the Terminal window.
- Full text logging of all events in the Terminal window.
- Context sensitive help in all screens, accessible through F1 key.

Getting Started

Installing Y Term

Software Kit Contents

The Y Term software kit (SMCGUI1) that you have received should include the following:

- One CD ROM labeled 'Y Term SMC Development Environment.'
- The Y Term Software Manual, YEA-SIA-SMC-1.1A.
- One programming serial cable, SMCCBL7.
- A Software Registration card.

If any of the Y Term items are missing or damaged, contact Customer Service at Yaskawa Electric America for replacement, telephone number 1-800-YASKAWA.

System Requirements

Y Term requires the following minimum PC system configuration:

- A Pentium 233 MHz, 32MB RAM.
- VGA resolution monitor.
- An asynchronous adapter (RS-232 Serial port) on the computer.
- Microsoft Windows 95, 98, NT or 2000.

Software Installation

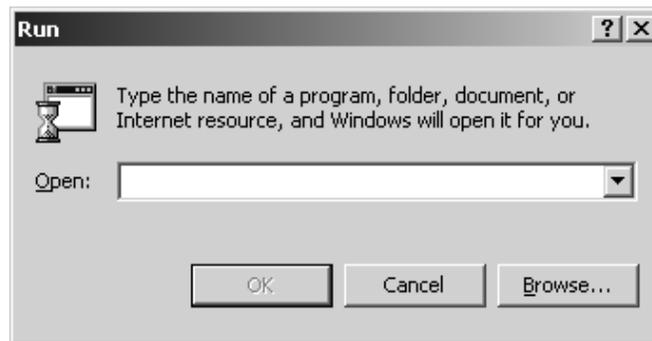
Exit other programs as a precaution against a program conflict occurring the first time you install the software.

All the files required for setup are contained on the CD ROM. Before using Y Term, run the Y Term INSTALL.EXE program. This program decompresses and copies the Y Term program and its associated files onto your PC hard disk.

INSTALL.EXE does not modify CONFIG.SYS, AUTOEXEC.BAT, WIN.INI or SYSTEM.INI. It may update Windows components.

To run the INSTALL program:

1. Start Microsoft Windows.
2. Insert CD ROM into CD ROM drive .
3. In Windows 95, 98, NT and 2000 from the Start Menu, select the Run option.
4. Type G:\INSTALL.EXE (Your system may use a different letter designation for the CD ROM drive).



5. Press **OK**. The INSTALL program will begin to execute.
6. Read the instruction screen and press **Next** to proceed.
7. Enter the user name and company name information and press **Next**.
8. Select in the folder where you want to copy the Y Term files. Press **Next** to proceed.
9. The “Ready to install the application” window appears. Press **Next** to proceed.
10. The INSTALL program will now copy files from the CD ROM to the selected folder.

Note: At this time, please complete your Yaskawa software registration card found in the Y Term Software kit. This is necessary in order to provide updates and support to registered users.

11. The installation is now complete. Press **Finish** to end the installation program.

YTerm Software Manual

Upon completion of a successful installation, the YTerm icon will appear on the PC desktop window:

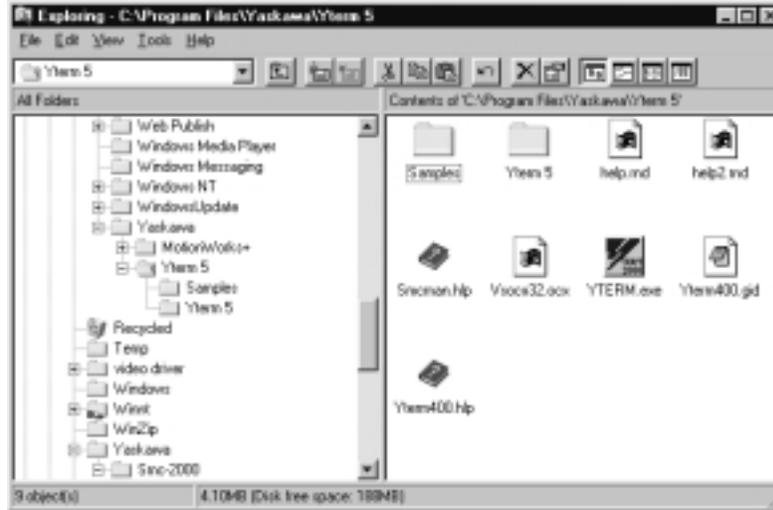


Figure 1: Y Term Program Group in Windows 95

Y Term creates a Windows program group that defaults to Yaskawa Software and creates four program items ("shortcuts"):

1. Y Term 2000 (The SMC communication program)
2. Y Term 2000 Help (Y Term's associated help file)
3. YConsole 2000 (A simple terminal program)
4. Y Term Tip of the Day (the tip application for Y Term 2000)

Launching Y Term

To run Y Term, double click on the Y Term icon.

The following screen (Figure 2) will appear, while the application loads indicating the version number and release date, and any user information that you entered during the installation process.



Figure 2: Y Term Splash Screen.

This screen will display for a few seconds while the application loads. When the application is loaded, it will attempt to establish communication with an SMC. The connection will be based on previously saved communication parameters. The first time the program runs, it will use the first free communication port in the computer, and the connection will default to 19200 baud.

If the communication access attempt was successful, the following screen appears:

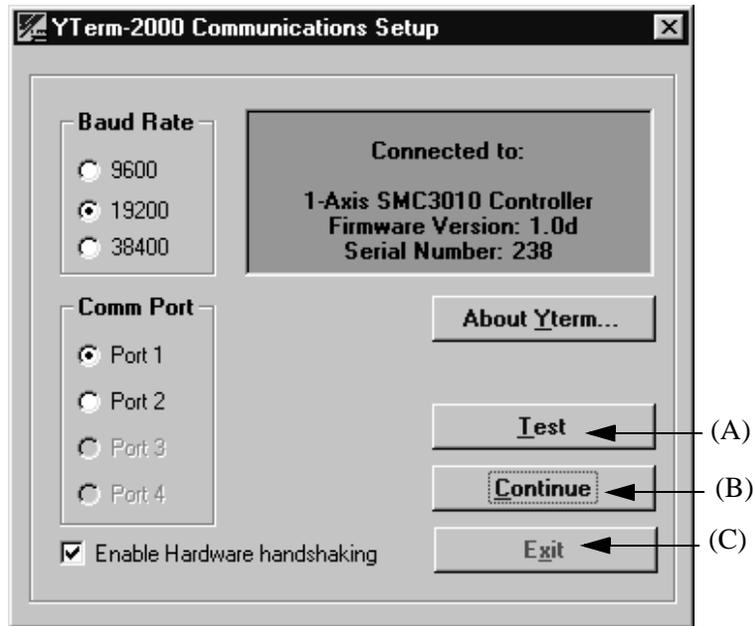


Figure 3: Communication Setup Screen Showing Successful Communication

To enable hardware handshaking, select the **Enable Hardware Handshaking** check box. Press **Continue** to proceed to the first (Programming) screen.

Note: Hardware handshaking is the recommended mode of operation.

The default setting is enabled.

To view the “About Y Term” screen, double click on the **About YTerm** button. Press **Exit** to exit Y Term.

If the communication access attempt failed, this screen will display the "No Connection" message as follows:

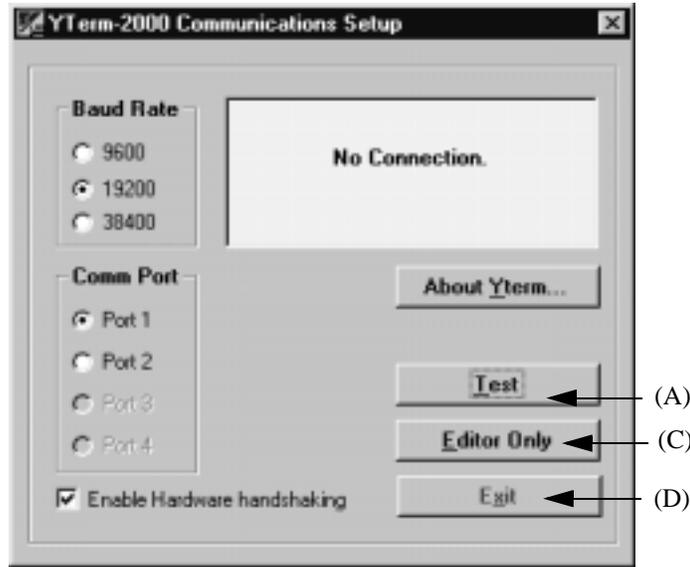


Figure 4: Communication Setup Showing Unsuccessful Communication Attempt.

When establishing communications with a connected SMC, check all cable and power connections. Make sure that the cable between the computer and motion controller is plugged into the correct computer port. Verify the computer port matches the one selected in Y Term.

Press **Test (A)** to try to establish communication once more and press **Continue (B)** when you see the connection screen.

If problems persist, contact technical support.

Press **Editor Only (C)** to work in offline mode if you do not have an SMC connected. In offline mode, only the Programming screen is available.

Press **Exit (D)** to exit Y Term.

Note: All SMC units are configured for 19200 baud rate by default.

Using Y Term

The Programming Screen

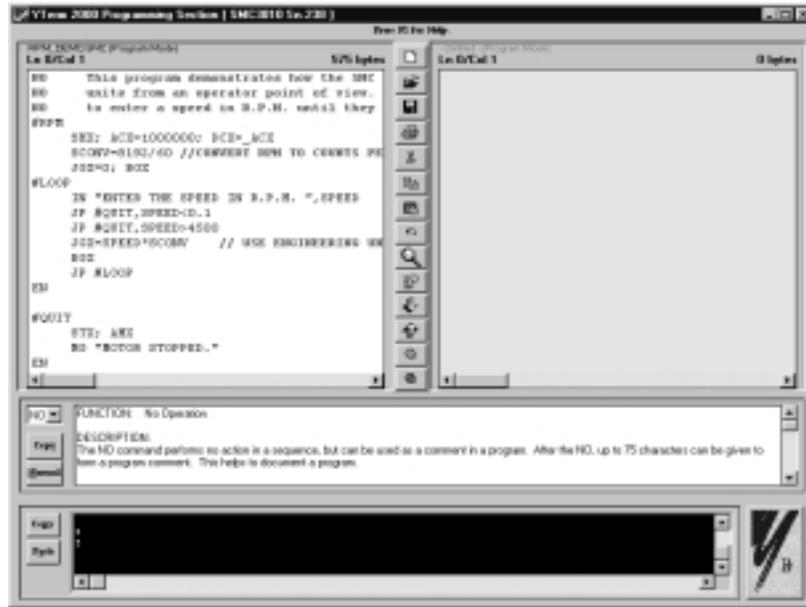


Figure 5: Programming Screen.

After Y Term is running and communication with the SMC has been established, the Programming Screen (Figure 5) is displayed. Use this screen to develop and execute SMC programs.

Note: The first time Y Term is run the Tip of the Day window (see figure 6) will pop up on top of the Programming Screen.

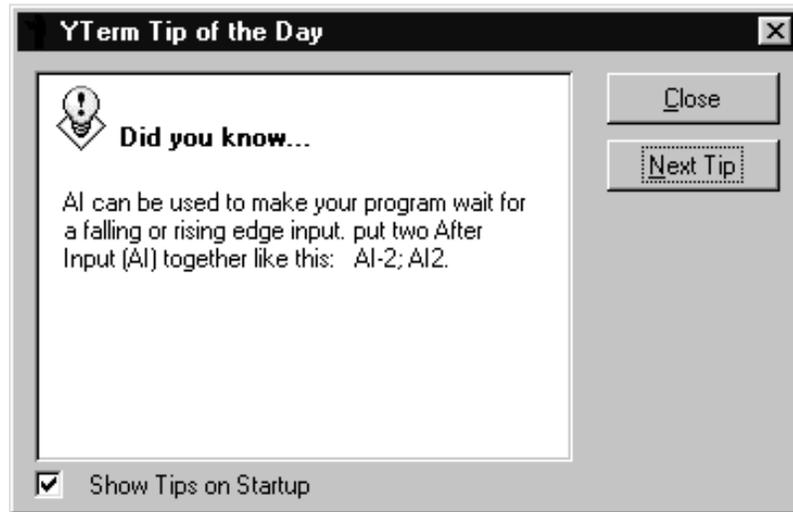


Figure 6: Y Term Tip of the Day window

Press **Close** to close the window.

Press **Next Tip** to view more tips.

If you wish to see the tips each time Y Term is run, check the “Show Tips on Startup” checkbox.

Navigating around the Programming Screen

Click on a specific icon on the screen to activate. For example, to select one of the editing windows, move the mouse pointer to the desired window you want to work in and click the left mouse button. The title of the active window is highlighted while the title of the other editing window will be gray. To edit one of the programs in full screen mode, double click the left mouse button on the frame of one of the windows (double clicking on the text area will select text). Double click again to return to normal viewing.

Key Commands (shortcuts) are available:

- **Alt+1** moves the cursor to the editing window on the left.
- **Alt+2** moves the cursor to the editing window on the right.
- **Alt+3** moves the cursor to the Command Reference pull down menu.
- **Alt+4** moves the cursor to the terminal window.

The Edit Windows

Y Term provides the ability to add comments to the program. Any program line beginning with a double slash (//) will be ignored as the program is sent to the SMC. This allows you to add as many comments as needed without overloading the controller's memory with comments.

Programs in the SMC can be up to 1,000 lines, with a maximum of 80 characters per line (excluding lines that begin with a double slash, which are not loaded into the controller).

The Toolbar and the Pop-up menu provide program editing functions.

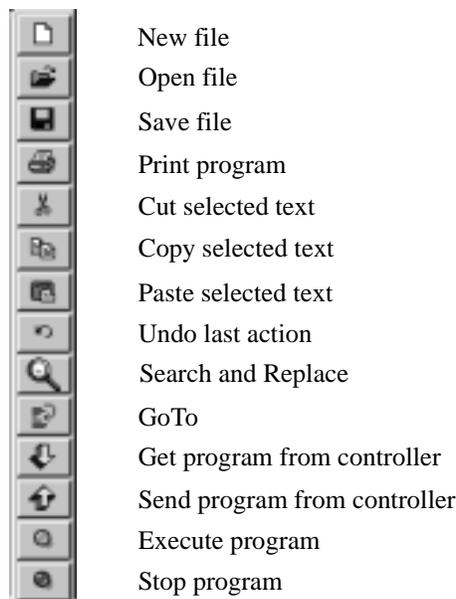


Figure 7- The Edit Toolbar.

Note: The functions accessed through the Toolbar are for the active edit window.

If monitor resolution is 1024 x 768 or more and/or when a window is in full screen mode, five (5) additional buttons will appear as follows:

- Search and Replace: displays dialog box for search and replacement of text in a program.
- Go to: displays dialog box for accessing to a given line number in a program.
- Swap: exchanges the visible program for the one that was not visible (when the program window is maximized).

- Execute: (green light) sends the EXECUTE ("XQ") command to the controller.
- Stop: (red light) sends the STOP ("ST") command to the controller.

The Pop-up Menu is accessed by clicking the mouse's right button while the cursor is located in one of the edit windows. The Active window is highlighted. The pop-up menu is shown below:



Figure 8: The Edit Pop-up Menu

The pop-up menu has the following options:

- Select **Cut** to transfer the current selection onto the clipboard.
- Select **Copy** to duplicate the current selection onto the clipboard.
- Select **Paste** to insert the contents of the clipboard onto the page at the current cursor position.
- Select **Undo** to cancel the last (or more) edit.
- Select **Goto** to move to a specific line in your program.
- Select **Print** to print out the program or selected text (in the active window) on the default printer. To change the default printer, refer to your operating system manual.
- Mark **Send Compressed** to remove all "/" comments, spaces and to delete empty lines before sending the program to the controller. Select this again to send the program to the "as is" except for changing all "/" comments to native SMC comments ("NO").

Note: Send Compressed is the default setting. A compressed program will execute slightly faster.

- Select **Array Mode** to use the edit window to send, receive, load and save array data . Comments are not allowed in arrays. When the **Array Mode** is selected, **Send Compressed** is disabled. All arrays are compressed before being sent to the controller.
- Select **Search and Replace** to search the program in the active window for text. If text is highlighted before selecting this function, the selected text will be used as the text to seek. You can also use this to replace text in the program.

The Command Reference Window



Figure 9: SMC Command Reference Window.

The Command Reference window provides a reference for the SMC programming language. Get help on any command by the use of two methods:

1. When one of the two programming windows is selected, the Command Reference window will update to show help for the command on the current line.
2. You may view the help for any command by entering the two letter command in the Keywords box (Figure 9). By clicking on the **down arrow** (located next to the box) a list of available commands will appear. Select the desired command. You can scroll up and down the list with the vertical scroll bar (located next to the list) to view keywords.

If detailed help on SMC commands is needed, press the **Manual (A)** button. The SMC Online Manual (if installed) will come up in a separate window.

To copy text from the Command Reference window, select the text to be copied by pressing on the mouse button while dragging the cursor over the text. Release the mouse button and click on **Copy (B)** to duplicate the selected text onto the clipboard.

A double click on the Command Reference window will display the window in full screen mode. Double click again to return to the normal view.

The Terminal Window

The Terminal window functions as a terminal emulator connected to the SMC. Commands typed here are executed by the motion controller after the **(Enter)** or **(;)** (**semi colon**) key is pressed.

The Terminal window can also be used (by the SMC) to display controller status information such as I/O, debug messages, input prompts, error messages, etc.

The **Paste** button completes the transfer of the text (from the clipboard) onto the Terminal window.

The Terminal window has a pop-up menu similar to the Editing window that is accessed by clicking the right mouse button while the cursor is on the Terminal window. The pop-up menu provides functions to communicate with the controller such as enabling or disabling servo power, status reporting, and logging features.

When the terminal window pop-up menu is active, the following menu will appear:

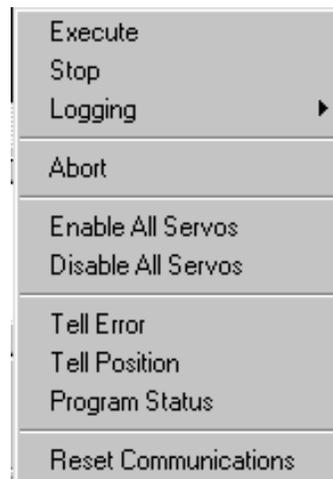


Figure 10: The Communication Pop-up Menu.

The pop-up menu has the following options:

- Select **Execute** to start the current program in the controller.
- Select **Stop** to stop any running motors. If no motors are running, **Stop** will stop the current program in the controller.
- Select **Logging** to access the sub-menu used to control the capture file (SMCLOG.LOG) of events in the terminal window.
- Select sub-command **Start Logging** to start writing all the events to the SMCLOG.LOG file
- Select sub-command **Stop Logging** to stop writing to the SMCLOG.LOG file.
- Select sub-command **View Log File** to load the SMCLOG.LOG file in Microsoft Write and view it.
- Select **Abort** to stop the execution of the current program in the controller.
- Select **Enable all Servos** to energize (enable) all servos.
- Select **Disable all Servos** to de-energize (disable) all servos.
- Select **Tell Error** to display the current position error of all servo motors.
- Select **Tell Position** to display the current position of all the connected servo motors.
- Select **Program Status** to observe program execution. See Program Monitoring.
- Select **Reset Communication** to reset the communication channel between the PC and the SMC. This clears any existing communications by closing the serial port, restarting it again, and verifying that Y Term can communicate with the SMC.

Notes: If the log file is started and not stopped, it will continue to log the events in the Terminal window.

The file size will continue to increase until you turn it off or when you exit Y Term.

Program Monitoring

Once a program has been created and sent to the controller, you can now execute the program and monitor its progress with this function. The Program Status window, shown in Figure 11, is accessed through the pop-up menu on the Terminal window.

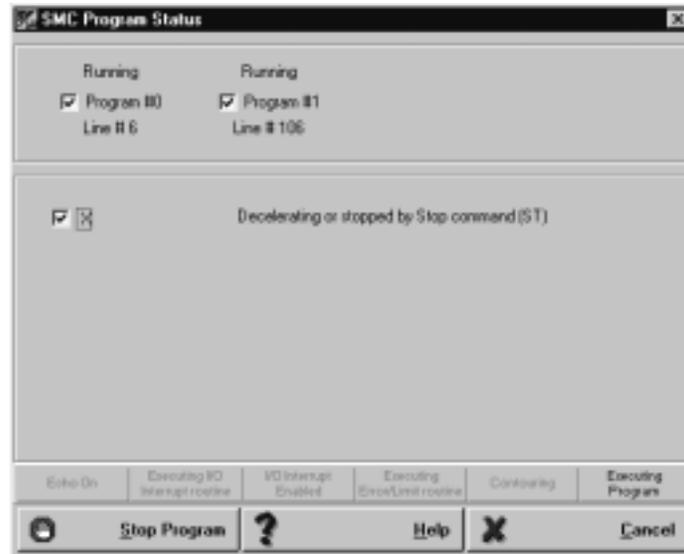


Figure 11: The Program Status Screen.

It is possible to execute the controller's program from the Terminal window or the Pop-up menu of the Terminal window, and then view the Program Status.

Programs are executed by clicking on the left mouse button. When a program is executing, the button text will say "Stop Program", and when the program is halted it will indicate "Execute Program."

Select **Cancel** to stop monitoring and return to the Programming screen.

Once the program is running, the current status of each of the four possible programs is displayed at the top of the screen. This includes the state of the program (Running, At Trippoint and Not Running) and the current line being executed.

The lower portion of the screen will indicate the state of the axes. Select the axes to monitor.

A status bar at the bottom of the screen indicates the SMC status byte.

In the event of a program error, the SMC stops the execution of the program. Y Term will display the reported error and the line on which it occurred. This will replace the top portion of the window (which displayed the programs status) with the Error Report as shown below in Figure 12.

You can restart the programs by selecting **Execute Program**.



Figure 12: Error reporting in the Program Monitoring Screen.

The Next Button

To switch to the Tuning Screen, click the Next button. The **Next** button is used to advance to the next screen in Y Term. The **Next** button icon will appear on each screen located in the lower right corner.



Figure 13: The "Next" Button

The Tuning Screen

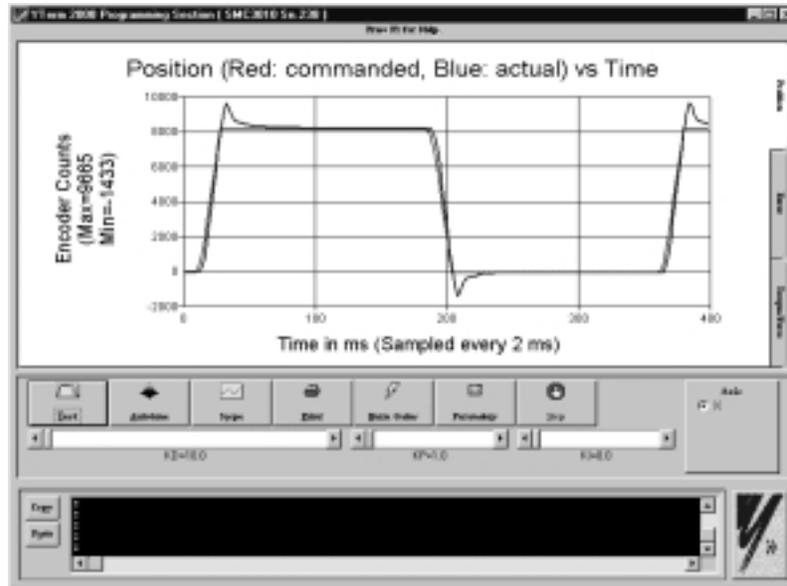


Figure 14: Tuning Screen

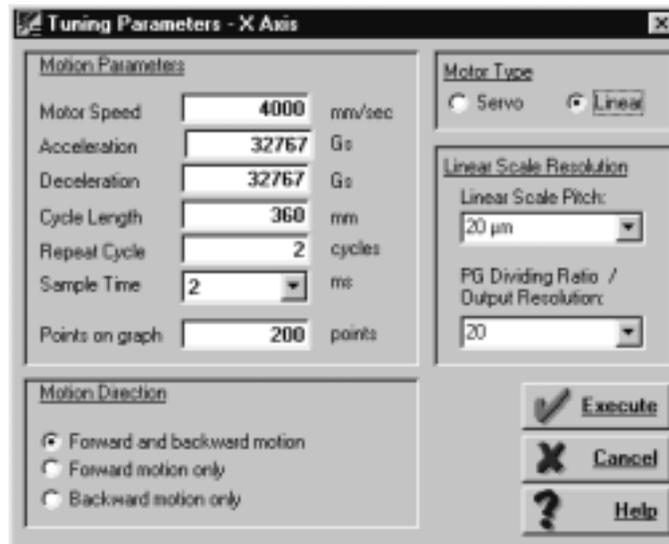


Figure 14A: Tuning Screen (Linear Servo Motor)

The Tuning screens (Figures 14 and 14A), are used to set up the gains of the servo motors connected to the SMC. See the SMC User's Manual for detailed explanation about tuning a servo system.

The Terminal screen is not resizable.

Note: Use the Axis Selection Panel to select the motor to tune. You are able to tune only one motor at a time.

Manual Tuning

See the SMC User's Manual for proper tuning technique.

In order to manually tune a servo system connected to the SMC Controller:

1. Select the axis by clicking on the appropriate radio button on the axis selection panel.
2. Use the terminal window to send the SH* (where * = X, Y, Z, W, E, F, G, H) command to enable the servo motor.
3. Set default values for the gains.
4. Increase KP, KD, KI gains accordingly, by moving the horizontal scroll bars above each gain label. Moving the bar to the right increases the value of the gain, moving it to the left decreases it.
5. For KI and KP, click inside the bar to change the value by 1. Click the arrow on the bar to change the value by 0.1.
6. For KD, click inside the bar to change value by 10. Click the arrow on the bar to change value by 1.

Autotuning

- Y Term includes a routine that autotunes a connected servo system. This function is able to tune most systems. Systems can be tuned to any one of five levels of rigidity.
- See the appendix for details on the theory of Autotuning.

In order to Autotune a servo system connected to the SMC:

1. Select the axis to be tuned, by clicking on the appropriate icon button in the axis selection panel.
2. Use the terminal window to send the SH* (where * = X, Y, Z, W, E, F, G, H) command to enable the servo motor.
3. Click on the **Autotune** button. The dialog screens shown in Figures 15 and 15A will appear. If Autotuning was previously performed on this axis, previous values used will be loaded.

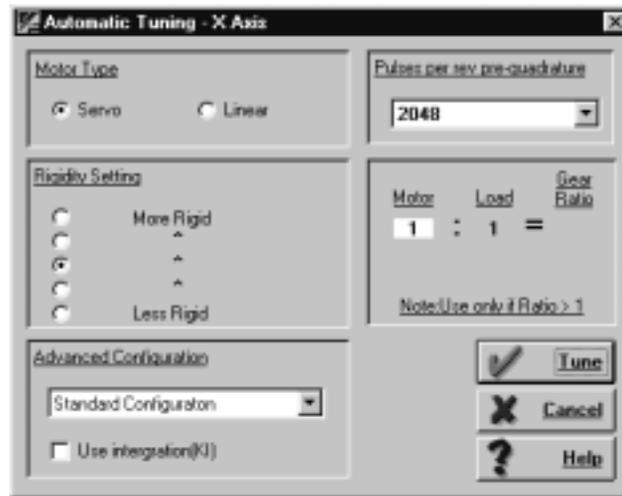


Figure 15: Autotuning Dialog Screen



Figure 15A. Autotuning Dialog Screen

4. Select the level of rigidity that you want to tune the system from the Rigidity Setting panel.
5. Select the desired machine configuration (appearing in the Advanced Configuration panel) from the available options list.
6. Enter the motor to load gear ratio.
7. Check the **Use Integrator (KI)** box to include the integration constant of the PID loop in the autotune calculations.
8. Select the correct number of Pulse per rev (revolution) pre-quadrature for your specific motor or the linear scale resolution if a linear encoder is to be turned.
9. Click on **Tune** to execute the Autotune program. Click **Cancel** to close the dialog screen and cancel the Autotune operation.

Testing the Tuning

Once a servo system is tuned, you can test the results of the tuning and observe the performance of the system. The test will execute a program based on a user-defined motion profile.

In order to run the test program:

1. Select the axis (to which it is connected) by clicking on the appropriate icon button in the axis selection panel.
2. Use the terminal window to send the SH* (where * = X, Y, Z, W, E, F, G, H) command to enable the servo motors
3. Click on **Test**. One of the dialog boxes shown below will appear.

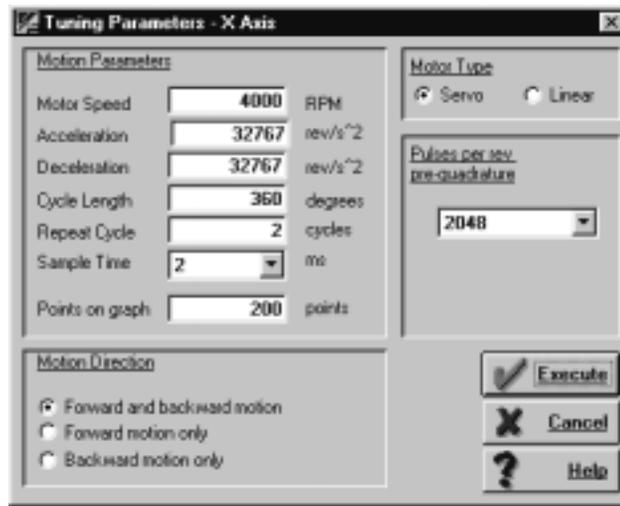


Figure 16: Tune Test Dialog Screen - Servo

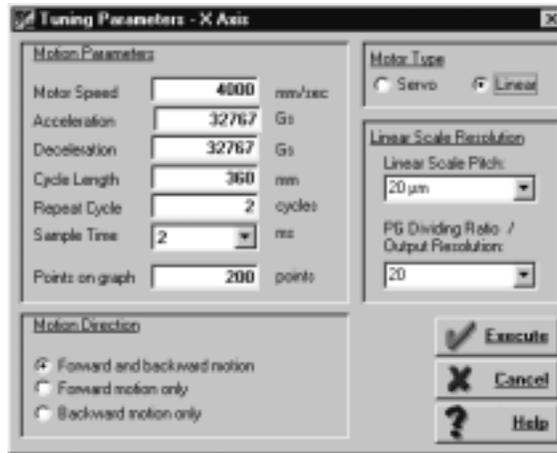
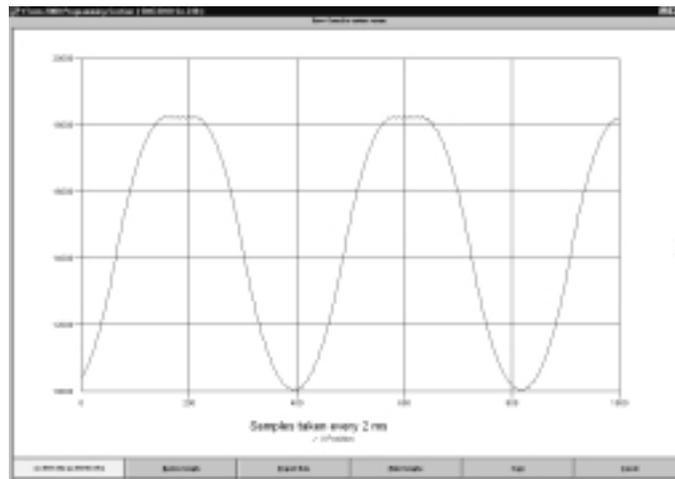


Figure 16A: Tune Test Dialog Screen - Linear

4. Define the motion profile by entering the motion parameter fields in the screen's appropriate boxes. Be sure to select the direction of motion and the correct Encoder pulses per rev.
5. Click on **Execute** to execute the test program.

Viewing the Tune Test Results

After the controller completes sampling the data, the information is transferred to the PC and displayed as follows:



Printing The Tuning Test Graphs

The graphs of the tuning test with all of the test parameters can be printed by clicking on the **Print** button. Yterm will print out the three graphs on the default printer. To change the printer, use Window's Printer Manager Program to change the default printer.

Storage Scope

The storage scope is used to store data. This allows the user to choose the parameters observed and duration. The storage scope has the capability to store up to four parameters (dependent on the type of graph selected).

To run the Storage Scope:

1. Click on **Scope** on the Tuning Screen to display the screen shown below:

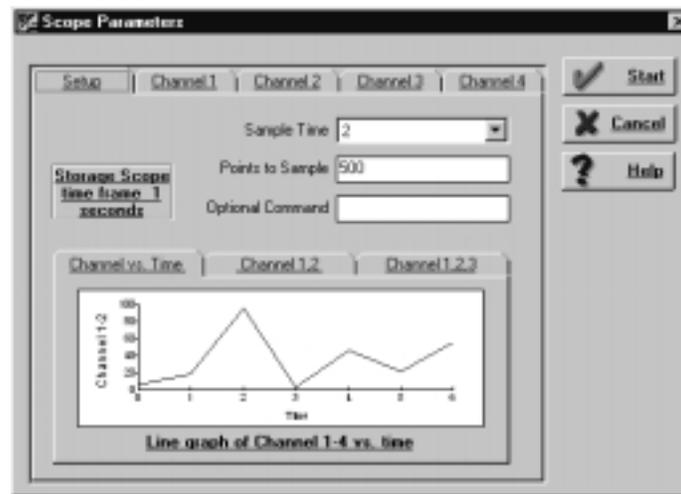


Figure 17: Storage Scope Parameters Screen

2. Determine and select Sample Time (in milliseconds) so the Controller will sample the selected data at the appropriate intervals.
3. Determine number of points to sample and display on the graph.
4. The time frame in which the controller samples the data is a function of: Sample Time x Points to Graph. This number is displayed in Scope Time frame box on the Storage Scope Graph.
5. Enter an optional command to be executed before starting to store the data. Example: Enter the command XQ to execute the program on the controller.
6. Choose the type of graph.

Three graph types are available:

- Time Graph - displays up to four (4) channels of data as a function of time.
- Two Dimensional Data Graph - displays a plotted line as a function of two (2) channels of data.
- Three Dimensional Data Graph - displays a plotted line as a function of three (3) channels of data.

7. Define the data to be sampled. Click on the desired channel tab.

The dialog box appears as follows:



Figure 18: Storage Scope Parameters Channel Screen

8. Select Axis (or I/O) to sample. Select **none** if nothing is to be stored on this channel).
9. Select the **Data** to be stored.
10. Select the **Color** of the line to be plotted.
11. Select the **Thickness** of the line to be plotted.

Note: Two Dimensional and Three Dimension graphs' line color and thickness is determined by the linecolor and thickness selected in Channel #1.

12. Enter Engineering Units value.

Note: One (1) is the minimum engineering unit conversion. Use the engineering units field to convert stored data from encoder counts to the desired unit.

13. Repeat Steps 7 through 11 for other data parameters to be stored.
14. Click **Start** to begin storing data.

Viewing the Scope Results

After the controller completes sampling the data, the information is transferred to the computer and displayed as follows:

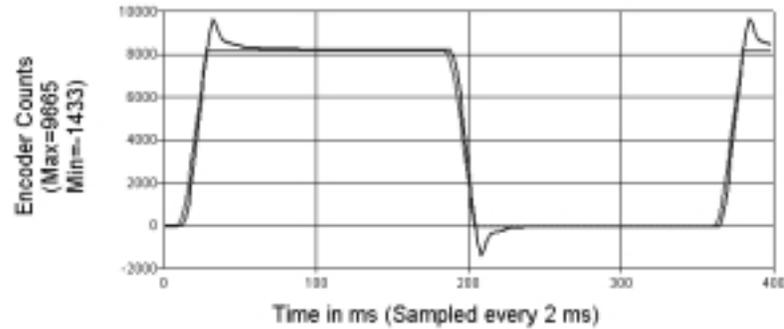


Figure 19: Example of Storage Scope Graph Screen

Saving the Gains on the SMC Controller

To write the gains to the motion controller, click on **Burn Gains** button. After verifying this, the gains are burned onto the SMC's EPROM (This is the equivalent to typing BN in the Terminal window). The gains will now be saved and not be lost after the power disconnected.

Notes: If the gains are not burned, they will be lost after a software or hardware reset of the SMC.

The motor state at power up on the SMC (enabled or disabled) is saved at this time.

SMC Parameter Utility

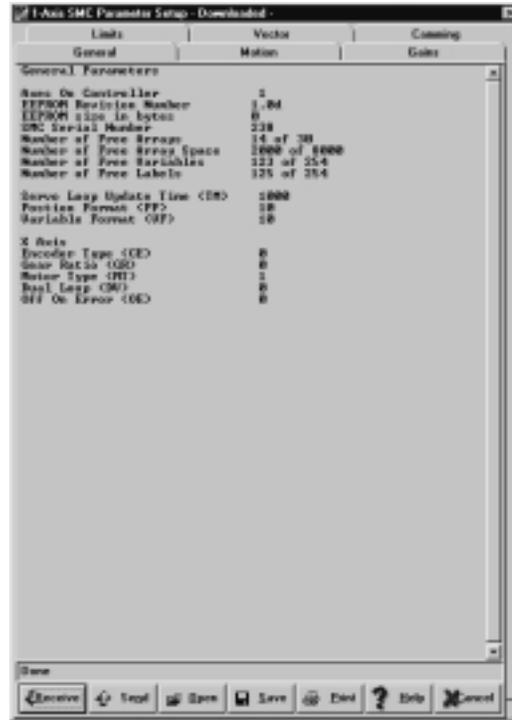


Figure 20: Parameter Setup Screen

The SMC Parameter Setup screen allows you to upload, download, save-to-file, and load-from-file parameter sets for the SMC. You can use it for quick setup of SMC Controllers, backup of setups, debugging of applications, etc.

Parameters are grouped according to function. By clicking on the desired function's tab, the current parameters of that group are displayed:

- Select **Receive** to download the SMC parameters into Y Term.
- Select **Open** to open a parameter set from a file.
- Select **Send** to send the current parameters set to the SMC.
- Select **Save** to save the current parameter set into a file.
- Select **Print** to print the current parameter set on the default printer. To change the printer, use Window's Printer Manager Program to change the default printer.

Note: Open will open the parameters into Y Term, but will not send them to the SMC.

Sigma Servo Amplifier Setup

The Sigma servo amplifier setup program is designed for configuring the amplifier to work with the SMC 2000 Controller only.

Disconnect the serial communications cable from the SMC and connect the Yaskawa YS-11 Serial Communication Cable to the servopack. Once this is done, you can run the setup program from Y Term using the Servopack button.

Connection will be established with the Servo amplifier, the result is a return of the servo amplifier's present settings, and should look similar to Figure 21.

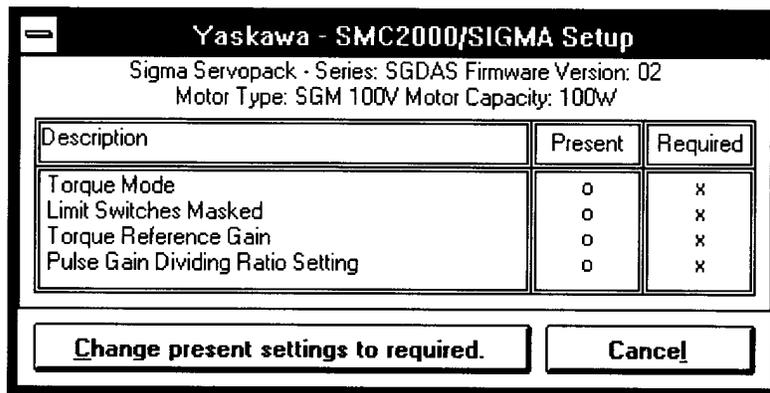


Figure 21: SMC/SIGMA Setup

1. Click on **Cancel** to cancel the current servo amplifier setup.
2. Click on **Change present settings to required** button to change the servo amplifier settings to match the required ones. After this is done, you will be asked if you want to install an absolute encoder. If yes, you will be asked to select the desired pulse gain dividing ratio.

Now your servo amplifier is configured for work with the SMC. The result should now look like Figure 22.

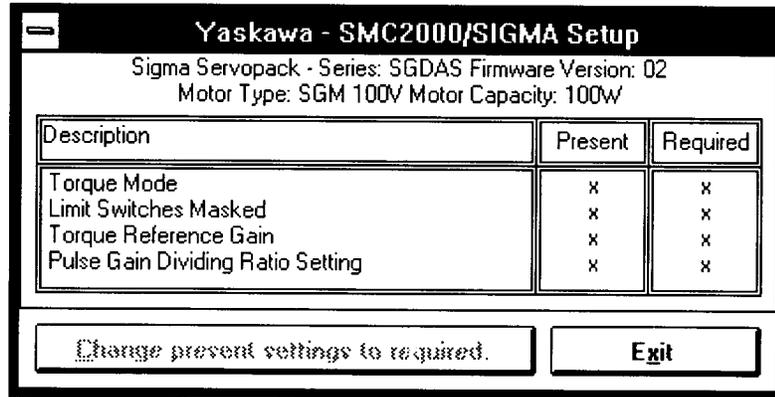


Figure 22: SMC/SIGMA Setup screen (after setup is complete).

Click on **Exit** to return to Y Term. Disconnect the Yaskawa YS-11 Serial communications cable. Reconnect the standard serial communications cable. You can now resume connection to the SMC via Y Term.

Emergency Stop Button

In the event that you need to stop the motion of the attached servo system, click on the **Stop** button. This will issue Abort (AB) and Motor Off (MO) commands to the SMC for the selected axis. While executing Autotune and Tune Test, the stop button will stop the selected axis, and cancel the function, otherwise all axes will be stopped.

Note: The Abort command will stop all program execution. The Motor Off command will turn off the command functions to the selected motor.

The Monitoring Screen

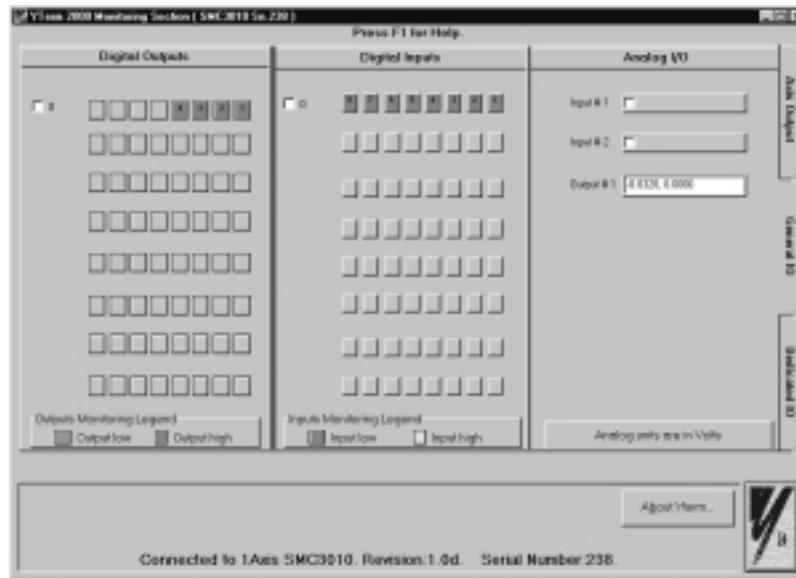


Figure 23: The Monitoring Section Screen.

The Monitoring Section screen, shown in Figure 23, provides you with the ability to observe the status of selected axes. This screen can be used to track motion parameters, inputs, and outputs.

You can choose specific axes to be monitored, and select which parameters are to be returned. There are tabs to select from three screens of SMC status information.

- 1.Axis Output - Position, Position Error, Speed and Torque.
- 2.General IO - Digital Inputs, Digital Outputs and Analog Inputs.
- 3.Dedicated IO - Forward, Backward Limit and Home switches.

Axis Output

Selecting the **Axis Output** tab will display a screen to allow you to monitor any servo system on the SMC's axes. The monitoring consists of returning in real-time, the values of any of the following parameters:

- Position
- Position Error
- Speed
- Torque/Force

Select any combination of the available axes to monitor. This is done by clicking on the button with the letter representing the desired axis in the data monitoring panel. The buttons are labeled X, Y, Z, W, E, F, G, H.

To stop monitoring an axis, press again on the **Axis Selection** button for that axis. To select a parameter for monitoring, click the check box located left of the name label of the desired parameter.

The axis outputs can be displayed in listing or in graphical format as shown in Figures 24-25.

To switch between the two modes of display screen, Press the **Display List/Display Graph** button on the Axis Output Screen.



Figure 24: Axis Output Screen - List Display

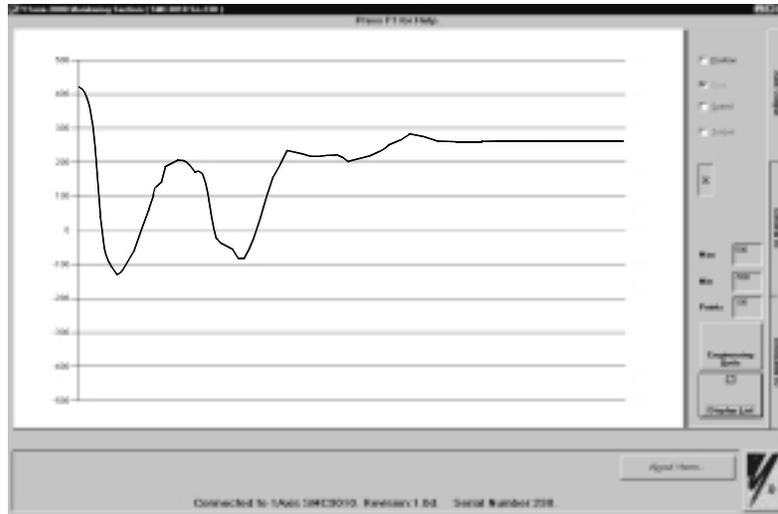


Figure 25: Axis Output Screen - Graphic Display

The Max. and Min. fields are used to enter the upper and lower range of values to be displayed. The points field will determine how many points of data are displayed on the graph.

Note: Be certain that the Min. and Max. values include the actual range of values that the controller is reporting. This can be verified through the listing mode (see below).

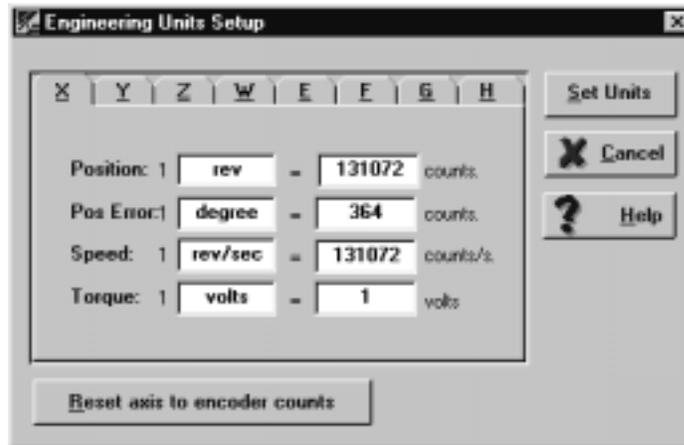


Figure 26: Engineering Unit Setup Screen

The Engineering Unit Setup Screen enables the user to enter pre-determined motions (engineering units) into the controller to be able to retrieve data in the units of measure related to the particular application.

To enter the engineering units for a program:

1. Select the desired Axis.
2. Enter name in the parameter (position, pos. error, speed, torque).
3. Enter the engineering unit factor (counts, counts/s., volts).
4. Select Set Units.

Click on **Reset axis to encoder counts** to restore to default values and continue monitoring with the default (1) engineering units.

General I/O

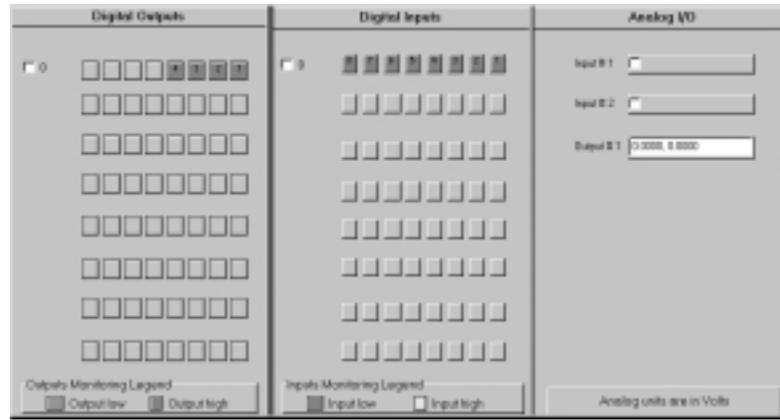


Figure 27: General IO Monitoring Screen.

Selecting the General IO tab will allow you to monitor any I/O connected to the SMC. The monitoring consists of returning in real-time, the values of any of the following parameters:

- Digital Outputs
- Digital Inputs
- Analog Inputs

The digital inputs and outputs are banked. In groups of eight, click on the check box located to the left of the bank to activate. The bank will update in real time as the status on the SMC changes. Check boxes only appear for I/O that exist on the connected SMC.

For digital outputs, green boxes indicate low (i.e. "ON"), dark gray indicate high (i.e. "OFF"), and light gray indicates not available.

For digital inputs, yellow boxes indicate high (i.e. "ON"), dark gray indicates low (i.e. "OFF"), and light gray are not available.

The analog inputs are activated in a similar way, each one with its own check box. The analog value of the input is displayed next to it's check box.

You can "force" the status of a digital output by clicking the buttons. After the output is clicked, the status will change from high to low, or low to high, identified by a color change when YTerm reads the output status from the controller.

Dedicated I/O

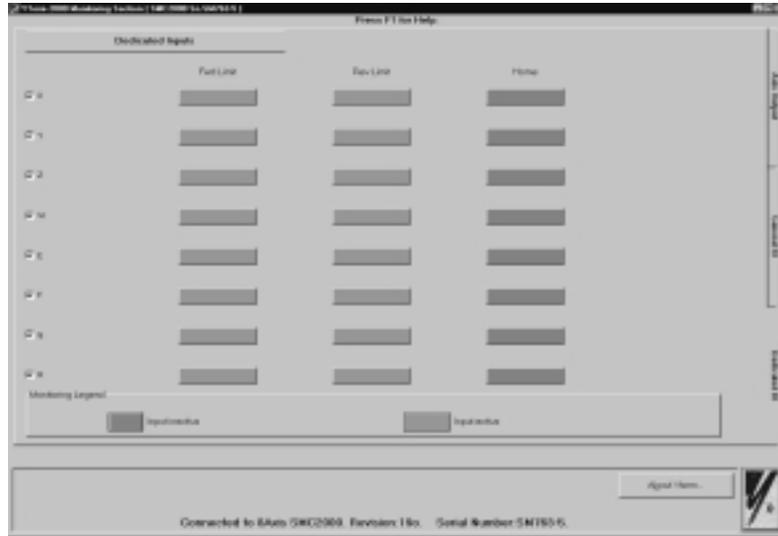


Figure 28: Dedicated IO Monitoring Screen.

Selecting the **Dedicated IO** tab will allow you to monitor the limits and home inputs on the SMC. The monitoring consists of returning, the values of any of the following parameters in real-time:

- Forward Hardware Limits
- Reverse Hardware Limits
- Home Switches

The dedicated I/O are banked in groups of eight. To make a bank active, click on the check box next to the bank. Check boxes only appear for I/Os that are connected on the SMC.

Green boxes indicate inputs that are active, regardless of their on-state configuration, dark gray indicates the inputs are not active, and light gray indicates not available.

Appendix

SMC to RS-232 Connection (SMCCBL7 cable)

The layout of the connection cable between the SMC and the PC serial port (RS-232) is as follows:

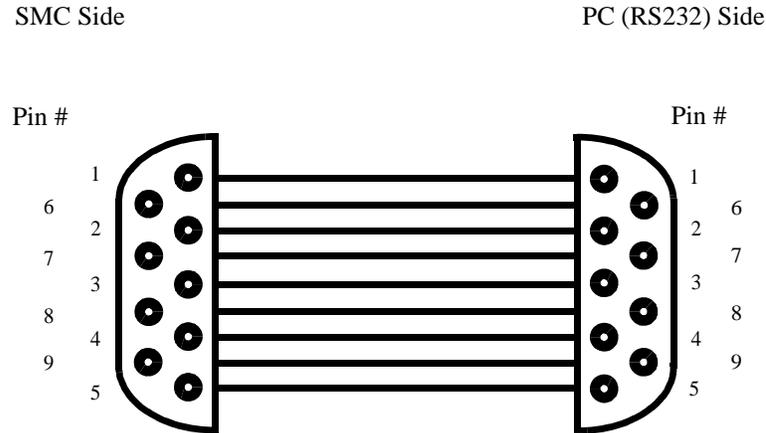


Figure 29: SMC / Personal Computer Connection Cable Layout.

Note: Both connectors are 9 pin female.

Table 1: Pin Descriptions

<u>Pin Number</u>	<u>Pin Name</u>	<u>Function</u>
1	CTS	output
2	Transmit Data	output
3	Receive Data	input
4	RTS	input
5	GND	ground
6	CTS	output
7	RTS	input
8	CTS	output
9	No Connect / 5V	not used

Sigma servo amplifier to PC Connection (YS-11 cable)

The layout of the cable, between the PC serial port (RS-232) and the Sigma Servo amplifier is as follows:

Sigma Servopack Side

PC (RS232) Side

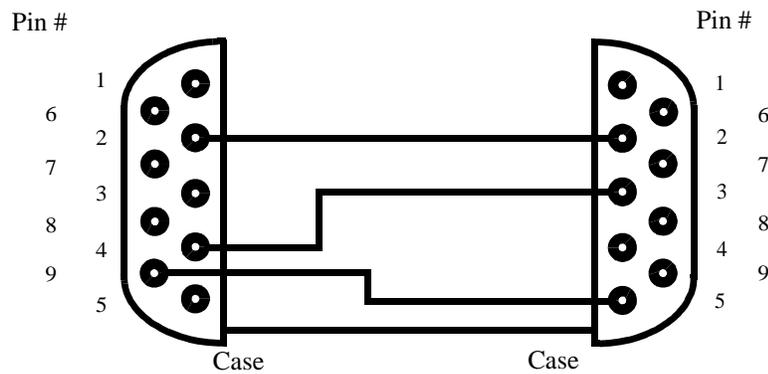


Figure 30: PC /Sigma Servo amplifier Communication Cable Layout.

Table 2: Pin Descriptions (PC Side- 9 PIN Female)

<u>Pin Number</u>	<u>Pin Name</u>	<u>Function</u>
1	n/c	not used
2	Transmit Data	output
3	Receive Data	input
4	n/c	not used
5	GND	ground
6	n/c	not used
7	n/c	not used
8	n/c	not used
9	n/c	not used

Table 3: Pin Description (Servo Amplifier Side - 9 Pin Male)

<u>Pin Number</u>	<u>Pin Name</u>	<u>Function</u>
2	TXD - Transmit Data	output
4	RXD - Receive Data	input
9	GND	ground

Theory of Operation of the Autotuning Algorithm

The motor is jogged in a positive direction at 3.75 R.P.M. while 5000 torque reference values are recorded and averaged. The purpose of this is to get an idea of the torque required to overcome friction. This is done with minimal gains settings of $KD=10$, $KP=1$, and $KI=0$.

The PID loop is shut off ($KD=0$, $KP=0$, and $KI=0$) and a voltage of 1.5 volts is applied to the motor command output for 100 msec. The motor position is recorded before and after this voltage is applied to determine how far the motor traveled in 100 msec. The farther it moved, the lower the inertia mismatch.

Calculations are made to determine KD , KP , and KI based on the inertia and selected rigidity level.

The motor is moved backward and forward (approximately 11 degrees for an 1:1 gear ratio, more for higher ratios). The motion is repeated as the gains are increased until an oscillation is detected at the end of the move. When this happens, the gains are decreased. If the rigidity level is other than 1, the process is repeated using less reduction in the gains after oscillation while watching for smaller amounts of oscillation.

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