PRODUCT: SMC-4000

SUBJECT: DEMONSTRATING SMC-4000

CATEGORY: PRODUCT NOTE

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SMC-4000 Demo Program

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The SMC4000 Sales Demo consists for the following components:

1) SMC4040
1) Sigma II amplifier & motor
1) Legend Amplifier & motor
1) V7 Inverter with Ethernet module
1) Netgear hub
8) Dedicated inputs for two axes
8) General purpose I/O points

Note: the F7 inverter is not functional until the Ethernet cards become available. Most demos were modified to operate the inverter in August 2004.

Preparing for the demonstration:

What You will need:
1. SMC-4000 Demo unit (P/N DEMO4000)
2. Y-Term software v7.0.1 or greater
3. SMCCBL7 communication cable (supplied with Y-Term or an Ethernet cable)
4. The File "Official SMC4000 Demo Program.SMC" from Yaskawa's FTP site.

Supporting Documentation:

YEA-CHA-SMC-4.1
YEA-SIA-SMC-4.2a   (User's Manual Feb 2004) or greater
YEA-SIA-SMC-1.1b   (Software Manual)
YEA-TOA-SMC-4.3   (Startup Guide / Wiring)

Setting up the demo unit:
1. Open the case and locate the black cables labeled "X" and "Y" near the SMC-4000. They have 20 pin 3M connectors, and must be attached to the "X" & "Y" connectors on the SMC4000 controller.
2. Connect a blue Ethernet cable from the SMC-4000 to the Netgear hub.
3. Note: If using Ethernet to communicate to the controller, the official demo program assigns 192.168.1.040 as the IP address of the SMC-4000. If using a computer to communicate to the SMC, set the computer's IP address to 192.168.1.60.

4. Connect a blue Ethernet cable from the V7 Inverter to the Netgear hub.
5. Connect the 50-pin I/O cable to CN5 on the SMC-4000.
6. If using serial communication, connect the communication cable to the CN6 connector.
7. Start with all general inputs in the middle state of the switches.
8. Connect the 110 VAC power cable near the lower right of the demo unit.
9. If the controller has the demo program burned in, it will automatically run, if not, download it with Y-Term now. After downloading, go to the terminal window and type "BP" to save the program in flash memory.
10. The reset input must be in the middle/down state. (If this is "up," the controller will always reset.)

If reconfiguration is necessary…

The parameters and settings of each piece of hardware on the demo unit are likely to be set properly. However, if the demo program is not working as expected, it may be due to an incorrect parameter setting in one of the pieces of hardware.

SMC-4000
1. Default Reset:
   a. Ensure that all SMC parameters, gains, etc are at factory default:
      i. Connect to the SMC using the serial connection
      ii. Type "RS" in the terminal while holding the "Ctrl" key. This will produce strange looking characters in the terminal.
      iii. Hit the "Enter" key and in a couple seconds you should hear the controller reset with a 'click' sound.
      iv. Proceed to load the demo program.

V7 INVERTER
1. Verify the Inverter IP address
   a. The default IP address for the V7 Inverter is 192.168.1.20. If it has been changed, it should be changed back to default. Some may have been changed to 192.168.2.20 or 192.168.1.1.
      i. Set the computer's IP address to 192.168.1.60 (set as shown in the eLM),
      ii. Connect the Ethernet cable to the hub,
      iii. Open Internet Explorer and

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iv. Type in the possible inverter IP addresses. One of them should load the inverter homepage stored on the inverter itself.
v. If not, change the computer's IP address to 192.168.2.60 and type 192.168.2.20 in Internet Explorer.
vi. Once connected to the inverter homepage, be sure that the IP address is set to the default: 192.168.1.20. If it is not, change it within the homepage itself.
vii. If none of the IP addresses work, then it is possible that the IP address is unknown. It may be necessary to reset the Ethernet card to factory default. This is quite difficult to do because it involves removing the circuit board from the inverter, shorting jumpers, and cycling power.
1. (See eLM.AFD7.07.ModbusTCPIP on Yaskawa.com).
2. Inverter Parameter Settings: Be sure the following are set:
   a. n001 = 4   (unlock parameters)
   b. n002 = 1   (open loop vector)
   c. n003 = 3   (Operation Method Selection set to option card)
   d. n004 = 9   (Reference Selection set to option card)
   e. n010 = 1   (Disconnection of Digital operator produces fault)
   f. Check and set these on the digital operator by 1) pressing DSPL until n001 is displayed. 2) Use the arrow keys to select the parameter, 3) the DATA/ENTER key to set the parameter, and 4) the arrow keys to set the value, and finally 5) the DATA/ENTER key to save the value. 6) A power cycle may also be necessary. These parameters may also be set using DriveWizard and a special serial cable.

SIGMA 2 Amplifier (SGDH) Parameter Settings

1. Reset Parameters Fn005:
   a. Press MODE/SET until "Fn000" is displayed
   b. Press ^ arrow 4 times until Fn005 is displayed
   c. Hold DATA/< for 1 second until display changes to "pinit" and release
   d. Press MODE/SET and wait for display to finish flashing "done"
   e. Cycle power
2. Torque Mode Pn000.1=2:
   a. Press MODE/SET until "Pn000" is displayed
   b. Hold DATA/< for 1 second until display changes to "n0000"
   c. Press Data/< 1 time until nibble 1 flashes (n0000)
   d. Press ^ arrow 1 time until display changes to "n0020"
   e. Press MODE/SET. Display should flash quickly
   f. Cycle power

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3. Auto-Tuning Off Pn110.0=2:
   a. Press MODE/SET until "Pn000" is displayed
   b. Use arrow buttons and DATA/< to change display until "Pn110" is displayed
   c. Hold DATA/< for 1 second until display changes to "n0000"
   d. Press ^ arrow 2 times until display changes to "n0012"
   e. Press MODE/SET. Display should flash quickly
   f. Cycle power
4. Over-Travels Off Pn50A.3=8 and Pn50B.0=8:
   a. Follow procedure similar to above to select Pn50A or Pn50B
   b. Pn50A should be changed to "n8100"
   c. Pn50B should be changed to "n6548"
   d. Cycle power
5. Absolute Encoder as Incremental and 8192 post-quad resolution: *
   a. Follow procedure similar to above to select Pn002 and Pn201
   b. Pn002 should be changed to "n0100"
   c. Pn201 should be changed to "002048" pre-quad pulses per rev
6. (Optional) Torque reference scaling and Reference Filter to match LEGEND
   a. Follow procedure similar to above to select Pn400 and Pn401
   b. Pn400 should be changed to 67
   c. Pn401 should be changed to 10

* Absolute encoder parameters only need to be set when using an SMC-4000 demo from the Training Department. These demos are equipped with a 16-bit absolute encoder. The standard demo is not.

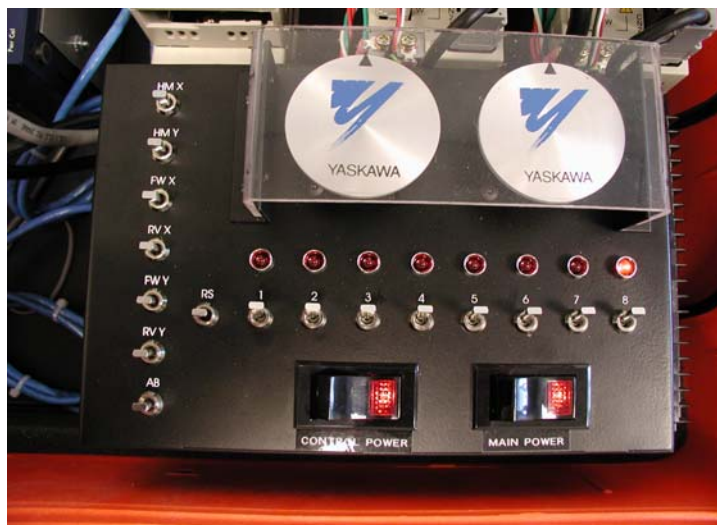## LEGEND (SGDG) Amplifier Switch Settings
1. Switch Settings
   a. All switches should be set to ZERO, or ON.

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The following demonstrations can be performed with the supplied program
"Official SMC4000 Demo Program.SMC"

Check for any updates to this documentation or the SMC example program:

http://www.yaskawa.com/site/webfaqmotion.nsf/SearchV/86256ED000746B6A86256F260071CD05?OpenDocument

Or go to the home page www.yaskawa.com and type "SMC4000" in the search box.

All Switches start in the UP/middle position (except RS.)

Program Execution

Homing – Type "MODE=1" in Y-Term's terminal window or click general input #1 down and both servos will find the C channel, then do an offset move. The offset can be changed in the program by setting the variables "XOffset" and "YOffset" to the appropriate distance so that the Yaskawa logo on the inertia wheel is horizontal with the demo.

Here's how to align the servos for home on your demo case:

1) Complete homing after setting "XOffset" and "YOffset" to zero.
2) In the terminal window, type ST <Enter> MO <ENTER>
3) Move the servos to the home position by hand. (Yaskawa logo horizontal with demo)
4) In the terminal window, type TP.
5) Use the results of the TP command as the value for the home offset variables.
6) Update the program, then download and BP (burn program)

Indexing – In the terminal window, type "MODE=3" in Y-Term's terminal window or click general input #3 down and both servos will index with different distances. The variables used for indexing are:

IndexX=-8192   (counts)
IndexY=20480   (counts)
Xspeed=100000   (counts/sec)
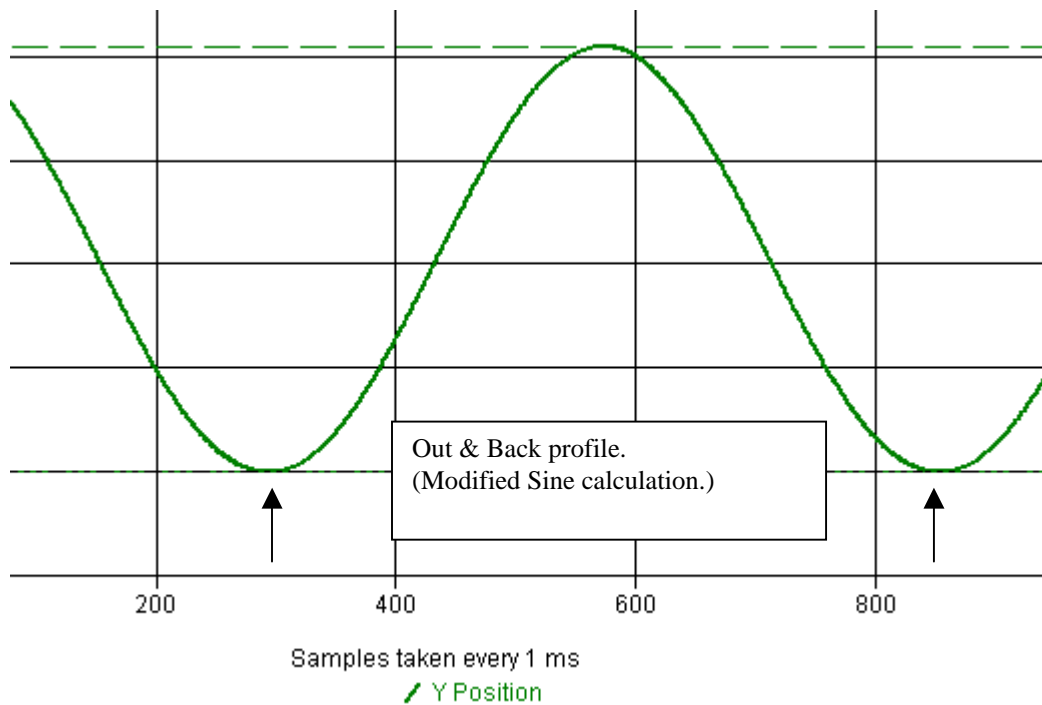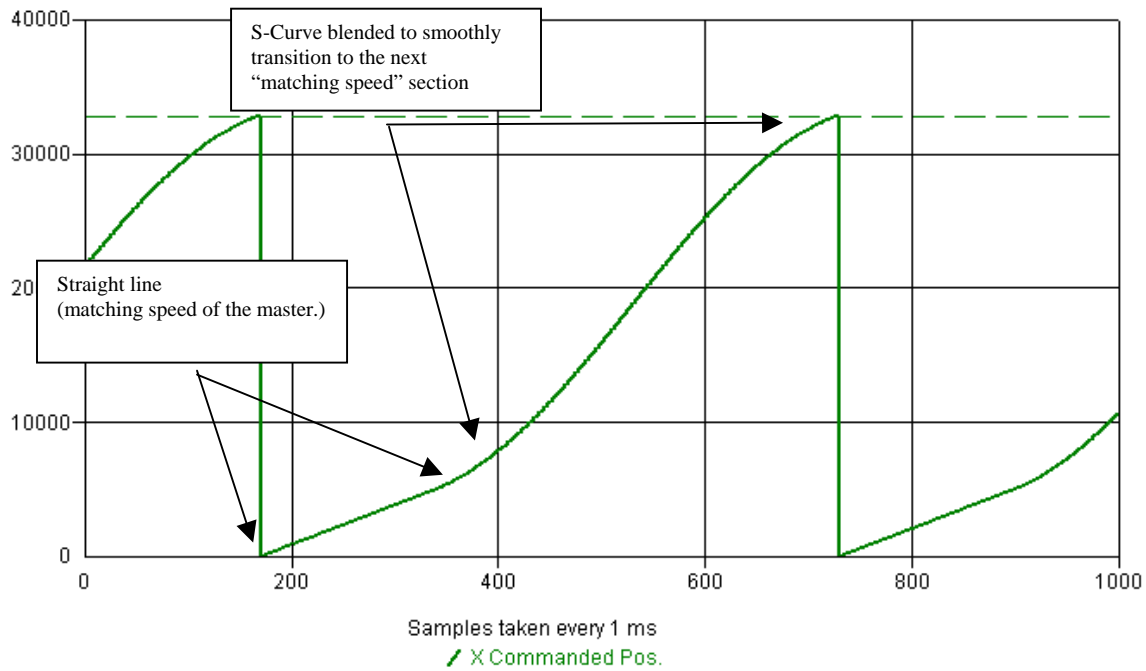Yspeed=25000   (counts/sec)
Dwell=250   (mSec)

They are initialized when the controller powers up, and they can be changed by typing a new value in Yterm's terminal window at any time. Example: Dwell=50.

Outputs 1 & 2 will indicate when the respective servo has finished its move. General outputs 3-8 energize as the X axis travels through its move.

Return input 3 to the up/middle position, or type MODE=0 in Y-Term's terminal window.

Camming – In the terminal window, type "MODE=2" or click the general input #2 down. Both axes will follow the SMC4000's virtual master. To change the master speed, change "CamSpeed" to a value between 2000 and 60000.

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The cam formulas in the program generate cam profile that look like this:

S-Curve blended to smoothly transition to the next "matching speed" section

Straight line (matching speed of the master.)

Samples taken every 1 ms
X Commanded Pos.

Out & Back profile.
(Modified Sine calculation.)

Samples taken every 1 ms
Y Position

Vector Mode – In the terminal window, type "MODE=4" or click general input #4 down. Both servos are commanded to plot a "racetrack" course that can be viewed on Yterm's Scope screen. Five laps are performed in a shrinking pattern, which demonstrates the powerful vector commands. Multiple segments can be pre loaded into the controllers buffer, then executed. This pattern requires 20 segments.
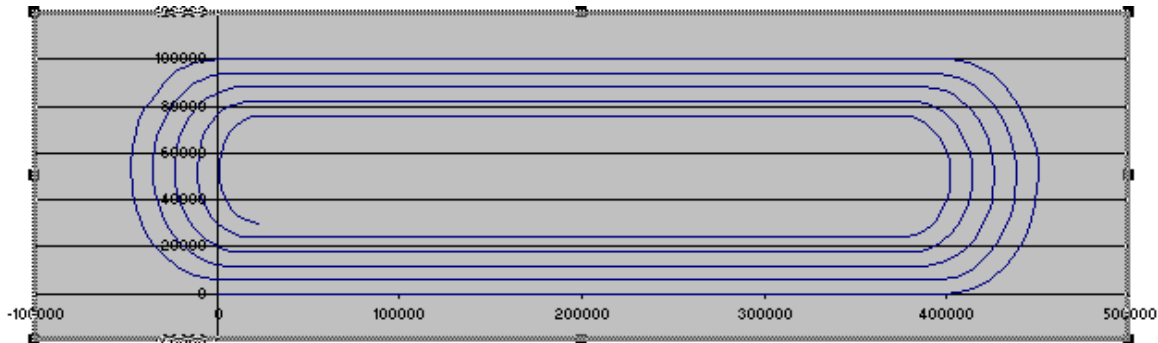
Setting the command, VR (Vector Speed Override) during motion will cause the vector profiler to change speed. Example: VR3 commands the vector path to travel at three times the pre programmed speed.

Inverter Speed control - A separate program thread in the SMC4000 controls communication with the inverter. Output LED #6 blinks during the time that communication with the inverter is being attempted. The light is off when normal communication is occurring.

The default IP address of an inverter is 192.168.1.20. Some inverters we changed to 192.168.2.20 for the demo program in the SMC4000 to communicate with the inverter. (This may have been done when the demos were originally configured.) Use Internet Explorer to connect to the inverter by typing the IP address into the address bar. The inverter contains a web page that allows changing the IP Address. Cycle power after changing it.

Another method to return the Inverter's communication card to the default IP address is to put a jumper across the "C" and "/LD" terminals. This requires removing the communication card to access the jumpers, and re-installing it. Power up the unit with the jumper installed, then remove the jumper.

- The Inverter program thread in the SMC will continue to send speed values in Hz ranging from 0.00 to 60.00 Hz.
- Input #6 is for forward motion.
- Input #7 is for reverse motion.
- To monitor direction, press DSPL 4 times until u-01 is displayed. Then press data/enter.
- When Input #8 is toggled, any alarms in the V7 inverter are cleared. Inputs 6 & 7 must be off.
- Produce an alarm by setting parameter n010=1 and remove operator keypad.

Note:

If there is an SMC program fault, all general outputs on the demo will flash at once. If you notice this, use Y-Term's terminal window and check the value of ErrCode and ErrLine.

For Example, type MG ErrCode, ErrLine and the values of both will be displayed. This information will help Yaskawa to improve the demo. Note that case sensitivity is important when typing in the names of the variables.

Downloading the demo program:

1. Launch Y-Term 7 or greater, and locate and open the SMC program called "Official SMC4000 Demo Program.SMC"
2. Plug in the Communication cable SMCCBL7 to the CN6 connector on the controller.
3. Turn on the power to the demo, and verify that the green power LED is lit on the SMC-4000.
4. Use the "Send to Controller" icon in Y-Term to download the program to the controller.
5. Go to the terminal window (blue screen) and type "BP" to burn the program into the flash memory.
6. Cycle power or type "XQ" to start the program.

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Appendix: Selling points of the SMC-4000

Advantages of the SMC-4000 controller:
- Easy to Use
    o Simple program language enables a short development time.
    o Versatile: Ethernet can be used to network eight devices together at once.
    o Standard 8 input, 8 output, plus 3 dedicated inputs per axis.
    o Plug & play cables available for Sigma and Legend
    o Only requires 24 VDC power.
- Simple to Set Up and Configure
    o Y-Term Software with simple, three screen layout.
    o Graphical scope tools
    o Auto Program formatting and Syntax Checking.
    o Connect via serial port or Ethernet, for remote debugging.
    o Very little configuration required, most defaults are a good starting point.
- Compact
    o 1/3 the size of the SMC2000 controller.
    o Same panel depth as a 100 watt Sigma Amplifier
- Affordable
    o 40% cost reduction compared to the SMC20004M.
- Application Emphasis
    o Rotary Tables
    o Feed to length, including roll feeding, bag making, press feed
    o High Speed, accurate indexing
    o Linear, rotary, direct drive servos, third party steppers, Yaskawa "7" series inverters.
    o Pick & place systems, gantry robots
    o Winding.
    o Transfer Line.
    o Flying Shear
    o Wire bonder
    o A wider area control system can be achieved by connecting multiple SMC4000 and SMC3010 controllers together.
    o A comprehensive array of analog & digital I/O available from third party Modbus TCP/IP providers.
    o Yaskawa 20 bit absolute encoder.
    o UL and cUL compliance

Additional Information concerning SMC-4000 Demo Tuning

QUESTION

In the SMC-4000 demo, both motors are the same and both the LEGEND and SIGMA2 amps are the same wattage, but the tuning of the axes is very different. Why?

CONLCUSION

Four factors contribute to the difference in tuning between the two axes in the SMC-4000 demo

1. The encoder resolution Pn201
2. The LEGEND amplifier mismatch
3. The torque reference setting Pn400
4. The torque filter setting in Pn401

SOLUTION

Set the SGDH to match the characteristics of the LEGEND. (Pn201=2048, Pn400=67, Pn401=10) in addition to the basic parameter settings necessary (Pn000.1=2, Pn110.0=2, Pn50A.3=8, Pn50B.0=8)

DETAIL

1) Encoder resolution only affects tuning on the SMC-4000 demos belonging to the Training Department, which use the 16-bit absolute encoder with the sigma 2 axis. This encoder has a resolution 8x higher than the 13-bit incremental. So as the controller PID loop sees it, the same torque correction makes the motor move 8x as many pulses, requiring that the gains be set 8x lower compared to the LEGEND axis with the 13-bit encoder.

2) The LEGEND amplifier mismatch is part of the design of all SMC-4000 demos, and works fine for demonstration purposes, but this combination is not recommended in the field. As per the LEGEND catalog p.23, the SGMAH-01B motor is supposed to be used with the 400W amp (SGDG-04GT), NOT the 100W amp (SGDH-01GT). The SGDH-01GT can be used, but the torque output will be that of the 50W SGMAH-A5B motor. The reason is due to the intended design of the LEGEND. The 01-GT is designed to output 100W at 200V. This means the IGBTs are rated for the current of the 200V AH-01A motor. This motor requires twice the voltage, but half the current. In order to run the 100V 100W motor, the amplifier treats it as a 50W motor.

3) The torque reference setting in Pn400 is directly related to the LEGEND amplifier mismatch issue. First, the parameter units are different. Legend units are [0.001V / peak torque] and Sigma2 defines it as [0.1 V/ rated torque]. This means that 3.0 V torque command will cause the Sigma2 axis to move with 100% rated torque (0.318 Nm), and 3.0v torque command will cause the LEGEND to move with 90% torque. However, as discussed in factor #2, this is 90% of the rated torque of a 50W motor (even though a 100w motor is connected), resulting in a torque output of 45% of the 100W motor's torque capability (0.144 Nm) when a 3.0v command is given. The sigma2 axis can be configured to match this simply by setting Pn400=67 (6.7 volts for 100% torque), so that when 3.0v is commanded to the sigma2, 45% torque will be output.

4) The default setting of Pn401 is 10 in the LEGEND and 100 in the Sigma2 (units are both [0.01ms]). The setting of this parameter has a significant effect in the tuning performance, and especially affects the result of YTerm AutoTuning.

Packing the demo for shipment:

Remove cables as shown in the picture:

(3) Axis cables from SMC4000
(1) I/O cable from SMC4000 CN5
(1) Ethernet cable from SMC4000 CN4
(1) Axis cable from SGDH CN1
(1) Axis cable from SGDG CN1

Remove the power cord from the demo (lower right side), and wrap it in the right side of the demo case.

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